CHAPTER 3

AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

To evaluate the potential impacts resulting from the proposed action and alternatives it is first necessary to understand the current condition of the project area. In accordance with federal guidelines implementing NEPA and FAA regulations for the preparation of an EIS, this description of the affected environment addresses the existing conditions of the human environment, including the following natural and human resources:

Section	Title
3.1	Noise
3.2	Human Environment and Compatible Land Use
3.3	Socioeconomic and Demographic Characteristics
3.4	Air Quality
3.5	Geology and Soils
3.6	Water Resources and Floodplains
3.7	Vegetation
3.8	Wetlands
3.9	Fisheries
3.10	Wildlife
3.11	Cultural Resources
3.12	Visual Resources
3.13	Department of Transportation Section 4(f) – Section 303

The "project area" may vary for each of the above resources, but its definition is typically based on the area potentially impacted by the proposed actions or alternatives, including mitigations incorporated into the preferred alternatives. Therefore, the project area can differ substantially in geographic coverage. For example, the project area for soils and geology is, for the most part, confined to the Airport and immediate surroundings (and isolated locations related to sites selected for impact mitigation) because of the potential for earth disturbance and facility development. On the other hand, noise impacts may extend miles beyond an airport's boundaries.

However, the resources descriptions often need to range far beyond the area of potential impact for the descriptions to be placed in context. So, for example, to understand why earthquakes are a concern in Juneau and facilities need to be constructed in consideration of seismic event potential, it is necessary to provide background information on regional geologic forces. Another reason why descriptions go beyond impact boundaries is to establish thresholds for impact significance. For example, direct impacts to wetlands and other local resources may be locally constrained to construction or development zones, but those impacts may have greater ecological importance when viewed on a regional scale because of resource scarcity.

3.1 NOISE

This section of the EIS describes the existing setting regarding noise from the Airport. The focus in this presentation is on noise generated by aircraft, since most of the noise from the Airport is related to aircraft landing or takeoff. The intent of this section is to provide the reader with an understanding of noise, and to document the information needed to assess changes to noise levels caused by the proposed actions and alternatives. Three main subsections are provided. The first subsection is an introduction to noise, included as an aid to the reader in understanding how sound is measured and the effects of noise. Regulations and policies governing noise from airports are then described to provide context for conditions at JNU. The last section describes the existing noise levels at the Airport and in the surrounding area. The analysis of future noise impacts in Chapter 4 is based on the information provided in these sections.

The information in this section provides a simple presentation of the science of sound, which is highly dependent on a variety of influences, conditions, and regulatory policies. Other studies concerning noise are available for additional information, including JNU's Part 150 Airport Noise Compatibility Planning Study Update (HMMH 2000). This report, completed in 1999, identifies the Airport's proposed program for reducing existing and future aircraft noise and land use conflicts. It is available at the Mendenhall and Juneau libraries or the JNU Airport Manager's office.

3.1.1 ACOUSTICS OF SOUND

Noise by definition is unwanted sound. In general, noise can interfere with activities such as face-to-face conversation, radio and telephone use, sleep, etc. Noise may also have detrimental impacts on human health. Noise can cause actual physical harm such as hearing loss, and it may have an adverse effect on mental health. All of these issues have been studied, but there are few clear-cut conclusions concerning health effects related to aircraft noise.

3.1.1.1 MEASUREMENT OF SOUND

The characterization of a sound as noise depends on many factors, including the information content, the familiarity of the sound, a person's control over the sound, and whether or not the sound interrupts an activity. Three characteristics of sound can be measured: magnitude (loudness), frequency spectrum, and time variation. The unit used to measure the magnitude of sound is the decibel (dB). Unlike most measurement scales, the decibel scale is expressed as a logarithm because the range of sound pressures that occur is so large. According to this logarithmic scale, a sound that is 10 times as great as another is 10 dB greater and a sound that is 100 times greater than another is 20 dB greater. For example, a sound level of 70 dB has 10 times the acoustic energy as a level of 60 dB, while a sound level of 80 dB has 100 times the acoustic energy as 60 dB. However, human perception and response to noise does not follow a similar scale. A sound of 10 dB higher than another is usually judged by humans to be twice as loud, while a sound 20 dB higher seems to be four times as loud, and so forth. Therefore, different scales are established to reflect human response to sound.

The frequency of a sound is expressed in Hertz (Hz), or cycles per second. The normal audible frequency range for young adults is 20 Hz to 20,000 Hz. The prominent frequency range for community noise, including aircraft and motor vehicles, is between 50 Hz and 5,000 Hz. The human ear is not equally sensitive to all frequencies; some frequencies are judged to be louder for a given signal or acoustic energy level than others. As a result, research studies have analyzed how individuals make relative judgments as to a sound's loudness or annoyance.

The most common weighting is the A-weighted noise curve (dBA). The dBA noise-weighting curve has been used to develop the A-weighted decibel scale. This scale has a built-in "compensation" for judgments of sound loudness by discriminating against frequencies in a manner approximating the sensitivity of the human ear. In the A-weighted decibel, everyday sounds normally range from 30 dBA (very quiet) to 100 dBA (very loud). Most community and airport noise analyses are based upon the A-weighted decibel scale. Examples of various sound environments, expressed in dBA, are presented in Table 3-1.

3.1.1.2 Sound Level Metrics

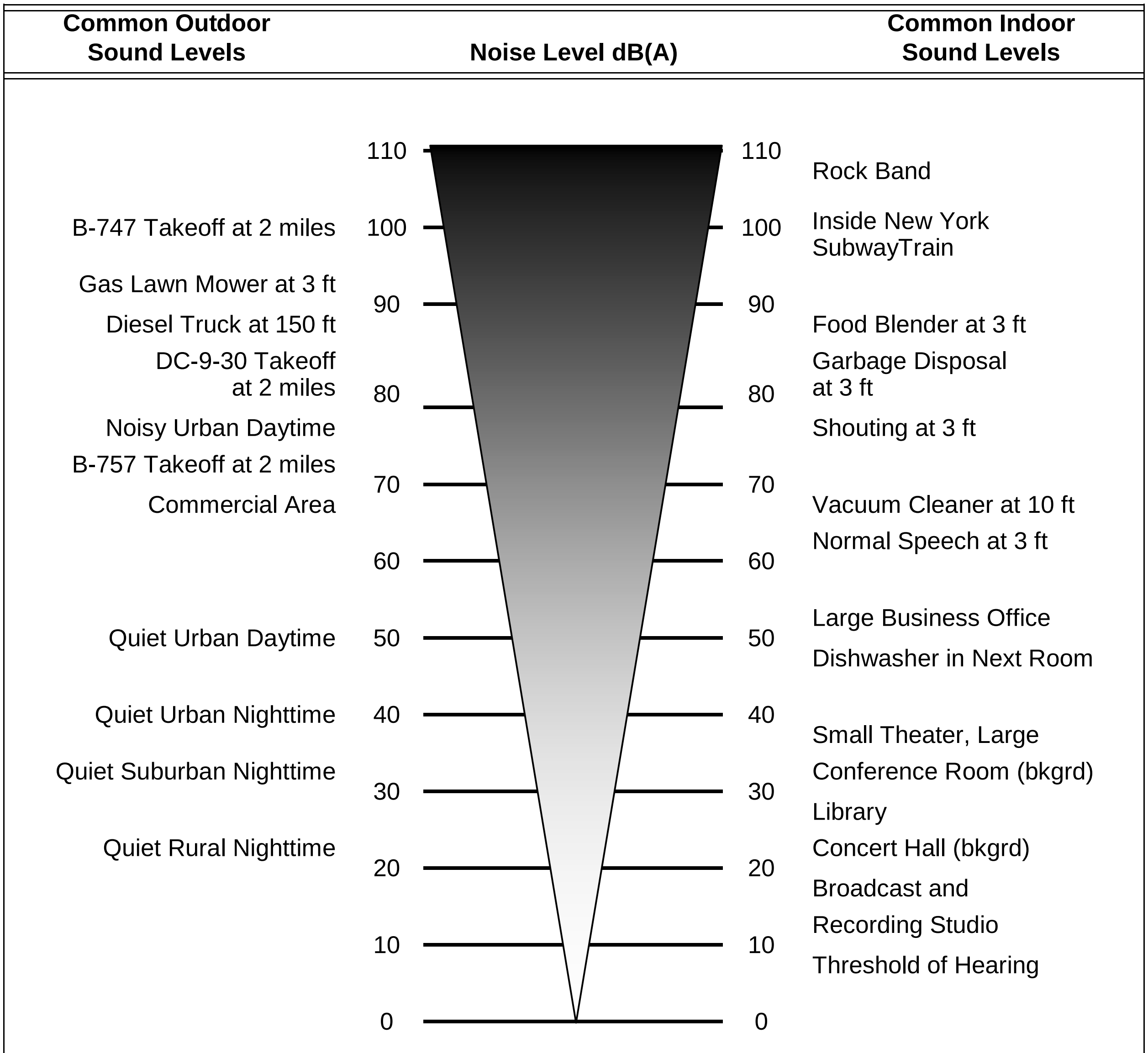
Various rating metrics have been devised to approximate the human subjective assessment of "loudness" or "noisiness" of a sound. Noise metrics (the term used for various types of noise measurements) can be categorized as single event metrics and cumulative metrics. The noise metrics used in this study are summarized below.

Cumulative noise metrics, used to describe noise in terms of total exposure throughout the day, have been developed to assess community response to noise, such as from aircraft noise. They are useful because these scales attempt to include the loudness and duration of the noise, the total number of noise events, and the time of day these events occur into one single number rating scale.

- Day-Night Noise Level (DNL). DNL (also known through the mathematical expression Ldn) is the metric required by FAA for determining if an action would cause significant noise impacts or a community's response to noise, as noted above. The DNL is a 24-hour average annual sound level that includes a 10-dBA penalty for sounds occurring between 10 p.m. and 7 a.m. The DNL takes into account the number of noise events, loudness of the events, duration of the events, and time of day that they occur. The 10-dBA penalty reflects people's sensitivity to noise during the generally quieter hours when many people are asleep.
- Equivalent Noise Level (LEQ). LEQ is the "energy" average taken from the sum of all the sound that occurs during a certain time period; however, it is based on the observation that the potential for a noise to affect people is dependent upon the total acoustical energy content. LEQ is typically measured for 15 minutes, 1 hour, or 24 hours. LEQ for 1 hour is used to develop the DNL values for aircraft operations.

Single event metrics describe the noise from individual events, such as aircraft flyover.

Table 3-1. Common Indoor and Outdoor Sound Levels



Sources: Federal Aviation Administration Seminar presented by Bolt, Beranek and Newman, Inc. Noise Control Plan Development, 1979.

Federal Aviation Administration Advisory Circular 36-3C, Estimated Airplane Noise Levels in A-Weighted Decibels, 1983

- Maximum Noise Level. The highest noise level reached during a noise event is called the "Maximum Noise Level." For example, as an aircraft approaches, the sound of the aircraft begins to rise above ambient noise levels. The closer the aircraft gets, the louder it is, until the aircraft is at its closest point directly overhead[1]. As the aircraft passes, the noise level decreases until the sound level settles to ambient levels. It is this metric to which people generally respond when an aircraft flyover occurs.

- Sound Exposure Level (SEL). The SEL, also known as the single event sound exposure level, is the integration of all the acoustic energy contained within a sound event. This metric takes into account the maximum noise level of the event and the duration of the event. For aircraft flyovers, the SEL value is typically approximately 10 dBA higher than the maximum noise level. Single event metrics, such as the SEL, are a convenient method for describing noise from individual aircraft events. In addition, cumulative noise metrics can be computed from SEL data.
- Time Above (TA) a threshold of A-Weighted Sound. The Time Above index refers to the total time in seconds or minutes that aircraft noise exceeds certain dBA noise levels in a 24-hour period. It is typically expressed as TA 65, TA75, and TA85 dBA sound levels.

3.1.1.3 Health Effects of Noise

Noise is known to have several adverse effects on people. The following discuss some of the physiological and emotional impacts associated with unwanted sound. Although the focus of the noise analysis in Chapter 4 is appropriately on aircraft noise, increased noise levels could also result from construction activities, airfield vehicles, and other sources associated with the proposed actions and alternatives. Therefore, the discussion targets the effects of noise, as opposed to differences in noise sources.

Hearing loss is generally not a concern in association with community noise levels, even in communities near a major airport or a freeway. The potential for noise-induced hearing loss is more commonly associated with occupational noise exposures in heavy industry, very noisy work environments with long-term exposure, or certain very loud recreational activities, such as target shooting and motorcycle or car racing. The Occupational Safety and Health Administration (OSHA) identifies a noise exposure limit of 90 dBA over 8 hours per day to protect from hearing loss (higher limits are allowed for shorter duration exposures). Noise levels even in very noisy neighborhoods near the Airport do not exceed this standard and thus, are not at sufficient levels to cause hearing loss. However, hearing loss can be a concern to workers in certain airport environments without proper safety protection.

Communication interference is one of the primary concerns in environmental noise. Communication interference includes speech interference and interference with activities such as watching television or conducting yoga. Normal conversational speech is in the range of 60 dBA to 65 dBA and any other sounds in this range or louder may interfere with speech. There are specific methods for describing speech interference as a function of the distance between speaker and listener, and voice level. Figure 3-1 illustrates the effects of noise on communication (as distance between the speaker and receiver increases, with various background noise, the speakers must raise their voices).

1. An observer may not notice this effect, however. The loudest sound is *apparently* present when the aircraft is beyond the position directly overhead. This is due to the continuing movement of the aircraft and the time required for the noise it generates to reach the ears of the receptor.

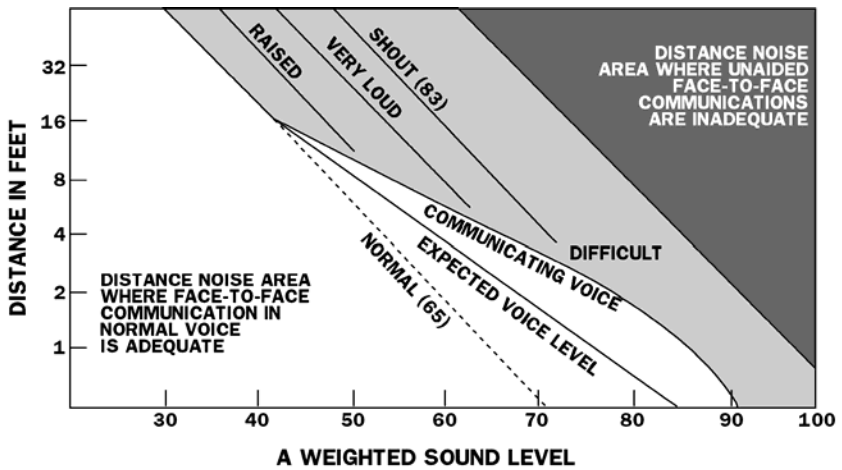


Figure 3-1. Speech interference vs. noise levels.

Sleep interference is a major concern and is most critical during nighttime hours. Sleep disturbance is one of the major annoyances from community noise. Noise makes it difficult to fall asleep, creating momentary disturbances of natural sleep patterns by causing shifts from deep to lighter stages; and it may cause awakening. Extensive research has been conducted on the effect of noise on sleep. Recommended values for desired sound levels in residential bedroom space range from 25 dBA to 45 dBA with 35 dBA to 40 dBA being the norm. The National Association of Noise Control Officials has published data on the probability of sleep disturbance with various single event noise levels. Based on experimental sleep data as related to noise exposure, a 75 dBA interior noise level event will cause noise-induced awakening in 30% of the cases (NANCO 1981).

Recent research from England and the United States Air Force shows that the probability of sleep disturbance is less than what had been reported in earlier research (FICON 1992, FICAN 1997). This research showed that once a person is asleep, it is relatively unlikely that they will be awakened by a noise. The primary difference in the recent study is the use of actual in-home sleep disturbance patterns as opposed to laboratory data that had been the historic basis for predicting sleep disturbance.

Physiological responses reflect measurable changes in pulse rate, blood pressure, and other bodily functions. Generally, physiological responses reflect a reaction to a loud, short-term noise, such as a rifle shot or a very loud jet passing overhead. While physiological effects can be induced and observed, the extent to which these physiological responses cause harm is not known.

Annoyance is the most difficult of all noise responses to describe. Annoyance is an individual characteristic and can vary widely from person to person. What one person considers tolerable may be unbearable to another of equal hearing capability. The level of annoyance also depends on the characteristics of the noise (i.e., loudness, frequency, time, and duration), and how much activity interference (e.g., speech interference and sleep interference) results from the noise. However, the level of annoyance is also a function of the attitude of the receiver. Personal sensitivity to noise varies widely. It has been estimated that 2% to 10% of the population is highly susceptible to annoyance from noise not of their own making, while approximately 20% are relatively unaffected by noise.

3.1.2 Applicable Regulations, Plans, and Policies

The purpose of this section is to present information regarding noise and land use criteria that may be useful in evaluating noise impacts on the human environment. The following laws and regulations are applicable to the analysis.

The Federal Aviation Regulation (FAR) for noise standards was originally adopted in 1960 (FAR Part 36). FAR Part 36 prescribes noise standards for issuance of new aircraft type certificates; it also limited noise levels for certification of new types of propeller-driven, small airplanes and for large, transport category airplanes. Subsequent amendments extended the standards to certain newly produced aircraft of older type designs. Other amendments extended the required compliance dates. Aircraft may be certificated as Stage 1, Stage 2, or Stage 3 aircraft based on their noise level, weight, number of engines, and, in some cases, number of passengers. Stage 1 aircraft are no longer permitted to operate in the United States. Stage 2 aircraft having a maximum takeoff weight of more than 75,000 pounds were phased out of service from use in the contiguous 48 States in December 31, 1999.

The Aviation Safety and Noise Abatement Act of 1979 (ASNA) established the requirement for use of the DNL in the evaluation of airport noise. This Act also established the Federal Aviation Regulation Part 150 process to standardize the presentation of noise characteristics from airports as well as the evaluation of airport noise abatement alternatives and the development of noise compatibility plans.

Another federal aviation regulation, Part 150, implemented the ASNA by establishing a consistent approach to evaluating ways of reducing existing and future aircraft noise exposure (FAR Part 150). As part of the FAR Part 150 Noise Compatibility Planning program, the FAA published noise and land-use compatibility charts to be used for land-use planning with respect to aircraft noise levels. These charts offer FAA recommendations to local authorities for determining acceptability and compatibility of land uses relative to DNL noise levels above DNL 65 dBA. The guidelines specify the maximum amount of noise exposure (in terms of DNL) that will be considered compatible with residential areas and working areas.

FAA Order 5050.4A: *Airport Environmental Handbook* and Order 1050.1E: Considering Impacts: *Policies and Procedures* are guidance documents used by the FAA for implementing the National Environmental Policy Act and associated regulations. These guidelines include noise exposure contours showing 65, 70, and 75 DNL noise levels. FAA Order 1050.1E (Appendix A14.3) states: "A significant noise impact would occur if analysis shows that the proposed action will cause noise sensitive areas to experience an increase in noise of DNL 1.5 dB or more at or above DNL 65 dB noise exposure when compared to the no action alternative for the same time-frame." Therefore, environmental documents identify areas where the project (relative to the Do-Nothing/No Build) would generate an increase of 1.5 DNL or greater over a noise-sensitive use as significant noise exposure (65 DNL).

The Airport Noise and Capacity Act of 1990 (ANCA) provided two broad directives for the FAA: (1) establish a method to review aircraft noise, and airport use or access restriction, imposed by airport proprietors, and (2) institute a program to modify or phase-out Stage 2 aircraft over 75,000 pounds by December 31, 1999. Stage 2 aircraft are older and have not been equipped with hushkits to reduce noise (B-737-200, B-727, and DC-9). Stage 3 aircraft are newer and quieter (B-737-300, B-757, MD-80/90). To implement ANCA, FAA amended Part 91, which addressed the phasing out of large Stage 2 aircraft and the phasing in of Stage 3 aircraft. Alaska airports were exempt from the ANCA phase-out, but nearly all, if not all operations in Juneau, meet Stage 3 levels. All operations by Alaska Airlines, the principal air carrier at Juneau, and Northern Air Cargo meet Stage 3 levels.

3.1.3 BASELINE AIRPORT NOISE LEVELS

To provide context for the evaluation of future noise exposure associated with the actions described in Chapter 2, the noise associated with existing or baseline airport activity was assessed. The following summarizes the methodology used to quantify aircraft noise exposure. A description of the modeling approach used to predict aircraft noise exposure impacts, in Chapter 4, is also presented. The model was verified against the results from the noise survey conducted in 1999 as part of the Noise Compatibility Study (HMMH 2000).

3.1.3.1 NOISE SURVEY METHODOLOGY

The noise environment at JNU has been depicted through the collection of actual noise measurements of aircraft events and ambient noise levels, collection of aircraft operational data, and the incorporation of this information into an airport noise computer model.

Noise measurements were conducted over several days at six locations around the Airport, as shown on Figure 3-2. Noise data collected at these sites included single event noise levels from individual aircraft flyovers, cumulative 24-hour continuous measurements, and ambient non-aircraft noise sources. Noise monitors also recorded the ambient noise level in the communities surrounding each monitoring site. Aircraft noise exposure is commonly depicted in terms of lines of equal noise levels, or noise contours.

3.1.3.2 CONTOUR MODELING

The FAA's Integrated Noise Model (INM), version 6.1, was used to generate aircraft noise exposure contours for JNU. The INM is a computer program developed to generate and plot noise contours for airports, with an extensive database of civilian aircraft noise characteristics. The latest version, 6.1, was released for use in the Spring of 2003 and is state-of-the-art in airport noise modeling.

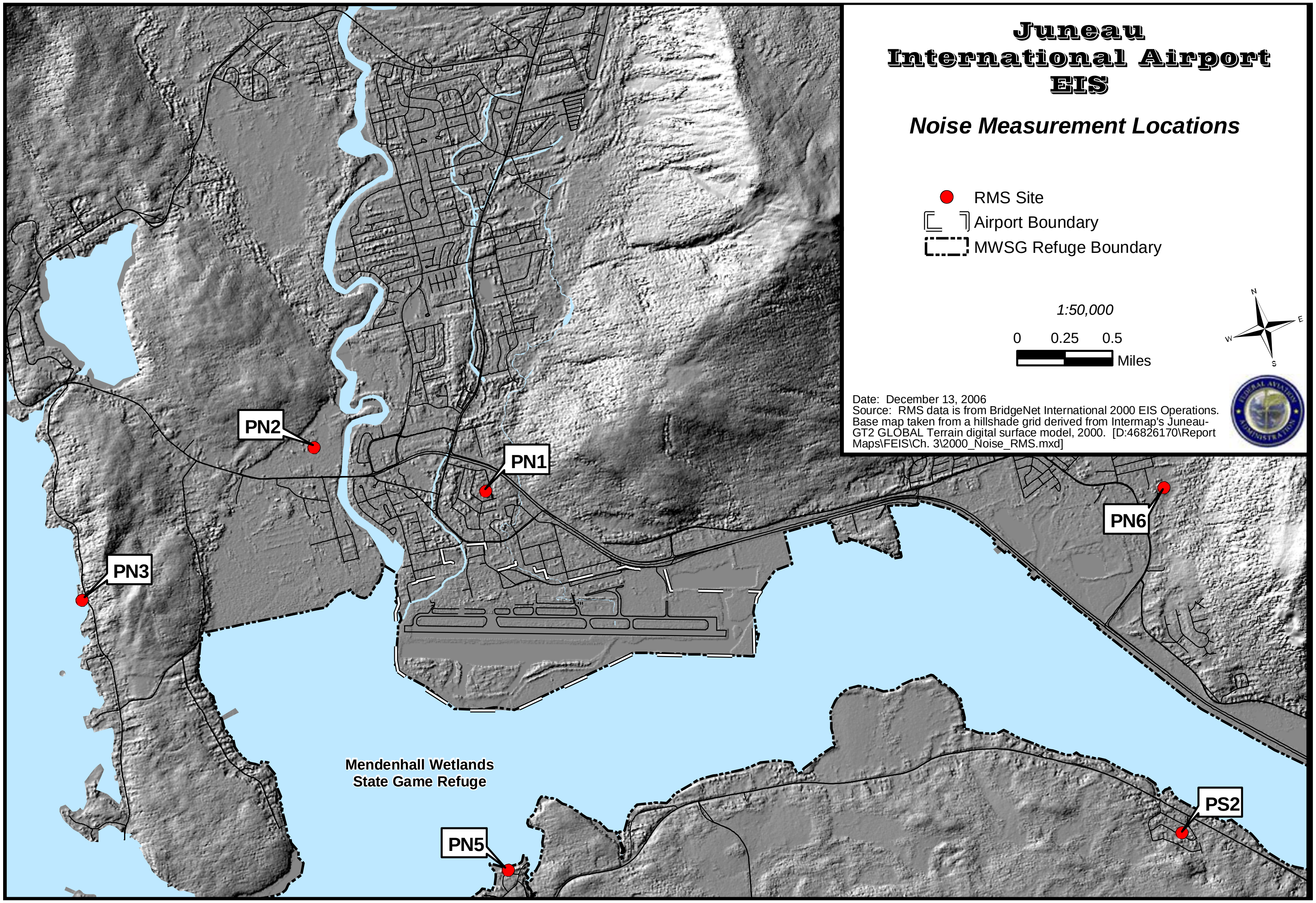


Figure 3-2. Noise measurement locator map.

One of the most important factors in generating accurate noise contours is the collection of accurate operational data. The INM requires the input of the physical and operational characteristics of an airport, including the following:

- Number of aircraft operations by aircraft type and time of day.
- Flight tracks (imaginary paths relative to the ground over which aircraft are flying) and the use of the tracks.
- Runway layout and use of the runway by aircraft type and time of day.
- Flight profiles (approach and departure procedures).
- Average meteorological conditions.

Because of the unique topographical conditions in the vicinity of JNU, a data file of geographic topographic conditions was also input to the analysis.

JNU's existing noise environment was analyzed according to year 2000 operational conditions. The data used in the analysis was derived from various sources, including historical data from the JNU Master Plan Update and data from the FAA's national airspace system's aircraft situation display radar that tracks aviation traffic across North America. A variety of operational data are necessary to determine the noise environment around the Airport. These data include aircraft activity levels, fleet mix of aircraft operating at the Airport, time of day operations are occurring, runways used, and the specific flight paths employed. The results from the noise measurement survey in year 2000 were used to facilitate the development of airport noise contours. In other words, the noise model has been verified using the actual local noise data collected during a measurement survey, and is based on year 2000 operational conditions. This verification effort confirms applicability of the model to the analysis.

3.1.3.3 Baseline (2000) Aircraft Noise Exposure

The noise exposure contours for JNU in the year 2000 are shown on Figure 3-3. This exhibit presents the 60, 65, 70, and 75 DNL noise contours. Table 3-2 lists the area within each noise exposure contour. The noise contours showing conditions in year 2000 reflect 145,631 annual aircraft operations. Before producing this Draft EIS, consideration was given to how aircraft noise conditions might have changed between 2000 and 2004. As of December 2004, the last complete year of annual aircraft operations data available from the FAA was for 2002, indicating that operations had decreased to 130,390 (a reduction of nearly 12% in total operations). During this period, air carrier activity increased by 12%, with commuter/air taxi traffic and general aviation traffic both decreased by 12% and military traffic decreased by 20%. As a result of these changes, it is expected that the year 2000 contours are slightly larger than conditions in 2002. FAA data indicates that year 2005 operations are expected to reach 130,561, similar to the 2002 operations level.

The existing aircraft noise analysis, prepared for this EIS, was compared to the noise analysis conducted for JNU's Part 150 update (see Figure 8.2, HMMH 1999). In general, the maps are very similar, with some differences in extent and direction of the 60 DNL contour. The area within the

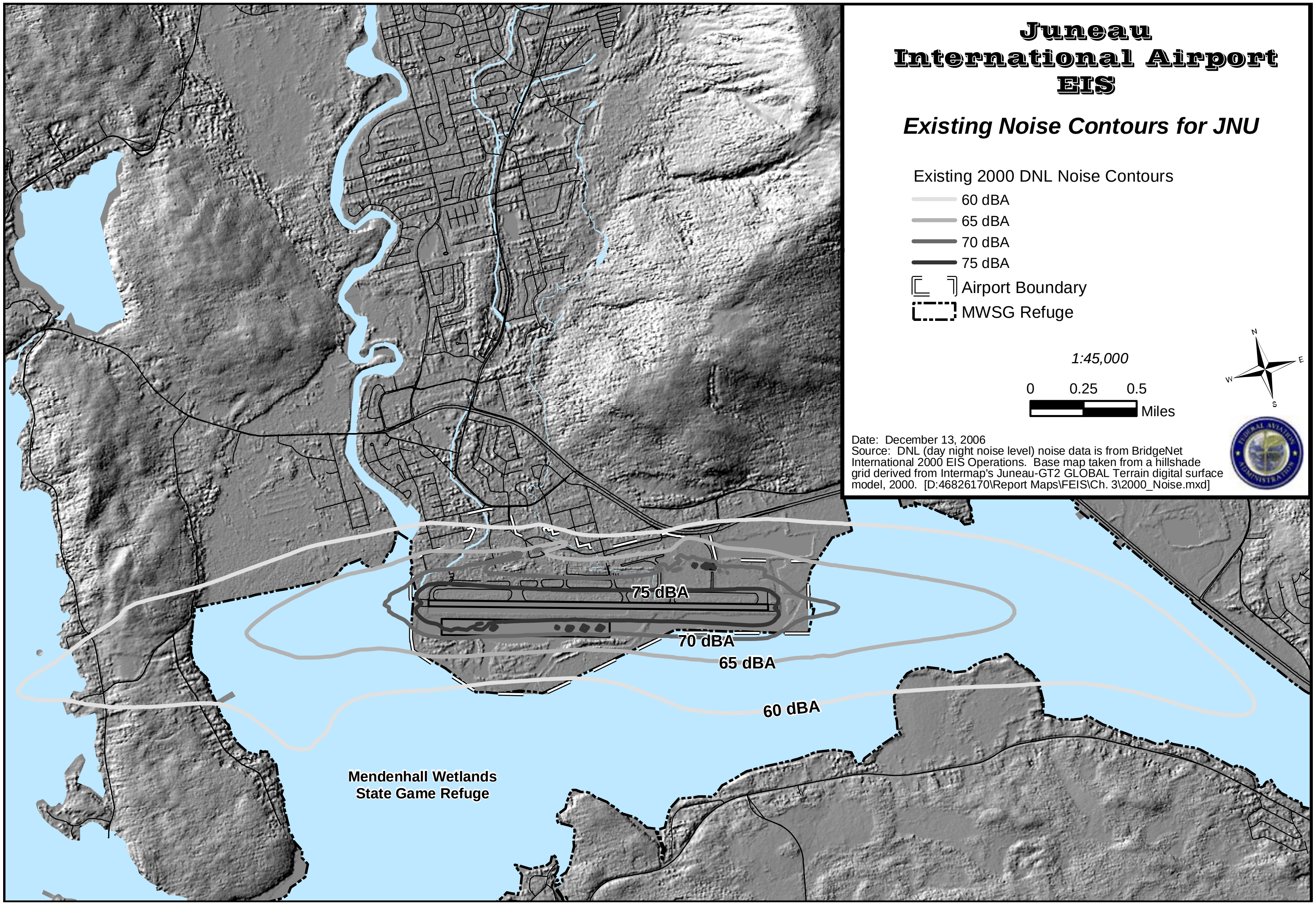


Figure 3-3. Existing airport noise exposure contours.

Table 3-2. Area Affected by Aircraft Noise

Noise Impact	Square Miles	Acres
60-65 Ldn	2.29	1,464
65-70 Ldn	0.82	524
70-75 Ldn	0.16	101
75-80 Ldn	0.38	241
65 Ldn and Greater	1.35	866
60 Ldn and Greater	3.64	2,330

Source: Bridgenet Consulting Services, September 2004.

various contour intervals is also similar. For example, this analysis estimates that approximately 1,464 acres fall within the 60 to 65 DNL contour, while the Part 150 exposure map shows an area of 1,483 acres for the same interval (see Table 8.1 of HMMH 1999). These small differences are likely the result of the new version of the noise exposure model employed for this EIS, and of the different data sets used as input files for the model. In addition to the aircraft noise exposure contours, a grid analysis (showing the DNL, SEL, and TA analysis) was prepared and is presented in Appendix C.

3.1.4 Summary of Noise Environment

The 65 DNL noise level is an established guideline for which residential land uses (including schools, hospitals, and places of worship) are not recommended without mitigation. Relative to FAA guidelines, the area currently affected by JNU-aircraft noise at or above 65 DNL caused by aviation activity is relatively small. More importantly, perhaps, there is no residential housing or human population within the 65 DNL or higher noise level areas.(Section 3.2, Human Environment and Land Use, presents the population, housing, and noise-sensitive facility impacts associated with the existing noise exposure).

Single-event noise measurements include the operation of float planes and helicopters, but these events in themselves do not have a large impact on the DNL because of their low noise level relative to large jet aircraft. These noise events are characterized by relatively low magnitude of a fairly long duration. At JNU, they occur quite often during summer season, because they are associated with the increase in tourism and scenic overflights.

3.2 Human Environment and Compatible Land Use

The Borough of Juneau, which includes the Alaskan capital city of Juneau, is located in southeast Alaska. The Borough also contains the mountainous Juneau Icefield and portions of some nearby islands. Only a small portion of the 2,080,000 acres within the Borough is urbanized, and this urban region occupies a slender strip between the icefield and the ocean. The rest of the Borough is used mainly for recreation and some commercial business activity, such as harvest of timber for wood products. A large part of the area is waterway and roadless wilderness, and these characteristics are much of what draw both residents and tourists to the area and shape the region's land uses.

Land use in the Airport vicinity includes residential and commercial use, transportation corridors, and land used for recreation and fish and wildlife habitat. The following sections describe land management, ownership, and uses in the Juneau area and specifically in the vicinity of the Airport. An assessment of existing land use compatibility with noise generated by aviation activities is also provided. The last section describes recreational opportunities on and around the Airport.

3.2.1 LAND OWNERSHIP

The Borough covers 2,080,000 acres of land, including tidelands and submerged lands. Approximately 82% of the Borough (approximately 1,710,900 acres) is federal public land managed by the U.S. Department of Agriculture, Forest Service (USFS) as part of the Tongass National Forest (the Forest). The Alaska Department of Natural Resources (Alaska DNR) claims ownership of approximately 17% of the land within the CBJ, including many of the same submerged lands and tidelands claimed by the USFS as part of the Tongass National Forest.[2] For this and other reasons, quantification of exact land holdings by all entities within the CBJ is difficult. Figure 3-4 illustrates estimated property boundaries within the CBJ. The CBJ owns 23,000 acres, including all property within the Airport boundary with the exception of one privately owned lot with a hangar (Loken Aviation).

The Alaska DNR has ownership and management jurisdiction over most state lands in the CBJ, including state-owned uplands, state-selected uplands, and submerged lands and tidelands below mean high water, approximately 15 feet above msl (even those lands that have been filled, as many have in Juneau). According to the Juneau State Land Plan, state lands in the CBJ encompass 351,300 acres, of which 44,400 acres are uplands and the remainder is tidelands or submerged lands (Alaska DNR 1993). The Alaska DNR can convey rights-of-way (ROWs) or transfer management of these lands to another state entity through Interagency Land Management Authorities. Alaska DNR land can be leased to municipalities if it is going to be used for something consistent with DNR's land plan for the area.

All lands within the CBJ, regardless of ownership, are subject to CBJ land use and zoning policies. The Alaska Coastal Management Program (Alaska CMP) and Juneau Coastal Management Program (Juneau CMP) have management jurisdiction over coastal areas (CBJ 1986).

---

2. The USFS and the Alaska DNR both claim ownership of submerged lands and tidelands within or adjacent to the Tongass National Forest boundary. Settlement of this dispute is expected through decision by the U.S. Supreme Court.

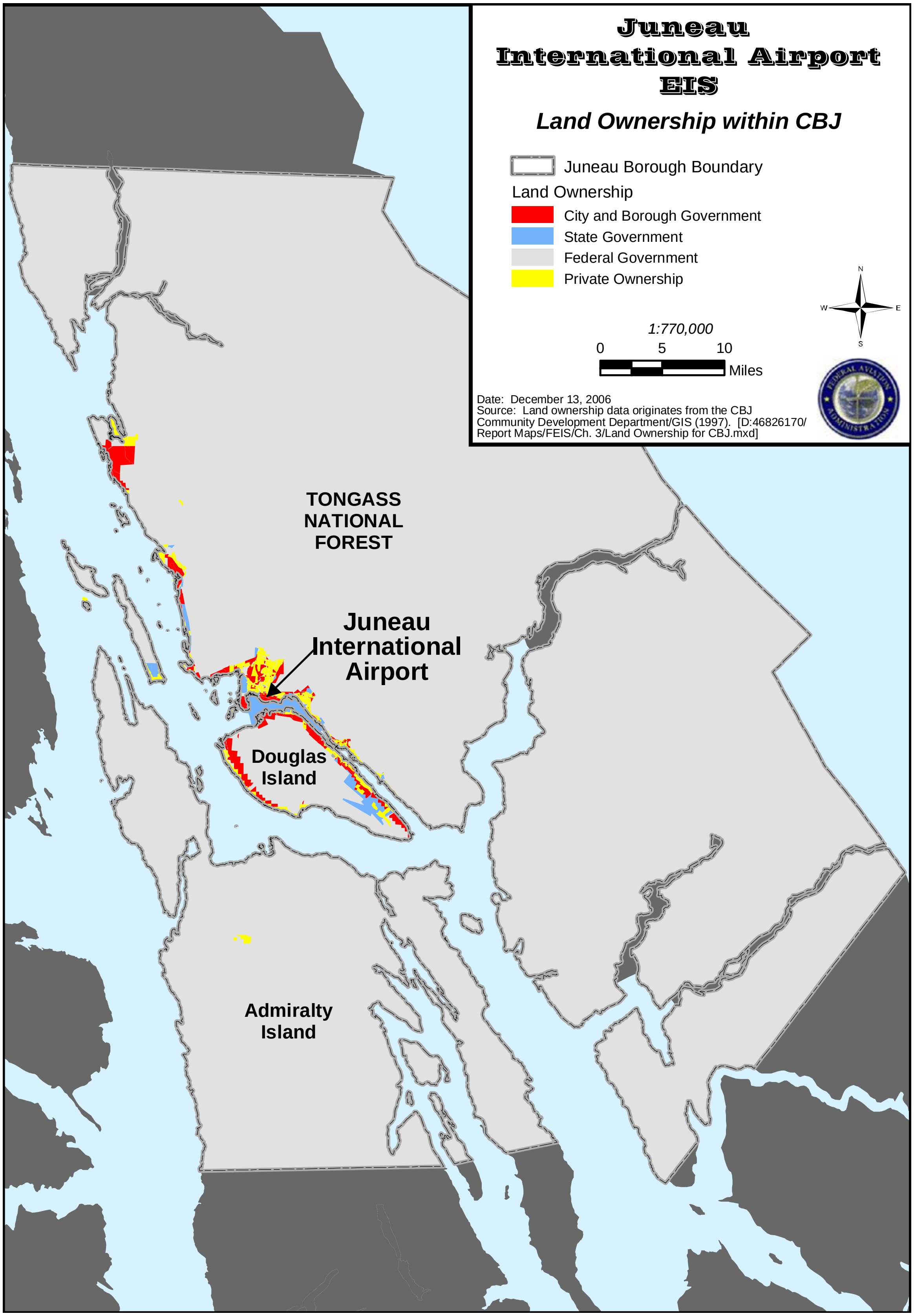


Figure 3-4. Land ownership within CBJ.

3.2.2 AREA LAND USE: PLANNING AND ZONING POLICIES

Guidelines and policies for land use in the Juneau area have been developed by several different governmental agencies, including CBJ, Alaska Department of Fish and Game (ADF&G), Alaska DNR, and the USFS. Each policy generally refers to lands under the jurisdiction of that specific agency, but there is some overlap in jurisdiction. The plans in Table 3-3 guide how land is used within the CBJ.

Table 3-3. Plans Governing CBJ Land Use

Plan	Agency	Purpose
City and Borough of Juneau Land Management Plan (CBJ 2001)	CBJ	Overall guiding policies for the management of CBJ-owned land.
City and Borough of Juneau Comprehensive Plan (CBJ 1996)	CBJ	Development plan for all lands within the CBJ, regardless of ownership.
Juneau Coastal Management Program (CBJ 1986)	CBJ	Local plan to manage on- and off-shore coastal resources as required under AS 66.60.030, the Alaska Coastal Management Act. Local version of the Alaska Coastal Management Program.
Juneau Waterfront Improvement Plan (Norton-Arnold and Janeway 2002)	CBJ	Plan for management of Juneau's waterfront, with focus on waterborne commerce facilities and business activities adjacent to the waterfront.
Mendenhall Wetlands StateGame Refuge Management Plan (ADF&G 1990)	ADF&G; Alaska DNR	Plan to protect/manage natural resources of the wetlands in Gastineau Channel consistent with AS 16.20.034.
Tongass Land Management Plan (USFS 1997)	USFS	Management plan for lands within the Tongass National Forest (82% of Borough lands).

General policies for land use have been established by the Alaska DNR and pertain to submerged lands and tidelands, but those policies are superseded by the Mendenhall Wetlands State Game Refuge Management Plan (Refuge Management Plan) with respect to affected land near the Airport. In addition, a Juneau Wetlands Management Plan was developed in 2001 and is incorporated within the CBJ Land Management Plan (CBJ 2001).

3.2.2.1 CITY AND BOROUGH OF JUNEAU (CBJ) LAND MANAGEMENT PLAN

The CBJ Land Management Plan is part of the municipal code and pertains to management of CBJ-owned land, classifying it into one of seven categories (CBJ 2001):

1. Agricultural (currently no land in this designation)
2. Commercial/Industrial (includes the Airport)
3. Public Use (recreation, education, access, transportation, public facilities, open space, habitat protection, protection of environmentally sensitive lands)

4. Reserved Use (can be reclassified to any of the other uses and includes all lands not otherwise classified)
5. Residential
6. Residential Recreational (currently no land in this designation)
7. Resource (mineral or non-mineral deposits or timber of commercial value)

Figure 3-5 illustrates zoning classifications and prescribed uses for the area near the Airport. The municipal code allows for multiple classifications for areas of multiple use. Table 3-4 itemizes the land management policies used to develop the CBJ Land Management Plan (CBJ 2001).

3.2.2.2 City and Borough of Juneau (CBJ) Comprehensive Plan

The CBJ Comprehensive Plan is the development plan for all lands within the Borough regardless of ownership. This plan will determine what land use is appropriate for each area of the CBJ and specifies allowable population densities or intensity of use. Land use is addressed through a number of policy statements and maps of the entire Borough (CBJ 1996).

Table 3-4. CBJ Land Management Policies for the CBJ Land Management Plan

Multiple use is encouraged.
Land used for resource extraction or removal shall be consistent with future use of the land.
Development is encouraged in areas where public services already exist, or can be economically extended, or where development of a viable economic base is probable.
A significant quantity of land of a variety of types and locations should be reserved to provide an opportunity for future decisions. Adequate lands for public development and use, including recreational beaches with appropriate uplands, should be reserved.
Tidelands should be leased only for specific water-dependent and water-related uses (as designated by the Juneau CMP) and not sold.
Wetlands should be leased only for specific uses, and not sold.
Land should not be made available for residential, commercial or industrial development in area that have significant landslide, avalanche, or floodplain hazards, unless the development proposal includes adequate mitigation measures to prevent loss of life and property.
Land should be made available to encourage a variety of housing opportunities to meet the needs of residents.
The region's scenic, environmental, and economically valuable natural resources should be protected from adverse impacts of urban development.
Conflicts between residential and other land uses should be minimized.
Land should be set aside for the necessary provision of transportation, public facilities, and services.
Lands and shoreline that possess recreational, scenic, wildlife, and other environmental qualities should be preserved as open space.

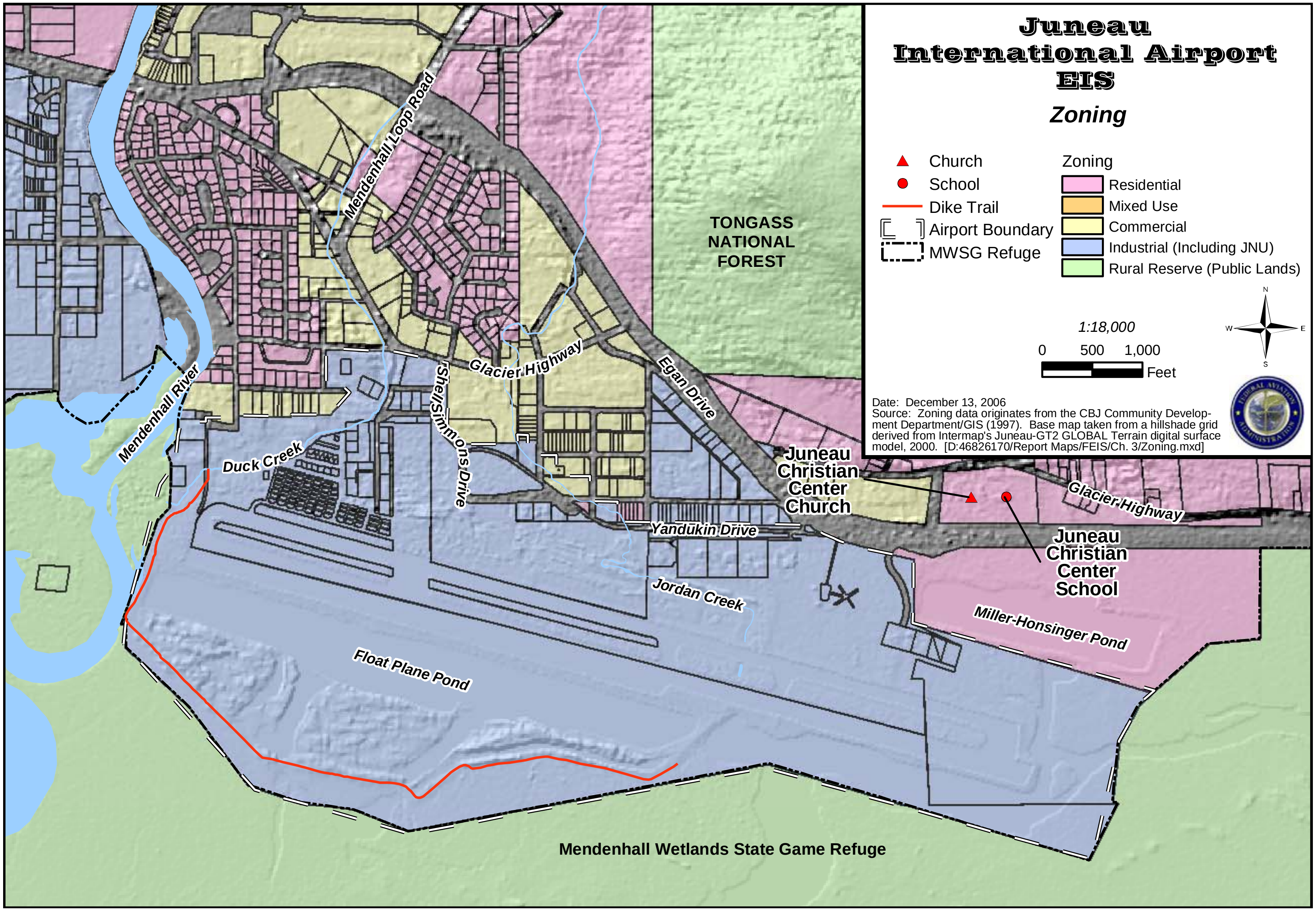


Figure 3-5. Land zoning in the vicinity of JNU.

3.2.2.3 JUNEAU COASTAL MANAGEMENT PROGRAM (JUNEAU CMP)

Inspired by the federal Coastal Zone Management Act of 1972, the Alaska legislature agreed that Alaska's coastal resources were important and in direct need of management. They passed the Alaska Coastal Management Act of 1977 (AS 66.60.030), and the resulting Alaska CMP structured a plan for general management of coastal resources. The state Act stipulates that local governments shall be the primary managers of coastal resources and requires that all Alaska municipalities located along the coast develop a local plan to manage on- and off-shore coastal resources. The CBJ developed the Juneau CMP in 1986 (CBJ 1986).

The Alaska CMP and Juneau CMP manage use and development of natural resources in coastal areas. Both plans' policies assure sufficient available land for port and harbor facilities, water-related transportation, and business activities, now and into the future. While assuring this land's availability, the policies also call for protection of important wildlife and other coastal resources, continued recreational access to the waterfront, and preservation of esthetic views. Specific enforceable policies address discharge of dredge or fill, especially in highly productive wetlands areas. The policies also support improvement of air and marine transportation located in coastal areas, mainly because of community dependence on these transportation systems in locations such as Juneau and throughout southeast Alaska.

The Alaska Legislature passed changes to the Alaska CMP during the 2003 session that could substantially affect not only the current statewide program but each local program as well. The consequences of the changes have not been fully determined, but it is believed they will have little or no impact on the analysis and decisions regarding the projects being studied in this EIS.

3.2.2.4 JUNEAU WATERFRONT IMPROVEMENT PLAN

CBJ is currently updating its Waterfront Improvement Plan. While it is possible that lands near the Airport could be incorporated into the new plan, it is not likely, because the plan pertains mainly to downtown Juneau, 8 miles from the Airport. In addition, the plan focuses on waterborne commerce facilities and water-related business activities, neither of which exists near the Airport (Norton-Arnold and Janeway 2002).

3.2.2.5 MENDENHALL WETLANDS STATE GAME REFUGE MANAGEMENT PLAN (REFUGE MANAGEMENT PLAN)

The Mendenhall Wetlands State Game Refuge (Refuge) was established by the Alaska Legislature in 1976 (AS 16.20.034(l)) to protect the natural resources of the wetlands in Gastineau Channel. Alaska Statute 16.20.034(g) places management responsibility for the surface and subsurface estate with the Alaska DNR. Any actions by the Alaska DNR that affect the habitat are to be in conformity with a management plan, proposed and adopted by ADF&G after reasonable public hearings and after consultation with CBJ (ADF&G 1990). The management plan is to be revised annually, if necessary and appropriate, under the same procedures followed for initial adoption.

As required by AS 16.20.034(l), management of the Refuge includes provision for expanding the Airport, adding new transportation corridors, and adding publicly owned and operated docking facilities (ADF&G 1990:8-11). The Refuge Management Plan of 1990 contains the policies that guide how the CBJ may acquire land for these purposes.

The statute establishing the Refuge also authorizes expansion of the Airport into the Refuge through purchase, exchange or other acquisition of Refuge land. The statute further states that a contract or other documentation by Alaska DNR will establish that use of the acquired land is restricted to Airport expansion. Alaska Statute 16.20.034(h) prohibits activities on the Refuge that would create a hazard to aircraft, which could include creating or enhancing waterfowl habitat in the area. The statute goes on to say that the Alaska DNR and ADF&G are to assist CBJ in filling in bodies of water next to the Airport runway that are attractants to waterfowl and, thus, a hazard to aircraft.

The Refuge Management Plan contains the following land use policies for the Refuge applicable to the Airport and/or the actions being considered in this EIS.

- The CBJ may acquire Refuge land for Airport expansion, provided CBJ can show 1) significant public need for the expansion that cannot reasonably be met off-Refuge or via use of alternative transportation modes and technologies; 2) use of Refuge lands are avoided or minimized to the maximum extent feasible; 3) all impacts to the Refuge and to Refuge resources are fully mitigated via restoration and/or replacement; and 4) the Airport expansion will not create a hazard to aviation by attraction of waterfowl.
- Individual Special Area Permits (authorized under 5 Alaska Administrative Code (AAC) 95) may be issued for motorized vehicles used in the Refuge for other than recreational purposes. The Alaska DF&G will, at its discretion, issue an individual Special Area Permit under 5 AAC 95 for the off-road use of a motorized vehicle if the use is consistent with goals and policies of the Refuge Management Plan, if need for use is demonstrated, and if no feasible alternative is available.
- Evaluation and, as appropriate, implementation of wildlife or fish habitat restoration and enhancement projects, especially for disturbed habitat, and anadromous fish and waterfowl habitat must occur. Waterfowl enhancement will be designed and sited to avoid conflict with air traffic patterns.
- New permanent structures will be allowed within the Refuge only for the purpose of habitat maintenance and enhancement, public use and enjoyment, or essential navigational aids. New temporary structures will be allowed in the Refuge only if there is a significant public need that cannot be met off-Refuge and if they are consistent with Refuge statutes, regulations, goals, and policies.
- Water quality of marine and estuarine environments in the Refuge shall meet or exceed standards for growth and propagation of fish and wildlife and harvesting for consumption of raw mollusks and other aquatic life.

- No alteration of the natural shoreline will be allowed through dredging or filling, except to maintain the Gastineau navigational channel or for maintaining, restoring, or enhancing Refuge habitat. Dredging and filling activity must be consistent with Refuge statutes, regulations, goals, and policies.
- Material extraction (gravel removal) will not be allowed within the Refuge except for purposes of maintaining, restoring or enhancing Refuge habitat.
- A new utility or pipeline may be allowed to cross the Refuge, provided there is a significant need and no feasible alternative off-Refuge. Existing corridors will be used wherever possible and consistent with Refuge statutes, regulations, goals and policies.

3.2.2.6 TONGASS NATIONAL FOREST LAND AND RESOURCE MANAGEMENT PLAN

Approximately 82% of the lands in CBJ are federal lands within the National Forest System, managed by USFS via the Tongass National Forest Land and Resource Management Plan (USFS 1997). Most of the land surrounding the urban areas of CBJ are within the Forest (see Figure 3-4). The USFS has no direct jurisdiction over land immediately adjacent to the Airport or land that could be directly affected by Airport development.

3.2.3 JUNEAU INTERNATIONAL AIRPORT – LOCAL LAND USES AND AUTHORITIES

All of the lands within Airport boundaries are owned by CBJ, with the exception of a portion of a hanger and adjacent apron space owned by Alaska Seaplane Services. CBJ-owned land outside but in the immediate vicinity of the Airport is zoned as commercial/industrial, residential, and/or land reserved for future use. Transportation and utility corridors also cross the area adjacent to JNU (see Figure 3-5). To the north of the Airport is the Egan Expressway—the primary roadway between downtown Juneau and urbanized areas to the north. On either side of the expressway, the land is in commercial/industrial and residential use. Further north of the expressway, the land is reserved for future use. With a few exceptions, the only land zoned for residential use adjacent to the Airport is on the northeast, around the Miller-Honsinger Pond.

The Juneau Christian Center (both a school and a church) is located across the highway on the east end of the runway. Above and to the southeast of the Juneau Christian Center is Glacier Gardens, a private commercial garden and viewing area that offers tours.

Land in the Refuge (which surrounds Airport property on three sides, basically west, south and east) is managed by the ADF&G in accordance with state statutes and their 1990 Refuge Management Plan. Walking, hunting, fishing, boating, and bird and wildlife viewing opportunities are the main land uses in the Refuge.

To the west of the Refuge lie the Mendenhall Peninsula and Fritz Cove areas. To the south of the Refuge, across Gastineau Channel, lies the North Douglas area. All three areas are mainly residential, with some recreational uses. Pederson Hill, located on the Mendenhall Peninsula west of the Airport, houses a CBJ water tower, FAA navigational aid equipment, an NOAA weather camera, and several telecommunications towers. A hiking trail to the top of Pederson Hill was rerouted at the suggestion of the FAA to reduce public use near the sensitive avigational equipment. An access road to the buildings on Pederson Hill is not currently maintained. The Pederson Hill area is considered by CBJ a good area for future residential development.

The only commercial fishing in Gastineau Channel near the Airport is the terminal area cost recovery fishery at the Douglas Island Pink and Chum hatchery site at Salmon Creek, approximately four miles southeast of the Airport.

The CBJ Comprehensive Plan specifies that "It is critical to continue the orderly development of the Airport to meet the expanding needs of Juneau residents and to provide access for Alaskans to their legislature and state government" (1996:86). Implementing actions incorporated into the Plan include the provisions to protect all designated Airport properties from land use conflict and/or displacement and to improve transportation facilities that accommodate air and marine links between CBJ and outlying communities.

Also within the CBJ Comprehensive Plan, subarea land use guidelines and considerations for the East Mendenhall Valley and Airport area include:

- Limit Airport expansion to areas designated in the Airport Master Plan (USKH 1999) and amendments and maintain adjacent publicly owned wetlands and tidelands for open space;
- Utilize CBJ-selected lands for residential development, recognizing constraints of sensitive areas;
- Maintain public access to the wetlands along the northern Airport dike; and
- Allow for continued industrial development in existing industrial areas.

3.2.4 Land Use Compatibility and Airport Noise

Aircraft noise can influence and affect land uses near airports. This section summarizes the population, housing, and noise-sensitive facilities that are within the area affected by current Airport operations. The compatibility of the current noise levels with existing land uses is also evaluated.

3.2.4.1 Methodology and Compatibility Criteria

Noise contours delineating locations of equal noise exposure (60, 65, 70, and 75 DNL) were developed for existing conditions as discussed in Section 3.1.1.[3] Figure 3-6 shows the year 2000 noise contours and land uses, including noise-sensitive uses, in relation to the Airport. To determine the extent of population and housing areas affected by noise, the contours were electroni-

3. Similar noise contours were generated relatively recently in support of the updated Noise Compatibility Program in accordance with FAA Part 150 regulations (see HMMH 2000). That study could not be used for this EIS, however, because some alternatives involving runway modifications or facility development could result in more or less aircraft-generated noise. Therefore, it was necessary to prepare updated noise contours that can also incorporate elements of each alternative for impact analysis. See Section 3.1, and impact analyses in Sections 4.1 and 4.2.

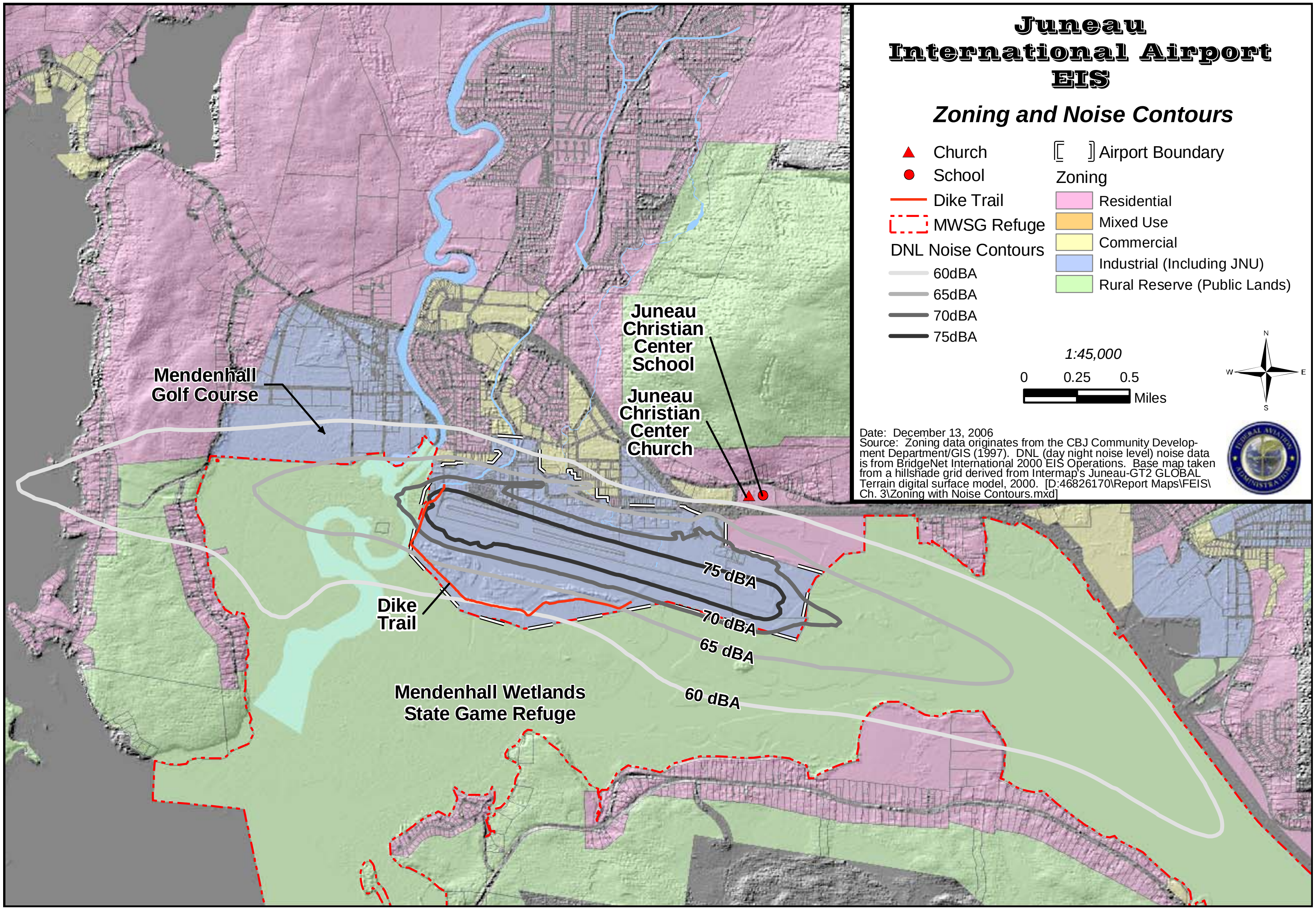


Figure 3-6. Land zoning with DNL noise contours.

cally overlaid on the 1999 parcel data provided by the CBJ Property Tax Assessor's Office. The Assessor's Office also provided information about noise-sensitive facilities in the Airport vicinity, for use in determining which land uses may be affected by aircraft-generated noise.

The degree of impact associated with aircraft noise exposure was determined using guidelines set forth in FA Regulation Part 150. This regulation stipulates that if local land use authorities have enacted local aircraft noise compatibility guidelines, they can be used in lieu of the Part 150 guidelines. However, none of the land-use jurisdictions in the vicinity of the JNU have enacted guidelines concerning aircraft noise exposure. Several jurisdictions (including CBJ and State of Alaska) have established property line noise guidelines that do not relate to the land use compatibility guidelines.

Table 3-5 lists these federal land use compatibility guidelines. The table indicates that residences and certain public-use facilities are not compatible with high levels of aircraft noise and are also normally not compatible with noise levels in excess of 65 DNL. With appropriate soundproofing, however, residential structures may be compatible with noise exposure levels of 65-75 DNL. Other noise-sensitive land uses—including medical, educational, religious, and cultural facilities; resorts; and group camps—follow these same patterns of compatibility (see Figure 3-6).

