Draft
Appendix H-2
Habitat and Mitigation Analysis

March 2024

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1 Introduction

The Keystone Dam Safety Modification Study (DSMS) is located in the Arkansas River Basin in Tulsa County, Oklahoma.

This appendix will describe the habitat classifications, model selections, data collection, and future without-project (FWOP) and future with-project (FWP) habitat conditions. In addition to habitat quantification, this appendix will also describe the mitigation plan and the monitoring and adaptive management plan associated with mitigation efforts. Additional information regarding the study can be found in the Draft Environmental Assessment (EA).

2 Habitat Classification

2.1 Ecology of the Project Area

Three basic vegetation zones can be found around Keystone Dam: upland forest, wetlands, and non-native grasslands. Non-native grasses are abundant around the dam and are expected to yield very low habitat quality due to regular disturbance. Wetlands around Keystone Dam are similar and mostly caused by rutting due to the extensive recreation use at White Water Off-road Vehicle (ORV) Park.

The upland forest, Post Oak-Blackjack (Cross Timbers regions) types, represents a mixture of forest and grassland ecosystems characteristic of most of the lake shoreline and recreation areas. The Cross Timbers region is a transition area between the once-prairie, now winter-wheat growing regions to the west, and the forested low mountains of eastern Oklahoma. The region does not possess the arability and suitability for crops such as corn and soybeans that are common in the Central Irregular Plains to the northeast. The Cross Timbers stretch across Oklahoma from north to south, with portions extending into Kansas to the north and Texas to the south and are sometimes described as containing some of the most extensive tracts of ancient forests in the eastern United States. Included in this ecoregion for Keystone Lake is the Keystone Ancient Forest, with 300-year-old post oaks and 500-year-old cedars. This forest type exists because of its limited commercial value for timber production and is protected through its designation as an Environmentally Sensitive Area by USACE. Transitional "cross-timbers" (little bluestem grassland with scattered blackjack oak [*Quercus merilandica*] and post oak trees [*Quercus stellata*]) is the native vegetation, and rangeland and pastureland comprise the predominant land cover.

2.2 Model Selection and Data Collection

Three habitat types were assessed for the Keystone DSMS: upland forest, wetland, and grassland. This assessment was based on the existing conditions of the area surrounding Keystone Dam. The Barred Owl Habitat Suitability Index (HSI) and Downy Woodpecker HSI were utilized to assess upland forest habitat (U.S. Fish and Wildlife Service [USFWS], 1987). The American Coot HSI and Red-eared Slider HSI were used to assess the ecological integrity and conditions of wetlands within the potential project areas. The Eastern Meadowlark HSI was used to evaluate grassland habitat around Keystone Dam. The models were chosen based on similar habitat surveys in Tulsa, OK and best professional judgment.

Table 1. Models and Corresponding Habitat Type

	Upland Forest	Wetland	Grassland
Barred Owl	X		
Downy Woodpecker	X		
Slider Turtle		X	
American Coot		X	
Eastern Meadowlark			X

The habitat assessments for the Keystone DSMS were conducted on August 10-11, 2021. The data collection sites were selected based on aerial imagery from existing Geographic Information System (GIS) data and were in accordance with the final array of alternatives as described in the Draft EA (Figure 1). See Attachment A for photos of the existing site conditions.

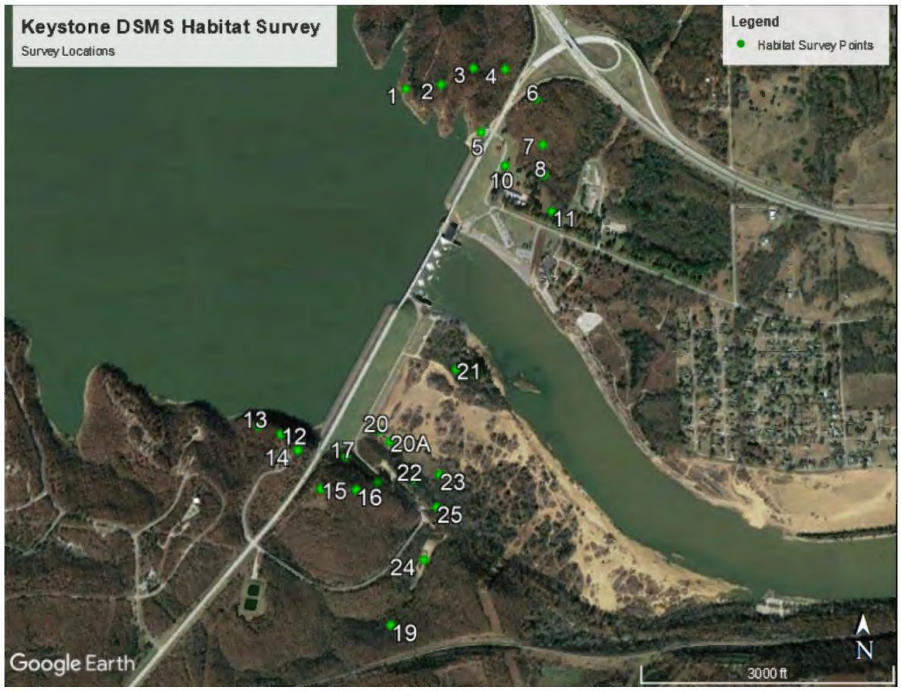

Figure 1. Keystone DSMS Habitat Survey

2.3 Habitat Evaluation Procedure and Habitat Suitability Index

A baseline assessment using the Habitat Evaluation Procedure (HEP) was required before any habitat impacts to the project area could be quantified. See Attachment B for existing conditions as observed through the evaluation. HEP involves defining the study area, delineating habitats

(i.e., cover types) within the study area, selecting HSI models and/or evaluation species, and characterizing the study area based on the results of the HEP. HEP was developed by the U.S. Fish and Wildlife Service (USFWS) in order to quantify the impacts of habitat changes resulting from land or water development projects (USFWS 1980). HEP is based on suitability models that provide a quantitative assessment of the habitat requirements for a species or group of species.

Habitat quality is estimated using the habitat models selected to represent each specific habitat type(s). Each model consists of a list of variables or Suitability Indices (SIs) that are essential to satisfy the life requisites (e.g., reproduction, food, cover, etc.) of a particular species. Each SI can be expressed as a mathematical function with each habitat metric as an independent variable. Each SI ranges from 0.1 to 1.0, with 1.0 representing optimal condition for the variable in question. The SIs for each specific life requisite are then calculated using a mathematical formula to estimate the Life Requisite Suitability Index (LRSI) for each life requisite. The final Habitat Suitability Index (HSI) of the habitat type can then be calculated as a function of the LRSIs.

The HSI methodology and calculations for the slider turtle habitat model is provided in Table 2. Three LRSIs are calculated (food/cover, water, and temperature). The suitability of the food/cover component (SIFC) is assumed to be equal to the suitability level determined for the percent of cover of emergent and submerged vegetation. The suitability of the water component (SIW) is assumed to be the lowest suitability of the three water component variables. The suitability of the temperature component (SIT) is assumed to be equal to the suitability determined for the mean surface water temperature during the critical period (USFWS, 1986).

Table 2. Slider Habitat Suitability Index Metrics

Species	**Life Requisite Suitability Indices (LRSI)**	**HSI Formula**
		$SIFC = SIV1$
Slider	Food/ Cover	$SIW = \min\{SIV2, SIV3, SIV4\}$
	Water	$SIT = SIV5$
	Temperature	$HSI = \min\{SIFC, SIW, SIT\}$

Life Requisite Suitability Index Formulas & Variables	
SIV_1	Percent cover of emergent and submerged vegetation
SIV_2	Velocity
SIV_3	Water depth
SIV_4	Water regime
SIV_5	Water temperature

The American coot HSI information is provided below in Table 3. One LSRI is calculated for reproduction. The percent of the wetland basin dominated by persistent herbaceous vegetation and the interspersion of such vegetation, evaluated by the edge index between emergent vegetation and open water, are assumed to have equal value in determining the reproductive habitat index value (RSI) (USFWS, 1985).

Table 3. American Coot Habitat Suitability Index Metrics

Species	**Life Requisite Suitability Indices (LRSI)**	**HSI Formula**
American Coot	Reproduction	$HSI = SIR = \{SIV1 \times SIV2\}^{1/2} \times SIV3$
	Life Requisite Suitability Index Formulas & Variables	
	SIV_1	Percent of wetland basin dominated by persistent emergent herbaceous vegetation
	SIV_2	Edge index between emergent vegetation and open water
	SIV_3	Water regime

The barred owl HSI information is provided below in Table 4. One LSRI is calculated for reproduction. The calculation of an HSI for the barred owl considers only the life requisite value calculated for reproductive habitat. Therefore, the HSI for the barred owl is equal to the reproduction suitability index (SIR) (USFWS, 1987).

Table 4. Barred Owl Habitat Suitability Index Metrics

Species	**Life Requisite Suitability Indices (LRSI)**	**HSI Formula**
Barred Owl	Reproduction	$HSI = SIR = \{SIV1 \times SIV2\}^{1/2} \times SIV3$
	Life Requisite Suitability Index Formulas & Variables	
	SIV_1	Number of trees greater than or equal to 51 centimeters diameter at breast height/0.4 hectare
	SIV_2	Mean dbh of overstory trees
	SIV_3	Percent canopy cover of overstory trees

The downy woodpecker HSI information is provided below in Table 5. Two LSRIs are calculated for food and reproduction. The HSI is equal to the lowest life variable (USFWS, 1983).

Table 5. Downy Woodpecker Habitat Suitability Index Metrics

Species	Life Requisite Suitability Indices (LRSI)	HSI Formula
Downy Woodpecker	Food Reproduction	$HSI = V1\ or\ V2$
	Life Requisite Suitability Index Formulas & Variables	
	V_1 Basal area	
	V_2 Number of snags > 15 cm (6 inches) dbh/0.4 ha (1.0 acre)	

The eastern meadowlark HSI information is provided below in Table 6. One LSRI is calculated for food/reproduction. The HSI for the eastern meadowlark is equal to the life requisite value for food/reproduction (USFWS, 1982).

Table 6. Eastern Meadowlark Habitat Suitability Index Metrics

Species	Life Requisite Suitability Indices (LRSI)	HSI Formula
Barred Owl	Food/ Reproduction	$\{V_1 \times V_2 \times V_3 \times V_4\}^{1/4} \times V_5$
	Life Requisite Suitability Index Formulas & Variables	
	V_1 Percent herbaceous canopy cover	
	V_2 Proportion of herbaceous canopy cover that is grass	
	V_3 Average height of herbaceous canopy (average spring conditions)	
	V_4 Distance to perch site	
	V_5 Percent shrub crown cover	

2.4 Habitat Survey Results

After collecting variables in the field, baseline habitat conditions were assessed with HEP using the methodology presented in ESM 102 *Habitat Evaluation Procedures* (USFWS, 1980). The HSI for each sample plot was evaluated by applying field data to applicable variables for each species' model. Baseline HSI for each evaluation species and habitat type are presented in Table 7 (scores are rounded to the nearest decimal).

Table 7. Average Baseline HSI Scores for the Keystone DSMS

	Right Abutment	Left Abutment
Barred Owl	0.8	0.5
Downy Woodpecker	0.5	0.5
American Coot	0.1	--
Slider Turtle	0.7	--
Eastern Meadowlark	0.0	0.0

2.5 Target Years

Target Year (TY) 0 habitat conditions are represented by the existing, or baseline, habitat conditions. The field and desktop collected data were used to quantify the habitat quality of that baseline condition. Target Year 0 conditions serve as a basis of comparison for both Future Without-Project (FWOP) and Future-With Project (FWP) scenarios.

Additional TYs were identified based on when implemented measures would be expected to elicit community responses represented by changes in the projected habitat variables.

TY 1 is used as a standard comparison year to identify and capture changes in habitat conditions that occur within one year after impacts have occurred or restoration/mitigation measures have been constructed. Amount of wetted area, reduction in invasive species, and water regimes are likely variables that may improve within this time period.

TY 5 was selected to capture the possible decrease in habitat quality associated construction that may impact the ecosystem relatively quickly such as natural plant establishment, aquatic vegetative abundance, and plant diversity.

TY 10 is used as a point after the initial growth of vegetation remaining and the likely increase in size they would have sustained for either construction impacts or restoration efforts.

Similarly, TY 25 was selected to capture the growth of upland habitats. Native tree abundance and diversity are also key response variables for this target year.

TY 50 is used as the last projected TY for the study.

2.6 Habitat Units

USACE quantifies the existing, FWOP, and FWP Ecosystem Restoration (ER) benefits using a Habitat Unit (HU) metric. HUs are calculated as the product of the HSI and the number of acres of the habitat of interest. HUs for each FWOP and FWP are then annualized over the 50-year period of analysis utilizing Equation 1 below.

Equation 1: Annualization of Habitat Units for the FWOP and FWP Conditions

$$\int_0^T HU\ dt = (T_2 - T_1)\left[\left(\frac{A_1H_1 + A_2H_2}{3}\right) + \left(\frac{A_2H_1 + A_1H_2}{6}\right)\right]$$

Where:

$$\int_0^T HU\ dt = Cumulative\ HUs$$

T_1= first target year of time interval

T_2 = last target year of time interval

A_1 = area of available habitat at beginning of time interval

A_2= area of available habitat at the end of time interval

H_1 = Index score at the beginning of time interval

H_2 = Index score at the end of time interval

3 and 6 = constants derived from integration of Index score x Area for the interval between any two target years

This formula was developed to estimate cumulative HUs when either the HSI/TXI and/or area is between two time intervals (Tx to Tx+1). The sum of these time intervals over the period of analysis divided by the total number of years of that analysis (50 years for this study) provides an Average Annual Habitat Unit (AAHU). This annualization accounts for the temporal shifts in the logarithmic rate of accumulating ecological benefits that is common when dealing with the unevenness found in nature (USFWS, 1980).

As ecological systems are rarely static, the AAHUs for the FWOP may not be equal to the AAHUs of the existing condition. Therefore, the impact of a project is quantified by calculating the difference between the FWP scenarios and the FWOP. The difference in AAHUs between the FWOP and the FWP represents the net impact attributable to the project in terms of habitat quantity and quality.

Using the habitat models used to establish the existing habitat quality, an interagency team comprised of biologists from USACE, USFWS, Oklahoma Department of Wildlife Conservation (ODWC) and Oklahoma Department of Environmental Quality (ODEQ) projected the future habitat conditions for the FWOP and FWP conditions based on best professional judgment and existing conditions.

2.7 Institute for Water Resources Planning Suite II

The Institute for Water Resources (IWR) Planning Suite II is a water resources investment decision support tool originally built for the formulation and evaluation of ecosystem restoration alternatives; however, it is now more widely used by all USACE business lines for evaluation of actions involving monetary and non-monetary cost and benefits.

The purpose of the IWR Planning Suite II is to assist with the formulation and comparison of plans for Ecosystem Restoration and Mitigation Plans. It has the capability of performing the Cost Effectiveness and Incremental Cost Analysis (CE/ICA). The IWR Planning Suite II has an annualization tool to calculate the AAHUs for the FWOP and each FWP plan.

