Susitna-Watana Hydroelectric Project
(FERC No. 14241)

Landbird and Shorebird Migration, Breeding, and Habitat Use
Study Plan Section 10.16

Initial Study Report
Part B: Supplemental Information (and Errata) to Part A (February 3, 2014 Draft Initial Study Report)

Prepared for

Alaska Energy Authority

SUSITNA-WATANA HYDRO

Clean, reliable energy for the next 100 years.

Prepared by

ABR, Inc.—Environmental Research & Services
Anchorage, Alaska

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PART B: SUPPLEMENTAL INFORMATION (AND ERRATA) TO PART A (FEBRUARY 3, 2014 DRAFT INITIAL STUDY REPORT)

Part A Reference	Description
Passim	As explained in the ISR Overview and depicted in Figure 1, following release of the draft ISR in February 2014, AEA added a new north-south transmission and access corridor alignment from the dam site to the Denali Highway. This new alignment is referred to as the Denali East Option. For clarity, the north-south alignment studied to date (and historically referred to as the Denali Corridor) is now referred to as the Denali West Option. Hence, all references in Part A to the "Denali Corridor" are referencing the newly designated Denali West Option.
Section 4.1.1, p. 4	Based on comments from the USFWS on the plot-allocation procedures during the wildlife program technical meeting on March 6, 2014 (see http://www.susitna-watanahydro.org/wp-content/uploads/2014/03/2014-03-06TT_Wildlife_MeetingNotes.pdf), the second paragraph (beginning with the third sentence) is revised as follows: *"The stratified systematic/random sampling design used to select the locations of transects and point-count plots on each transect involved the use of a two-stage, cluster sampling technique (Morrison et al. 2008). First, a grid of potential point-count plot locations was created across the entire study area using a Geographic Information System (ArcGIS). The locations of point-count plots determined using systematic grids of points located randomly mirrors the plot-allocation approach used by the Alaska Landbird Monitoring System (ALMS; Handel and Cady 2004) in which the starting points for systematic grids of point-count locations are randomly located within 100 km^2 (24,710 acre) sampling blocks distributed across the entire state of Alaska. In this study, the only difference from the ALMS approach is that the starting points for the systematic grids of point-count locations are randomly located within habitat types instead of 100 km^2 (24,710 acre) blocks (see below). The randomly located grids of point-count plots used in this study and by ALMS are unbiased with respect to the distribution of breeding birds on the landscape, and Buckland et al. (2004) note that the random placement of a systematic grid of sample points ensures that estimated distance and covariate data are statistically independent, thus satisfying one of the primary assumptions in distance sampling using covariates, which was the data analysis approach used in this study. As in the ALMS protocol, the grid of potential point-count plots is created to maintain minimum distances between point-count plots (see below), while maximizing efficiency of access to the point-count plots in the field. Using the vegetation types mapped by Kreig and Associates (1987) to define open and closed habitats, all potential point-count plots in closed habitat types were spaced 250 m (820 ft) apart, and all potential point-count plots in open habitat types were spaced 500 m (1,640 ft) apart, in accordance with the ALMS field sampling protocols developed for landbird*