The FAR Part 150 land use compatibility guidelines indicate that most land uses, including residences, are compatible with noise exposure levels below 65 DNL. FAA has no thresholds characterizing such an effect on persons exposed to the levels below this 65 DNL threshold. However, the Part 150 study for JNU identified numerous residences in the 60-65 DNL area and this EIS evaluates potential noise impacts from various alternatives that might change noise exposures, particularly so as to determine whether any of those residences would now fall into a greater noise contour interval.

3.2.4.2 COMPATIBILITY WITH EXISTING AIRCRAFT NOISE EXPOSURE.

Demographics of the affected area were considered relative to the exposure contours, to determine whether existing land uses are compatible with Airport-related noise levels. Table 3-6 provides an estimate of the number of residential units and persons residing within each noise contour. Table 3-7 identifies the noise-sensitive facilities affected by 65 DNL or higher noise levels

The number of housing units within the current study's 60-65 DNL contour differs somewhat from the number of units stated in the study for the Airport's Part 150 update. One reason may be that additional units have been constructed in the years since the Part 150 update. For example, in 1997 (after the Part 150 update baseline year of 1996), a senior citizen housing complex with 25 units was built on Teal Street, close to the Airport. Importantly, however, this EIS has determined there are no residential housing units or population within contours at or above 65 DNL.

.

Table 3-5. Part 150 Land Use Compatibility Guidelines

Land Use	Yearly Day-Night Average Sound Level (Ldn) in Decibels					
	<65	65-70	70-75	75-80	80-85	>85
Residential						
Mobile Home Parks	Y	N	N	N	N	N
Transient Lodging	Y	N[1]	N[1]	N[1]	N	N
Other Residential Types[9]	Y	N[1]	N[1]	N	N	N
Public Use						
Schools, Hospitals, and Nursing Homes[10]	Y	25	30	N	N	N
Churches, Auditoriums, and Concert Halls[11]	Y	25	30	N	N	N
Governmental Services	Y	Y	25	30	N	N
Transportation[12]	Y	Y	Y[2]	Y[3]	Y[4]	Y[4]
Parking	Y	Y	Y[2]	Y[3]	Y[4]	N
Commercial Use						
Offices, Business, Professional[13]	Y	Y	25	30	N	N
Wholesale and Retail Building Materials[14]	Y	Y	Y[2]	Y[3]	Y[4]	N
Retail Trade – General[15]	Y	Y	25	30	N	N
Utilities	Y	Y	Y[2]	Y[3]	Y[4]	N
Communication	Y	Y	25	30	N	N
Manufacturing and Production						
Manufacturing, General[16]	Y	Y	Y[2]	Y[3]	Y[4]	N
Photographic and Optical Professional[17]	Y	Y	25	30	N	N
Agriculture (except livestock) and Forestry[18]	Y	Y[6]	Y[7]	Y[8]	Y[8]	Y[8]
Livestock Farming and Breeding	Y	Y[6]	Y[7]	N	N	N
Mining and Fishing, Resource Production and Extraction[19]	Y	Y	Y	Y	Y	Y
Recreational						
Outdoor Sports Arenas and Spectator Sports	Y	Y[5]	Y[5]	N	N	N
Outdoor Music Shells, Amphitheaters	Y	N	N	N	N	N
Nature Exhibits and Zoos	Y	Y	N	N	N	N
Amusements, Parks, Resorts and Camps[20]	Y	Y	Y	N	N	N
Golf Course, Riding Stables, and Water Recreation	Y	Y	25	30	N	N

Table 3-5. Part 150 Land Use Compatibility Guidelines, continued

Source: FAA 1983b. Designations contained in the table do not constitute a Federal determination of land use acceptability or unacceptability. Local authorities appropriately make that determination based on local needs and values. Adjustments or modifications of the descriptions of the land use categories may be desirable after consideration of specific local conditions.

Land use types and distinctions are derived from the Standard Land Use Coding Manual.

Y = Yes	Land Use and related structures compatible without restrictions.
N = No	Land Use and related structures are not compatible and should be prohibited.
25, 30, or 35	Land Use and related structures generally compatible; measures to achieve Noise Level Reduction (NLR), outdoor to indoor, of 25, 30, or 35 must be incorporated into design and construction of structure.

NOTES FOR TABLE 3-5

[1] Where the community determines that residential uses must be allowed, measures to achieve outdoor to indoor Noise Level Reduction (NLR) of at least 25 dB and 30 dB should be incorporated into building codes and be considered in individual approvals. Normal construction can be expected to provide a NLR of 20 dB, thus, the reduction requirements are often stated as 5, 10 or 15 dB over standard construction and normally assume mechanical ventilation and closed windows year round. However, the use of NLR criteria will not eliminate outdoor noise problems.

[2] Compatible where measures to achieve NLR of 25 are incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

[3] Compatible where measures to achieve NLR of 30 are incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

[4] Compatible where measures to achieve NLR of 35 are incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

[5] Land use is compatible provided special sound reinforcement systems are installed.

[6] Prime use only, any residential buildings require NLR of 25 to be compatible.

[7] Prime use only any residential buildings require an NLR of 30 to be compatible.

[8] Prime use only, NLR for residential buildings not normally feasible, and such uses should be prohibited.

[9] Includes household units, single detach and semidetached units, single attached row units, side-by-side units, two units one above the other, walkup apartments, elevator apartments, group quarters, residential hotels, and other residential other than mobile homes and transient.

[10] Includes educational services, hospitals, and nursing homes.

[11] Includes cultural activities (and churches), auditoriums, and concert halls.

[12] Includes railroad, rapid transit, street transportation; railway transportation, motor vehicle transportation, aircraft transportation, marine craft transportation, and highway/street ROW.

[13] Includes finance, insurance, and real estate services; personal and business services; professional services; other medical facilities; and miscellaneous services.

[14] Includes hardware and farm equipment wholesale trade; retail trade-building materials, hardware and farm equipment; repair services; contract construction services.

[15] Includes retail general merchandise; retail food; retail automotive, marine craft, aircraft and accessories; retail apparel and accessories; retail furniture, home furnishings, and equipment; retail eating and drinking establishments; and other retail trade.

[16] Includes Food and kindred products; Textile mill products; Apparel and other finished products made from fabrics, leather and similar materials; Lumber and wood products (except furniture); Furniture and fixtures; Paper and allied products; Printing, publishing, and allied industries; Chemical and applied products; Petroleum refining and related industries; Rubber and misc. plastic products; Stone, clay and glass products; Primary metal industries; Fabricated metal products; Miscellaneous manufacturing.

[17] Includes scientific and controlling instruments; photographic and optical goods; watches and clocks manufacturing.

[18] Includes agriculture (except livestock); agriculture-related activities; forestry activities and related services.

[19] Includes fishing activities and related services; mining activities and related services; and other resource production and extraction.

[20] Includes amusement; parks; public assembies; resorts and group camps, and other cultural, entertainment, and recreation

Table 3-6. Populations and Housing Currently Affected by Aircraft Noise

	Population	Housing
60-65 Ldn	416	160
65-70 Ldn	0	0
70-75 Ldn	0	0
75 Ldn	0	0
80+ Ldn	0	0

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

Table 3-7. Noise Sensitive Facilities in the Vicinity of JNU

Property[1]	Estimated Ldn Noise Exposure
Mendenhall Golf Course	64.6
Dike Trail	71.6
State Game Refuge	69.7
Juneau Christian Center Church	58.3
Juneau Christian Center School	58.3
	Number of Sites
Historic/Cultural sites affected by 65 Ldn and greater	0
Churches affected by 65 Ldn and greater	0
Schools affected by 65 Ldn and greater	0
Parks affected by 65 Ldn and greater	1

[1] Locator codes shown on Figure 3-6.

The only corrective land use measure recommended in the Part 150 update was acquisition of undeveloped parcels in the Airport vicinity. Preventive measures recommended include adoption of fair disclosure regulations regarding noise impacts, as well as comprehensive planning. The CBJ has incorporated the Airport's Part 150 Noise Compatibility Planning Program noise contours into the Comprehensive Plan (CBJ 1996).

3.2.5 Recreational Opportunities and Activities

Recreational activities in Juneau are generally related to the natural environment surrounding the community. There are nearly 100 trails in the city of Juneau that are used for hiking, picnicking, bird and wildlife viewing, camping, and other activities. Recreational boating—for sightseeing, fishing, hunting and camping—is also popular. In 2001, 14,179 recreational anglers made 33,405 boat trips in the Juneau area and fished a total of 53,571 person-days (ADF&G 2003). As of 2003, 318 private aircraft were owned by Juneau residents. It is believed that many of the residents use their aircraft primarily for recreational purposes.

Hunting is popular within the CBJ, including duck hunting in the Refuge and on the Airport. According to ADF&G, approximately 600 Juneau residents purchased duck stamps in 1999, and it is likely that many of these residents hunted at least once in the Refuge that year.

3.2.5.1 Recreation in the Airport Vicinity

Recreation in the vicinity of the Airport includes activities within the approximately 4,000-acre Refuge, such as duck hunting, hiking, bird and wildlife viewing, golfing (at a course west of the Airport across the Mendenhall River), and recreational boating, as well as activities within the Gastineau Channel such as sport and personal-use fishing. The Mendenhall River supports boating recreation, primarily non-motorized kayaking and rafting. Recreational private aviation, including use of ultralights and powered parachutes, occurs on the grass field toward the northeast end of the Airport runway. Figure 3-7 shows some of the recreational uses in the Airport vicinity.

Mendenhall Wetlands State Game Refuge. The Refuge surrounds the Airport on three sides (east, south and west). The Refuge can be accessed from various points, including a trail at the end of Mendenhall Peninsula Road, the end of Sunny Drive on Sunny Point, a pullout along Egan Expressway between Lemon and Switzer Creeks, North Douglas Island south across Gastineau Channel from the Airport, and along the Airport Dike Trail (see Figure 3-7). Recreation in the Refuge includes hiking, jogging, dog walking, bird and wildlife viewing, waterfowl hunting (in season), and boating and personal-use fishing at the appropriate tides.

According to a 1988 study, approximately 17,155 people per year used the Dike Trail to walk dogs, run, and watch birds (USFWS 1988). In other parts of the Refuge, 4,563 people or about 12.5 people per day recreated by hunting, fishing, boating, viewing birds and wildlife, walking, and gathering subsistence resources. Although an exact count was not made, it was observed that the majority of the uses of the Refuge were non-consumptive.[4] In addition to those users actually in the Refuge or on the Dike Trail, many commuters view and enjoy the open space, flocks of birds, and other wetland attributes as they drive past on the Egan Expressway. Hundreds of residents enjoy views of the Refuge from their homes.

The Mendenhall wetlands is one of eight major waterfowl hunting areas in southeast Alaska (USFWS 1988). In 1998, it had the highest number of hunter days (n = 3,660 for the year), the greatest number of ducks shot (n = 2,985 for the year), and the second highest number of geese shot that year. This constitutes 25% of hunter days and ducks shot in southeast Alaska in 1988. Conclusions from the 1988 U.S. Fish and Wildlife (USFWS) report indicate that, considering both consumptive and non-consumptive uses, acre for acre, the Refuge and adjacent areas may accommodate more human recreation use that any other wetlands in Alaska.

4. Consumptive uses are activities (such as hunting, fishing, and gathering) that consume or use the resource. Non-consumptive uses (such as hiking, boating, viewing and photography), may enjoy the resource without diminishing populations or quantities of the resource.

Section 3.2.2.5 provides a discussion of the Refuge Management Plan, which guides the use and development of lands within the Refuge. Wetlands, wildlife, and other natural attributes of the Refuge are described in later sections of this chapter.

Other Area Recreation Sites. Recreational trails occur in the hills and ridges to the north of the Airport, along the Mendenhall Peninsula, and on North Douglas Island to the south of the Airport. Together, the trails cover an extent of at least 33 miles and traverse altitudes from sea level to approximately 4,000 feet above msl. The trails are used for cross-country skiing, hiking, motorized recreation, backcountry access, mountain biking, and so forth. Recreational boating (more frequently with smaller boats due to depth and tidal restrictions) occurs to the south, east, and west of the Airport, and a boat launch ramp is located directly across Gastineau Channel from the Airport, near False Outer Point on North Douglas Island.

To the west of the runway, on the west side of the Mendenhall River, is the Mendenhall Golf Course—a par three, nine-hole course with a driving range located on private property. The course covers approximately 110 acres of land and accommodates approximately 15,000 rounds of golf per year. The current approach pattern for Runway 08 goes over the south edge of the course, and helicopter traffic over the course is frequent in the summer.[5]

3.2.5.2 Recreation Activities on Airport Property

Juneau residents use their 318 private aircraft (most of which are based at JNU) for recreational flying. In 2003, 128 Juneau residents had private pilots' licenses, 33 had student pilots' licenses, and 74 had flight instructor certifications. The most recent data indicate that 152 Juneau residents have commercial pilots' licenses, but it is likely that many of those pilots also do recreational flying in the Juneau area (ADF&G 2003). According to the Airport Master Plan (USKH 1999), 37,954 general aviation operations are forecast for 2005. This amounts to 23% of all operations at JNU forecast for that year, a number of which would be for recreational flying. In addition to fixed wing aircraft and helicopters, several Juneau residents own and operate ultralights or powered parachutes and use the grass field to the northeast of the RCO and ASOS for takeoffs and landings.

In addition to recreational flying by Juneau residents, the airport is accessed almost daily by private aircraft from surrounding communities. During the spring and summer months, visitors from around the world land at JNU in recreational aircraft.

The Dike Trail, used by Juneau residents for recreating, is also an Airport road that provides access for emergency response vehicles. The history of that trail follows.

In about 1960, CBJ built a protective dike around the west end of the runway and the Float Plane Pond. An emergency vehicle access road was established alongside and atop the dike to provide emergency vehicle access to the Float Plane Pond and the south side of the runway. This road's use and name evolved as local residents began using the top of the dike as a walking trail. The

5. As the golf course is privately owned it does not qualify as a DOT-4(f) facility (see Section 3.13).

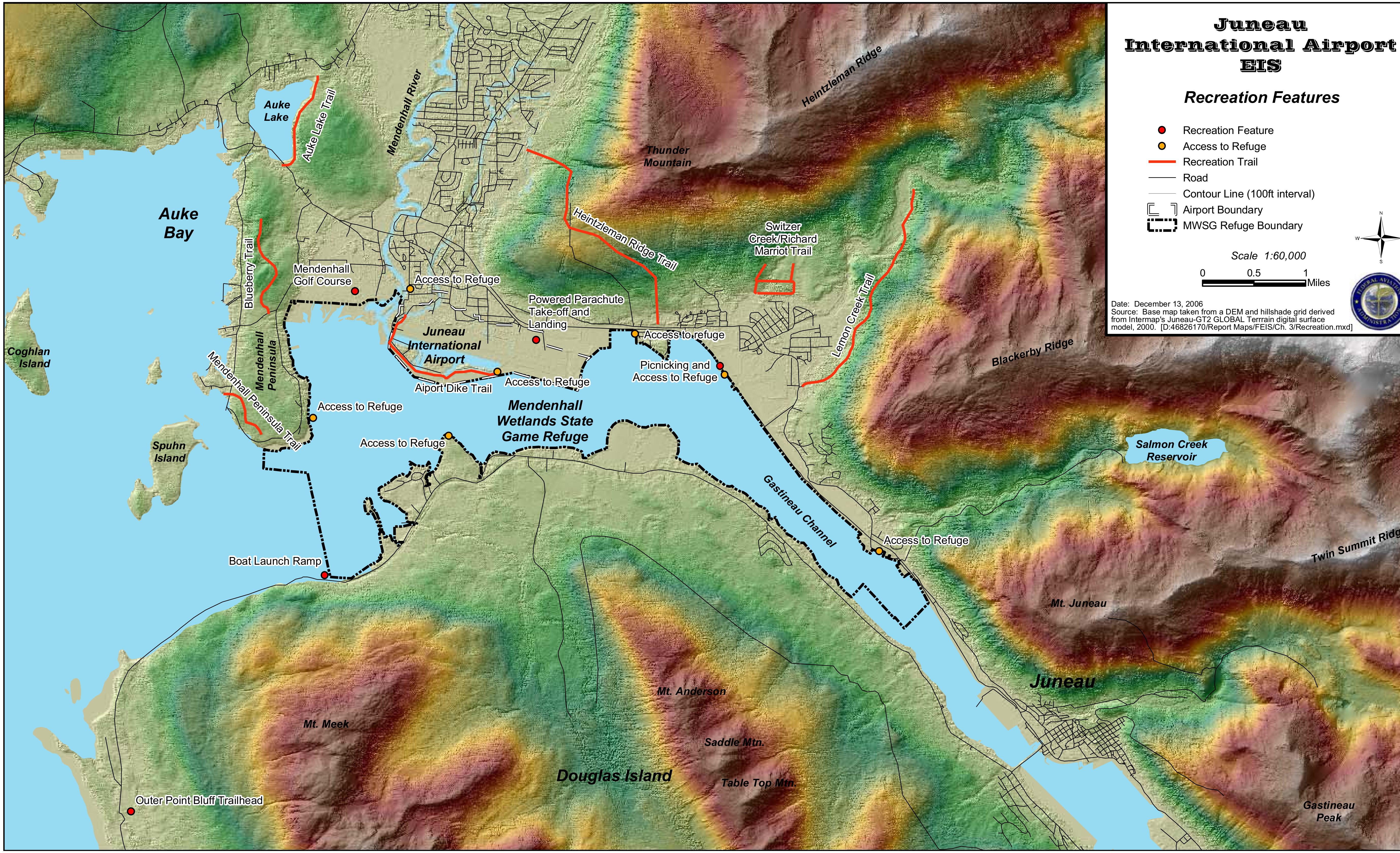


Figure 3-7. Recreation features within the vicinity of JNU.

THIS PAGE INTENTIONALLY LEFT BLANK

Dike Trail is located entirely within the Airport boundary, with the exception of the southwestern-most corner, which touches the boundary line between the Airport and the Refuge. In 1994, the Airport undertook a project to stabilize and aesthetically improve the dike, and therefore the trail as well, and to improve and extend its accessibility to emergency access vehicles.

The Dike Trail is a short, easy trail close to a large residential area. It is graveled, flat, approximately 3/4 mile long, and of recreational value for walking, jogging, wildlife viewing, and other activities. Native peoples use it to access materials used in their traditional practices. According to the 1995 Juneau Trails Study, the Dike Trail is the most heavily used trail in Juneau, with projected annual use at 77,178 person trips (Roberds 1997). Results of a survey performed for this Study indicate that each trail user makes an average of 39 trips per year on the Airport Dike Trail (Roberds 1997).

The Dike Trail has been considered a public access pathway to and from the Refuge since it was officially established in 1976. In the past, it has also been a primary access point for the Juneau School District "Sea Week" educational program. While the dike and emergency access road are maintained by Airport management, the ADF&G provides interpretive signage pertaining to the Refuge along the trail. For the purposes of this EIS, the Dike Trail is considered a public recreation area, although, as the Dike Trail is collocated with the emergency vehicle access road and is located on JNU property, JNU management has the authority to deny or limit access to the trail for security or emergency purposes and has done so in the past.

3.2.6 Description of Future Development Projects

Various projects that may impact potential Airport improvement projects are planned within the Juneau area. These developments are classified as infrastructure, recreation, and commercial/industrial and residential. Projects with potential to directly impact the Airport in terms of land use, noise, or air traffic, as well as projects that may require consideration for the cumulative effects analysis in this EIS, are listed in Table 3-8.

Table 3-8. Future Projects Potentially Impacting Land Use

Project	Description	Sponsor	Schedule
	Infrastructure Projects		
North Douglas Road Extension/ West Douglas Development	Extend road to West Douglas Island, develop housing, deepwater harbor, marina, etc.	CBJ and Goldbelt Inc.	On hold
Satellite Heliport	Site a heliport to lessen noise impacts while maintaining accessibility and convenience.	CBJ/USFS/ Alaska DOT&PF	Preliminary planning (on hold)
Juneau Second Channel Crossing	Provide a second hard link between Douglas Island and the Juneau mainland.	CBJ	EIS in progress

Table 3-8. Future Projects Potentially Impacting Land Use, continued

Project	Description	Sponsor	Schedule
Juneau Access	Provide improved access from Juneau to continental road system via road link and/or improved ferry service.	CBJ and ADOT	FSEIS published/ ROD issued in April 2006
Egan Drive Improvements	Improve traffic patterns along Egan Drive, including Yandukin Drive, Egan Drive intersection, and past JNU.	Alaska DOT	Construction 2007 and beyond
Mendenhall Wastewater Treatment Plant Connection to North Douglas	Six-inch sewer pipe connection from North Douglas wastewater collector center to the Mendenhall Treatment Plant. The pipe will cross the MWSGR and be routed around the west end of the JNU runway, to connect to the plant.	CBJ	Construction in 2006-2007
Juneau Airport Fuel Farm Expansion	Potential expansion of existing Airport fuel farm facility	CBJ	Pending appeal of denied application
	Commercial Industrial		
NOAA/NMFS Building/Lab	Construction of NOAA/NMFS office building and lab at Lena Point (23 acres, 107 employees).	NOAA/ NMFS	Construction 2004-2006
Kensington Gold Mine	Underground gold mine 45 miles north of Juneau.	Coeur Alaska	Construction 2005-2006, Operation 2006-2016
Cascade Point Development	Development of 1,400 acres of land for housing, harbor, marina, and business development.	Goldbelt Inc.	Pending permits for dock.
Auke Bay Commercial Facility	Construct a commercial loading dock and facility at Auke Bay. Potential for additional commercial and recreational development.	CBJ	In planning phase. Construction 2008-2012
	Residential		
Housing Development	Potential housing development north of JNU behind Fred Meyer.	Private Party	Construction 2006-2007
Housing Development	Spuhn Island development (near Fritz Cove) has received preliminary plat approval. Appeals have been filed.	Private Party	Construction 2007

3.3 SOCIOECONOMIC AND DEMOGRAPHIC CHARACTERISTICS

This section describes the socioeconomic characteristics of Juneau, with particular reference to the role of the JNU in the local and area economy. Juneau's regional and state commercial and political significance, as well as its landlocked nature, give special prominence to air transportation and associated facilities. Juneau's roles as a regional center, as a visitor destination, and as the state capital are considered in the analysis. In addition, this section presents economic and transportation trends for Juneau's future and the future of the region.

3.3.1 DEMOGRAPHIC CHARACTERISTICS

CBJ is located on the northwest coast of North America, between the western edge of the Coast Mountains and the sea. As with most Southeast Alaska communities, it is landlocked, with no road connection to any location outside of the community. Residents and visitors must rely on air and marine transportation to travel into and out of Juneau. JNU accommodates both jets and smaller air carriers to carry passengers, freight, and mail between Juneau, its surrounding communities, and the rest of the world. Commercial passenger ships (cruise ships), state-run ferries, and commercial barge lines provide the only other form of transportation for passengers, vehicles, freight, and mail via water.

In 2002, Juneau's population was estimated at 30,981 residents. It is the largest and most developed community in southeast Alaska. Demographic characteristics of Juneau residents, determined from the 2000 Census, are shown in Table 3-9.

3.3.2 EMPLOYMENT AND INCOME

Juneau is the capital city of Alaska, and, as such, houses the administrative and legislative centers of state government. State government is the single largest industry in Juneau. Other important industries are tourism (employment in tourism appears mainly in the services, retail trade, and transportation industry categories), mining, manufacturing (which includes fish processing employment), and construction. Details of Juneau's employment and income between 1985 and 2002 are available in Table 3-10.

Per capita annual personal income in Juneau in 2001 was $34,487, which was $4,074 greater than the national average. Approximately 12.7% of Juneau residents' personal income is in the form of transfer payments such as retirement benefits, welfare payments, and permanent fund dividend payments during that year. The mining industry paid the highest wages, with a 2002 average annual salary of nearly $100,000. Retail trade had the lowest 2002 average annual wage, at $19,148 (many retail trade jobs are seasonal and part time).

Table 3-9. Demographic Characteristics of CBJ

	Number	Percent
Total Population	30,711	100.0%
Age - Median Age	35.3	
Under 5 years	2,003	6.5%
School Age (5-18)	6,414	20.9%
18 years and over	22,294	72.6%
Sex		
Male	15,469	50.4%
Female	15,242	49.6%
Race		
White	22,969	74.8%
Native American	3,496	11.4%
Two or more races	2,121	6.9%
Asian (includes Filipino)	1,438	4.7%
Other	539	1.8%
Black	248	0.8%
Households – Total	11,543	
Family Households	7,638	66.2%
Non-family Households	3,905	33.8%
Households with children under 18	4,570	39.6%
Households with adults over 65	1,391	12.1%
Average Household Size	2.6	
Average Family Size	3.1	
Owner-Occupied Housing Units	7,356	63.7%

Source: U.S. Census Bureau, Census 2000.

Table 3-10. City and Borough of Juneau Economic Profile, 1985–2002

Economic Indicators	1985	1990	1995	2000	2002	Ten Years % Change	2002 Average Ann'l Wage
Population	26,037	26,751	28,700	30,711	30,981	9.7%	NA
Civilian Labor Force	13,983	15,201	16,677	17,129	16,467	2.2%	NA
Unemployment	1,113	776	959	839	973	-14.9%	NA
Percent Unemployed	8.0%	5.1%	5.8%	4.9%	5.9%	-16.9%	NA
Total Employment	12,870	14,425	15,718	16,290	15,494	3.5%	NA
Covered* Employment (Number of Jobs)	13,607	14,122	15,812	17,047	17,342	19.5%	$34,488
Private Employment	6,630	6,673	8,918	10,111	9,817	34.0%	$28,716
Mining**	NA	75	187	291	285	280.0%	NA
Construction	733	414	629	796	901	64.4%	$49,236
Manufacturing	253	148	327	375	218	-18.7%	NA
Transportation, Commun. & Util.	777	911	1,072	1,203	1,078	12.6%	NA
Wholesale Trade	178	197	184	325	187	-5.1%	NA
Retail Trade	1,942	2,042	2,736	2,483	1,943	-14.3%	$22,872
Finance, Insurance & Real Estate	615	496	681	573	481	-17.8%	$35,880
Services	2,034	2,333	3,017	3,952	4,645	97.1%	$21,930
Agriculture, Fisheries & Forestry	36	NA	78	101	78	11.4%	NA
Nonclassifiable	NA	NA	7	12	0	-100.0%	0
Government Employment	6,977	7,449	6,894	6,933	7,518	4.5%	$42,024
Federal Government	1,040	1,406	908	876	891	-18.6%	$61,188
State Government	4,509	4,535	4,315	4,284	4,541	0.2%	$40,020
Local Government	1,428	1,508	1,671	1,773	2,087	33.2%	$38,220

Table 3-10. City and Borough of Juneau Economic Profile, 1985–2002, continued

Economic Indicators	1985	1990	1995	2000	2002	Ten Years % Change	2002 Average Ann'l Wage
Covered* Jobs Annual Average Wage	$27,540	$28,336	$32,212	$33,058	$34,488	9.6%	NA
Covered* Payroll ($000)	$374,743	$400,168	$509,340	$563,432	$597,755	30.9%	NA
Gross Fish Sales (State Managed) ($000)	$12,043	$18,530	$17,273	$14,909	NA	-13.4%	NA
Reported Gross Business Sales ($000)	$541,179	$675,989	$956,585	$1,244,900	$1,304,800	70.8%	NA
Per Capita Income	$23,246	$26,708	$31,723	$34,113	NA	24.8%	NA
Per Capita Difference: Juneau - U.S.	$8,245	$4,998	$5,925	$4,317	NA	-46.5%	NA
Transfer Payments as a percent of income	9.0%	12.8%	13.4%	12.7%	NA	15.8%	NA
New Residential Building Permits - Total	243	32	257	95	124	37.8%	NA
Single Family (number of housing units)***	137	32	182	81	90	21.6%	NA
Multi Family (number of housing units)	106	0	75	14	34	112.5%	NA
Anchorage Consumer Price Index (CPI-U)	105.8	118.6	138.9	150.9	158.2	23.4%	NA
Annual Change (Percent)	2.4%	6.2%	2.9%	1.7%	2.0%	-41.2%	NA
U.S. Consumer Price Index (CPI-U)	107.6	130.7	152.4	172.2	179.9	28.2%	NA
Annual Change (Percent)	3.6%	5.4%	2.8%	3.4%	1.6%	-46.7%	NA

Sources: Alaska Department of Labor, Alaska Commercial Fisheries Entry Commission, U.S. Bureau of Economic Analysis, and City and Borough of Juneau. Prepared by Southeast Strategies, Juneau, November 2003.

* "Covered" refers to all workers covered by unemployment insurance legislation. Multiple job holders are counted more than once.

** Greens Creek Mine was annexed to the City and Borough of Juneau in 1994. Prior to that time, Greens Creek employment was not counted in Juneau's employment figures.

*** Does not include mobile homes.

NA = Not available.

Note: the Federal Government restructured the way they classify employment in 2001. Prior to that time, jobs were classified using the Standard Industrial Classification System (SIC). They now use the North American Industry Classification System (NAICS). Consequently, job and wage information beginning in 2001 are not strictly comparable to similar information before 2001.

3.3.3 INFRASTRUCTURE AND CHARACTER

Juneau has a relatively well-developed infrastructure. The CBJ community has piped water and sewer services, over 40 miles of paved roads, public bus service, ferry and air service, developed docks and harbors, a municipal land fill, and home postal delivery. In addition, Juneau has a regional hospital, banks and business services, and considerably more wholesale and retail shopping opportunities than other communities in southeast Alaska.

Juneau has a downhill ski area, numerous restaurants, several movie and live theatres, a symphony, an active nightlife, and access to numerous wilderness and natural recreational activities. The percent of the population owning private boats and small planes is one of the highest in the country, as illustrated by the following comparison in Table 3-11 of boat and plane registrations and private pilots licenses per 1,000 in population in the United States, Alaska and Juneau.

Table 3-11. Private Boat and Plane Registrations and Licensed Private Pilots per 1,000 in Population

	Registered Private Boats[1]	Registered Private Planes	Private Pilots Licenses
United States	44.7	1.1	0.9
Alaska	85.6	15.6	5.6
Juneau	144.4	10.3	4.1

Sources: U.S. Coast Guard Numbered Boats by State, 2001; FAA Aircraft Registry and Airmen Certification, 2003; and Alaska Division of Motor Vehicles Boat Registrations, 2001.

[1] United States registered private boats are those registered and numbered by the U.S. Coast Guard. Alaska and Juneau registered boats are those registered by the Alaska Division of Motor Vehicles and includes some boats (including non-powered boats over 10 feet long) which are not registered by the Coast Guard.

Juneau is the capital city of Alaska and serves as a regional commerce and transportation center. Economic, political, and social interaction with the southeast region and the rest of the state have an economic affect on the Juneau economy that is difficult to overstate.

3.3.4 TRANSPORTATION ACCESS

Residents of outlying communities that are not located on a commercial jet route must travel to Juneau to make air connections to other parts of the state, the country, and the world. Table 3-12 shows passenger traffic, and freight, and mail volumes for scheduled commuter aircraft into and out of Juneau. Although some summer traffic is made up of visitors, the majority of this traffic consists of Southeast Alaska residents. Juneau is the transfer point for freight and mail for many outlying communities.

Juneau is also a hub for ferry service. Northern panhandle residents travel to Juneau on the feeder ferry service and transfer to mainline ferry service to make road connections out of southeast Alaska (see Table 3-13). Though some of the summer travelers on the feeder routes are visitors, residents from neighboring communities (mainly from Haines and Skagway) also travel on the mainline vessels to reach Juneau.

Table 3-12. 1998–2000 Quarterly (and Yearly) Average of Commuter Air Traffic

Quarter/Full Year	Passengers	Freight (lbs)	Mail (lbs)
Into Juneau			
1	4,679	47,058	65,848
2	12,445	125,885	106,141
3	14,593	114,891	134,488
4	6,782	62,665	107,108
Full Year	38,499	350,500	413,585
Out of Juneau			
1	4,887	246,012	323,783
2	13,253	536,231	563,541
3	14,557	489,145	506,109
4	7,016	293,693	460,485
Full Year	39,713	1,565,081	1,853,918

Note: Does not include statistics for air taxi charters.
Source: U.S. Department of Transportation, Bureau of Transportation Statistics.

Table 3-13. Ferry Traffic to Juneau, Passengers/Vehicles Disembarking, 2002

	May – Sept.	Oct. – April	Full Year
All Ships:			
Passengers Disembarking	45,419	26,364	71,783
Vehicles Disembarking	10,530	7,640	18,170
Mainline Service:			
Passengers Disembarking	39,272	17,148	56,420
Vehicles Disembarking	9,193	5,402	14,595
Feeder Service:			
Passengers Disembarking	6,147	9,216	15,363
Vehicles Disembarking	1,337	2,238	3,575

Notes: Mainline Service connects the major Southeast Alaska Communities of Haines, Skagway, Sitka, Juneau, Petersburg, Wrangell and Ketchikan. Feeder Service connects smaller Southeast communities with regional and sub-regional hubs.
Source: Alaska Marine Highway Annual Traffic Volume Report, 2002.

3.3.5 Regional Center Role

As a regional shopping, banking, medical, and business center, Juneau attracts visitors from the surrounding communities of Haines, Skagway, Gustavus, Hoonah, Pelican, Elfin Cove, Angoon, Tenakee Springs, Kake, and even Sitka, Petersburg and Wrangell. The total population of the Southeast Alaska region is approximately 75,000, and Juneau serves as a regional hub for much of that population. In addition to commercial activities, regional social, recreational, and cultural activities, such as the Gold Medal basketball tournament and the Alaska Folk Festival, take place yearly in Juneau.

Juneau receives over 50,000 visits annually from residents of neighboring communities. Although it is difficult to quantify the actual economic impact of Juneau's role as a regional center without considerable study, some statistics are available that hint at the magnitude. Shoppers who are not residents of CBJ are allowed to purchase sales tax exemption cards from the local government. Exemption cardholders do not have to pay sales tax on goods and services purchased for consumption outside of CBJ. In CBJ fiscal year 2002, approximately 1,100 tax-exempt cards were purchased by residents of Alaska, most of whom were probably Southeast residents. In FY 2002, these Southeast residents spent nearly $5.0 million in Juneau for goods and services used outside the Borough. This figure does not account for the even greater impact due to money spent by regional residents in Juneau for items or services that are consumed while in Juneau, such as hotel rooms, food and drink, and entertainment. In addition, regional residents come to Juneau to obtain health care, business, repair, and transportation services.

3.3.6 State Capital Role

Juneau is Alaska's capital city. Many Juneau businesses are able to operate year-round, because of the economic contribution of legislators and their staffs during the winter months. Several attempts to move the capital of Alaska out of Juneau have failed, but the issue is revisited nearly every year. Transportation access to the State Capital is frequently discussed in association with the Capital move issue, and JNU plays a critical role in that access.

The main offices of the departments in the administrative branch of the state government are located in Juneau. Legislative sessions are held every year between mid-January and mid-May. During that period, approximately 150 to 200 non-CBJ resident legislators and their staffs live in Juneau. In addition, some federal offices and private sector offices are located in Juneau in order to be close to the administrative and legislative branches of state government. Some business services have located in the capital in order to provide support for the government sector. Lobbyists, government employees, and other interested parties (such as school groups) also travel to Juneau to do business with the legislature and other branches of state government. Most of these travelers are from other parts of Alaska, but some travel from the continental U.S., and other countries, such as Canada and Russia.

3.3.7 Visitor Destination Role

Alaska has been a popular visitor destination since John Muir first visited in 1879. With the advent of efficient and affordable forms of travel, its popularity has increased. The attraction is the wilderness setting, and the recreational and wildlife/bird viewing opportunities. During the summer of 2002, over one million tourists visited Juneau. Of those visitors, 718,633 came by cruise ship, 72,825 came by ferry, and 232,902 came by air (jet only). While development of transportation and other facilities may improve safety and comfort, they may also diminish the attraction to the visitor and resident alike. The CBJ recently completed a long-range tourism plan and adopted a set of tourism management policies to ensure the success, longevity, and harmony of the tourism industry within Juneau's economic structure.

3.3.8 Seasonal Economy

The Juneau economy shows a definite seasonal pattern. January begins the legislative season, which runs through mid-May. Travel during this season consists mainly of legislators and staff traveling to their home districts (mostly on weekends), and lobbyists, government representatives, and other interested parties traveling to Juneau to participate in the legislative session.

In early May, before the end of the legislative session, recreational visitors (tourists) begin arriving in Juneau, and continue to arrive through September. Once they have arrived via plane, ferry, or cruise ship, many visitors take small air carriers to surrounding communities or lodges, or take fixed-wing ice cap or helicopter glacier landing tours during the summer season.

Between the end of tourist season in late September and the beginning of the legislative session in mid-January, primarily local citizens and the occasional regional resident visitors populate the town. Because Juneau's weather in fall is particularly cold and damp, and business activity is comparatively slow, many Juneau residents travel to sunny destinations for vacation during this season. Other residents and some Juneau visitors travel to remote sites for late summer and fall hunting and fishing trips.

3.3.9 Economic Trends

The economy of southeast Alaska is in a slump, mostly due to decreased timber industry activity and weak markets for Alaskan fish. According to the Alaska Department of Labor, timber cutting operations and employment in the region have significantly declined in the past decade. Alaska Limited Entry Commission data shows declining value of fish harvested within the region as wild Alaska salmon struggles for market share against farmed salmon. As Juneau is a regional center, and the capital of Alaska, the economy of the region directly impacts that of Juneau. The Tongass National Forest, which covers most of southeast Alaska, is again beginning limited timber harvest after a temporary shutdown in response to court decisions. Unless timber-cutting and wood-processing activities resume to previous levels, it is likely that Forest Service activities will slow in the region.

The tourism sector continues to grow, but a depressed national economy and high fuel prices may affect that growth, and tourists are not filling the airplane seats left open by the timber industry in areas with previous logging activity. Commercial fishing income is down due mainly to competition from farmed fish. Mining in the region is stagnant, and generally dependent on metal prices.

Juneau's economy is slightly more stable than that of the region as a whole, mainly due to its lack of dependence on the timber and fisheries industries. As the state government continues to operate on a deficit, spending and employment cuts in that industry are expected to continue.

The Alaska Department of Labor reports that the services sector of the economy will continue to grow, mainly due to expansion of the health care industry and in support of the tourism industry (ADL 2001). Also, construction employment is projected to increase, due to scheduled transportation projects, planned construction of a new wing on the University of Alaska Juneau campus, and other development projects.

3.3.10 Marine Transportation Trends

As the majority of southeast Alaska is not accessible by road, marine transportation is the only alternative to air transportation for most communities in the region. The Alaska Marine Highway System (AMHS) provides public ferry service between many communities in the northern and central portions of southeast Alaska. In addition, charter passenger-only ferries are available from the private sector. Barge service is available for shipment of goods and equipment.

The Alaska Department of Transportation and Public Facilities (ADOT) is currently revising the Southeast Alaska Regional Transportation Plan (SATP; KJS 1999), and alternatives involve improved surface transportation in the form of better ferry service and connecting roads. Approximately 50% of respondents to a survey conducted as part of the SATP stated that they would travel on the ferry more frequently if better service was provided. As faster ferry service, dayboat service and road connections are implemented throughout the region, it may reduce demand for some air carrier and commuter services.

The M/V Fairweather, AMHS's new fast vehicle ferry, began service out of Juneau in the summer of 2004. That ship provides service between Juneau and the ports of Haines, Skagway and Sitka in about half the time as the current ferries provide. In addition, a private company (Pacific Seaflight) intends to provide service between Juneau and Hoonah, and Juneau and Haines/Skagway with 8 passenger ground effects craft. These craft fly just above the water at a maximum speed of 85 knots, and are inexpensive to operate. Both of these new services will likely impact demand for air services in the area, including jet service between Juneau and Sitka.

3.3.11 Air Services Trends

A survey of all air carriers in southeast Alaska undertaken as part of the Angoon Airport Reconnaissance Study indicates that a consolidation of Part 135 air carriers (commercial airlines operating planes with seating for less than 30 passengers) in the region has occurred, and will likely continue to occur (R&M 2000). Trends in the Part 135 air carrier industry in southern Southeast

Alaska could affect service to the north. New dayboat ferry service between Prince of Wales Island and Ketchikan has decreased air traffic demand, especially for seaplanes. Construction of a bridge between Ketchikan and its airport on Gravina Island and construction of an airport in Angoon on Admiralty Island may also reduce the demand for seaplanes.

Air traffic within the Southeast Alaska region is expected to increase slightly over the next 20 years, similar to the trends for JNU forecast in the Master Plan and summarized in Table 1-4 of Chapter 1. Many of the communities in the region have no outside road access and ferry service is limited, thereby making air travel a necessary and sometimes sole option to move within and outside of the region. Aircraft operations at JNU have not consistently increased in the past five years, as was projected in the Master Plan. Enplaned passenger projections for airports (from the Alaska Aviation System Plan Update) in the Southeast Region vary but average about a 1.8% increase between the years 2005 and 2010. Increasing air carrier costs and plans for competing fast ferry transportation services and increased road access in the region could dampen demand.

3.3.12 Economic Importance of JNU

JNU ranks high in relative importance to the community because of the small number of transportation options for residents and visitors, and because many of Juneau's economic sectors (such as government and tourism) rely on air transportation. The lack of a road connection to areas outside the immediate vicinity magnifies the importance of air cargo for shipment of goods and mail to the community. For example, air transportation is crucial in getting large volumes of fresh fish to market, furthering Juneau's role as a regional seafood hub.

In addition, safe and frequent access to Juneau from the rest of the state is essential to effective and efficient operation of the capital. Several attempts to relocate the state government out of Juneau have failed, but the issue is revisited nearly every year. Access is continually brought up as a major reason to support moving the capital. The economic contribution that the capital makes to CBJ is hard to overstate. Many Juneau businesses are able to operate year-round because of the economic contribution of legislators, their staff members, and their visitors during the winter months.

As Juneau is the State Capital, JNU plays an important role in connecting the state to its capital. Legislators, constituents and other government representatives travel between Juneau and their home districts, and access Washington, D.C., and other locations via JNU.

The CBJ recently contracted an economic impact study of the Airport (McDowell 2000). Results of this study indicate that direct and induced economic impacts of Airport activity produce 767 obs in Juneau for an annual payroll of $23.5 million. In addition, direct and induced income from purchases in Juneau by Airport–related business equals $17.9 million annually, and those businesses pay approximately $0.6 million in taxes yearly. Although it is not solely attributable to the Airport, spending by out of state visitors using the facility is estimated to create another 647 local jobs with a payroll of $9.3 million and another $32.0 million in purchase of local goods and services.

The economic impact of JNU is not limited to the local community. JNU is classified in the Alaska Aviation System Plan as a regional airport, one of two in southeast Alaska (the second is Ketchikan). Sitka uses Juneau as the regional hub, while Petersburg and Wrangell use both Juneau and Ketchikan. Of the 24 community airports in the southeast Alaska area, nine use Juneau as the hub. In addition, there are about 125 airports designated as local and unclassified, most of them seaplane bases, many of which use Juneau as a hub. Only Regional and District class airports in Southeast (with the exception of Yakutat, which is classified as a Transport facility) receive jet service. Many residents of smaller communities must travel to Juneau to get air carrier connections to areas outside the region. More than 20 Southeast Alaska communities use Juneau as a postal hub.

Surrounding communities need safe and frequent access to Juneau for shopping, health care, business services, transportation services, repair services, educational services, and cultural and recreational activities. Quick access to Juneau's regional hospital through medical evacuation of critical care patients is dependent on JNU. The Airport facilitates regional distribution of freight and mail, and local air carriers employ people in neighboring communities.

3.4 Air Quality

The following sections discuss the existing air quality conditions at JNU and the Mendenhall Valley.

3.4.1 Climate

Juneau is near the northern end of a temperate rain forest found on the North Pacific Coast from San Francisco to Anchorage. Juneau weather is characterized by a North Pacific maritime climate with frequent storms and abundant precipitation. The mean summer high temperature is 62° F, and the mean winter high temperature is 33° F. There are approximately 150 frost-free days annually.

CBJ lies in an area that is influenced by the Japanese Current, which creates a significant amount of precipitation and overcast conditions. The wettest year for Juneau in recorded history was 1991, when CBJ recorded 85.15 inches of rain. The mean annual precipitation at the Airport is 54 inches (water equivalent), which includes 98 inches of snow. However, the mean annual precipitation measured in downtown Juneau, 10 miles southeast of JNU, is 94 inches. While both sites are moist, the substantially higher average precipitation in downtown Juneau is a result of orographic effects: the combination of storm systems coming out of the Gulf of Alaska and colliding with the abrupt mountains of the Coast Mountains behind Juneau. More details about rainfall differences are included in the Water Resources Technical Working Paper #3 (Vigil-Agrimis 2002).

3.4.2 APPLICABLE REGULATIONS, PLANS, AND POLICIES, AND LOCAL AIR QUALITY

When considering air quality, it is important to consider the federal and state regulations and policies that establish compliance thresholds, and therefore impact criteria for environmental analysis. The following sections describe applicable regulations and policies.

3.4.2.1 NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS)

The Clean Air Act (42 U.S.C. §§ 7401-7671q) requires the adoption of National Ambient Air Quality Standards (NAAQS) to protect the public health (primary standard) and welfare (secondary standard) from the effects of air pollution. EPA has periodically updated the NAAQS. Current standards are set to limit emission quantities for the following criteria pollutants: sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), particulate matter equal to or less than 10 microns in size (PM_{10}), fine particulate matter equal to or less than 2.5 microns in size ($PM_{2.5}$), and lead (Pb). In the most recent update to these standards, the 8-hour O_3 and $PM_{2.5}$ standards became effective on September 15, 1997, and policies and systems to implement these new standards will be developed in the coming years.[6] In 2004, the EPA formally designated areas relative to the 8-hr ozone standard and $PM_{2.5}$: all of Alaska was designated as attainment for these standards. The State of Alaska Department of Environmental Conservation has established state standards, which follow the national standards. The state standards are shown on Table 3-14.

Air quality standards are the levels established to protect the public health and welfare with an adequate margin of safety. All areas of the country are required to demonstrate attainment with the standards.

Volatile organic compounds (VOCs) are not a criteria pollutant, and therefore no ambient air standards have been established for them. Since VOCs, however, react with nitrogen oxides in sunlight to form ozone, VOCs and nitrogen oxide emissions are considered precursor pollutants and thus are included in this evaluation for the EIS.

3.4.2.2 CONFORMITY RULE

The 1990 Amendments to Section 176 of the Clean Air Act require the EPA to promulgate rules to ensure that federal actions conform to the appropriate state implementation plan. Two forms of conformity exist: transportation and general. Transportation conformity applies to federal actions of the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA), or to projects that affect regionally significant roadways. General conformity applies to all other federal actions. The proposed actions at JNU do not involve funding from FHWA or FTA; nor do they affect regionally significant roadways. Therefore, general conformity was considered in preparing the EIS. The General Conformity Rule (40 C.F.R.§§ 93.150-.160.) requires any federal agency responsible for an action in a non-attainment area (i.e., an area that does not meet the stan-

6. In April 2001, the United States Supreme Court upheld the new standards.

Table 3-14. Ambient Air Quality Standards

Pollutant	National Primary	National Secondary	State of Alaska
Carbon Monoxide (CO)			
8 Hour Average	9 ppm (10 μg/m^3)	N/A	10 μg/m^3
1 Hour Average	35 ppm (40 μg/m^3)	N/A	40 μg/m^3
Particulate Matter (PM_{10})			
Annual Arithmetic Ave.[b]	50 μg/m^3	50 μg/m^3	50 μg/m^3
24 Hour Average[c]	150 μg/m^3	150 μg/m^3	150 μg/m^3
Particulate Matter ($PM_{2.5}$)			
24-Hour Standard	65 μg/m3	65 μg/m3	N/A
Annual Arithmetic Ave.	15 μg/m3	15 μg/m3	N/A
Ozone (O_3)			
1 Hour Average[d]	0.12 ppm	0.12 ppm	0.12 ppm
8 Hour Average	0.08 ppm	0.08 ppm	N/A
Sulfur Dioxide (SO_2)			
Annual Average[e]	80 μg/m^3	N/A	80 μg/m^3
30 Day Average	N/A	N/A	N/A
24 Hour Average	365 μg/m^3	N/A	365 μg/m^3
3 Hour Average	N/A	1300 μg/m^3	1300 μg/m^3
1 Hour Average[f]	N/A	N/A	N/A
1 Hour Average	N/A	N/A	N/A
30 Minute Average[a]	N/A	N/A	50 μg/m^3
Lead			
Calendar Quarter Average[e]	1.5 μg/m^3	1.5 μg/m^3	1.5 μg/m^3
Nitrogen Dioxide (NO_2)			
Annual Average[e]	0.053 ppm (100 μg/m^3)	0.053 ppm	100 μg/m^3
Ammonia			
8 consecutive hours[a]	N/A	N/A	2.1 μg/m^3

Notes:
ppm = parts per million
μg/m^3 = micrograms per cubic meter
Annual, Quarter and 30 Day standards never to be exceeded; shorter-term standards not to be exceeded more than once per year unless noted.
N/A - Not Applicable
[a] Not to be exceeded more than once a year.
[b] Standard attained when the expected annual arithmetic mean concentrations is less than or equal to 50μg/m^3.
[c] Standard attained when the expected number of days per calendar year with a 24-hour average concentration above 150 μg/m^3 is equal to or less than one.
[d] Standard attained when expected number of days per calendar year with maximum hourly average concentration above 0.12 ppm is equal to or less than one.
[e] Never to be exceeded.
[f] Not to be exceeded more than twice in seven consecutive days.

dards for one or more criteria pollutants) to determine that the action is either exempt from the General Conformity Rule requirements or that the action conforms to the applicable state implementation plan.

3.4.2.3 STATE IMPLEMENTATION PLAN

The Clean Air Act requires states with areas that exceed the NAAQS to develop plans for each area that, when implemented, will reduce air pollutants and attain the standards. These attainment plans must be adopted by the state and submitted to the EPA in the form of a state implementation plan. Compliance with the NAAQS (i.e., establishing the area as attainment or non-attainment) is determined by long-term monitoring throughout the region.

The Southeast Alaska Intrastate Air Quality Control Region is designated as non-attainment for PM_{10} and attainment for all other pollutants. However, as the southern boundary of the PM_{10} non-attainment area is described as the north boundary of the Airport, JNU is in attainment for all pollutants (Shepard 2001). Therefore, the requirements of the Clean Air Act for general conformity do not apply to the Airport, as the federal action would be occurring outside the non-attainment area. Not withstanding the requirements of the General Conformity Regulation, the EIS quantifies existing and future emissions associated with activities at the Airport that would be affected by the proposed actions and alternatives. Included in this evaluation is the effect on carbon monoxide, nitrogen oxides, particulate matter, volatile organic compounds, and sulfur oxides.

Portions of the Juneau area, including the Mendenhall Valley, are subject to the Alaska State Implementation Plan (SIP) for particulate matter, due to higher-than-acceptable values monitored in the air quality area. As noted earlier, this non-attainment area does not include the Airport; however, it does include areas immediately north and west of the Airport. The state and EPA adopted an amended PM_{10} State Implementation Plan in 1993.

3.4.2.4 BACKGROUND AND REGIONAL AIR QUALITY

Although the Juneau area is designated as non-attainment for PM_{10}, no exceedances of the standard have been recorded since the early 1990s. At that time, the primary air pollutant concerns in the area were associated with wood smoke and road dust. Wood smoke has been reduced through the implementation of exhaust and use controls, while road dust has been reduced through paving key area roads (Hefferand 2001).

3.4.3 EXISTING AIRPORT EMISSIONS

To provide context for the evaluation of future air emissions, the emissions associated with existing Airport activities were assessed. The following summarizes the methodology used to quantify emissions and the results of the emissions modeling.

3.4.3.1 Methodology

An aircraft pollutant inventory was prepared to quantify the emissions associated with aircraft and ground support vehicle activity at JNU. The aircraft emissions inventory was performed using the EPA-approved Emissions and Dispersion Modeling System (EDMS) computer model, version 4. Aircraft activity information for the year 2000 was input to EDMS based on the existing aircraft fleet. Default information available in EDMS was used for the aircraft time in mode (takeoff, climbout, approach, and taxi/idle), as well as for use of ground support equipment.

3.4.3.2 Baseline (2000) Emissions Inventory

Based on current activity levels and aircraft fleet mix, an emissions inventory was prepared as listed in Table 3-15 to quantify the yearly emissions by aircraft and ground support equipment. Emissions of CO, VOCs, nitrogen oxides (NOx), sulfur oxides (SOx), and PM_{10} were quantified. (Note: Because this EIS is concerned with the evaluation of impacts associated with additional development at the Airport, the inventory only accounts for sources that would be affected by the proposed actions and the alternatives).

Table 3-15. Existing (2002) Emissions Inventory for JNU (Tons/Year)

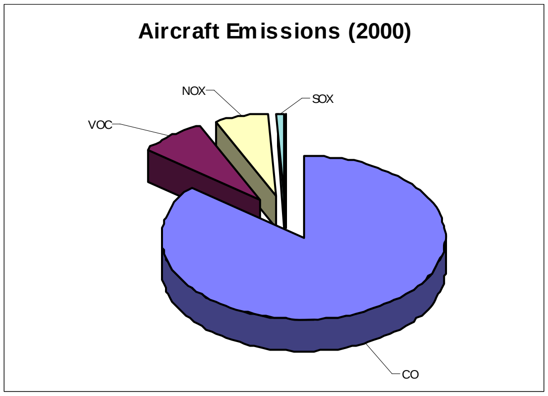
Pollutant	Aircraft	Ground Support Equipment[2]	Total
Carbon Monoxide (CO)	559.8	424.2	984.0
Volatile Organic Compounds (VOCs)	37.9	16.6	54.6
Nitrogen Oxides (NOx)	37.7	22.3	60.0
Sulfur Oxides (SOx)	4.1	2.1	6.2
Particulate Matter (PM_{10})	Unknown[1]	0.7	>0.7

Source: Bridgenet Consulting Services, September 2004. Default assumptions were used for Ground Equipment. May not add due to rounding

[1] The EDMS contains very little data concerning PM_{10} emissions, as little industry accepted data is available concerning particulate matter emissions from large commercial aircraft engines.

[2] Ground support equipment also includes APU use (auxiliary power units, the on-board generators that provide power to the aircraft when engines are not in use or when ground power is not available).

As noted above, the primary quantity of pollution emitted by aircraft and ground support equipment is CO. The charts in Figure 3-8 illustrate the relative contribution of each criteria pollutant from aircraft and ground equipment during year 2000.



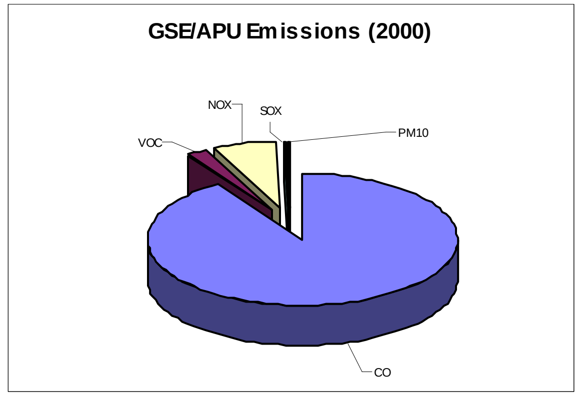


Figure 3-8. Relative contributions of emissions in 2000.

3.5 Geology and Soils

This section describes the geological resources and soils in the area of the JNU. An overview of the geologic setting is provided, but the focus is on the geologic characteristics of the areas that could be altered by actions at JNU, or that could influence design and implementation of actions. A description of the geologic processes formative to the terrain and landforms follows. Although European settlement was initiated due to the discovery of gold, this aspect of the geologic setting, so important to Juneau's history and economy, has no bearing on the actions being considered at the Airport or possible impacts. Therefore, little information has been included concerning economic geology and ore mineralogy.

3.5.1 Geologic Setting

JNU is located on the northeast side of Gastineau Channel, within the Mendenhall River Basin, which extends from the Coast Mountains of southeast Alaska. The river basin ranges in elevation from sea level, where JNU is located, to approximately 7,000 feet above sea level in the upper Mendenhall Valley. Most of the upper basin is characterized by steep terrain with glacier cover. The lower river basin is relatively flat and supports commercial and residential development, in addition to the Airport. Although the mountains in this area are comprised primarily of metamorphic and igneous rocks, the recent (in geologic terms) glacial advances and retreats have heavily altered the topography and landform.

The Juneau Gold Belt is a narrow 100-mile-long strip of land in the northeast corner of the CBJ and extends from south of Skagway to the Coast Range. The gold belt is made up of the Coast Plutonic Complex of tonalite, a rock unit characterized by the minerals hornblende, biotite, and magnetite, with quartz veins that are locally abundant in gold (Brew 1980).

Several studies have described the geology of the Mendenhall Valley (Alcorn and Hogan 1995, Barnwell and Boning 1968, Hicks and Shofnos 1965, Motyka 1988). The underlying bedrock is composed of tightly consolidated sedimentary (slate, greywacke, and sandstone), igneous (extruded volcanics), and metamorphic rocks (greenstone and schist) that are relatively impervious to moisture. Many of these bedrock materials are highly mineralized, which supported the gold mining that led to settlement of Juneau. As described in Section 3.6, Water Resources, groundwater throughout the valley has a high dissolved iron content (Barnwell and Boning 1968). Figure 3-9 shows the surficial geology in the area around the Gastineau Channel, JNU, and Mendenhall Valley.

Glaciomarine deposits of the Gastineau Channel Formation, overlain by glacial outwash deposits, characterize the Mendenhall Valley (Figures 3-9 and 3-10). The outwash deposits range in thickness from 10 feet to 100 feet. They are comprised of sand-size to cobble-size rocks that have been overlain in some small areas, mostly down the middle of the valley, by muskeg or plant debris in various stages of decay. Moraine deposits composed of loose till and unsorted gravelly sand are found in the upper valley. Farther down the valley, beach deposits and glaciomarine deposits from the Gastineau Channel Formation characterize most of the Gastineau Channel.

3.5.2 Geologic Processes

JNU is located on a glacial outwash with stream and marine deposits. A delta associated with the Mendenhall River extends out into Gastineau Channel. These landforms are the expression of a number of geological processes: glacial and post-glacial, alluvial, tidal, and isostatic rebound. The following sections summarize the processes that have shaped landforms in the vicinity of JNU.

3.5.2.1 Glacial Processes and History

The Mendenhall Glacier is a key feature of Mendenhall Valley's geology, in terms of water resources, sediment deposition, and geomorphology. The Mendenhall Glacier currently terminates at the north end of Mendenhall Lake. Through glacial advances and retreats, the Mendenhall Glacier deeply scoured and then partially refilled the valley. During the Pleistocene, bedrock materials were scoured by an ice sheet approximately 4,000 to 5,000 feet thick (Barnwell and Boning 1968).

Since the Pleistocene, net temperatures have increased, causing glaciers to melt and recede. The major glacial retreat that began at the conclusion of the Pleistocene, approximately 17,000 years ago, left extensive outwash deposits of gravel, sand, and silt. While the net result under the present climate regime has been a dramatic retreat of glaciers worldwide, there have been mini-ice ages in the intervening period, when the Mendenhall and other glaciers have advanced for short periods of time. The resulting glacial activity and corresponding sea level changes left a complex network of gravels, sands, silts, marine deposits, peat, and clay across the valley. These alluvial, organic, and estuarine deposits are several hundred feet thick in the center of the valley.

Since the glacier's most recent, dramatic recession, the lake has continued to act as a sink for coarse debris and sediment from the Mendenhall Glacier and from Nugget and Steep Creeks. Current sources of coarse sediment for the Mendenhall River are derived from bank erosion and down cutting of the channel. Montana Creek also contributes coarse material to the lower reaches of the river.

Barnwell and Boning (1968) estimate that the most recent Mendenhall Glacier retreat began in 1750, just 250 years ago. They estimate the overall rate of retreat at 40 feet per year. Just outside the JNU property, to the north, there are relatively recent glacial outwash deposits. These glacial deposits comprise a majority of the surrounding region. They are generally gray silty sand with local boulders, and the thickness ranges from 10 feet to 60 feet. This layer is generally 40 feet thick in the Mendenhall River Valley floor (Miller 1975). Deposits of glacial outwash most likely underlie the layers of fill, alluvium, and marine deposits.

Muskeg is a unit shown on Figure 3-9 that is often mischaracterized as peat, and commonly found in locations previously inundated by glaciers. There is a small outcrop of peat on JNU in the woodlands immediately south of the Float Plane Pond. Peat is typically a brown, dark-brown residuum produced by the partial decomposition of mosses, sedges, trees, and other plants that grow in marshes and wet areas. Muskeg is more accurately described as the thick accumulations of mosses in swamps and marshes.

3.5.2.2 Alluvial Processes

The alluvial processes of the Mendenhall River, Duck Creek, and other tributaries have deposited sediments in stream channels throughout Mendenhall Valley, in both ancient and currently active stream channels. The U.S. Geological Society (USGS) mapped these deposits around the north boundary of JNU and on the west side of the Mendenhall River Delta (Figures 3-9 and 3-10).

There are modern alluvial deposits that indicate areas of sediment transported by water, down the middle of the Mendenhall Valley, along the east side of the valley and Jordan Creek, and along the Duck Creek extension of Mendenhall River into Fritz Cove. Alluvium is also found along the northern boundaries of JNU property (Figure 3-9). These deposits are relatively modern, having been deposited throughout the period since the last continental glaciation or ice age (an epoch known as the "Holocene"), and they consist of brown to gray sand and pebble gravel, with some isolated boulders lying on bedrock. The thickness of these deposits ranges from a few inches to several feet. The grain size of these deposits includes sand, gravelly sand, sandy gravel, and gravel.

3.5.2.3 Tidal Processes

Much of JNU lies directly on imported, undifferentiated fill deposits. This fill is made up of rock, silt, sand, gravel, soil, and trash, and in some areas, it includes trees and sawdust. However, much of this fill and the area around JNU, particularly east and northeast of the Airport, rest on intertidal marine deposits. These sedimentary deposits range from a few feet to greater than 25 feet thick, and were deposited by the tidal actions within Gastineau Channel and Fritz Cove. The sediments consist of gray to dark-gray sandy silt, silty gravelly sand, and sandy gravel; and the thickness of these sediments ranges from 3 feet to 20 feet. The northwest corner of the property lies in an area dominated by emergent intertidal deposits consisting of gray to dark gray sandy silt and silty gravelly sand.