The IWR Planning Suite II Annualizer Tool was utilized to annualize the HUs of each alternative's FWOP and FWP condition for the Continuing Authorities Program (CAP). In addition to the IWR Planning Suite II, Ecosystem Restoration Planning Center of Expertise (ECO-PCX) annualization spreadsheets were utilized to verify the average annual outputs for each alternative as well. All annualization calculations for AAHUs were confirmed by using two separate methods for verification.

3 Final Array of Alternatives

The final array of management measures, fully described in the Keystone DSMS Draft EA, were combined into alternatives that would address flood risk, as well as provide flood control within the study area.

There were six alternatives considered during the study, including the No Action Alternative. For the purpose of this appendix, only Risk Management Plans (RMPs) 5a, 5c, 6e, 6g, and 7 will be described from a habitat analysis point-of-view. Those alternatives would have physical implications on environmental resources as a result of their implementation. Additional descriptions of each alternative can be found in Section 1.5 of the Draft EA.

- No Action
- RMP 5a and 5c – Dam Raise and Existing Stilling Basin Modification
- RMP 6e – 804 ft Wide Gated Auxiliary Spillway with Stilling Basin Modifications
- RMP 6g - 803 ft Labyrinth Auxiliary Spillway with Stilling Basin Modifications
- RMP 7 – 904 ft Wide Gated Auxiliary Spillway with Dam Raise and Decommissioning of Existing Service Spillway

3.1 Staging, Laydown, and Haul Routes

All alternatives evaluated will require staging, laydown, and haul routes during construction. These temporary construction sites will be placed within pre-disturbed locations to the greatest extent practicable. All impacts from staging, laydown, and haul routes would be temporary in nature and fully restored with native vegetation upon completion of construction features. The areas shown in Figure 2 are approximate and are likely to be updated during the Preconstruction, Engineering, and Design (PED) Phase. Although these areas may be modified at a later date, it is assumed there will be at least 10 acres needed for staging, laydown, and haul routes that may require minimal tree clearing in accordance with the Best Management Practices (BMPs) stated in the Draft EA. It should be noted that there are no expected impacts to habitat resulting from staging, laydown, and haul routes so they will not be discussed in further detail within this Appendix.

Figure 2. Proposed Staging and/or Laydown Area

3.2 RMP 5a and RMP 5c

Risk Management Plan 5a and 5c are the least environmentally damaging alternatives. Adverse impacts to habitat would be limited to potential staging and laydown areas, as well as haul routes. The construction for this alternative would be limited to pre-disturbed locations on the dam embankment (**Error! Reference source not found.**).

Figure 3. Risk Management Plan 5a and 5c

Figure 4. Bridge and Cofferdam Locations

3.3 RMP 6e

Permanent impacts to vegetative communities would result from construction activities associated with the implementation of RMP 6e. Approximately 80 acres of upland forest would be impacted during construction and 5 acres of emergent wetland habitat (Figure 5). It is anticipated that the construction of any staging, laydown, or haul routes would impact vegetative communities. In addition to the general impacts associated with the actual construction site, considerations shall also be made for potential disposal locations for associated excavated material. Although USACE does not intend to use sites that are heavily vegetated for disposal, USACE will assume the highest level of impact to ensure appropriate consideration before the PED Phase. It is assumed RMP 6e would require 155 acres of land to dispose excavated material.

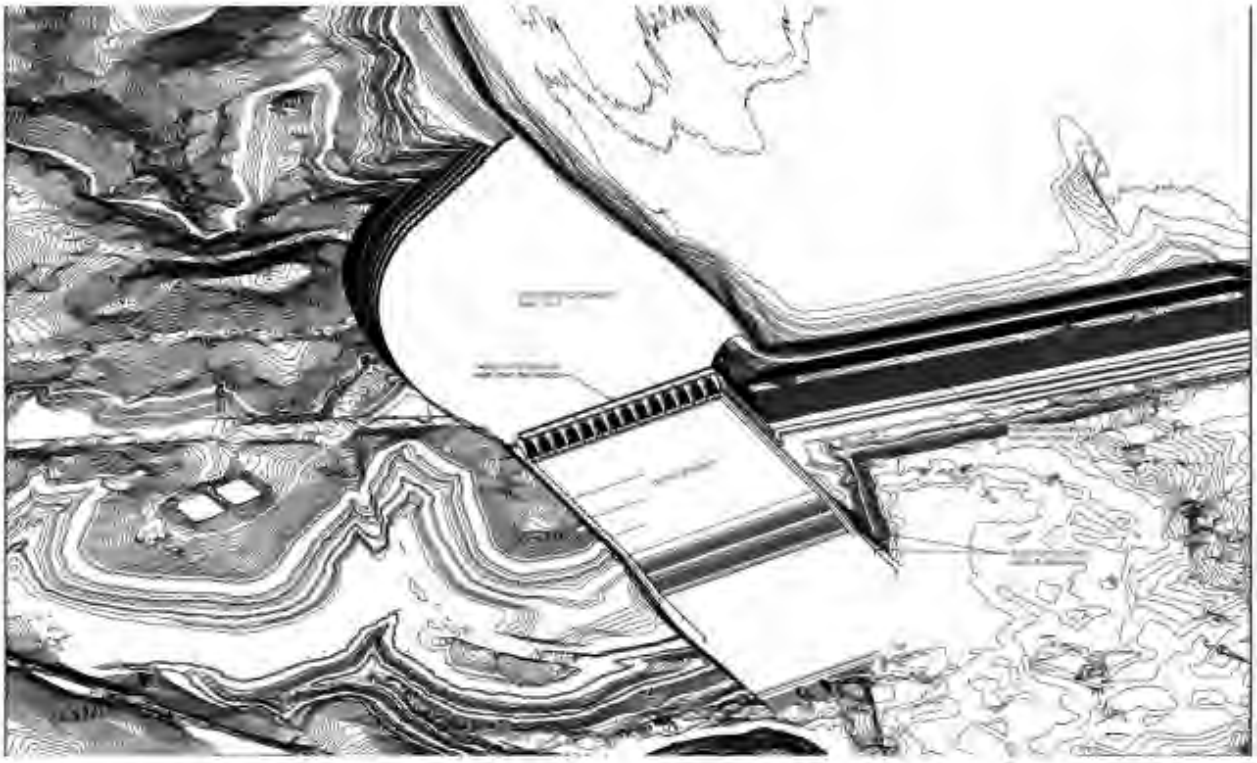

Figure 5. Risk Management Plan 6e

3.4 RMP 6g

Implementation of RMP 6g would result in similar impacts compared to RMP 6e; however, there would be permanent impacts to 40 acres of upland forest habitat and 5 acres of emergent wetland habitat (Figure 6). It is anticipated that the construction of any staging, laydown, or haul routes would impact vegetative communities. In addition to the general impacts associated with the actual construction site, considerations shall also be made for potential disposal locations for associated excavated material. Although USACE does not intend to use sites that are heavily vegetated for disposal, USACE will assume the highest level of impact to ensure appropriate consideration before the PED Phase. It is assumed RMP 6g would require 70 acres of land to dispose excavated material.

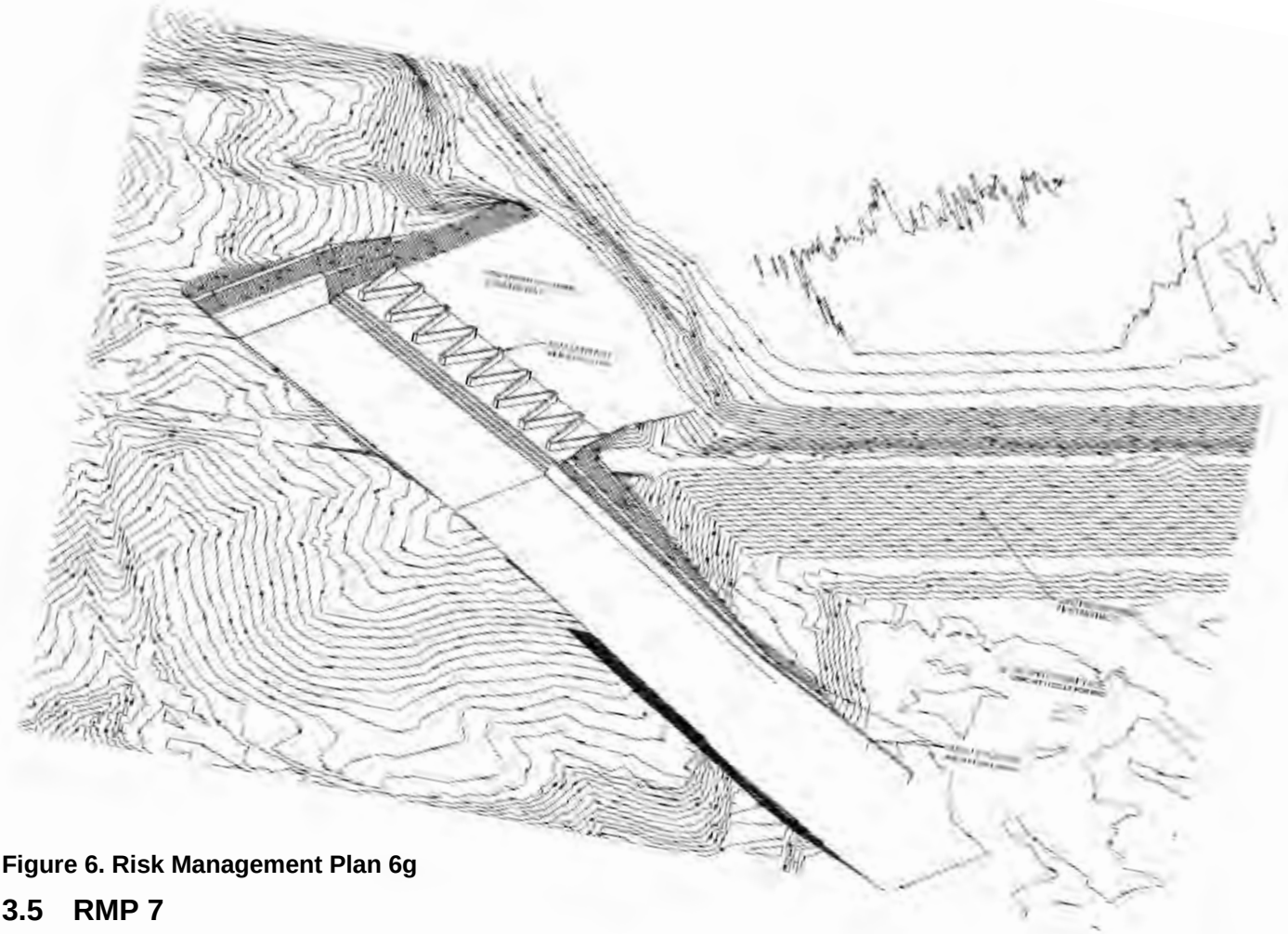

Figure 6. Risk Management Plan 6g

3.5 RMP 7

Risk Management Plan is a combination of a dam raise feature and construction of a new labyrinth spillway. Implementation of RMP 7 would result in similar impacts compared to RMP 6e; however, there would be permanent impacts to 120 acres of upland forest habitat and 5 acres of emergent wetland habitat (Figure 7). It is anticipated that the construction of any staging, laydown, or haul routes would impact vegetative communities. In addition to the general impacts associated with the actual construction site, considerations shall also be made for potential disposal locations for associated excavated material. Although USACE does not intend to use sites that are heavily vegetated for disposal, USACE will assume the highest level of impact to ensure appropriate consideration before the PED Phase. It is assumed RMP 7 would require 295 acres of land to dispose excavated material.

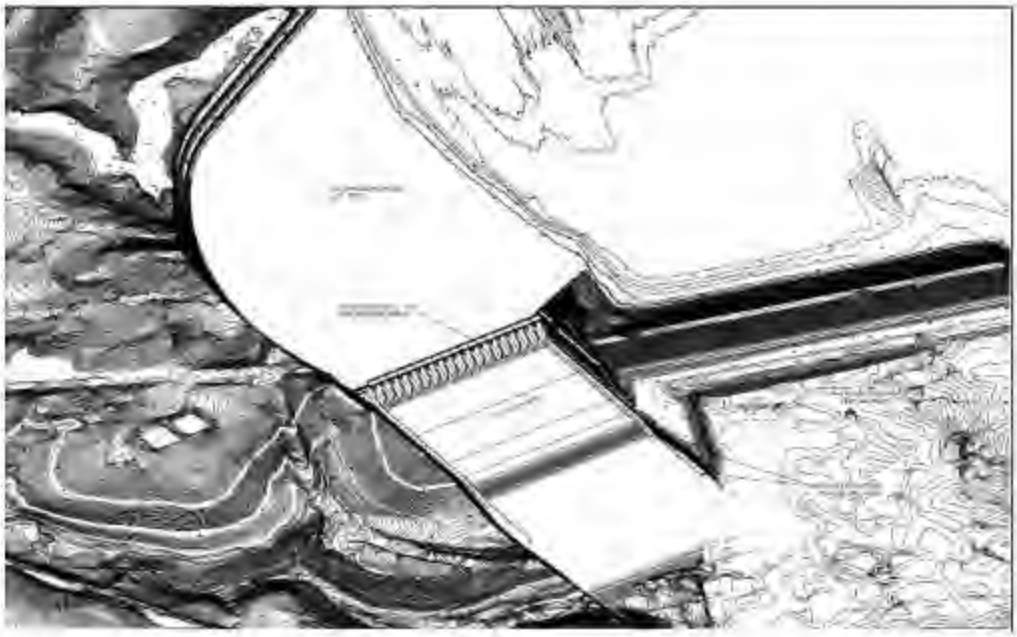

Figure 7. Risk Management Plan 7

4 Summary

This Section provides the inputs and results of the existing, FWOP, and FWP conditions analyses. Section 4.1 is a description of the justifications, calculations and results of the Existing Conditions and FWOP conditions, otherwise known as the No Action Alternative. Section 4.2 will describe the likely future conditions in the study area over the life of each alternative (FWP conditions). See Attachment C for FWOP and FWP assumptions.

The table below depicts the highest level of impact associated with potential disposal sites for excavated material. It should be noted that the FWP for disposal sites is assumed to be 0 beginning in TY 1 to TY 50 due to the permanent disturbance of the sites.

Table 8. Disposal Site AAHUs

				Target Year											
	Area	Model	Acres	0		1		5		10		25		50	
				HSI	HU	HSI	HU	HSI	HU	HSI	HU	HSI	HU	HSI	HU
FWOP	RMP 6e	Not Applicable	155	1.0	155	1.0	155	1.0	155	1.0	155	1.0	155	1.0	155
FWOP	RMP 6g	Not Applicable	70	1.0	70	1.0	70	1.0	70	1.0	70	1.0	70	1.0	70
FWOP	RMP 7	Not Applicable	295	1.0	295	1.0	295	1.0	295	1.0	295	1.0	295	1.0	295

RMP 6e AAHUs = 155
RMP 6g AAHUs = 70
RMP 7 AAHUs = 295

Habitat Units have been rounded to the nearest whole number. Habitat Suitability Index has been rounded to the nearest decimal. Future With-Project Assumes the temporary construction areas would be restored and considers TY 1 as the year after implementing restoration measures.