	point-count surveys in Alaska (Handel and Cady 2004).”
Section 4.1.3.2, p.9.	Based on comments of the USFWS during the wildlife program technical meeting on March 6, 2014, Section 4.1.3.2 is revised as follows: *“Knowing how well birds are detected during field surveys is critical for producing accurate estimates of density and abundance (Buckland et al. 2001; 2004). For point-count surveys, detectability varies with both the radial distance of the target bird from the observer and environmental conditions, which may hinder detections of vocalizations or visual observations (e.g., wind and river noise, closed vs. open habitats). In the analyses conducted for this ISR, density estimates were made by taking into account distances to the target birds and common environmental variables known to influence detectability.* *Using the first year of data collected for this study, densities of breeding birds corrected for detectability (hereafter corrected densities) were estimated using the distance sampling analysis tools specific to point-count surveys available in the computer software package MRDS in program R (Miller 2012), and by following the analytical methods for distance analyses described by Buckland et al. (2001; 2004). The density estimates in this ISR are based on a single year of data and should be considered preliminary only; final density estimates for this study will be presented in the USR using the combined data from all survey years. The distance analysis approach used accounts for the decreased probability of detecting a bird with increased distance from the observer and for environmental variables recorded during the surveys, which were treated as covariates in the calculations. A minimum of approximately 60 observations for each species or species group is necessary to fit detection functions accurately (Buckland et al. 2001). To meet this minimum sample-size criterion, each species was assigned to one of seven detection groups, based on shared vocalization quality and behaviors that affect visual detections. The detection groups used—grouse, warblers, flycatchers, thrushes, chickadees, sparrows, and corvids (Gray Jay, Black-billed Magpie, and Common Raven)—also represent taxonomic groupings, but species outside those taxonomic groups were included in a detection group if they exhibited similar vocalization quality and behavior. Species that did not fit into one of the seven detection groups were excluded from the preliminary density analyses conducted for this ISR. For the USR, sample sizes of observations will be larger with two or more years of data, so it should be possible to produce more accurate detection function models and estimate densities for more species.* *The inclusion of data for birds that are detected while flying over a point-count plot leads to an overestimation of densities of breeding birds (Buckland et al. 2001; 2004), so all observations of flying birds were excluded from the distance analyses. In particular, this restriction greatly reduced the estimated relative abundance level for Common Redpolls*

	compared to the analyses based on the uncorrected data (see Section 4.1.3.1 above). For many species, especially songbirds, males have a much higher detection probability than females because males often engage in singing and other territorial display activities. For those detection groups in which at least 85 percent of the observations consisted of singing males (warblers and flycatchers), the observations of females and individuals of unknown sex were excluded from analysis. These male-only analyses were conducted because the male-only detection models (see below) were the best fit for those two detection groups. Density estimates for the species within those censored detection groups are estimates of male density only. For all detection groups, only those observations made ≤ 250 m (820 ft) from the observer were included in the analyses, which results in a 250-m (820-ft) radius survey area for all point-counts. The 250 m (820 ft) threshold was chosen because it is the minimum spacing distance between point-count locations in closed habitats recommended in the ALMS protocol (i.e., most observations are made at shorter distances; Handel and Cady 2004). Getting accurate distance measurements to birds observed at greater distances is more difficult, and the inclusion of observations made at long distances in analyses typically does not improve the accuracy of detection functions (Buckland et al. 2001). The observation data were not truncated by time of day before analysis. However, in the final distance analyses to be prepared for the USR the study team will conduct exploratory analyses to assess whether or not bird detections may have been declining at later hours in the day. The results of these analyses may indicate that some point-count survey data should be removed before calculating densities to reduce a possible downward bias in density estimates from the inclusion of surveys conducted in late morning. *Density estimation was conducted in two steps. First, as noted above, a detection function was fitted for each detection group to estimate the probability of detection for the species in that group, based on the radial distances of the target birds from the observer and three common covariates known to influence detectability (see below). Second, the best group-specific detection function model was applied to each species within a group to estimate species-specific densities for the entire study area, assuming a uniform density distribution throughout the study area.* *Each detection function model produces a curve fitted to the distribution of detection probabilities by target distances while incorporating the influence of covariate(s) that, in combination, best explain the variation in the data. For each detection group, nine detection models were fitted to the distribution of observation distances to find the model that best estimated the probability of detection (see Section 5.1.1.3 below). The detection models used employed a half-normal key function and included observer, habitat type (closed vs. open), and background noise as covariates. Models without covariates were evaluated with and without a cosine adjustment term. Detection model fit was evaluated based on Akaike Information*