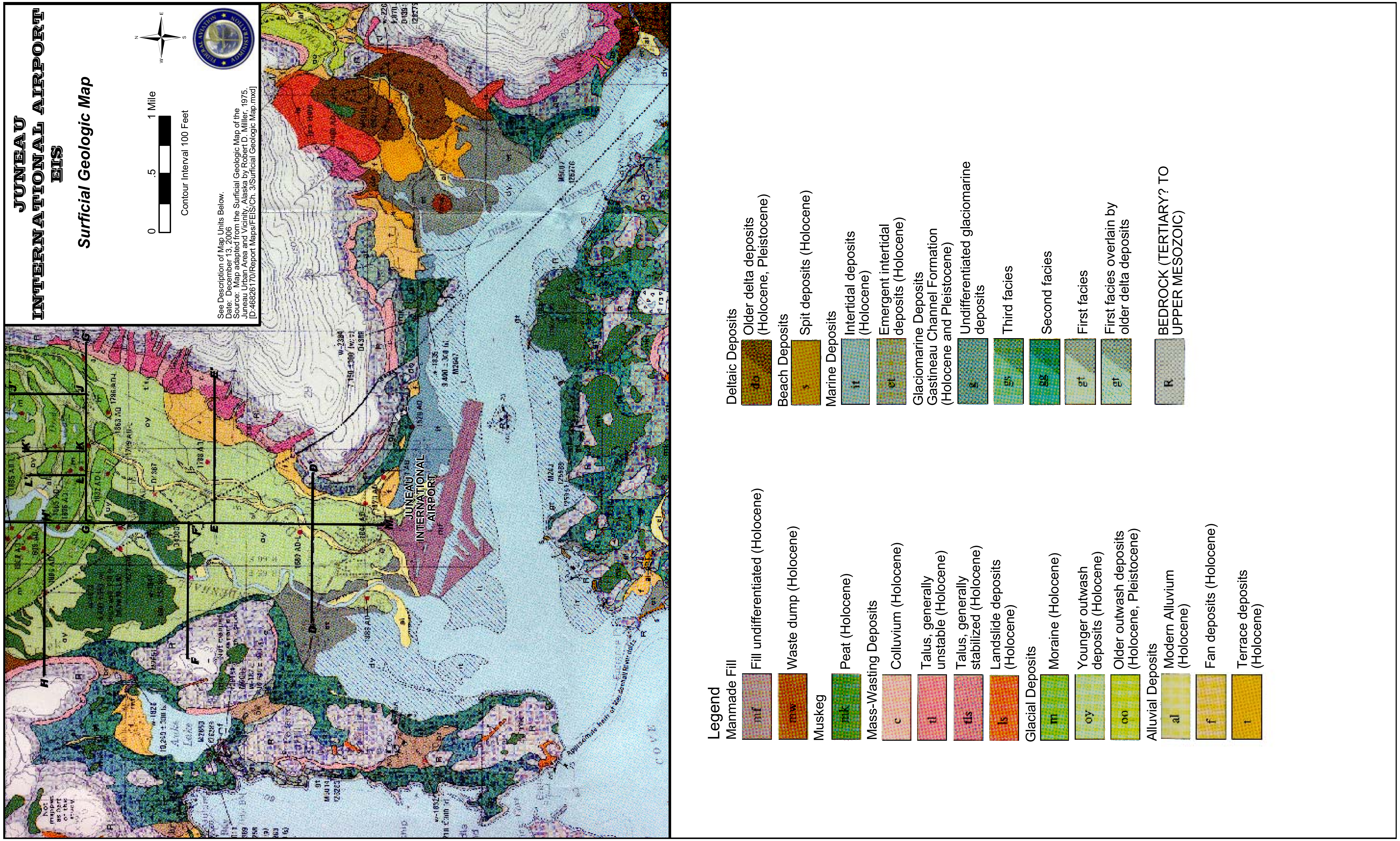
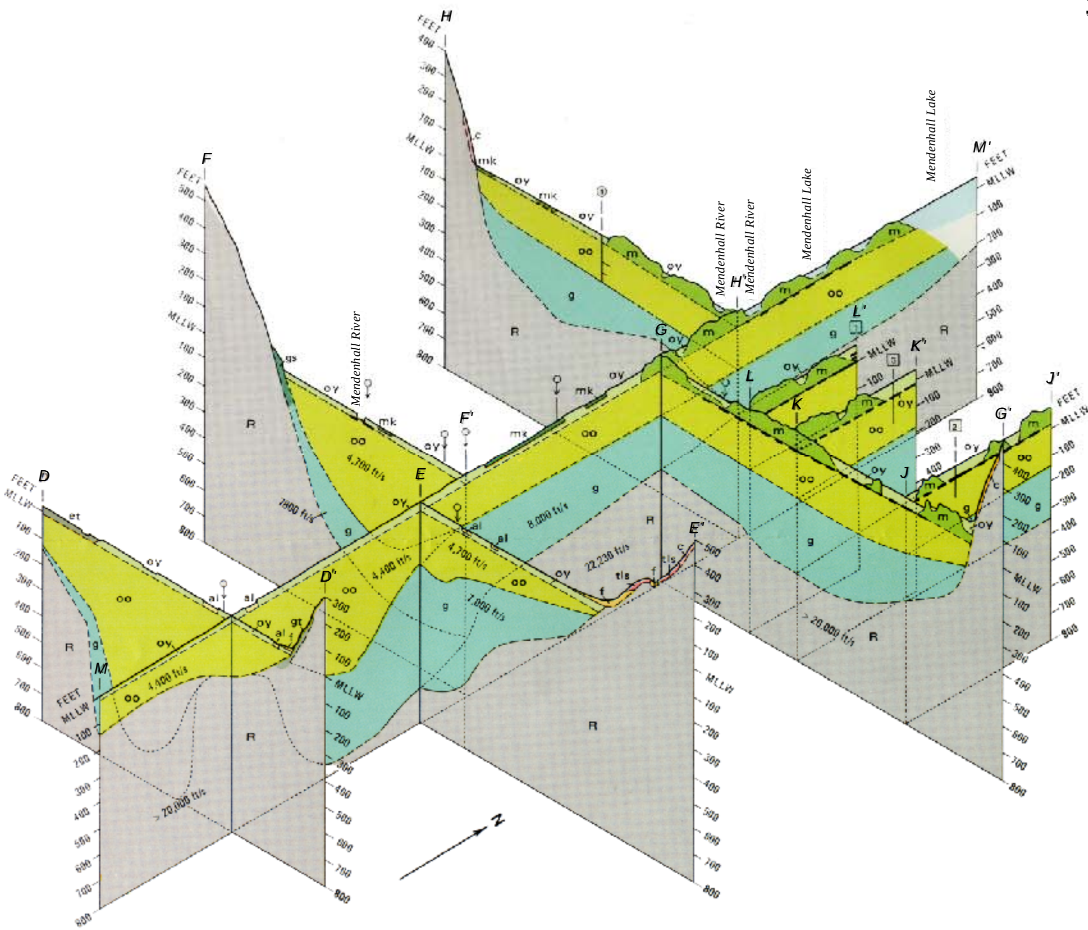


Figure 3-9. Surficial geologic map.

THIS PAGE INTENTIONALLY LEFT BLANK



Shows interpretation of the depth to, and configuration of, bed rock and overlying geologic units beneath the Mendenhall River Valley; based primarily on seismic data. Lines of section are shown on the Surficial Geologic Map (See Figure 3.5-1.) Gastineau Channel fault of Ford and Brew (1973) is not shown. Map adapted from the Surficial Geologic Map of the Juneau Urban Area and Vicinity, Alaska by Robert D. Millller, 1975.

JUNEAU INTERNATIONAL AIRPORT EIS

Fence Diagram of Mendenhall River Valley Area

EXPLANATION

Rock unit symbols and colors are the same as on the Surficial Geologic Map (See Figure 3.5-1)

CONTACT -- Dashed where inferred; dotted where concealed behind part of diagram

ORGANIC LAYER -- A peat and wood deposit; believed to be forest layer that may extend throughout the Mendenhall River valley area

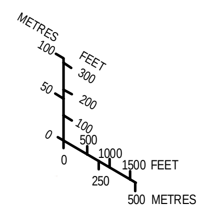
22,230 ft/s VELOCITY OF SEISMIC WAVE IN ROCK UNIT -- Velocity depends upon type of lithology.

1 TEST WELL LOCATION -- From unpublished well data of the U.S. Geological Survey, Juneau, AK; used here to show the depth to the organic layer and the thickness of younger outwash deposits (oy)

1 WATER WELL LOCATION -- Data from Barnwell and Boning (1968)

SEISMIC STATION LOCATION -- Seismic determinations and interpretations by R.A. Farrow and E.E. McGregor, U.S. Geological Survey, Denver, Co., 1966

MLLW MEAN LOWER LOW WATER POSITION OF SEA LEVEL



VERTICAL EXAGGERATION X 4
Vertical scale shows altitude relative to MLLW (mean lower low water) of sea level

Figure 3-10. Mendenhall Valley fence diagram.

There were also times in geologic history when the sea level extended into the upper Mendenhall Valley. Approximately 10,000 to 12,000 years ago, after a retreat of the ice sheet, the valley floor was covered with sea that may have been more than 400 feet deep (Barnwell and Boning 1968). This higher sea level allowed for a layer of intertidal deposits to be lain down throughout the area, where the Airport is now and up into the Mendenhall Valley.

3.5.2.4 Tectonic Processes

Due to pressures exerted on the earth's crust and outer mantle, slabs of ocean floor sink into the hot mantle along subduction zones, where an oceanic plate is driven under a lighter continental plate. Some of the materials resist subduction and get transferred onto the overriding continental plate; this action leads to accretion and the growth of continents. Tectonic processes have played a significant role in the formation of continental Alaska and continue to affect the seismic activities in the Gulf of Alaska, including southeast Alaska and Juneau (Jacob 1988). In turn, the seismic activities caused by tectonic processes can have some bearing on the design and cost of structures such as bridges and buildings in southeast Alaska. The following section provides a summary introduction to the tectonic processes so as to establish a context for the discussion of possible seismic hazards in the vicinity of JNU.

The Gulf of Alaska is one of the most active tectonic regions in the world. The Pacific Ocean floor is comprised of a geologic plate that moves north-northwest relative to the North American continental plate at an approximate rate of 5 centimeters (cm) to 7 cm annually. This movement causes tectonic, seismic, and volcanic activity, and influences the shape and form of the Gulf of Alaska. A majority of the movement happens along the Aleutian Trench, which lies off the Aleutian chain of volcanic islands. The Trench is part of a ring of subduction zones that encircle the Pacific Ocean, known as the Circum-Pacific Seismic Belt or "The Ring of Fire." This seismic belt is made up of the subduction zones that extend in a horseshoe shape around the east, north, and west edges of the Pacific Ocean along the Southeast Alaska Coast, and forms the Aleutian Island chain. Here, the ocean crust is moving in a north-northwest direction. This causes a greater amount of subduction north of Juneau, where the coast bends out in a more east-west orientation. Along Southeast Alaska there is more right, lateral crustal movement accompanied by a smaller amount of subduction.

As the ocean crust sinks beneath the continental crust, the subducting plate, comprised of basaltic ocean floor, carries moisture into the earth's mantle (the inner viscous portion of the earth's layers). This moisture causes further melting of the mantle. The lighter and hotter melting mantle, in the form of magma, rises as a volcano. The magma is typically viscous and gassy, which causes volcanoes to have explosive eruptions. Volcanoes formed the Aleutian Islands in a classic island arc formation, with a convex curve facing the open ocean. Volcanic activity is not considered a hazard to southeast Alaska; however, it is taken into account to help explain the tectonics and earthquake hazards of the region. Classic island arcs, like the Aleutian Islands, have shallow-focus earthquakes associated with the elongated ocean floor depression, which was caused by the subduction activity. Intermediate-depth earthquakes are found under and behind the volcanic islands created by this activity. Besides the Aleutian Islands, there is another earthquake zone that causes a majority of the earthquakes that are felt in Juneau. This earthquake zones extends from north of the Yakutat Bay, southeastward, to the west coast of Vancouver Island.

3.5.2.5 Seismic Hazards

Alaska has had some of the largest earthquakes ever recorded. Devastating earthquakes, with magnitudes up to 9.2 on the Richter scale, have generated tsunamic effects felt as far away as Hawaii, California, and Japan. The damage that earthquakes could have at JNU may be exacerbated by the depth, type, and amount of unconsolidated fill that JNU is built upon. Impacts from seismic activity can include ground shaking, soil liquefaction, and subsidence. Avalanches and landslides from seismic activity in the upper Mendenhall Valley are obvious concerns, but are not a direct concern for JNU. The following description of earthquakes and seismic activity is included in this section because some of the alternatives initially considered for the RSA would use piers or bridge-like designs. These structures would have to be designed and constructed to withstand applicable ground motions.

Seismic activity felt in Juneau can be caused by one of two major earthquake zones. The first is the classic island arc, described above. The second major earthquake zone includes a series of associated active faults that occur within the CBJ.

The Gastineau Channel-Berners Bay Fault, Silverbow Fault, Fish Creek Fault (on Douglas Island), and the Lynn Canal-Chatham Strait Fault are within the CBJ. Generally, the statistical probability for earthquakes of a certain magnitude is based on centuries of seismic records. Earthquakes in the region of JNU have ranged from 4.0 to 6.5 on the Richter scale. Figure 3-11 shows the estimated epicenters and magnitudes for earthquakes. Although there is no known history of movement along these faults in Pleistocene or more recent times, there are areas of possible future movement. Indications of considerable ground movement in the past include rockslide, avalanche, and landslide deposits. The lack of more recent activity may indicate that pressure, which could eventually be released in the form of an earthquake, is building. The Lynn Canal-Chatham Strait Fault and the Gastineau Channel-Berners Bay Fault are southeast extensions of the very active Denali Fault. This association with the Denali Fault could lead to speculation that recent activity on the Denali Fault may be causing strain to accumulate on the Lynn Canal-Chatham Strait Fault and on the Gastineau Channel-Berners Bay Fault.

The major earthquakes of Alaska were some of the largest recorded in the world, but moderate, shallow earthquakes pose more frequent risks. They are less damaging to man-made structures, but can still have serious consequences to structures built on unconsolidated fill, such as JNU (Jacob 1988).

3.5.2.6 Geologic Responses to Ground Movement

Geologic units react differently to the shaking and rolling motion of earthquakes. Unconsolidated fill, like that underlying JNU, has a granular response to earthquakes that triggers compaction. In terms of earthquake damage to structures, fill is a very unstable surface upon which to build. As shown in the 1906 earthquake in San Francisco, structures built upon soft ground may suffer five to 10 times the damage of similar structures on hard rock foundations. Also, in the 1906 earthquake the uncompacted land lurched and settled unevenly, causing roads to crack and buildings to

Figure 3-11. Earthquake epicenters and magnitudes.

settle. Furthermore, water-filled alluvium or saturated filled-ground tends to magnify the amplitude of earthquake shock waves and transmit them further than bedrock. This is known as liquefaction.

Soil mass wasting, the gravity-driven down-slope movement of rock, soil, and organic debris, is the dominant process of slope erosion in the mountains above Juneau. In particular, landslide activity is frequent on Mount Juneau and on Mount Roberts. The Juneau topography is geologically young, and recent glaciation and uplift have caused over-steepening of slopes. Slope stability of the shallow soils on the mountain slopes ranges from 28 to 37 degrees, but the average slope above Juneau is 40 degrees and can be as much as 70 degrees. Steep slopes and shallow, coarse-grained soils are two factors that make landslides a hazard in the mountains surrounding Juneau. Soil creep, rockfall, rockslides, rock avalanches, debris slides, debris avalanches, and debris flows are common landslide types in the Juneau area.

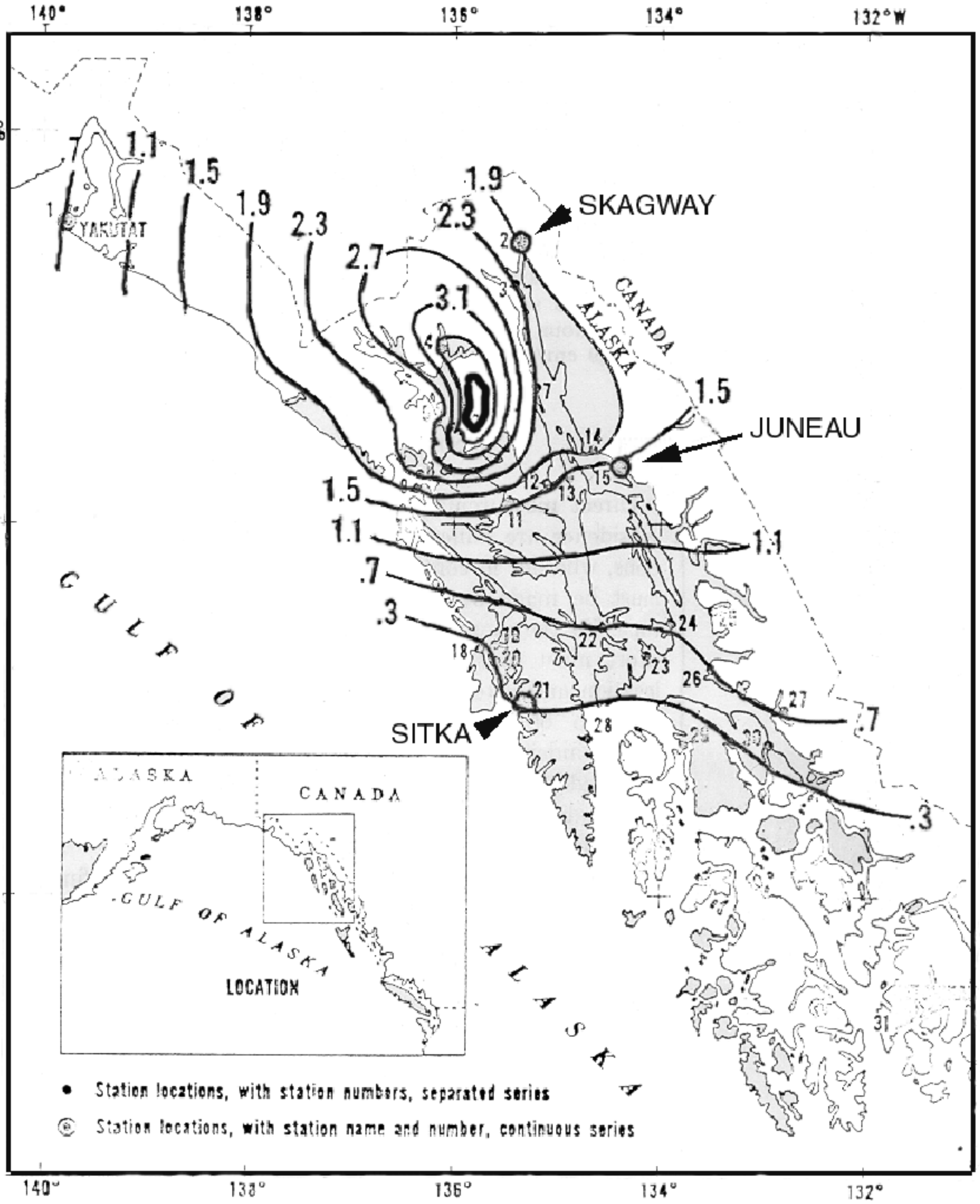
JNU's location, on the river delta and away from mountain slopes, suggests it would not be susceptible to landslides, avalanches, or other mass wasting events. However, because JNU is constructed on fill materials and unconsolidated sediments that are probably often water-saturated, facilities may be subject to liquefaction during sufficiently large ground-shaking events. Fortunately, design standards have been established for construction of buildings, roads, bridges, and other facilities in areas prone to seismic events.

3.5.2.7 Isostatic Rebound

Glacial retreat is accompanied by rebound of the earth surface. The release of weight that happens when a massive ice sheet diminishes causes an upward buoyancy of the landmass, resulting in an elevation rise of the land mass and a lower relative sea level. This change in elevation with relation to sea level is referred to as isostatic rebound.

Hicks and Shofnos (1965) calculated regional uplift in the valley to be approximately 0.75 inches per year. They attribute the uplift to isostatic rebound from the retreating Mendenhall Glacier combined with post-Wisconsin deglaciation. Hudson et al. (1982) confirm the uplift rate determination, but offer tectonic uplift as an alternative explanation for the rate. The Coast Mountains are the result of massive uplift from tectonic forces working on the gigantic plates comprising the earth surface. Regardless of cause, the land surface uplift rate was most recently calculated to be approximately 0.6 inches per year for the Mendenhall Valley (Neal and Host, 1999). Should uplift continue at these rates, in 100 years the Mendenhall Valley will be approximately 5 feet higher than at present.

The rate of land emergence was mapped by Hicks to be greatest in a reniform shape (i.e., shaped like a kidney) west of Skagway and Juneau, as shown on Figure 3-12. The emergence rate drops with distance away from the reniform center, and has been leveling off since 1955. However, extremely low sea levels were again observed in 1962 at Yakatat and Skagway (Hicks 1965). Professor Motyka at the University of Alaska, Southeast, is currently examining the recent rates of rebound, but his research is not yet published.



Rates of Land Emergence
0.4 cm/yr interval. (Adapted from Hicks, 1965.)

Figure 3-12. Comparative rates of uplift due to isostatic rebound.

3.5.3 SOILS

For this EIS, data collected during a 1974 USDA soil survey and information collected at ground-truth checkpoints during wetland delineations in August 2001 were used to understand soil conditions in the JNU area. These checkpoints consisted of pits up to 20 inches deep. All visible soils horizons were documented. The Munsell Color Chart was used to match colors of the soil matrix and any mottles or inclusions. The vegetation and depth to saturation and/or standing water were also noted.

The JNU property consists of the BeA, CoA, and LeA soil-mapping units, with BeA the predominant mapping unit on the JNU property (USDA 1974). BeA is excessively drained, very gravelly sand with 0% to 3% slopes. This soil is found on nearly level alluvial plains and terraces, along with spots of wet, sandy soils. This soil rarely floods. However, in a few low-lying areas near the coast and adjacent to streams, inundation may occur when tides or streams are exceptionally high. The vegetation found on BeA soils consists of slow-growing Sitka spruce, willows, patches of cottonwood, and scattered open patches of low shrubs, grasses, and herbs.

A small portion of the northwest JNU property consists of the CoA soil-mapping unit. This soil is a poorly drained silt loam found on low-lying, nearly level, alluvial plains. The angles of slopes on which this soil is found range from 0% to 3%. In most places, this soil is susceptible to occasional overflow from freshwater streams, and in a few places it may be inundated by exceptionally high tides. This soil unit may include spots of very poorly drained shallow peat soils. The dominant vegetation consists of sedge and grasses, but in a few places the soils support stands of Sitka spruce and western hemlock.

A small section on the northern edge of the JNU property consists of the LeA soil-mapping unit. This mapping unit includes areas of small streams. The soil is a very poorly drained silt loam found on slight depressions in broad stream valleys; the slope ranges from 0% to 3% and is almost always nearly level. This soil is susceptible to occasional flooding. The predominant vegetation consists of sedges, grasses, and patches of willow and alder brush (USDA 1974).

3.6 WATER RESOURCES AND FLOODPLAINS

The Airport is located in a dynamic water resources setting where post-glacial landforms, abundant precipitation, and wide tidal fluctuations create and sustain varied environments. Freshwater, brackish, and saltwater environments exist on and/or adjacent to JNU. Some of these water resources, such as the Float Plane Pond, are important to aviation operations at JNU, while the habitat provided by others can create wildlife hazards to aviation. These varied environments are the result of several interconnected earth processes, which are more thoroughly described in the Water Resources Technical Working Paper #3 (Vigil-Agrimis 2002) and Section 3.5 of this EIS.

The following sections describe the study area in terms of the Mendenhall Watershed, including the study area, surface water, groundwater, tidal influence, and water quality of the valley and Airport property through review of available reference material, aerial photography, geographic information systems (GIS) data, and on-site investigations.

3.6.1 GEOGRAPHIC SETTING

JNU is situated in the south end of the Mendenhall Valley, where the Mendenhall River flows into Fritz Cove and Jordan Creek flows through the Refuge into the Gastineau Channel. Much of the south end of the valley is tidally influenced. Figure 3-13 depicts the watershed boundaries and major surface water features, based on the Mendenhall Valley Drainage Study (R&M Engineering 1996). The porous valley floor deposits make for complicated relationships between surface water and groundwater that are challenging to describe with typical watershed delineations.

Most of the surface water flowing out of the valley comes from the approximately 100 square miles (mi) Mendenhall River watershed. Major tributaries to the Mendenhall River include Nugget Creek, Steep Creek, Montana Creek, and Duck Creek. Duck Creek has a drainage area of approximately 1.6 mi at the Nancy Street gage. Jordan Creek, with a watershed area of approximately 3.3 mi just below Egan, is the other major stream system in the valley.

Tides are an important influence on the southern part of the Mendenhall Valley. The yearly tide cycle at Juneau has a range of about 24 feet from approximately +11 to -13 feet msl between extreme high tide conditions and extreme low tide conditions. The mouth of Montana Creek is generally acknowledged as the upstream extent of tidal influence on the Mendenhall River. Duck Creek and Jordan Creek are tidally influenced to Glacier Highway (R & M Engineering 1996). Extensive tidal flats border the mouth of the Mendenhall River.

Water resources in the JNU vicinity have three major influences: moist marine climate, orographic effects of the Coast Mountains, and wide tidal fluctuations. These influences lead to surface water and groundwater discharges in freshwater, brackish, and saltwater systems. Freshwater systems in the valley are streams and wetlands fed by surface water and groundwater. Brackish systems exist where streams and wetlands are affected by tides. Saltwater systems exist where wetlands and aquatic systems are dominated by tidal activity.

3.6.2 GEOLOGIC INFLUENCE ON WATER RESOURCES

JNU is located on the Mendenhall River delta, which extends into Gastineau Channel. This major feature and other landforms are the expression of a number of geological processes: glacial, alluvial, and tectonic. See Section 3.5 of this EIS and Water Resources Technical Working Paper #3 (Vigil-Agrimis 2002) for additional description of the geology in the study area.

Glacial activity, and particularly that of the Mendenhall Glacier, has had a strong influence on both surface and ground water resources in the vicinity of JNU. The Mendenhall Glacier currently terminates at the north end of Mendenhall Lake as shown in Figure 3-13. Through its past advances and retreats, the Mendenhall Glacier deeply scoured and then partially refilled the valley. The major glacial retreat that began at the conclusion of the Pleistocene approximately 10,000 years ago left extensive outwash deposits of gravel, sand, and silt from meltwater. While the net result in the present climate regime has generally been a dramatic retreat of glaciers worldwide, there have subsequently been mini-ice ages when the Mendenhall and other glaciers have periodically advanced. Glacial activity and corresponding sea level changes left a complex network of gravels, sands, silts, marine

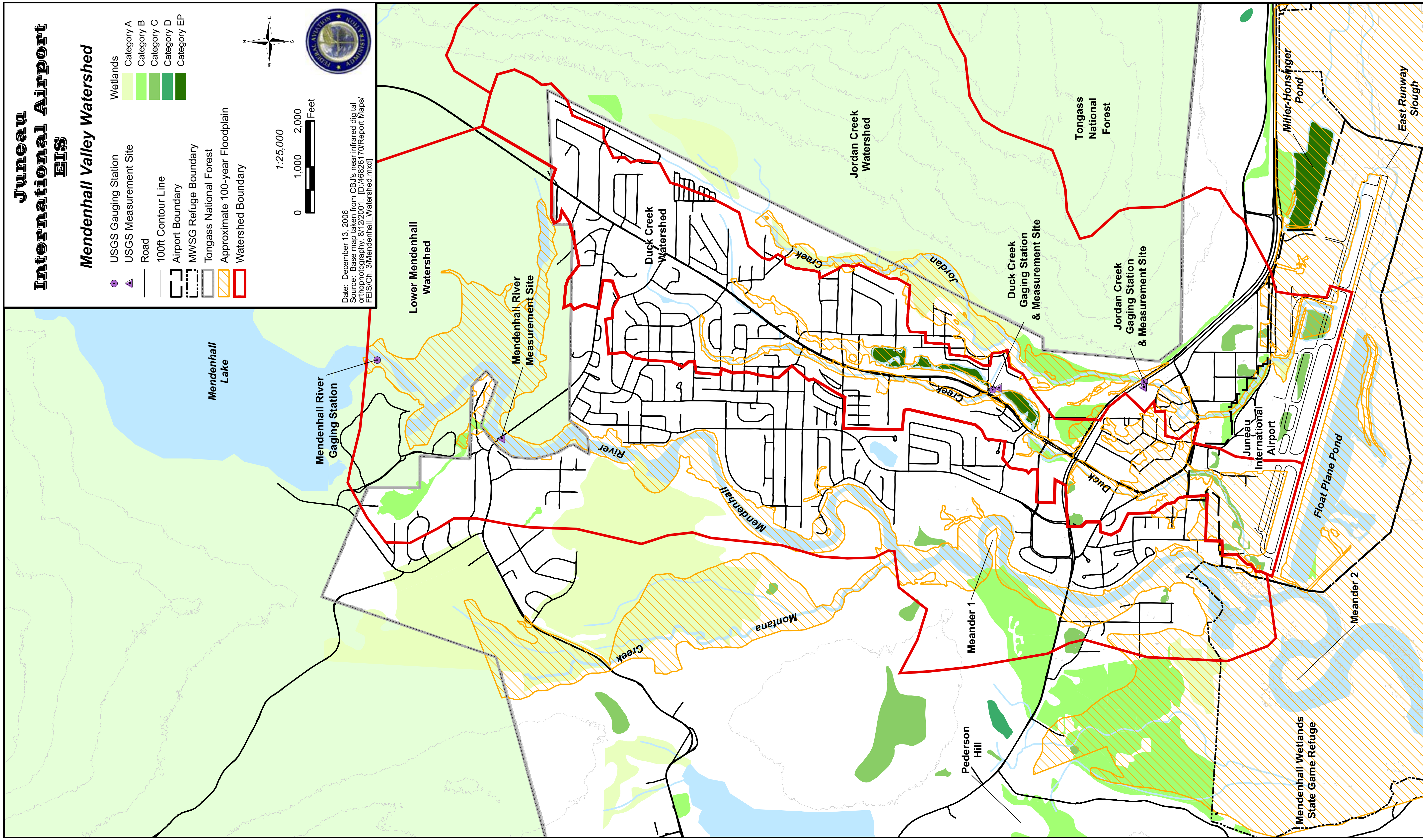


Figure 3-13. Mendenhall Valley watershed.

THIS PAGE INTENTIONALLY LEFT BLANK

deposits, peat, and clay across the valley. These alluvial, organic, and estuarine deposits are several hundred feet thick in the center of the valley (Barnwell and Boning 1968).

The Duck Creek Watershed Management Plan (Koski and Lorenz 1999) shows the terminus of the Mendenhall Glacier at the Mendenhall Loop Road in 1750, which is approximately two miles seaward of its present position.

Another important geologic influence on water resources in the study area is isostatic rebound. Section 3.5 of this EIS provides a summary of this process and effects in the Juneau area. Regional and localized uplift will influence the on-going adjustments made by surface waters. Where streams are laterally confined, channel adjustments will likely take the form of streambed incision or down cutting, especially in the absence of grade control and energy dissipation features such as large woody debris or boulders. These changes in geomorphic pattern may affect water resources (including water quality, aquatic habitat and life forms, and wetlands) in ways that are hard to predict. Water quality may improve or degrade as streams incise to underlying geologic stratum. Intertidal, estuarine wetlands currently in abundance around the Airport could be lost, as would the important functions and values these areas provide to salmonid species, marine life, and other wildlife.

Duck Creek and Jordan Creek may respond differently to this regional earth process based on characteristics of their channel bed materials, surface water and groundwater hydraulic connections, watershed properties, and hydrology. Figure 3-14 is a cross-section of the valley illustrating surficial geology, several aspects of which are important in terms of how these streams might respond differently to the uplift process.

First, floodplain and outwash deposits of silt, sand, gravel, and peat extend across the valley floor with a thickness varying from 30 feet to 50 feet generally. These materials have a high capacity to transport water, particularly the abandoned outwash channel deposits underlying Duck and Jordan creeks. Boning and Barnwell note that the best aquifers in the valley are found in these abandoned outwash deposits.

Second, Duck Creek is located a mile or less from the Mendenhall River and appears to straddle the margin between the abandoned outwash deposits in the east portion of the valley, and the floodplain deposits of the Mendenhall River. It also appears that Duck Creek is strongly connected hydraulically to longitudinal water flows down the valley by its position along this margin.

Third, Jordan Creek is located two miles from the Mendenhall River in an abandoned glacial outwash channel that overlies the main valley floor material along the east valley wall. These porous channel bed materials abut relict natural levee and floodplain deposits that may contain lenses of finer materials that may provide some hydraulic isolation from the Mendenhall River.

Finally, landslide and colluvial deposits (erosional materials from adjacent hill slopes) along the east valley wall are an additional source of water and sediment to Jordan Creek. Jordan Creek is also located near the east valley wall where numerous small tributaries discharge from Thunder Mountain as stream flow and/or as melting avalanche deposits. Landslide deposits of rock and large woody debris may provide grade control against channel incision. From these observations, it appears that Jordan Creek may respond less dramatically than Duck Creek to potential effects of uplift and resulting channel incision of the Mendenhall River.

3.6.3 Historical and Current Land Use and Water Resources

Native American uses of the valley included harvesting food from local waters and collecting materials such as grasses, sedges, rushes, tree roots, and tree bark for various domestic uses. Historical land uses in the valley since European settlement have included mining, dairy farming, fur farms, commercial vegetable farming, and logging. More recent developments have included gravel mining, a network of roads, stream crossings, housing developments, the Airport (constructed in the 1930s and expanded steadily since WWII), and a wastewater treatment plant. Airport expansion changed the locations of the Jordan Creek and Duck Creek channels (Adamus 1987). The Corps dredged the Gastineau Channel in 1959 and deposited the dredge materials in the Refuge wetlands (Adamus 1987). Several of the islands in the Gastineau Channel are formed from dredge materials.

Large portions of the floodplains of the Mendenhall River, Duck Creek, and Jordan Creek have been developed. Figure 3-13 shows the floodplains for Duck Creek, Jordan Creek and the Mendenhall River. This figure indicates that the Duck Creek floodplain is more constrained by road crossings than the other drainages. Wetlands in these systems have been filled as part of the urbanization of the valley. Table 3-16 compares drainage characteristics in the Mendenhall valley.

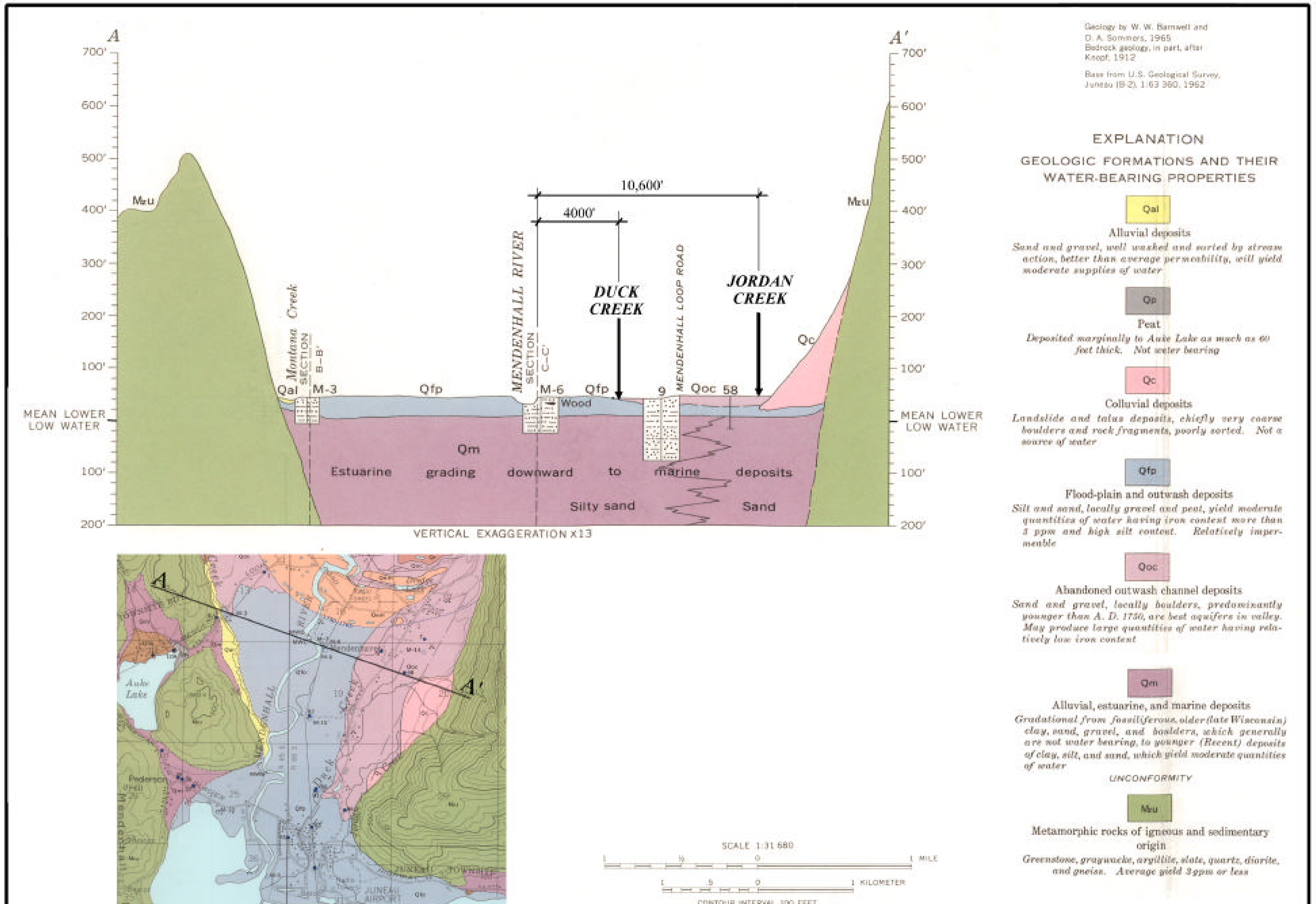
JNU occupies a total area of approximately 660 acres, with 370 acres devoted mostly to existing developed aviation infrastructure. This infrastructure consists generally of structures and pavements, stormwater facilities that transport precipitation runoff quickly to receiving water resources. Groundwater recharge is almost negligible in these areas. In contrast, parks, retained native vegetation, and planted areas tend to discharge lesser stormwater flows at slower rates. Groundwater recharge capacity is generally retained by vegetated areas.

3.6.4 Watershed Stakeholders and Initiatives

Water resources protection efforts have developed within the Juneau community to address multiple issues. Although these efforts may not carry the regulatory responsibility and authority of state or federal agencies, their planning efforts have some bearing on the evaluation of potential impacts from Airport projects and to any mitigation strategy. A few of these key stakeholders and initiatives are described below.

3.6.4.1 Mendenhall Watershed Partnership (MWP)

The Mendenhall Watershed Partnership (MWP) formed in January 1998 to improve the health of the Mendenhall Valley's streams. The MWP's mission is to maintain and enhance the environmental quality and economic vitality of the Mendenhall watershed. MWP is a non-profit organi-



Source: Barnwell and Boning 1968

Figure 3-14. Mendenhall River Valley cross section and surficial geology.

THIS PAGE INTENTIONALLY LEFT BLANK

Table 3-16. Comparison of Drainage Area Characteristics in the Mendenhall Valley

	Lower Mendenhall River*	Duck Creek	Jordan Creek
Drainage Area (acres)	2121.0	1013.0	2092.0
Drainage Area (sq. miles)	3.3	1.6	3.3
Wetland Area (acres)	237.0	42.8	199.8
High Quality Wetland Area (A)	94.3	0.0	111.2
Moderate Quality Wetland Area (B/C)	74.1	22.5	72.9
Low Quality Wetland Area (D/EP)	0.0	16.7	0.0
Unclassified Wetland	68.6	3.6	15.7
Floodplain Area	522.9	196.1	163.0
Developed Floodplain Area	125.6	144.8	77.8
Undeveloped Floodplain Area	397.3	51.3	85.2
Mapped Road Area (miles)	30.0	30.0	10.8
Ratios			
Wetland Area/Drainage	0.110	0.040	0.100
High Quality Wetland Area/Drainage	0.044	0.000	0.053
Moderate Quality Wetland Area/Drainage	0.035	0.022	0.035
Low Quality Wetland Area/Drainage	0.000	0.016	0.000
Floodplain/Drainage	0.250	0.190	0.080
Undeveloped Floodplain/Floodplain Area	0.760	0.260	0.520
Mapped Road/Drainage (miles/sq. mile)	9.000	18.900	3.300

Source: Mendenhall Watershed Partnership/CBJ GIS information. (Wetland data shown is from Partnership and used for informational purposes.)

* This includes the lower Mendenhall River only and does not include the entire 101 square mile watershed because limited datasets were available. This skews some of the ratios.

zation supported by grant funding, and member and business contributions. Volunteers supply time, energy, and expertise and technical staff from local, state, and federal agencies also provide assistance.

3.6.4.2 Duck Creek Advisory Group (DCAG)

The Duck Creek Advisory Group (DCAG) was formed in 1993 to coordinate activities for planning, initiating, and implementing a program of restoring water quality and anadromous fish habitat in Duck Creek. The Duck Creek Watershed Management Plan, completed by DCAG in

July 1999, recommends several restoration projects to achieve community benefits beyond the statutory environmental standards. Additionally, DCAG seeks to prevent further degradation by applying best management practices (BMPs) and new policies and recommendations made by DCAG because of the substantial loss of aquatic resources in the watershed (EPA 1999).

Federal agencies involved in DCAG projects include the Corps, NMFS, EPA, USGS and FWS. State agencies include DNR, ADF&G, and ADEC. CBJ is the primary local Sponsor of the proposed Corps projects for watershed restoration actions and has agreed in principle to support the projects by matching up to 35% of the Corps expenditure. Most of that match will likely be "in-kind" services such as providing rights-of-way, construction materials, or engineering services. The proposed projects are being designed primarily to restore stream flows and enhance aquatic habitat for fish and wildlife.

3.6.4.3 SOUTHEAST ALASKA GUIDANCE ASSOCIATION (SAGA)

A number of restoration projects have been completed with the help of Southeast Alaska Guidance Association (SAGA). SAGA serves as a key partner in acquiring and planting willow stakes and wetland vegetation, and in stabilizing seeding areas with grass seed. See the Water Resources Technical Working Paper #3 for examples of recent SAGA projects (Vigil-Agrimis 2002).

3.6.5 AIRPORT SETTING

JNU is located on the Mendenhall River delta. Material excavated from the Float Plane Pond was used in the original Airport construction (Adamus 1987) in the late 1930s and early 1940s, and a wide variety of other sources were used as fill to develop the large elevated surface that JNU now occupies.

JNU is bordered by the Mendenhall River on the west, the Refuge to the south and east, and industrial and commercial land to the north. A dike in the western and southern portions of the Airport property protects the Float Plane Pond and other assets from the Mendenhall River to the west and from the Gastineau Channel to the south and southeast. The Gastineau Channel inundates the Refuge daily at high tide to elevation 16 feet MLLW regularly, and to 21 feet MLLW during spring tides. The lower reaches of Duck Creek and Jordan Creek pass through Airport property.

Duck Creek enters Airport property from the northwest, through a culvert under Berners Avenue (Figure 3-13). Duck Creek bends southwest through an undeveloped parcel of land in the northwest corner of Airport property. Duck Creek leaves the site via a culvert that passes under the dike to the west and discharges to the Mendenhall River approximately 1, 500 feet later. The creek has been channelized in several reaches through infrastructure development activities. The floodplain is constricted in many locations.

Jordan Creek enters Airport property from the north approximately 1,400 feet east of Duck Creek (Figure 3-13). Jordan Creek crosses Yandukin Drive and meanders for approximately 1,300 feet before crossing underneath Crest Street through a culvert. Jordan Creek is channelized along portions of the reach below Yandukin Drive, and the floodplain is especially constricted below Crest Street. The channel bends sharply as it travels through Airport property. The creek passes through long culverts under the taxiway and then the runway prior to leaving Airport property and entering the Refuge.

Vegetated ditches that drain most of the runways and taxiways discharge stormwater to Duck Creek and Jordan Creek. High tides create backwater conditions on Jordan Creek that can cause ponding in these ditches.

The Float Plane Pond is surrounded by the runway to the north, the Mendenhall River to the west, the dike to the south, and the mouth of Jordan Creek to the east. A dike separates the Float Plane Pond from tidal wetlands and the Gastineau Channel. The Float Plane Pond is approximately 5,300 feet long by 430 feet wide, with an average depth of four to five feet. A 30-foot deep pocket of water is located in the south end of the pond. Several sloughs and side channels extend from the main body of the pond into the wooded area to the south. The total surface area of the Float Plane Pond is approximately 80 acres, including sloughs and side channels. The water level of the pond is controlled by a tide gate at the west end of the pond. During high tide conditions, brackish water from the Mendenhall River enters the pond through this structure.

3.6.6 WATERSHED-SCALE WATER RESOURCES

Watershed processes that occur throughout the contributing basins influence the rivers and creeks that flow by and through JNU. Available literature, and studies conducted for this EIS provide a substantial amount of information to consider. Following is a summary of the rivers and creeks, other waters, groundwater, and water quality of the Mendenhall Valley. For more detailed information, see the Water Resources Technical Working Paper #3 (Vigil-Agrimis 2002) and other cited documents.

3.6.6.1 MENDENHALL RIVER

Mendenhall River discharge is dominated by glacial meltwater from Mendenhall Lake, a feature formed by the retreat of the Mendenhall Glacier. Mendenhall Lake is located at the northern end of the valley at the terminus of the Mendenhall Glacier. The Mendenhall River flows south from the lake through the valley approximately 5.5 miles until it enters Fritz Cove, the saline water body that connects the Gastineau Channel with Stephens Passage. Additional inflows to the lake and the Mendenhall River are from Nugget Creek, Steep Creek, Montana Creek, and unnamed tributaries.

The approximately 100 mi Mendenhall River watershed ranges in elevation from sea level to nearly 7,000 feet msl. The upper watershed is undeveloped, glaciated bedrock, whereas a majority of the valley has been developed with housing, commercial centers, and roads. Muskeg and spruce forest cover much of the undeveloped portions of the valley. Peak flows in the Mendenhall River usually occur in the late summer or fall when high temperatures are coupled with heavy rain, and/or snowmelt.

The USGS operates a stream gauging station near the outlet of Mendenhall Lake (Station No. 15052500) that has been collecting daily average flow data from 1965 to the present. The mean annual discharge is 1,164 cubic feet per second (cfs). Peak monthly flows occur during June through September, and the lowest flows occur in the winter months of January through March.

The Mendenhall River is a geologically young river. Its main channel probably formed in the current position sometime after 1750, when the Mendenhall Glacier began its most recent recession. A moraine dam was breached at the current outlet of Mendenhall Lake and the flow of water incised the current channel through the outwash and floodplain deposits. Geomorphology studies by USGS, as represented in Figure 3-15, show that the river has three distinct zones: upper, middle, and lower. The middle zone on the moraine face is where most discharge measurements are made; it is markedly steeper than the upper and lower zones and much steeper than the mean valley slope. The downstream half of the lower zone is the flattest and is tidally influenced.

Comparisons of cross-sections from eight discharge measurements made by the USGS at the Mendenhall Loop Road Bridge (see location in Figure 3-13) between 1981 and 2000 are shown in Table 3-17. These data indicate two key observations:

- The Mendenhall channel has downcut 1.5 feet over 20 years (-1.9' to –3.4', or 0.075 feet per year), slightly faster than the rate of surface uplift (0.05 feet per year),
- The Mendenhall channel shape has remained about the same as indicated by the ratio of maximum velocity to mean velocity.

Taken together, the data suggest that the cross-sectional shape of the river appears to be very stable. The ratios of maximum depth to mean depth, and maximum velocity to mean velocity have remained essentially constant over the period as well, indicating that channel shape has remained stable while the channel downcut its bed.

Table 3-18 shows how the Mendenhall River has also become longer by meandering during the period of record since 1926. In addition, this section of the river has consistently moderate to high mean velocities, with high maximum velocities capable of transporting large quantities of sediment composed of sand, gravels, and cobbles. This sediment transport capability is consistent with the finding of channel downcutting (also termed "incision").

The discharge information and meander habit of the river has relevance to some actions being considered for development on the west end of the Airport. For example, cutting off a meander in the vicinity of the Airport would reduce the overall length of the Mendenhall River. This, in turn, would reduce the amount of friction and increase the total energy of the river system. As a result, the river system would likely balance out this increase in potential energy by forming new meanders up and downstream. As these adjustments occur the Mendenhall is likely to exert more pressure on the dike at the western end of the Float Plane Pond, which is located on the outside bend of a meander. Periodic channel movement is a natural river process. The potential for this type of occurrence on the lower Mendenhall is increased by the tidal influences.

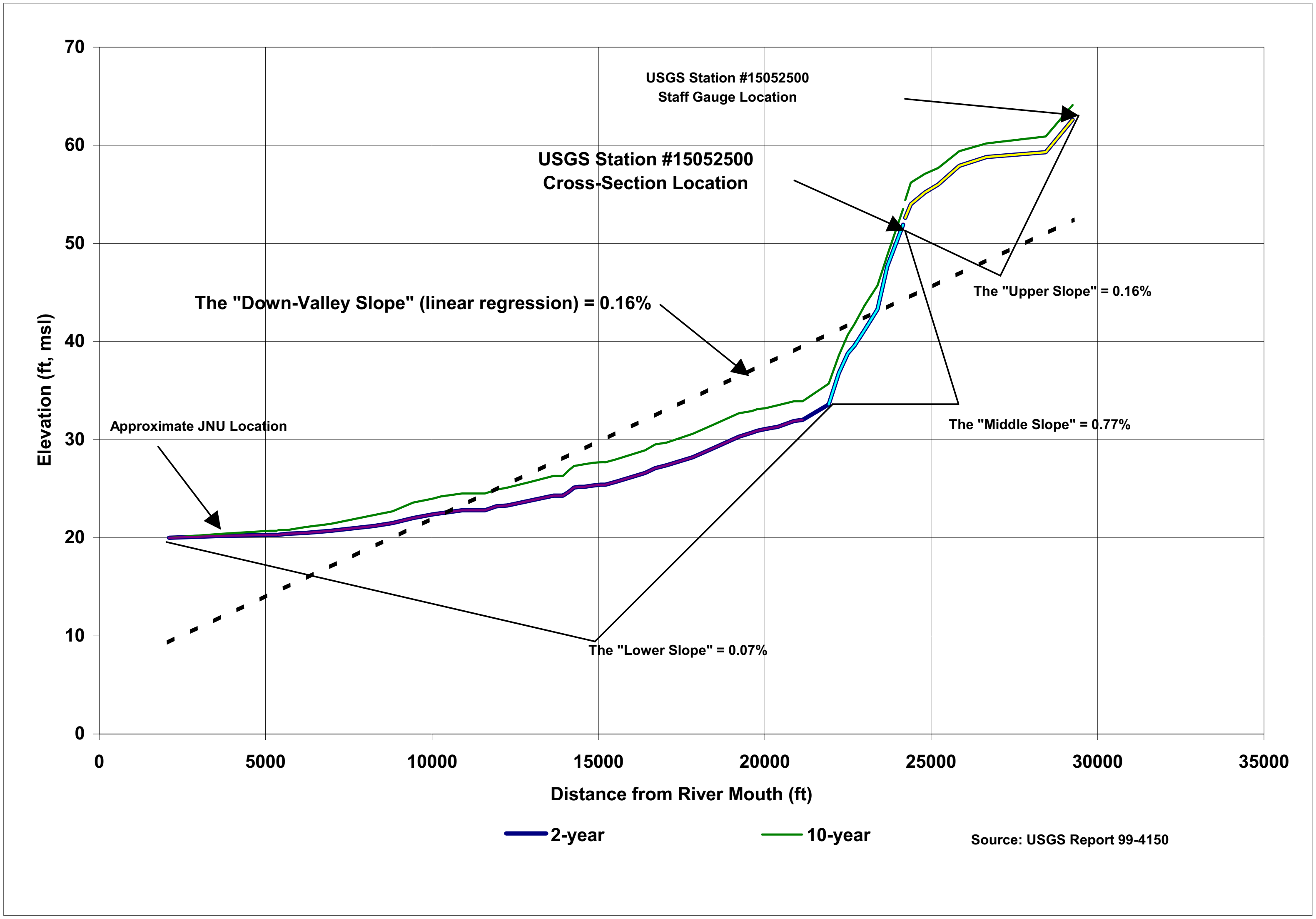


Figure 3-15. Mendenhall River slope (hydraulic grade line).

Table 3-17. Comparison of Mendenhall River Discharge Measurement Information

Date	Discharge (cfs)	Channel Width (ft)	Mean Depth (ft)	Max. Depth (ft)	Max./ Mean Depth	Gage Height (ft)	Low Point Elev. (ft)	Cross-section Area (ft)	Mean Velocity (fps)	Max. Velocity (fps)	Max./ Mean Velocity
12-Sep-81	5,310	139	5.50	8.8	1.60	6.92	-1.88	768	6.91	11.87	1.72
7-Aug-89	3,220	108	4.78	8.3	1.74	5.61	-2.69	535	6.02	10.12	1.68
11-Jul-90	4,400	108	5.70	9.6	1.68	6.09	-3.51	649	6.78	11.33	1.67
1-Jul-92	4,110	111	5.84	9.2	1.58	6.14	-3.06	639	6.43	10.62	1.65
23-Sep-93	10,100	134	8.06	12.6	1.56	9.51	-3.09	1,080	9.35	15.17	1.62
20-Aug-97	2,752	105	5.10	8.3	1.63	5.15	-3.15	518	5.31	9.07	1.71
17-Sep-99	3,670	108	5.30	8.9	1.68	5.67	-3.23	591	6.21	10.52	1.69
22-Sep-00	1,460	95	4.40	7.2	1.64	3.82	-3.38	426	3.43	5.82	1.70
Mean					**1.64**						**1.68**

Source: Data from U.S. Geological Survey, 2001;USGS discharge measurement notes
fps = feet per second
cfs = cubic feet per second

Table 3-18. Summary Comparison of Channel Lengths and Sinuosities

Stream Measurement Range: Entire Mendenhall Valley from mouth of Mendenhall River to Mendenhall Lake.

Source: Surdex infrared imagery (2001).

	Stream Length Measurement	Sinuosity
	2001	2001
Jordan Creek	14,900	1.17
Duck Creek	9,750	1.17
Mendenhall River	20,750	1.92

Stream Measurement Range: Mendenhall Valley from mouth of Mendenhall River to north of meander 1 near Nancy Street.

Source: Surdex infrared imagery (2001), Intermap aerial photography (1961).

	Stream Length Measurement		Annual Rate of Change	Sinuosity	
	1961	2001	1961-2001	1961	2001
Jordan Creek	13,850	14,900	26.3	1.39	1.49
Duck Creek	11,480	9,750	-43.3	1.44	1.22
Mendenhall River	17,600	20,750	78.8	1.49	1.76

Stream Measurement Range: Mendenhall Valley from mouth of Mendenhall River to Brotherhood Bridge.

Source: Surdex infrared imagery (2001), Intermap aerial photography (1961), National Archives Trimetrigon photos (1926).

	Stream Length Measurement			Annual Rate of Change		Sinuosity		
	1926	1961	2001	1926-1961	1961-2001	1926	1961	2001
Jordan Creek	10,400	12,300	14,400	54.3	52.5	1.30	1.54	1.80
Duck Creek	6,400	7,800	7,200	40.0	-15.0	1.10	1.34	1.24
Mendenhall River	9,600	13,100	15,900	100.0	70.0	1.20	1.64	1.99

Stream Measurement Range: Mendenhall Valley

Source: Roman Motyka, personal communication (2001).

	Sinuosity			
	1909	1948	1982	1998
Mendenhall River	1.25	1.44	1.47	1.51

* Sinuosity measurement based on Motyka is defined as the length of the river divided by the wave length of meanders. Other sinuosity values are based upon stream length divided by valley length.

Figure 3-16 shows the Mendenhall Valley rivers and streams in 1926. The channel locations from this archival aerial photograph were compared with current locations, as documented in Table 3-18. In summary, the sinuosity of the river (i.e., the ratio of stream length to valley length) has greatly increased during that timeframe. Changes in stream pattern can result in changes in stream channel dimension (channel area), and stream channel profile (slope and potential energy).

Channel pattern did change on the lower Mendenhall River in August 2004 when the channel cut off a meander neck just downstream from the airport. A limited assessment was made of this cut off, or channel avulsion, in late 2005. The assessment examined channel migration and updated an existing hydraulic model to understand better how the channel is responding since the cut off, and how it might respond to proposed alterations to the channel and floodplain as part of runway safety area improvements and wildlife hazard management modification.

Figure 3-17 shows where the patterns of bends and bars in the channel and where the cut off occurred. This figure also shows where Global Positioning System (GPS) readings were taken along the edge of the river in late 2005, and indicates where the channel is migrating east and south against its outer bank. A new bar is forming immediately downstream of the cut off. Over time the old channel may be abandoned or become a shallow flat that only holds water at higher tides or high stage events in the Mendenhall River. The river will continue to exert pressure on that outer bank as it tries to reestablish a channel profile similar to the original profile that was shortened and thus steepened by the cut off. It appears likely that the channel will try to migrate to the southeast below the Float Plan Pond, and that the meander neck at the cut off may extend to the northwest.

3.6.6.2 Duck Creek

Duck Creek and its watershed lie within the center of the Mendenhall Valley, situated between the Mendenhall River and Jordan Creek. Duck Creek is approximately 3.5 miles long. The Duck Creek basin covers 1.6 mi at the Nancy Street gage and ranges in elevation from approximately 15 feet to over 40 feet. This area represents less than half of the 3.4 mi that was once estimated as the watershed area, (Koski and Lorenz 1999). It appears that the basin size has been reduced by infra-structure development and urbanization, including a substantial loss of drainage area resulting from construction of the Airport beginning in the 1930s. Since then, much of the Duck Creek watershed has been developed and approximately 36% of the Duck Creek watershed has been made impervious (Koski and Lorenz 1999). Duck Creek has been rerouted and even mined to accommodate the urbanization. The effects of mining may have prematurely lowered the gradient of Duck Creek. Urbanization has also clearly been an important watershed modification process.

Watershed boundaries of Duck Creek have remained relatively consistent over the past 30 years (Koski and Lorenz 1999). It appears that due to its geographic proximity to the Mendenhall River and through the highly permeable glacial outwash materials forming the valley floor that Duck Creek has a strong hydraulic connection to the Mendenhall River. This appears especially true in the lower portions of the watershed (Noll 1995).

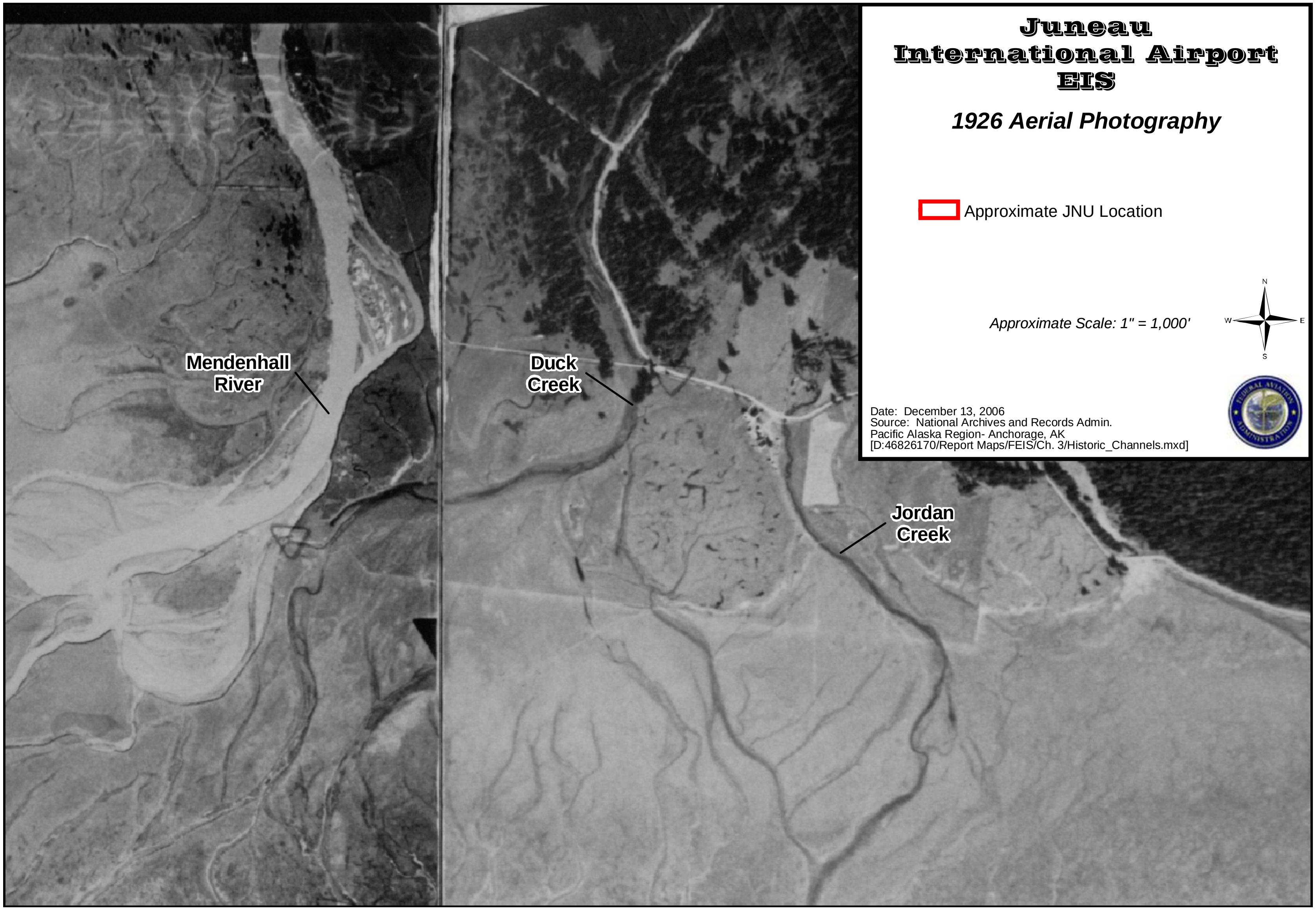


Figure 3-16. Historic channel location of Duck Creek, Jordan Creek and the Mendenhall River (1926).