As noted above for the potential disposal locations, the FWP for RMP 6e, 6g, and 7 assume total loss due to permanent impacts. The tables below depict FWOP AAHUs only in order to understand the loss of habitat quality. In addition, because RMP 5a and 5c do not require full-scale tree clearing and excavation, those alternatives will not be included in Table 9.

Table 9. RMP 6e, 6g, and 7 AAHUs for Upland Forest Habitat

	Area	Model	Acres	Target Year 0		1		5		10		25		50	
				HSI	HU	HSI	HU	HSI	HU	HSI	HU	HSI	HU	HSI	HU
FWOP	RMP 6e	Barred Owl	80	0.4	30	0.4	34	0.5	38	0.6	44	0.7	56	0.8	65
FWOP	RMP 6e	Downy Woodpecker	80	0.5	40	0.5	40	0.5	40	0.5	40	0.5	40	0.5	40

Barred Owl AAHU = 53
Downy Woodpecker AAHU = 40

Average AAHU Between Barred Owl and Downy Woodpecker =46

	Area	Model	Acres	Target Year 0		1		5		10		25		50	
				HSI	HU	HSI	HU	HSI	HU	HSI	HU	HSI	HU	HSI	HU
FWOP	RMP 6g	Barred Owl	40	0.4	15	0..4	17	0.5	19	0.6	22	0.7	28	0.8	33
FWOP	RMP 6g	Downy Woodpecker	40	0.5	20	0.5	20	0.5	20	0.5	20	0.5	20	0.5	20

Barred Owl AAHU = 26
Downy Woodpecker AAHU = 20

Average AAHU Between Barred Owl and Downy Woodpecker = 23

	Area	Model	Acres	Target Year 0		1		5		10		25		50	
				HSI	HU	HSI	HU	HSI	HU	HSI	HU	HSI	HU	HSI	HU
FWOP	RMP 7	Barred Owl	120	0.4	44	0.4	51	0.5	57	0.6	66	0.7	83	0.8	98
FWOP	RMP 7	Downy Woodpecker	120	0.5	60	0.5	60	0.5	60	0.5	60	0.5	60	0.5	60

Barred Owl AAHU = 79
Downy Woodpecker AAHU = 60

Average AAHU Between Barred Owl and Downy Woodpecker = 70

Habitat Units have been rounded to the nearest whole number. Habitat Suitability Index has been rounded to the nearest decimal. Future With-Project Assumes the temporary construction areas would be restored and considers TY 1 as the year after implementing restoration measures.

Table 10. RMP 6e, 6g, and 7 AAHUs for Emergent Wetland Habitat

	Area	Model	Acres	Target Year 0		1		5		10		25		50	
				HSI	HU	HSI	HU	HSI	HU	HSI	HU	HSI	HU	HSI	HU
FWOP	RMP 6e, 6g, and 7	Slider	5	0.1	1.0	0.1	1.0	0.1	1.0	0.2	1.0	0.1	1.0	0.1	1.0
FWOP	RMP 6e, 6g, and 7	American Coot	5	0.1	1.0	0.1	1.0	0.1	1.0	0.1	1.0	0.1	1.0	0.1	1.0

Slider AAHU = 1
American Coot AAHU = 1

Average AAHU Between Slider and American Coot = 1

Habitat Units have been rounded to the nearest whole number. Habitat Suitability Index has been rounded to the nearest decimal. Future With-Project Assumes the temporary construction areas would be restored and considers TY 1 as the year after implementing restoration measures.

The summary of AAHUs for each alternative is shown below in Table 11. Risk Management Plan 7 is expected to have the most significant effect to upland forest, followed by RMP 6e, and then RMP 6g. The outcome of this analysis was an important factor when determining the Tentatively Selected Plan (TSP). Risk Management Plan 5a is the TSP and does not require mitigation because the impacts associated with the project would be temporary and occur on pre-disturbed and regularly maintained areas.

A summary of the AAHUs associated with disposal location are not included because they have not been surveyed or refined. If another alternative is selected after the EA is completed, a supplement to evaluate environmental effects of disposal locations must be prepared.

Table 11. The AAHU Difference between FWOP and FWP for Each Alternative for Terrestrial Habitat

Alternative	Habitat Type	FWOP AAHUs	FWP AAHUs	Loss of AAHUs
RMP 6e	Upland	46	0	46
RMP 6g	Upland	23	0	23
RMP 7	Upland	70	0	70
RMP 6e, 6g, and 7	Emergent Wetland	1	0	1

5 References

U.S. Fish and Wildlife Service. 1980. Ecological Services Manual – Habitat as a Basis for Environmental Assessment. 15 September 1980.

--- 1982. Habitat Suitability Index Models: Eastern Meadowlark

--- 1983. Habitat Suitability Index Models: Downy Woodpecker

--- 1985. Habitat Suitability Index Models: American Coot

--- 1986. Habitat Suitability Index Models: Slider Turtle

--- 1987. Habitat Suitability Index Models: Barred Owl

6 List of Preparers

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Bailee Clemmons – Biologist, Regional Planning and Environmental Center; 2 years USACE experience.

ATTACHMENT A

1 North

1 East

1 South

1 West

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ATTACHMENT B

Site	Habitat Type	Date	Model	Metric	Metric Score	Measurement	Vegetation On Site
1	Grassland	August 10th	Eastern Meadowlark	V1	20	%	johnsongrass, persimmon, illinois bundleflower, boneset, trumpet creeper, bush clover, gumweed
	Left Abutment			V2	0	%	inundated with johnsongrass, heavily degraded, low quality, HSI may not be accurate because johnsongrass was bumping up the score
				V3	91	centimeters	20% herb w/o johnsongrass, 0% grass w/o johnsongrass, 3 ft height w/o johnsongrass
				V4	13	meters	
				V5	10	%	
2	Upland	August 10th	Downy Woodpecker	SIV1	100	ft2/acre	post oak, green ash, virginia creeper, sparkleberry, winged sumac, red mulberry, poison ivy, Panicum, hickory, downy milkpea, eastern red cedar
	Left Abutment			SIV2	5	#	
			Barred Owl	SIV1	0	#	
				SIV2	6	inches	
				SIV3	80	%	
3	Riparian w/Drainage	August 10th	Downy Woodpecker	SIV1	80	ft2/acre	downy milkpea, red mulberry, hickory, greenbriar, poison ivy, bush clover, summer grapevine, southern red oak, virginia creeper, eastern red cedar, post oak
				SIV2	4	#	
			Barred Owl	SIV1	0	#	
				SIV2	16	inches	
				SIV3	70	%	
4	Upland	August 10th	Downy Woodpecker	SIV1	130	ft2/acre	green ash, black hickory, virginia creeper, post oak, sumac, eastern red cedar, downy milkpea, poison ivy, sedge
				SIV2	3	#	
			Barred Owl	SIV1	1	#	heavily inundated with a variety of oaks (hard to identify separate species)
				SIV2	12	inches	
				SIV3	50	%	
5	Grassland	August 10th	Eastern Meadowlark	V1	90	%	bermudagrass, trumpet creeper, frogfruit, water oak
				V2	90	%	
				V3	10	centimeters	park area, mowed and maintained. All grass was non-native, score would be low if looking at native grasses.
				V4	7.6	meters	
				V5	0	%	
6	Upland	August 10th	Downy Woodpecker	SIV1	70	ft2/acre	bush clover, american elm, greenbriar, virginia creeper, thistle, eastern red cedar, hickory, live loak, inland sea oats, summer grapevine, white oak, muscadine grape, coral berry, black oak, flowering dogwood, southern red oak
				SIV2	2	#	
			Barred Owl	SIV1	2	#	
				SIV2	13	inches	
				SIV3	65	%	
7	Upland	August 10th	Downy Woodpecker	SIV1	120	ft2/acre	catalpa, poison ivy, black oak, bushclover, downy milkpea, greenbriar, inland sea oats, virginia creeper, coral berry, bull nettle, white oak, hickory, summer grape, sedge
				SIV2	2	#	
			Barred Owl	SIV1	1	#	
				SIV2	9	inches	
				SIV3	85	%	
8	Upland	August 10th	Downy Woodpecker	SIV1	90	ft2/acre	black oak, greenbriar, virginia creeper, poison ivy, eastern red cedar, coralberry, bull nettle, sumac, bedstraw, black gum, inland sea oats, elephant's foot
	36,9,11			SIV2	0	#	
	96,14,51		Barred Owl	SIV1	2	#	
				SIV2	5	inches	
				SIV3	50	%	
9	SKIPPED						
10	Grassland	August 10th	Eastern Meadowlark	V1	0	%	Saint Augustine, bermudagrass, crabgrass, poison ivy, virginia creeper, dandelion, eastern red cedar, loblolly pine
				V2	0	%	
				V3	5.08	centimeters	All non-native grasses, HSI score is skewed
				V4	3	meters	
				V5	0	%	
11	Riparian	August 10th	Downy Woodpecker	SIV1	80	ft2/acre	coralberry, american black elder, poison ivy, virginia creeper, inland sea oats, cedar elm, muscadine grape, sedge, greenbriar, virginia wild rye
				SIV2	2	#	
			Barred Owl	SIV1	4	#	
				SIV2	18	inches	
				SIV3	90	%	
12	Upland	August 10th	Downy Woodpecker	SIV1	60	ft2/acre	inland sea oats, poison ivy, hickory, virginia creeper, red bud, black oak, white oak, ash, muscadine grape, red mulberry
				SIV2	0	#	
			Barred Owl	SIV1	1	#	tons of small DBH oaks
				SIV2	4	inches	
				SIV3	40	%	
13	Upland	August 11th	Downy Woodpecker	SIV1	90	ft2/acre	poison ivy, beggars tick, white oak, virginia creeper, greenbriar, muscadine grape, green ash, blackjack oak
				SIV2	2	#	
			Barred Owl	SIV1	1	#	
				SIV2	8	inches	
				SIV3	40	%	
14	Upland	August 11th	Downy Woodpecker	SIV1	0	ft2/acre	sumac, johnsongrass, red bud, persimmon, red mulberry, poison ivy, virginia creeper, dogwood, juniper, summer grape, winged elm, chinkapin oak
				SIV2	0	#	
			Barred Owl	SIV1	0	#	
				SIV2	2	inches	
				SIV3	0	%	
15	Upland	August 11th	Downy Woodpecker	SIV1	110	ft2/acre	poison ivy, dogwood, mulberry, greenbriar, sumac, coral berry, american elm, red bud, white oak, mustang grape, virginia creeper, hickor, chinkapin oak, blackjack oak
				SIV2	2	#	
			Barred Owl	SIV1	4	#	
				SIV2	12	inches	
				SIV3	40	%	
16	Upland	August 11th	Downy Woodpecker	SIV1	100	ft2/acre	goldenrod, sunflower, red bud, red oak, sumac, poison ivy, japanese brome, blackjack oak, ash, bedstraw, hickory
				SIV2	2	#	
			Barred Owl	SIV1	2	#	
				SIV2	16	inches	
				SIV3	45	%	
17	Grassland	August 11th	Eastern Meadowlark	V1	0	%	johnsongrass, poison ivy, goldenrod, sunflower, red bud, dogwood, persimmon, trumpet creeper, yarrow, beggars tick
				V2	0	%	
				V3	121	centimeters	heavily degraded, mostly johnsongrass skewing score
				V4	30	meters	
				V5	5	%	
18	Upland	August 11th	Downy Woodpecker	SIV1	110	ft2/acre	poison ivy, coral berry, red bud, virginia creeper, inland sea oats, sunflower, black oak, chinkapin oak, red oak
	36,8,32			SIV2	1	#	
	96,15,17		Barred Owl	SIV1	4	#	
				SIV2	15	inches	
				SIV3	70	%	
19	Upland	August 11th	Downy Woodpecker	SIV1	50	ft2/acre	poison ivy, sugarberry, persimmon, red bud, coral berry, cedar elm, cottonwood, chinkapin oak, beggars tick, bedstraw, juniper, virginia creeper, greenbriar
	36,8,35			SIV2	0	#	
	96,15,15		Barred Owl	SIV1	1	#	
				SIV2	7	inches	
				SIV3	60	%	
20	Grassland	August 11th	Eastern Meadowlark	V1	0	%	johnsongrass, snake cotton, muscadine grape, persimmon, western ragweed, false indigo, sunflower, mesquite
				V2	0	%	
				V3	30.48	centimeters	heavily degraded recreation
				V4	9.1	meters	
				V5	20	%	
20A	Wetland	August 11th	Slider	SIV1	30	%	floating primrose, bermudagrass, spike rush
	36,8,37			SIV2	0	Ft/sec	
	96,15,15			SIV3	0.5	feet	degraded wetland in high recreation area
				SIV4	A	Regime	
				SIV5	D	Celcius	
			American Coot	V1	30	#	
				V2	2	#	
				V3	A	Density	
21	Upland	August 11th	Downy Woodpecker	SIV1	140	ft2/acre	loblolly pine, sugarberry, red mulberry, winged elm
	36,8,46			SIV2	3	#	
	96,15,5		Barred Owl	SIV1	4	#	
				SIV2	12	inches	
				SIV3	95	%	
22	Upland	August 11th	Downy Woodpecker	SIV1	50	ft2/acre	chinkapin oak, poison ivy, dogwood, juniper, red bud, shumard oak, muscadine grape, virginia creeper, bedstraw, green ash, persimmon
				SIV2	0	#	
			Barred Owl	SIV1	1	#	small dbh trees with diversity
				SIV2	4	inches	
				SIV3	80	%	
23	Wetland	August 11th	Slider	SIV1	30	%	spikerush, persimmon, switchgrass, ash
				SIV2	0	Ft/sec	
				SIV3	0	feet	
				SIV4	D	Regime	
				SIV5	NA	Celcius	
			American Coot	V1	30	#	
				V2	2	#	
				V3	D	Density	
24	Upland	August 11th	Downy Woodpecker	SIV1	90	ft2/acre	poison ivy, greenbriar, sumac, red bud, juniper, white oak, blackjack oak, red oak, winged elm, coral berry, chinkapin oak
				SIV2	1	#	
			Barred Owl	SIV1	1	#	
				SIV2	8	inches	
				SIV3	70	%	
25	Riparian	August 11th	Downy Woodpecker	SIV1	80	ft2/acre	cottonwood, sugarberry, summer grapevine, sedge, virginia creeper, beggars tick, inland sea oats, poison ivy, greenbriar, box elder, greenbriar, ash, american elm, soapberry, hickory
	36,8,29			SIV2	5	#	
	96,15,8		Barred Owl	SIV1	4	#	
				SIV2	14	inches	
				SIV3	40	%	

ATTACHMENT C

Left Abutment (1-11)