	Criterion (AIC) values and Pearson's chi-squared tests. In general, the best fitting models selected for use in estimating densities were those with the lowest AIC values and the fewest number of covariates. The chi-squared tests were used in cases in which the AIC scores were very similar for several models (AIC scores within two integer values of the lowest scoring model). In these cases, chi-squared tests were used to assess how well each detection model fit the data, by determining whether or not there was an association between the observed and fitted detection probability values. If the p-value for the chi-squared test was > 0.05, the null hypothesis that both the observed and fitted values were from the same distribution was accepted (i.e., the model fit the data well). If the p-value was < 0.05, that model was rejected as a possible best model. Based on the models remaining (within two AIC scores of each other and chi-squared p-values > 0.05), the simplest model with the fewest covariates was selected as the best model. Model fit was assessed in relation to all observations within a detection group, but the fit of each group-specific detection model to the subset of observations for the individual species within each detection group will vary. *Once the best detection model was selected for each detection group, the fitted detection function model was applied to the subset of observations, distance estimates, and covariate states for the individual species within each detection group, and species-specific corrected densities for the study area then were calculated. Density estimates will vary among species within a detection group due to differences in the number of observations recorded and also because of each model's dependence on distance estimates and the modeled covariate(s) that influence the detectability of individual species. As more data become available in future study years, the detection groups may be modified to provide better detection model fit for each species. Corrected density estimates were calculated with the formula:* $$\hat{D} = \frac{n \cdot \hat{E}(s)}{a \cdot \hat{P}_a}$$ *where* $\hat{D}$ *is the corrected density estimate,* n *is the total number of observations,* $\hat{E}(s)$ *is the average flock size,* a *is the area sampled at each point-count plot (using a radius of 250 m [820 ft]) multiplied by the number of plots sampled, and* $\hat{P}$ *is the probability of detection as a function of distance for each detection group as estimated by the detection function model (Buckland et al. 2001). The specific equations used to calculate densities for each species incorporated the covariate(s) for the best model for each detection group (see Section 5.1.1.3 below) to improve the density estimates following the procedures presented by Buckland et al. (2001).*

	Confidence intervals for the density estimates were calculated using bootstrap procedures (Buckland et al. 2001), and the estimated numbers of breeding birds of each species in the study area was calculated by applying density estimates to the area encompassed by the 2-mi buffer study area (assuming uniform densities throughout the study area)."
Tables 5.1-3 and 5.1-4: starting on p. 38.	In compiling the data for the detection function modeling and density calculations, an error was made so that birds in flight—for all species except Common Redpoll—were not removed before analysis as planned (see Section 4.1.3.2 above). This error has been corrected and the analyses were re-run. Only Tables 5.1-3 and 5.1-4 are affected by this change. In general, the density estimates do not change substantially because of this change, probably because relatively few landbird species are observed in flight during point-count surveys. This change does reduce the amount of data used in the calculations, however, and this may account for the rather large 95% confidence limits around the density estimates for Olive-sided Flycatcher, Alder Flycatcher, and Gray Jay (see the revised Tables 5.1-3 and 5.1-4 below).
Table 5.1-4: starting on p. 39.	In the wildlife program technical meeting on March 6, 2014, USFWS noted that similar numbers of observations were made for Swainson's Thrush (354) and American Robin (357)—both of which are members of the thrush detection group—but that each species had notably different densities and total estimated numbers of birds for the study area. USFWS asked how this result occurred. As noted above in the revised Section 4.1.3.2, the density estimates for individual species within a detection group depend both on the number of observations made and on the effects of the specific covariate(s) associated with the observations for each species. Because the density calculations specifically incorporate covariates known to influence the detectability of individual species, it is likely that variation in one or more of the three covariates in the thrush detection model (habitat type, observer, and noise) accounts for the different densities estimated for Swainson's Thrush and American Robin. Using a hypothetical example with a reduced number of variables for simplicity, there could be two observers, one with a negative coefficient for the observer covariate and one with a positive coefficient. If most Swainson's Thrushes were detected by the observer with the positive coefficient whereas most American Robins were recorded by the other observer with the negative coefficient, then the Swainson's Thrush density estimate would be high compared to the estimate for American Robin, even if the number of observations was similar for both species.
No specific text or table reference.	In the wildlife program technical meeting on March 6, 2014, USFWS requested that detectability estimates be reported for the detection function groups used in estimating densities for landbird species. The average detection probabilities for each detection group and the associated model coefficients used in the detection function modeling and density calculations are presented in a new appendix table (Appendix H, see