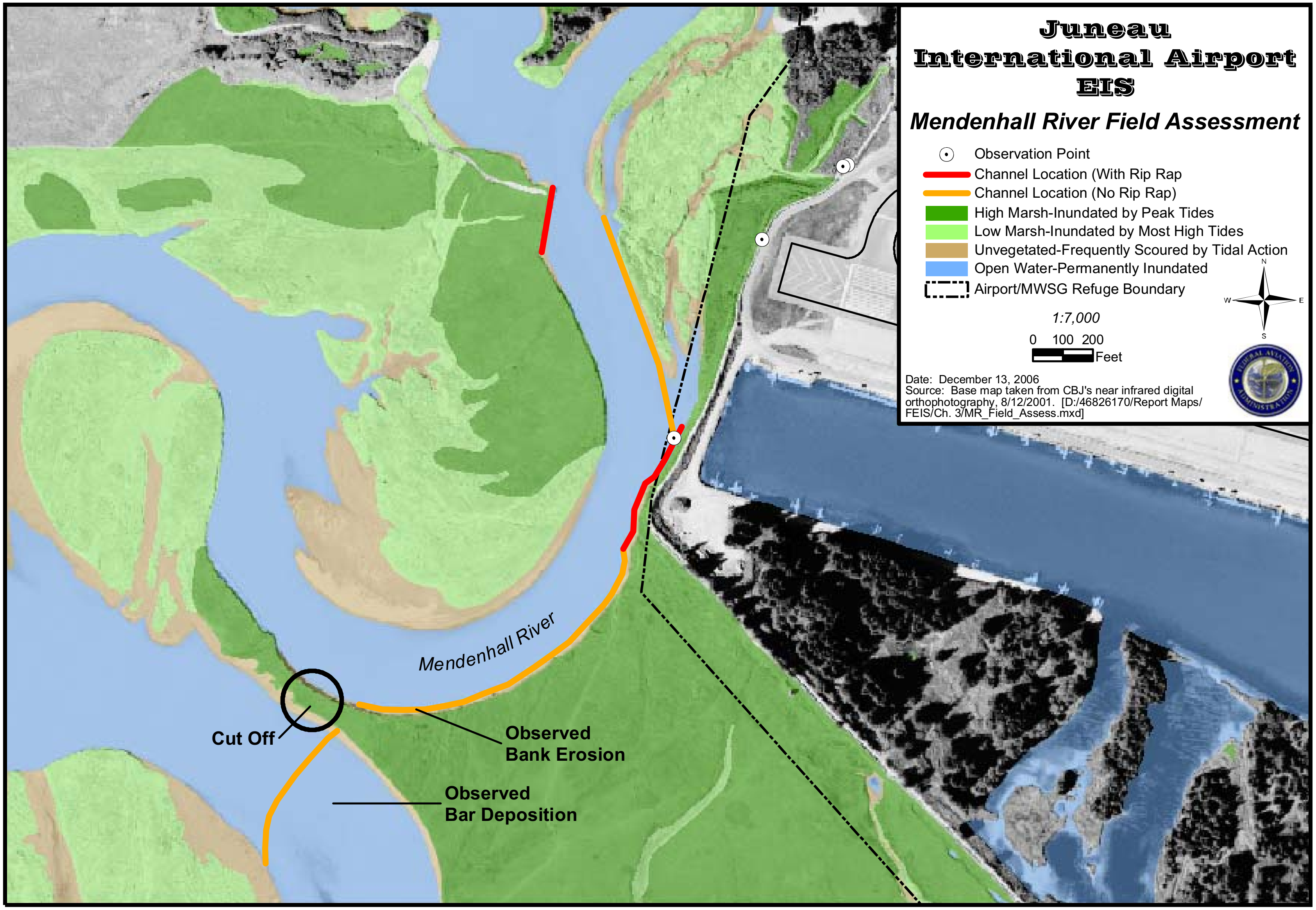


Figure 3-17. Mendenhall River field assessment.

The nature of the Duck Creek watershed has changed substantially over the last 80 years. Urbanization, in the upper watershed especially, has diverted the channel and replaced permeable surfaces with paved roads, parking lots, and roofs in many areas. The watershed modifications have led to loss of channel over the last 40 years demonstrated by the stream length and sinuosity data provided in Table 3-18.

The USGS has a number of gauging stations established within the Duck Creek watershed. The most complete record of flow data has been recorded at the gauging station below Nancy Street (Station No. 15053200, as located on Figure 3-13). The highest daily mean and lowest daily mean recorded since 1993 are 68 cfs on December 28, 1999 and 0.19 cfs on March 15, 2000. Based on the USGS data, a flow of 8.5 cfs is exceeded 10% of the time, a flow of 2.6 cfs is exceeded 50% of the time, and a flow of 1.0 cfs is exceeded 90% of the time. Peak monthly flows occur during September and October, and the lowest flows occur in the winter months of January through March.

Noll (1995) and other researchers (Koski and Lorenz 1999) have determined that the surface water and groundwater are hydraulically connected with each other. Beilhartz (1998) observed that the lower reaches of Duck Creek become dry when the stream flow at the Nancy Street Gage is between 1.6 to 5.2 cfs. When the stream flow is less than 7 cfs, more than 50% of the flow is lost underground by infiltration through the porous streambed. However, when the flow is 12 cfs or more the lower reach has the same flow as at the Nancy Street gauge site (Beilhartz 1998). This information suggests that Duck Creek requires runoff from rain and snowmelt events and/or a high groundwater table to sustain streamflows.

Comparisons were made of channel cross-sections from eight discharge measurements made by USGS at the Nancy Street stream gauging station between 1993 and 1999. The cross-section shape and area for mean discharge appear to vary regularly over the study period. The channel thalweg, or deepest part, appears to remain fairly close to center, and the channel width appears to remain constant as well, between approximately 5.5 feet and 6 feet for flows in the range of 2.5 cfs to 5 cfs. In addition, the channel bed elevation appears to remain constant over the period, but varying up and down approximately 0.2 feet. This section of the creek typically has consistently low mean and maximum velocities. These velocities are not capable of transporting large quantities of sediment composed of sand and gravels. This apparent lack of sediment transport capability is consistent with the finding of no net change in channel bed elevation at the discharge measurement site.

Localized flooding along Duck Creek during high flow events due to channel constrictions and backwater effect has previously been described (R&M Engineering 1996). These conditions occur generally where culverts are undersized and/or installed at an elevation above the (natural) streambed. R&M Engineering (1996) suggests "improvements" in the form of greater drainage efficiency (oversized and lowered culverts) and lowering of the channels to allow for underground drainage facilities and to minimize flooding of adjacent properties. Drainage efficiency may improve flooding conditions, but may worsen aquatic habitat conditions by simplifying channel structure and preventing groundwater storage in adjacent riparian and wetland areas, ultimately diminishing base flow conditions during low precipitation and very cold periods of the year.

Several of the culverts on lower Duck Creek have been replaced. Recent replacements include Berners Drive culvert immediately upstream of JNU at Cessna Drive. The new culverts are intended to reduce upstream flooding. The improved conveyance will increase and transfer the downstream flows of water, sediment, and large woody debris.

In addition, a portion of Duck Creek was restored by ADOT immediately downstream of Egan Drive. The channel was improved from a roadside ditch to include a riparian buffer. The restoration project includes lining the bottom of the creek to help prevent surface water to groundwater losses, a new streambed layered with gravels, and bio-engineered stream banks.

3.6.6.3 Jordan Creek

Jordan Creek, is approximately 4 miles long, and lies along the east side of the Mendenhall Valley. The basin covers 3.3 mi and ranges in elevation from approximately sea level to 2,900 feet. Much of the Jordan Creek watershed is within the Tongass National Forest and is managed for water supply, fisheries, timber production, and recreation.

The USGS has operated a stream gauging station on Jordan Creek below Egan Drive since May 1997 (Station No. 15052475). The drainage area at the gage is 2.6 mi. The highest daily flow was estimated from flood marks to be 140 cfs on September 25, 1996, and 129 cfs on December 28, 1999. No flow was observed by USGS on 9 days during this period. Based on the limited period of record from 1997 to 2000 at the Jordan Creek gage, a flow of 19 cfs is estimated to be exceeded 10% of the time, a flow of 5.2 cfs is estimated to be exceeded 50% of the time, and a flow of 1.1 cfs is exceeded 90% of the time. Peak monthly flows occur during September and October, and the lowest flows occur in the winter months of February and March.

Figure 3-18 is a comparison of stream flow for Mendenhall River, Duck Creek, and Jordan Creek for the 1998 calendar year, which included a typical early fall storm with heavy rain and melting snow. The graphs illustrate that the amount of water carried by Duck Creek and Jordan Creek is determined by the amount of precipitation, while Mendenhall River stream flows are controlled by snow and ice melt.

The channel locations shown on Figure 3-16 were compared with current locations. Jordan Creek appears to have diverted east and been lengthened during the period since 1926. A comparison of stream length and channel sinuosities (see Table 3-18) suggests that while the Mendenhall River and Jordan Creek have become longer and more sinuous during that period, Duck Creek has become shorter and less sinuous. The USGS is currently establishing baseline data on Jordan Creek. The USGS study includes seepage runs that define gaining and losing reaches, water quality sampling, and stream characteristics such as cross-sectional area, bed type, channel velocities, and riparian vegetation.

3.6.6.4 Summary of River and Creeks Functional Attributes

Table 3-16 provides a comparison of drainage characteristics for the three major streams in the lower valley. Review of these characteristics reveals three key differences between Duck Creek and Jordan Creek in particular. First, the Jordan Creek basin has moderate- to high-quality

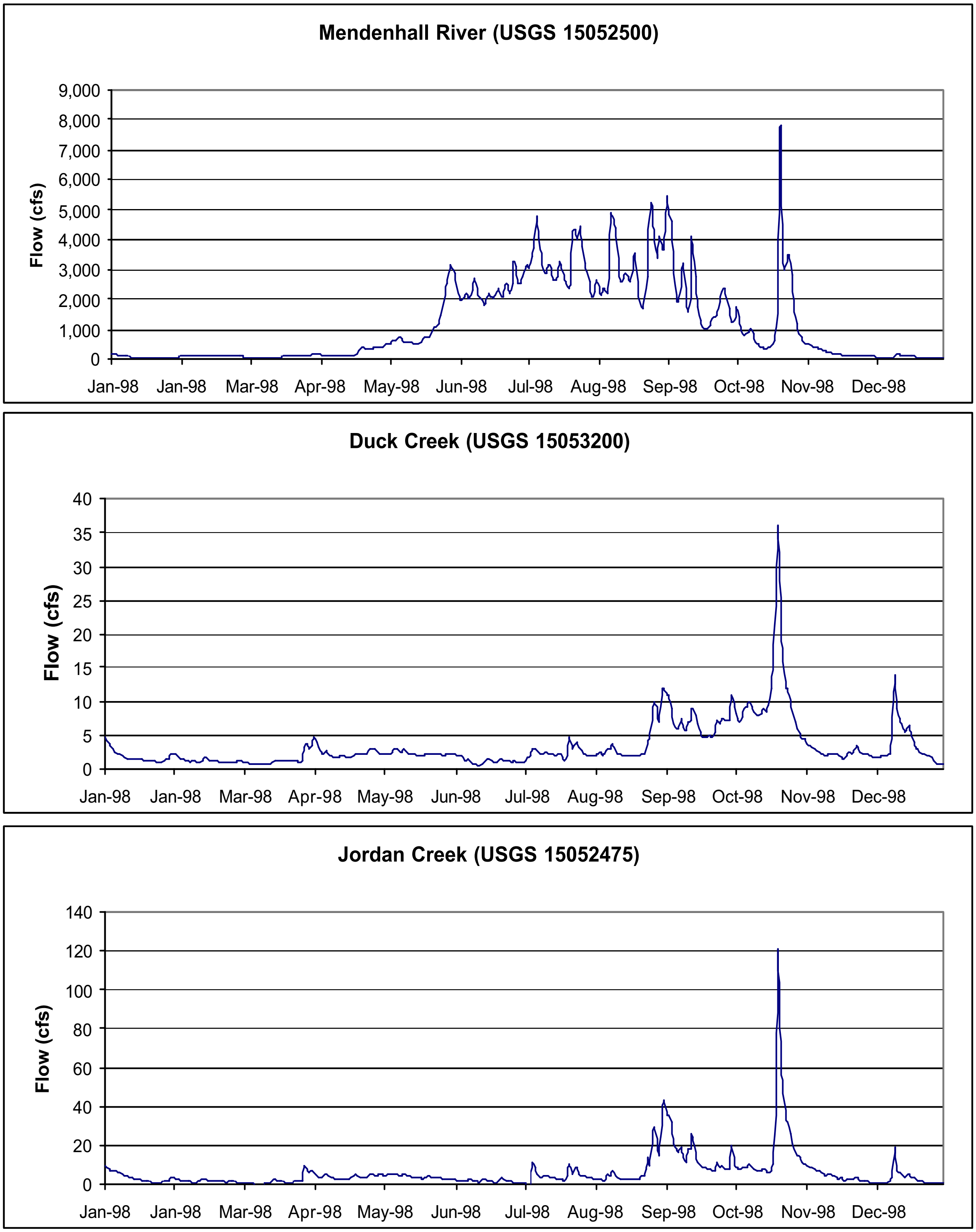


Figure 3-18. Daily mean discharges for the 1998 calendar year.

wetlands (Adamus 1987) over nearly 9% of its area, while Duck Creek has only 2% in those categories of wetlands. Second, 52% of the Jordan Creek floodplain remains undeveloped, while only 26% of the Duck Creek floodplain remains undeveloped. Lastly, the road density in the Jordan Creek basin at 3.3 mi/mi is only 1/6th of that in the Duck Creek basin at 18.9 mi/mi.

May et al. (1997) established a strong correlation between road density and total impervious area in the Puget Sound area. Road density can be used as an indicator of basin ability to provide stream functions. This study found the risk of potential peak flow increase from urbanization and resulting potential loss of aquatic function as follows:

- Road density <4.2 miles/mi – low.
- Road density 4.2- 5.5 miles/mi – moderate.
- Road density >5.5 miles/mi – high.

From this basin-wide perspective, it appears that Duck Creek, at 18.9 mi/mi, is well above the threshold for high risk of impacts and loss of functions. Jordan Creek, at 3.3 mi/mi, on the other hand, is currently below the threshold for loss of function, especially in the upper basin.

3.6.6.5 Other Waters

The Miller-Honsinger Pond is a private body of water located north of the east end of the runway that was created by dredging for gravel fill material. The pond is approximately 450 feet wide by 2,500 feet long and is deep enough to prevent fish mortality when the pond surface freezes (Adamus 1987). Several small tributaries originating from the southwestern end of Thunder Mountain flow into the vicinity of the pond. The estimated drainage area is 0.5 mi. A flapgate valve allows brackish water to enter the pond during high tide. The quality of water in the pond is not known.

The Refuge borders JNU on all sides except to the north. The estuarine wetland system on the Refuge (and within portions of JNU) is influenced by a strong tidal fluctuation. The dynamics of flows in this system resulting from the 25-foot tide range have not been studied. The estuarine system seems to be responding to a landscape affected by regional uplift and by JNU and roadway infrastructure development. The presently prominent Miller-Honsinger Slough is not apparent in the 1926 image of the study area (Figure 3-16).

Fieldwork was conducted in late 2005 on the system of sloughs that pass east of Runway 26 as part of an effort to understand better how this system might respond to proposed runway safety areas improvements. Terrestrial surveys were performed earlier to help establish channel profiles. Both of these efforts led to an improved understanding of the relationships between East Runway Slough, Sunny Slough, and Dredge Slough.

Figure 3-19 shows these sloughs with channel order assigned. Channel order describes a hierarchy of channels where smaller tributary channels feed larger, higher order channels. Currently Sunny Slough and East Runway Slough are both 3rd order channels. Flows in these channels are

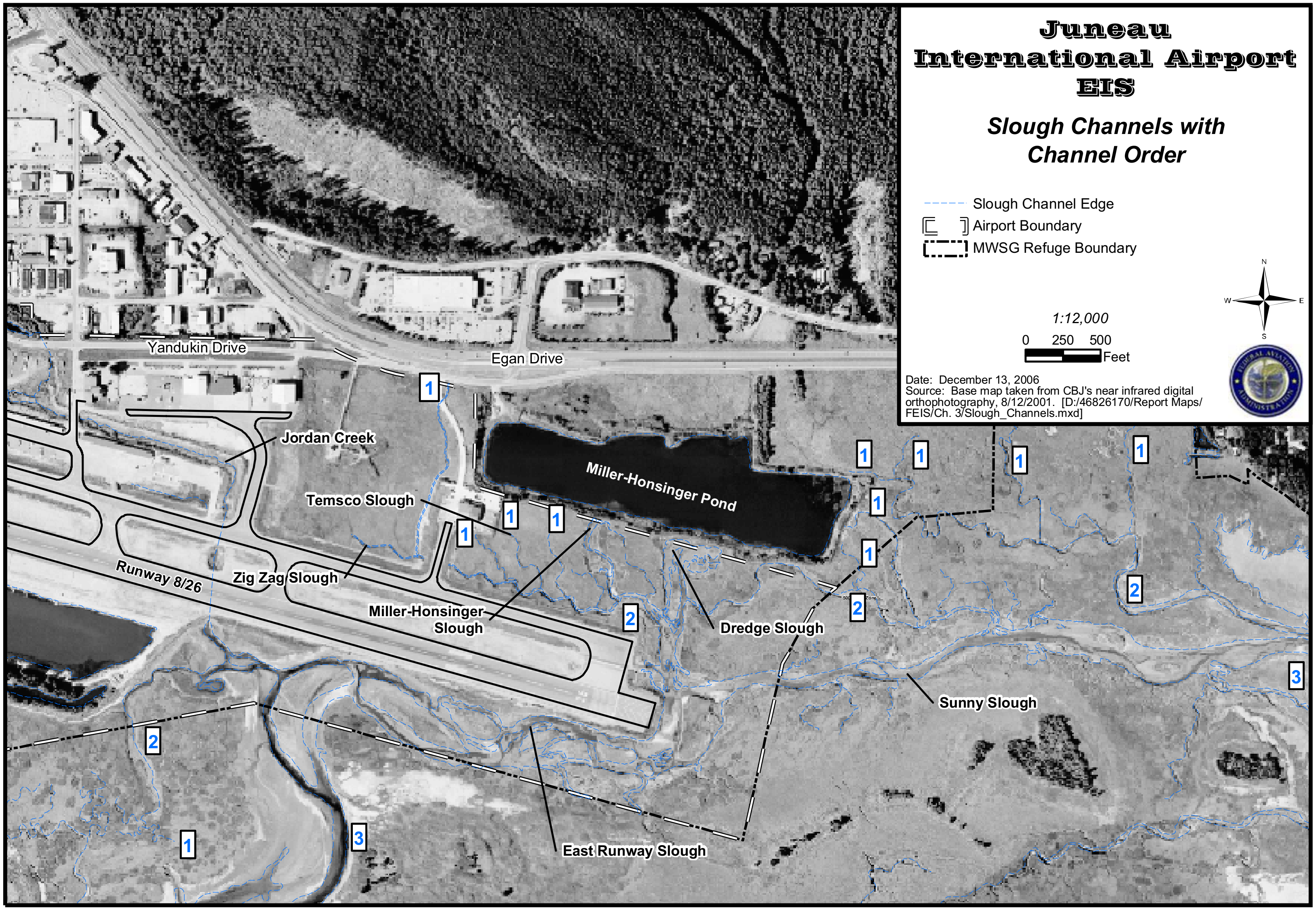


Figure 3-19. Slough channels with channel order.

variable due to a number of factors that include tidal stage, tidal stage relative to some high points or tipping points, and any freshwater flows that are contributed to these estuarine sloughs. The first slough east of TEMSCO is fed by an overflow culvert from Miller-Honsinger pond.

Approximately half of the flow in East Runway Slough below Jordan Creek currently comes from Dredge Slough under certain conditions. Table 3-19 presents discharge measurements made during a low tide in November 2005 that describe that relationship that may be important to salmonids' navigating back to Jordan Creek.

Table 3-19. East Runway Slough System Discharge Measurements

Station and Number	Width (feet)	Area (sq-ft)	Mean Depth (feet)	Velocity (ft/sec)	Discharge (cfs)
East Runway Slough above Jordan Creek	28.2	12.5	0.44	0.78	9.9
Jordan Creek below culvert	29.0	17.0	0.59	0.73	12.4
East Runway Slough below Jordan Creek	36.9	22.6	0.61	1.11	24.0

3.6.6.6 GROUNDWATER

The Mendenhall Valley contains two aquifers (Barnwell and Boning 1968). The upper aquifer lies within the unconfined sediments of silt, sand, and gravel at a depth of 3 to 15 feet below the ground surface. The thickness of the upper aquifer ranges from 0 to 300 feet (Osgood 1990). Mendenhall Lake is a major source of recharge for the upper aquifer. The lower aquifer is separated from and confined by a layer of bedrock below the upper aquifer. The water table flows southwesterly through the valley towards the Mendenhall River. All groundwater/surface-water interactions are with the upper aquifer (Alcorn and Hogan 1995).

On a broad scale, the upper reaches of the Mendenhall Valley generally gain flows from the groundwater and the lower reaches generally lose water to the ground (Barnwell and Boning 1968, Osgood 1990, Alcorn and Hogan 1995). However, because of the complex geology of the unconsolidated valley-fill sediments, local interactions between groundwater and surface water can be quite different. Mendenhall Lake appears to be a contributing source of groundwater for Duck Creek, and Jordan Creek appears to receive groundwater recharge from Mendenhall Lake and from numerous springs and groundwater discharge zones originating on Thunder Mountain.

Current research of the groundwater/surface water interactions in the valley is being conducted by Professor Todd Walter formerly of the University of Alaska Southeast (pers. comm. 2001) and Ed Neal of the USGS (pers. comm. 2001).

3.6.6.7 WATER QUALITY

The quality of surface water in the Mendenhall Valley varies considerably from the upper to lower portions of the watershed. Many small tributaries in the upper watershed have almost pristine conditions, while the waters in the lower watershed have severely degraded conditions. A standard way of reviewing water quality is to compare reported conditions with recognized beneficial uses and standards. The following sections discuss water quality and regulatory standards for waters in the valley. A later section discusses water quality for waters on and adjacent to the Airport.

Beneficial Uses and Water Quality Standards. The EPA and ADEC regulate the quality of surface waters in the State of Alaska by defining their "beneficial uses" and associated water quality standards, as required by the Clean Water Act. These beneficial uses are in essence the uses that the waters are intended to serve, such as for drinking water, growth and propagation of fish, shellfish, and other aquatic life, etc. Table 3-20 is a summary of the beneficial uses for the key waters of interest to this study. These water quality regulations apply to all "waters of the state", which require meeting Alaska's water quality standards for all potential uses. Section 46.03.900 (33) of Alaska Statute states that "waters include natural or artificial, public or private, inland or coastal" water bodies. Thus, Miller-Honsinger pond and even the Float Plane Pond, which was man-made for aviation uses, may both be regulated for water quality.

Table 3-21 shows the water quality standards found at 18 AAC 70(1)(A)(I), which are the reference values for individual water quality parameters that must be met in order to support the recognized beneficial uses for a waterway. For example, to protect the beneficial use of aquatic life, waters used by anadromous and resident fish must typically contain dissolved oxygen (DO) concentrations of more than 7 milligrams per liter (mg/L). (One of the most significant water quality concerns in the study area is the low concentration of DO found in area streams. According to EPA (2000b), many of the lower elevation streams of the Mendenhall Valley suffer from a chronic case of low DO.)

Water Quality Conditions of Interest or Concern. To identify water quality conditions of interest or concern, water quality regulators compare the water quality conditions in a particular waterway with water quality standards that protect the recognized beneficial uses of the waterway. Waters that do not meet these standards are termed "water quality limited" or impaired. Both Duck Creek and Jordan Creek exceed water quality criteria for dissolved gas, sediment load, and residues, but Duck Creek also exceeds criteria for a number of other parameters including fecal coliform bacteria, turbidity, metals, and petroleum hydrocarbons. (It should also be noted that even though other surface waters such as the Mendenhall River and Float Plane Pond are not listed does not mean they do not exhibit water quality problems. They may not have been sampled yet for purposes of quality characterization.)

Table 3-20. Beneficial Uses Summary**

	Mendenhall River	Duck Creek	Jordan Creek	JNU Float Plane Pond	Gastineau Channel	Miller-Honsinger Pond
Fresh Water Uses						
(A) Water Supply	X	X	X	X	---	X
(i) drinking, culinary, food processing						
(ii) agriculture						
(iii) aquaculture						
(iv) industrial						
(B) Water Recreation	X	X	X	X	---	X
(i) contact recreation						
(ii) secondary recreation						
(C) Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife	X	X	X	X	---	X
Marine Water Uses						
(A) Water Supply	X*	X*	X*	X*	X	X*
(i) aquaculture						
(ii) seafood processing						
(iii) industrial						
(B) Water Recreation	X*	X*	X*	X*	X	X*
(i) contact recreation						
(ii) secondary recreation						
(C) Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife	X*	X*	X*	X*	X	X*
(D) Harvesting for Consumption of Raw Mollusks or Other Raw Aquatic Life	---	---	---	---	X	---

* Alaska Water Quality Standards 18 AAC 70.040(3) state that "...in estuaries, where the fresh and marine water quality criteria differ within the same use class, the standard will be determined on the basis of salinity…"
** According to ADEC, all water bodies in Alaska are regulated as "waters of the state," and they are regulated to the most stringent standard of all uses (Smith, 2001). Therefore, the waterbodies marked by an "X" have those designated beneficial uses.

Table 3-21. State of Alaska Water Quality Standards for Fresh Water (18 AAC 70)

Parameter	Applicable Water Quality Standard	Most Restrictive Beneficial Use for Parameter
Fecal coliform bacteria	Mean may not exceed 20 FC/100 ml (geometric measurement for 30-day period), and not more than 10% of the samples may exceed 40 FC/100 ml. For groundwater, the FC concentration must be less than 1 FC/100 ml, using the fecal coliform Membrane Filter Technique, or less than 3 FC/100 ml, using the fecal coliform most probable number (MPN) technique.	Water supply*
Dissolved gas	D.O. must be greater than 7 mg/l in waters used by anadromous and resident fish. In no case may D.O. be less than 5 mg/l to a depth of 20 cm in the interstitial waters of gravel used by anadromous or resident fish for spawning. For waters not used by anadromous or resident fish, D.O. must be greater than or equal to 5 mg/l. In no case may D.O. be greater than 17 mg/l. The concentration of D.O. may not exceed 110% of saturation at any point of sample collection.	Aquatic life
pH	May not be less than 6.5 or greater than 8.5. May not vary more than 0.5 pH unit from natural conditions. If the natural condition pH is outside this range, substances may not be added that cause an increase in the buffering capacity of the water.	Recreation (primary contact)
Turbidity	May not exceed 5 nephelometric turbidity units (NTU) above natural conditions when the natural turbidity is 50 NTU or less, and may not have more than 10% increase in turbidity when the natural turbidity is more than 50 NTU, not to exceed a maximum increase of 25 NTU.	Water supply*
Temperature	May not exceed 20^{o}C at any time. The following maximum temperatures may not be exceeded, where applicable: ▪ Migration routes 15oC ▪ Spawning areas 13oC ▪ Rearing areas 15oC ▪ Egg & fry incubation 13oC ▪ For all other waters, the weekly average temperature may not exceed site-specific requirements needed to preserve normal species diversity or to prevent appearance of nuisance organisms.	Aquatic life
Dissolved inorganic substances	Total dissolved solids (TDS) from all sources may not exceed 500 mg/l. Neither chlorides nor sulfates may exceed 200 mg/l.	Water supply*
Sediment	The percent accumulation of fine sediment in the range of 0.1 mm to 4.0 mm in the gravel bed of waters used by anadromous or resident fish for spawning may not be increased more than 5% by weight above natural conditions (as shown from grain size accumulation graph). In no case may the 0.1 mm to 4.0 mm fine sediment range in those gravel	Aquatic life

Table 3-21. State of Alaska Water Quality Standards for Fresh Water (18 AAC 70), continued

Parameter	Applicable Water Quality Standard	Most Restrictive Beneficial Use for Parameter
Sediment, cont.	beds exceed a maximum of 30% by weight (as shown from grain size accumulation graph). In all other surface waters no sediment loads (suspended or deposited) that can cause adverse effects on aquatic animal or plant life, their reproduction or habitat may be present.	
Toxics and other deleterious (organic and inorganic) substances	(See Table 12b)	Water supply* & Aquatic life
Color	May not exceed 15 color units or the natural condition, whichever is greater. Color or apparent color may not reduce the depth of the compensation point for photosynthetic activity by more than 10% from the seasonally established norm for aquatic life.	Water supply* & Aquatic life
Petroleum hydrocarbons, oils, and grease	Total aqueous hydrocarbons (TAqH) in the water column may not exceed 15 µg/l. Total aromatic hydrocarbons (TAH) in the water column may not exceed 10 µg/l. There may be no concentrations of petroleum hydrocarbons, animal fats, or vegetable oils in shoreline or bottom sediments that cause deleterious effects to aquatic life. Surface waters and adjoining shorelines must be virtually free from floating oil, film, sheen, or discoloration.	Aquaculture
Radioactivity	Same as (1)(A)(i) except that concentration factors for organisms involved may not exceed maximum permissible limits for specific radioisotopes and unidentified mixtures as established by 10 C.F.R. 20 and National Bureau of Standards, Handbook 69.	Water supply* & Aquatic life
Total residual chlorine	May not exceed 2.0 µg/l for salmonid fish or 10.0 µg/l for other organisms.	Aquaculture
Residues (floating solids, debris, sludge, deposits, foam, scum, or other residues)	May not, alone or in combination with other substances or wastes, make the water unfit or unsafe for the use, or cause acute or chronic problem levels as determined by bioassay or other appropriate methods. May not, alone or in combination with other substances, cause a film, sheen, or discoloration on the surface of the water or adjoining shorelines, or cause leaching of toxic or deleterious substances, or cause a sludge, solid, or emulsion to be deposited beneath or upon the surface of the water, within the water column, on the bottom, or upon adjoining shorelines.	Aquatic life

* Alaska Water Quality Standards 18 AAC 70 (1)(A)(i) references drinking water standards 18 AAC 80

There may be a number of causes for poor water quality in area streams and water bodies. For example, underlying geology heavily influences groundwater quality. Where groundwater passes through glaciomarine deposits it accumulates dissolved iron, which is commonly present as pyrite (FeS_2) in the +2 oxidation state (EPA 2000b). When the dissolved iron enters the aerobic environment of a stream through groundwater interactions with surface water, it is oxidized through biochemical reactions that consume available DO and produce an iron precipitate or floc (EPA 2000b). USGS and ADEC water quality monitoring results support the conclusion that the DO in streams of the lower valley are primarily attributable to oxidation of inorganic iron compounds found in the valley geology, not biodegradation of organic material (which is more typically the cause of low DO levels in urban streams). This finding has important implications to the potential mitigation measures potentially available to address this undesirable condition.

Data collected by EPA, ADEC, and Alaska Water Watch document that the reaches of Duck Creek with the lowest minimum DO concentrations have occurred in the geologic formations with the highest concentration of iron. Jordan Creek DO concentrations are typically higher than Duck Creek's, and correlated by geologic formations with lower iron concentrations. (The Jordan Creek DO concentration is based on a more limited data set collected by USGS staff during stream monitoring in 1998 and 1999.)

Three distinct reaches of Duck Creek experience iron-rich groundwater seepage according, to Beilhartz (1998) as cited in EPA (2000b): near Taku Boulevard, below Berners Avenue, and reaches adjacent to the dredge ponds on the East Fork of the creek.

Other potential sources for groundwater and surface water contamination in the upper watershed (above JNU) include petroleum products from roads, parking lots, and private vehicle oil changes (Koski and Lorenz 1999). Additional concerns include spills from residential home heating oils, leaks from underground fuel tanks, landfills, dumped trash, failing septic systems, and nutrient introduction from fertilizers, and other sources.

Total Maximum Daily Loads (TMDLs). State and federal regulators/agencies routinely evaluate the quality of waters, by comparing water quality monitoring data with water quality standards. If there is substantial evidence that the water is impaired or water quality limited, Total Maximum Daily Loads (TMDLs) are developed to address the impairments. A TMDL defines the quantity of material that may be discharged into a waterway from all recognized sources, while still maintaining applicable water quality standards.

EPA reviewed water quality on Duck Creek and found the creek is water quality limited for bacteria, DO and iron, turbidity/sediment, and residues/debris (EPA 1999). To address these undesirable conditions, EPA has developed TMDLs for some of these parameters and is continuing to develop TMDLs for others. Table 3-22 is a summary of the established TMDLs for Duck Creek.

Table 3-22. Duck Creek Total Maximum Daily Loads (TMDL) Summary

	Fecal Coliform Bacteria (FC)	Dissolved Oxygen and Iron	Turbidity[1]	Residues[1, 2]
Theoretical Load Capacity	2.34 x 1011 FC/yr at the mouth of Duck Creek	0.23 tons/yr iron (with proposed flow augmentation of 3 cfs, 1.13 tons/yr)	Monthly Loading Capacity	Zero (0); the standard for "residues" prohibits deposits on or in the streambeds and streambanks
Load Allocation	2.24 x 1011 FC/yr at the mouth of Duck Creek	0.27 tons/yr iron	Monthly Loading Capacity	Zero (0) "residues" above natural conditions
Load Reduction	38% Reduction	3.87 tons/yr iron (93%)		
Wasteload Allocation	No point sources; wasteload allocation set to zero	No point sources; wasteload allocation set to zero	No point sources; wasteload allocation set to zero	Zero (0); non point sources only
Environmental Indicators	E. Coli monitoring	Dissolved oxygen monitoring and mats of iron floc	Turbidity/Total suspended solids/Suspended sediment concentration	Residue (solid waste, debris, including wood, waste metals, abandon oil tanks, and plastics)
Primary Sources	Urban runoff, including domestic animal and wildlife waste	Groundwater and dissolved ferrous iron from glaciomarine sediments; nutrient decomposition is reportedly NOT significant	Urban runoff and highway maintenance practices	Littering and urban runoff from residential and commercial development

Source: EPA 1999.
[1] Not Applicable to Ground Water
[2] Floating Solids, Debris, Sludge, Deposits, Foam, Scum, or Other Residues

3.6.7 JUNEAU INTERNATIONAL AIRPORT WATER RESOURCES

Listed below are the major water resources on JNU property or in the immediate vicinity:

- Mendenhall River.
- Duck Creek.
- Jordan Creek.
- Miller-Honsinger Pond and adjacent "Miller-Honsinger/East Runway" Slough.
- Float Plane Pond.
- Tidal influence of the Gastineau Channel and associated estuarine wetlands.

This section identifies the current conditions of the water resources within the immediate vicinity of JNU. These data include an analysis of culvert capacities and fish passage, stormwater runoff from JNU, water quality and groundwater quality at JNU, and Airport operations that affect water quality.

Field studies were conducted on Duck Creek and Jordan Creek by the study team to determine the current pattern, dimension, and profile of the existing channels. This work was performed using common methods (Rosgen 1996, Leopold 1994) to assess current conditions and to assist in determining what opportunities would be available relocate streams and further aviation facility needs.

3.6.7.1 MENDENHALL RIVER

The Mendenhall River has a watershed area of approximately 103 mi at JNU that meanders along an approximately 2,400-foot-long path just west of the runway. The river mouth on Fritz Cove is located approximately 12,000 feet downstream from the west runway end.

Tidal influence is very strong in the lower Mendenhall River. One indication of this influence is that the river widens from approximately 130 feet average width in the vicinity of the Brotherhood Bridge, 1 mile upstream of JNU, to approximately 250 feet wide at the west end of the runway. During extreme high tides, overtopping on the right bank opposite JNU creates a channel that is approximately 1,000 feet wide. The channel bed is a mixture of sands, gravels, and cobbles.

The combination of relatively flat slope and tidal influence create conditions in which channel adjustment may occur. High tides cause water to back up in channels and increase overbank flooding. In summer 2004 this condition was exacerbated by warmer than average summer temperatures which accelerated glacial snow melt and increased the amount and duration of discharge in the Mendenhall River. The increased discharge peaked with runoff from a heavy thunderstorm during an outgoing tide, and the combination of forces caused a chute channel to develop across the neck of a meander spur. This type of adjustment will likely continue in the low gradient tidally influenced reach of the Mendenhall. The complicated hydrology created by the combination of tidal and riverine influences make it difficult to predict either the location or magnitude of these adjustments. However, adjustments will occur periodically.

Approximately 1,900 feet of the river is within the Refuge. The last 500 feet of this reach marks the beginning of a meander bend on the left bank of the river. This bank, formed by the Airport service road that provides access to the Refuge, receives the full force of the river during high flows, and is therefore heavily armored with large riprap along its approximately 500-foot reach.

The left bank adjacent to JNU is armored with riprap and concrete rubble. The left bank is typically steep with a 1.5:1 (horizontal:vertical) slope, and steeper in some spots. A water control structure connects the west end of the Float Plane Pond with the Mendenhall, while ongoing channel incision presents potential stability issues for this reach of the river. The average streambed elevation of the Mendenhall River is approximately -5 msl according to Neal and Host (1999), which is approximately 20 feet below the grade of the Airport.

The Hydrologic Engineering Center – River Analysis System (HEC-RAS, version 3.1.3) hydraulic modeling software was used to model the existing hydraulic conditions of the Mendenhall River (VA0 2006a and 2006b). An existing HEC-RAS hydraulic model created by the USGS to model the Mendenhall River (Neal and Host 1999) was built upon to analyze conditions at JNU. The existing USGS model geometry is based on a combination of USGS cross-sections surveyed in September 1997 and spring 1998 (Neal and Host 1999). The EIS analysis added seven new cross-sections to the existing model. These cross-sections were defined using 2-foot LiDAR contour data (SWCA 2001) for the land surface. The below-water portions of these cross-sections were approximated using data from neighboring USGS surveyed cross-sections. The source of this below-water information is as much as eight years old, and conditions in the channel have likely changed during this time. Because of these dynamic channel conditions, the model results provide only planning-level information on hydraulic conditions in the vicinity of the proposed changes. More detailed analysis will be required if a project alternative that encroaches into the Mendenhall River moves to implementation.

Five of the added cross-sections (41.9, 41.8, 41.5, 41.2, and 41.1) are located near the west end of Runway 8. Figure 3-20 shows the locations of these and nearby model cross-sections. The model was run under both low tide (MLLW; -13-ft-msl low tide downstream boundary condition) and high tide (MHHW; 11-ft-msl high tide downstream boundary condition). Table 3-23 shows the existing hydraulic conditions near the west end of Runway 8 under low tide conditions, and Table 3-24 shows the existing hydraulic conditions near the west end of Runway 8 under high tide conditions.

Shear stress and velocity are two well-established indicators of channel stability. Channel shear stress is a calculation of the force that moving water exerts on the channel bed and banks (force/area). As channel flow becomes deeper or steeper, shear stress increases, which enables the stream to carry larger sediment materials downstream. For reference, a shear stress of 1.0 will initiate movement of cobble-sized (approximately 3-inch diameter) material. Channel velocity is calculated by dividing channel discharge by channel cross-sectional area. This means velocity does not capture localized velocities that may be higher and lower.

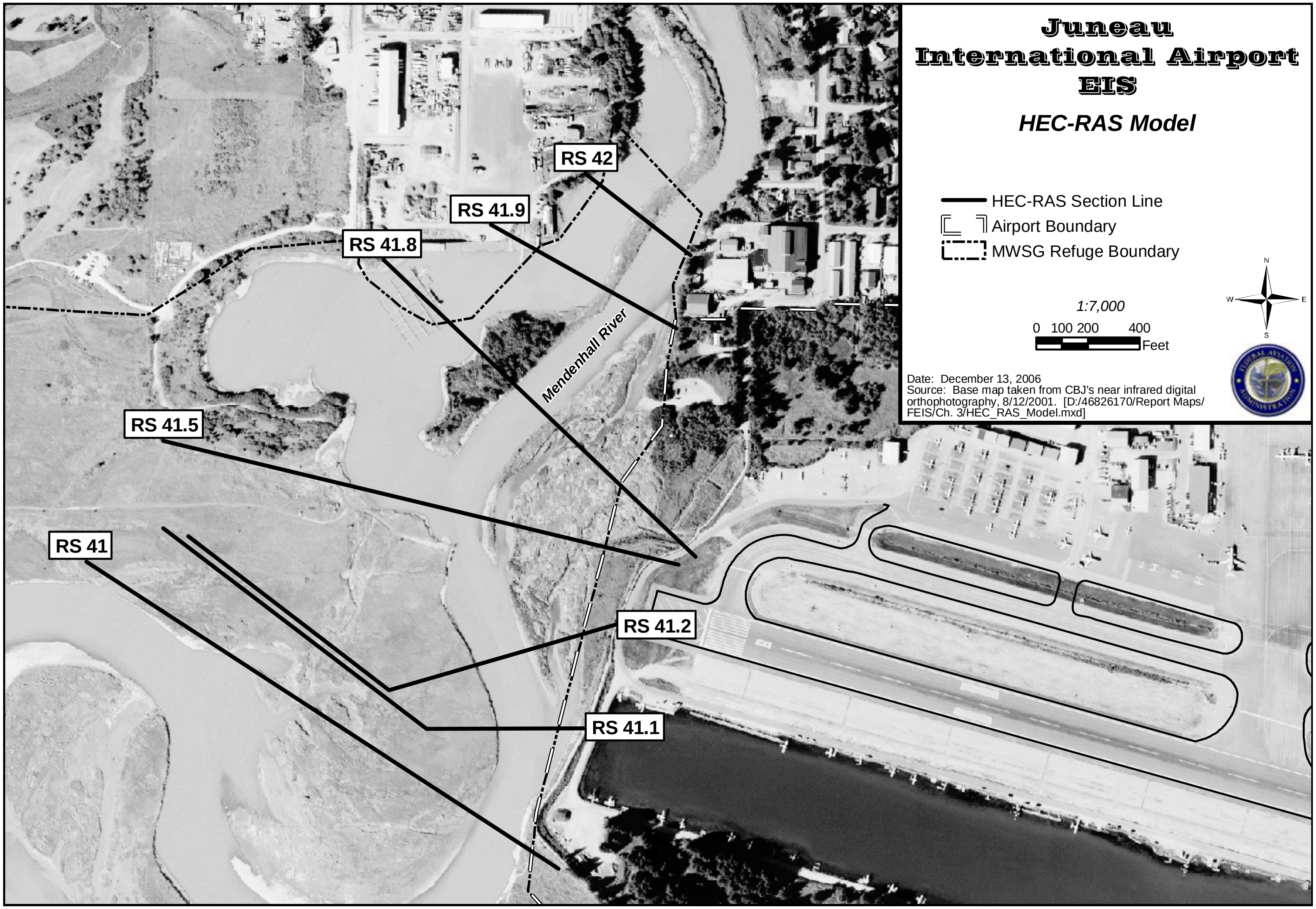


Figure 3-20. Location of HEC-RAS model cross-sections.

Table 3-23. Existing Modeled Hydraulic Conditions near the West End of Runway 8 under 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	9,580	6.2	4.8	0.2	1,990
41.9	100-year	20,480	9.0	7.7	0.5	2,680
41.8	2-year	9,580	5.9	5.4	0.3	1,780
41.8	100-year	20,480	8.4	8.5	0.6	2,920
41.5	2-year	9,580	5.8	4.3	0.2	2,390
41.5	100-year	20,480	8.5	6.2	0.3	3,930
41.2	2-year	9,580	5.4	5.2	0.3	1,850
41.2	100-year	20,480	7.9	7.0	0.5	2,990
41.1	2-year	9,580	4.9	6.2	0.4	1,550
41.1	100-year	20,480	6.3	10.7	1.1	1,910

Table 3-24. Existing Modeled Hydraulic Conditions near the West End of Runway 8 under 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	9,580	11.0	3.0	0.1	3,250
41.9	100-year	20,480	11.2	6.3	0.3	3,280
41.8	2-year	9,580	11.0	2.6	0.1	4,780
41.8	100-year	20,480	11.2	5.5	0.2	4,870
41.5	2-year	9,580	11.0	2.1	0.0	5,550
41.5	100-year	20,480	11.1	4.5	0.2	5,620

Table 3-24. Existing Modeled Hydraulic Conditions near the West End of Runway 8 under High Tide Conditions, continued

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)
41.2	2-year	9,580	11.0	1.8	0.0	7,290
41.2	100-year	20,480	11.1	3.8	0.1	7,410
41.1	2-year	9,580	11.0	2.1	0.0	6,480
41.1	100-year	20,480	10.9	4.6	0.2	6,360

In general, velocities and shear stresses are moderate under low tide conditions for the 2-year event near the west end of Runway 8. However, during the 100-year event under low tide conditions, channel velocities and shear stresses become erosive in some areas. Under high tide conditions, the river near the west end of Runway 8 is in a backwatered condition; that is, the water surface elevation primarily controlled by the tide rather than by the flow of water coming down the river. As a result, shear stresses are low, and velocities are lower than those under low tide conditions.

3.6.7.2 Duck Creek

Duck Creek has a drainage area of approximately 2.6 mi at JNU (versus 1.6 mi at the Nancy Street Gage). Duck Creek runs for approximately 2,000 feet from Cessna Drive to the Dike Trail, and then approximately 1,600 feet from the Dike Trail to meet the Mendenhall River.

Duck Creek meanders very gently through its valley here with a gentle gradient of approximately 0.1% slope. Duck Creek generally has a well-developed floodplain, except where obvious alterations have reduced the floodplain. Streambed materials were assessed visually and ranged from gravels to sands, with some silt and muck mixed in the sand channel sections. The stream has a single-thread channel for approximately 1,000 feet, and has a multiple-thread channel for almost 400 feet in the middle reach between stations 510 and 870.

The measured pool percentage is 52%. Riffles comprise 24% of the channel in this reach; glides are approximately 13%; runs are approximately 10% of the channel. Judged by the Washington Forest Practices, Standard Methodology for Conducting Watershed Analysis (1995), this reach of Duck Creek would be rated fair to good for habitat in terms of the pool percentage (fair: 40-55%; good >55%). Pool depths at bankfull condition range from 3 to 4.5 feet deep.

3.6.7.3 Jordan Creek

Jordan Creek runs for approximately 2,500 feet from Yandukin Drive to the runway, and then approximately 1,800 feet from the runway culvert to meet the Gastineau Channel. The channel was moved to its present location starting with initial construction of the Airport in the 1930s.

Jordan Creek meanders through its valley here with a gentle gradient of approximately 0.2% slope. This creek generally has a well-developed floodplain, except where obvious alterations have reduced the floodplain, such as the placement of fill along both banks in some sections. Streambed materials were assessed visually and ranged from cobbles and gravels to sands, with some silt and muck mixed in the sand channel sections. The stream has a single thread channel for approximately 300 feet upstream of the taxiway culvert, and generally has a multiple thread channel upstream from the taxiway to just upstream of Yandukin Drive.

The channel structure varies between the downstream reach south of the runway, and upstream reach north of the runway. Downstream, the measured pool percentage is 49%. Riffles comprise 24% of the channel in this reach; runs are approximately 24% of the channel. Upstream, the measured pool percentage is 29%. Riffles comprise 40% of the channel in this reach; glides are approximately 31% of the channel. Judged by the Washington Forest Practices, Standard Methodology for Conducting Watershed Analysis (1995), the downstream reach of Jordan Creek would be rated fair to good, and the upstream reach rated poor for habitat in terms of the pool percentage (poor: <40%; fair: 40-55%; good >55%). Pool depths at bankfull condition range from 5 to 7.5 feet deep downstream, and 3 to 4 feet deep upstream.

3.6.7.4 Culverts and Fish Passage

The primary functions of culverts are to channel and move water downstream, and to allow for suitable fish passage. The conveyance capacity of a culvert is based on the size, type of material, and slope. Fish passage design is based on culvert length, velocity, and flow depth.

At the Airport, CBJ maintains three culverts along Duck Creek, four culverts along Jordan Creek, and one culvert from the Float Plane Pond to the Mendenhall River. All of these culverts, with the exception of the culvert from the Float Plane Pond, provide fish passage. The Float Plane Pond has a tide gate and a fish screen on the culvert (Adamus 1987). All of the culverts on JNU are affected by the tides. Tidal inundation periodically reduces downstream conveyance capacity, and high flows may impede upstream fish passage as high tides recede.

Table 3-25 lists the Airport culverts and summarizes their characteristics. The maximum conveyance capacities of the culverts have been calculated using the Manning's Equation for pipe conveyance. This table also illustrates the fish passage criteria for culverts per National Marine Fisheries Service guidelines. High tides, not accounted for in Table 3-25, would also reduce culvert hydraulic capacity.

Comparing the estimated maximum culvert velocities and characteristics in Table 3-25 with the NMFS fish passage criteria for culverts, it appears that some culverts along Jordan Creek may have local high velocities at low tide levels. During incoming flood tides, the downstream culvert

Table 3-25. JNU Culverts, Estimated Capacities, and Criteria for Fish Passage

Creek	Location	Design Size	Length ft	Average Slope ft/ft	Estimated Capacity[1] cfs	Max Design Velocity[1] fps	Mannings n
Duck	Radcliff Road / Dike	72" CMP	66.5	0.009	200	7.1	0.026
Duck	Just West of Cessna Drive	64" CMP	50	0.01	160	7.2	0.025
Duck	Cessna Drive2	17' Arch Culvert	94.5	0.006	890	10.2	0.028
Jordan	Airport Runway	96" CMP	350	0.003	220	4.7	0.032
Jordan	Airport Taxiway	96" CMP	235	0.003	220	4.7	0.032
Jordan	Crest Street	12' x 6.25' CMP	81	0.003	435	7.5	0.024
Jordan	Yandukin Drive	(2) 11.5' x 7.25' CMP	100	0.002	680	5.3	0.024
Float Pond	Dike Road3	48" CMP	-	-	-	-	

Fish Passage Criteria for Culverts

Criteria	Culvert Length (ft)	Maximum Allowable Velocity at Design Flow (fps)
Maximum velocity	0-20	11
	20-50	8
	50-100	6
	100-150	5
	150-200	4
	200-300	3
	300+	2
Minimum flow depth (inches)	12	
Preferred maximum slope	1%	

From: National Marine Fisheries Service, Culvert Passage Guidelines (1996).
[1] Capacities and velocities calculated by the Mannings equation for maximum pipe flow.
[2] With D/S weir boxes.
[3] With tide gate and fish screen.
CMP - Corrugated metal pipe with circular shape. Arch Culvert - Metal or Concrete Culvert that is arch-shaped.
Note: Based on USGS records from 1993 to 2000, the maximum flow in Duck Creek (USGS Station No. 115053200) was determined as 68 cubic feet per second (cfs) on December 28, 1999. Based on USGS records, the maximum recorded flow for Jordan Creek (USGS Station No. 15052475) from 1996 to 2000 was 140 cfs on September 25, 1996.

capacity is reduced, thereby enhancing opportunities for fish passage. During high tide events, the Radcliffe Road culvert along Duck Creek; and the Crest Avenue, taxiway, and runway culverts along Jordan Creek surcharge as the flow reverses and the water level rises. This flow reversal and surcharging reduces the culverts conveyance capacity for a few hours until the tide begins to recede.

Figure 3-21 shows the culvert invert elevations with respect to tidal cycle. The invert elevations of the culverts affect the frequency and magnitude of tidal inundation. This tidal inundation of the culverts may enable better fish passage; fish may be able to more easily pass through the culverts when they are inundated. Since the Duck Creek culvert has a higher invert elevation than the Jordan Creek culvert, the Duck Creek culvert becomes inundated less frequently than the Jordan Creek culvert. This less frequent tidal inundation on the Duck Creek culvert may also limit the fish passage up Duck Creek.

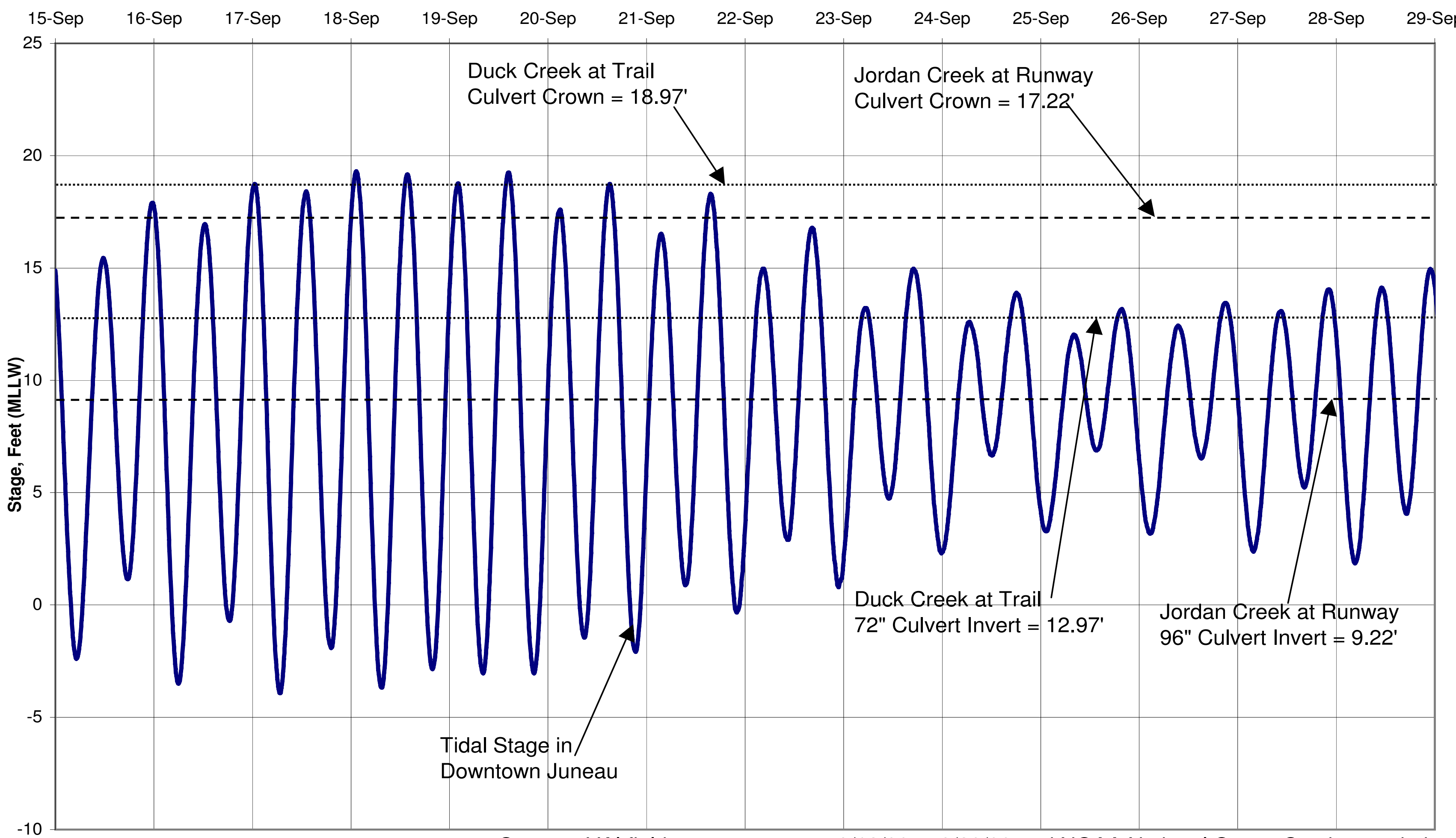
3.6.7.5 Other Waters of Interest Near the Airport

Other waters of interest on or near the Airport include:

- Miller-Honsinger Pond
- Miller-Honsinger/East Runway Slough[7]
- Dredge Slough[7]
- Sunny Slough[7]
- Zig Zag Slough[7]
- Float Plane Pond and surrounding basin
- Wetlands of the Refuge
- High tides from the Gastineau Channel that immediately affect adjacent estuarine wetlands

Miller-Honsinger Pond. The Miller-Honsinger pond is a privately owned pond that is fed by groundwater and a small tributary. The pond was created by prior gravel dredging operations to obtain fill for local infrastructure projects. A tidal flapgate allows salt water to enter the pond during high tides. The presumed fluctuations in salinity and water levels, scarcity of cover, and partially restricted fish access limit its present habitat value for fish although marine species do reside in the pond.

7. Note that features such as Miller-Honsinger/East Runway Slough, Dredge Slough, Zig Zag Slough and Sunny Slough are identified for ease of communication, and not to suggest that a formal nomenclature exists for these features.



Source: VAI field measurements - 9/18/00 to 9/20/00 and NOAA National Ocean Services website:
http://www.co-ops.nos.noaa.gov/cgi-bin/station_info.cgi?stn=9452210+Juneau+,+AK

Figure 3-21. Observed tidal stage on Duck and Jordan Creeks near Juneau, Alaska.

According to staff from the ADEC (Smith 2001), all impoundments of water, including private waters like the Miller-Honsinger pond, are protected by the state's water quality standards. They are protected for the most stringent beneficial use that the water could be used for, which is typically drinking water. However, the lack of water quality data for the Miller-Honsinger pond makes it difficult to draw conclusions about the existing water quality conditions of the pond.

Miller-Honsinger/East Runway Slough. The Miller-Honsinger/East Runway Slough is an estuarine channel that is immediately east of the JNU runway. The end of the slough closest to Miller-Honsinger Pond is referred to as Miller-Honsinger Slough while the end closest to the runway is often referred to as East Runway Slough. A flapgate from the Miller-Honsinger Pond drains into this slough area along with stormwater runoff from JNU. The Dredge and Sunny Slough channels enter this slough from Miller-Honsiger Pond to the north and the Refuge to the east. During high tide events, brackish water inundates this slough via the Sunny Slough channel. This slough drains approximately 380 acres of estuarine wetlands or approximately 10% of the Refuge. As shown on Figures 3-22 and 3-31, the slough drains into Jordan Creek as it enters the Refuge.

Dredge Slough. Dredge Slough is an estuarine channel that runs between Miller-Honsinger Pond south toward Miller-Honsinger/East Runway Slough. It conveys tidal waters, and is shown on Figures 3-22 and 3-31.

Sunny Slough. Sunny Slough is an estuarine channel that runs east from Miller-Honsinger Slough east toward Sunny Point. It conveys tidal waters to and from the east, and is partially shown on Figures 3-22 and 3-31.

Zig Zag Slough. Zig Zag Slough is a man made estuarine channel that runs parallel to the runway south of Miller-Honsinger Pond. It conveys tidal waters to and from the east, and is partially shown on Figures 3-22 and 3-31.

Float Plane Pond. The Float Plane Pond is connected to the Mendenhall River through a tide gate at the west end of the pond adjacent to the river. Water flows into the Float Plane Pond from the river during a flood/incoming tide. Water exits the Float Plane Pond when the water surface gets high enough to flow over the top of an outlet pipe/weir. This outlet control structure helps maintain a design water surface elevation. The tide gate on the Float Plane Pond allows tidal salt water inundations, creating an estuary-like environment (Bethers, Munk, and Seifert 1995). A levee on the south, west, and east side of the Float Plane Basin prevents it from being inundated by the high tide. The Float Plane Pond was stocked for sport fishing until the FAA mandated an end to all non-aircraft activities at the pond for Airport safety (Adamus 1987; Bethers, Munk, and Seifert 1995). It still inadvertently contains variable populations of fish species because the design of the tide gate allows fish passage.

The Float Plane Pond was constructed for aviation uses, but there are potential conflicts between the regulatory classification for waters of the state requiring stringent water quality standards and the intended uses of the pond. The ADF&G report (Bethers, Munk, and Seifert 1995) suggests that the Float Plane Pond receives pollutants from aircraft and petroleum products. It also

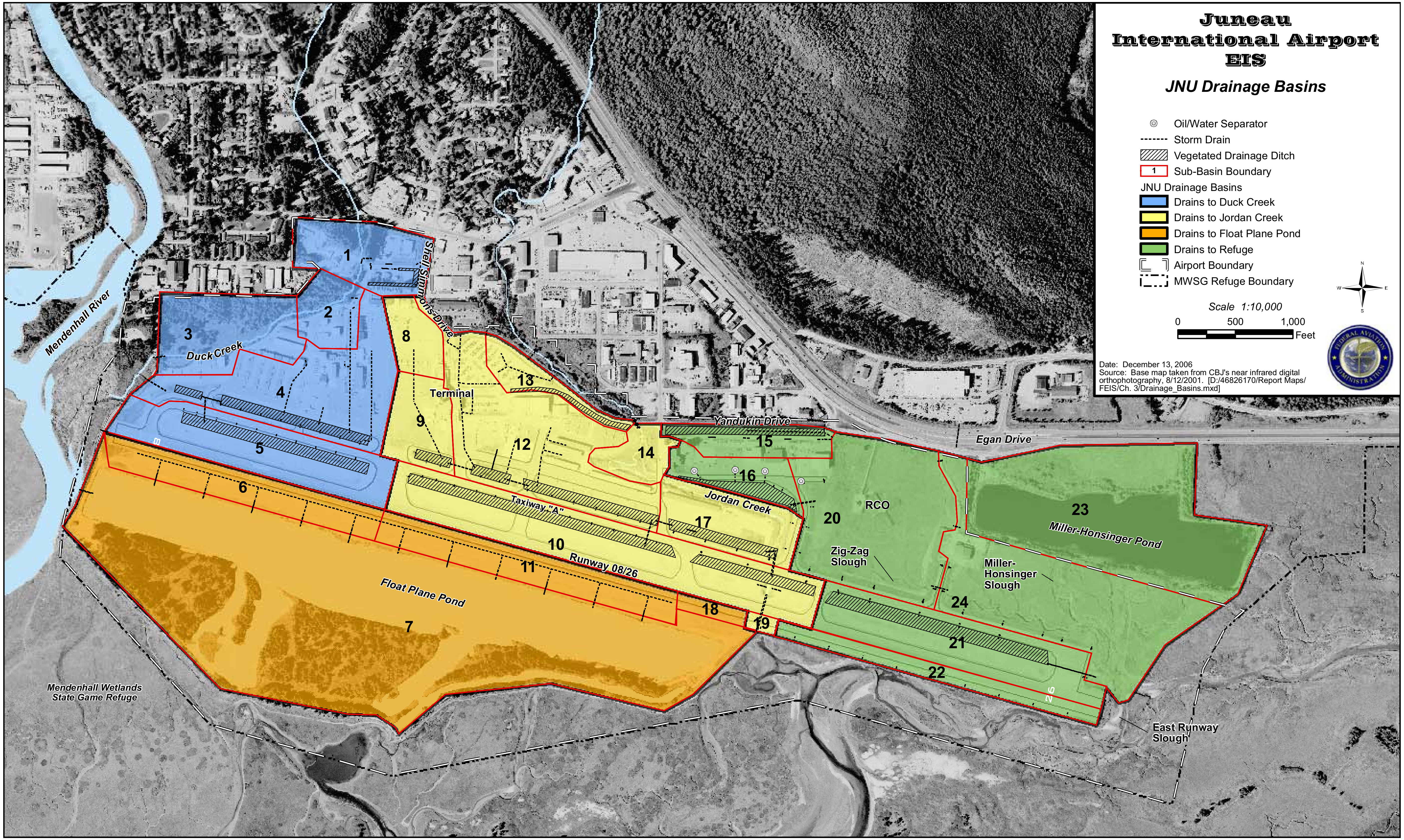


Figure 3-22. JNU drainage layout and receiving waters.