HSI Model	Habitat Type	Metric	Existing Condition/TY 0	TY 1	TY5	TY 10	TY 25	TY 50	Measurement
Slider	Wetland	Percent cover of emergent and submerged vegetation							%
	Wetland	Velocity							Feet/second
	Wetland	Water depth							feet
	Wetland	Water regime							A: Permanently flooded B: Intermittently exposed C: Semi permanently flooded D: Seasonally flooded E: Temporarily flooded F: Saturated G: Intermittently flooded
	Wetland	Water temperature							A: <15 C B: 15 - 20 C C: 20 - 25 C D: 25 - 30 C E: 30 - 35 C F: 35 - 40 C G: >40 C
American Coot	Wetland	Percent of wetland basin dominated by persistent emergent herbaceous vegetation							%
	Wetland	Edge index between emergent vegetation and open water (Edge Index between emergent and open water Wetlands that are close to circular in shape and contain no emergent vegetation, or emergent vegetation in an extremely narrow band adjacent to the shore (1), In contrast, a wetland of equal area containing many small stands of emergent vegetation or a highly asymmetrical shoreline will receive a high edge index. Wetlands containing stands of emergent vegetation surrounded by water will receive a higher index value than will wetlands where such vegetation is only present adjacent to the shoreline. A wetland that yields four times the amount of edge present due to emergent vegetation would equal 4.)							1 2 3 4 5
	Wetland	Water regime							A: Permanently flooded B: Intermittently exposed C: Semi permanently flooded D: Seasonally flooded E: Temporarily flooded F: Saturated G: Intermittently flooded
Barred Owl	Upland	Number of trees* >20 in DBH/1 acre [≥2=1.0]	1	1	1	2	3	4	0 1 2 3 4
	Upland	Mean DBH of overstory trees* that are ≥ 80% of the height of the tallest tree in the stand	11	11	12	13	15	17	inches
	Upland	Percent canopy cover of overstory trees*	70	70	70	72	75	78	percent
Downy Woodpecker	Upland	Basal area	96	96	96	95	92	90	Ft^2/acre
	Upland	Number of snags > 6 inches dbh/1.0 acre	3	3	3	3	4	5	0 1 2 3 4 5+
Eastern Meadowlark	Grassland	Herbaceous canopy cover	37	0	0	0	0	0	%
	Grassland	Portion grass canopy	30	0	0	0	0	0	%
	Grassland	Height of canopy	35	56	56	56	56	56	centimeters
	Grassland	Distance to perch	8	8	8	8	8	8	meters
	Grassland	Shrub crown coverage	3	3	3	3	3	3	%

Right Abutment (12-24)

HSI Model	Habitat Type	Metric	Existing Condition/TY 0	TY 1	TY5	TY 10	TY 25	TY 50	Measurement
Slider	Wetland	Percent cover of emergent and submerged vegetation	30	30	29	27	25	20	%
	Wetland	Velocity	0	0	0	0	0	0	Feet/second
	Wetland	Water depth	0.25	0.25	0.25	0.25	0.25	0.25	feet
	Wetland	Water regime	C	C	C	C	C	C	A: Permanently flooded B: Intermittently exposed C: Semi permanently flooded D: Seasonally flooded E: Temporarily flooded F: Saturated G: Intermittently flooded
	Wetland	Water temperature	D	D	D	D	D	D	A: <15 C B: 15 - 20 C C: 20 - 25 C D: 25 - 30 C E: 30 - 35 C F: 35 - 40 C G: >40 C
American Coot	Wetland	Percent of wetland basin dominated by persistent emergent herbaceous vegetation	30	30	30	30	30	28	%
	Wetland	Edge index between emergent vegetation and open water (Edge Index between emergent and open water Wetlands that are close to circular in shape and contain no emergent vegetation, or emergent vegetation in an extremely narrow band adjacent to the shore (1), In contrast, a wetland of equal area containing many small stands of emergent vegetation or a highly asymmetrical shoreline will receive a high edge index. Wetlands containing stands of emergent vegetation surrounded by water will receive a higher index value than will wetlands where such vegetation is only present adjacent to the shoreline. A wetland that yields four times the amount of edge present due to emergent vegetation would equal 4.)	2	2	2	2	2	2	1 2 3 4 5
	Wetland	Water regime	C	C	C	C	C	C	A: Permanently flooded B: Intermittently exposed C: Semi permanently flooded D: Seasonally flooded E: Temporarily flooded F: Saturated G: Intermittently flooded
Barred Owl	Upland	Number of trees* >20 in DBH/1 acre [≥2=1.0]	2	2	2	3	4	4	0 1 2 3 4
	Upland	Mean DBH of overstory trees* that are ≥ 80% of the height of the tallest tree in the stand	9	9	10	11	13	15	inches
	Upland	Percent canopy cover of overstory trees*	53	53	53	55	58	61	percent
Downy Woodpecker	Upland	Basal area	68	75	75	74	71	69	Ft^2 /acre
	Upland	Number of snags > 6 inches dbh/1.0 acre	1	5	5	5	5	6	0 1 2 3 4 5+
Eastern Meadowlark	Grassland	Herbaceous canopy cover	0	0	0	0	0	0	%
	Grassland	Portion grass canopy	0	0	0	0	0	0	%
	Grassland	Height of canopy	76	76	76	76	76	76	centimeters
	Grassland	Distance to perch	20	20	20	20	20	20	meters
	Grassland	Shrub crown coverage	13	13	13	13	13	13	%

Left Abutment (1-11)

HSI Model	Habitat Type	Metric	Existing Condition/TY 0	TY 1	TY5	TY 10	TY 25	TY 50	Measurement
Slider	Wetland	Percent cover of emergent and submerged vegetation							%
	Wetland	Velocity							Feet/second
	Wetland	Water depth							feet
	Wetland	Water regime							A: Permanently flooded B: Intermittently exposed C: Semi permanently flooded D: Seasonally flooded E: Temporarily flooded F: Saturated G: Intermittently flooded
	Wetland	Water temperature							A: <15 C B: 15 - 20 C C: 20 - 25 C D: 25 - 30 C E: 30 - 35 C F: 35 - 40 C G: >40 C
American Coot	Wetland	Percent of wetland basin dominated by persistent emergent herbaceous vegetation							%
	Wetland	Edge index between emergent vegetation and open water (Edge Index between emergent and open water Wetlands that are close to circular in shape and contain no emergent vegetation, or emergent vegetation in an extremely narrow band adjacent to the shore (1), In contrast, a wetland of equal area containing many small stands of emergent vegetation or a highly asymmetrical shoreline will receive a high edge index. Wetlands containing stands of emergent vegetation surrounded by water will receive a higher index value than will wetlands where such vegetation is only present adjacent to the shoreline. A wetland that yields four times the amount of edge present due to emergent vegetation would equal 4.)							1 2 3 4 5
	Wetland	Water regime							A: Permanently flooded B: Intermittently exposed C: Semi permanently flooded D: Seasonally flooded E: Temporarily flooded F: Saturated G: Intermittently flooded
Barred Owl	Upland	Number of trees* >20 in DBH/1 acre [≥2=1.0]	1	0	0	0	0	0	0 1 2 3 4
	Upland	Mean DBH of overstory trees* that are ≥ 80% of the height of the tallest tree in the stand	11	0	0	0	0	0	inches
	Upland	Percent canopy cover of overstory trees*	70	0	0	0	0	0	percent
Downy Woodpecker	Upland	Basal area	96	0	0	0	0	0	Ft^2 /acre
	Upland	Number of snags > 6 inches dbh/1.0 acre	3	0	0	0	0	0	0 1 2 3 4 5+
Eastern Meadowlark	Grassland	Herbaceous canopy cover	37	0	0	0	0	0	%
	Grassland	Portion grass canopy	30	0	0	0	0	0	%
	Grassland	Height of canopy	35	0	0	0	0	0	centimeters
	Grassland	Distance to perch	8	0	0	0	0	0	meters
	Grassland	Shrub crown coverage	3	0	0	0	0	0	%

Right Abutment (12-24)

HSI Model	Habitat Type	Metric	Existing Condition/TY 0	TY 1	TY5	TY 10	TY 25	TY 50	Measurement
Slider	Wetland	Percent cover of emergent and submerged vegetation	30	0	0	0	0	0	%
	Wetland	Velocity	0	0	0	0	0	0	Feet/second
	Wetland	Water depth	0.25	0	0	0	0	0	feet
	Wetland	Water regime	C	0	0	0	0	0	A: Permanently flooded B: Intermittently exposed C: Semi permanently flooded D: Seasonally flooded E: Temporarily flooded F: Saturated G: Intermittently flooded
	Wetland	Water temperature	D	0	0	0	0	0	A: <15 C B: 15 - 20 C C: 20 - 25 C D: 25 - 30 C E: 30 - 35 C F: 35 - 40 C G: >40 C
American Coot	Wetland	Percent of wetland basin dominated by persistent emergent herbaceous vegetation	30	0	0	0	0	0	%
	Wetland	Edge index between emergent vegetation and open water (Edge Index between emergent and open water Wetlands that are close to circular in shape and contain no emergent vegetation, or emergent vegetation in an extremely narrow band adjacent to the shore (1), In contrast, a wetland of equal area containing many small stands of emergent vegetation or a highly asymmetrical shoreline will receive a high edge index. Wetlands containing stands of emergent vegetation surrounded by water will receive a higher index value than will wetlands where such vegetation is only present adjacent to the shoreline. A wetland that yields four times the amount of edge present due to emergent vegetation would equal 4.)	2	0	0	0	0	0	1 2 3 4 5
	Wetland	Water regime	C	0	0	0	0	0	A: Permanently flooded B: Intermittently exposed C: Semi permanently flooded D: Seasonally flooded E: Temporarily flooded F: Saturated G: Intermittently flooded
Barred Owl	Upland	Number of trees* >20 in DBH/1 acre [≥2=1.0]	2	0	0	0	0	0	0 1 2 3 4
	Upland	Mean DBH of overstory trees* that are ≥ 80% of the height of the tallest tree in the stand	9	0	0	0	0	0	inches
	Upland	Percent canopy cover of overstory trees*	53	0	0	0	0	0	percent
Downy Woodpecker	Upland	Basal area	68	0	0	0	0	0	Ft^2/acre
	Upland	Number of snags > 6 inches dbh/1.0 acre	1	0	0	0	0	0	0 1 2 3 4 5+
Eastern Meadowlark	Grassland	Herbaceous canopy cover	0	0	0	0	0	0	%
	Grassland	Portion grass canopy	0	0	0	0	0	0	%
	Grassland	Height of canopy	76	0	0	0	0	0	centimeters
	Grassland	Distance to perch	20	0	0	0	0	0	meters
	Grassland	Shrub crown coverage	13	0	0	0	0	0	%

ATTACHMENT D

NATIONWIDE STANDARD CONSERVATION MEASURES

Listed below are effective measures that should be employed at all project development sites nationwide with the goal of reducing impacts to birds and their habitats. These measures are grouped into three categories: General, Habitat Protection, and Stressor Management. These measures may be updated through time. We recommend checking the Conservation Measures website regularly for the most up-to-date list.

1. **General Measures**

a. Educate all employees, contractors, and/or site visitors of relevant rules and regulations that protect wildlife. See the Service webpage on Regulations and Policies for more information on regulations that protect migratory birds.

b. Prior to removal of an inactive nest, ensure that the nest is not protected under the Endangered Species Act (ESA) or the Bald and Golden Eagle Protection Act (BGEPA). Nests protected under ESA or BGEPA cannot be removed without a valid permit. i. See the Service Nest Destruction Policy

c. Do not collect birds (live or dead) or their parts (e.g., feathers) or nests without a valid permit. Please visit the Service permits page for more information on permits and permit applications.

d. Provide enclosed solid waste receptacles at all project areas. Non-hazardous solid waste (trash) would be collected and deposited in the on-site receptacles. Solid waste would be collected and disposed of by a local waste disposal contractor. For more information about solid waste and how to properly dispose of it, see the EPA Non-Hazardous Waste website.

e. Report any incidental take of a migratory bird, to the local Service Office of Law Enforcement.

f. Consult and follow applicable Service industry guidance.

2. **Habitat Protection**

a. Minimize project creep by clearly delineating and maintaining project boundaries (including staging areas).

b. Consult all local, State, and Federal regulations for the development of an appropriate buffer distance between development site and any wetland or waterway. For more information on wetland protection regulations see the Clean Water Act sections 401 and 404.

c. Maximize use of disturbed land for all project activities (i.e., siting, lay-down areas, and construction).

d. Implement standard soil erosion and dust control measures. For example: i. Establish vegetation cover to stabilize soil ii. Use erosion blankets to prevent soil loss iii. Water bare soil to prevent wind erosion and dust issues

3. Stressor Management

Stressor: Vegetation Removal

Conservation Goal: Avoid direct take of adults, chicks, or eggs.

Conservation Measure 1: Schedule all vegetation removal, trimming, and grading of vegetated areas outside of the peak bird breeding season to the maximum extent practicable. Use available resources, such as internet-based tools (e.g., the FWS's Information, Planning and Conservation system and Avian Knowledge Network) to identify peak breeding months for local

bird species; or, contact local Service Migratory Bird Program Office for breeding bird information.

Conservation Measure 2: When project activities cannot occur outside the bird nesting season, conduct surveys prior to scheduled activity to determine if active nests are present within the area of impact and buffer any nesting locations found during surveys.

1) Generally, the surveys should be conducted no more than five days prior to scheduled activity.

2) Timing and dimensions of the area to be surveyed vary and will depend on the nature of the project, location, and expected level of vegetation disturbance.

3) If active nests or breeding behavior (e.g., courtship, nest building, territorial defense, etc.) are detected during these surveys, no vegetation removal activities should be conducted until nestlings have fledged or the nest fails or breeding behaviors are no longer observed. If the activity must occur, establish a buffer zone around the nest and no activities will occur within that zone until nestlings have fledged and left the nest area. The dimension of the buffer zone will depend on the proposed activity, habitat type, and species present and should be coordinated with the local or regional Service office.

4) When establishing a buffer zone, construct a barrier (e.g., plastic fencing) to protect the area. If the fence is knocked down or destroyed, work will suspend wholly, or in part, until the fence is satisfactorily repaired.

5) When establishing a buffer zone, a qualified biologist will be present onsite to serve as a biological monitor during vegetation clearing and grading activities to ensure no take of migratory birds occurs. Prior to vegetation clearing, the monitor will ensure that the limits of construction have been properly staked and are readily identifiable. Any associated project activities that are inconsistent with the applicable conservation measures, and activities that may result in the take of migratory birds will be immediately halted and reported to the appropriate Service office within 24 hours.

6) If establishing a buffer zone is not feasible, contact the Service for guidance to minimize impacts to migratory birds associated with the proposed project or removal of an active nest. Active nests may only be removed if you receive a permit from your local Migratory Bird Permit Office. A permit may authorize active nest removal by a qualified biologist with bird handling experience or by a permitted bird rehabilitator.

Conservation Measure 3: Prepare a vegetation maintenance plan that outlines vegetation maintenance activities and schedules so that direct bird impacts do not occur.