	below). The average detection probabilities in Appendix H must be interpreted with caution, however, because one cannot simply multiply the average detection probability by the number of birds detected to get a corrected abundance metric. This is because distance analysis procedures depend fundamentally on a distribution of detection probabilities, not a single value, and those values change as a function of distance from the observer. It is the curve that is fitted to the distribution of detection probabilities by distance (the detection function model) that is used to correct for detectability, and, in the modeling conducted in this study, the detection probability distributions and the detection functions are influenced as well by each of the covariates, which also affect detectability.
Section 4.1.3.2: starting on p.9.	In the wildlife program technical meeting on March 6, 2014, ADFG asked whether or not distance estimates were truncated before analysis. As noted above in the revised Section 4.1.3.2, distance estimates for all point-count observations were truncated at 250 m (820 ft), which results in a 250-m (820-ft) radius survey area for all point-counts.
Tables 5.1-3 and 5.1-4: starting on p. 38.	The USFWS requested that the authors indicate which density estimates were made using the data for all observations (males and females) and which were estimated using male-only detection function models. This is indicated already in the footnotes to both tables. Flycatchers and warblers were the only groups in which densities were estimated using male-only detection function models; for the remainder of the other species all observations were used to estimate detection functions and densities.
Section 5.1.1.3: p.18, 1st paragraph, 3rd sentence.	A factual error was made in the 3rd sentence in the paragraph in question. The paragraph has been corrected and should read as below: *"In the distance analyses used to estimate breeding bird densities, the best detection model for most bird detection groups was the model with the lowest AIC score. Several detection groups had more than one model within two integer AIC scores of the best model. When more than one model was supported by the data, the associated chi-squared statistic was evaluated to determine which model represented a better fit to the data (see Section 4.1.3.2 above). For each detection group, all models within two AIC scores of the best model are presented (Table 5.1-3)."*

Revised Table 5.1-3. DISTANCE Detection Groups, Model Covariates, Estimated Densities, Akaike Information Criterion (AIC) Scores, and Associated Results from Detection-function Modeling of Point-count Survey Data, 2013.

Detection Group	Model [a]	Density: Birds/km^2 (95% Confidence Limits)	AIC [a]	∆AIC	Model Weight	Chi-sq [b]	Chi-sq *P* [b]
All Birds							
Grouse	Habitat Type	2.6 (1.9–3.4)	315.60	0	0.25	0.87	0.83
	No covariates	2.6 (1.9–3.4)	316.53	0.93	0.16	0.66	0.72
	Habitat Type + Observer	3.6 (0.0–64,379.7)	316.54	0.94	0.16	41.66	0.01
	Observer	3.5 (0.0–110,821.3)	316.62	1.02	0.15	17.28	0.44
	Habitat Type + Noise	2.7 (2.0–3.6)	317.59	2.00	0.19	1.77	0.99
Chickadees	**Habitat Type + Observer**	24.3 (0.0–230,789.3)	185.07	0	0.58	123.6	0.09
	Habitat Type + Observer + Noise	25.3 (0.0–203,847.5)	186.83	1.76	0.24	183.65	0
Corvids	**Habitat Type**	6.3 (0.0–1,414.7)	351.70	0	0.50	4.94	0.96
	Habitat Type + Noise	6.3 (0.0–1,373.8)	353.33	1.62	0.23	12.19	0.99
Thrushes	Habitat Type + Observer	53.7 (18.6–154.9)	4,262.41	0	1.00	132.86	0.04
	Habitat Type + Observer + Noise	53.9 (13.9–208.9)	4,263.56	1.15	0.56	198.69	0.62
Sparrows	**Habitat Type + Observer + Noise**	160.5 (153.0–168.3)	49,790.85	0	0.81	739.66	1.00
Males Only [c]							
Warblers	**Habitat Type + Observer + Noise**	129.1 (120.9–137.9)	26,440.46	0	0.78	429.23	0.88
Flycatchers	**Observer + Noise**	6.0 (0.0–145,065)	208.93	0	0.26	10.11	0.87
	Habitat Type + Observer + Noise	10.43 (0.0–119,408)	210.41	1.27	0.14	21.24	0.70

Notes:

a. All models within two integer AIC values of the lowest AIC value are presented; the best model selected for density estimation in each detection group (see text) is in bold.

b. Pearson's chi-squared values and chi-squared probabilities (chi-sq *P*) used to test for an association between observed and fitted detection probabilities (see text).

c. Detection models for warblers and flycatchers were based on observations of males only.