THIS PAGE INTENTIONALLY LEFT BLANK

describes the lake as having high biological production. ADEC staff members indicate that impoundments of water, including the Float Plane Pond, are protected by state water quality standards (Smith 2001).

Wetlands of the Refuge. This 4,000-acre wetland refuge has dynamic and complex flows mixing freshwater, brackish water, and tidal water. Regional uplift and infrastructure development have contributed to concentrating flows. The impacts of these changed flow patterns have not been studied.

3.6.7.6 GROUNDWATER

The groundwater at JNU is controlled by the local geology. JNU is located on the Mendenhall River delta, and the runway and associated taxiways were built up by fills of sand and gravel, mostly from the excavation of the Float Plane Pond. The porous nature of the geology under JNU, possibly including the old stream channels from Duck Creek and Jordan Creek, likely facilitates groundwater interaction with surface water. A groundwater study along a 2,000-foot reach of Duck Creek on Airport property (Noll 1995) found that the creek receives flow from the groundwater along the upper third of the site, but loses flow to the groundwater along the lower third of the study area. Stream flow in the middle section of Duck Creek was observed to be in equilibrium with groundwater.

According to a research project being developed by Todd Walter, a former professor at University of Alaska Southeast in Juneau, and Ed Neal of the U.S. Geological Survey in Juneau (pers. comm. 2001); surface waters are generally losing water to groundwater in the lower valley. As the valley continues to rise, it is believed that the surface water losses from lower Duck and Jordan creeks to groundwater will increase. This phenomenon is believed to have greater impact on Duck Creek, due to the nature of groundwater flows (Noll 1995), and hydrology impacts from urbanization.

3.6.7.7 STORMWATER

An understanding of JNU stormwater drainage was developed using previous studies from Isbill Associates, Inc. (1996) R&M Engineering (1996), the current runoff basin map, and aerial photography. Field visits were made to the JNU property in summer and fall of 2001 for verification. The Stormwater Management Plan is currently being revised and updated by the CBJ.

The JNU property has been divided into 24 drainage basins with an approximate area of 590 acres, as shown in Figure 3-19. The acreage that has not been accounted for is mostly pervious land in between the Refuge boundary and the levee that surrounds JNU, and the south side of the runway. The remainder of this unaccounted for land is a wooded area north of Yandukin Drive. Table 3-26 summarizes the status of JNU drainage basins. Stormwater runoff from JNU drains directly into four different bodies of water: Duck Creek, Jordan Creek, the Float Plane Pond, and the Miller-Honsinger Slough/Refuge.

Table 3-26. JNU Drainage Basin Status Summary

						Potential Water Quality Issues				Water Quality BMPs		
Basin ID	Estimated Area (ac)	% Impervious	% Pervious	% Open Water	Estimated 50 yr Storm Runoff Volume (acre-ft)*	Receiving Waters	Area of Deicing Application[+] (ac)	Runway / Taxiway[°] (ac)	Parking Areas w/o Oil Water Separators (ac)	Oil Water Separators (ac)	Length (ft) of Vegetated Drainage Ditch	Comments
Basin 1	14.3	30%	70%	0%	2.86	Duck Creek	-	-	1.0	-	950	Duck Creek runs through this basin. Bulk fuel storage facilities.
Basin 2	7.2	56%	44%	0%	1.91	Duck Creek	-	-	-	-	-	Duck Creek runs through a portion of this basin.
Basin 3	17.9	25%	75%	0%	3.36	Duck Creek	-	-	-	-	-	Duck Creek runs through the basin.
Basin 4	30.6	88%	12%	0%	10.56	Duck Creek	0.5	2.7	-	-	1,500	Some deicing occurs in this basin. 14% taxiway drainage.
Basin 5	24.2	48%	52%	0%	5.93	Duck Creek	-	11.6	-	-	1,600	Drains to Duck Creek via Basin 3.
Basin 6	16.5	62%	38%	0%	4.62	Float Pond	-	10.5	-	-	-	Drains runway and taxiway. Erosion concerns.
Basin 7	151.5	3%	42%	55%	9.79	Float Pond						Float Plane Pond.
Basin 8	6.2	100%	0%	0%	2.33	Jordan Creek	-	-	-	-	-	Airport terminal building and private plane storage.
Basin 9	9.9	93%	7%	0%	3.54	Jordan Creek	1.3	1.1	-	-	275	Most of the airplane deicing occurs in this basin.
Basin 10	38.8	45%	55%	0%	9.22	Jordan Creek	-	17.5	-	-	3,150	Jordan Creek runs through this basin. Runoff from taxiway and runway.
Basin 11	17.9	83%	17%	0%	5.95	Float Pond	-	11.8	-	-	-	Drains runway and taxiway. Erosion concerns.
Basin 12	36.2	85%	15%	0%	12.22	Jordan Creek	0.6	2.4	4.0	-	1,450	Some airplane deicing. Airport equipment storage and car parking.
Basin 13	6.0	73%	27%	0%	1.85	Jordan Creek	-	-	2.2	-	950	Airport parking lot and Yandukin Drive.
Basin14	5.8	17%	83%	0%	0.97	Jordan Creek	-	-	-	-	-	Jordan Creek runs through basin.
Basin 15	8.7	65%	35%	0%	2.50	Refuge	-	-	1.4	-	2,300	Fire and rescue facilities and Yandukin Drive.

Table 3-26. JNU Drainage Basin Status Summary, continued

Basin ID	Estimated Area (ac)	% Impervious	% Pervious	% Open Water	Estimated 50 yr Storm Runoff Volume (acre-ft)*	Receiving Waters	Potential Water Quality Issues: Area of Deicing Application+ (ac)	Potential Water Quality Issues: Runway / Taxiway° (ac)	Potential Water Quality Issues: Parking Areas w/o Oil Water Separators (ac)	Water Quality BMPs: Oil Water Separators (ac)	Water Quality BMPs: Length (ft) of Vegetated Drainage Ditch	Comments
Basin 16	8.5	63%	37%	0%	2.40	Refuge	-	-	-	3.6	1,100	Oil-water separators used in this basin. Detention pond in basin.
Basin 17	14.5	52%	48%	0%	3.70	Jordan Creek	-	1.6	-	-	800	Jordan Creek runs through this basin. Detention pond in basin.
Basin 18	2.2	55%	45%	0%	0.58	Float Pond	-	1.2	-	-	-	Runoff from taxiway and runway.
Basin 19	0.9	60%	40%	0%	0.25	Jordan Creek	-	0.5	-	-	-	Runoff from runway. Jordan Creek culvert.
Basin 20	38.2	13%	87%	0%	6.02	Refuge	-	1.7	-	1.8	-	Overflow runoff from Fred Meyer. Oil/water separator.
Basin 21	25.6	52%	48%	0%	6.53	Refuge	-	13.0	-	-	1,950	Runoff from taxiway and runway.
Basin 22	10.0	74%	26%	0%	3.10	Refuge	-	7.4	-	-	-	Sheet flow into refuge.
Basin 23 ~	54.5	0%	46%	54%	3.13	Refuge						Not on JNU Property. Miller-Honsinger Pond.
Basin 24	40.5	12%	88%	0%	6.24	Refuge	-	1.6	0.7	-	-	Temsco facilities. Sloughs from Miller-Honsinger pond.
Total	**586.6**	**34%**	**47%**	**19%**	**109.53**		**2.4**	**84.6**	**9.3**	**5.4**	**16,025**	
Total by Receiving Waters												
5 Basins	94.2	55%	45%	0%	24.61	Duck Creek	0.5	14.3	1.0	0.0	4050	
8 Basins	118.3	65%	35%	0%	34.06	Jordan Creek	1.9	23.1	6.2	0.0	6625	
4 Basins	188.1	17%	39%	44%	20.94	Float Pond	0.0	23.5	0.0	0.0	0	
7 Basins	186.0	22%	62%	16%	29.92	Refuge	0.0	23.7	2.1	5.4	5350	

* Volume estimated by the Rational Method. Runoff coefficient for impervious = 0.90. Runoff coefficient for pervious = 0.30. 50-year storm event = 5".
+ Ethylene glycol or propylene glycol applied to planes typically.
° Urea applied to taxiway and runways typically.
~ Not on JNU Property.

Fifty-three percent of JNU has been classified as impervious to stormwater infiltration and 47% of the land has been identified as pervious. The total volume of runoff coming from Airport property from a 50-year storm event has been estimated to be 110 acre-feet. Three different Airport-related activities or land uses that could potentially affect water quality have been identified, including 1) de-icing of airplanes, 2) de-icing of the runway and taxiways, including snow storage, and 3) vehicle parking areas.

Two stormwater structural BMPs are present at JNU:

- Oil/water separators in Basins 16, 20, and 24,
- Vegetated drainage ditches, primarily between taxiways/runways.

Duck Creek receives stormwater runoff from five Airport drainage basins totaling 94 acres. Referring to Figure 3-22, these drainage basins include 1, 2, 3, 4, and 5. Fifty-five percent of this area has been identified as impervious and 45% has been identified as pervious. Duck Creek passes directly through the Basins 1, 2, and 3 for approximately 2,500 feet. The de-icing of airplanes occurs on approximately 0.5 acres within Basin 4, and approximately 14 acres of the Duck Creek drainage comes off of the runway/taxiways. Approximately 4,000 linear feet of vegetated drainage ditches are present within these Duck Creek drainage basins.

Jordan Creek receives stormwater runoff from eight Airport drainage basins totaling 118 acres. These drainage basins include 8, 9, 10, 12, 13, 14, 17, and 19. Sixty-five percent of this area has been identified as impervious and 35% has been identified as pervious. Jordan Creek passes directly through Basins 10, 14, 17, and 19 for approximately 3,500 feet. The de-icing of airplanes occurs on approximately 2 acres within Basins 9 and 12. Approximately 23 acres of the Jordan Creek drainage is contributed by runway/taxiways. Approximately 6,600 linear feet of vegetated drainage ditches are present within the Jordan Creek drainage basins. A vegetated swale with a storage volume of approximately 20,000 cubic feet that is located in Basin 17 also provides storm water detention.

The Float Plane Pond receives stormwater runoff from four Airport drainage basins totaling 181 acres. These drainage basins include 6, 7, 11, and 18. Seventeen percent of this area has been identified as impervious, 39% has been identified as pervious, and 44% has been identified as open water. A screened tide gate with a 48-inch storm pipe controls the flow to and from the Mendenhall River. Approximately 24 acres of the Float Plane Pond drainage is contributed by the runway/taxiways.

The Refuge receives stormwater runoff from seven Airport drainage basins totaling 186 acres. These drainage basins include 15, 16, 20, 21, 22, 23, and 24. Twenty-two percent of this area has been identified as impervious, 62% has been identified as pervious, and 16% has been identified as open water. Approximately 24 acres of the Refuge drainage is contributed by the runway/taxiways. Approximately 5,350 linear feet of vegetated drainage ditches are present within the Refuge drainage basins. The Miller-Honsinger pond is in Basin 23 and is on private property, not JNU property. The Miller-Honsinger Slough occupies a portion of Basin 24. The Refuge drainage basin receives additional drainage from the Fred Meyer retail development north of Egan Drive. A vegetated swale with a storage volume of approximately 60,000 cubic feet that is located in Basin 16 also provides storm water detention.

3.6.7.8 WATER QUALITY CONDITIONS

Many natural and human-caused factors have adversely affected water quality upstream of JNU. These factors help establish baseline conditions for waters entering JNU and include the following:

- Regional uplift and isostatic rebound (Hicks and Shofnos 1965 & Hudson et al. 1982, as cited in Neal and Host 1999) with lateral channel confinement (Adamus 1987), increases the potential for channel incision into iron-rich substrata of glaciomarine deposits.
- Iron-rich groundwater inflow leads to a chronic condition of low DO and iron floc production (Jordan Creek, and Duck Creek especially).
- Urban development has reduced wetland areas and wetland functions with roads, parking and development; destabilized stream banks; and increased stormwater pollution from urban sources.
- Periodic low water conditions occur when Duck Creek (frequently) and Jordan Creek (occasionally) streambeds are reportedly dry (Adamus 1987).
- Road crossings disrupt sediment transport.

Based on these factors, it is clear that streams passing through Airport property show signs of impairment prior to entering the property. The primary waterways of interest within and adjacent to Airport property include the lower reaches of the Mendenhall River, Duck Creek, and Jordan Creek.

Lower Mendenhall River. During high tides, the salinity associated with tidal waters from the Gastineau Channel and Fritz Cove increase the concentration of dissolved ions in the lower Mendenhall River. This effect is reflected in the conductance data (which measures dissolved ions and salinity in the water column) from September 19th and September 21st sampling by the study team. On September 19th the specific conductance of the River near the mouth of Duck Creek was approximately 156 microsiemens per centimeter (uS), showing the effect of tide water. On September 21st, approximately one-half mile upstream from the mouth of Duck Creek (near the outfall of the sewage treatment plant), the specific conductance was only 34 uS, depicting more typical fresh water conditions.

Sources of pollutants to the lower Mendenhall River include urban runoff from residential areas and industrial sites adjacent to the river, animal waste, degrading fish carcasses, and probably faulty septic systems as a potential source for nutrients.

Water quality conditions on the Mendenhall River near the Airport could also be affected by discharges from the area's wastewater treatment facility. CBJ operates a wastewater treatment plant that discharges its effluent to the Mendenhall River approximately one-half mile upstream from the Airport. The Mendenhall treatment facility has a capacity of 7.25 million gallons per day (MGD) and uses a sequenced batch reactor treatment technology. Ultraviolet disinfection technology in the plant came on-line in September 2003. The current waste treatment facility is designed for an average daily waste load of 2.25 MGD and a peak waste load of 7.25 MGD. The Mendenhall plant's treatment capability is projected for wastewater flows anticipated through the year 2006, according to the CBJ's Wastewater Utility Division.

The Mendenhall treatment plant discharges its effluent through a 90-foot long, 36-inch diameter diffuser pipe with 6 to 8 diffuser ports to the Mendenhall River, just upstream of the Airport. The current diffuser was installed in March 2001. The 2001 treatment plant permit has allocated a mixing zone within the Mendenhall River of 150 meters upstream and 150 meters downstream of the diffuser pipe and extends 30 meters on either end of the diffuser pipe. This mixing zone roughly parallels the airport boundary along the Mendenhall River for approximately 46 meters (150 feet).

Adamus (1987) reports that in general, nitrate concentrations are relatively low along the Mendenhall River, while phosphorous levels are relatively high. In the vicinity of the wastewater treatment plant, nitrogen, phosphorous, and silica levels tend to peak temporarily. Following the completion of wastewater treatment plant improvements in 1989, excessive nitrate or phosphate levels at the plant's outfall structure have not been a regulatory concern (Hulse pers. comm. 2001). Effluent turbidity should have little effect on the river, since it is commonly less than 5 Nephelometric Turbidity Units (NTUs) and by contrast the ambient turbidity in the Mendenhall River can vary from 25 NTUs in August to more than 180 NTUs in October, as a result of glacial flour held in suspension (Adamus 1987).

The treatment plant is currently modifying its processes in an effort to lower the concentration of dissolved copper in its effluent. Its 2001 permit requires monthly reporting of samples from the Mendenhall River. The treatment plant has changed its disinfectant process from chlorination to ultraviolet (UV) light. It has also modified its diffuser pipe to increase the dilution of the effluent in the mixing zone.

Lower Duck Creek. Duck Creek is listed by ADEC as "water quality impaired," because it fails to meet state standards for DO, residues (debris), metals, fecal coliform, turbidity, and petroleum aromatic hydrocarbons. ADEC has classified Duck Creek as "Tier 2" water quality limited water body. Tier 2 streams have had assessments completed and require TMDLs or Waterbody Recovery Plans. A TMDL was established for turbidity 1999, residues/debris and fecal coliform in 2000, and DO and iron in 2001. General water quality concerns stem from extensive channel modification, urban development, and the inflow of iron-rich ground-water. Based upon rapid declines in their returns, the ADEC has selected coho salmon to be the water quality indicator species for Duck Creek (EPA 1999).

Koski and Lorenz (1999) argue that urban runoff from non-point source pollution and improper land-use management are the two primary causal factors of water quality impairments along Duck Creek. Dissolved iron in the groundwater is also a primary factor in poor water quality. Based on the information presented here and in earlier sections of the report, it is clear that the water quality in lower Duck Creek is currently degraded and in need of improvement.

High tides can affect the entire reach of Duck Creek that passes through Airport property. While conducting fieldwork for this study, the investigators witnessed a complete flow reversal condition on lower Duck Creek where a high tide caused the creek to flow upstream. These tidal influences also have a positive effect on water quality conditions in the lower creek by the regular flushing of water and materials. The confluence of Duck Creek with the Mendenhall River is outside of the regulatory mixing zone for the Mendenhall treatment plant, and no water quality concerns related to the mixing zone are experienced in the creek.

Lower Jordan Creek. ADEC has classified Jordan Creek as "Tier 1" water quality limited water body. Tier 1 streams require water quality assessments to verify the extent of pollution, and what controls are in place or needed. The 1998 Section 303(d) list for Alaska lists Jordan Creek as impaired because of sediment, debris, and DO. Currently, there are no TMDLs established for Jordan Creek. Based upon rapid declines in their returns, the ADEC selected coho salmon to be the indicator species for water quality in Jordan Creek.

Tides have a similar effect on Jordan Creek as they do on Duck Creek. Incoming tides push marine water into lower Jordan Creek, increasing conductance (a measure of dissolved ions and salinity) dramatically. The water in lower Jordan Creek changes from fresh water to brackish water in just a few minutes. These tidal effects cause changes in water chemistry and hydraulic conditions that favor upstream migration of returning salmonids. The study team observed many fish in lower Jordan Creek, presumably coho salmon, moving upstream on the incoming tide.

No substantial changes to water temperature were observed by the study team in Jordan Creek during the tidal changes. The Mendenhall River is believed to have caused the temperature decrease observed on Duck Creek, but the Mendenhall River does not affect Jordan Creek.

3.6.7.9 Airport Groundwater Quality

Limited site-specific data exist on groundwater quality at JNU. Noll (1995) conducted a hydrogeologic study near Duck Creek and concluded that the groundwater quality was affected significantly by tidal conditions. He found that high tides recharged the groundwater with brackish water on a regular basis. He also determined that downcutting of Duck Creek into sand and gravel deposits, including along the JNU property, facilitates direct interaction between ground and surface waters. His sampling of groundwater confirmed the influence of brackish tidal waters on water quality in Duck Creek.

A similar effect would be expected on groundwater in the Jordan Creek part of the Airport. As noted elsewhere in this report, surface water quality in Jordan Creek changes from fresh to brackish water due to tidal influences. These tidal effects would be expected to affect groundwater quality as well.

JNU groundwater quality can also be impacted by activities such as fuel/oil spills and failing septic systems. Alaska Airlines recently completed an investigation of soil and groundwater quality near two facilities where underground storage tanks (USTs) had previously been used and removed (Ecology and Environment, 2002). These facilities at JNU (Air Cargo/Ground Support Equipment Facility and Wings of Alaska Facility) are located in the northern portion of Basin 4, as identified in Figure 3-19.

The investigators collected and evaluated soil and groundwater samples at several locations in the vicinity of the former USTs near the two facilities. The organic compounds evaluated included diesel range organics (DRO), gasoline range organics (GRO), benzene, toluene, and xylenes. Based on their review, the researchers concluded that:

- Soil and groundwater near the Wings of Alaska facility have not been degraded by organic compounds at concentrations exceeding the soil and groundwater alternative cleanup levels proposed in the report.
- Soil and groundwater near the Alaska Airlines ground support facility have been degraded by organic compounds at concentrations exceeding the soil and groundwater alternative cleanup levels proposed in the report.

The researchers also evaluated the groundwater gradient near these facilities and found that the gradient was approximately 0.0025 (ft/ft) towards the southwest (S55°W).

Based on the results of the study, the investigators recommended that additional work be performed to characterize the down gradient and lateral extent of the suspected contaminant plume. No analysis was apparently conducted during the studies to determine whether de-icing or anti-icing compounds have degraded water quality in this area.

3.6.7.10 Airport Operations Affecting Water Quality

The following Airport operations have the potential to affect water quality in the water bodies on or near the JNU:

- Application of de-icing/anti-icing chemicals on aircraft and paved surfaces, where stormwater collection and treatment facilities might not be available or used and pollutants could enter receiving streams as runoff through drainage systems.
- Septic facilities, should they not be maintained properly.
- Stormwater management facilities, where treatment capacity might be inadequate.
- Snow and ice management, where contaminated materials might be placed close to receiving water bodies.
- The event of fuel and/or oil spills, where there might be inadequate attention or delays in remediating problems associated with past spills or leaks.
- Erosion control during construction, where practices might be improper or inadequate.

Application of De-icing/Anti-icing Chemicals: Deficits in dissolved oxygen and other water quality concerns can occur when de-icing chemicals are allowed to drain directly into receiving waters (EPA 1999). At JNU, commercial airlines and private owners (tenants) use de-icing/anti-icing formulas on their aircrafts during winter weather and Airport crews use de-icing chemicals (urea mixtures) on runways and other paved surfaces.

The use of aircraft de-icing fluids (ADFs) is common at airports that experience below freezing winter weather to ensure that ice does not build up on aircraft. De-icing chemicals are applied to runways and taxiways to make them safe for aircraft movement. The fate and transport of ADFs in the environment is a function of the following factors:

- Type of fluid and ingredients.
- Application practices-–amount applied (aircraft size), where applied.
- Chemical recovery and treatment facilities.
- Weather conditions.
- Receiving stream conditions (stage, velocity, tidal influences, etc.).

It is generally difficult to characterize the quality and use of ADFs at an airport. Manufacturers often withhold product information for proprietary protection and the composition of their formulas may change from year to year (EPA 1999). Historical use of ADFs at JNU evolved over time with technological and product improvements, as well as safety regulations. The actual application of ADFs at JNU is variable, depending on the particular winter weather patterns in southeast Alaska during any given year.

The composition of ADFs may be inferred from common ingredients. The primary ingredient for most formulations is usually ethylene glycol or propylene glycol (EPA 1999). Ethylene glycol and propylene glycol are commonly used as bases for commercial ADF products. Based upon information from the Airport's pollution prevention site drawing (CBJ 1999), most tenants at the Airport are currently using ethylene glycol diluted to 50% or less with water for aircraft de-icing. Some tenants are reportedly considering the switch to propylene glycol. Table 3-27 summarizes the amount and type of de-icing chemicals that have been used at JNU over the last 2 years.

Glycols can biodegrade rapidly, but exert a large oxygen demand on the receiving stream (EPA 1999). Biodegradation rates are a function of temperature, available oxygen, and the volume of material released. Glycols have not been found to persist in the environment or to bioaccumulate.

Urea is the de-icing chemical used on the runways and taxiways. Urea is a common nutrient for algae and other water plants as a nitrogen source and is not considered toxic. The biodegradation of urea exerts a slightly greater oxygen demand than the breakdown of glycols. However, urea is generally used in a much smaller concentration than the chemicals used on for de-icing the planes. Excessive urea in receiving waters may accelerate algae blooms, although no such algal blooms have been reported in the vicinity of JNU.

Table 3-27. Application of De-icing/Anti-icing Chemicals at JNU

Year	Urea Application[1] Affected Drainage Basins 4, 5, 6, 9, 10, 11, 12, 17, 18, 19, 20, 21, 22, 24	Glycol Application: Plane De-icing	
		Alaska Airlines[2] Affected Drainage Basins 9, 12	Aero Services[3] Affected Drainage Basin 4
2000-2001	179 tons of Urea	10,000 gallons of Glycol	7,000 gallons of Glycol
	112,000 gallons of urea mixture	20,000 gallons of glycol mixture	11,667 gallons of glycol mixture
2001-2002	268 tons of Urea	25,000 gallons of Glycol	2,500 gallons of Glycol
	168,000 gallons of urea mixture	50,000 gallons of glycol mixture	7,000 gallons of glycol mixture

Source: Ver Haar Personal Communication 2002.
[1] Urea Solution: 13 tons per 8,000 gallons of water, for runway and taxiway de-icing.
[2] Alaska Airlines Glycol Solution: 50% glycol to 50% water.
[3] Aero Services Glycol Solution: 60% glycol to 40% water.

The amount of fluid applied to an aircraft depends in part upon the type of fluid. Up to 4,000 gallons of "Type I" ADF fluid may be applied during the de-icing of a large aircraft. Of that amount, 80% generally runs off the airplane, 15% is dispersed to the air, and only 5% remains on the aircraft (EPA 1999). Other formulas for ADF fluid, known as "Type II" and "Type IV", contain polymers and other additives to improve adherence to the surfaces of the aircraft. Smaller amounts of the Type II and Type IV agents are used relative to Type I.

It is likely that de-icing chemicals get into surface waters and possibly groundwater around the Airport, but the fate and transport of those chemicals has not been well-studied at JNU. De-icing chemicals applied at the terminal are transported to Jordan Creek through vegetated drainage ditches. De-icing chemicals applied in the vicinity of the Aero Services hanger are transported to Duck Creek, also through existing vegetated drainage ditches. Drainage ditches can serve to capture and treat runoff containing de-icing chemicals by adsorption and biodegradation. However, the effectiveness of treatment in the vegetated drainage ditches at JNU is unknown.

Runway and taxiway de-icing chemicals (such as urea solutions) drain in approximately equal amounts to Duck Creek, the Float Plane Pond, Jordan Creek, and to the Refuge at the east end of the runway and taxiway. Snow storage near Duck and Jordan creeks may contribute residual ADFs to receiving waters.

Stormwater Management. The CBJ and their consultant completed a Stormwater Pollution Prevention Plan for JNU in 2001 (Carson Dorn, 2001). They are presently in the process of updating that plan. As required by the Clean Water Act, that plan identifies potential sources of stormwater pollution and develops methods (BMPs) to eliminate or minimize impacts from these discharges. The stormwater discharges from JNU are regulated through the National Pollutant Discharge Elimination System (NPDES) program under the conditions of a Multi-Sector Group Permit.

The stormwater plan identifies 12 major assessment areas based on the industrial activities occurring in these areas: (1) main ramp area, (2) parking lot area, (3) runway and taxiway areas, (4) West ramp area, (5) fuel farm area, (6) FAA automated flight service station area, (7) East ramp, (8) National Guard ramp area, (9) C-2 ramp area, (10) TEMSCO ramp area, (11) Float Plane Pond area, and (12) drainage areas along road system outside of fence.

The stormwater plan reviews the activities that occur in each assessment area, the potential pollutants associated with these activities, and where stormwater runoff from these areas would flow. Possible pollutants would typically include aircraft, automobile, and machine fuels; oils and greases; paints; cleaners; solvents; and ADFs.

The plan identifies the existing stormwater infrastructure, including inlets, pipes, drainage ditches, and major outfalls, and it has graphics showing the location of the major infrastructure components. The plan outlines BMPs to properly control and manage stormwater runoff. One other key element of the plan is to identify a pollution prevention team comprised of individuals who are the most familiar with the facility, including Airport manager and staff.

Finally, the plan reviews the stormwater monitoring needs at JNU based on the NPDES permit requirements. The stormwater plan is available for review at CBJ and JNU offices.

Other Activities and Their Relationship to Water Quality. The CBJ reports that wastewater facilities at JNU are undersized in some areas and do not always meet the demand, especially during summer peak periods (CBJ 1997). Some tenants at the Airport's west end still use septic systems for wastewater disposal.

Snow removal operations at JNU lead to concerns over snow storage, adequate drainage, equipment storage, and the potentially adverse environmental impacts associated with de-icing chemicals application. The primary areas for snow removal include the main runway, two principal taxiways, and sufficient apron to accommodate aircraft operations during snowfall periods. The equipment used for snow removal includes snow blowers, plows, runway brooms, spreaders (dry and liquid), and front loaders (Isbill 1996). Most of the snow is either plowed into the vegetated drainage ditches or plowed off the edges of the runway. However, snow from apron and facility parking areas has also been collected and stored adjacent to both Duck and Jordan creeks.

Fuel spills are a common concern at airport facilities. Isbill (1996) reports that oil-water separators are warranted in the bulk fuel area and the Civil Air Patrol parking lot to reduce the potential for hydrocarbon runoff. Refueling operations at the Float Plane Pond may also provide an additional pathway for spills to enter the environment.

3.6.7.11 JNU Water Resources Summary

The Mendenhall River, Duck Creek, and Jordan Creek are major geographic features at JNU, presenting challenges to Airport operations and natural resource management. The Airport is located where these streams meet the Gastineau Channel. Tide cycles strongly influence the hydraulic and hydrologic character of these streams; backwater effects and saltwater intrusion create dynamic environments for aquatic, wetland, and riparian communities. The geological setting of the Mendenhall Valley contributes natural stressors to water quality. Human urbanization on this complex landscape rarely complements natural stream processes.

The Airport has three culverts along Duck Creek, four culverts along Jordan Creek, and one culvert from the Float Plane Pond to the Mendenhall River. All of these culverts, with the exception of the culvert from the Float Plane Pond, provide fish passage (when tidal conditions allow). High tides reduce the downstream conveyance of surface water and appear to facilitate fish passage.

The Mendenhall River flows through the Refuge adjacent to JNU. The last 500 feet of this reach marks the beginning of a meander bend on the left bank of the river. This bank, formed by the Dike Trail providing access to JNU facilities and to the Refuge, receives the full force of the river during high flows. This meander appears vulnerable to bank cutting and possible oxbow formation.

The study team conducted geomorphology field studies to determine the current pattern, dimension, and profile of the existing Duck Creek and Jordan Creek channels. This work was performed according to standard methods, and findings indicate that the streams are substantially disturbed. The porous substrate underlying JNU, including the alluvium of historic channels of Duck Creek and Jordan Creek, leads to important groundwater/ surface water interactions.

Stormwater runoff from JNU drains directly into Duck Creek, Jordan Creek, the Float Plane Pond, and the Refuge/Miller-Honsinger Slough. Many natural and human-caused factors have adversely affected water quality and habitat conditions upstream of JNU. These factors help establish "baseline conditions" for waters entering JNU and include the following:

- Regional uplift and isostatic rebound increase the potential for channel incision into iron-rich substrata of glaciomarine deposits.
- Iron-rich groundwater inflow leads to a chronic condition of low DO and iron floc production.
- Urban development has reduced wetland areas and wetland functions and contributes stormwater pollutants.
- Periodic low water conditions occur when the streambed is dry.
- Fish passage obstructions exist.
- Road crossings disrupt sediment transport.

Currently, no TMDLs are established for the Mendenhall River. The Mendenhall wastewater treatment plant treats an average daily waste load of approximately 1.8 to 2.0 MGD, and the greatest peak flow has been approximately 6.0 MGD. The Mendenhall Valley Wastewater Treatment Plant's treatment capability is projected for wastewater flows anticipated through the year 2006 according to the CBJ's Wastewater Utility Division.

ADEC lists Duck Creek as a "Tier 2" water quality-limited water body. General water quality concerns stem from extensive channel modification, urban development, and the inflow of iron-rich groundwater. TMDLs have been established for turbidity, fecal coliform, residues/debris, DO, and iron.

ADEC lists Jordan Creek as a "Tier 1" water quality limited water body for sediment, debris, and DO. Currently, no TMDLs have been established for Jordan Creek. As a "Tier 1" stream, however, ADEC acknowledges that pollution problems exist, and that many of the same factors affecting water quality in Duck Creek (as described earlier) may also be affecting water quality in Jordan Creek.

Limited site-specific data exists on groundwater quality at JNU. Noll (1995) conducted a hydrogeologic study near Duck Creek and concluded that the groundwater quality was affected significantly by tidal conditions. He found that high tides recharged the groundwater with brackish water on a regular basis. JNU groundwater quality can be impacted by activities such as fuel/oil spills and failing septic systems. Alaska Airlines is currently in the process of studying groundwater quality near their operations at JNU.

The following Airport operations have the potential to affect water quality in the water bodies on or near JNU:

- Application of de-icing/anti-icing chemicals on aircraft and paved surfaces, where stormwater collection and treatment facilities might not be available or used and pollutants could enter receiving streams as runoff through drainage systems.
- Septic facilities, should they not be maintained properly.
- Stormwater management facilities, where treatment capacity or capability might be inadequate.
- Snow and ice management, should contaminated materials be placed close to receiving water bodies.
- The event of fuel and/or oil spills, including delays in remediating problems associated with past spills or leaks.
- Erosion control during construction, where practices might be inappropriate for the work or inadequate for the scale of the work.

DO deficits and other water quality problems can occur when de-icing chemicals are able to drain directly into receiving waters (EPA 1999). At JNU, commercial airlines and private owners (tenants) use de-icing/anti-icing formulas on their aircrafts during winter weather and Airport crews use de-icing chemicals on runways and other paved surfaces.

The CBJ (1997) reports that wastewater facilities at JNU are undersized in some areas and do not always meet the demand, especially during summer peak periods. A wastewater/sewer line was installed to the west side of the Airport in 2003 to address some of these issues.

Snow removal operations at JNU affect snow storage, adequate drainage, equipment storage, and may cause the build up and/or discharge of runoff containing de-icing fluids and chemicals into surface water. Snow storage near surface waters can provide easy pathways for sediments and ADFs and de-icing chemicals to degrade water quality. Runoff from impervious surfaces used by vehicles pose a water quality concern if there is no treatment prior to off-site discharge.

3.7 VEGETATION

This section of the EIS describes the various plant communities that occur on and around the project area, which consists of the existing JNU property and immediately adjacent areas that have the potential to be directly affected by one of the proposed actions or its alternatives. There are three general vegetation types that grow in the project area: woodland, shrub-scrub, and herbaceous. Within each of these types, there are a number of plant communities or species associations. For instance, much of the herbaceous vegetation is comprised of salt marsh, which has been subdivided into several plant communities by Stone (1993). Stone's community classification, with some minor modifications to reflect local current conditions, provided the basis for mapping and describing plant communities associated with the intertidal zone, the areas just above the intertidal zone (i.e., the "supratidal" zone), and the freshwater wetlands. Stone did not describe woody communities in the area. Consequently, the different plant associations within this vegetation type are based on observations of vegetation at the site. Large portions of the project area are developed or in some manner disturbed. Developed areas have not been mapped but are apparent in the aerial photography of the site. Disturbed areas are generally mapped and include the following: places that have been scraped clear of vegetation; areas with unvegetated or partially vegetated rock fill; and other partially vegetated, weedy, or barren areas that do not qualify as developed land. A number of areas at JNU have been disturbed in the past and since revegetated. These areas are mapped according to their existing plant community type. *Technical Working Paper #4: Biological Resources* (SWCA 2002) provides a more detailed description of the methodology used to map plant communities within the project area and surroundings.

Two levels of vegetation mapping have been completed for this project and are described below. Detailed mapping of individual plant communities was conducted within the project area. To provide additional context and facilitate better understanding of project-related and cumulative impacts, a larger "landscape area" was also identified. For the purposes of this analysis, the landscape area was defined as encompassing JNU, the area just east of JNU known as the Miller-Honsinger property, and the Refuge. Due to the size and vegetative complexity of this area, a coarser level of mapping was conducted for the landscape area in which up to four similar plant communities were grouped.

3.7.1 PROJECT AREA

There are 23 different cover types that have been mapped within the project area, 19 of which represent individual plant communities. Table 3-28 lists each of these communities, as well as four unvegetated cover types: "open water," "unvegetated tidal," "sand," and "disturbed." Table 3-28 also provides information on the absolute (acreage) and relative abundances (percent of area occupied) of each of these cover types within the project area. Common names of plants are used throughout this section. Please refer to Appendix D for a more complete list of plants in the area, their scientific names, and their community associations. In general, the herbaceous communities are listed in the order they are found from low intertidal, to supratidal, and upland. Communities dominated by woody species (shrubs and trees) occur above tidal influence and are listed in general order from early successional, wetter associations to later successional, more upland communities.

Table 3-28. Plant Communities within the JNU Project Area

Plant Community	Acreage	Percent of Project Area
Open Water	86.5	18.8
Unvegetated Tidal	32.5	7.1
Algae Tidal	0.6	.01
Pacific Alkali Grass – Goosetongue	9.9	2.2
Pacific Alkali Grass – Lyngbye Sedge	4.1	0.9
Lyngbye Sedge	19.9	4.3
Beach Rye	27.2	5.9
Coastal Grass Meadow	73.0	15.9
Beach Rye – Beach Pea	0.0	0.0
Sand	0.1	0.0
Coastal Forb Meadow	44.8	9.7
Ditch Grass	4.8	1.0
Fresh Sedge Marsh	1.4	.03
Fresh Grass Marsh	7.5	1.6
Reed Canary Grass	3.5	0.8
Marestail	0.1	0.0
Sphagnum Bog	0.6	0.1
Deciduous Shrub-Scrub	22.6	4.9
Deciduous Forest	3.2	0.7
Mixed Woodland	26.0	5.7
Spruce Forest	13.5	2.9
Lichen – Moss	0.1	0.0
Seeded Grassland	42.0	9.1
Disturbed	35.9	7.8
Totals	**459.8**	**100%**

Descriptions of the above plant communities, including their primary and secondary dominant species and their general location within the analysis area, are provided below. Figure 3-23 shows the distribution and abundance of these cover types within the project area.

3.7.1.1 Open Water

The open water cover type includes the Mendenhall River, Jordan and Duck Creeks, constructed impoundments (e.g., the Float Plane Basin), as well as depressions within the salt marsh that retain water even at low tide, when most tidal channels or sloughs are dry.

3.7.1.2 Unvegetated Tidal

This cover type refers to unvegetated lands associated with the bottoms of estuarine sloughs and flats regularly scoured by tidal action. Substrates can be sandy or silty, and a minor algal vegetation component and/or seaweed may be present along with a sparse coverage of low marsh vegetation such as Pacific alkali grass, goosetongue, and sea milkwort.

3.7.1.3 Algae Tidal

This community type occurs as small, localized patches in some of the estuarine sloughs east and south of the Airport. It comprises mats of green algae (species unknown) located on beds slightly above the surrounding unvegetated tidal areas. The largest and best examples of this community type were found in the estuarine slough just off the east end of the runway.

3.7.1.4 Pacific Alkali Grass – Goosetongue

As the name implies, this plant community is dominated by a combination of Pacific alkali grass and goosetongue. Other primary dominants include sea milkwort and sand spurry. A seaweed, *Fucus* sp., may also occur as a dominant in the lowest reaches of this community. Secondary dominants include: seablite, common silverweed, seaside arrowgrass, low chickweed, scurvy grass, and Gmelin saltweed. Within the analysis area, this community occurs on the lowest vegetated portions of tidal sloughs.

3.7.1.5 Pacific Alkali Grass – Lyngbye Sedge

The primary dominant species in this plant community include Pacific alkali grass, Lyngbye sedge, and seaside arrowgrass. Secondary dominants include many of the same species in the Pacific alkali grass – goosetongue community, such as goosetongue, sea milkwort, sand spurry, low chickweed, scurvy grass, and Gmelin saltweed. This plant community generally occurs just above the Pacific alkali grass – goosetongue community within the low intertidal zone.

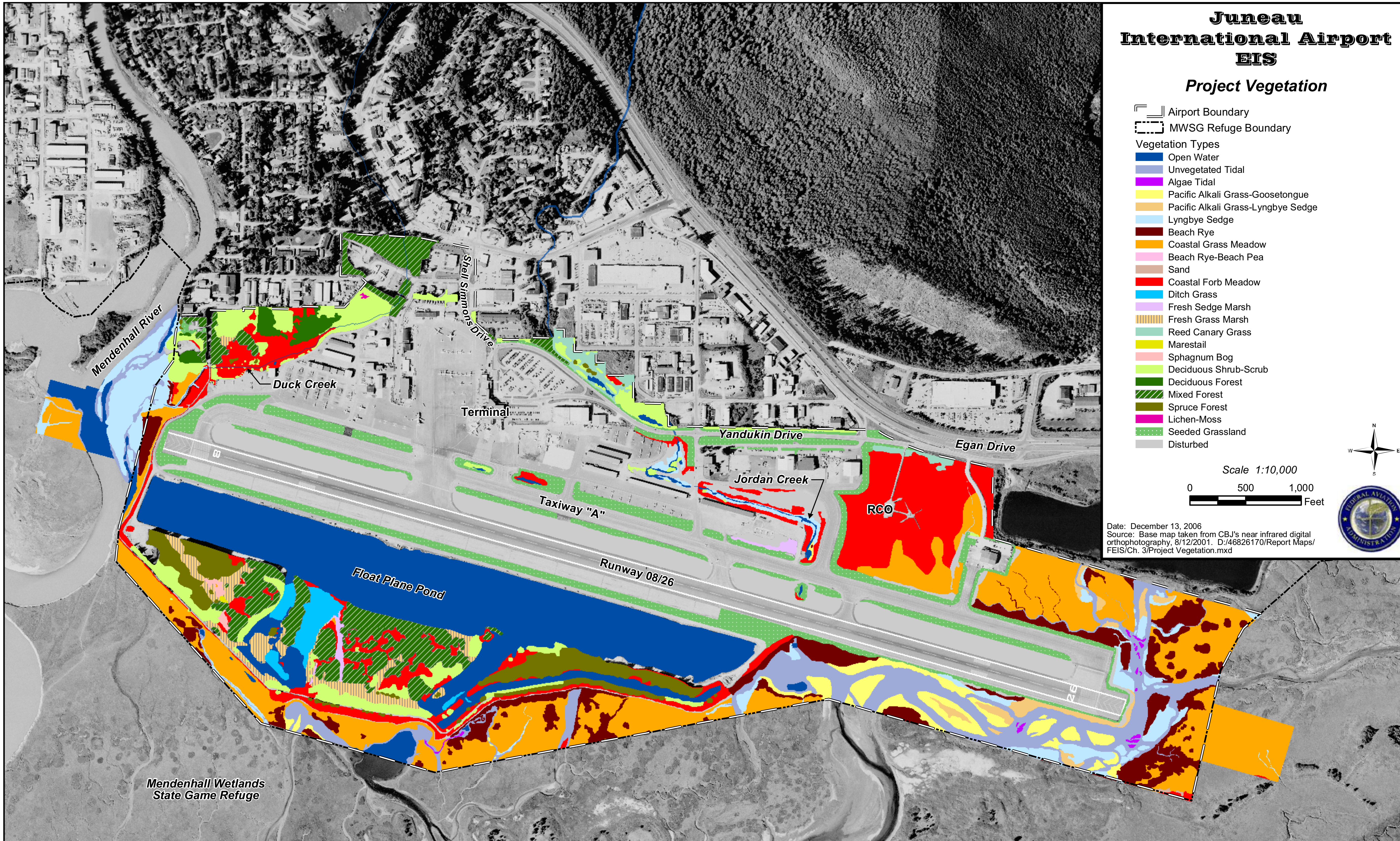


Figure 3-23. Project area vegetation.

THIS PAGE INTENTIONALLY LEFT BLANK

3.7.1.6 Lyngbye Sedge

In addition to Lyngbye sedge, this community may be dominated by common silverweed. Secondary dominants include sea milkwort, seaside arrowgrass, sand spurry, and low chickweed. Within the project area, this species association is typically found on low slough terraces in the mid-intertidal zone. A large, nearly monocultural stand of Lyngbye sedge is located just outside of the northwest portion of Airport property where Duck Creek enters the Mendenhall River. The upper boundary of this community type represents the break between the low and high marsh communities discussed in Section 3.7.2.

3.7.1.7 Beach Rye

This community is typically dominated by its namesake, beach rye. Common silverweed is often found as a dominant groundcover in this community, under the canopy of rye grass. Stone (1993) lists seabeach sandwort or beach greens as another primary dominant within this community type. However, SWCA found the distribution of beach greens to be much more limited than beach rye within the analysis area. This community is most prevalent on the upper banks of slough channels (immediately above the Lyngbye sedge community), sandy substrates on the periphery of dredge spoil islands, within vegetated channels at the uppermost extent of tidal influence, and as patches within the coastal grass meadow community.

3.7.1.8 Coastal Grass Meadow

Primary dominants within the coastal grass meadow community include the following grasses: foxtail barley, red fescue, tufted hairgrass, and meadow barley. This community occupies large areas in the upper limits of tidal influence (generally inundated only during peak tides).

3.7.1.9 Beach Rye – Beach Pea

As the name implies, this community is comprised primarily of beach rye and beach pea. Although Stone (1993) lists seabeach sandwort and sea bluebells as other primary co-dominants, the presence of these species within the analysis area appears to be very limited. This community occurs on the lower slopes around the periphery of some of the dredge islands and in isolated patches surrounded by coastal grass meadow.

3.7.1.10 Sand

This unvegetated cover type occurs on the slopes of dredge spoil islands and other areas that remain devoid of vegetation due to wave action and other factors. This type differs from the unvegetated tidal map unit in that it is not directly associated with tide channels and is often surrounded by high marsh community types.

3.7.1.11 Coastal Forb Meadow

Coastal forb meadow is probably the most botanically diverse of the plant communities within the project area. Primary dominant species include beach rye, beach pea, red fescue, yarrow, Nootka lupine, cow parsnip, sea-watch and kneeling angelica, beach lovage, hemlock parsley, Indian paintbrush, fireweed, and chocolate lily. Secondary dominants include tufted hairgrass, cleavers, and nagoonberry. The coastal forb meadow community is common along and above the upper marsh border, just above the coastal grass meadow community. It is also prevalent on fill slopes and in the herbaceous uplands within the Float Pond Woodland. In general, coastal forb meadow is a supratidal community, i.e., it occurs above tidal influence. An exception to this rule is in the lower Duck Creek area where coastal forb meadow has become established and persists in an area that becomes inundated during extreme high tides (19-20 feet). Given that many of the plant species associated with the coastal forb community are intolerant of salt water, it is likely that extreme high tides cause the lower Duck Creek area to be flooded by predominantly freshwater that gets backed up from the Mendenhall River and Duck Creek.

3.7.1.12 Ditch Grass

Ditch grass is an aquatic plant that occurs in the sloughs adjoining the south side of the Float Plane Basin. Although this is actually a subtype of the open water map unit, because of the importance of ditch grass to waterfowl, areas containing a preponderance of this species have been mapped as a separate cover type. It should be noted that this cover type was only mapped where it occurs in shallow water and is apparent on the aerial photography. Because ditch grass can occur in water over 14-feet deep (USGS 2003), it may be present in other areas of the Float Plane Basin in waters too deep to be detected via aerial photography. Thus, the acreages shown for this community in the project and landscape areas (Table 3-28 and 3-29, respectively) should be considered the minimum amount present.

3.7.1.13 Fresh Sedge Marsh

Stone (1993) identifies fresh sedge marsh as being dominated by Lyngbye sedge and common silverweed. Secondary dominants include tufted hairgrass, cleavers, Pacific water-parsley, northern grass-of-Parnassus, yellow marsh-marigold, marsh cinquefoil, Douglas' water-hemlock, and arctic daisy. Previous work within the project area has also identified Sitka sedge as a component of this community type. Fresh sedge marsh is limited to a few small patches within the Float Pond Woodland.

3.7.1.14 Fresh Grass Marsh

Fresh grass marsh is dominated by grass species, including bluejoint reedgrass, spike bentgrass, and beach rye. Sedges are a secondary component of this community. It typically occurs below the coastal forb community in non-tidally influenced areas. This habitat community is most prevalent within the Float Pond Woodland wetland complex.

Table 3-29. Landscape Area Vegetation Cover Types, Acreages, and Relative Cover

Landscape Area Cover Type	Included Cover Type(s)	Landscape Area Acreage	Percent Relative Cover
Open Water	Open Water	1,691.9	37.8
Unvegetated	Unvegetated Tidal; Sand; Algae Tidal	776.4	17.3
Low Marsh	Pacific Alkali Grass-Goosetongue; Pacific Alkali Grass-Lyngbye Sedge; Lyngbye Sedge	665.4	14.8
High Marsh	Beach Rye; Coastal Grass Meadow	962.6	21.5
Supratidal	Beach Rye-Beach Pea; Coastal Forb Meadow, Reed Canary Grass, Lichen-Moss	160.5	3.6
Ditch Grass	Ditch Grass	4.8	0.1
Freshwater Marsh	Fresh Sedge Marsh; Fresh Grass Marsh	13.2	0.3
Marestail	Marestail	0.1	0.0
Sphagnum Bog	Sphagnum Bog	0.6	0.0
Shrub-Scrub	Deciduous Shrub-Scrub	34.3	0.8
Forest	Deciduous Forest; Mixed Woodland; Spruce Forest	90.6	2.0
Seeded Grassland	Seeded Grassland	44.4	1.0
Disturbed	Disturbed	37.0	0.8
Totals		**4,481.7**	**100%**

3.7.1.15 Reed Canary Grass

Reed canary grass, an invasive species that may or may not be native to the Juneau area (Pojar and MacKinnon 1994), appears to thrive in areas disturbed by human activity. Reed canary grass is an invasive grass that often occurs in single-species patches. The reed canary grass cover type is prevalent in the northernmost section of the northeast Airport area, and along Jordan Creek north of Yandukin Drive. It also occurs in the northwest Airport area in a narrow band along Duck Creek upstream of the coastal forb community. While reed canary grass is considered an obligate wetland species in Alaska, wetland surveys of the project area indicate that the mono-cultural stands of this species in the Jordan Creek area north of Yandukin Drive occur in uplands.

3.7.1.16 Marestail

The marestail community consists of single-species stands of marestail. The community occurs in small, localized patches within the lowest, wettest portions of the Float Pond Woodland wetland complex. It typically occurs as an emergent in shallow pools of standing water. With the exception of the lichen – moss community, this is the least common plant community within the project area.

3.7.1.17 Sphagnum Bog

The sphagnum bog community occurs only in the Float Pond Woodland in an area that had been an open, freshwater pond as recently as 1984. In addition to sphagnum, this community is characterized by marsh cinquefoil and white water-buttercup.

3.7.1.18 Deciduous Shrub-Scrub

The deciduous shrub-scrub community is dominated by a combination of Barclay and Sitka willow and Sitka alder. Secondary species include goat's beard, and scattered saplings of black cottonwood and Sitka spruce may also be present where this association occurs as an intermediate community in transition to deciduous or mixed woodland.

3.7.1.19 Deciduous Forest

Within this project area, the deciduous forest community occurs in the northwest Airport area and consists of 50-foot tall black cottonwoods with an understory of mountain ash and fern interspersed with Sitka and/or Barclay's willows and Sitka alder. Typical herbaceous species range from forbs such as fireweed, cow parsnip, and angelicas, to bluejoint reedgrass.

3.7.1.20 Mixed Woodland

In general, the term "woodland" refers to tree-dominated community types in which the trees are spaced far enough apart that they do not create a continuous "forest" canopy. Because of the open canopy, woodland types typically have well-developed shrub/sapling or herbaceous groundcover layers or both. Mixed woodland is a transitional community between deciduous forest and spruce forest. It is typically dominated by cottonwood and Sitka spruce. Willows and alders may or may not be present in the understory.

3.7.1.21 Spruce Forest

The spruce forest community is dominated by an overstory of Sitka spruce. Groundcover varies from bare soil, leaf litter or "duff," to mosses and lady fern. Due to the deep shade created by spruce trees, there is typically little understory or groundcover in dense stands of this species.

3.7.1.22 Lichen-Moss

This community occurs in only one small location north of Duck Creek in the Northwest Development Area of the Airport. It occurs on excessively drained, coarse sandy substrates and is dominated by a combination of moss and lichen species, including *Stereocaulon* and *Rhacomitrium* species. A variety of woody species, including willows, alders, black cottonwood, and spruce, typically occur on the periphery of this community type. While the lichen-moss community is rare within the project area, it is quite typical of the tops of the dredge spoil islands within the landscape area (see below).

3.7.1.23 Seeded Grassland

This is a human-created plant community consisting of a variety of manually seeded grasses. This community occurs along runways, taxiways, infields, roads, and other revegetated areas within the project area.

3.7.1.24 Disturbed

As described above, this cover type is a catch-all for areas disturbed or otherwise influenced by human activities that are not technically "developed" and do not represent any of the natural community types described above. In addition, this cover type includes two small areas on the east side of the TEMSCO taxiway and building pad where drift wood has accumulated.

3.7.2 Landscape Area

As discussed above, the landscape area consists of the project area combined with the Miller-Honsinger property and the Refuge. Within the landscape area, the above community types have been variously combined into the following, more general vegetation cover types: unvegetated, low marsh, high marsh, supratidal, lichen-moss, and woodland. Table 3-29 summarizes the relationship between the project area cover types and the more general landscape types along with the acreages and relative cover of these map units within the landscape area. Not all of the communities identified in the project area have additional occurrences outside of the project area. For instance, within the landscape area, the ditch grass, marestail, and sphagnum bog communities have only been mapped within the project area. Thus, the landscape area acreages for those plant communities are identical to those reported for the project area. Figure 3-24 depicts the boundaries of the landscape area and the distribution and abundance of these cover types within it.

3.7.3 Regional Area

Summarizing the relative acreages of the landscape area vegetation types across a regional area would help to provide a larger context for assessing direct, indirect, and cumulative impacts associated with the actions considered in this EIS. Unfortunately, there are no suitable synoptic data sources (such as those available for some states through the U.S. Geological Survey Gap Analysis Program) that would allow development of such a context at this time.

3.7.4 THREATENED AND ENDANGERED PLANTS

No federal or state listed threatened and endangered plants are known to occur in the project or landscape areas. There is the potential for several of the listed Alaska Natural Heritage Program rare plant species and Tongass National Forest sensitive plant species to occur based on these species having been documented in the Juneau area in the past and the similarity of their habitat requirements to that of the project area. However, the agencies have no record of their occurrence within the project or landscape areas and none were identified during field studies in support of the EIS. These species are listed in Table 3-30 along with their ranking within the state of Alaska. State ranking definitions are located in Appendix D.

Table 3-30. Alaska State Rare and USFS Sensitive Plant Species Potentially Occurring within the Project or Landscape Area

Common Name	Scientific Name	Global/State Rank
Western paper birch	*Betula papyrifera* var. *commutata*	G5T5/S2
Bebb's sedge	*Carex bebbii*	G5/S1
Goose-grass sedge	*Carex lenticularis* var. *dolia**	G5T3Q/S3
Black hawthorn	*Crataegus douglasii* var. *douglasii*	G5T4S1/S2
Alaskan pretty shooting-star	*Dodecatheon pulchellum* ssp. *alaskanum*	G5T2T4Q/S2
Northern wild-licorice	*Gallium kamtschaticum*	G5/S2
Broadlip listera	*Listera convallarioides*	G5/S1
Bog adder's mouth	*Malaxis paludosa*	G4/S2S3
Bigtooth lousewort	*Pedicularis macrodonta*	G4Q/S3
Choriso bog-orchid	*Platanthera chorisiana*	G3/S3
Western yellowcress	*Rorippa curvisiliqua*	G5/S1
Selkirk violet	*Viola selkirkii*	G5?/S3

[1] Alaska Natural Heritage Program Rare Species List (AKNHP 2002); Tongass National Forest Sensitive Species List.
[2] See Appendix B for ranking definitions.

3.8 WETLANDS

This section of the EIS describes wetland resources within the project area and its surroundings as delineated in the summer of 2001. Wetlands are among the most productive ecosystems on Earth and include bogs, freshwater marshes, prairie potholes, forested swamps, and saltwater estuaries. Wetlands provide critical nesting, rearing, feeding, and stop-over habitat for birds and other wildlife populations and are essential to estuary, river, and watershed health, trapping sediments and cleaning polluted waters, preventing floods, recharging groundwater aquifers, and protecting

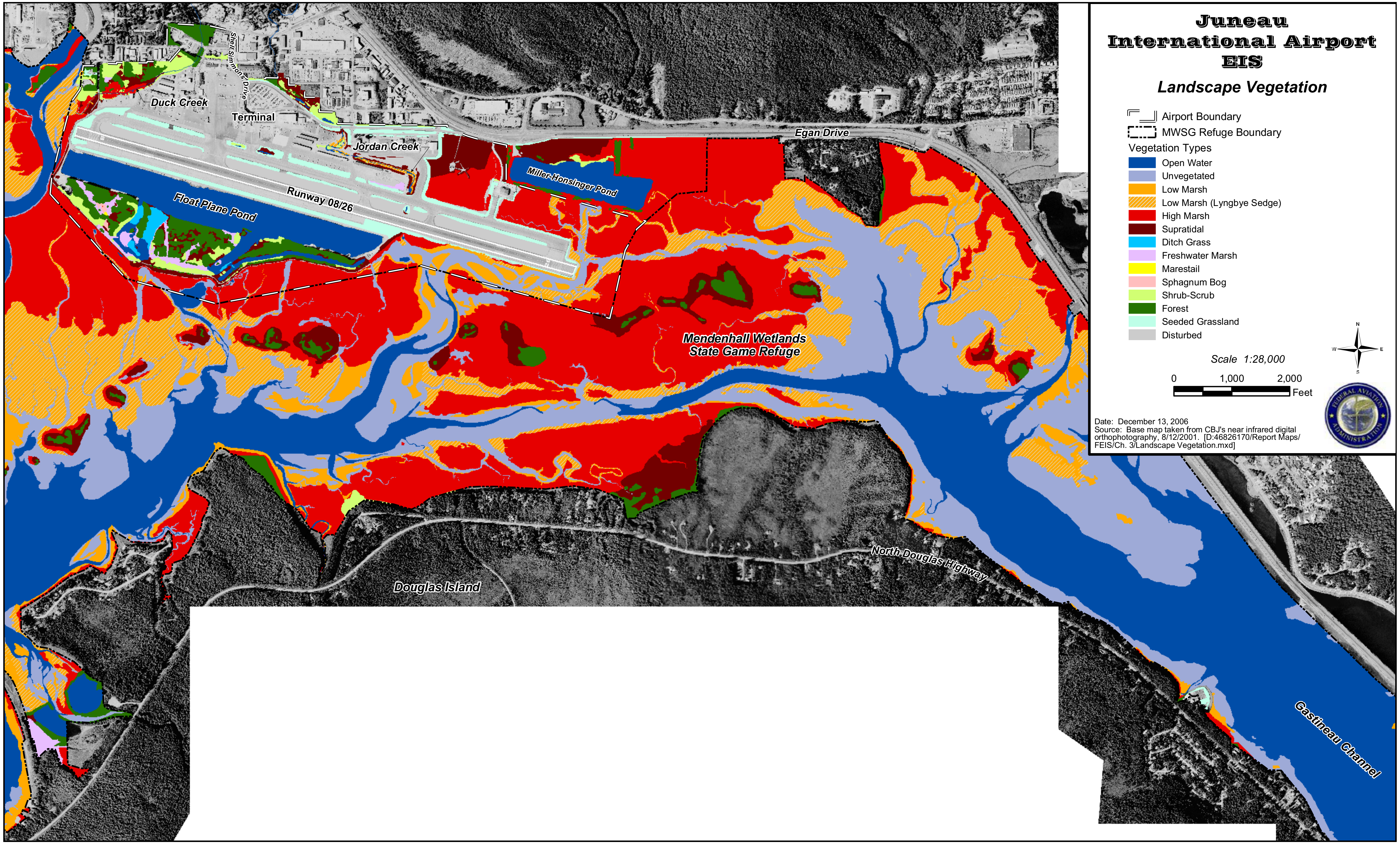


Figure 3-24. Landscape area vegetation.

THIS PAGE INTENTIONALLY LEFT BLANK

shorelines. The following sections describe the regional and local physiography relevant to wetlands, the functions and values of wetlands in the area, and finally, a description of the specific wetland types present in the project area.

For the purpose of this analysis, wetland resources include both wetlands, as defined below, and perennial and seasonal streams. This is because wetlands and streams are often hydrologically interrelated, and because the Corps has jurisdiction under the Clean Water Act to regulate activities within waters of the U.S., which include wetlands. The actions and alternatives being considered for implementation at JNU thus have potential to affect resources that are regulated by law. The overall regulatory framework and permit requirements related to activities potentially affecting wetlands and waters of the U.S. was described earlier in Chapter 1 (see Section 1.6.2.1 and Table 1-8).

Under the Clean Water Act, wetlands are defined as:

> Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas [Environmental Laboratory 1987, p. 9]

Wetland boundaries in the Northwest Development Area, the Float Pond Woodland, and the Northeast Development Area were determined using the methodology described in the Corps' 1987 Wetland Delineation Manual (Environmental Laboratory 1987). Wetlands in the Eastern RSA, Western RSA and Jordan Creek were mapped using infrared aerial photography, vegetation ground control points, and visual ground truthing.

The delineation of wetlands for the JNU project area was conducted primarily in August and September of 2001. Follow-up work was conducted in July of 2002 during a Corps field review of the Airport wetland delineation. All waters of the U.S. contained in the JNU project area fall within Corps of Engineers regulatory jurisdiction. A wetland delineation report (SWCA 2002) has been prepared for the project and provides a detailed explanation on how wetlands were delineated and why the wetland boundaries presented in this document and others are correct. This study was reviewed by the Corps and made available for review to the other cooperating agencies including NMFS, ADF&G, and USFWS. The Corps provided comment on a first draft of the report. The second and final draft of the delineation report, revised to address comments by the Corps and others, is available for public review at the Juneau and Mendenhall public libraries.

3.8.1 Wetland Functions and Values

As part of the delineation effort, wetland functions and values were evaluated within the EIS project area. They were assessed using a modified version of the Adamus wetland evaluation technique (WET) that was originally developed for the City and Borough of Juneau in 1987 (Adamus 1987). Based on agency input, the Adamus approach was adapted to better match the conditions of the EIS project area, particularly estuarine wetlands that were not the primary focus of the original Juneau WET. Adaptations were made in full collaboration with representatives of the Corps, EPA, USFWS, NMFS, and ADF&G, based on accepted wetland evaluation techniques and professional judgment of the involved parties. The wetland functional assessment provides a means of evaluating potential impacts to wetlands and identifying mitigation measures that could be used to preserve, restore, or enhance wetland functions.