Stressor: Invasive Species Introduction

Conservation Goal: Prevent the introduction of invasive plants.

Conservation Measure 1: Prepare a weed abatement plan that outlines the areas where weed abatement is required and the schedule and method of activities to ensure bird impacts are avoided.

Conservation Measure 2: For temporary and permanent habitat restoration/enhancement, use only native and local (when possible) seed and plant stock.

Conservation Measure 3: Consider creating vehicle wash stations prior to entering sensitive habitat areas to prevent accidental introduction of non-native plants.

Conservation Measure 4: Remove invasive/exotic species that pose an attractive nuisance to migratory birds.

Stressor: Artificial Lighting

Conservation Goal: Prevent increase in lighting of native habitats during the bird breeding season.

Conservation Measure 1: To the maximum extent practicable, limit construction activities to the time between dawn and dusk to avoid the illumination of adjacent habitat areas.

Conservation Measure 2: If construction activity time restrictions are not possible, use down shielding or directional lighting to avoid light trespass into bird habitat (i.e., use a 'Cobra' style light rather than an omnidirectional light system to direct light down to the roadbed). To the maximum extent practicable, while allowing for public safety, low intensity energy saving lighting (e.g. low pressure sodium lamps) will be used.

Conservation Measure 3: Minimize illumination of lighting on associated construction or operation structures by using motion sensors or heat sensors.

Conservation Measure 4: Bright white light, such as metal halide, halogen, fluorescent, mercury vapor and incandescent lamps should not be used.

Stressor: Human Disturbance

Conservation Goal: Minimize prolonged human presence near nesting birds during construction and maintenance actions.

Conservation Measure 1: Restrict unauthorized access to natural areas adjacent to the project site by erecting a barrier and/or avoidance buffers (e.g., gate, fence, wall) to minimize foot traffic and off-road vehicle uses.

Stressor: Collision

Conservation Goal: Minimize collision risk with project infrastructure and vehicles.

Conservation Measure 1: Minimize collision risk with project infrastructure (e.g., temporary and permanent) by increasing visibility through appropriate marking and design features (e.g., lighting, wire marking, etc.).

Conservation Measure 2: On bridge crossing areas with adjacent riparian, beach, estuary, or other bird habitat, use fencing or metal bridge poles (Sebastian Poles) that extend to the height of the tallest vehicles that will use the structure.

Conservation Measure 3: Install wildlife friendly culverts so rodents and small mammals can travel under any new roadways instead of over them. This may help reduce raptor deaths associated with being struck while tracking prey or scavenging road kill on the roadway.

Conservation Measure 4: Remove road-kill carcasses regularly to prevent scavenging and bird congregations along roadways.

Conservation Measure 5: Avoid planting “desirable” fruited or preferred nesting vegetation in medians or Rights of Way.

Conservation Measure 6: Eliminate use of steady burning lights on tall structures (e.g., >200 ft).

Stressor: Entrapment

Conservation Goal: Prevent birds from becoming trapped in project structures or perching and nesting in project areas that may endanger them.

Conservation Measure 1: Minimize entrapment and entanglement hazards through project design measures that may include:

1. Installing anti-perching devices on facilities/equipment where birds may commonly nest or perch

2. Covering or enclosing all potential nesting surfaces on the structure with mesh netting, chicken wire fencing, or other suitable exclusion material prior to the nesting season to prevent birds from establishing new nests. The netting, fencing, or other material must have no opening or mesh size greater than 19 mm and must be maintained until the structure is removed.

3. Cap pipes and cover/seal all small dark spaces where birds may enter and become trapped.

Conservation Measure 2: Use the appropriate deterrents to prevent birds from nesting on structures where they cause conflicts, may endanger themselves, or create a human health and safety hazard.

1. During the time that the birds are trying to build or occupy their nests (generally , between April and August, depending on the geographic location), potential nesting 5 surfaces should be monitored at least once every three days for any nesting activity, especially where bird use of structures is likely to cause take. It is permissible to remove non-active nests (without birds or eggs), partially completed nests, or new nests as they are built (prior to occupation). If birds have started to build any nests, the nests shall be removed before they are completed. Water shall not be used to remove the nests if nests are located within 50 feet of any surface waters.

2. If an active nest becomes established (i.e., there are eggs or young in the nest), all work that could result in abandonment or destruction of the nest shall be avoided until the young have fledged or the nest is unoccupied. Construction activities that may displace birds after they have laid their eggs and before the young have fledged should not be permitted. If the project continues into the following spring, this cycle shall be repeated. When work on the structure is complete, all netting shall be removed and properly disposed of.

Stressor: Noise

Conservation Goal: Prevent the increase in noise above ambient levels during the nesting bird breeding season.

Conservation Measure 1: Minimize an increase in noise above ambient levels during project construction by installing temporary structural barriers such as sand bags

Conservation Measure 2: Avoid permanent additions to ambient noise levels from the proposed project by using baffle boxes or sound walls.

Stressor: Chemical Contamination

Conservation Goal: Prevent the introduction of chemicals contaminants into the environment.

Conservation Measure 1: Avoid chemical contamination of the project area by implementing a Hazardous Materials Plan. For more information on hazardous waste and how to properly manage hazardous waste, see the EPA Hazardous Waste website.

Conservation Measure 2: Avoid soil contamination by using drip pans underneath equipment and containment zones at construction sites and when refueling vehicles or equipment.

Conservation Measure 3: Avoid contaminating natural aquatic and wetland systems with runoff by limiting all equipment maintenance, staging laydown, and dispensing of fuel, oil, etc., to designated upland areas.

Conservation Measure 4: Any use of pesticides or rodenticides shall comply with the applicable Federal and State laws.

1. Choose non-chemical alternatives when appropriate

2. Pesticides shall be used only in accordance with their registered uses and in accordance with the manufacturer's instructions to limit access to non-target species.

3. For general measures to reducing wildlife exposure to pesticides, see EPA's Pesticides: Environmental Effects website.

Stressor: Fire

Conservation Goal: Minimize fire potential from project-related activities.

Conservation Measure 1: Reduce fire hazards from vehicles and human activities (e.g., use spark arrestors on power equipment, avoid driving vehicles off road).

Conservation Measure 2: Consider fire potential when developing vegetation management plans by planting temporary impact areas with a palate of low-growing, sparse, fire resistant native species that meet with the approval of the County Fire Department and local FWS Office.

NATIONAL BALD EAGLE MANAGEMENT GUIDELINES

U.S. Fish and Wildlife Service

May 2007

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INTRODUCTION

The bald eagle (*Haliaeetus leucocephalus*) is protected by the Bald and Golden Eagle Protection Act (Eagle Act) and the Migratory Bird Treaty Act (MBTA). The MBTA and the Eagle Act protect bald eagles from a variety of harmful actions and impacts. The U.S. Fish and Wildlife Service (Service) developed these National Bald Eagle Management Guidelines to advise landowners, land managers, and others who share public and private lands with bald eagles when and under what circumstances the protective provisions of the Eagle Act may apply to their activities. A variety of human activities can potentially interfere with bald eagles, affecting their ability to forage, nest, roost, breed, or raise young. The Guidelines are intended to help people minimize such impacts to bald eagles, particularly where they may constitute "disturbance," which is prohibited by the Eagle Act.

The Guidelines are intended to:

(1) Publicize the provisions of the Eagle Act that continue to protect bald eagles, in order to reduce the possibility that people will violate the law,

(2) Advise landowners, land managers and the general public of the potential for various human activities to disturb bald eagles, and

(3) Encourage additional nonbinding land management practices that benefit bald eagles (see Additional Recommendations section).

While the Guidelines include general recommendations for land management practices that will benefit bald eagles, the document is intended primarily as a tool for landowners and planners who seek information and recommendations regarding how to avoid disturbing bald eagles. Many States and some tribal entities have developed state-specific management plans, regulations, and/or guidance for landowners and land managers to protect and enhance bald eagle habitat, and we encourage the continued development and use of these planning tools to benefit bald eagles.

Adherence to the Guidelines herein will benefit individuals, agencies, organizations, and companies by helping them avoid violations of the law. However, the Guidelines themselves are not law. Rather, they are recommendations based on several decades of behavioral observations, science, and conservation measures to avoid or minimize adverse impacts to bald eagles.

The U.S. Fish and Wildlife Service strongly encourages adherence to these guidelines to ensure that bald and golden eagle populations will continue to be sustained. The Service realizes there may be impacts to some birds even if all reasonable measures are taken to avoid such impacts. Although it is not possible to absolve individuals and entities from liability under the Eagle Act or the MBTA, the Service exercises enforcement discretion to focus on those individuals, companies, or agencies that take migratory birds without regard for the consequences of their actions and the law, especially when conservation measures, such as these Guidelines, are available, but have not been implemented. The Service will prioritize its enforcement efforts to focus on those individuals or entities who take bald eagles or their parts, eggs, or nests without implementing appropriate measures recommended by the Guidelines.

The Service intends to pursue the development of regulations that would authorize, under limited circumstances, the use of permits if “take” of an eagle is anticipated but unavoidable. Additionally, if the bald eagle is delisted, the Service intends to provide a regulatory mechanism to honor existing (take) authorizations under the Endangered Species Act (ESA).

During the interim period until the Service completes a rulemaking for permits under the Eagle Act, the Service does not intend to refer for prosecution the incidental “*take*” of any bald eagle under the MBTA or Eagle Act, if such take is in full compliance with the terms and conditions of an incidental take statement issued to the action agency or applicant under the authority of section 7(b)(4) of the ESA or a permit issued under the authority of section 10(a)(1)(B) of the ESA.

The Guidelines are applicable throughout the United States, including Alaska. The primary purpose of these Guidelines is to provide information that will minimize or prevent violations only of *Federal* laws governing bald eagles. In addition to Federal laws, many states and some smaller jurisdictions and tribes have additional laws and regulations protecting bald eagles. In some cases those laws and regulations may be more protective (restrictive) than these Federal guidelines. If you are planning activities that may affect bald eagles, we therefore recommend that you contact both your nearest U.S. Fish and Wildlife Service Field Office (see the contact information on p.16) and your state wildlife agency for assistance.

LEGAL PROTECTIONS FOR THE BALD EAGLE

The Bald and Golden Eagle Protection Act

The Eagle Act (16 U.S.C. 668-668c), enacted in 1940, and amended several times since then, prohibits anyone, without a permit issued by the Secretary of the Interior, from “taking” bald eagles, including their parts, nests, or eggs. The Act provides criminal and civil penalties for persons who “take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or any manner, any bald eagle ... [or any golden eagle], alive or dead, or any part, nest, or egg thereof.” The Act defines “take” as “pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb.” “Disturb’’ means:

> "Disturb means to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior."

In addition to immediate impacts, this definition also covers impacts that result from human-induced alterations initiated around a previously used nest site during a time when eagles are not present, if, upon the eagle=s return, such alterations agitate or bother an eagle to a degree that injures an eagle or substantially interferes with normal breeding, feeding, or sheltering habits and causes, or is likely to cause, a loss of productivity or nest abandonment.

A violation of the Act can result in a criminal fine of $100,000 ($200,000 for organizations), imprisonment for one year, or both, for a first offense. Penalties increase substantially for additional offenses, and a second violation of this Act is a felony.

The Migratory Bird Treaty Act

The MBTA (16 U.S.C. 703-712), prohibits the taking of any migratory bird or any part, nest, or egg, except as permitted by regulation. The MBTA was enacted in 1918; a 1972 agreement supplementing one of the bilateral treaties underlying the MBTA had the effect of expanding the scope of the Act to cover bald eagles and other raptors. Implementing regulations define "take" under the MBTA as "pursue, hunt, shoot, wound, kill, trap, capture, possess, or collect."

Copies of the Eagle Act and the MBTA are available at: http://permits.fws.gov/ltr/ltr.shtml.

State laws and regulations

Most states have their own regulations and/or guidelines for bald eagle management. Some states may continue to list the bald eagle as endangered, threatened, or of special concern. If you plan activities that may affect bald eagles, we urge you to familiarize yourself with the regulations and/or guidelines that apply to bald eagles in your state. Your adherence to the Guidelines herein does not ensure that you are in compliance with state laws and regulations because state regulations can be more specific and/or restrictive than these Guidelines.

NATURAL HISTORY OF THE BALD EAGLE

Bald eagles are a North American species that historically occurred throughout the contiguous United States and Alaska. After severely declining in the lower 48 States between the 1870s and the 1970s, bald eagles have rebounded and re-established breeding territories in each of the lower 48 states. The largest North American breeding populations are in Alaska and Canada, but there are also significant bald eagle populations in Florida, the Pacific Northwest, the Greater Yellowstone area, the Great Lakes states, and the Chesapeake Bay region. Bald eagle distribution varies seasonally. Bald eagles that nest in southern latitudes frequently move northward in late spring and early summer, often summering as far north as Canada. Most eagles that breed at northern latitudes migrate southward during winter, or to coastal areas where waters remain unfrozen. Migrants frequently concentrate in large numbers at sites where food is abundant and they often roost together communally. In some cases, concentration areas are used year-round: in summer by southern eagles and in winter by northern eagles.

Juvenile bald eagles have mottled brown and white plumage, gradually acquiring their dark brown body and distinctive white head and tail as they mature. Bald eagles generally attain adult plumage by 5 years of age. Most are capable of breeding at 4 or 5 years of age, but in healthy populations they may not start breeding until much older. Bald eagles may live 15 to 25 years in the wild. Adults weigh 8 to 14 pounds (occasionally reaching 16 pounds in Alaska) and have wingspans of 5 to 8 feet. Those in the northern range are larger than those in the south, and females are larger than males.

Where do bald eagles nest?

Breeding bald eagles occupy "territories," areas they will typically defend against intrusion by other eagles. In addition to the active nest, a territory may include one or more alternate nests (nests built or maintained by the eagles but not used for nesting in a given year). The Eagle Act prohibits removal or destruction of both active and alternate bald eagle nests. Bald eagles exhibit high nest site fidelity and nesting territories are often used year after year. Some territories are known to have been used continually for over half a century.

Bald eagles generally nest near coastlines, rivers, large lakes or streams that support an adequate food supply. They often nest in mature or old-growth trees; snags (dead trees); cliffs; rock promontories; rarely on the ground; and with increasing frequency on human-made structures such as power poles and communication towers. In forested areas, bald eagles often select the tallest trees with limbs strong enough to support a nest that can weigh more than 1,000 pounds. Nest sites typically include at least one perch with a clear view of the water where the eagles usually forage. Shoreline trees or snags located in reservoirs provide the visibility and accessibility needed to locate aquatic prey. Eagle nests are constructed with large sticks, and may be lined with moss, grass, plant stalks, lichens, seaweed, or sod. Nests are usually about 4-6 feet in diameter and 3 feet deep, although larger nests exist.