A detailed description of the various functions and values of wetlands in and around Juneau is provided in Adamus (1987) and, as they apply to this analysis, in the wetlands section of Technical Working Paper 4 – Biological Resources (SWCA 2002). This section provides a summary description of wetland functions and values as per Adamus (1987). A brief explanation of each function is accompanied by a description of its importance to other natural resources and/or human society. A quantitative functional rating system is presented that is to compare potential project impacts in Chapter 4. Appendix E includes a sample data sheet used to rate wetland function. The functional ratings for wetlands within the project area are provided in Section 3.8.2.

3.8.1.1 Groundwater Recharge and Discharge

Groundwater recharge is the net downward flow of surface water into an underlying aquifer, a process important to water filtration and cleansing, and to re-supply aquifers. Recharge wetlands are often hydrologically linked with other wetlands such that their disturbance can have far-ranging, indirect impacts to other associated wetlands.

3.8.1.2 Surface Hydrologic Control

Surface hydrologic control refers to the capacity of wetlands to reduce the magnitude of peak flows and associated floods, delay the release of water to downslope/downstream areas following storms, sustain stream flows during dry seasons by producing a steady outflow, and reduce bank erosion and channel scour. Accordingly, the hydrologic control function is important in minimizing flood damage and maintaining proper drainage in developed areas, maintaining aquatic habitats and fisheries during periods of low surface flows, and maintaining the balance between freshwater and saltwater and their associated plant communities in estuarine zones.

3.8.1.3 Sediment/Toxicant Retention

Sediment and toxicant retention refers to the ability of wetlands to remove inorganic sediments from aqueous suspension and/or toxic metals and organic compounds from solution. This function is usually prevalent in flat, vegetated areas. The location of wetlands downstream of potential sediment and toxicant sources is also an indicator of their value for this function (USACE 2000; Adamus 1987). This function may benefit downstream water quality at the expense of habitat quality in wetlands where the sediment or toxicant is accumulating. Sediment retention has economic value in that it can help prevent or reduce the frequency of dredging to maintain navigable waterways in certain areas (Adamus 1987).

3.8.1.4 Nutrient Transformation/Export

This function refers to a wetland's capacity for transforming and/or exporting organic forms of nitrogen and phosphorous. In many environments, the removal or retention of these nutrients is important to maintaining water quality in downstream areas. Wetlands are also capable of transforming these nutrients into forms more available to aquatic and marine food webs. The value of the nutrient transformation/export function to other natural resources or the human environment therefore varies and can be a benefit under some conditions (e.g., reduced water treatment effort) and locations and a liability in others.

3.8.1.5 Riparian Support

Wetlands, regardless of whether they themselves are important fish habitats, may have a critical influence on aquatic habitat quality in adjacent streams, downstream areas and estuaries. The riparian support function refers to the positive influence wetlands may have on regulating stream temperatures and exporting decaying plant material which provides nutrients to aquatic and estuarine habitats.

3.8.1.6 Fish Habitat

The fish habitat function refers to the existing suitability of a wetland to produce any of the local salmonid and marine fishes, including coho, pink, chum, and sockeye salmon; cutthroat and steelhead trout; Dolly Varden char, eulachon, and herring. Juneau's salmon fisheries are a key component of the area's economy with respect to commercial and sport fisheries and tourism. Estuarine and riparian wetlands provide important breeding, rearing, and foraging habitat for fishes and their prey. For more detailed information on fisheries in and adjacent to the project area, refer to Section 3.9.

3.8.1.7 Wildlife

This function refers to the extent to which a given wetland supports wildlife species. Thus, wetlands that rate high for this function are those in which the most wildlife are likely to occur. Salt marsh is a key staging and foraging area for migratory birds, shorebirds, waterfowl, raptors, and passerines. Waterbird species are the number one indicator of high wildlife value. Gulls, corvids, and songbirds, although important, are not themselves indicators of high function for the purposes of this analysis. Resources used for wildlife function determination include Bird Use of the Mendenhall Wetlands in Juneau, Alaska (Cain et al. 1988), the Wildlife Hazard Assessment for the Juneau International Airport (USDA 2001) and field surveys conducted for this EIS (Carstensen and Armstrong 2002).

3.8.1.8 Regional Ecological Diversity

In general, "regional ecological diversity" refers to the number of species (flora and fauna) native to a given region. With respect to function, wetlands that support rare species contribute more to regional ecological diversity than wetlands with a high number of relatively common or widespread species. Thus, the rating criteria for this function depend on the frequency of occurrence of various uncommon bird species in a given wetland, and whether or not the wetland contains the types of habitat with which these species are typically associated.

3.8.1.9 Erosion Sensitivity

Erosion sensitivity refers to a wetland's capacity to stabilize soils and sediments as a function of its vegetative cover, slope and soil type, and probable groundwater situation. While erosion is a natural process, this function refers to the potential for accelerated erosion resulting from human activity in or adjacent to wetlands.

3.8.1.10 Ecological Replacement Cost

Ecological replacement cost refers to the cost of restoring or recreating the ecological characteristics of a given wetland, should it be developed or disturbed. Older (i.e., later successional) plant communities such as forested wetlands and peat bogs are usually more difficult to replace than younger (i.e., early successional) communities. Thus, these wetlands rank high in terms of ecological replacement costs, whereas ponds, emergent, and scrub-shrub wetlands are more easily recreated, and rate low for this function.

3.8.1.11 Recreational Use

Because Adamus (1987) evaluated the recreational use of wetlands through administration of a public survey, this function was not evaluated for EIS project area wetlands in the field. Recreational values of sites within and around the Airport are instead described in Section 3.2.5.

3.8.1.12 Downslope Beneficiary Sites

This wetland function is based on the ecological services that wetlands provide to downslope or downstream sites in terms of reducing peak flows and thereby providing flood protection. Thus, wetlands that are geographically situated higher in the watershed are more likely to generate these cost-saving services and are assigned a higher rating for this function. Because the wetlands surrounding JNU are situated downslope of urban development they rate low for this function.

3.8.2 Project Area Wetland Resources

For ease of description, the overall project area was divided into seven wetland analysis areas:

- Jordan Creek
- Northeast Development Area
- Eastern Runway Safety Area (RSA)
- Otter Pond Area (south of the Float Pond Woodland)
- Float Pond Woodland

- Western Runway Safety Area (RSA)
- Northwest Development Area (Duck Creek)

Figure 3-25 shows the location of these analysis areas within the overall project area.

Wetland classification and boundary designations in the Northwest Development Area, the Float Pond Woodland, and the Northeast Development Area were determined based on standard Corps methods described in the Wetland Delineation Manual (Environmental Laboratory 1987). Wetlands in the Eastern RSA, Western RSA and Jordan Creek were mapped using infrared aerial photography, vegetation ground control points, and visual ground truthing.

Wetlands were assigned National Wetland Inventory (NWI) mapping codes based on the Cowardin classification system (Cowardin et al. 1979). Four wetland systems occur within or adjacent to the JNU property: palustrine, estuarine, lacustrine, and riverine. Each of these systems is divided into several subsystems that are further divided into classes. SWCA classified delineated wetlands within the study area to nine different wetland classes. These include the following:

PEM1 Palustrine emergent marsh wetlands with persistent vegetation structure throughout the year.

PSS1 Palustrine scrub-shrub wetlands with broad-leafed, deciduous, woody vegetation less than six meters (20 feet) tall. The species include true shrubs, young trees (saplings), and trees or shrubs that are small or stunted because of environmental conditions (e.g., shrubby willows, alder, dogwood, etc.).

PAB3 Palustrine aquatic bed wetlands with unconsolidated sandy bottoms. Aquatic bed wetlands have standing water year-round and support floating vascular plants.

PUB4 Palustrine organic unconsolidated bed wetlands. Species include *Sphagnum* mosses that form peat in peat bogs. Vascular plant species may be perched on the topmost layers of moss.

L1UBH Littoral lacustrine wetlands with an unconsolidated bed. Wetlands are clear of vegetation due to water depth. This wetland type is limited to the Float Plane Pond.

E1UB3 Subtidal estuarine wetlands with unconsolidated muddy bottoms. These wetlands were identified with aerial photography.

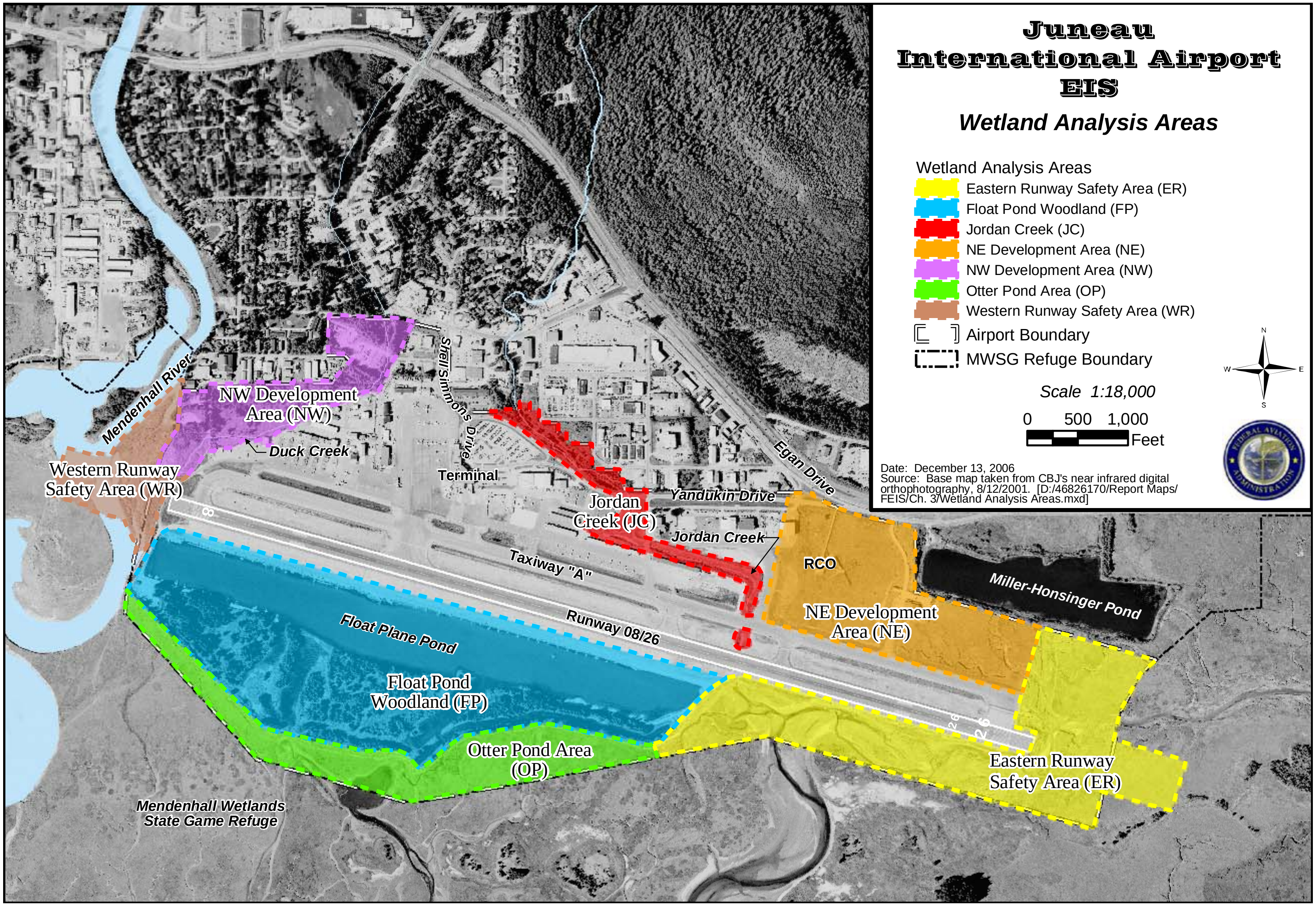


Figure 3-25. Wetland analysis areas.

E2EM1 Intertidal estuarine emergent wetlands with persistent vegetation structure (H/L) throughout the year. These wetlands were split into high marsh and low marsh since the fish habitat function is greater in the low marsh.

E2USN Intertidal estuarine wetlands with regularly flooded unconsolidated shores; these are typically unvegetated.

R3UB2 These are wetlands associated with streams characterized by a high gradient, fast water velocity, and flow throughout the year. The substrate consists of rock, cobbles, or gravel with occasional patches of sand. There is very little floodplain development

These wetland types were mapped across the project area, illustrated on Figures 3-26 through 3-29. Existing wetland condition, classification, and critical wetland functions were then described for each of the seven wetland analysis areas. Wetland functions and values were evaluated using the Adamus (1987) approach modified with input from the *Southeast Alaska Freshwater Wetland Assessment* (USACE 2000)**,** and resource specialists from the cooperating agencies. The acreage and functional ratings for each of these wetlands is summarized in Tables 3-28 through 3-34. The alphanumeric wetland designations in Figures 3-26 through 3-29 correspond to the NWI code listed in Tables 3-31 through 3-37. For example, in Figure 3-23, the area of wetlands labeled "NE1" has been identified as wetlands type PEM1 (palustrine emergent marsh). Table 3-32 also shows this correlation along with the functional ratings of the wetlands found in area NE1. The other wetland areas have similar reference keys and summary tables.

3.8.2.1 JORDAN CREEK

The Jordan Creek area within the Airport boundary extends from the Aspen Hotel to the north side of the runway. The creek flows through culverts beneath Taxiway A and Runway 26 into the Dredge Channel and out to the Gastineau Channel. The Jordan Creek area within the Airport boundary encompasses 5.96 acres of wetlands (Table 3-31). This total includes wetlands located between Airport buildings and the taxiway (Figure 3-26).

Table 3-31. Jordan Creek Wetland Acreages and Functional Ratings

	Wetland ID[1]	JC1	JC2	JC3	JC4	JC5
	NWI Code	R3UB2	PEM1	PSS1	E2EM1 (H/L)	E2USN
	Adamus Wetland ID	M5, M7	M5, M7	M5, M7	M5	M5
	Acreage	0.4	0.8	1.8	0.3/1.8	0.8
Functional Ratings	Groundwater Recharge	L	L	L	L	L
	Groundwater Discharge & Lateral Flow	MH	MH	MH	MH	MH
	Surface Hydrologic Control	ML	H	ML	L	L
	Sediment/ Toxicant Retention	L	H	MH	MH	MH
	Nutrient Transform. & Export	H	M	M	M	H
	Riparian Support	H	MH	MH	H	MH
	Fish Habitat	VH	ML	ML	H/VH	VH
	Wildlife	H	L	H	H	H
	Regional Ecological Diversity	H	L	MH	H	H
	Erosion Sensitivity	ML	L	L	L	ML
	Ecological Replacement Cost	H	L	L	H	L
	Downstream Beneficiary Sites	L	L	L	L	L

[1] No sample points were taken for any wetland acreages.
Key to Functional Ratings: VH = Very High; H = High; MH = Moderate-High; M = Moderate; ML = Moderate-Low; L = Low.

3.8.2.2 Northeast Development Area

The Northeast Development Area extends off the northeastern side of the runway and encompasses 39.2 acres of wetlands (Figure 3-26). Three wetland classes were delineated in the this area, including: palustrine emergent marsh wetlands with persistent vegetation structure throughout the year (PEM1), intertidal estuarine emergent wetlands with persistent vegetation structure throughout the year (E2EM1), and intertidal unconsolidated shore estuarine wetlands (E2USN). Acreage of each wetland type is summarized in Table 3-32.

Figure 3-26. NE development area and Jordan Creek wetlands.

THIS PAGE INTENTIONALLY LEFT BLANK

Table 3-32. Northeast Development Area Wetland Acreages and Functional Ratings

Wetland ID[1] (Sample Points)		**NE1** (1, 2, 3, 4, 5, 6, 13, 14, 33)	**NE2** (12, 19, 20, 21, 22, 23, 24, 25, 26, 27, 34, 35, 36)	**NE3** (37)
NWI Code		PEM1	E2EM1(H/L)	E2USN
Adamus Wetland		ES15	ES15	ES11
Acreage		5.3	31.6/1.1	1.2
Functional Ratings	Groundwater Recharge	L	L	L
	Groundwater Discharge & Lateral Flow	L	MH	MH
	Surface Hydrologic Control	H	L	L
	Sediment/ Toxicant Retention	H	MH	MH
	Nutrient Transformation and Export	L	M	H
	Riparian Support	L	H	MH
	Fish Habitat	VL	H/VH	VH
	Wildlife	MH	H	H
	Regional Ecological Diversity	H	MH	H
	Erosion Sensitivity	L	L	ML
	Ecological Replacement Cost	L	H	H
	Downstream Beneficiary Sites	L	L	L

[1] No sample points were taken for any wetland acreages.
Key to Functional ratings: VH = Very High; H = High; MH = Moderate-High; M = Moderate; ML = Moderate-Low; L = Low

3.8.2.3 Eastern Runway Safety Area

The eastern RSA abuts the east side of the Northeast Development Area and contains similar wetland habitat (Figure 3-27). The eastern RSA encompasses 85.9 acres of undeveloped land and consists of a mosaic of intertidal vegetated and unvegetated estuarine wetlands. Wetland classes include intertidal estuarine emergent wetlands with persistent vegetation structure throughout the year (E2EM1) and unvegetated tidal sloughs comprising intertidal unconsolidated shore estuarine wetlands (E2USN). Acreages of each wetland type are summarized in Table 3-33.

Table 3-33. Eastern RSA Wetland Acreages and Functional Ratings

Wetland ID[1]		ER1	ER2
NWI Code		E2EM1 (H/L)	E2USN
Adamus Wetland		ES11, ES14	ES11, ES14
Acreage		38.8/21.2	25.9
Functional Ratings	Groundwater Recharge	L	L
	Groundwater Discharge & Lateral Flow	MH	MH
	Surface Hydrologic Control	L	L
	Sediment/Toxicant Retention	MH	MH
	Nutrient Transformation and Export	M	H
	Riparian Support	H	MH
	Fish Habitat	H/VH	VH
	Wildlife	VH	VH
	Regional Ecological Diversity	H	H
	Erosion Sensitivity	L	ML
	Ecological Replacement Cost	H	H
	Downstream Beneficiary Sites	L	L

[1] No sample points were taken for any wetland acreages.
Key to Functional ratings: VH = Very High; H = High; MH = Moderate-High; M = Moderate; ML = Moderate-Low; L = Low.

3.8.2.4 OTTER POND AREA

The Otter Pond Area is directly connected to the Refuge and is separate from the Float Pond Woodland wetlands due to differences in hydrology imposed by the dike that surrounds the Float Plane Basin and woodland (Figure 3-28). The Otter Pond Area contains 41.30 acres of estuarine wetlands (Table 3-34). Wetland types represented in the Otter Pond Area include intertidal unconsolidated shore estuarine wetlands (E2USN), intertidal estuarine emergent wetlands (E2EM1), and subtidal estuarine wetlands with unconsolidated bottoms (E1UB3).

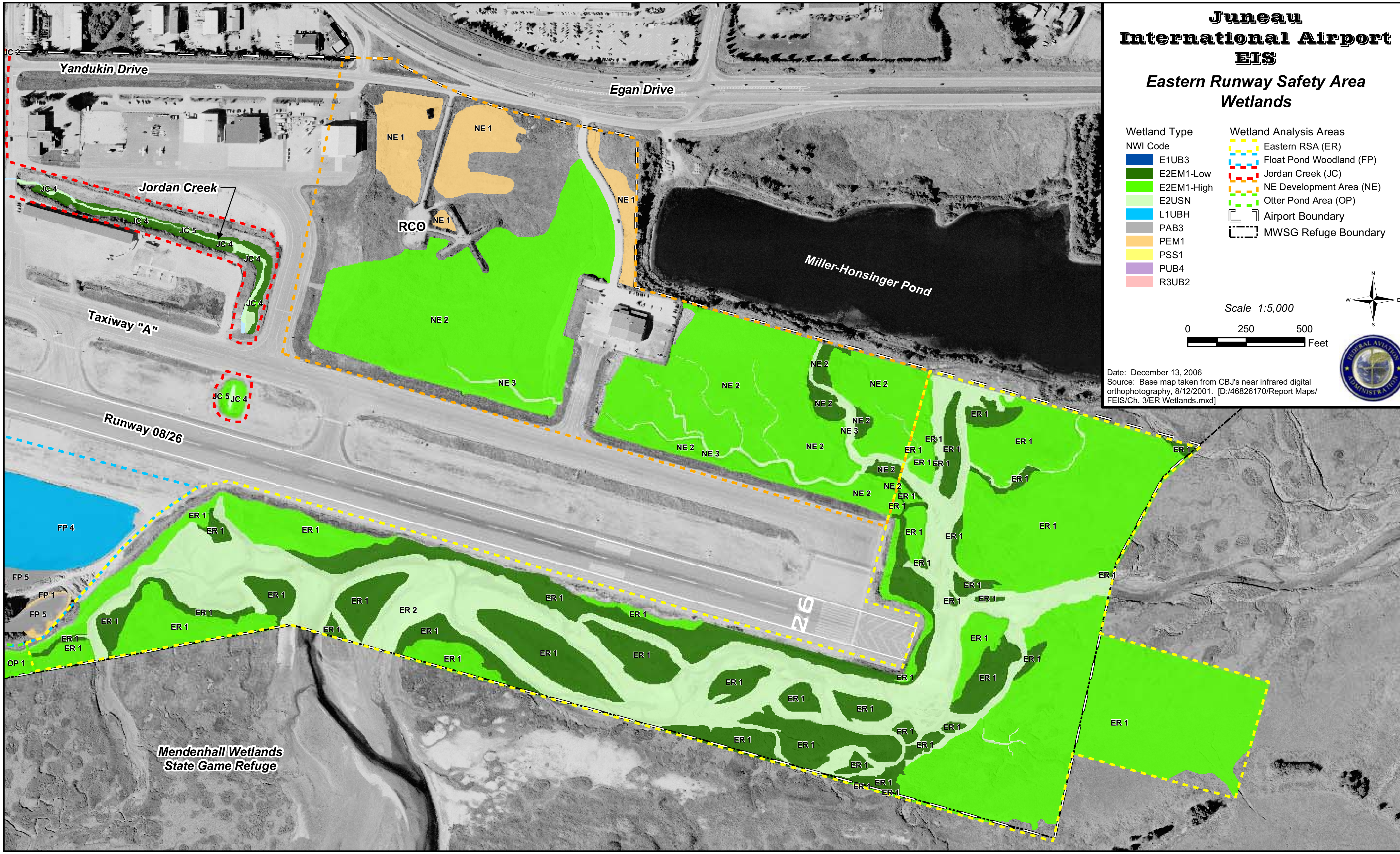


Figure 3-27. Eastern runway safety area wetlands.

THIS PAGE INTENTIONALLY LEFT BLANK

Figure 3-28. Float Plane Pond woodland and Otter Pond area wetlands.

THIS PAGE INTENTIONALLY LEFT BLANK

Table 3-34. Otter Pond Area Wetland Acreages and Functional Ratings

Wetland ID[1]		OP1	OP2	OP3
NWI Code		E2EM1 (H/L)	E2USN	E1UB3
Adamus Wetland		M1B	M1B	M1B
Acreage		34.1/0.8	4.7	1.7
Functional Ratings	Groundwater Recharge	L	L	L
	Groundwater Discharge & Lateral Flow	MH	MH	MH
	Surface Hydrologic Control	L	L	L
	Sediment/ Toxicant Retention	MH	MH	MH
	Nutrient Transformation and Export	M	H	H
	Riparian Support	H	MH	MH
	Fish Habitat	H/VH	VH	VH
	Wildlife	VH	VH	VH
	Regional Ecological Diversity	H	H	H
	Erosion Sensitivity	L	ML	L
	Ecological Replacement Cost	H	H	L
	Downstream Beneficiary Sites	L	L	L

[1] No sample points were taken for any wetland acreages.
Key to Functional ratings: VH = Very High; H = High; MH = Moderate-High; M = Moderate; ML = Moderate-Low; L = Low

3.8.2.5 Float Pond Woodland

The Float Pond Woodland is comprised of a mosaic of Sitka spruce, Sitka alder, red alder, black cottonwood, and Barclay and Sitka willows interspersed with a variety of herbaceous communities. Many of these species occur predominantly in upland habitats. Upland habitat in the Float Pond Woodland was created by material dredged from the adjacent float plane impoundment. A popular recreation trail is located on the constructed dike that bounds the Float Pond Woodland to the south and separates it from the estuarine wetland system (Figure 3-25).

The Float Pond Woodland encompasses 97.4 acres of wetland. The Float Plane Pond comprises over 60% of this area, at 59.7 acres. Five of nine wetland classes described above are represented in this area. The acreage of each wetland type is summarized in Table 3-35.

Table 3-35. Float Pond Woodland Wetland Acreages and Functional Ratings

	Wetland ID (Sample Points)	**FP1 (62, 75, 77, 80, 82, 88, 91)**	**FP2 (64, 65, 71, 74, 78)**	**FP3 (67, 68)**	**FP4 (None)**	**FP5 (None)**
NWI Code		PEM1	PSS1	PUB4	L1UBH	PAB3
Adamus Wetland ID		M1B/M1C	M1B	M1B	M1	M1B
Acreage		11.1	2.8	0.5	59.7	23.3
Functional Ratings	Groundwater Recharge	L	L	L	L	L
	Groundwater Discharge & Lateral Flow	L	L	L	L	L
	Surface Hydrologic Control	MH	MH	MH	H	MH
	Sediment/ Toxicant Retention	H	H	H	H	H
	Nutrient Transform. & Export	L	L	L	L	L
	Riparian Support	L	L	L	L	L
	Fish Habitat	VL	VL	VL	ML	ML
	Wildlife	H	ML	H	H	VH
	Regional Ecological Diversity	ML	MH	ML	MH	H
	Erosion Sensitivity	L	L	L	L	L
	Ecological Replacement Cost	L	L	M	L	L
	Downstream Beneficiary Sites	L	L	L	L	L

Key to Functional ratings: VH = Very High; H = High; MH = Moderate-High; M = Moderate; ML = Moderate-Low; L = Low; VL = Very Low

3.8.2.6 WESTERN RUNWAY SAFETY AREA

The Western RSA includes the land off the west end of the runway and into the Mendenhall River (Figure 3-29). Indications of past human disturbance are evident throughout this area, such as the large rock dikes emplaced off the west end of the runway. These dikes protect the runway from the undercutting effects of the Mendenhall River and tidal action.

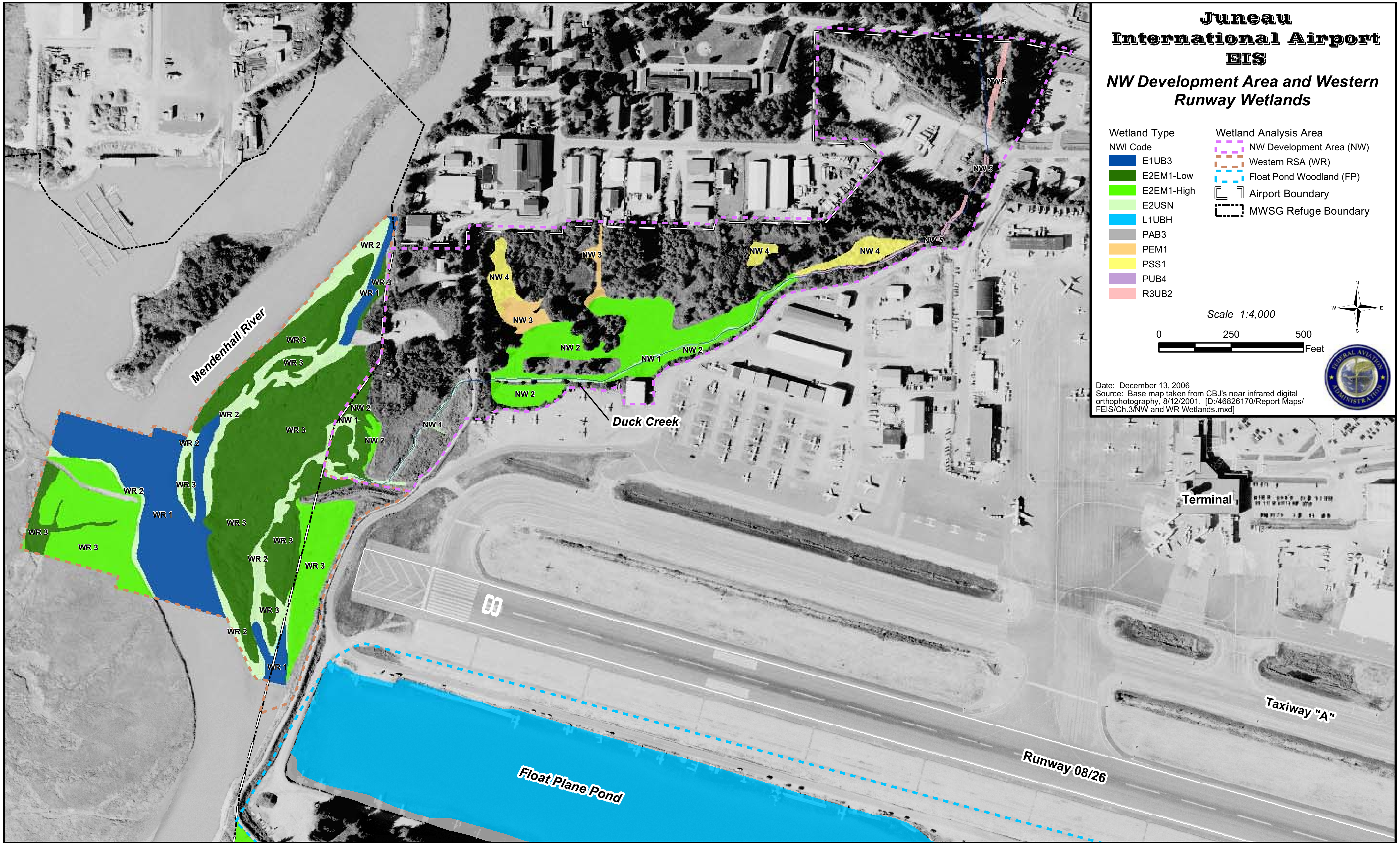


Figure 3-29. NW development area and Western Runway Safety area wetlands.

THIS PAGE INTENTIONALLY LEFT BLANK

The Western RSA encompasses 19.6 acres of wetlands, represented by three of nine wetland classes. Wetland classes within this area include intertidal estuarine emergent wetlands with persistent vegetation structure throughout the year (E2EM1), intertidal unconsolidated shore estuarine wetlands (E2USN), and subtidal unconsolidated bottom estuarine wetlands (E1UB3) Acreage of each wetland type is summarized in Table 3-36.

Table 3-36. Western RSA Wetland Acreages and Functional Ratings

Wetland ID[1]		WR1	WR2	WR3
NWI Code		E1UB3	E2USN	E2EM1 (H/L)
Adamus Wetland		ES1	M51	M52
Acreage		4.5	2.8	3.8/8.5
Functional Ratings	Groundwater Recharge	L	L	L
	Groundwater Discharge & Lateral Flow	MH	MH	MH
	Surface Hydrologic Control	L	L	L
	Sediment/ Toxicant Retention	MH	MH	MH
	Nutrient Transformation and Export	H	H	H
	Riparian Support	MH	MH	H
	Fish Habitat	VH	VH	H/VH
	Wildlife	H	H	H
	Regional Ecological Diversity	H	H	H
	Erosion Sensitivity	MH	ML	L
	Ecological Replacement Cost	H	H	H
	Downstream Beneficiary Sites	L	L	L

[1] No sample points were taken for any wetland acreages.
Key to Functional ratings: VH = Very High; H = High; MH = Moderate-High; M = Moderate; ML = Moderate-Low; L = Low

3.8.2.7 NORTHWEST DEVELOPMENT AREA

The Northwest Development Area includes Duck Creek and the northwest portion of the Airport (Figure 3-29). Indications of past human disturbance are evident throughout the area. For example, Duck Creek has been channelized and diked by previous land development and management activities. The Northwest Development Area encompasses 6.1 acres of wetlands, with five of nine wetland classes delineated. Wetland classes within the area include palustrine emergent marsh wetlands with persistent vegetation structure throughout the year (PEM1), palustrine scrub-shrub wetlands with broad-leafed, deciduous, woody vegetation (PSS1), intertidal estuarine emergent wetlands with persistent vegetation structure throughout the year (E2EM1), intertidal unconsolidated shore estuarine wetlands (E2USN), and lower riparian areas with unconsolidated sandy bottoms (Duck Creek - R3UB2). The acreage and function of each wetland type is summarized in Table 3-37.

Table 3-37. Northwest Development Area Wetland Acreages and Functional Ratings

	Wetland ID (Sample Points)	NW1 (None)	NW2 (42, 47, 49, 53)	NW3 (50)	NW4 (39, 43, 44, 51)	NW5 (38)
NWI Code		E2USN	E2EM1 (H/L)	PEM1	PSS1	R3UB2
Adamus Wetland ID		M51	M52	M52	M51, M52	M49
Acreage		0.5	3.2/0.7	0.5	0.9	0.3
Functional Ratings	Groundwater Recharge	L	L	L	L	L
	Groundwater Discharge & Lateral Flow	MH	MH	MH	MH	MH
	Surface Hydrologic Control	L	L	ML	H	ML
	Sediment/ Toxicant Retention	MH	MH	MH	H	L
	Nutrient Transform. & Export	H	H	M	L	H
	Riparian Support	MH	H	MH	L	H
	Fish Habitat	VH	VH	VL	VL	ML[1]
	Wildlife	ML	ML	L	ML	ML
	Regional Ecological Diversity	H	H	H	MH	H
	Erosion Sensitivity	ML	L	L	L	ML
	Ecological Replacement Cost	H	H	L	L	H
	Downstream Beneficiary Sites	L	L	L	L	L

Key to Functional ratings:
VH = Very High; H = High; MH = Moderate-High; M = Moderate; ML = Moderate-Low; L = Low; VL = Very Low
[1] The rating for Duck Creek's Fish Habitat reflects actual ecological conditions, not the future desired condition or its status as EFH

3.8.3 LANDSCAPE AREA WETLAND CONTEXT

The Mendenhall Valley and JNU are located on the outwash plain of the Mendenhall Glacier. The modern delta of the Mendenhall River extends to the Gastineau Channel. As a result, the majority of wetlands surrounding JNU and comprising the Refuge are estuarine wetlands influenced by both freshwater and marine tides. Non-estuarine, palustrine wetlands also occur in the area and are generally located upslope of estuarine wetlands in areas influenced by groundwater rather than streams or tides. Wetlands within the landscape area are mapped at a lower resolution than those within the project area. Just as for vegetation resources, the wetland landscape area includes JNU, the adjacent Miller-Honsinger property, and the Refuge.

Wetlands within the landscape area are described to the "subsystem" level of the NWI wetlands classification system whereas wetlands within the project area are described to the more specific "class" level (Cowardin et al. 1979). Eleven wetland subsystems were mapped within the landscape area. Marine and estuarine wetlands include subtidal marine wetlands with unconsolidated bottoms (M1UB), subtidal estuarine wetlands with unconsolidated bottoms (E1UB), intertidal estuarine unconsolidated shore wetlands (E2US), intertidal estuarine aquatic beds (E2AB), and intertidal estuarine emergent wetlands (E2EM, high and low). Lacustrine, palustrine, and riverine wetlands include littoral lacustrine wetlands with unconsolidated bottoms, and palustrine emergent wetlands (PEM1), palustrine shrub-scrub wetlands (PSS), bogs (PUB), palustrine aquatic beds, and stream channels (R3UB). The approximate acreage of these wetland subsystems is summarized in Table 3-38, and distribution of these wetlands at the landscape level can be viewed in Figure 3-30.

3.8.4 AFFECT OF UPLIFT ON AREA WETLANDS

The type and extent of wetlands within both the project and landscape areas are controlled by a number of factors, including isostatic rebound and tectonic uplift. As was described in Section 3.5.2.7, the ground surface is slowing being raised in the Mendenhall Valley and surrounding areas of Juneau at an estimated rate of 0.60 to 0.75 inches of uplift per year. This geologic phenomenon has the potential to reshape wetlands and change wetland types regionally and locally, in the vicinity of the Airport.

The uplift of land supporting estuarine wetlands will cause changes in tidal hydrology. It is likely that salts in uplifted marine sediments would gradually be leached out of the soil profile, producing a non-saline environment. Over time, it would be expected that estuarine wetland types would retreat towards the ocean, giving way to costal forb meadow on water-shedding (convex) surfaces and palustrine emergent wet meadows in depressional (concave) surfaces. The following transitions in wetland types are expected:

- estuarine tidal slough to estuarine emergent marsh
- estuarine emergent marsh to palustrine emergent marsh or costal forb meadow
- palustrine emergent marsh to costal forb meadow

Table 3-38. JNU Landscape Area Wetlands

Sub-system	Acreage (% of total)	Landscape Position	Main Functions
M1UB (marine)	463.2 (11.2%)	Deep water habitat of the eastern Gastineau Channel. Little mixing of fresh and salt water.	Not Rated (marine wetlands did not occur in the project area).
E1UB	1119.5(27.0%)	Associated w/ Gastineau Channel, Mendenhall R., and Jordan and Duck Creeks. Lowest landscape position.	Nutrient transformation and transport, riparian support, fish habitat, regional ecological diversity, disturbance sensitive wildlife habitat.
E2US	662.5 (16.0%)	Regularly flooded, unvegetated sloughs and shorelines of the Gastineau Channel and Fritz Cove in the MWSGR. Located above E1UB wetlands.	Nutrient transformation and transport, riparian support, fish habitat, regional ecological diversity, disturbance sensitive wildlife habitat.
E2AB	115.5 (2.8%)	Regularly flooded sloughs and shorelines of the Gastineau Channel and Fritz Cove in the MWSGR displaying semi-aquatic vegetation. Located above E1UB wetlands.	Nutrient transformation and transport, riparian support, fish habitat, regional ecological diversity, disturbance sensitive wildlife habitat.
E2EM (H/L)	950.9/681.8 (23.0/16.5%)	Located at the highest estuarine landscape position above E1UB, E2US, and E2AB.	Groundwater recharge and discharge, sediment and toxicant retention, nutrient transformation and transport, riparian support, fish habitat, disturbance sensitive wildlife habitat, regional ecological diversity.
L1UB	88.2 (2.1%)	The Miller-Honsinger Pond and float plane pond	Surface hydrologic control, sediment and toxicant retention, erosion sensitivity.
R3UB	0.7 (<0.1%)	Duck Creek and Jordan Creek above tidal influence.	Groundwater recharge and discharge, nutrient transformation and export, riparian support, fish habitat, regional ecological diversity.
PAB	23.3 (0.6%)	Palustrine aquatic bed wetlands confined to the sloughs south of the float plane impoundment.	Surface hydrologic control, sediment and toxicant retention, disturbance sensitive wildlife habitat, regional ecological diversity.
PSS	6.8 (0.2%)	Shrub-scrub palustrine wetlands in the float pond woodland and along Duck Creek.	Nutrient transformation and export, riparian support (except in the float pond woodland), regional ecological diversity.
PEM	28.2 (0.7%)	Palustrine emergent wetlands north of the Miller-Honsinger Pond and interspersed throughout the float pond woodland, the NEDA, and the NWDA.	Surface hydrologic control, nutrient transformation and export.
PUB	0.5 (<0.1%)	Palustrine unconsolidated bottom wetland (bog) located in the float pond woodland.	Surface hydrologic control, sediment and toxicant retention, disturbance sensitive wildlife habitat, regional ecological diversity. These wetlands would have a moderate ecological replacement cost.
Total Acres:	**4141.1**		

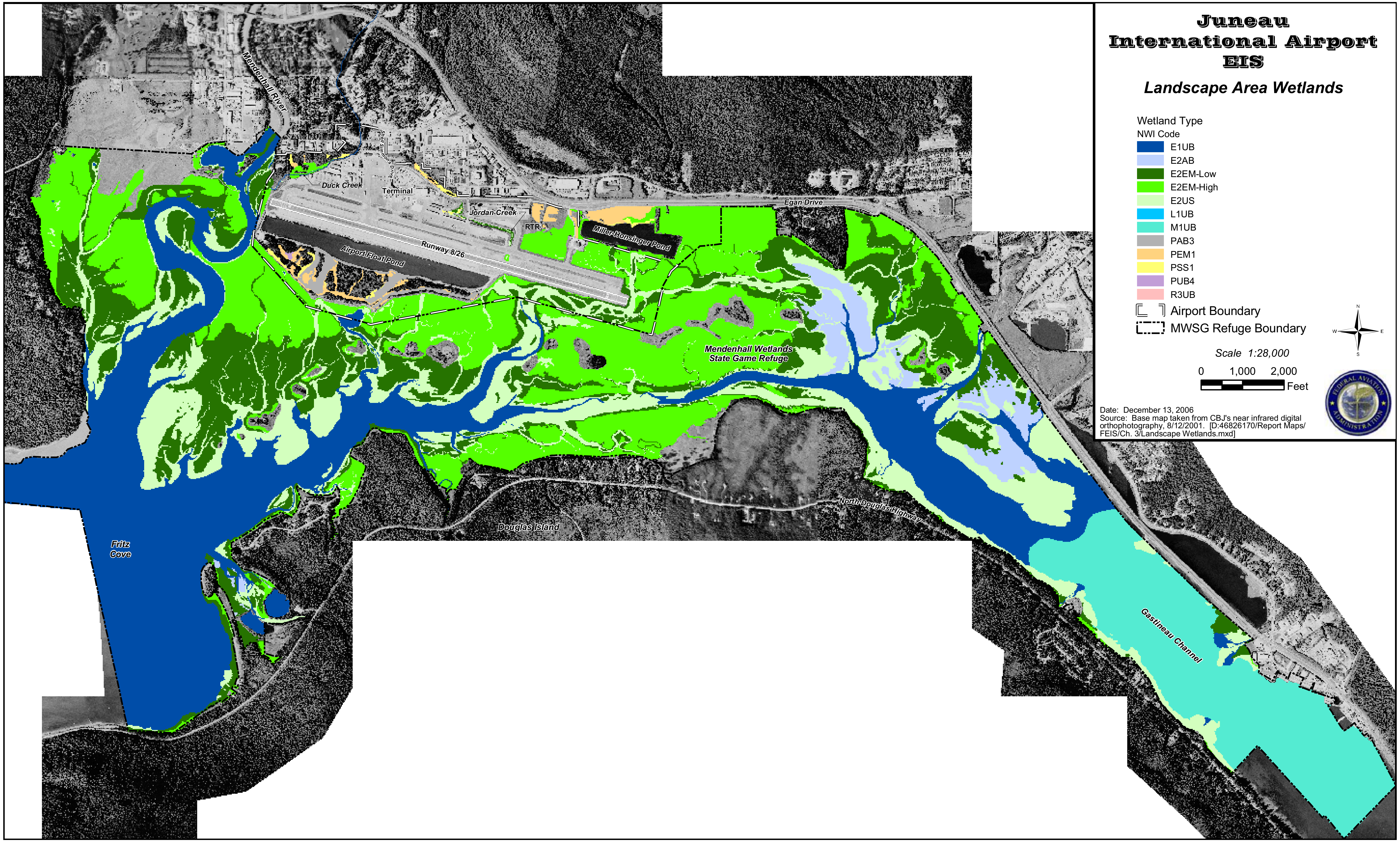


Figure 3-30. Landscape area wetlands.

THIS PAGE INTENTIONALLY LEFT BLANK

These geologically rapid changes in hydrology and vegetation will obviously alter the habitat value for wildlife. Through time, regional uplift will inexorably affect the nature of undeveloped areas on and near the Airport and in the Refuge. The changes in habitat will affect the use and distribution of these areas by birds and other wildlife. These changes do not mean, however, that the ecological importance of these areas will lessen.

3.9 FISHERIES

Proposed actions at JNU could affect fish and aquatic organisms in three basic types of fish habitat: the tidal wetlands surrounding much of the Airport, freshwater streams and rivers bordering and flowing through JNU, and the Float Plane Basin. The streams include Duck Creek, Jordan Creek, and the Mendenhall River, while the tidal wetlands include slough and salt marsh habitats. The Float Plane Basin is a unique, man-made habitat recharged by brackish water at high tides, with a valve that inhibits outflow and fish movement. Tidal movements affect the distribution of fish daily and seasonally in all of these habitats.

Anadromous trout and salmon, which spawn in freshwater and spend at least part of their lifecycle feeding in saltwater, can be found at some season in all of these habitats. Table 3-39 identifies the aquatic habitats used by different species during different lifestages. These fish include the adult and juvenile lifestages of chinook salmon (*Oncorhynchus tshawytscha*), chum salmon (*O. keta*), coho salmon (*O. kisutch*), pink salmon (*O. gorbuscha*), and sockeye salmon (*O. nerka*); steelhead (*O. mykiss*); cutthroat trout (*O. clarki*); and Dolly Varden char (*Salvelinus malma*). Eulachon (*Thaleichthys pacificus*) are also anadromous, but their freshwater use is limited to the spawning and incubation portions of their lifecycle which occurs only in the lower reaches of streams and rivers. Also found in most of these aquatic habitats are adult and juvenile lifestages of species which tolerate both fresh and brackish water such as staghorn sculpin (*Leptocottus armatus*), coastrange sculpin (*Cottus aleuticus*), starry flounder (*Platichthys stellatus*), and three-spined stickleback (*Gasterosteus aculeatus*). Saltwater species such as capelin (*Mallotus villosus*) and Pacific herring (*Clupea palasi*) tend to move into and out of the project area with the tides.

These habitats have been affected by Airport, industrial, commercial, municipal, and residential development. Fish populations have been subjected to habitat degradation, exploitation (e.g., commercial, subsistence, and sport harvest), and hatchery production. The sport harvest from the Juneau area during 1990-2004 averaged 40,397 coho salmon and 13,120 chinook salmon (ADF&G 2006). Between 2003 and 2005, Douglas Island Pink and Chum, Inc. (DIPAC) released an average of approximately 35.5 million young salmon annually into Gastineau Channel. The releases have resulted in approximately 224,000 adult hatchery-bred salmon returning to Gastineau Channel, dwarfing the local production of wild salmon (Table 3-40). Juvenile hatchery fish may compete directly with wild fish in estuarine and open ocean waters, and adults that stray into area streams may compete with wild adults for mates and spawning habitats. Hatchery pink salmon adults have been observed in several streams north of the Mendenhall Wetlands, such as Auke and Waydelich creeks (Mortensen et al. 2002). It should be noted, however, that DIPAC stopped producing pink salmon in 2002.

Table 3-39. Seasonal Use of Aquatic Habitats within and adjacent to the EIS Project Area by Various Fish Species[1] and Lifestages

Species, lifestage	**Duck Creek**	**Jordan Creek**	**Mend-enhall River**	**Tidal Slough, Low Marsh**	**High Marsh**	**Float-plane Basin**	**Relative Abundance, Other Notes**
Coho salmon (EFH)							Common in Duck Creek, abundant in Jordan Creek
adult migration (in)	**F**	**F**	**F**	**F**			
spawning	**F**	**F**	F				
incubation	F, W	F, W	F, W				Tends to fail in Duck Creek
juvenile rearing	**F, W, Sp, Su**	**F, W, Sp, Su**	F, W, Sp, Su	Sp, **Su**, F	Sp, Su, F		
juvenile migrations (in+out)	**F, Sp**	**F, Sp**	Sp				Often limited in Duck Creek due to limited flows, dewatered sections, and poor water quality
Chinook salmon (EFH)							Montana Creek, DIPAC origin
adult migration (in)			**F**	**F**			
spawning			F				
incubation			F, W				Tends to fail in Duck Creek
juvenile rearing			Sp, Su	Sp, Su	Sp, Su		
juvenile migrations (out)			Sp				Often limited in Duck Creek due to limited flows, dewatered sections, and poor water quality
Chum & pink salmon (EFH)							Chum abundant, pink common
adult migration (in)	**Su**	**Su**	**Su**	**Su**			
Spawning	**Su**	**Su**	Su?				
incubation	Su, F, W	Su, F, W	Su, F, W?				Tends to fail in Duck Creek
juvenile rearing				**Sp**	**Sp**		Largely hatchery fish from DIPAC

Table 3-39. Seasonal Use of Aquatic Habitats within and adjacent to the EIS Project Area by Various Fish Species[1] and Lifestages, continued

Species, lifestage	**Duck Creek**	**Jordan Creek**	**Mend-enhall River**	**Tidal Slough, Low Marsh**	**High Marsh**	**Float-plane Basin**	**Relative Abundance, Other Notes**
juvenile migration (out)	Sp	**Sp**	Sp				
Sockeye salmon (EFH)							Common
adult migration (in)			Su				
juvenile migration (out)			Sp				
Steelhead							Small run in Montana Creek?
adult migration (in)			W, Sp	W, Sp			
spawning			Sp				
incubation			Sp, Su				
juvenile rearing			F, W, Sp, Su				
juvenile migrations (out)			Sp				Downstream in spring
Cutthroat trout & Dolly Varden char							Cutthroat common, Dolly Varden abundant
Adults	**Sp,** Su, **F**	**Sp, Su, F**	Sp, Su, F, W	Sp, Su, F	Sp, Su, F		Mendenhall Lake is major overwinter habitat
juveniles	**Sp,** Su, **F, W**	**Sp, Su, F, W**	Sp, Su, F, W	Sp, Su, F	Sp, Su, F		
Migration (in+out)	Sp, **F**	**Sp, F**	Sp, **F**				Downstream spring; upstream fall
Eulachon (forage fish EFH)							Sporadically abundant
Spawning			**Sp**				
Capelin (forage fish EFH)							Common
Adults				Sp, **Su**	Sp, Su		

Table 3-39. Seasonal Use of Aquatic Habitats within and adjacent to the EIS Project Area by Various Fish Species[1] and Lifestages, continued

Species, lifestage	**Duck Creek**	**Jordan Creek**	**Mend-enhall River**	**Tidal Slough, Low Marsh**	**High Marsh**	**Float-plane Basin**	**Relative Abundance, Other Notes**
Spawning							Spawns on beaches
Juveniles				**Sp, Su**	Sp, Su		
Herring (forage fish EFH)							Abundant
Adults				Sp, **Su**	Sp, Su		
Larvae				Sp, **Su**	Sp, **Su**		
Juveniles				Su	Su		
Pacific sandlance (forage fish EFH)							Common
adults + juveniles				**Sp**, Su, F, W			
Staghorn sculpin (EFH)							Abundant
all stages	**Sp, Su,** F	**Sp, Su, F**		**Sp, Su,** F	**Sp, Su,** F	Sp, Su, F, W	
Coastrange sculpin							Abundant
all stages	**Sp, Su,** F, W	**Sp, Su**, F, W	Sp, Su, F, W				
Starry flounder							Abundant
Juveniles	**Sp, Su,** F	**Sp, Su,** F		**Sp, Su,** F	**Sp, Su,** F	Sp, Su, F, W	
Three-spined stickleback							Abundant
all stages	**Sp, Su, F,** W	**Sp, Su, F,** W		**Sp, Su,** F	**Sp, Su,** F	**Sp, Su, F,** W	

Table 3-39. Seasonal Use of Aquatic Habitats within and adjacent to the EIS Project Area by Various Fish Species[1] and Lifestages, continued

Species, lifestage	Duck Creek	Jordan Creek	Mend-enhall River	Tidal Slough, Low Marsh	High Marsh	Float-plane Basin	Relative Abundance, Other Notes
Yellowfin sole (EFH)							Observed in Mendenhall Wetlands; not adjacent to Airport
Rock sole (EFH)							Observed in Mendenhall Wetlands; not adjacent to Airport

[1] Species include those for which NMFS designates Essential Fish Habitat. Codes: Sp=Spring, Su=Summer, F=Fall, W=Winter. **Bold** indicates seasonal use confirmed during various studies (note: little is known about winter use of the tidal sloughs and salt marsh).

Table 3-40. DIPAC Salmon Releases and Returns, 2003-2005[1]

Species[2]	Coho		Chum		Chinook	
	releases	returns	releases	returns	releases	returns
DIPAC minimum	499,616	21,930	34,221,606	163,793	120,891	2,392
DIPAC average	616,942	35,398	34,763,053	183,917	173,511	4,390
DIPAC maximum	783,928	49,505	35,268,947	203,040	222,218	5,937

[1] Salmon juveniles released from and adults returning to DIPAC's Macaulay Hatchery in Gastineau Channel, and the approximate escapement of wild-spawning adults to area rivers (Montana, Steep, Switzer, Duck, and Jordan creeks).
[2] Note that DIPAC does not produce sockeye salmon and discontinued producing pink salmon in 2002.

Thus, some adult hatchery fish likely stray into Duck and Jordan creeks also, although most of the chum salmon in these streams are likely of DIPAC origin (Celewycz, et al. 1994). The brief history and status of fish habitat and populations is described below for each area, with more detail for the reaches on Airport property.

Although only relatively short portions of the streams and rivers associated with the Airport will be affected, these impacts occur in reaches where these streams and rivers transition into the tidal wetlands. These transitional stream/estuary ecotones have been shown to be valuable feeding and holding areas and are often used as migration corridors for the fish species listed above. Studies have shown that these tidally influenced reaches can produce up to eight times more food (benthic invertebrates such as shrimp and isopods) for juvenile salmon than the freshwater portion of stream above tidal influence (Merrell and Koski 1978). This is also where juvenile salmon undergo the potentially stressful physiological changes as they transition from freshwater to salt-water.

This section of the EIS describes the potentially affected fisheries and their habitats associated with the Airport. Fish habitat and populations in streams were described from existing information and field reconnaissance. Stream habitat on the JNU property portions of Duck and Jordan creeks was surveyed on October 10 and 11, 2001, using habitat characteristics and rating criteria developed for the area (Adamus 1987). Field reconnaissance in June and August 2001 provided a first-hand sense of seasonal variation in habitat characteristics. Adult pink and chum salmon were observed during August field surveys in Duck and Jordan creeks, and adult coho salmon were captured in weirs and counted from mid-September to mid-November as they migrated into the creeks to spawn. Juvenile coho salmon and other small fish were also sampled periodically in Duck and Jordan creeks during this period. Figure 3-31 depicts aquatic and estuarine habitats and sampling locations within the project area. In the following description of stream fisheries, emphasis is placed on the habitat and populations of coho salmon because this species is the most valuable from commercial and sport perspectives and the most likely to use all affected habitats. In addition, coho salmon are a physiologically sensitive species requiring diverse, quality habitats capable of supporting most co-existing species.

3.9.1 DUCK CREEK

The hydrology, water quality and other stream characteristics of Duck Creek are described in Section 3.6.6.2. The following sections describe aquatic habitat and fish populations in Duck Creek, and specific conditions within the Airport property.

3.9.1.1 HABITAT

The majority of Duck Creek has been directly modified by channel relocation, gravel extraction, encroachment of roads, road crossings, residential development, and commercial development. Its hydrology and water quality has similarly been modified by development. Development of Duck Creek began in the 1880s with homesteading, agriculture, and livestock. The first road was built up the watershed in 1910, and during the 1940s, Duck Creek was realigned to flow into the Mendenhall River as it does today, instead of flowing (at least partially) into the tidal marsh. Since the 1950s, residential and commercial development has continued along Duck Creek.

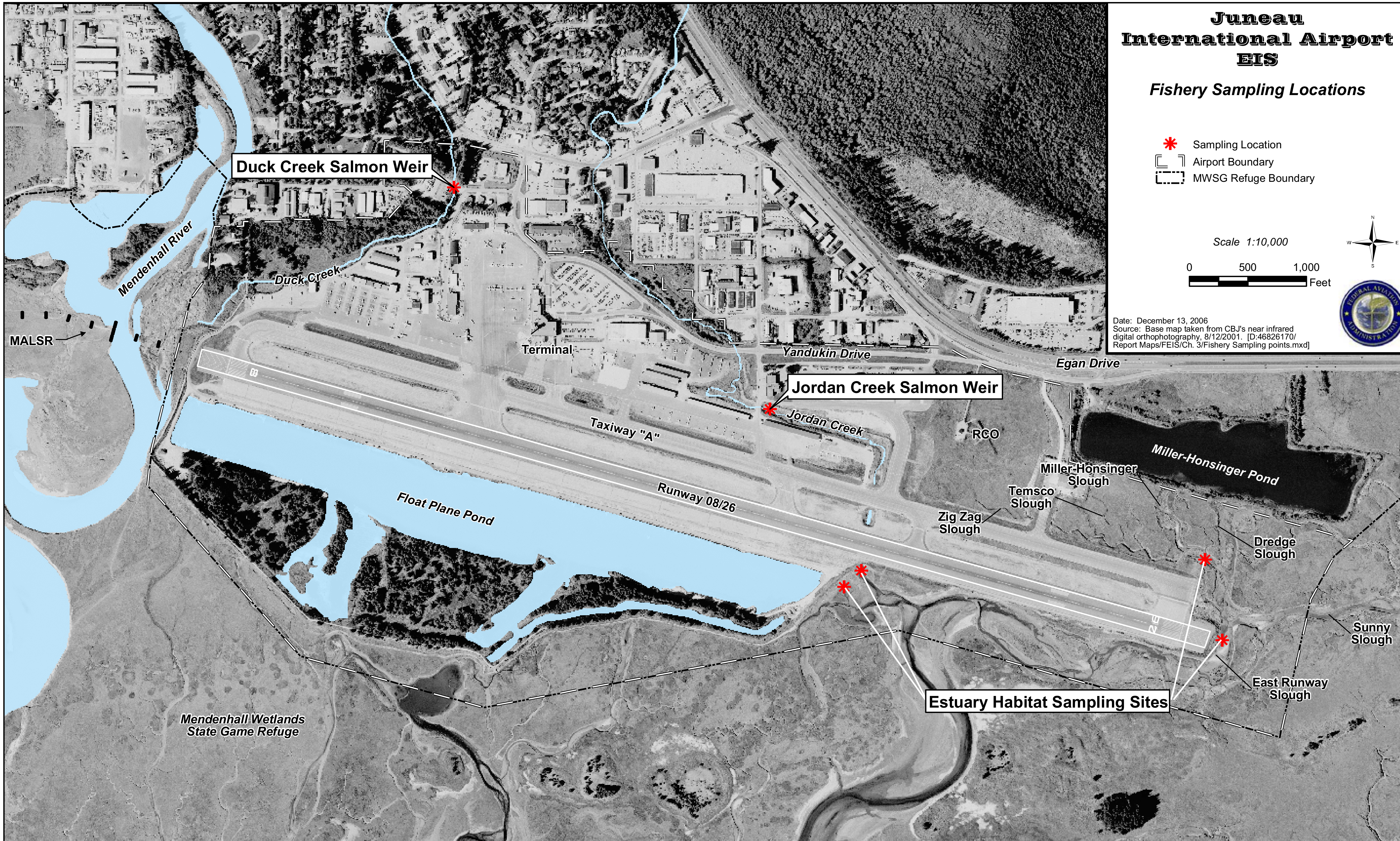


Figure 3-31. Fishery sampling locations.

THIS PAGE INTENTIONALLY LEFT BLANK

Currently, the fish habitat in Duck Creek suffers from flooding and localized dewatering, channelization, extreme amounts of dissolved and oxidized iron, sedimentation of gravels, low dissolved oxygen content, dearth of riparian vegetation, poorly-functioning stream crossings, and urban pollutants (Koski and Lorenz 1999). The lower portion of Duck Creek is often dewatered during extended warm, dry weather, a phenomenon possibly related to urbanization and downcutting, or even a natural condition of this stream (Bethers et al. 1995; see Section 3.6.6.2 of this EIS). Duck Creek is considered the most physically altered stream in the Juneau area (Bethers et al. 1995).

Duck Creek is also the subject of a habitat restoration effort (Koski and Lorenz 1999) that is guiding the implementation of habitat improvements. In the past decade, improvements have included streamside revegetation, wetland creation, replacement of poorly functioning culverts, cleaning of fine sediment from spawning gravels, channel reconstruction to increase habitat diversity, pond filling to reduce dissolved iron, and channel lining to increase surface flow. Plans exist to continue these projects and further address flood control, flow augmentation, and the control of dissolved iron. The abundant groundwater inflow and connected ponds upstream from Airport property suggest Duck Creek could be most useful as a rearing stream for overwintering salmonids, especially coho salmon juveniles. Unfortunately, the lower reaches of Duck Creek are considered losing reaches during portions of the year in which there is a low water table. This often impacts the area's value for spawning, rearing, and migrating salmonids due to low water flows, elevated water temperatures, low dissolved oxygen, and high concentrations of iron and other inorganic compounds.

3.9.1.2 Populations

Historically, Duck Creek reportedly supported substantial populations of chum salmon (10,000 in 1940), coho salmon (500 in 1966), and other salmonids (Bethers et al. 1995). Between 2002 and 2005, it contained small populations of coho salmon, cutthroat trout, Dolly Varden char, coast range and staghorn sculpin, and three-spined stickleback (ADF&G 2006). The native run of chum salmon is presumed extinct (Koski and Lorenz 1999). The coho salmon run in Duck Creek, illustrated in Figure 3-32, has declined from approximately 500 to 15 adults over the past 40+ years.

Duck Creek probably contains some salmon of hatchery origin. It was stocked with 50,000 to 130,000 hatchery coho salmon fry per year in 1919-20, 1977, and 1984 (Bethers et al. 1995), and it is likely that chum, pink, and coho salmon of DIPAC origin stray into and spawn in Duck Creek. Upstream from Airport property, minnow traps set by ADF&G have routinely captured coho salmon fry, juveniles, and smolts as well as occasional cutthroat trout and Dolly Varden char, and numerous sticklebacks (Bethers et al. 1995). Sporadic counts between 1973 and 1993 of adult coho salmon spawning in Duck Creek have ranged from 2 to 120, with no consistent temporal trend (Bethers et al. 1995). Index counts were often inhibited by the turbid, iron-stained water and were discontinued after 1993.