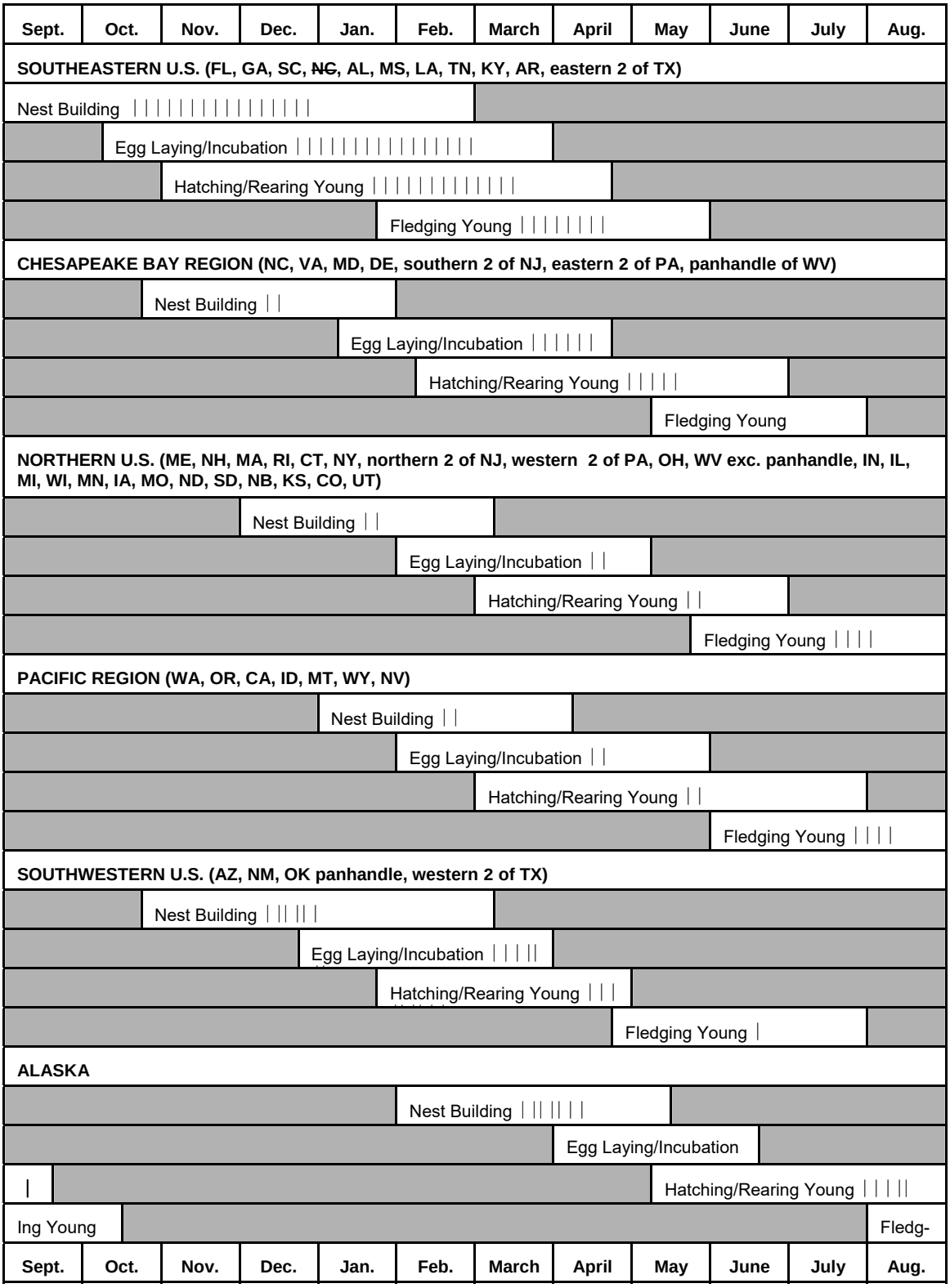
The range of breeding bald eagles in 2000 (shaded areas). This map shows only the larger concentrations of nests; eagles have continued to expand into additional nesting territories in many states. The dotted line represents the bald eagle's wintering range.

When do bald eagles nest?

Nesting activity begins several months before egg-laying. Egg-laying dates vary throughout the U.S., ranging from October in Florida, to late April or even early May in the northern United States. Incubation typically lasts 33-35 days, but can be as long as 40 days. Eaglets make their first unsteady flights about 10 to 12 weeks after hatching, and fledge (leave their nests) within a few days after that first flight. However, young birds usually remain in the vicinity of the nest for several weeks after fledging because they are almost completely dependent on their parents for food until they disperse from the nesting territory approximately 6 weeks later.

The bald eagle breeding season tends to be longer in the southern U.S., and re-nesting following an unsuccessful first nesting attempt is more common there as well. The following table shows the timing of bald eagle breeding seasons in different regions of the country. The table represents the range of time within which the majority of nesting activities occur in each region and does not apply to any specific nesting pair. Because the timing of nesting activities may vary within a given region, you should contact the nearest U.S. Fish and Wildlife Service Field Office (see page 16) and/or your state wildlife conservation agency for more specific information on nesting chronology in your area.

Chronology of typical reproductive activities of bald eagles in the United States.



How many chicks do bald eagles raise?
The number of eagle eggs laid will vary from 1-3, with 1-2 eggs being the most common. Only one eagle egg is laid per day, although not always on successive days. Hatching of young occurs on different days with the result that chicks in the same nest are sometimes of unequal size. The overall national fledging rate is approximately one chick per nest, annually, which results in a healthy expanding population.

What do bald eagles eat?
Bald eagles are opportunistic feeders. Fish comprise much of their diet, but they also eat waterfowl, shorebirds/colonial waterbirds, small mammals, turtles, and carrion. Because they are visual hunters, eagles typically locate their prey from a conspicuous perch, or soaring flight, then swoop down and strike. Wintering bald eagles often congregate in large numbers along streams to feed on spawning salmon or other fish species, and often gather in large numbers in areas below reservoirs, especially hydropower dams, where fish are abundant. Wintering eagles also take birds from rafts of ducks at reservoirs and rivers, and congregate on melting ice shelves to scavenge dead fish from the current or the soft melting ice. Bald eagles will also feed on carcasses along roads, in landfills, and at feedlots.

During the breeding season, adults carry prey to the nest to feed the young. Adults feed their chicks by tearing off pieces of food and holding them to the beaks of the eaglets. After fledging, immature eagles are slow to develop hunting skills, and must learn to locate reliable food sources and master feeding techniques. Young eagles will congregate together, often feeding upon easily acquired food such as carrion and fish found in abundance at the mouths of streams and shallow bays and at landfills.

The impact of human activity on nesting bald eagles
During the breeding season, bald eagles are sensitive to a variety of human activities. However, not all bald eagle pairs react to human activities in the same way. Some pairs nest successfully just dozens of yards from human activity, while others abandon nest sites in response to activities much farther away. This variability may be related to a number of factors, including visibility, duration, noise levels, extent of the area affected by the activity, prior experiences with humans, and tolerance of the individual nesting pair. The relative sensitivity of bald eagles during various stages of the breeding season is outlined in the following table.

Nesting Bald Eagle Sensitivity to Human Activities

Phase	Activity	Sensitivity to Human Activity	Comments
I	Courtship and Nest Building	Most sensitive period; likely to respond negatively	Most critical time period. Disturbance is manifested in nest abandonment. Bald eagles in newly established territories are more prone to abandon nest sites.
II	Egg laying	Very sensitive period	Human activity of even limited duration may cause nest desertion and abandonment of territory for the breeding season.
III	Incubation and early nestling period (up to 4 weeks)	Very sensitive period	Adults are less likely to abandon the nest near and after hatching. However, flushed adults leave eggs and young unattended; eggs are susceptible to cooling, loss of moisture, overheating, and predation; young are vulnerable to elements.
IV	Nestling period, 4 to 8 weeks	Moderately sensitive period	Likelihood of nest abandonment and vulnerability of the nestlings to elements somewhat decreases. However, nestlings may miss feedings, affecting their survival.
V	Nestlings 8 weeks through fledging	Very sensitive period	Gaining flight capability, nestlings 8 weeks and older may flush from the nest prematurely due to disruption and die.

If agitated by human activities, eagles may inadequately construct or repair their nest, may expend energy defending the nest rather than tending to their young, or may abandon the nest altogether. Activities that cause prolonged absences of adults from their nests can jeopardize eggs or young. Depending on weather conditions, eggs may overheat or cool too much and fail to hatch. Unattended eggs and nestlings are subject to predation. Young nestlings are particularly vulnerable because they rely on their parents to provide warmth or shade, without which they may die as a result of hypothermia or heat stress. If food delivery schedules are interrupted, the young may not develop healthy plumage, which can affect their survival. In addition, adults startled while incubating or brooding young may damage eggs or injure their young as they abruptly leave the nest. Older nestlings no longer require constant attention from the adults, but they may be startled by loud or intrusive human activities and prematurely jump from the nest before they are able to fly or care for themselves. Once fledged, juveniles range up to ¼ mile from the nest site, often to a site with minimal human activity. During this period, until about six weeks after departure from the nest, the juveniles still depend on the adults to feed them.

The impact of human activity on foraging and roosting bald eagles

Disruption, destruction, or obstruction of roosting and foraging areas can also negatively affect bald eagles. Disruptive activities in or near eagle foraging areas can interfere with feeding, reducing chances of survival. Interference with feeding can also result in reduced productivity (number of young successfully fledged). Migrating and wintering bald eagles often congregate at specific sites for purposes of feeding and sheltering. Bald eagles rely on established roost sites because of their proximity to sufficient food sources. Roost sites are usually in mature trees where the eagles are somewhat sheltered from the wind and weather. Human activities near or within communal roost sites may prevent eagles

from feeding or taking shelter, especially if there are not other undisturbed and productive feeding and roosting sites available. Activities that permanently alter communal roost sites and important foraging areas can altogether eliminate the elements that are essential for feeding and sheltering eagles.

Where a human activity agitates or bothers roosting or foraging bald eagles to the degree that causes injury or substantially interferes with breeding, feeding, or sheltering behavior and causes, or is likely to cause, a loss of productivity or nest abandonment, the conduct of the activity constitutes a violation of the Eagle Act's prohibition against disturbing eagles. The circumstances that might result in such an outcome are difficult to predict without detailed site-specific information. If your activities may disturb roosting or foraging bald eagles, you should contact your local Fish and Wildlife Service Field Office (see page 16) for advice and recommendations for how to avoid such disturbance.

RECOMMENDATIONS FOR AVOIDING DISTURBANCE AT NEST SITES

In developing these Guidelines, we relied on existing state and regional bald eagle guidelines, scientific literature on bald eagle disturbance, and recommendations of state and Federal biologists who monitor the impacts of human activity on eagles. Despite these resources, uncertainties remain regarding the effects of many activities on eagles and how eagles in different situations may or may not respond to certain human activities. The Service recognizes this uncertainty and views the collection of better biological data on the response of eagles to disturbance as a high priority. To the extent that resources allow, the Service will continue to collect data on responses of bald eagles to human activities conducted according to the recommendations within these Guidelines to ensure that adequate protection from disturbance is being afforded, and to identify circumstances where the Guidelines might be modified. These data will be used to make future adjustments to the Guidelines.

To avoid disturbing nesting bald eagles, we recommend (1) keeping a distance between the activity and the nest (distance buffers), (2) maintaining preferably forested (or natural) areas between the activity and around nest trees (landscape buffers), and (3) avoiding certain activities during the breeding season. The buffer areas serve to minimize visual and auditory impacts associated with human activities near nest sites. Ideally, buffers would be large enough to protect existing nest trees and provide for alternative or replacement nest trees.

The size and shape of effective buffers vary depending on the topography and other ecological characteristics surrounding the nest site. In open areas where there are little or no forested or topographical buffers, such as in many western states, distance alone must serve as the buffer. Consequently, in open areas, the distance between the activity and the nest may need to be larger than the distances recommended under Categories A and B of these guidelines (pg. 12) if no landscape buffers are present. The height of the nest above the ground may also ameliorate effects of human activities; eagles at higher nests may be less prone to disturbance.

In addition to the physical features of the landscape and nest site, the appropriate size for the distance buffer may vary according to the historical tolerances of eagles to human activities in particular localities, and may also depend on the location of the nest in relation

to feeding and roosting areas used by the eagles. Increased competition for nest sites may lead bald eagles to nest closer to human activity (and other eagles).

Seasonal restrictions can prevent the potential impacts of many shorter-term, obtrusive activities that do not entail landscape alterations (e.g. fireworks, outdoor concerts). In proximity to the nest, these kinds of activities should be conducted only outside the breeding season. For activities that entail both short-term, obtrusive characteristics and more permanent impacts (e.g., building construction), we recommend a combination of both approaches: retaining a landscape buffer *and* observing seasonal restrictions.

For assistance in determining the appropriate size and configuration of buffers or the timing of activities in the vicinity of a bald eagle nest, we encourage you to contact the nearest U.S. Fish and Wildlife Service Field Office (see page 16).

Existing Uses

Eagles are unlikely to be disturbed by routine use of roads, homes, and other facilities where such use pre-dates the eagles' successful nesting activity in a given area. Therefore, in most cases *ongoing* existing uses may proceed with the same intensity with little risk of disturbing bald eagles. However, some *intermittent, occasional, or irregular* uses that pre-date eagle nesting in an area may disturb bald eagles. For example: a pair of eagles may begin nesting in an area and subsequently be disturbed by activities associated with an annual outdoor flea market, even though the flea market has been held annually at the same location. In such situations, human activity should be adjusted or relocated to minimize potential impacts on the nesting pair.

ACTIVITY-SPECIFIC GUIDELINES

The following section provides the Service=s management recommendations for avoiding bald eagle disturbance as a result of new or intermittent activities proposed in the vicinity of bald eagle nests. Activities are separated into 8 categories (A – H) based on the nature and magnitude of impacts to bald eagles that usually result from the type of activity. Activities with similar or comparable impacts are grouped together.

In most cases, impacts will vary based on the visibility of the activity from the eagle nest and the degree to which similar activities are already occurring in proximity to the nest site. Visibility is a factor because, in general, eagles are more prone to disturbance when an activity occurs in full view. For this reason, we recommend that people locate activities farther from the nest structure in areas with open vistas, in contrast to areas where the view is shielded by rolling topography, trees, or other screening factors. The recommendations also take into account the existence of similar activities in the area because the continued presence of nesting bald eagles in the vicinity of the existing activities indicates that the eagles in that area can tolerate a greater degree of human activity than we can generally expect from eagles in areas that experience fewer human impacts. To illustrate how these factors affect the likelihood of disturbing eagles, we have incorporated the recommendations for some activities into a table (categories A and B).

First, determine which category your activity falls into (between categories A – H). If the activity you plan to undertake is not specifically addressed in these guidelines, follow the recommendations for the most similar activity represented.

If your activity is under A or B, our recommendations are in table form. The vertical axis shows the degree of visibility of the activity from the nest. The horizontal axis (header row) represents the degree to which similar activities are ongoing in the vicinity of the nest. Locate the row that best describes how visible your activity will be from the eagle nest. Then, choose the column that best describes the degree to which similar activities are ongoing in the vicinity of the eagle nest. The box where the column and row come together contains our management recommendations for how far you should locate your activity from the nest to avoid disturbing the eagles. The numerical distances shown in the tables are the closest the activity should be conducted relative to the nest. In some cases we have included additional recommendations (other than recommended *distance* from the nest) you should follow to help ensure that your activity will not disturb the eagles.