Studies during the mid-1990s found that, even though salmon spawning appeared unsuccessful, juvenile coho salmon do use Duck Creek to overwinter. Overwintering survival for coho salmon in Duck Creek is estimated to be relatively high. Between 2002 and 2005, coho spring smolt outmigration ranged from 14 to 1,384 individuals (ADF&G 2006). Outmigration conditions in Duck

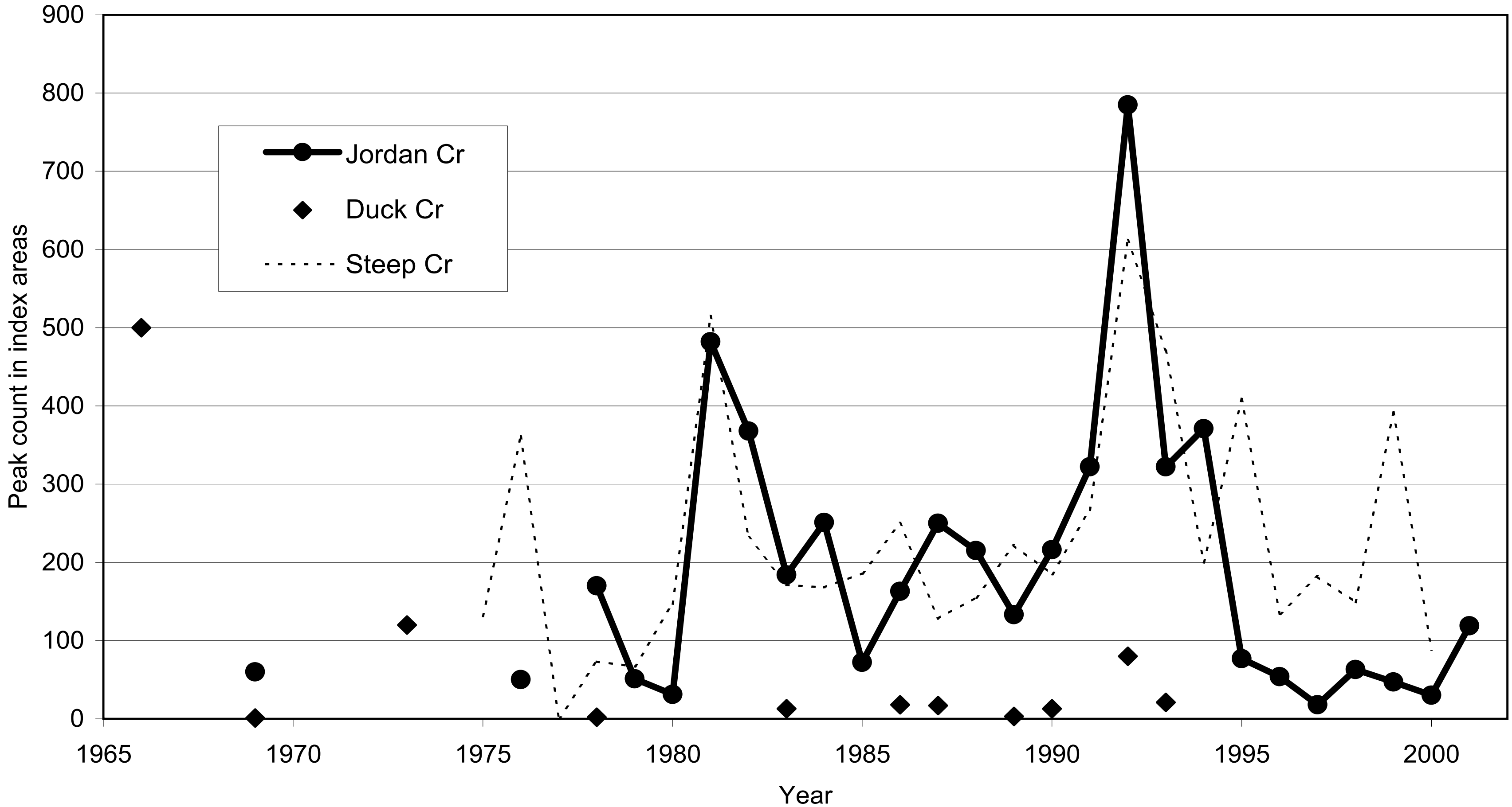


Figure 3-32. Adult coho salmon, peak index counts (ADF&G data).

Creek are often poor because of limited flows, dewatered sections, and poor water quality. Table 3-41 provides comparative habitat and population data for Duck Creek, Jordan Creek, and Steep Creek.

Table 3-41. Relative Fish Habitat and Population Characteristics of Duck, Jordan, and Steep Creeks

Parameter	Duck Creek	Jordan Creek	Steep Creek
Annual peak index counts of coho adults (1970-2005 for Jordan and Steep Creeks, 1970 to 1993 for Duck Creek; ADF&G data)	2-120	18-1,396	0-612
Relative salmonid egg to fry survival (bioassays)	Low	Moderate	High
Average fall rearing density (#/acre) of juvenile coho	88	87	-
Average number of overwintering coho	6,000	-	-
Survival of juvenile coho through the winter	50%	36%	-
Number of coho juveniles, fry,,, and smolts outmigrating in Spring (2002-2005) (ADF&G 2006)	15-1,388	6,514-19,445	-
Parasite density on coho smolts	2x that of Jordan and Steep creeks	-	-
Sedimentation in spawning gravels	Up to 30% more than Jordan or Steep creeks	-	-
Summer rearing for coho juveniles	Poor, limited by water pollution, parasitism, dewatering	Moderate, some local dewatering	-
Winter rearing for coho juveniles	Moderate, good in groundwater influenced ponds	Good, especially in ponds and swamps	-
Migration conditions for coho juveniles (Spring, Fall)	Poor, often limited by dewatered reaches	Moderate, flows usually adequate	-

*Data is from the mid-1990s (Koski and Lorenz 1999) unless otherwise indicated. Steep Creek serves as a local reference stream, relatively unimpacted by development.

3.9.1.3 Airport Reach of Duck Creek

Within JNU property, Duck Creek has been modified by channel relocation, encroachment of roads and Airport facilities, and sedimentation from Airport operations. Stream habitat was surveyed between the runway approach lights and the Cessna Drive culvert. Overall, this reach comprises a narrow, small-substrate estuarine channel. Such channels are characterized by low gradient, low stream energy, high deposition, and sand and gravel substrate. Nonforested plant communities dominate the riparian zone and sideslope angles are low (dikes, roads, and development encroachment are exceptions to this condition). These types of channels are generally considered to have high value for spawning and rearing of coho and pink salmon, spawning chum salmon, and moderate value for spawning and rearing Dolly Varden char (Paustian et al. 1992).

This reach is used periodically by most of the freshwater and anadromous species known in the vicinity. Because of its association with the Mendenhall River, eulachon may use Duck Creek during their spring spawning runs as well. Capelin have also been observed upstream from Radcliffe Road during high spring tides, possibly as part of a spawning movement (Koski 2001). The value of this reach for salmonids is often reduced by low flows and occasional dewatering, low dissolved oxygen, limited cover, and deposition of fine sediments. This area's value for spawning, rearing, and migrating salmonids is described below.

Spawning. Gravel is common in the sections with faster water, but the gravel is of small size and heavily embedded with fine sediment so its value to spawning salmonids is limited. In August 2001, several adult chum salmon were observed holding in nearly stagnant water upstream from Radcliffe Road. During habitat surveys in October 2001, evidence of chum and/or pink salmon redds (from August spawning) was observed both downstream of Radcliffe Road (approximately 10 redds) and upstream of Radcliffe Road (several possible redds). The remains of approximately 10 decomposed pink and/or chum salmon carcasses were also observed downstream of Radcliffe Road. Coho salmon were not observed spawning in these reaches during fall 2001 and most likely move further upstream beyond Airport property and tidal influence to spawn. Koski and Lorenz (1999) observed no fry production from Duck Creek, documented dead eggs in all redds excavated in the Airport reach, and suggested that virtually all redds in this reach are unsuccessful that year due to suffocation of eggs by sediments and low dissolved oxygen.

Rearing. Within the Airport property, Duck Creek contains enough overhanging and aquatic vegetation (primarily sedges) to rate as "good" quality winter rearing habitat for juvenile coho salmon (Adamus 1987). Airport operations may limit the habitat value, however, as snow removed from Airport apron has at times been placed directly into the stream channel, undoubtedly altering water quality and negatively affecting winter habitat. At other times of year, the low flows, low dissolved oxygen, and dearth of shade and cover (e.g., undercut banks) in these reaches could limit their use by rearing salmonids. A deep, off-channel pool approximately 60 square feet in surface area near the Civil Air Patrol building, and a deep adjacent pool in the stream channel, are small features with potentially high value for rearing and holding juvenile and adult salmon, respectively.

During 1986-87, coho salmon juveniles were observed in this reach during the summer, but not in the winter (Adamus 1987). Fewer than 10 juvenile salmon were observed on Airport property during habitat surveys on October 10, 2001. Potential for dewatering, low dissolved oxygen, and lack of cover probably limit the value of this reach for rearing salmon, especially in the summer, during low tides. But it may be valuable rearing habitat when inundated by tidal flow.

Migration. Between September 26 and November 21, 2001, only 23 adult coho salmon passed upstream through this reach and entered the weir at Cessna Drive. In the fall of 2002, 2003, and 2004, zero adult coho were recorded moving upstream through this reach. In 2005, 15 coho adults immigrated into Duck Creek (ADF&G, 2006). The three main periods of upstream movement tended to correspond with increased streamflow, but not with high tide cycles. During periodic monitoring during October and November 2001, there appeared to be net upstream movement of at least 264 juvenile coho salmon, 53 Dolly Varden char, and three cutthroat trout beyond the weir at Cessna Drive. A smolt weir operated by ADF&G during the extremely dry conditions of the spring of 2002 captured 489 downstream-migrating coho salmon juveniles and smolts, 18 Dolly Varden char, and few other fish. Others have noted a spring downstream migration of 1,700 to 3,200 coho salmon smolts through airport property during the mid-1990s (Koski and Lorenz 1999). Spring counts from 2002 - 2005 recorded between 14 and 1,384 coho smolts emigrating from Duck Creek (ADF&G 2006).

This data suggests that the reach within Airport property, if not valuable for spawning, is at least a corridor through which juvenile and adult coho salmon move from the Mendenhall Wetlands to upper reaches of Duck Creek. However, dewatering has caused high mortality among down-stream-migrating salmonids – in some years, virtually all outmigrating smolts were trapped in dewatered reaches and either died or were hand-rescued from isolated pools (Koski and Lorenz 1999). In May 2002, Duck Creek was dewatered for approximately 400 yards upstream of Cessna Road to where tides inundated the channel (pers. comm. Brian Glynn, ADF&G, November 2002).

Culverts and Special Features. Duck Creek flows through three culverts on Airport property: Radcliffe Road, just west of Cessna Drive at the old entrance to the Airport fuel farm, and Cessna Drive, at the new entrance to the Airport fuel farm. The Radcliffe Road culvert is a 6-foot circular culvert, approximately 66 feet long. The culvert west of Cessna Drive is a similar shape but approximately 8 inches lesser diameter, and approximately 50 feet long. The newer culvert on Cessna Drive at the fuel farm access is a 17-foot high bottomless arch. They all have buried bottoms with gravel, sand, and silt substrate, indicating sufficiently low water velocities and bottom roughness for passage of all stream fish in both directions at most, if not all, flows.

All of Duck Creek on Airport property is subject to periodic tidal influence. Tidal peaks in this area tend to be approximately one foot lower than the tide tables indicate for Fritz Cove (Carstensen 1995). Consequently, a predicted tide of approximately 13.5 feet would reach the base of the Radcliffe Road culvert (4.082 feet MLLW). A tide of approximately 16.2 feet would reach the base of culvert just west of Cessna Drive, and it would take only a slight increase in tide level to reach the Cessna Drive culvert. These tidal inundations could assist the upstream movement of fish from the estuary or the Mendenhall River through the culverts.

3.9.1.4 Fish Habitat Function of Duck Creek

Although impacted by development, the lowest, tidally-influenced reach of Duck Creek remains "good" quality habitat for rearing salmonids, and its low marsh component is good habitat for rearing resident and marine fish when tidally inundated. Upstream of the tidally influenced zone, fish habitat is considered to be of a lower quality due to restricted access caused by low and intermittent flows, since some reaches are seasonally dewatered. Overall, within the Airport property, Duck Creek rates as high value habitat where tidally influenced, and moderate-low value habitat above tidal range. Section 3.8.2 provides more information concerning wetland functions in the Northwest Development Area, including Duck Creek.

3.9.2 Jordan Creek

The hydrology, water quality and other stream characteristics of Jordan Creek are described in Section 3.6.6.3. The following sections describe aquatic habitat and fish populations in Jordan Creek, and specific conditions within the Airport property.

3.9.2.1 Habitat

Jordan Creek's aquatic habitat has been affected by most of the same activities as Duck Creek, but to a lesser extent. Consequently, most recent effort has been aimed at protecting the remaining intact habitat. Jordan Creek has spring-fed headwaters, abundant rearing and spawning habitat throughout its length (including swamps and beaver ponds), and no major barriers to fish migration (Bethers et al. 1995). Upstream from Egan Drive, Jordan Creek is relatively natural, with the east side of the channel and valley nearly undeveloped, and substantial public land within the watershed. Downstream from Egan Drive, commercial development has encroached upon much of the stream, with most of its length relocated, channelized, diked, or otherwise altered. Still, it retains features of quality salmonid habitat such as diversity of depth and velocity, overhanging vegetation, undercut banks, spawning gravels, and substantial riparian canopy. Overall, Jordan Creek has healthier salmon populations, more natural habitat, and better water quality than Duck Creek (Table 3-38).

Two large pools in Jordan Creek (each approximately 200 to 300 feet long and six to eight feet deep) along Yandukin Drive are especially noteworthy, as they constitute excellent summer and winter rearing habitat for juvenile coho salmon and holding habitat for adult coho salmon and Dolly Varden char. (Several adult and juvenile coho salmon, and at least 100 Dolly Varden char were observed in these ponds during October 2001). Their juxtaposition near spawning habitats (where pink salmon were observed spawning in August, and coho salmon were observed spawning in October) increases their value to all salmonids.

3.9.2.2 Populations

Jordan Creek hosts most of the freshwater and anadromous fish species that inhabit the area (Table 3-36). It has populations of coho salmon, pink salmon, Dolly Varden char, and cutthroat trout, coastrange and staghorn sculpin, and three-spined stickleback. Jordan Creek was stocked with 4,800 coho salmon in 1970 (Bethers et al. 1995). Peak counts of coho salmon adults from

1969 to 2005 in index reaches, assumed to represent approximately 20 percent of total escapement, have ranged from 18 to 1,396 fish (see Figure 3-32). These numbers suggest a downward trend in abundance until 2001, which was not reflected in other local streams. The record count of 2002 is attributed, in part, to high flows facilitating upstream migration of adult coho salmon.

Jordan Creek was once a favorite cutthroat trout fishery, but was closed to salmon fishing in 1962 and to all fishing in 1983 (Bethers et al. 1995). Some salmon fishing still occurs at the mouth beyond the Airport runway.

3.9.2.3 AIRPORT REACH OF JORDAN CREEK

Within JNU property, Jordan Creek has been modified by channel relocation, encroachment of roads and Airport facilities, and sedimentation from airfield operations. Habitat was surveyed between the taxiway culvert and Yandukin Drive, and also in the 2,200-foot reach upstream of Airport property between Yandukin Drive and Glacier Highway, during August and October, 2001.

Overall, the Airport reach comprises a narrow, small-substrate estuarine channel. It is characterized by having a low gradient, low stream energy, high deposition, and sand and gravel substrate. Nonforested plant communities dominate the riparian zone and sideslope angles are low (dikes, roads, and development encroachment are exceptions to this condition). These channels are considered of high value for spawning and rearing of coho and pink salmon, and spawning chum salmon, and moderate value for spawning and rearing Dolly Varden char (Paustian et al. 1992). Exceptions to this habitat rating are the coarser cobble-lined sections between the taxiway and runway (100 ft long) and between the runway and the small rock dam downstream from it. These short sections comprise narrow, large-substrate estuarine channels, and are considered to have less value to spawning and rearing salmon than small-substrate channel types (Paustian et al. 1992). The large-substrate channel type indicates higher energy and more scour than the small-substrate type.

The Airport reach is used periodically by most of the freshwater and anadromous species known in the vicinity. Species associated with brackish water (e.g., staghorn sculpin and starry flounder) have been captured in minnow traps as far upstream as the first big "elbow" bend upstream from Crest Street. This area's value for spawning, rearing, and migrating salmonids is described below.

Spawning. Good quality gravel substrates occur in several riffles along the Airport reach. However, erosion along several portions of the dikes lining this reach could cause sedimentation of the spawning gravels. During habitat surveys in 2001, no redds were observed between the taxiway culvert and Crest Street. Between Crest Street and Yandukin Drive, several active chum salmon redds (August) and coho salmon redds (October) were observed. Adamus (1987) indicated that reaches both upstream and downstream from Crest Street were used by spawning chum and pink salmon.

Rearing. Jordan Creek below the Glacier Highway rates as "fair" for quality winter rearing habitat for juvenile coho salmon according to the Adamus salmonid habitat functional rating criteria (Adamus 1987) primarily due to of lack of aquatic vegetation. However, the history of salmonid use in these reaches suggests that there is greater value than the Adamus approach indicates. The habitat complexity associated with several deep bend pools (each with substantial woody debris and overhanging vegetation) and sedge-lined split channels between Crest Street and Yandukin Drive contribute to habitat complexity and quality here, but the removal of trees during summer of 2001 nearly eliminated overhead cover, and will likely contribute to bank instability and erosion in this reach.

In 1987, coho salmon fry were documented using the reaches upstream and downstream of Crest Street during spring and summer. At times, these fry were abundant enough to catch 250 in one seine-net haul (Bishop et al. 1987). Fall rearing by juvenile coho salmon was documented in these reaches during October and November 2001, via periodic minnow trapping. Traps generally caught one to nine juvenile coho salmon per set on Airport property, and slightly more near the ponds upstream from Yandukin Drive.

Migration. During fall 2001 (September 8 to November 6), 519 adult coho salmon entered a weir at Crest Street and were passed upstream. The two main periods of upstream movement tended to correspond with increased streamflow and high tidal cycles. In the falls of 2003 to 2005, 227-562 coho adults passed upstream through a weir located just downstream of Yandukin Drive. During the falls of 2003 and 2005, respectively, 87 and 110 pink salmon, 7 and 11 chum salmon, and zero and one chinook salmon passed upstream through this weir. During the fall of 2004, no pink, chum, nor chinook adults were recorded passing upstream through this reach (ADF&G 2006).

During springs of 2001-2005, the ADF&G operated the Yandukin Drive weir to count downstream-migrating fish. Fish captured here were passed downstream into the Airport reach of Jordan Creek. The number of coho salmon caught during this period ranged from nearly 27,000 coho salmon juveniles and smolts in 2001 (ADF&G file data) to just over 6,500 smolts, fry, and juveniles in 2005. Approximately 90 percent of the coho salmon recorded in 2001 were age 1+ juveniles and smolts headed into saltwater to rear or mature. During the springs of 2002 to 2005, other fish captured in this weir included 61-1,028 chum salmon fry, 77-1,133 Dolly Varden char, 1-143 cutthroat trout, 414-1,323 sculpin, and 39-104 sticklebacks.

The above observations, in addition to previous ADF&G index counts of salmon escapement, make it clear that the portion of Jordan Creek on Airport property is a well-used migration corridor for coho salmon adults and juveniles, and is also frequented by chum and pink salmon, Dolly Varden char, and cutthroat trout. It is also clear that forage fish use this reach when tides permit, and that the number of salmonids using this reach may vary substantially from year to year.

Culverts and Special Features. Jordan Creek flows through four culverted road crossings on Airport property at: Yandukin Drive, Crest Street, the taxiway, and the runway. The Airport culverts are described below.

Yandukin Drive has two 11.5-ft wide culverts buried in natural gravel substrate. The creek has semi-natural characteristics (e.g., meanders, gravel bars) within the culverts and they appear easily passable by adult and juvenile fish. The Crest Street culvert is a buried arch 12-feet wide with a sandy bottom. The water is deeper than one-foot during August low flows, and was less than one foot per second (fps) velocity during October at an estimated flow of 10 cubic feet per second (cfs). Its depth, velocity, and substrate appear to be negotiable by any stream-dwelling fish at most, if not all, flows. In addition, it was routinely used as a holding pool by adult coho salmon in October 2001.

The taxiway culvert is an eight-foot diameter round design with a baffled bottom that retains substantial gravel (greater than two feet deep at the upstream end) throughout its length. During August low flows, the minimum water depth in this culvert was 0.5 feet, and velocity was mostly 1-1.5 fps. Combined with the gravel substrate, it appeared to be easily negotiable by adult and juvenile stream fish in both directions.

The runway culvert is also an eight-foot diameter round design but lacks the baffled bottom of the taxiway culvert. There is also a slope break about midway through the culvert, with the upstream half set at a steeper slope than the downstream half. The culvert bottom is mostly exposed corrugated metal, with little natural substrate and few substantial velocity breaks to facilitate fish passage. However, during visits in August and October, 2001, the minimum water depth of 0.7 feet and water velocities of 0.5-1.5 fps were in the range negotiable by adult salmonids, although juvenile salmonids and other small fish may encounter difficulty in the upstream half of the culvert. Fortunately for upstream-migrating fish, this culvert is partially inundated for portions of nearly every day of the year by tides exceeding approximately 2 feet MLLW.

3.9.2.4 Salmonid Habitat Function

Because this portion of Jordan Creek has documented salmon rearing and spawning, it rates overall as "high" salmonid habitat value (Adamus 1987). Section 3.8.2 provides more information concerning overall habitat and wetlands functions and values along Jordan Creek.

3.9.3 Mendenhall River

The Mendenhall River is a glacial river and because of constant turbidity, its fish resources have not been well-studied (Bethers et al. 1995). Information gleaned from tributaries such as Montana and Steep Creeks, in the upper portion of the watershed, help to describe and identify the species that migrate up and down the Mendenhall River. The hydrology, water quality and other stream characteristics of the Mendenhall River are described in Section 3.6.6.1.

3.9.3.1 Habitat

The Mendenhall River was not considered in the Adamus (1987) method for characterizing salmonid habitat values. Its turbid water and open, eroding, rocky banks and bottom are vastly different from the clearer water and vegetated banks and bottoms of most of the smaller salmonid rearing streams in the area. Still, the Mendenhall River may provide substantial rearing habitat for salmonids. It may also provide spawning habitat for chum and pink salmon. Coho salmon are known to spawn in the Mendenhall River between Mendenhall Lake and the bridge on Loop Road, approximately 2 miles upstream from the Airport (Bethers et al. 1995). It should also be noted that the Juneau wastewater treatment plant outfall is located on the Mendenhall River just upstream from Airport property and may have a localized effect on water quality and temperature.

3.9.3.2 Populations

The Mendenhall River system has wild populations of coho salmon, pink salmon, chum salmon, sockeye salmon, cutthroat trout, steelhead/rainbow trout, and Dolly Varden char (Bethers et al. 1995). Coastrange and staghorn sculpin, and three-spined stickleback probably also inhabit the system. Chinook salmon and steelhead were introduced to Montana Creek (the largest tributary) from hatcheries during the 1970s and 1980s, but returns were poor and hatchery programs were discontinued (Bethers et al. 1995). Tens of thousands of salmon, and 30,000 Dolly Varden char, migrate up the Mendenhall River annually (Bethers et al. 1995). The salmon are primarily destined for Montana and Steep Creeks, while Dolly Varden char are primarily destined to overwinter in Mendenhall Lake. In addition, some salmon and Dolly Varden char may also spawn and/or rear and overwinter within the Mendenhall River. Eulachon spawn in the lower reaches of the river adjacent to the runway during spring, and the estuarine river mouth may be used by rearing salmon as well as resident and marine fish.

3.9.3.3 Mendenhall River Adjacent to Airport Property

The Mendenhall River channel does not intersect Airport property. However, the channel does lie in the approach to the west end of the runway and thus creates issues for wildlife hazard management and approach navigation. A portion of the Mendenhall River bank adjacent to west ends of the runway and taxiway has been diked and armored with riprap. This reach of the Mendenhall River is used periodically by large numbers of migrating salmon, trout, char, capelin, eulachon, and other fish. Particularly during the spring, birds have been observed feeding on concentrations of outmigrating trout, char, and salmon and spawning eulachon (Armstrong 2001a). Carcasses of spawned-out pink and chum salmon were observed in this vicinity during August and October 2001; a likely attraction to scavengers.

3.9.3.4 Fish Function and Value

Because the Mendenhall River mouth is so important for large numbers of migrating fish, it is considered "high" value overall for fish functions. Section 3.8.2 provides more information concerning overall habitat and wetlands functions and values along the western end of the runway and Mendenhall River.

3.9.4 Tidal Wetlands

Aside from the tidal wetlands associated with the mouths of Duck and Jordan creeks, the tidal wetlands potentially affected by proposed Airport activities include sloughs and salt marsh habitats adjacent to the east end of the runway and parallel taxiway (see Figures 3-23 and 3-24). Except for some slough habitats that contain flow even when the tide is out, these habitats are available to fish only when inundated by tides. Sloughs lie primarily between elevations 4 and 7 feet MLLW, while salt marsh is comprised of "low marsh" between 5 and 8 feet MLLW, and "high marsh" between 8 and 12 feet MLLW (Bishop et al. 1987). Because sloughs and low marsh habitats overlap in vertical position, and are closely associated from an aquatic habitat perspective, they are treated together in this section.

Although tidal wetlands and salt marshes are among the most productive aquatic habitats, they are also among the most complex, variable, and least-studied. Their complexity is due to frequent and sometimes extreme variations in water level, salinity, currents, flora, and fauna on daily, seasonal, annual, and decadal time scales. The Mendenhall Wetlands are potentially even more complex than most estuaries due to the mixing of glacial Mendenhall River flow with the clearer flows of Jordan Creek and Gastineau Channel, the substantial range of the local tides, effects of glacial rebound, and the impacts of human development.

The species of fish that are likely to use these habitats continuously are those most tolerant of brackish water, including sticklebacks, staghorn sculpins, and starry flounders. Species that are likely to use these habitats only seasonally, but perhaps in large numbers and for critical functions, include juvenile anadromous salmonids and near-shore saltwater fish. Table 3-36 documents the species and habitats used.

3.9.4.1 Sloughs and Low Marsh

These are the estuary habitats of most value to aquatic organisms, as they are inundated more frequently and thus more accessible than high marsh habitats, and they tend to contribute their nutrients and production directly to the estuary via the slough channels (Bishop et al. 1987). Estuarine wetlands, particularly sedge-dominated low marsh habitat, may contribute essential nursery habitat for anadromous fish despite comprising less than 0.5 percent of coastal wetlands (Gerke et al.1999). At tides of approximately 7 feet MLLW, Gerke et al. (1999) found that pink and chum salmon fry were abundant in tidal sloughs and low marsh during April: 88 percent of the pink and 72 percent of the chum salmon were captured from low marsh habitat, the remainder from tidal sloughs. However, pink and chum were not caught during the reference study in these habitats from May through September, nor were many other fish. Using similar methods, however, EIS field personnel found substantial numbers of sticklebacks, sculpins, and Pacific herring larva using the Airport sloughs during August 2001.

Habitat. The primary slough features of the affected area are Zigzag, Miller-Honsinger, East Runway, and Dredge Channel sloughs (see locations on Figure 3-31). Tidal sloughs are characterized by a sand and silt bottom with little or no rooted vegetation. In the summer, patches of algae cover some of the siltier portions of the bottom. Low marsh habitats are found primarily around the perimeter of sloughs and are characterized by sparse to dense patches of Lyngbye sedge, goosetongue, and Pacific alkali grass (Bishop et al. 1987).

Tidal sloughs are depositional channels characterized by low gradient, low energy, high suspended sediment load, and bank sloughing (Paustian et al. 1992). They are considered to be of high value for rearing coho salmon, but low to negligible value for other salmonids (Paustian et al. 1992).

During low tide, virtually all low marsh habitat is dewatered, but water may remain in parts of some sloughs: the lower portion of Zigzag Slough is charged by a small amount of bank seepage, Miller-Honsinger Slough is charged by a flow of approximately 0.5 cfs of brackish water from Miller-Honsinger pond, Dredge Channel Slough holds stagnant brackish water, and East Runway

Slough passes these combined flows. Salinity during August 2001 studies ranged from approximately 3.4 parts per thousand (ppt) in Miller-Honsinger pond to 15.3 ppt at the peak of the high tide.

Populations. A variety of anadromous, brackish, and saltwater species have been observed using these habitats during spring and summer, and may use them during fall and winter also. Winter use, however, may be reduced due to harsh conditions including wind, waves, and scouring ice. Salmonid juveniles and smolts sometimes use these habitats in great abundance during spring, while feeding and acclimating to saltwater (Gerke et al. 1999, Merrell and Koski 1978). Capelin and sandlance (*Ammodytes hexapterus*) may use these habitats for spawning and/or feeding, while Pacific herring likely feed here as larva and juveniles. Staghorn sculpin, sticklebacks, and starry flounder are common (Bishop et al. 1987).

In August 2001, flume nets were used to sample slough and low marsh habitats during the ebbing high tide (7 ft MLLW) in Miller-Honsinger and East Runway sloughs (Figure 3-31). Dipnets were used to sample some of the same areas, mostly during low tide conditions. Table 3-42 documents the species and size distributions captured during this effort. Except near Jordan Creek, where few fish were captured, the high-tide catch was dominated by sticklebacks and Pacific herring larva with fewer staghorn sculpins and one gunnel (Pholidae) larva also captured. The water was fairly clear and no fish were observed escaping capture in the nets, except that hundreds or perhaps thousands of larval fish were so small they passed through the mesh.

Examination of these sloughs during low tide in August revealed that the siltier, more stagnant sloughs harbored a few sculpins and sticklebacks, while the sand-bottomed sloughs with flowing water harbored a greater abundance of these fish, plus juvenile starry flounders. A pool at the outlet of the Miller-Honsinger pond harbored thousands of sticklebacks. No Pacific herring larvae were found during low tide, suggesting that they were washed in as well as out with the high tides. Pacific herring probably do not spawn in this area, as their spawning habitat is considered to be eelgrass and other structure below 2-feet MLLW (Craig Farrington, ADF&G, pers. comm. April 2002). However, these schools of Pacific herring larvae were likely using this intertidal habitat for foraging during a critical phase in their life history, and these intertidal wetlands are probably very important for this herring stock.

Fish Function and Value. Because of their diversity of habitat and aquatic fauna, frequency of inundation, and rarity along the coast, tidal sloughs and low marsh habitat are considered of high value to fish and aquatic organisms. Section 3.8.2 provides more information concerning overall habitat and wetlands functions and values along the sloughs and low marsh habitat.

3.9.4.2 High Marsh

Less is known about the fishery value of high marsh habitats than low marsh habitats. Locally, Gerke et al. (1999) did not sample high marsh estuary habitats, nor other habitat types during tides high enough to inundate the high marsh. Since they have no substantial channels, high marsh habitats were not considered in Paustian et al.'s (1992) channel typing guide.

Table 3-42. Catch by Species and Size Range from Tidal Slough and Low Marsh Habitats during August 6–8, 2001

Site	Condition[1] and Salinity	Stickle-backs	Staghorn Sculpin	Starry Flounder	Pacific Herring Larva[2]
Miller-Honsinger Slough (sand bottom)	ebbing tide 14.9 ppt	263 0.8-2.4"	6 4.0-4.5"	0	58 1.0-1.7"
	low tide 3.4 ppt	100s	100s	100s	0
East Runway Slough off east end of runway (sand bottom)	ebbing tide 15.3 ppt	166 0.8-3.0"	1 4"	0	930 1.0-1.4"
	low tide 7.1 ppt	10s	100s	100s	0
East Runway Slough near Jordan Creek (vegetated low marsh)	ebbing tide 14.8 ppt	2 1.2-1.8"	7 2-4"	0	0
Mouth of Jordan Creek (off runway culvert, cobble bottom)	ebbing tide 15.2 ppt	0	1 1"	0	0
Zigzag Slough (silt/sand bottom)	low tide 10.9 ppt	100s	100s	0	0
Dredge Channel (silt bottom)	low tide 14.9 ppt	10s	10s	1	0

[1] ebbing tide sampled with flume net, low tide sampled by wading and dipnetting.
[2] incomplete estimates – many larvae passed through flume nets uncounted.
ppt = parts per thousand

High marsh habitat is characterized by relatively gentle slopes and fairly dense coverage by rye grass, hairgrass, and foxtail barley (see Section 3.7.2; Bishop et al. 1987). Because it lies above 8 feet MLLW, high marsh is accessible to fish and aquatic organisms less frequently and for shorter periods than low marsh habitats. Because the slope is relatively level and the roughness is high (due to dense stands of tall, rooted vegetation), tidal currents over high marsh tend to be gentle and insufficient to move large amounts of vegetation and detritus as in low marsh habitats. Thus, high marsh tends to transfer fewer nutrients to the rest of the estuary than does low marsh habitat (Bishop et al. 1987). 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.

3.9.5 FLOAT PLANE POND

The Float Plane Pond is not intended to provide habitat for fishery resources even though fish do inhabit the area. Dense growths of ditchweed along the pond margins and shallower arms provide abundant habitat for sticklebacks and aquatic invertebrates which were observed in the pond during cursory site visits in 2001. Staghorn sculpin and starry flounder most likely also inhabit the pond. In the past, trout and salmon have been planted into the pond to provide for a fishery, but this program ceased when it became evident that a fishery, by attracting fish-eating bird species, increases the risks to float planes and all aviation in the area.

Currently, the pond's inlet/outlet to the Mendenhall River includes a screen intended to inhibit fish immigration, and a tidal flapgate that prevents fish emigration. The existing screen has square woven-wire mesh size of 2 square inches, and while it prevents immigration of adult salmon and large fish, it may not preclude the introduction of smaller fish such as capelin, Pacific herring, eulachon, sandlance, sticklebacks, sculpin, and juvenile salmon, trout, and char. Occasional introductions of fish into the Float Plane Pond have stimulated avian predation (see Section 3.9.8, below). However, because fish immigration is inhibited, emigration is blocked, and the Airport strives to keep fish populations low, the Float Plane Pond has low value for fish habitat.

3.9.6 ESSENTIAL FISH HABITAT (EFH)

Congress defined Essential Fish Habitat (EFH) as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (16 U.S.C. 1802(10)). The "waters" incorporated within the definition include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include aquatic areas historically used by fish where appropriate. "Substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities. "Necessary" habitat is that which is required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem. By incorporating "…spawning, breeding, feeding, or growth to maturity" within the definition Congress ensured that a full life cycle of the managed species would be included (EFH Interim Final Rule, 62 FR 66531).

Fish species in the Juneau area for which the NMFS has identified EFH include chinook, chum, coho salmon, pink, and sockeye salmon in fresh and estuarine waters; and sculpins, sablefish (*Anoplopoma fimbria*), Pacific Ocean perch (*Sebastes alutus*), yelloweye rockfish (*S. ruberrimus*), shortraker rockfish (*S. borea*), rougheye rockfish (*S. aleutianus*), dusky rockfish (*S. ciliatus*), Pacific cod (*Gadus macrocephalus*), yellowfin sole (*Pleuronectes asper*), rock sole (*P. bilineatus*), and various "forage fish" in marine waters (Table 3-37).

Of these, chum, coho salmon, pink, and sockeye salmon are known to use the freshwater rivers and estuarine low marsh habitats on and adjacent to Airport property; and sculpins are routinely observed in the fresh and brackish waters on and adjacent to Airport property. Of the sculpins, staghorn sculpins are most often found in the brackish waters (sloughs, low marsh, and intertidal portions of streams), while coastrange sculpin and prickly sculpin (*Cottus asper*) are found upstream from tidal influence. Gerke et al. (1999) also captured yellowfin sole and rock sole from mudflat habitats in the Mendenhall Wetlands, south of the Mendenhall Peninsula approximately 1.5 miles from the Airport.

"Forage fish" including Pacific herring, eulachon, capelin, and sandlance are known to occur in and around the project area. The local Lynn Canal stock of Pacific herring was a commercially important stock until it declined in the early 1980s for unknown reasons. Since then, Pacific herring abundance has increased but has not exceeded the target threshold of 5,000 tons of spawning fish established as a criterion for renewing a commercial fishery. These Pacific herring spawn primarily in Berner's and Auke bays during May and June, and deposit spawn on eelgrass, pilings, and other substrate along the water's edge at tides of up to +2 ft MLLW (Craig Farrington, ADF&G, pers. comm. April 2002). Eulachon have been observed spawning in the Mendenhall River and capelin and sandlance have been observed in estuarine waters near the Airport but make up a minor portion of the forage fish community in the project area. Other EFH species, including chinook salmon, sablefish, Pacific Ocean perch, yelloweye rockfish, shortraker rockfish, rougheye rockfish, dusky rockfish, and Pacific cod, are not regularly associated with the project area.

Thus, all aquatic habitats within and adjacent to the Airport, aside from the Float Plane Pond, constitute EFH for the salmon, sculpins, and forage fish listed above. The water quality and hydraulics of the tidal wetlands, sloughs, and freshwater streams and rivers associated with this area are also considered important factors in maintaining EFH.

3.9.7 Threatened and Endangered Species

No fish or aquatic organisms found in the Airport vicinity are listed as Federally-listed threatened or endangered species. However, Steller sea lions (threatened) and humpback whales (endangered) may be indirectly affected by impacts to some of their forage fish that do use habitats within and near the Airport. These include immature and adult salmon (chum, coho salmon, pink, sockeye) and adult Pacific herring, capelin, sandlance, and eulachon migrating from the vicinity of the Airport. More information on the Steller sea lion and humpback whale is provided in the Wildlife section (Section 3.10.5).

3.9.8 Interactions Among Fish and Birds

Although the occurrence of fish-eating birds was low during surveys in 1999-2000 (USDA 2001), the interaction of fish and birds factors into the management of wildlife hazards at the Airport. Many species of birds that frequent the Airport vicinity may prey on fish. Juvenile salmonids, and particularly saltwater forage fish such as sticklebacks, staghorns and starry flounders, constitute prey for a variety of birds, including great blue herons, mergansers, kingfishers, terns, and gulls. Gulls and eagles scavenge adult salmon carcasses and many species of ducks and other birds such as American dippers consume salmon eggs. Occasional concentrations of spawning and outmigrating fish can stimulate large-scale feeding activity. For instance, as many as 85 bald eagles and hundreds of Bonaparte's gulls and Arctic terns have been observed feeding on sandlance within the intertidal channels south of the Airport dike (Bishop et al. 1987). Similarly, spawning eulachon and outmigrating salmonid juveniles have stimulated feeding by gulls and terns in the Mendenhall River near the west end of the runway (Armstrong 2001a).

3.10 WILDLIFE

This section describes wildlife common to or characteristic of different habitat types present within the project area (defined in Section 3.7 as JNU and immediately adjacent areas) and the landscape area (encompassing JNU, the Refuge, and Miller-Honsinger property). This section also notes high-interest species and federal and/or state-listed threatened, endangered, and sensitive species with potential to occur in the area. For the purposes of this report, the term wildlife refers to avian species and terrestrial and aquatic mammals, amphibians, and reptiles. Invertebrates are not described in detail. Information on fish species that use the marine, estuarine, and aquatic habitats in and around JNU is provided in Section 3.9, Fisheries[8].

The primary sources of information for this section include: Bird Use of the Mendenhall Wetlands (Cain et al. 1988), Birds of Mendenhall Wetlands Checklist (Armstrong and Gordon 2002), the Juneau International Airport Environmental Assessment (USKH 2000), the Wildlife Hazard Assessment for JNU (USDA 2001), a small mammal survey conducted in September 2001, bird surveys conducted by Robert Armstrong and Richard Carstensen from December, 2001, to November, 2002, and a mammal tracking survey conducted by Carstensen in March of 2002. These and other sources are cited where appropriate throughout this section. Appendix F to this EIS shows the common and scientific names of wildlife in the vicinity of JNU, and the habitats with which those species are associated.

3.10.1 CHARACTERISTIC WILDLIFE

Characteristic wildlife is a term used to describe species that are associated with a specific habitat type, and may be considered common or fairly common in their occurrence within that habitat type during at least one season or significant timeframe a year (i.e., summer/breeding season, spring and/or fall migration, winter). Characteristic wildlife may also include species that are not common or fairly common, but are closely associated with one or more elements (e.g., plant communities, water features, etc.) of the habitat type.

For the purposes of this section, 21 of the 23 vegetative cover types identified in Section 3.7 provide some level of habitat value to wildlife. Several of these cover types provide similar habitat value for wildlife. These have been aggregated into 11 wildlife habitat types, shown in Table 3-43. The two remaining cover types, Disturbed and Developed, are assumed to have negligible wildlife habitat value. Characteristic wildlife is described with respect to these ten habitat

8. Appendix F lists the wildlife species discussed below and provides their scientific names, seasonal habitat use, and relative abundance within the landscape area. The lists found in Appendix F do not constitute a complete catalog of all wildlife species known or with potential to occur in the vicinity of the Airport.

types. Detailed descriptions of the 21 cover types comprising these wildlife habitats may be found in Section 3.7.2 of this report. Figure 3-33 depicts the distribution and abundance of habitat types within the project and landscape areas.

Table 3-43. Wildlife Habitat Types within the Project and Landscape Areas

Wildlife Habitat	Landscape Area Vegetation Type	Project Area Vegetation Type	Acreage[1]	
			Project	Landscape
Open water	Open Water	Open Water	86.5	1691.9
Freshwater marsh	Freshwater Marsh; Marestail; Sphagnum Bog	Fresh Sedge Marsh; Fresh Grass Marsh; Marestail; Sphagnum Bog	9.6	13.9
Ditch grass	Ditch Grass	Ditch Grass	4.8	4.8
Unvegetated	Unvegetated	Unvegetated Tidal; Sand; Algae Tidal	33.2	776.4
Estuarine low marsh	Low Marsh	Pacific Alkali Grass – Goosetongue; Pacific Alkali Grass – Lyngbye Sedge; Lyngbye Sedge	34.5	665.4
Lyngbye sedge	Low Marsh (partial)	Lyngbye Sedge	19.9	483.3
Estuarine high marsh	High Marsh	Beach Rye; Coastal Grass Meadow	100.2	962.6
Supratidal	Supratidal	Beach Rye – Beach Pea; Coastal Forb Meadow, Reed Canary Grass; Lichen –Moss	48.4	160.4
Seeded Grassland	Seeded Grassland	Seeded Grassland	42.0	44.4
Shrub-scrub	Shrub-Scrub	Deciduous Shrub-Scrub	22.6	34.3
Woodland	Forest	Deciduous Forest; Mixed Woodland; Spruce Forest	42.7	90.6

[1] Acreages of habitat types calculated for this EIS.

Because of its importance to wildlife, Lyngbye sedge, which comprises a portion of the low marsh habitat type, has been distinguished from the rest of the low marsh community (dominated by Pacific alkali grass, goosetongue, sea milkwort, and/or sand spurry) in Figure 3-33 as well as in the impacts analysis presented in Chapter 4.

Some common local species of birds such as the bald eagle, northwestern crow, and common raven are associated with a wide variety of habitats they inhabit on a year-round basis. These species are, for the most part, not discussed in this section. The bald eagle is, however, subsequently considered in the high interest wildlife section.

3.10.1.1 Open Water Habitat

The open water habitat surrounding JNU including the Mendenhall River, Float Plane Pond, Miller-Honsinger Pond and tidal sloughs, is host to many species of wildlife. Bird species characteristic of these open water habitats include the: surf scoter; bufflehead; Vancouver Canada goose; tundra and trumpeter swans; Barrow's goldeneye; common merganser; short-billed dowitcher greater and lesser scaup; green-winged teal; mallard; northern pintail; northern shoveler; American wigeon; greater and lesser yellowlegs; least, western and semipalmated sandpipers; long-billed dowitcher; arctic tern; Bonaparte's, glaucous-winged, herring, and mew gulls; barn, tree, bank, and violet-green swallows; and belted kingfisher (Cain 1988, USDA 2001, Armstrong and Gordon 2002).

Of birds recorded in the aquatic habitat surrounding JNU, waterfowl species represent the greatest number of individuals, with mallards and Canada geese being the most prevalent. Waterfowl are most often seen along intertidal sloughs and in the Mendenhall River. Their peak abundance occurs in March and April. Shorebird numbers peak in May and September, coinciding with spring and fall migration periods, and the most common shorebirds in the area are sandpiper species (including the western, least, semipalmated, and rock sandpipers). Sandpipers feed along intertidal sloughs, and fly in dense flocks from one feeding location to another. Many gulls are year-round residents and feed along the Mendenhall River. Tree swallow abundance peaks in May and June, and large flocks have been recorded foraging over the intertidal ponds in the vicinity of the project area. Kingfishers forage in Jordan Creek and the float pond and fly over the runway on their way to and from these areas. Kingfishers have a relatively low year-round abundance in the project area (USDA 2001) but are considered fairly common in the landscape area (Armstrong and Gordon 2002).

Marine and terrestrial mammals also occur in the open water habitats in the study and landscape areas. Mammal species that are characteristic of aquatic habitats near JNU include the harbor seal, river otter, and mink. The muskrat is also known to occur throughout southeast Alaska, the Juneau area, and the Refuge. Therefore, it is likely an inhabitant of aquatic areas around the Airport (ADF&G 1990).

3.10.1.2 Freshwater Marsh Habitat

The mallard; pintail; green-winged teal; northern shoveler; American wigeon; greater scaup; Barrow's goldeneye; bufflehead; common merganser; Vancouver Canada goose; semipalmated plovers; spotted, western, and least sandpipers; and short-billed dowitcher are common and characteristic species for the freshwater marsh habitat, particularly during the spring and fall migratory periods. During the summer breeding season, spotted sandpipers and common snipe are likely the most prevalent shorebirds to inhabit these areas. Least sandpipers have nested within the project area (Watson 1979, ADF&G 1990) but nests and adults during breeding season have not been seen in recent years (Armstrong 2002). During the summer, most dabbling ducks using this habitat may be found south and west of the Airport, and near the Mendenhall River. Likewise, shorebirds that remain in the area may be found in this habitat type along the creeks around the

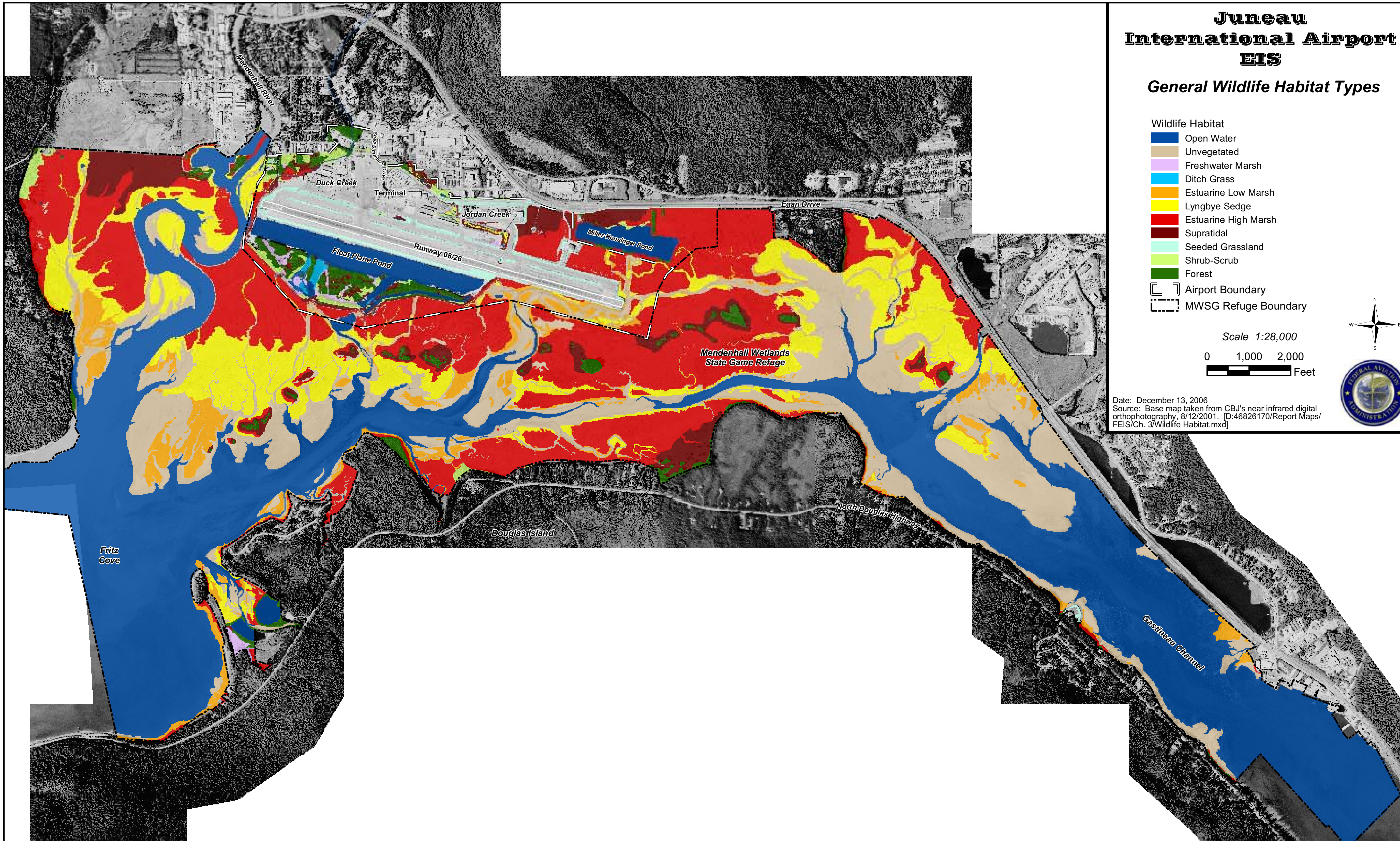


Figure 3-33. General wildlife habitat types.

THIS PAGE INTENTIONALLY LEFT BLANK

Airport (Watson 1979). Other birds that characteristically feed here include the migrating northern harrier; American kestrel; American pipit; savannah, Lincoln's, and song sparrows; northwestern crow; American robin; red-winged blackbird; and greater white-fronted goose (Watson 1979, ADF&G 1990, Armstrong and Gordon 2002).

The Sitka black-tailed deer, river otter, mink, short-tailed weasel, long-tailed vole, masked shrew, and northern bog lemming are species characteristic of freshwater marsh habitats in the study and landscape areas. It is likely that black bears visit this habitat, although probably for short durations considering the favorable surrounding habitat (ADF&G 1990).

Freshwater marshes in southeast Alaska support four species of amphibian: spotted frog, wood frog, rough-skinned newt, and western toad. Of these four species, only the western toad is likely to occur within the study and landscape areas (Armstrong 2001b). According to the Refuge Management Plan (ADF&G 1990), the western toad is the only amphibian that occurs within the boundaries of the Refuge, and therefore, the only amphibian likely to occur on Airport property. Field surveys have not, however, produced any sighting or sign of this species.

3.10.1.3 Ditch Grass

Because of its importance as a forage resource to waterfowl, ditch grass (*Ruppia maritima*), although part of the open water community, is considered a separate habitat for the purpose of this analysis. Ditch grass is an aquatic macrophyte that grows in shallow ponds. Ditch grass is prevalent within the sloughs and other shallow portions of the float pond, and is important to wildlife because of its palatability and the habitat structure it provides to forage fish and aquatic invertebrates. While only 1% of the project area is mapped as ditch grass habitat, this is likely an underestimate and should be considered the minimum amount of this habitat type within the project area. As noted in Section 3.7, the ditch grass community was mapped based on aerial photography. Because the photography was unable to detect ditch grass in the deeper water of the Float Plane Basin and other dredge ponds (e.g., Miller-Honsinger Pond), ditch grass is probably more prevalent in the project and landscape areas than indicated in this document. Ditch grass habitat is important because it tends to receive disproportionately high use by water birds. Canada geese, swans, and dabbling ducks consume all portions of this plant, including the seeds, branches, leaves, and rootstocks (Bishop et al. 1987, ADF&G 1990). In addition, the ditch grass feeds and shelters invertebrates and small fish such as sticklebacks and sculpins. These then attract diving ducks, belted kingfishers, great blue herons, and arctic terns. Ditch grass habitat is an important feeding area during late winter for resident birds, and during spring and fall for migratory birds (Bishop et al. 1987).

Ditch grass habitat is also important to aquatic mammals that feed on the invertebrates and small fish prevalent within these areas. Otters and mink make extensive use of the prey species found in ditch grass habitat (ADF&G 1990).

3.10.1.4 UNVEGETATED

As defined here, unvegetated habitat is primarily comprised of intertidal mudflats along the edges of Gastineau Channel. This habitat includes areas with algal mats as well as areas containing sparse, low marsh vegetation such as Pacific alkali grass, goosetongue, and sea milkwort and/or seaweed (*Fucus* sp.). Unvegetated habitat, when exposed during low tides, supports foraging by migratory shorebirds such as greater and lesser yellowlegs; least, pectoral, spotted, western, and rock sandpipers; dunlin; black-bellied and semipalmated plovers; whimbrel; ruddy turnstone; and short- and long-billed dowitchers. Other common and characteristic birds of unvegetated habitat include Bonaparte's, mew, glaucous-winged, and herring gulls; the Arctic tern; and waterfowl such as the green-winged teal, mallard, northern pintail, northern shoveler, and American wigeon.

A variety of invertebrates reside in unvegetated flats and provide the prey base for many of the species listed above. Fish undoubtedly traverse these areas when they are submerged at higher tides. With the exception of river otters and mink, mammals are unlikely to use this habitat to any substantive degree.

3.10.1.5 ESTUARINE LOW MARSH

Common and/or characteristic species of birds known to use the estuarine low marsh habitat during migration include the great blue heron; tundra and trumpeter swans; greater white-fronted goose; Vancouver Canada goose; dabbling ducks (e.g., mallard and green-winged teal); bald eagle; northern harrier; Bonaparte's, mew, herring, and glaucous-winged gulls; arctic terns; American pipit; and Lapland longspur (Watson 1979, ADF&G 1990, Armstrong and Gordon 2002). Invertebrates and larval stages of small fish species such as sticklebacks, sculpins, capelin, and sandlance, make the shallow-water component of this habitat attractive to waterfowl and shorebirds. The Vancouver Canada goose and white-fronted goose graze and rest in estuarine low marsh habitat from April through June (ADF&G 1990).

This habitat type is home to invertebrates and larval stages of small fish species such as stickle-backs, sculpins, capelin, and sandlance (refer to the fisheries section for more detail on fish species associated with the low marsh habitat). These prey species make the shallow-water com-ponent of this habitat type very attractive to fish-eating mammals. River otters and mink likely make extensive use of this habitat while black bear probably only use it on an occasional basis (ADF&G 1990).

3.10.1.6 LYNGBYE SEDGE

As described above, because of its ecological importance to a wide range of fish and wildlife species, the Lyngbye sedge community, although part of the low marsh zone, is considered sepa-rately from the rest of the estuarine low marsh habitat for the purposes of tracking project-related impacts. Wildlife species characteristic of the Lyngbye sedge habitat include most of those listed above for estuarine low marsh habitat. Lyngbye sedge grows in dense patches that stabilize sedi-ments and provide habitat structure and cover for a variety of invertebrates, epiphytic algaes, and rearing fish. Lyngbye sedge seeds provide food for songbirds while the high protein content of its shoots and roots provide forage for waterfowl, deer, and bear. Probably the most notable user of the Lyngbye sedge habitat type is the Vancouver Canada goose. This species is treated in detail in the high interest wildlife section, below.

3.10.1.7 ESTUARINE HIGH MARSH

This estuarine high marsh habitat is made up of the beach rye and coastal grass meadow cover types. Vegetation within this habitat type consists primarily of grasses. This habitat does not support the diversity and abundance of wildlife species characteristic of the low marsh habitat. Species known to use high marsh include raptors such as the bald eagle, northern harrier, sharp-shinned hawk, American kestrel, and merlin. Great horned and short-eared owls may also forage over high marsh. The American golden-plover and least sandpiper are among the few shorebirds likely to use this habitat and the arctic tern may forage within high marsh as well. (Watson 1979, ADF&G 1990, Armstrong and Gordon 2002). The northern shrike, American robin, Lapland longspur, American pipit, and common redpoll may use this habitat type, with the longspur and pipit occurring in the greatest numbers during migration (Carstensen 2003). Savanna, song, and Lincoln sparrows are known to breed within high marsh habitats in the project and landscape areas (Watson 1979, ADF&G 1990, Armstrong 1995, Armstrong and Gordon 2002).

Mammals characteristic of the estuarine high marsh habitat include those found in estuarine low marsh habitat, though aquatic mammals such as mink and otter would be expected to use high marsh at a lesser frequency and duration than low marsh. Because of the relative infrequency of tidal inundation, shrews and voles, which typically live in vegetation above daily tidal influence, may occur along the edges of high marsh habitat.

3.10.1.8 SUPRATIDAL

Although the term "supratidal" could refer to any habitat above the mean high tide level, for the purposes of this analysis it refers to a grouping of the herbaceous cover types that occur within the elevational zone above high marsh and below the shrub-scrub and woodland communities. For example, supratidal habitat is prevalent on the sandy soils of the small islands that were created by the dredging of Gastineau Channel in the 1960s. In general, the birds characteristic of supratidal habitat are similar to those associated with estuarine high marsh habitat. Where occurrences of supratidal habitat are not frequently disturbed by recreationists and domestic dogs, they provide suitable ground-nesting areas for spotted and least sandpipers, and the savannah sparrow (Watson 1979, ADF&G 1990). Until recently, an occurrence of supratidal habitat located on one of the dredge islands south of the project area supported a nesting colony of arctic terns. This colony did not nest on the island in 2002, possibly due to increasing levels of human and pet-related disturbance (Armstrong 2002).

The mammals that occur in the supratidal zone generally include those found in the low and high marsh habitats with shrews and voles more common due to lack of flooding. While not as productive as Lyngbye sedge-dominated low marsh habitat, supratidal or "uplift" meadows also provide an abundance of high quality forage for deer and bear. Due to their protection from tidal action, supratidal habitats likely also support more species of small mammal such as the masked shrew, and long-tailed and northern red-backed voles.

The western toad is likely the only herpetile with potential to occur in this habitat type and then, probably only where it borders substantial uplands. The majority of supratidal habitats within the landscape area are surrounded by brackish or saline waters and are too small to harbor important freshwater sources. Thus, their potential to support reptiles and amphibians is limited. Furthermore, there are no documented records for the garter snake in southeast Alaska and although it has been sighted up the Taku River it is not known to occur within the project area (Armstrong 2001b).

3.10.1.9 Seeded Grassland

As described earlier in Section 3.7.1, this anthropogenic or man-made habitat type is found on the Airport/taxiway infields, roadsides, lawns, and other managed sites throughout the study and landscape areas. Gulls, common ravens, northwestern crows, black-billed magpies, sandpipers, geese, swans, and ducks feed on worms in the grassy areas adjacent to the runway and taxiways (USDA 2001). These species are observed to move in dense, low-flying flocks over the runway. American pipits forage in the tall grass along the runway, taxiways, and at the end of the airfield, and frequently fly across the runway and taxiways. The abundance of these species coincides with spring and fall migration, except for resident species such as gulls, northwestern crows, and common ravens. Peak abundance for flocking insectivores within the project area occurs in May and June (USDA 2001).

Seeded grassland habitat may also attract Sitka black-tailed deer and support a variety of small mammals that, in turn, can attract avian and mammalian predators.

3.10.1.10 Shrub-Scrub

Shrub-scrub habitat is heavily used for stopover feeding by migrating passerines and, to a lesser extent, nesting habitat for resident songbirds. Characteristic bird species of shrub-scrub habitat include the American robin; common redpoll; Lincoln's, fox, and song sparrows; rufous hummingbird; yellow, orange-crowned, yellow-rumped, and Wilson's warblers. The American kestrel may also be considered a characteristic species of this habitat type due to the large number of insects, small birds, and small mammals available for prey (Watson 1979, USFWS 1988, ADF&G 1990, Armstrong 1995, Kaufman 1996, USDA 2001, Armstrong and Gordon 2002).

With the exception of the aquatic species such as mink and river otter, mammals with potential to occur in this habitat type include most of those species previously listed as using the various other habitat types in the study and landscape areas. Field surveys identified short-tailed weasels (or ermine), deer mice, and masked shrews in shrub-scrub habitats within the project area.

3.10.1.11 Forest

The forest habitat is made up of the deciduous forest, mixed woodland and spruce forest communities. Forest habitats are used for nesting, roosting, and/or feeding by a variety of avian species including the great blue heron, Steller's jay, black-billed magpie, northwestern crow, common raven, bald eagle, American kestrel, American robin, varied thrush, hermit thrush, European starling, tree swallow, American tree sparrow, Dark-eyed junco, yellow-rumped warbler, Townsend's warbler, rufous hummingbird, belted kingfisher, chestnut-backed chickadee, and ruby-crowned kinglet (USFWS 1988, Armstrong 1995, USDA 2001, Armstrong and Gordon 2002).

Mammal species characteristic of woodland habitat include the Sitka black-tailed deer, which use forest habitat for foraging and hiding during the summer. Deer were routinely observed in the Float Pond Woodland during the summers of 2001 and 2002; lack of tracks and other sign indicate that deer do not use the Float Pond Woodland during the winter. Red squirrels, short-tailed weasels, and deer mice were observed and/or tracked in forest habitat within the project area. Although field surveys did not detect any individuals, little brown bats are likely inhabitants of forest habitat on Airport property and the northern red-backed vole, hoary marmot, snowshoe hare, and porcupine, all of which occur in the Mendenhall Valley, may occur in the project area as well. Although the black bear is commonly associated with forest habitat throughout southeast Alaska and tracks have been observed the project area, it is only likely to occur here on an occasional basis.

Amphibians associated with forest habitats in southeast Alaska include the wood frog, western toad and rough-skinned newt. No individuals or sign were observed during general field surveys. and it is unknown whether or not these species occur within the project or landscape areas.

3.10.2 PROJECT AREA

Because of the diversity of available habitat, many bird species occur within the project area on or immediately near the Airport. A total of 167 species have been observed on Airport property (Armstrong and Gordon 2002). This represents 73% of the total bird species documented for all of the Mendenhall Wetlands. Eighty-six (86) of these bird species occur every year on Airport property. These include species that are classified by Armstrong and Gordon as common, fairly common and uncommon. The remaining 81 avian species are considered rare or accidental, and occur on Airport property occasionally (perhaps one or two times per year; Armstrong 2002).

The species of birds considered common or characteristic at a particular time of the year on Airport property include the following: great blue heron; Canada goose; green-winged teal; mallard; northern pintail; northern shoveler; American wigeon; greater scaup; Barrow's goldeneye; common merganser; bald eagle; northern harrier; semipalmated plover; greater and lesser yellowlegs; spotted, western, least, and pectoral sandpipers; short-billed dowitcher; common snipe; Bonaparte's, mew, herring, and glaucous-winged gulls, Arctic tern; rufous hummingbird; belted kingfisher; black-billed magpie; northwestern crow; common raven; tree swallow; barn swallow; ruby-crowned kinglet; American robin; varied thrush; American pipit; orange-crowned, yellow, yellow-rumped, and Wilson's warblers; savannah, song, and Lincoln's sparrows; and pine siskin (Armstrong 2002).

Several of the aforementioned species are thought to be regular nesting birds within the project area. These include the green-winged teal; mallard; bald eagle; semipalmated plover; spotted sandpiper; common snipe; rufous hummingbird; northwestern crow; common raven; ruby-crowned kinglet; hermit thrush; American robin; orange-crowned, yellow, yellow-rumped, and Wilson's warblers; and savannah, song, and Lincoln's sparrows (Armstrong and Gordon 2002).

Humans and their dogs are among the most common mammals within the vicinity of the project area. With regard to wild mammals, the river otter and mink are characteristic of open water and adjacent upland habitats, and the Sitka black-tailed deer occurs in a variety of upland and wetland habitats throughout the project area.

3.10.3 LANDSCAPE AREA

The boundary of the landscape area for wildlife is identical to that defined and described in Section 3.7.2. Figure 3-33 depicts wildlife habitat types within the study and landscape areas. This section discusses wildlife use within the landscape area. Some of the species mentioned are described in greater detail within other sections of this report (e.g., bald eagle and Canada goose).

A total of 230 species of birds have been documented as occurring within the landscape area (Armstrong and Gordon 2002). This represents 77% of the 300 bird species documented for the entire Juneau Area, from Taku Inlet to Berners Bay (van Vliet et al. 2001), and 69% of the 335 bird species documented for all of southeast Alaska, between Dixon Entrance and Yakutat (Armstrong and Gordon 2001). Because of the relative paucity of comparable wetland and estuarine habitat in southeast Alaska, the Mendenhall Wetlands provide a critical link in the coastal estuaries that support these species (Cain et al. 1988). The species list for the landscape area presently includes 40 species of shorebirds and 34 species of waterfowl.

Approximately 20 bald eagle nests border the Mendenhall Wetlands and approximately 35% of these may be active in any given year (Cain et al. 1988). At times, the wetlands seem to draw a large number of eagles. Up to 85 have been counted at one time feeding on eulachon and sand lance. The Mendenhall Wetlands is no doubt quite important to the maintenance of the Juneau-area eagles (Armstrong 2002).

Sea ducks are frequently observed at the mouth of the Mendenhall River in greater numbers than elsewhere in southeast Alaska, and likely include the surf and white-winged scoters (Armstrong and Gordon 2002). Accordingly, this may be an important feeding area for these birds. They feed primarily on mollusks, but also consume crustaceans, aquatic insects, small fishes, echinoderms, marine worms, and plant material consisting of sea lettuce, pondweeds, and sedges (Kaufman 1996).

Arctic terns have nested in a few areas surrounding the project area. In recent years, breeding colonies have occupied the dredge spoil islands, a rock in Mendenhall Lake, and another location near the Mendenhall Glacier Visitor Center. The landscape area is an important feeding area for one of the largest concentrations of Vancouver Canada geese in southeast Alaska. In the northern half of southeast Alaska (north of Petersburg), a population estimate recorded 9,842 individuals, with 694 of those occurring on the Mendenhall Wetlands. Out of 71 tidal flat areas surveyed, Swan Cove had the greatest abundance of Vancouver Canada Geese (11% of total birds observed), the Mendenhall Wetlands had the second greatest abundance (7.1% of total birds observed), and the area with the third greatest abundance had half the number of birds observed on the Mendenhall Wetlands. Swan Cove and Mendenhall Wetlands were recorded as collectively hosting 18.1%

of Vancouver Canada Geese wintering in the northern half of southeast Alaska, and the remaining 81.9% of individuals were dispersed throughout 69 other tidal flat areas (Hodges and Conant 1986).

Marbled murrelets are common in open marine waters adjacent to the landscape area (Armstrong and Gordon 2002). These small seabirds feed upon small fish (e.g., capelin, sand lance, and herring) and crustaceans (Kaufman 1996). Because of murrelet abundance during three-quarters of the year (excluding the fall) (Armstrong and Gordon 2002), it is likely that the Mendenhall Wetlands provide an important food source for this species.

3.10.4 High-Interest Species

High interest species are those that receive high levels of public attention and are, consequently, of high economic and/or social value. The species and species groups listed in Table 3-44, below, have been identified as high-interest species during public and agency scoping activities associated with the proposed project. Concerns may be based on a species' popularity as watchable wildlife, controversy involving their management, their value as a game species, or designation as a safety hazard for aircraft. For more detailed information on high-interest species, refer to Technical Working Paper #4 – Biological Resources (SWCA 2002).

3.10.5 Threatened, Endangered, and Sensitive Wildlife Species

This section describes the conservation status and natural history of, and habitat use by federal and/or state-listed threatened, endangered, and sensitive (TES) species, in the study and landscape areas. Threatened and endangered species include those species federally listed under the Endangered Species Act (ESA) of 1973 (as amended). The National Oceanic and Atmospheric Administration, NMFS is responsible for protecting most marine species including those that are listed as threatened or endangered under the ESA. The FWS is responsible for protecting all freshwater aquatic and terrestrial species that are listed as threatened and endangered under the ESA, as well as the marine mammals walrus, polar bear, and northern sea otter. The only two federally listed species with potential to occur in the vicinity of the project area are the Steller sea lion and the humpback whale. Both of these species are under the regulatory jurisdiction of NMFS. In addition to the analysis presented in the EIS, a Biological Assessment (BA) is being prepared to determine potential impacts on federally listed species in accordance with the consultation requirements of Section 7 of the ESA.

Two other government agencies involved with the proposed project maintain lists of sensitive species. These include the USDA-Forest Service for the Tongass National Forest (the Forest), and the State of Alaska for the ADF&G. The TNF designates "sensitive" species and ADF&G designates "species of special concern." For the purposes of this section, the term sensitive is used generally and refers to both "sensitive" species and "species of special concern." Table 3-45 lists TES Wildlife Species likely to occur in southeast Alaska, their regulatory/conservation status, and their potential to occur within the study and landscape areas. Sections following provide descriptions for each of the species.

Table 3-44. High-interest Wildlife Species within the Project and Landscape Areas

Species/ Group	Preferred Habitats	Distribution/Abundance
Migratory Waterfowl	Open Water, Ditch Grass	Float Plane Basin (breeding & foraging); Otter Pond (foraging) / Mallards most numerous with Cain et al. (1988) counting average of 186 individuals per survey. Northern shoveler, northern pintail, American wigeon, Canada goose (see below), green-winged teal, blue-winged teal, gadwall, and lesser scaup known to breed in Float Plane Basin.
Swans	Open Water, Ditch Grass	Float Plane Basin and sloughs, mouth of Mendenhall River and other areas with suitable forage resources such as aquatic plants, sedges, rushes, algae, and grasses.
Vancouver Canada Goose	Open Water, Ditch Grass, Estuarine Low Marsh (particularly Lyngbye Sedge), Seeded Grassland	Float Plane Basin & sloughs, Refuge when and where not harassed by hunters and recreationists / 500-1,200 individuals have been observed in the landscape area at one time. Vancouver Canada geese have been observed loafing and foraging in seeded grassland habitat adjacent to the Airport runway.
Bonaparte's Gull	Open Water, Unvegetated, Low Marsh, High Marsh	Mouth of Duck Creek and Mendenhall River / Common to the landscape area in the spring and fall, uncommon in the summer
Great Blue Heron	Open Water, Ditch Grass, Low Marsh	Shallow waters associated with Jordan Creek, Float Plane Basin sloughs, tide channels / 3 herons observed along Jordan Cr between Crest St. and Yandukin Drive at one time
Shorebirds	Estuarine Low Marsh, Unvegetated	Float Plane Basin, Otter Pond, and tidal channels adjacent to Airport dike / Greater and lesser yellowlegs, short- and long-billed dowitchers forage in the study and landscape areas during migration. Common snipe, spotted sandpiper, and semipalmated plover nest within the project area.
Bald Eagle	All habitats used to some extent for hunting; woodland habitat used for nesting	Floatpond woodland, mouth of Mendenhall River / Nesting pair in Floatpond Woodland with other pairs using area on opportunistic basis; 50-75 eagles observed feeding on eulachon in lower Duck Creek. Year-round resident.
Other Raptors	All habitats	Hawks, falcons, and owls frequent the study and landscape areas during migration
Rufous Hummingbird	Supratidal and High Marsh (in Duck Creek and northeast Airport areas only)	Floatpond woodland and other areas where fireweed and other forbs are common.

Table 3-44. High-interest Wildlife Species within the Project and Landscape Areas, continued

Species/ Group	Preferred Habitats	Distribution/Abundance
Swallows	Open water, Freshwater Marsh, Ditch Grass, Estuarine Low and High Marsh	Floatpond woodland and sloughs, estuarine marshes in study and landscape areas / Six species occur with peak abundances during fall staging and spring and fall migration.
Corvids	All habitats used for foraging, Woodland used for nesting	Throughout study and landscape areas, floatpond woodland used for nesting / Black-billed magpie, northwestern crow, common raven frequent the area.
Songbirds	Estuarine High Marsh, Supratidal, Shrub-Scrub, Woodland	Throughout study and landscape areas / American robin, Lincoln's sparrow, savannah sparrow, song sparrow, bank, yellow warbler, Wilson's warbler, orange-crowned warbler, yellow-rumped warbler, ruby-crowned kinglet, western wood pewee, chestnut-backed chickadee, pine siskin, and hermit thrush known to breed in area.
Black Bear	All habitats except Open Water, Unvegetated, Ditch Grass, and Seeded Grassland	Black bears may occur on a transitory basis throughout the study and landscape areas.
River Otter	Open Water, Freshwater Marsh, Ditch Grass, Estuarine High and Low Marsh, Shrub-Scrub, Woodland	Float Plane Basin and woodland, Otter Pond / Up to four otters commonly observed within the project area.
Sitka Black-tailed Deer	All habitats except Ditch Grass, Open Water, and Unvegetated	Nearly all areas and habitats within the study and landscape areas may be used on a transitory basis with the Floatpond Woodland favored for its abundant forage, browse, and hiding cover / Six deer were observed in floatpond woodland at one time during 2001 field surveys.

Table 3-45. Threatened, Endangered, and Sensitive Wildlife Species Occurrence in the Study and Landscape Areas

Common Name[1]	TES Status[2]	Potential To Be In / Known Occurrence In	
		Project Area	Landscape Area
Steller Sea Lion	T	Yes/No	Yes/Yes
Humpback Whale	E	No/No	Yes/Yes
Trumpeter Swan	SS	Yes/Yes	Yes/Yes
Queen Charlotte Goshawk	SS, SC	Yes/Yes	Yes/Yes
American Peregrine Falcon	SC	Yes/Yes	Yes/Yes
Arctic Peregrine Falcon	SC	Yes/Yes	Yes/Yes
Peale's Peregrine Falcon	SS	Yes/Yes	Yes/Yes
Olive-sided Flycatcher	SC	Yes/Yes	Yes/Yes
Townsend's Warbler	SC	Yes/Yes	Yes/Yes

[1] Scientific names are provided in Sections 3.10.5.1 through 3.10.5.7
[2] E = federally endangered, T = federally threatened, SS = USFS sensitive species, SC = ADF&G species of special concern.

3.10.5.1 Steller Sea Lion

The Steller sea lion (*Eumetopias jubatus*) is federally listed as both threatened and endangered. It is endangered west of Cape Sucklin, Alaska, and threatened throughout the remainder of its range, including the Juneau area. It is distributed throughout the North Pacific Rim from Japan to central California, and 70% of the worldwide population is found within the state of Alaska. Steller sea lions gather on well-defined, traditionally used haul-outs and rookeries to rest and breed, respectively. The nearest major haul-out to the project area is Benjamin Island, approximately 20 miles to the northwest of the project area. This haul-out site has been designated under the Endangered Species Act as Critical Habitat for the Steller sea lion.

Steller sea lions hunt schooling species of fish from the intertidal zone to the continental shelf. They have also been known to prey upon harbor seal pups, although this is thought to be quite rare. Preferred prey species include pollock, flounder, herring, capelin, Pacific cod, five species of Pacific salmon, rockfish, sculpin, Atka mackerel, and cephalopods such as squid and octopus. It should be noted that several of these species are produced within the estuarine habitats of the study and landscape areas (see Section 3.9, Fisheries).

While they have been observed in the western portion of the landscape area, Steller sea lions are not known to occur within the project area. However, because harbor seals frequent the lower Mendenhall River, sea lions could also use this area to hunt. The potential exists for Steller sea lions to occur in the portion of the project area that extends into the current river channel, i.e., west of the runway.

3.10.5.2 HUMPBACK WHALE

The humpback whale (*Megaptera novaeangliae*) is federally listed as endangered throughout its range. It is distributed seasonally throughout the world's oceans, from the Arctic to the Antarctic, with distinct populations located in virtually every sea. Presently, there are roughly 2,000 individuals in the southeast Alaska population. Driftnets, eutrophication (excessive nutrient loading, oxygen depletion, and commonly algae development) and pollution (most notably polychlorinated biphenyls) are currently the most common threats to humpback whale populations (Gardner 1993).

In southeast Alaska, Humpbacks feed on herring, sand eel, capelin, and mackerel (Bryant et al. 1981; Dolphin 1987a: Dolphin 1987b). Herring, a major food source for the humpback whale, has undergone substantial population declines in recent decades. The tidal sloughs within the study and landscape areas are considered an important source of herring larva for Auke Bay (Mattes 2003). Although the population of herring in Auke Bay is generally believed to be on the rise, it is still considered a weak population and the continued health of the sloughs may be an important factor in the recovery of herring, and potentially humpback whales, throughout these areas. Humpback rarely use Gastineau Channel and do not occur in the project area; however, they are known to frequent Fritz Cove, located about 1¼ miles west of JNU at the edge of the landscape study area.

3.10.5.3 TRUMPETER SWAN

The trumpeter swan is listed as a sensitive species by the U.S. Forest Service (USFS 2000). In Southeast Alaska they nest in the Yakutat forelands and Chilkat River valley and many winter in Blind Slough near Petersburg. The trumpeter swan is considered to be uncommon during spring and fall migration periods on the Mendenhall Wetlands (Armstrong and Gordon 2002) and they occasionally stop during migration on the Float Plane Basin where groups of 5 to 10 individuals have been seen (USDA 2001).

3.10.5.4 QUEEN CHARLOTTE GOSHAWK

The northern goshawk is considered rare or uncommon in the Juneau area during spring, summer, and fall, and rare to absent in winter (van Vliet et al. 1997, Armstrong and Gordon 2002). The Queen Charlotte goshawk (*Accipiter gentilis laingi*), a subspecies of the northern goshawk, has been identified by the Tongass National Forest's Regional Forester as a sensitive species (Forest Service 2000), and by the ADF&G as a species of special concern (ADF&G 2000). Although most authors suggest that a portion, if not all, of the goshawks in southeast Alaska belong to the Queen Charlotte subspecies, another subspecies, *A. g. atricapillus*, may also be present (Iverson et al. 1996). However, until more definitive information is available, the goshawks that occur in the landscape area should be considered the Queen Charlotte subspecies. The northern goshawk occurs within the project area on a rare basis, generally perching or hunting within the Float Pond Woodland (Armstrong and Gordon 2002).

3.10.5.5 Peregrine Falcon

The peregrine falcon is considered rare in the Juneau area during the spring and fall and absent during the summer and winter (van Vliet et al. 1997, Armstrong and Gordon 2002). Thus, it is unlikely to breed in the area. Regardless, all three subspecies of concern may occur in southeast Alaska on a transitory basis during migration. The American peregrine falcon (*Falco peregrinus anatum*) and the arctic peregrine falcon (*F. p. tundrius*) are listed as species of special concern by the ADF&G (ADF&G 2000). The Peale's peregrine falcon (*F. p. pealei*) is listed as a sensitive species by the Tongass National Forest's Regional Forester (Forest Service 2000). All three of these subspecies may occur in southeast Alaska during migration, but only the Peale's peregrine falcon is known to nest in the region (Armstrong 2002). Because peregrine falcons typically hunt over open areas (Campbell et al. 1990), most of the landscape area and portions of the project area provide potentially suitable habitat for this species.

3.10.5.6 Olive-sided Flycatcher

The olive-sided flycatcher is listed as a species of special concern by the ADF&G (ADF&G 2000). This species has declined throughout its breeding range in the lower 48 states and its nesting status in Alaska is uncertain. Loss of wintering habitat in South America is considered to be the main reason for population declines in the olive-sided flycatcher (Wright 2000). The olive-sided flycatcher is considered an occasional breeder in the Juneau area (van Vliet 1997), but its occurrence within the study and landscape areas is rare (Armstrong and Gordon 2002).

3.10.5.7 Townsend's Warbler

The Townsend's warbler is listed as a species of special concern by the ADF&G (ADF&G 2000), and their population trend of in Alaska has yet to be determined (Pogson et al. 1999). This species, along with many other migratory species, spends its winter in the highlands of northern Mexico and in Central America as far south as Costa Rica. There has been a long-term decline in migratory species' abundance throughout these wintering locations (Pogson et al. 1999). Within the project area, Townsend's warbler is considered an uncommon visitor to shrub-scrub and forest habitats during spring and fall migration, and is not present during the summer and winter (Armstrong and Gordon 2002).

3.11 Cultural Resources

Section 106 of the National Historic Preservation Act (NHPA) of 1966 (as amended) and its implementing regulation, 36 CFR Part 800, mandate that the FAA consider potential impacts to historical properties resulting from any project with a federal nexus (i.e., funding, permitting, etc.). Section 106-protected properties are historic or cultural sites either listed on or eligible for listing on the National Register of Historic Places (NRHP), Pursuant to this mandate, cultural resource investigations were undertaken in association with the proposed projects at JNU.

3.11.1 AREA OF POTENTIAL EFFECT

The area of potential effects (APE) for cultural resources was defined as all previously undisturbed and unsubmerged locations that are being considered for development or alteration in relation to the proposed project, including those on and off Airport property. Figure 3-34 shows these locations. For the purpose of this EIS, the APE for cultural resource investigations was limited to those areas that could be physically disturbed as a result of project implementation. While cultural resource APEs may also include broader areas that could be subject to visual and auditory impacts, such broad designation was unnecessary for this EIS as none of the projects would cause appreciable changes in the visual nature of the Airport or in aircraft approach or departure patterns. The APE for cultural resources was approved of by the Alaska SHPO as part of granting the permit to conduct the cultural resources inventory for the EIS.

The on-Airport study area included the Northwest Development Area (around Duck Creek), two parcels of land in the Northeast Development Area near the existing TEMSCO facility, two parcels of land in the Jordan Creek Area, the proposed RSAs east and west of the existing runway and taxiway, and the area between the Airport float plane pond and the Dike Trail. The float plane pond, which may be dredged to provide fill material for Airport projects or to remove vegetation attracting waterfowl, was excluded from the cultural resource APE. The exclusion of the pond from the cultural resource inventory was decided as part of the pre-inventory consultation with the Alaska SHPO, due to the inundated nature of the area, the magnitude of historical dredging activities that would have likely removed or significantly altered cultural resources that may have been present, and the resulting low probability of this area to yield intact cultural resources of scientific, religious, or traditional significance.

Off-Airport cultural resource study areas included a small parcel and access route on Pedersen Hill, the existing CBJ gravel pit, the future CBJ gravel pit, and the Stabler Point Quarry. The gravel pits and quarry were evaluated because of the potential for riprap and fill materials to be imported from CBJ-owned borrow sites. Pedersen Hill was evaluated because it had been considered a candidate site for relocation of the RCO.

3.11.2 STUDY APPROACH

First, a search of the site and project files at the Office of History and Archaeology in Anchorage was conducted by SWCA. Consultation with the Alaska State Historic Preservation Office (SHPO) was also initiated at that time. The purpose of the literature review was 1) to identify whether or not the Airport or portions of Airport property had been previously inventoried for cultural resources, 2) to identify any known and previously documented cultural resource sites within the study area, and 3) to provide some indication of the potential for encountering cultural resources during the field surveys.

No cultural inventories had previously been undertaken within the on-Airport or off-Airport study areas. One cultural resource site on Airport property, the LORAN monitoring facility just outside the Northwest Development Area (site JUN-718), has been documented previously. The site had been recently identified and described, and no site record was available at the Office of History and Archaeology during the literature review. A specific technical report outlining the methods used for and the results of the cultural resources investigations described has been prepared and submitted to the SHPO for review and concurrence as part of the Section 106 review process under the NHPA (Ellis 2002).

In addition to the field investigations, local Native American/Native Alaskan groups and individuals were consulted as part of the Section 106 review process under the NHPA (Table 3-46). This consultation took place between July and September 2001, and the results are incorporated in this report as they relate to the specific cultural resource study areas. A text of the oral history gleaned from interviews conducted as part of the consultation is provided in Appendix G.

Table 3-46. List of Individuals and Organizations Contacted as Part of the Native American Consultation Process

Warren Heisler, Assistant Regional Director, Bureau of Indian Affairs
Marie Olson, Auke Tlingit Elder
Rosita Worl, Director, Sealaska Heritage Foundation
Bob Sam, Auke Tribal Member
Corrine Garza, Tlingit and Haida Indian Tribes of Alaska
Rosa Miller, Auke Tlingit Elder
Randy Wanamaker, President, Goldbelt, Inc.
Ed Kunz, Jr., Auke Tlingit Elder
Dennis Demmert, Grand Secretary, Alaska Native Brotherhood
Andy Ebona, President, Alaska Native Brotherhood - Juneau Local Camp
Dorothy Owen, Douglas Indian Association
Janice Criswell, Juneau Area Haida/Tlingit Weaver
Albert Wallace, Auke Tlingit Elder
Gary Gillette, City and Borough of Juneau
Cecilia Kunz, Tlingit Elder
Delores Churchill, Southeast Alaska Native Weaver
Judy George, Tlingit and Haida Community Council

Alaska's first, and as yet only, formal Traditional Cultural Property (TCP) is located within the Auke Bay area. TCPs are sites or locations that have specific importance to a cultural/heritage group as a source of group identity. TCPs are defined based upon several factors, including their relationship to traditional subsistence practices, group myth and ideology (particularly origin myths), and specific religious or cultural practices. The Auke Cape TCP was defined in relation to ethnographic use of the area as a traditional village site and subsistence area for the Auke people.

In general, to be designated as a TCP, a property must be at least 50 years old and must be able to be geographically defined. However, in practice, boundaries are sometimes left only loosely defined, since group ideologies, group memory, and folk knowledge can be nebulous. Most of the Auke Bay TCP boundaries are roughly defined, but the eastern boundary towards JNU is not and should be considered fluid. However, other than the specific issues outlined below for individual study areas, no concerns related directly to potential impacts to the overall TCP were raised by

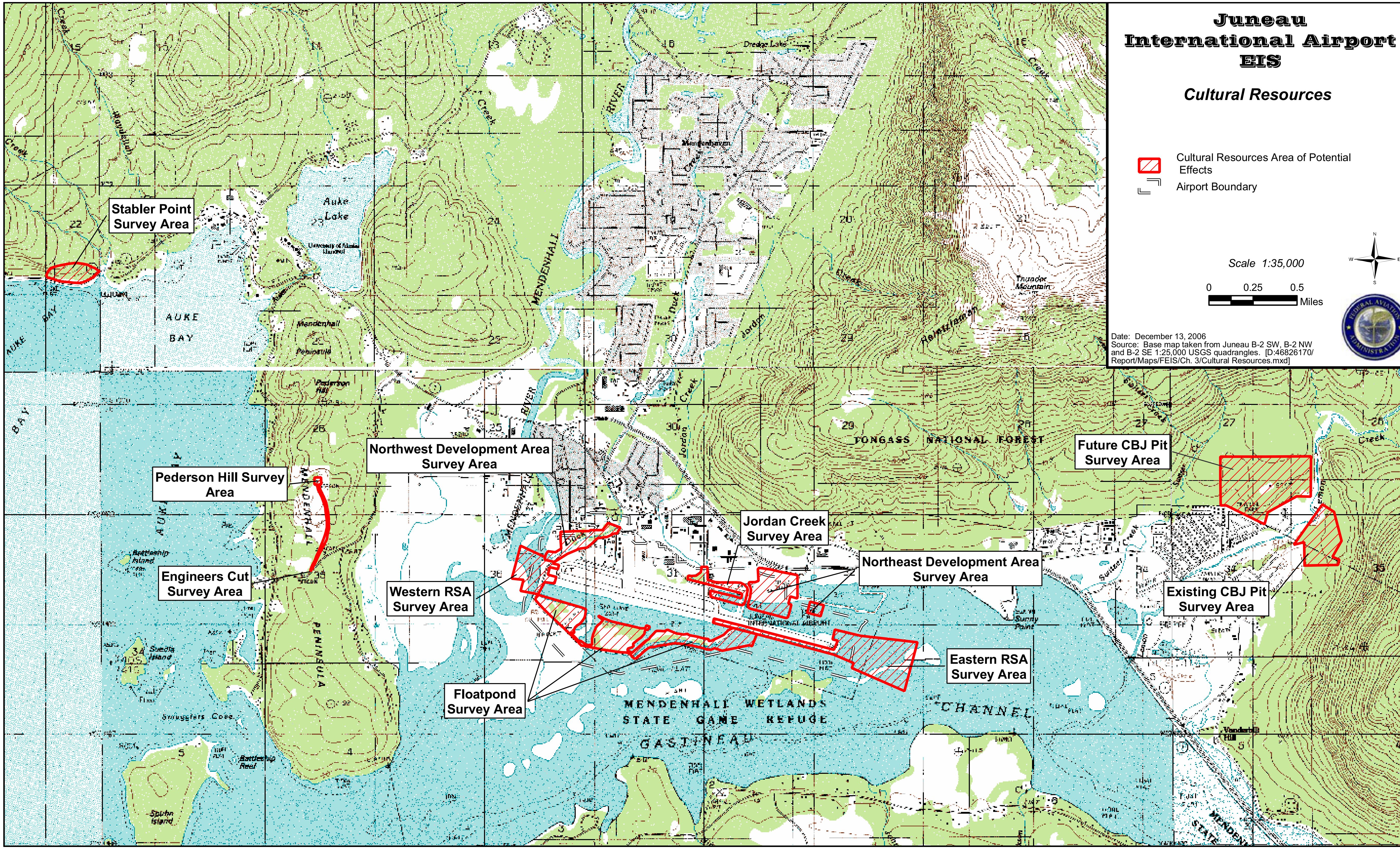


Figure 3-34. Areas of potential effect for cultural resources.

THIS PAGE INTENTIONALLY LEFT BLANK

consulting parties or identified by the EIS project team. Special consideration should be given to any development actions proposed by JNU or CBJ that would take place within the Auke Bay area, particularly the area west of the Mendenhall Peninsula and around Auke Cape. As detailed plans are developed for any such projects or actions, additional consultation with local native groups and individuals may be necessary to adequately assess potential impacts to the Auke Cape TCP.

3.11.3 CULTURAL RESOURCES SURVEY RESULTS: ON-AIRPORT STUDY AREAS

The cultural resources study area consists of several parcels of land located both on and off Airport property. This section addresses the results of the field investigations of the on-Airport parcels only.

3.11.3.1 NORTHWEST DEVELOPMENT AREA

The Northwest Development Area encompasses the land within JNU boundaries in the vicinity of Duck Creek, including the Airport fuel farm. The historical record indicates that bunkers, or revetments, for military aircraft associated with a World War II era encampment were located in the general vicinity of Duck Creek, northwest of the passenger terminal. Unfortunately, the only historical maps illustrating the military facilities that could be found were of such gross scale that no precise pinpointing of former features was possible.

Consultation with native informants revealed additional information concerning possible past uses of the Northwest Development Area. According to one native elder, the Cropley family smokehouse was located near the mouth of Duck Creek and was purchased and dismantled "a long time ago," possibly during World War II (see also Goldschmidt and Haas 1998:39, 113).

A field reconnaissance of the Northwest Development Area was conducted in July 2001. Vegetation, mostly spruce, devil's club, tall grasses, and riparian flora, was dense throughout the survey area, limiting ground visibility. During these field investigations, two pieces of a military-issue mess kit and a small, potentially historical site (Alaska Heritage Resources (AHRS) site number JUN-923) consisting of a steel propane tank, a possible generator, and a set of four concrete footings were documented. The mess kit, which included a tin cup with a belt hook and a tin bowl/pan, constitute an isolated find. As such, it is not eligible for consideration under the criteria of the NRHP.

The age of Site JUN-923 is questionable, but it is likely that it meets the minimum age requirement of 50 years to be considered historical. The site's features likely represent the earlier military activity in the area. In addition to the propane tank, which measures roughly 4 feet 4 inches (1.31 meters) long by 2 feet 6 inches (0.76 meters) in diameter and had no visible markings, the site includes four concrete and wood footings with rebar protruding from the centers. Three of the footings appear to be in the original locations, while one has been uprooted by vegetation. The footings measure approximately 1 foot 4 inches (40 centimeters (cm)) square, and, based upon the uprooted footing, are 6 inches (15.24 cm) in height. The footings are spaced approximately 2 feet 10 inches (86 cm) apart north-south and 6 feet 3 inches (1.9 meters) east-west. It is unclear what the footings may have held. Approximately 10 feet (3 meters) to the southeast of the propane tank is a piece of machinery that appears to be a small generator. The item is box-shaped and measures 2 feet 1 inch (63 cm) in height by 1 foot 8 inches (51 cm) wide by 1 foot 8 inches (51 cm) in depth. The artifact is in poor condition and exhibits moderate rusting. There were no markings or noteworthy characteristics visible on the artifact. Owing to dismantling, erosion, and an alteration of the setting of the items, the site lacks integrity of setting, feeling, association, and workmanship. The site's integrity of materials, location, and design has also been severely compromised.

The FAA, in consultation with the Alaska SHPO, has determined this site to be ineligible for the NRHP as per 36 CFR 800.4. The Duck Creek area appears to have been fairly heavily used by both the local native population and by the U.S. military. Evidence of this previous activity may still be present within the area. However, extremely dense vegetation cover obscures the ground surface, making a thorough examination of the area for surficial cultural resources exceptionally difficult.

3.11.3.2 Northeast Development Area

The Northeast Development Area consists of two parcels of land totaling roughly 40 acres located near the existing TEMSCO facility to the north of the runway/taxiway and east of the private hangars. One of the two parcels consists of the undeveloped land surrounding the current RTR and ASOS facilities. The second parcel is smaller and is located east of the TEMSCO property. Field survey in this area consisted of two archaeologists walking parallel transects spaced no more than 30 feet (10 meters) apart back and forth over the subject parcels until all portions of the parcels had been inspected. Though grass cover was thick, ground visibility was generally good. No cultural resources were noted within either of the two survey parcels.

3.11.3.3 Jordan Creek Area

The Jordan Creek study area consists of two parcels of land located east of the terminal area, along both sides of Jordan Creek. The natural flow of Jordan Creek has been altered through previous rerouting and piping of the channel during development of the Airport. Just prior to the cultural resource field studies, trees lining either side of the creek and scattered throughout the rest of the study parcel had been clear-cut. The activity surrounding removal of the trees also eliminated most ground-level vegetation. As such, ground visibility within the study was good. The survey area was inventoried by two archaeologists walking parallel transects spaced no more than 30 feet (10 meters) apart across both study parcels. No cultural resources were observed in the area.

3.11.3.4 Runway Safety Areas (RSAs)

The RSA study area consists of two parcels of land, each located at one end, the west and east, of the existing runway/taxiway. Also, the study included a narrow strip of land along the south side of the eastern half of the runway. The western parcel, for the purpose of the cultural resources investigations, extends across the Mendenhall River to the west side of the waterway. The eastern parcel extends from the end of the runway/taxiway eastward into the tidal flats and along the south side of the runway as described above.

Vegetation cover was thick in the western survey parcel, was composed largely of tall grasses, and made observing the ground difficult. The study area was inventoried by two archaeologists walking parallel transects spaced no more than 30 feet (10 meters) apart back and forth across all portions of the survey parcel. Special attention was paid to the cutbanks of the Mendenhall River for evidence of fish weirs and cultural strata that may have been exposed in the soil profile. No cultural resources were found within this survey area.

Vegetation cover within the eastern study parcel and the parcel along the southern edge of the runway was generally sparse, allowing good visibility of the ground surface. The eastern area was inventoried for cultural resources at low tide using the same survey techniques as described above. Special attention was given to the numerous runoff channels and meandering drainages for fish weirs and other cultural materials. No such resources were identified as a result of the field survey. However, it should be noted that marine and alluvial sediment deposition in this Eastern RSA study may have been buried any cultural resources that were once present.

A single historical site (AHRS site number JUN-924) was located and documented during examination of the narrow strip of land along the south side of the eastern half of the existing runway. This site is a remnant portion of a World War II asphalt runway. At present, three segments of the historical runway are being used as an apron or safety area along both the north and south sides of the modern runway. The segment on the south side of the modern runway measures roughly 50 feet (15.2 meters) wide and 5,000 feet (1,524 meters) long. It begins at the western end of the modern runway and extends southeasterly, contiguous with the south side of the modern runway. The second and third segments of the historical runway both measure roughly 50 feet (15.2 meters) wide. The western segment is located contiguous with the north side of the modern runway, at its western end; the second historical segment begins near the western end of the modern runway and extends roughly 1,800 feet (549 meters) southeasterly along the north side of the modern runway. The third historical segment begins just east of the main north-south ramp/taxiway and extends along the north side of the modern runway for a distance of approximately 2,200 feet (671 meters). The modern runway was constructed down the center of the historical runway, with the underlying section of the historical runway removed prior to the new development. Thus, the extant segments of the historical feature represent only a fraction of the original feature's size. Although the historical runway was associated with the World War II use of the Airport, the feature has been so heavily altered by subsequent development that it no longer retains its historical integrity. The FAA, in consultation with the Alaska SHPO, has determined this site to be ineligible for the NRHP as per 36 CFR 800.4.

3.11.3.5 AIRPORT FLOAT PLANE POND STUDY AREA

The Airport Float Plane Pond study area included all accessible areas of land that are south of the Float Plane Pond, and north of the Airport emergency vehicle access road and Dike Trail, near the southern perimeter of the Airport. According to the historical record, the earthen dike along which the road is located contained a series of defensive (anti-aircraft) bunkers during World War II. However, careful inspection of the levee yielded no evidence of these former features.

Although vegetation, primarily in the form of tree cover, was fairly dense throughout the Airport Float Plane Pond study area, visibility was generally good. The area was inventoried for cultural resources in the manner described previously. As a result of this inventory, two cultural features (one site and one isolated find) were identified south of the Float Plane Pond. The site (AHRS site number JUN-922) is an asphalt pad located in proximity to a possible abandoned dirt road. The visible portion of the pad measures approximately 50 feet (15.2 meters) north-south by 30 feet (9 meters) east-west. Vegetation cover and a surficial humus layer prevented definition of the full extent of the feature. The foundation has two yellow painted areas, with a pattern resembling a ladder. These painted areas are approximately 10 feet (3 meters) apart. A narrow two-track road, now resembling a trail rather than a road, is located approximately 15 feet (4.6 meters) to the east of the foundation. The road runs roughly parallel to the foundation, has two deep ruts, and is approximately 8 feet (2.4 meters) wide. It is heavily overgrown, indicating it has not been used for some time, and appears to see infrequent use as a footpath or animal trail. The road extends south-west, to where it intersects the Dike Trail on a narrow levee. No other features or artifacts were found in the vicinity. Temporal placement of the feature is difficult due to the lack of diagnostic artifacts. However, examination of historical air photos show that it was likely constructed some time between 1948 and 1962. That is, evidence of the foundation and road are visible on a 1962 air photo of the Airport. The features are not visible on a 1948 air photo of the same property. This information suggests that the features were not associated with the World War II military activity at JNU.

The second feature observed in this area is a portion of an apparent wooden scaffold-style power pole. The feature is no longer upright, in its original position, but has fallen over owing to extreme erosion and deterioration of the wood. Overall, the feature measures roughly 30 feet (9 meters) long by 10 feet (3 meters) wide. It appears to be constructed of 4-inch by 10-inch or 4-inch by 12-inch pieces of milled lumber, attached together with 12 to 14-inch long bolts. Railroad ties were "sandwiched" between the lumber planks, adding mass to the structure. There were no clear indicators of the structure's age, nor were any additional artifacts or features associated with it. The structure is not visible on any of the available air photos of the Airport (1946, 1962, 1998), though its small size would make it difficult to discern on such a photo. Owing to its dubious age, its extreme level of deterioration, and its lack of association, the FAA, in consultation with the Alaska SHPO, has determined this site to be ineligible for the NRHP as per 36 CFR 800.4.

In addition to the archaeological resources described above, consultation with local native groups and individuals and public scoping for this EIS identified at least one area of cultural concern related to the area south of the Float Plane Pond. As part of the consultation and scoping process, the Sealaska Heritage Institute (formerly Foundation) submitted written comment expressing concern over any possible alteration of the spruce tree forest located south of the Float Plane Pond and north of the Dike Trail. Sealaska indicated that the JNU area was traditionally used by tribal basket weavers as a location for gathering spruce root. More recently, native practitioners of basket weaving have gathered, and continue to gather, spruce root from the area immediately south of the Float Plane Pond. These weavers have suggested that the area be named after one of their most acclaimed weavers, Salina Peratrovich. Additional related comments regarding the spruce grove south of the Float Plane Pond indicate that owing to the sandy nature of the soil, some of the most desirable spruce roots in the CBJ area can be obtained from this area. Further, non-native basket weavers requested continued access to the spruce roots south of the Float Plane Pond.

Access to the spruce grove for the purpose of gathering spruce roots is by special permit only. According to Airport staff, as security increases, the number of permits issued for this purpose may decrease.

3.11.4 Cultural Resources Survey Results: Off-Airport Study Areas

In addition to those areas located on JNU property, four off-site locations were also included in the cultural resource investigations. These areas included a small parcel and access road on Pedersen Hill, the existing CBJ gravel pit, the site of the proposed/future CBJ gravel pit, and the Stabler Point Quarry. Each of these areas is discussed in more detail below.

3.11.4.1 Pedersen Hill Study Area

The Pedersen Hill Study Area consists of a 200-foot by 200-foot (61-meter by 61-meter) parcel of land centered on the existing FAA radio beacon facility, as well as a corridor, measuring roughly 3,000 feet (914 meters) long and 50 feet (15.2 meters) wide, for a proposed access road leading from Engineer's Cut-off Road to the tower facility. The possible path of an access road was centered on an existing trail leading to the tower on the summit. This area was surveyed because Pedersen Hill had been identified as a possible site for relocation of the RCO. Vegetation within this survey area, comprised primarily of a relatively young spruce/hemlock forest, was exceptionally dense and survey of the area by walking parallel transects was not feasible. Therefore, the study area was inspected for cultural resources by walking meandering transects. Special attention was paid to identifying any culturally modified trees that may have been present within the area. No cultural resources were identified during the field studies within this survey area.

3.11.4.2 Existing CBJ Gravel Pit

This study area includes the existing CBJ gravel pit east of Lemon Creek. The total acreage of this study parcel is approximately 29 acres. Some potential development projects at JNU, particularly construction of the RSAs, would require large volumes of fill material. The existing CBJ gravel pit has been identified as one of the possible publicly owned borrow locations for such material. As such, any disturbance at the pit that is directly related to or results from the activities evaluated in this EIS would be considered a connected action, and therefore subject to comparable environmental analysis.[9]

No specific cultural issues related to the Lemon Creek area have arisen as part of the general public scoping process. Local natives interviewed in 1946 as part of an early ethnographic study of Native Alaskans noted that the area "just north of Lemon Creek" had a stream used by the

9. Only publicly owned borrow sites were surveyed, since it would not have been possible to evaluate the potential for cultural resources on all privately held, possible quarries.

Auke to harvest dog salmon and coho, that there were "three or four smokehouses there belonging to the Auk (sic) people, but they were crowded by the road," and that the Auke used the Lemon Creek area for hunting and trapping purposes (Goldschmidt and Haas 1998:39). During interviews conducted as part of the Section 106 consultation in 2001, one local Auke Tlingit elder indicated that, although native peoples did not live in the Lemon Creek area traditionally, the general area "near the prison", where "Goldbelt had a gate" was used by a shaman. No additional information was obtained, and it is unclear whether the area indicated is within the existing CBJ gravel pit survey parcel.

As the existing CBJ pit is an active gravel quarry, much of the area has been significantly altered by previous soil removal activities unrelated to the proposed undertaking. These disturbed areas were not inspected for cultural resources, because of the exceptionally low probability of any intact features or sites. The as yet unaltered portions of the CBJ property were inspected to the extent permitted by the dense vegetation cover (approximately 85% cover), both in terms of low ground cover and spruce/hemlock forest tree cover. Careful attention was paid to identifying any culturally modified trees that might have been present within the area. No such resources were observed. The only cultural feature identified was an earthen ditch extending along the eastern and northern portions of the CBJ property. The age of the ditch is unknown, but it appears to have been constructed relatively recently for the purpose of redirecting runoff and natural stream water away from the active gravel pit workings and into Lemon Creek.

3.11.4.3 FUTURE CBJ GRAVEL PIT

This study area consists of a parcel of land located west of the Lemon Creek Correctional Facility and containing approximately 86 acres. This extensive parcel of land is slated to be purchased by the CBJ for development of a new gravel pit, and has been identified as a possible source of borrow material for future development at the Airport. As such, it is included in the cultural resource investigations related to this EIS.

As noted above, consultation with local native informants has yielded information regarding historical and potentially ethnographic use of the Lemon Creek area. While no specific sites per se were identified, an area "near the prison" and near the Goldbelt gate was identified as a former shamanic location. The informant did not provide precise information on the location of specific sites related to these activities. Pursuant to this information, additional consultation with native groups and individuals would be appropriate if and when more specific plans for the development of the proposed gravel pit are known.

As was the case with the existing CBJ pit, located southwest of and across Lemon Creek from the proposed gravel pit area, vegetation cover was exceptionally dense (approximately 85%) throughout this survey parcel. Vegetation consisted of a spruce/hemlock forest with fern, devil's club, and a variety of tall grasses. Some development has occurred within the parcel. Specifically, a small gravel pit is present in the south-central portion of the parcel, and there is a network of newly constructed dirt roads. These roads were created so recently that they had not been cleared of all of the fallen trees and other debris by the time of the cultural resources survey in July 2001. The study area was inventoried for cultural resources by walking meandering transects. Parallel transects were not possible, because of vegetation cover and dead fall. As in previous survey areas, special attention was paid to identifying culturally modified trees within this parcel. No such features nor any other historical or prehistoric artifacts or sites were observed within this study area.

3.11.4.4 Stabler Point Quarry

The Stabler Point Quarry Study Area consists of the existing Stabler Point Quarry immediately north of State Road 7, halfway between the Auke Bay ferry terminal and the Auke Bay harbor/ boat ramp. This publicly owned facility has been identified as a possible material source location for future projects at JNU. Therefore, this facility was included in the cultural resources study area for the EIS as a connected action site.

The Stabler Point Quarry is located near the traditional Auke village site and within the traditional core resource area for the local native populations. Nearby sites related to this traditional use include canoe runs, shell middens, forts, culturally modified trees, and petroglyphs. Furthermore, the first, and so far only, TCP within the State of Alaska was defined for the Auke Bay area. Although the boundaries of the TCP are vague, the Stabler Point Quarry is well within them.

During consultation under the Section 106 process, native informants provided information regarding possible previous cultural resources at the Stabler Point Quarry location. An Auke Tlingit elder indicated that a [native] village had been found by workmen at the quarry when it was first opened, but that when the elder went to look at it she found that all of the cultural materials had been removed. As no formal cultural resource inventory of the quarry area was conducted prior to the initial ground disturbance and no interviews of local native informants were carried out in association with the quarry's development, this site has never been verified.

At present, the Stabler Point Quarry consists of a relatively shallow area of a cliff face that is being mined northward, away from State Road 7. The modern cliff faces lining the road are between 60 feet and 80 feet high and sheer. A pedestrian inventory of the active workings and the surrounding cliff faces yielded no evidence of cultural materials or petroglyphs. As the full boundaries of the quarry could not be determined at the time of the field investigations, access to the top of the cliffs or the hill slope was not obtained. According to the local native informants, culturally modified trees may be present on the slopes above the quarry site. Additional Section 106 assessments of the area will be undertaken as part of the permit application process should the Stabler Point quarry be identified for development in association with proposed Airport projects.

3.12 Visual Resources

This section identifies and describes the visual resources that could be affected by the Proposed Action and alternatives. JNU and its immediate vicinity comprise the study area for this resource and include those areas that viewers may travel through or recreate in, or where existing views may be affected by the Proposed Action and alternatives.

3.12.1 LANDSCAPE CHARACTER

The CBJ, which includes the metropolitan area of Juneau and JNU, is an area that possesses extraordinary natural beauty and physical contrasts. The landscape is characterized by temperate rainforests, tidal beaches, wetlands, glaciers and steep, rugged, snow-capped mountains. Outstanding scenery is the main reason that visitors come to the Juneau area. Mendenhall Glacier, one of North America's most scenic and accessible glaciers, is part of the Juneau Icefield, and lies approximately 4.5 miles to the north of the Airport (USFS 1994). The Icefield is the third most popular scenic attraction in the state of Alaska (USFS 1997).

JNU lies within the Mendenhall River watershed; it is bounded on the north by the industrial and residential developments within Mendenhall Valley, on the east and south by the estuarine wetlands bordering the Gastineau Channel, and on the west by the Mendenhall River and its alluvial and glaciofluvial outwash. Much of the area surrounding JNU has been incorporated into the adjoining Mendenhall Wetlands State Game Refuge (Refuge). Primary access to the area is via Yandukin Drive, which extends from Egan Drive to the Airport. A secondary access road, Shell Simmons Drive, extends from Glacier Highway to the Airport (USKH 1999).

Mount Juneau, Thunder Mountain, and Mendenhall Glacier are the dominant features of the area, and they provide a scenic backdrop to views in the vicinity of the Airport. The character of the Mendenhall Valley is a mixture of residential, commercial, and rural areas (USKH 2000). The lower elevations of the valley consist of flat or rolling terrain that is vegetated by mixed deciduous and evergreen woodland, shrubs, scrub, and herbaceous plants (SWCA 2002). The upper elevations, on the surrounding steep mountain slopes, are covered by thick stands of evergreen trees, bare rock, and snowfields. This diversity of topography, vegetation, and geological formations characteristic of the area provides a variety of scenic experiences to those who live, work, or recreate in the area.

3.12.2 VISUAL RESOURCE MANAGEMENT IN THE VICINITY OF JNU

The degree of change to the landscape resulting from an action is determined for those areas of "high scenic value," or high visual sensitivity, i.e., those landscapes with the most variety or diversity in landform, vegetation, and water (USFS, Chapter 2380, Forest Service Manual).

Areas of visual sensitivity are analyzed from specific points of view to establish the existing scenic value. The potential visual impacts of the Proposed Action and alternatives can then be assessed according to the degree of change from existing conditions. The visual analysis points of view are selected based on such factors as length of time that the impacted areas are in public view, the potential number of viewers of the impacted areas, the slope angle of the impacted areas, and the relative size of the impacted areas. The areas selected as being visually sensitive and their corresponding points of view used to analyze the impacts of the Proposed Action and alternatives are:

- the west end of Runway 08, analyzed from the golf course clubhouse parking lot
- the east end of Runway 26, analyzed from the end of Sunny Point Road

- Duck Creek, analyzed from the trailhead parking lot
- the Dike Trail, analyzed from the covered picnic table area

These areas are described in the following sections and depicted in Figure 3-35.

3.12.2.1 West End of Runway 08

The landscape at the western end of the JNU project area, at the beginning of Runway 08, is characterized by relatively flat terrain vegetated with wetland grasses and shrubs. Commercial, residential and Airport buildings can be seen in the distance. The banks and channel of the Mendenhall River lie to the west of the Airport boundary; the mouth of Duck Creek lies to the north of the runway; and the Float Plane Pond lies to the south of the runway. These waterways within the area tend to disrupt the wetland topography, creating a moderate color and form contrast within the landscape. The vegetation adjacent to the runway is interspersed with paths, fences, and roadways, and this creates a strong color and form contrast. The MALSR adds a linear and vertical form contrast to the terrain.

3.12.2.2 East End of Runway 26

The landscape at the eastern end of the JNU project area, at the beginning of Runway 26, is characterized by relatively flat wetland vegetated with grasses and shrubs within the Refuge. Occasional clusters of evergreen trees on dredge piles break up the landscape, but the area does not present any strong visual contrasts and does not possess any notable visual features. This lack of contrast stems in part from the land use protections afforded by the Refuge. There is no aviation instrumentation and no security fence distinguishing the Refuge from Airport property.

3.12.2.3 Duck Creek

Duck Creek is a small stream that runs within the relatively flat or very gently rolling terrain along the northwestern boundary of JNU. Flat topography and forest-to-wetland vegetation dominate the area, with the Duck Creek stream channel creating a mild, linear contrast with the surrounding trees, grasses, and shrubs. Commercial, residential and Airport buildings are visible in the distance, but are generally obscured to the north and west by a thick belt of trees that border the Airport. The Duck Creek channel is unnaturally linear, having been altered and straightened since the development of the Airport.

3.12.2.4 Dike Trail

The Airport service road, also called the Dike Trail, extends from the trailhead north of the runway, bends around the western end of the runway, and trends generally west-east on the south side of the Float Plane Pond. This area is generally flat and is composed of wetlands to the south of the trail, dense stands and belts of evergreen and alder trees to the north of the trail, and intermittent fingers of water that project south from the Float Plane Pond. The projecting waterways break through the obscuring belt and stands of trees to permit views of the runway and buildings to the north. The trees visually dominate the area along the trail, and strong visual contrasts are created at the breaks between the trees when the Float Plane Pond and Airport structures come into view. The Dike Trail offers views east down the Gastineau Channel, south to Douglas Island, and farther across Stephens Passage to Mansfield Peninsula on Admiralty Island. The trail also offers views west over the Mendenhall delta toward the Chilkat Range. Except for breaks in the trees at the Float Plane Pond fingers, the Dike Trail woodlands block views of the Coast Range to the north.

3.13 DEPARTMENT OF TRANSPORTATION SECTION 4(F)

The U.S. Department of Transportation (DOT) Act Section 4(f) [recodified at 49 USC, Subtitle I, Section 303] strictly regulates implementation of transportation actions that could affect publicly owned land that is designated as a public park, recreation area, or wildlife and waterfowl refuge of national, state, or local significance or any historic site of national, state, or local significance. The FAA is not to approve any action that requires use of such land "unless there is no feasible and prudent 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 5050.4A, Paragraph 47e(7)).

In August 2005 and after publication of the Draft EIS, the Section 4(f) provisions were reauthorized as part of the Safe, Accountable, Flexible, Efficient, Transportation Equity Act: A Legacy for Users (SAFETEA-LU; Public Law 109-59). Specific additions and clarifications to the Section 4(f) legislation were included as part of this reauthorization. Of possible importance to this EIS is the addition of a *de minimis* provision to Section 4(f). This provision allows the FAA (as part of the Department of Transportation) to determine that use of a Section 4(f) property for transportation purposes, after consideration of impact avoidance, minimization, and mitigation or enhancement measures, results in a *de minimis* (non-adverse) impact on that property. In other words, a *de minimis* impact is one that will not adversely affect the protected features, attributes, or activities that qualify the property for protection under section 4(f). If such a finding is made, an analysis of avoidance alternatives is not always required, as was the case prior to the introduction of the *de minimis* provision. The *de minimis* provision allows for consideration of the situation as a whole, taking into account the overall effects of avoiding the Section 4(f) property and the net harm to the property after incorporating mitigation. The intent of this provision is to provide for wise transportation decisions that minimize overall harm when all prudent and feasible alternatives would use some Section 4(f) property, while still providing the special protection afforded by Section 4(f). In particular, this language recognizes that, in some instances, avoidance of a Section 4(f) property may result in severe environmental harm to other resources, outside the 4(f), that is not easily mitigated. *De minimis* findings must be made on an individual Section 4(f) property basis and cannot be made for a project as a whole.

The following sections describe the lands around JNU that are considered DOT 4(f) properties and could be affected by actions considered in this EIS.

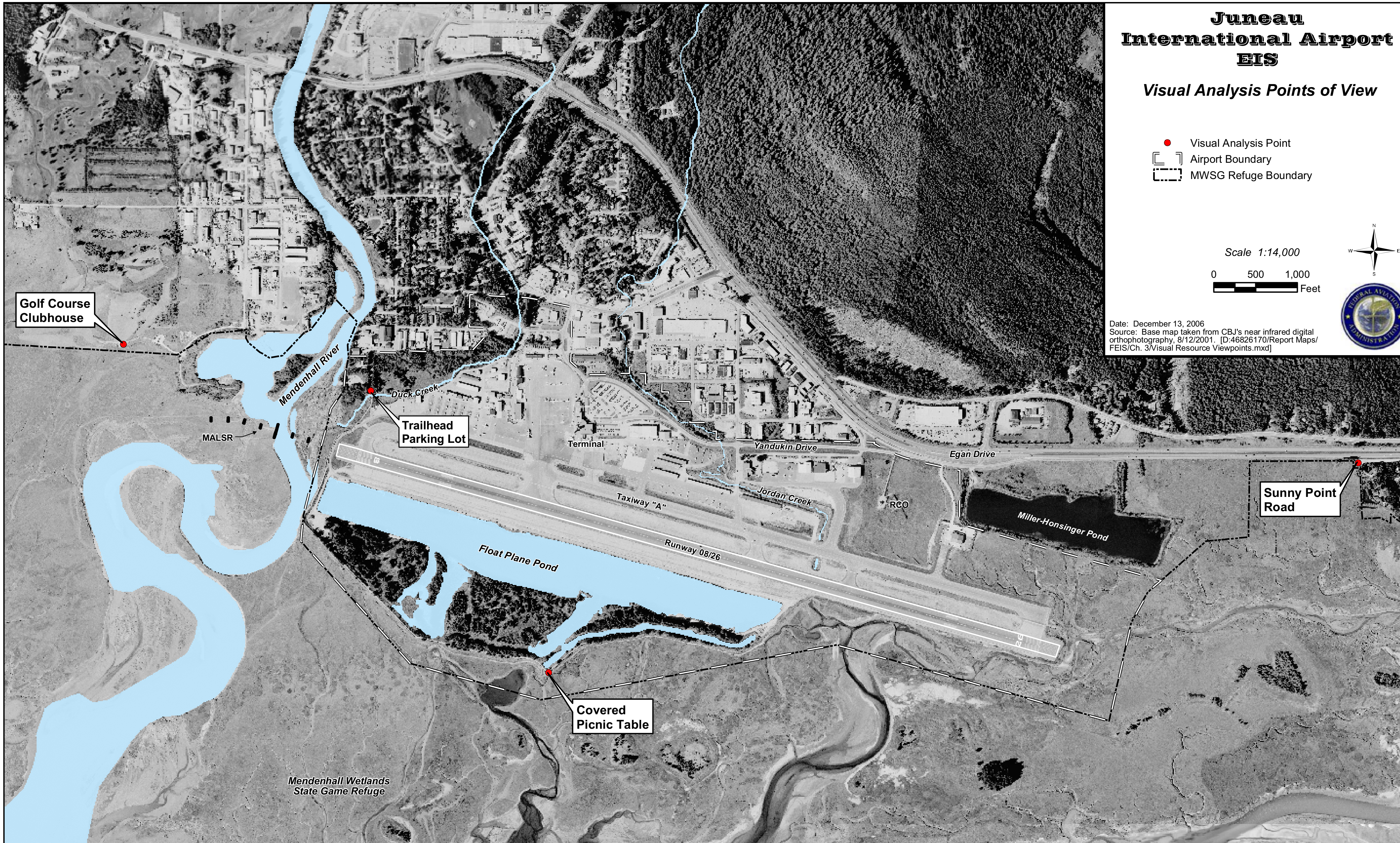


Figure 3-35. Visual analysis viewpoint locations.

THIS PAGE INTENTIONALLY LEFT BLANK

3.13.1 Section 4(f) Properties in the Vicinity of JNU

The evaluation of DOT 4(f) lands begins with the identification of properties located in the Airport area that may qualify as 4(f). As described in Section 3.2, two recreational and/or wildlife lands have been identified in the immediate Airport vicinity: the Refuge and the Mendenhall Golf Course.

In addition, the impact of the actions and alternatives upon the EVAR (road) known locally as the Dike Trail is also considered. Over time, an airport emergency access road has been adapted and used by the general public as a hiking trail to access the Refuge. Because this service road was not originally built as a public access road, but has been used as such and is noted on the CBJ recreational maps, it has been evaluated relative to potential DOT 4(f) land impacts. No federal, state, or local historic sites have been identified. Figure 3-7 in the land use section shows the locations for each of these sites.

3.13.1.1 Mendenhall Wetland State Game Refuge (The Refuge)

The Refuge surrounds the Airport on three sides (east, south and west). The borders of the Refuge generally include Egan Expressway (or Egan Drive) on the north, North Douglas Highway on the south, and the Mendenhall Peninsula on the west. As noted in the introduction to the Refuge Management Plan

> The Mendenhall Wetlands State Game Refuge encompasses approximately 3,800[10] acres and is best known for the Canada geese, ducks, and bald eagles that use the intertidal habitats. The Refuge is also enjoyed year-round by residents and visitors alike for seasonal activities such as wildlife viewing, waterfowl hunting, fishing, boating, horseback riding, and general sightseeing. Mendenhall Wetlands is the most popular area for public recreation in the Juneau area.

About 4,563 people per year use the Refuge for hunting, fishing, boating, bird and wildlife viewing, walking and gathering of subsistence resources. Although an exact count was not made, it has been observed that the majority of the uses of the Refuge are non-consumptive.[11] In addition to these users, thousands of commuters view and enjoy the open space, flocks of birds and other wetland attributes as they drive past on the Egan Expressway. Hundreds of residents enjoy views of the Refuge from their homes. Maintained trails are not available within the Refuge, as noted in the Refuge Management Plan, but 13 different access points for walking are available, including a trail at the end of Mendenhall Peninsula Road, the end of Sunny Drive on Sunny Point, a pullout along Egan Expressway between Lemon and Switzer Creeks, North Douglas Island south across Gastineau Channel from the Airport, and the Airport Dike Trail (see Figure 3-7).

---

10. More recent information suggests the Refuge encompasses approximately 4,000 acres. See, for example, the Refuge website at http://www.wildlife.alaska.gov/refuge/mendenha.cfm. Analysis in this EIS assumes a 4,000-acre Refuge.
11. Consumptive uses are activities (such as hunting, fishing, and gathering) use up or remove the resource. Non-consumptive uses (such as hiking, boating, viewing and photography), may enjoy the resource without diminishing it.

It is important to note that the legislation creating the Refuge anticipated that land-use conflicts might arise over time between the adjacent Airport and the Refuge. The legislation states the following (AS16.20.034):

> (h) An activity or use may not occur under (a) of this section in a manner which creates a hazard to aircraft. Gravel extraction is not considered an incompatible activity on or abutting state-owned land described in (a) or this section and is subject to the provisions of the management plan. Except for those ponds, lakes or other bodies of water adjacent to the airport that are required to be maintained by the City and Borough of Juneau as a seaplane basin under certification for the Juneau Municipal Airport granted by the Federal Aviation Agency, if requested by the City and Borough of Juneau the Departments of Fish and Game and Natural Resources shall assist in the filling the ponds, lakes or other bodies of water adjacent to the existing airport runway to eliminate them as sites attractive to waterfowl.

and

> (i) the management plan adopted under (g) of this section shall include provisions under which the City and Borough of Juneau may acquire land, by sale, exchange or otherwise, for purposes of expanding Juneau Municipal Airport, establishing additional transportation corridors, including water corridors, and establishing publicly-owned and operated docking facilities, and that these uses are considered preferential under Article VII of the State constitution but subject to the requirements for plan specification and approval under AS 16.20.060 . . .

and

> (j) Notwithstanding the provisions of (d)-(i) of this section, if the City and Borough of Juneau demonstrates to the Departments of Natural Resources and Fish and Game, jointly, that there is a superior public need for or use of the land to its use as a state game Refuge, after public hearing and a finding by the departments supporting the determination that such a need or use exists or is required, the use shall be permitted.

In determining the Refuge to be a Section 4(f) property, the FAA considered the legislation establishing the Refuge and the management plan for the property. The FAA also considered information obtained through consultation with the Alaska DF&G, information available on the Alaska DF&G website regarding the Refuge's use for wildlife viewing, and public testimony about the Refuge.

3.13.1.2 Emergency Vehicle Access Road: Dike Trail

As noted above, the locally known Dike Trail serves as one of five major access points to the Refuge. According to a 1988 USFWS study, approximately 21,718 people per year used this trail to walk dogs, run, and watch birds. According to a more recent study published in 1997, projected annual use of the trail may be as much as 77,178 person trips (Roberds 1997). Based upon this use by the public, the FAA determined the Dike Trail to be a Section 4(f) resource. The dike and its trail are located entirely within the Airport boundary, with the exception of the southwesternmost corner, which touches the boundary line between the Airport and the Refuge.

Around 1960, CBJ built a protective dike around the west end of the runway and the Float Plane Pond. A road was established alongside and atop the dike to provide emergency vehicle access to the Float Plane Pond and the south side of the runway. The Dike Trail developed as local residents began using the top of the dike as a walking trail. In 1994, CBJ undertook a project to stabilize and aesthetically improve the dike, and to improve and extend the marginal emergency access properties of the dike.

The Dike Trail is gravel, flat, and approximately 3/4 mile long. It is of recreational value for walking, jogging, wildlife viewing, and other uses. It also provides access for some native peoples to gather materials used in traditional practices.

3.13.1.3 MENDENHALL GOLF COURSE

This recreational facility is a privately owned, par three, nine-hole golf course with a driving range located to the west of the runway on the west side of the Mendenhall River. The course accommodates approximately 15,000 rounds of golf per year. Since the golf course is privately owned, it does not qualify for consideration as a DOT 4(f) property in this analysis.

3.13.2 SECTION 6(F) PROPERTIES IN THE VICINITY OF JNU

Consideration was also given to Section 6(f) of the Land and Water Conservation Fund (the "Fund"), which stipulates that no property acquired or developed with assistance from the Fund shall be converted to other than public outdoor recreation uses without the approval of the Secretary of Interior. If a conversion cannot be avoided, consultation would be required to discuss possible mitigation. It was determined during this EIS that the Fund was not used to acquire or develop resources at JNU or other properties in the Airport environs.

Therefore, the analysis of potential direct and constructive uses in Chapter 4 is focused on two DOT 4(f) lands: the Refuge and the Dike Trail.

THIS PAGE INTENTIONALLY LEFT BLANK