Alternate nests

For activities that entail permanent landscape alterations that may result in bald eagle disturbance, these recommendations apply to both active and alternate bald eagle nests. Disturbance becomes an issue with regard to alternate nests if eagles return for breeding purposes and react to land use changes that occurred while the nest was inactive. The likelihood that an alternate nest will again become active decreases the longer it goes unused. If you plan activities in the vicinity of an alternate bald eagle nest and have information to show that the nest has not been active during the preceding 5 breeding seasons, the recommendations provided in these guidelines for avoiding disturbance around the nest site may no longer be warranted. The nest itself remains protected by other provisions of the Eagle Act, however, and may not be destroyed.

If special circumstances exist that make it unlikely an inactive nest will be reused before 5 years of disuse have passed, and you believe that the probability of reuse is low enough to warrant disregarding the recommendations for avoiding disturbance, you should be prepared to provide all the reasons for your conclusion, including information regarding past use of the nest site. Without sufficient documentation, you should continue to follow these guidelines when conducting activities around the nest site. If we are able to determine that it is unlikely the nest will be reused, we may advise you that the recommendations provided in these guidelines for avoiding disturbance are no longer necessary around that nest site.

This guidance is intended to minimize disturbance, as defined by Federal regulation. In addition to Federal laws, most states and some tribes and smaller jurisdictions have additional laws and regulations protecting bald eagles. In some cases those laws and regulations may be more protective (restrictive) than these Federal guidelines.

Temporary Impacts

For activities that have temporary impacts, such as the use of loud machinery, fireworks displays, or summer boating activities, we recommend seasonal restrictions. These types of activities can generally be carried out outside of the breeding season without causing disturbance. The recommended restrictions for these types of activities can be lifted for alternate nests within a particular territory, including nests that were attended during the current breeding season but not used to raise young, after eggs laid in another nest within the territory have hatched (depending on the distance between the alternate nest and the active nest).

In general, activities should be kept as far away from nest trees as possible; loud and disruptive activities should be conducted when eagles are not nesting; and activity between the nest and the nearest foraging area should be minimized. If the activity you plan to undertake is not specifically addressed in these guidelines, follow the recommendations for the most similar activity addressed, or contact your local U.S. Fish and Wildlife Service Field Office for additional guidance.

If you believe that special circumstances apply to your situation that increase or diminish the likelihood of bald eagle disturbance, or if it is not possible to adhere to the guidelines, you should contact your local Service Field Office for further guidance.

Category A:
Building construction, 1 or 2 story, with project footprint of ½ acre or less.
Construction of roads, trails, canals, power lines, and other linear utilities.
Agriculture and aquaculture – new or expanded operations.
Alteration of shorelines or wetlands.
Installation of docks or moorings.
Water impoundment.

Category B:
Building construction, 3 or more stories.
Building construction, 1 or 2 story, with project footprint of more than ½ acre.
Installation or expansion of marinas with a capacity of 6 or more boats.
Mining and associated activities.
Oil and natural gas drilling and refining and associated activities.

	If there is no similar activity within 1 mile of the nest	***If there is similar activity closer than 1 mile from the nest***
If the activity will be visible from the nest	660 feet. Landscape buffers are recommended.	660 feet, or as close as existing tolerated activity of similar scope. Landscape buffers are recommended.
If the activity will not be visible from the nest	Category A: 330 feet. Clearing, external construction, and landscaping between 330 feet and 660 feet should be done outside breeding season. Category B: 660 feet.	330 feet, or as close as existing tolerated activity of similar scope. Clearing, external construction and landscaping within 660 feet should be done outside breeding season.

The numerical distances shown in the table are the closest the activity should be conducted relative to the nest.

Category C. Timber Operations and Forestry Practices

- Avoid clear cutting or removal of overstory trees within 330 feet of the nest at any time.

- Avoid timber harvesting operations, including road construction and chain saw and yarding operations, during the breeding season within 660 feet of the nest. The distance may be decreased to 330 feet around alternate nests within a particular territory, including nests that were attended during the current breeding season but not used to raise young, after eggs laid in another nest within the territory have hatched.

- Selective thinning and other silviculture management practices designed to conserve or enhance habitat, including prescribed burning close to the nest tree, should be undertaken outside the breeding season. Precautions such as raking leaves and woody debris from around the nest tree should be taken to prevent crown fire or fire climbing the nest tree. If it is determined that a burn during the breeding season would be beneficial, then, to ensure that no take or disturbance will occur, these activities should be conducted only when neither adult eagles nor young are present at the nest tree (i.e., at the beginning of, or end of, the breeding season, either before the particular nest is active or after the young have fledged from that nest). Appropriate Federal and state biologists should be consulted before any prescribed burning is conducted during the breeding season.

- Avoid construction of log transfer facilities and in-water log storage areas within 330 feet of the nest.

Category D. Off-road vehicle use (including snowmobiles). No buffer is necessary around nest sites outside the breeding season. During the breeding season, do not operate off-road vehicles within 330 feet of the nest. In open areas, where there is increased visibility and exposure to noise, this distance should be extended to 660 feet.

Category E. Motorized Watercraft use (including jet skis/personal watercraft). No buffer is necessary around nest sites outside the breeding season. During the breeding season, within 330 feet of the nest, (1) do not operate jet skis (personal watercraft), and (2) avoid concentrations of noisy vessels (e.g., commercial fishing boats and tour boats), except where eagles have demonstrated tolerance for such activity. Other motorized boat traffic passing within 330 feet of the nest should attempt to minimize trips and avoid stopping in the area where feasible, particularly where eagles are unaccustomed to boat traffic. Buffers for airboats should be larger than 330 feet due to the increased noise they generate, combined with their speed, maneuverability, and visibility.

Category F. Non-motorized recreation and human entry (e.g., hiking, camping, fishing, hunting, birdwatching, kayaking, canoeing). No buffer is necessary around nest sites outside the breeding season. If the activity will be visible or highly audible from the nest, maintain a 330-foot buffer during the breeding season, particularly where eagles are unaccustomed to such activity.

Category G. Helicopters and fixed-wing aircraft.
Except for authorized biologists trained in survey techniques, avoid operating aircraft within 1,000 feet of the nest during the breeding season, except where eagles have demonstrated tolerance for such activity.

Category H. Blasting and other loud, intermittent noises.
Avoid blasting and other activities that produce extremely loud noises within 1/2 mile of active nests, unless greater tolerance to the activity (or similar activity) has been demonstrated by the eagles in the nesting area. This recommendation applies to the use of fireworks classified by the Federal Department of Transportation as Class B explosives, which includes the larger fireworks that are intended for licensed public display.

RECOMMENDATIONS FOR AVOIDING DISTURBANCE AT FORAGING AREAS AND COMMUNAL ROOST SITES

1. Minimize potentially disruptive activities and development in the eagles' direct flight path between their nest and roost sites and important foraging areas.

2. Locate long-term and permanent water-dependent facilities, such as boat ramps and marinas, away from important eagle foraging areas.

3. Avoid recreational and commercial boating and fishing near critical eagle foraging areas during peak feeding times (usually early to mid-morning and late afternoon), except where eagles have demonstrated tolerance to such activity.

4. Do not use explosives within ½ mile (or within 1 mile in open areas) of communal roosts when eagles are congregating, without prior coordination with the U.S. Fish and Wildlife Service and your state wildlife agency.

5. Locate aircraft corridors no closer than 1,000 feet vertical or horizontal distance from communal roost sites.

ADDITIONAL RECOMMENDATIONS TO BENEFIT BALD EAGLES

The following are additional management practices that landowners and planners can exercise for added benefit to bald eagles.

1. Protect and preserve potential roost and nest sites by retaining mature trees and old growth stands, particularly within ½ mile from water.

2. Where nests are blown from trees during storms or are otherwise destroyed by the elements, continue to protect the site in the absence of the nest for up to three (3) complete breeding seasons. Many eagles will rebuild the nest and reoccupy the site.

3. To avoid collisions, site wind turbines, communication towers, and high voltage transmission power lines away from nests, foraging areas, and communal roost sites.

4. Employ industry-accepted best management practices to prevent birds from colliding with or being electrocuted by utility lines, towers, and poles. If possible, bury utility lines in important eagle areas.

5. Where bald eagles are likely to nest in human-made structures (e.g., cell phone towers) and such use could impede operation or maintenance of the structures or jeopardize the safety of the eagles, equip the structures with either (1) devices engineered to discourage bald eagles from building nests, or (2) nesting platforms that will safely accommodate bald eagle nests without interfering with structure performance.

6. Immediately cover carcasses of euthanized animals at landfills to protect eagles from being poisoned.

7. Do not intentionally feed bald eagles. Artificially feeding bald eagles can disrupt their essential behavioral patterns and put them at increased risk from power lines, collision with windows and cars, and other mortality factors.

8. Use pesticides, herbicides, fertilizers, and other chemicals only in accordance with Federal and state laws.

9. Monitor and minimize dispersal of contaminants associated with hazardous waste sites (legal or illegal), permitted releases, and runoff from agricultural areas, especially within watersheds where eagles have shown poor reproduction or where bioaccumulating contaminants have been documented. These factors present a risk of contamination to eagles and their food sources.

CONTACTS

The following U.S. Fish and Wildlife Service Field Offices provide technical assistance on bald eagle management:

Alabama	Daphne	(251) 441-5181
Alaska	Anchorage	(907) 271-2888
	Fairbanks	(907) 456-0203
	Juneau	(907) 780-1160
Arizona	Phoenix	(602) 242-0210
Arkansas	Conway	(501) 513-4470
California	Arcata	(707) 822-7201
	Barstow	(760) 255-8852
	Carlsbad	(760) 431-9440
	Red Bluff	(530) 527-3043
	Sacramento	(916) 414-6000
	Stockton	(209) 946-6400
	Ventura	(805) 644-1766
	Yreka	(530) 842-5763
Colorado	Lakewood	(303) 275-2370
	Grand Junction	(970) 243-2778
Connecticut	(See New Hampshire)	
Delaware	(See Maryland)	
Florida	Panama City	(850) 769-0552
	Vero Beach	(772) 562-3909
	Jacksonville	(904) 232-2580
Georgia	Athens	(706) 613-9493
	Brunswick	(912) 265-9336
	Columbus	(706) 544-6428
Idaho	Boise	(208) 378-5243
	Chubbuck	(208) 237-6975
Illinois/Iowa	Rock Island	(309) 757-5800
Indiana	Bloomington	(812) 334-4261
Kansas	Manhattan	(785) 539-3474
Kentucky	Frankfort	(502) 695-0468
Louisiana	Lafayette	(337) 291-3100
Maine	Old Town	(207) 827-5938
Maryland	Annapolis	(410) 573-4573
Massachusetts	(See New Hampshire)	
Michigan	East Lansing	(517) 351-2555
Minnesota	Bloomington	(612) 725-3548
Mississippi	Jackson	(601) 965-4900
Missouri	Columbia	(573) 234-2132
Montana	Helena	(405) 449-5225
Nebraska	Grand Island	(308) 382-6468
Nevada	Las Vegas	(702) 515-5230
	Reno	(775) 861-6300
New Hampshire	Concord	(603) 223-2541
New Jersey	Pleasantville	(609) 646-9310
New Mexico	Albuquerque	(505) 346-2525
New York	Cortland	(607) 753-9334
	Long Island	(631) 776-1401
North Carolina	Raleigh	(919) 856-4520
	Asheville	(828) 258-3939
North Dakota	Bismarck	(701) 250-4481
Ohio	Reynoldsburg	(614) 469-6923
Oklahoma	Tulsa	(918) 581-7458
Oregon	Bend	(541) 383-7146
	Klamath Falls	(541) 885-8481
	La Grande	(541) 962-8584
	Newport	(541) 867-4558
	Portland	(503) 231-6179
	Roseburg	(541) 957-3474
Pennsylvania	State College	(814) 234-4090
Rhode Island	(See New Hampshire)	
South Carolina	Charleston	(843) 727-4707
South Dakota	Pierre	(605) 224-8693
Tennessee	Cookeville	(931) 528-6481
Texas	Clear Lake	(281) 286-8282
Utah	West Valley City	(801) 975-3330
Vermont	(See New Hampshire)	
Virginia	Gloucester	(804) 693-6694
Washington	Lacey	(306) 753-9440
	Spokane	(509) 891-6839
	Wenatchee	(509) 665-3508
West Virginia	Elkins	(304) 636-6586
Wisconsin	New Franken	(920) 866-1725
Wyoming	Cheyenne	(307) 772-2374
	Cody	(307) 578-5939

National Office
U.S. Fish and Wildlife Service
Division of Migratory Bird Management
4401 North Fairfax Drive, MBSP-4107
Arlington, VA 22203-1610
(703) 358-1714
http://www.fws.gov/migratorybirds

State Agencies

To contact a state wildlife agency, visit the Association of Fish & Wildlife Agencies' website at http://www.fishwildlife.org/where_us.html

GLOSSARY

The definitions below apply to these National Bald Eagle Management Guidelines:

Communal roost sites – Areas where bald eagles gather and perch overnight – and sometimes during the day in the event of inclement weather. Communal roost sites are usually in large trees (live or dead) that are relatively sheltered from wind and are generally in close proximity to foraging areas. These roosts may also serve a social purpose for pair bond formation and communication among eagles. Many roost sites are used year after year.

Disturb – To agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior.

In addition to immediate impacts, this definition also covers impacts that result from human-caused alterations initiated around a previously used nest site during a time when eagles are not present, if, upon the eagle=s return, such alterations agitate or bother an eagle to a degree that injures an eagle or substantially interferes with normal breeding, feeding, or sheltering habits and causes, or is likely to cause, a loss of productivity or nest abandonment.

Fledge – To leave the nest and begin flying. For bald eagles, this normally occurs at 10-12 weeks of age.

Fledgling – A juvenile bald eagle that has taken the first flight from the nest but is not yet independent.

Foraging area – An area where eagles feed, typically near open water such as rivers, lakes, reservoirs, and bays where fish and waterfowl are abundant, or in areas with little or no water (i.e., rangelands, barren land, tundra, suburban areas, etc.) where other prey species (e.g., rabbit, rodents) or carrion (such as at landfills) are abundant.

Landscape buffer – A natural or human-made landscape feature that screens eagles from human activity (e.g., strip of trees, hill, cliff, berm, sound wall).

Nest – A structure built, maintained, or used by bald eagles for the purpose of reproduction. An **active** nest is a nest that is attended (built, maintained or used) by a pair of bald eagles during a given breeding season, whether or not eggs are laid. An **alternate** nest is a nest that is not used for breeding by eagles during a given breeding season.

Nest abandonment – Nest abandonment occurs when adult eagles desert or stop attending a nest and do not subsequently return and successfully raise young in that nest for the duration of a breeding season. Nest abandonment can be caused by altering habitat near a nest, even if the alteration occurs prior to the breeding season. Whether the eagles migrate during the non-breeding season, or remain in the area throughout the non-breeding season, nest abandonment can occur at any point between the time the eagles return to the nesting site for the breeding season and the time when all progeny from the breeding season have

dispersed.

Project footprint – The area of land (and water) that will be permanently altered for a development project, including access roads.

Similar scope – In the vicinity of a bald eagle nest, an existing activity is of similar scope to a new activity where the types of impacts to bald eagles are similar in nature, and the impacts of the existing activity are of the same or greater magnitude than the impacts of the potential new activity. Examples: (1) An existing single-story home 200 feet from a nest is similar in scope to an additional single-story home 200 feet from the nest; (2) An existing multi-story, multi-family dwelling 150 feet from a nest has impacts of a greater magnitude than a potential new single-family home 200 feet from the nest; (3) One existing single-family home 200 feet from the nest has impacts of a lesser magnitude than three single-family homes 200 feet from the nest; (4) an existing single-family home 200 feet from a communal roost has impacts of a lesser magnitude than a single-family home 300 feet from the roost but 40 feet from the eagles' foraging area. The existing activities in examples (1) and (2) are of similar scope, while the existing activities in example (3) and (4) are not.

Vegetative buffer – An area surrounding a bald eagle nest that is wholly or largely covered by forest, vegetation, or other natural ecological characteristics, and separates the nest from human activities.

RELATED LITERATURE

Andrew, J.M. and J.A. Mosher. 1981. Bald eagle nest site selection and nesting habitat in Maryland. Journal of Wildlife Management 46:382-390.

Anonymous. 1977. Bald Eagle Habitat Management Guidelines, Forest Service – California Region. U.S Forest Service, San Francisco, CA.

Anthony, R.G. 2001. Low productivity of bald eagles on Prince of Wales Island, southeast Alaska. Journal of Raptor Research 35:1-8.

Anthony, R.G., R.W. Frenzel, F.B. Isaacs, and M.G. Garrett. 1994. Probable causes of nesting failures in Oregon's bald eagle population. Wildlife Society Bulletin 22:576-582.

Anthony, R.G. and F.B. Isaacs. 1989. Characteristics of bald eagle nest sites in Oregon. Journal of Wildlife Management 53:148-158.

Arizona Game and Fish Department. 1999. Bald Eagle Conservation Assessment and Strategy (draft).

Avian Power Line Interaction Committee (APLIC). 1996. Suggested Practices for Raptor Protection on Power Lines: The State of the Art in 1996. Edison Electric Institute, Raptor Research Foundation, Washington, D.C.

Bangs, E.E., T.N. Bailey and V.D. Berns. Ecology of nesting bald eagles on the Kenai National Wildlife Refuge, Alaska. (USFWS staff)

Becker, J.M. 2002. Response of wintering bald eagles to industrial construction in southeastern Washington. Wildlife Society Bulletin 30:875-878.

Brauning, D.W. and J.D. Hassinger. 2000. Pennsylvania Recovery and Management Plan for the Bald Eagle (draft). Pennsylvania Game Commission. Harrisburg, PA.

Brown, B.T., G.S. Mills, C. Powels, W.A. Russell, G.D. Therres and J.J. Pottie. 1999. The influence of weapons-testing noise on bald eagle behavior. Journal of Raptor Research 33:227-232.

Brown, B.T. and L.E. Stevens. 1997. Winter bald eagle distribution is inversely correlated with human activity along the Colorado River, Arizona. Journal of Raptor Research31:7-10.

Buehler, D.A. 2000. Bald Eagle (*Haliaeetus leucocephalus*). *In* The Birds of North America, No. 506 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Buehler, D.A., T.J. Mersmann, J.D. Fraser, and J.K.D. Seegar. 1991. Effects of human activity on bald eagle distribution on the northern Chesapeake Bay. Journal of Wildlife Management 55:282-290.

Buehler, D.A., T.J. Mersmann, J.D. Fraser, and J.K.D. Seegar. 1991. Nonbreeding bald eagle communal and solitary roosting behavior and roost habitat on the northern Chesapeake Bay. Journal of Wildlife Management 55:273-281.

Chandler, SK., J.D. Fraser, D.A. Buehler and J.K.D. Seegar. 1995. Perch trees and shoreline development as predictors of bald eagle distribution on the Chesapeake Bay. Journal of Wildlife Management 59:325-332.

Cline, K. 1985. Bald Eagles in the Chesapeake: A Management Guide for Landowners. National Wildlife Federation. Washington, D.C.

Dell, D.D. and P.J. Zwank. 1986. Impact of a high-voltage transmission line on a nesting pair of southern bald eagles in southeast Louisiana. Journal of Raptor Research 20(3/4):117-119.

Dunwiddie, P.W. and R.C. Kuntz. 2001. Long-term trends of bald eagles in winter on the Skagit River, Washington. Journal of Wildlife Management 65(2):290-299.

Fletcher, R.J. et. al. 1999. Effects of recreational trails on wintering diurnal raptors along riparian corridors in a Colorado grassland. Journal of Raptor Research 33(3):233-239.

Fraser, J.D. 1981. The breeding biology and status of the bald eagle on the Chippewa National Forest. PhD. Dissertation, University of Minnesota.

Fraser, J.D., LD. Frenzel and J.E. Mathisen. 1985. The impact of human activities on breeding bald eagles in north-central Minnesota. Journal of Wildlife Management 49(3):585-592.

Garrett, M.G., J.W. Watson, and R.G. Anthony. 1993. Bald eagle home range and habitat use in the Columbia River Estuary. Journal of Wildlife Management 57(1):19-27.

Gerrard J.M. and G.R. Bortolotti. 1988. The Bald Eagle: Haunts and Habits of a Wilderness Monarch. Smithsonian Institution Press. Washington, D.C.

Grier, J.W. 1969. Bald eagle behavior and productivity responses to climbing to nests. Journal of Wildlife Management 33:961-966.

Grier, J.W. and J.E. Guinn. 2003. Bald eagle habitats and responses to human disturbance in Minnesota. Report to the Minnesota Department of Natural Resources.

Grubb, T.G. 1976. Survey and analysis of bald eagle nesting in western Washington. M.S. thesis, Univ. of Washington, Seattle.

Grubb, T.G. and R.M. King. 1991. Assessing human disturbance of breeding bald eagles with classification tree models. Journal of Wildlife Management 55:500-511.

Grubb, T.G., W.L. Robinson and W.W. Bowerman. 2002. Effects of watercraft on bald eagles nesting in Voyagers National Park, Minnesota. Wildlife Society Bulletin 30:156-161.

Grubb, T.G. and W.W. Bowerman. 1997. Variations in breeding bald eagle response to jets, light planes and helicopters. Journal of Raptor Research 31:213-222.

Grubb, T.G., W.W. Bowerman, A.J. Bath, J.P. Giesy, D.V.C. Weseloh. 2003. Evaluating Great Lakes bald eagle nesting habitat with Bayesian inference. RMRS-RP-45. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fort Collins, CO, 10 pp.

Hansen, J.A. 1977. Population dynamics and night roost requirements of bald eagles wintering in the Nooksack River Valley, WA. Huxley College of Environmental Studies, Western Washington State College, Bellingham, WA. (Problem Series)

Hansen, J.A., M.V. Stalmaster and J.R. Newman. 1980. Habitat characteristics, function, and destruction of bald eagle communal roosts in western Washington. Huxley college of Environmental Studies, Western Washington University.

Hunt, W.G., D.E. Driscoll, E.W. Bianchi, and R.E. Jackman. 1992. Ecology of bald eagles in Arizona. Report to U.S. Bureau of Reclamation, Contract 6-CS-30-04470. BioSystems Analysis Inc., Santa Cruz, California.

Isaacs, F.B and R.G. Anthony. 1987. Abundance, foraging, and roosting of bald eagles wintering in the Harney Basin, Oregon. Northwest Science 61(2), pp. 114-121.

Juenemann, B.G. 1973. Habitat evaluations of selected bald eagle nest sites on the Chippewa National Forest. M.S. thesis, University of Minnesota, Minneapolis.

Keister, G.P., R.G. Anthony and E.J. O'Neill. 1987. Use of communal roosts and foraging area by bald eagles wintering in the Klamath Basin. Journal of Wildlife Management 51(2):415-420.

Knight, R. and S.K. Knight. 1984. Responses of wintering bald eagles to boating activity. Journal of Wildlife Management 48:999-1004.

Linscombe, J.T., T.J. Hess, Jr., and V.L. Wright. 1999. Effects of seismic operations on Louisiana's nesting bald eagles. Proceedings of the Southeastern Association of Fish and Wildlife Agencies. 54:235-242.

Maine (State of) Inland Fisheries and Wildlife Rules. Chapter 8.05 Essential Habitat for Species Listed as Threatened or Endangered.

Mathisen, J.E. 1968. Effects of human disturbance on nesting bald eagles. Journal of Wildlife Management 32(1): 1-6.

McGarigal, K., R.G. Anthony and F.B. Isaacs. 1991. Interactions of humans and bald eagles on the Columbia River estuary. Wildlife Monographs 115:1-47.

McKay, K.J., J.W. Stravers, B.R. Conklin, U. Konig, S. Hawks, C.J. Kohrt, J.S. Lundh and G.V. Swenson. 2001. Potential human impacts on bald eagle reproductive success along the Upper Mississippi River.

McKewan, L.C. and D.H. Hirth. 1979. Southern bald eagle productivity and nest site selection. Journal of Wildlife Management 43:585-594.

Millsap, B.A. Status of wintering bald eagles in the conterminous 48 States. 1986. Wildlife Society Bulletin 14:433-440.

Millsap, B.A, T. Breen, E. McConnell, T. Steffer, L. Phillips, N. Douglass, and S. Taylor. In Press. Comparative fecundity and survival of bald eagles fledged from suburban and rural natal areas in Florida. Journal of Wildlife Management 68(4).

Montana Bald Eagle Working Group. 1986. Montana Bald Eagle Management Plan. Department of the Interior, Bureau of Land Management. Billings, MT.

Nesbitt, S.A., M.J. Folk and D.A. Wood. 1993. Effectiveness of bald eagle habitat protection guidelines in Florida. Proceedings of the Annual Conference of the Southeast Association of Fish and Wildlife Agencies.

Newman, J.R., W.H. Brennan and L.M. Smith. 1977. Twelve-year changes in nesting patterns of bald eagles on San Juan Island, Washington. The Murrelet 58(2)37-39.

Postapulsky, S. 1974. Raptor reproductive success: some problems with methods, criteria, and terminology. Pages 21-31 *in* F.N. Hammerstrom, Jr., B.E. Harrell, and R.R. Olendorff, eds. Management of raptors. Raptor Res. Found., Vermillion, S.D.

Rodgers, J.A. and Schwikert, S.T. 2003. Buffer zone distances to protect foraging and loafing waterbirds from disturbance by airboats in Florida. Waterbirds 26(4): 437-443.

Russell, D. 1980. Occurrence and human disturbance sensitivity of wintering bald eagles on the Sauk and Suiattle Rivers, Washington. In R.L. Knight, G.T. Allen, M.V. Stalmaster and C.W. Servheen [eds.]. Proceedings of the Washington Bald Eagle Symposium. Nature Conservancy, Seattle, Washington, pp. 165-174.

Shapiro, A.E., F. Montalbano, and D. Mager. 1982. Implications of construction of a flood control project upon bald eagle nesting activity. Wilson Bulletin 94(1), pp. 55-63.

Skagen, S.K. 1980. Behavioral responses of wintering bald eagles to human activity on the Skagit River, Washington. In R.L.Knight, G.T. Allen, M.V. Stalmaster and C.W. Servheen [eds.]. Proceedings of the Washington Bald Eagle Symposium. Nature Conservancy, Seattle, Washington, pp. 231-241.

Skagen, S.K., R.L. Knight and G.J.H. Orians. 1991. Human disturbance of an avian scavenging guild. Ecological Applications 1:215-225. (Internet)

Stalmaster, M.V. 1976 Winter ecology and effects of human activity on bald eagles in the Nooksack River Valley, Washington. MS Thesis, Western Washington State College, Bellingham.

Stalmaster, M.V. 1980. Management strategies for wintering bald eagles in the Pacific Northwest. Proceedings of the Washington Bald Eagle Symposium, pp 49-67.

Stalmaster, M.V. and J.L. Kaiser. 1998. Effects of recreational activity on wintering bald eagles. Wildlife Monographs 137:1-46.

Stalmaster, M.V. and J.L. Kaiser. 1997. Flushing responses of wintering bald eagles to military activity. Journal of Wildlife Management 61:1307-1313.

Stalmaster, M.V. and J.R. Newman. 1978. Behavioral responses of wintering bald eagles to human activity. Journal of Wildlife Management 42:506-513.

Steenhof, K. 1978. Management of Wintering Bald Eagles. FWS/OBS-78/79. U.S. Fish and Wildlife Service, Department of the Interior, Washington D.C.

Steidl, R.J. and R.G. Anthony. 2000. Experimental Effects of Human Activity on Breeding Bald Eagles. Ecological Applications 10(1), pp. 258-268.

Therres, G.D., M.A. Byrd and D.S. Bradshaw. 1993. Effects of development on nesting bald eagles: case studies from Chesapeake Bay. Transactions of the North American Wildlife and Natural Resources Conference 58:62-69.

U.S. Fish and Wildlife Service. 1979. Bald Eagle Management Guidelines: Oregon – Washington. Portland. OR.

U.S. Fish and Wildlife Service. 1983. Northern States bald eagle recovery plan. Appendices E, F, and G. U.S. Fish and Wildlife Service, Region 6, Denver, CO.

U.S. Fish and Wildlife Service. 1987. Habitat Management Guidelines for the Bald Eagle in the Southeast Region. U.S Fish and Wildlife Service, Region 4. Atlanta, GA.

U.S. Fish and Wildlife Service. 1993. Bald Eagle Basics. Anchorage, AK.

U.S. Fish and Wildlife Service. 1993. Habitat Management Guidelines for Bald Eagles in Texas. Austin, TX.

U.S. Fish and Wildlife Service and Virginia Department of Game and Inland Fisheries. 2001. Bald Eagle Protection Guidelines for Virginia. Gloucester and Richmond, VA.

Watson, J.W. 1993. Responses of nesting bald eagles to helicopter surveys. Wildlife Society Bulletin 21:171-178.

Watson, J.W. 2004. Responses of nesting bald eagles to experimental pedestrian activity. Journal of Raptor Research 38:295-305.

Wood, P.B. 1999. Bald eagle response to boating activity in northcentral Florida. Journal of Raptor Research 33:97-101.

Wood, P.B., T.C. Edwards Jr. and M.W. Collopy. 1989. Characteristics of bald eagle nesting habitat in Florida. Journal of Wildlife Management 53(2):441-449.

Young, L.S. 1980. A quantitative evaluation of human disturbance impacts on breeding eagle ecology of bald eagles in the San Juan Islands, Washington. Washington Department of Game, Olympia.