Revised Table 5.1-4. Estimated Density and Estimated Total Breeding Birds in the Landbird and Shorebird Study Area, Based on Point-count Survey Data, 2013.

Common Name	n	Average Flock Size	Density: Birds/km^2 (95% Confidence Limits)	Total Estimated Birds (95% Confidence Limits) [a]
Ruffed Grouse	1	1.00	0.02 (0–0.14)	34 (6–202)
Spruce Grouse	4	1.00	0.11 (0.03–0.44)	172 (46–644)
Willow Ptarmigan	80	1.01	1.73 (1.25–2.39)	2,542 (1,842–3,507)
Rock Ptarmigan	40	1.00	0.67 (0.45–1.01)	988 (660–1,480)
Unidentified ptarmigan	2	1.00	0.04 (0.01–0.13)	53 (15–189)
Olive-sided Flycatcher [b]	72	1.00	1.71 (0.0–34,506)	2,515 (1–50,692,690)
Alder Flycatcher [b]	16	1.00	4.32 (0.0–109,464.28)	6350 (1–160,813,976)
Gray Jay	124	1.14	5.96 (0.25–1,395.77)	8,766 (37–2,020,526)
Black-billed Magpie	1	1.00	0.03 (0.01–0.15)	44 (8–227)
Common Raven	9	1.00	0.26 (0.13–0.54)	388 (190–792)
Horned Lark	96	1.02	3.69 (2.84–4.83)	5,436 (4,167–7,092)
Tree Swallow	4	1.00	0.11 (0.04–0.33)	162 (54–491)
Ruby-crowned Kinglet [b]	582	1.00	24.94 (22.73–27.37)	36,642 (33,398–40,202)
Arctic Warbler [b]	87	1.01	5.21 (3.90–6.94)	7,648 (5,730–10,208)
Northern Wheatear	8	1.15	0.24 (0.11–0.52)	356 (166–768)
Gray-cheeked Thrush	444	1.01	12.11 (10.62–13.80)	17,791 (15,612–20,274)
Swainson's Thrush	352	1.01	10.37 (8.82–12.17)	15,230 (12,966–17,890)
Hermit Thrush	174	1.06	4.40 (0.29–67.80)	6,459 (418–99,610)
Unidentified (*Catharus*) thrush	2	1.11	0.12 (0.05–0.24)	158 (72–347)
American Robin	348	1.01	7.24 (0.37–140.78)	10,645 (547–206,816)
Varied Thrush	708	1.06	16.28 (14.45–18.36)	23,923 (21,222–26,969)
Unidentified thrush	2	1.00	0.04 (0.01–0.13)	58 (17–203)
American Pipit	115	1.03	2.89 (2.25–3.72)	4,245 (3,301–5,458)
Lapland Longspur	32	1.00	1.46 (0.85–2.50)	2,146 (1,253–3,675)
Snow Bunting	36	1.02	1.53 (0.98–2.41)	2,257 (1,440–3,535)
Northern Waterthrush [b]	311	1.00	16.97 (14.85–19.41)	24,937 (21,813–28,509)
Orange-crowned Warbler [b]	68	1.00	3.45 (2.60–4.71)	5,141 (3,819–6,920)
Yellow Warbler [b]	7	1.39	0.34 (0.14–0.85)	498 (200–1,543)
Blackpoll Warbler [b]	416	1.00	20.84 (18.68–23.25)	30,626 (27,455–34,163)
Yellow-rumped Warbler [b]	668	1.00	32.03 (29.09–35.27)	47, 059 (42,739–51,816)
Townsend's Warbler [b]	1	1.00	0.04 (0.01–0.20)	59 (12–303)
Wilson's Warbler [b]	498	1.00	25.05 (22.62–27.76)	36,813 (33,233–40,779)
Unidentified warbler [b]	4	1.00	0.14 (0.06–0.35)	206 (82–521)
American Tree Sparrow	543	1.01	22.31 (19.73–25.23)	34,091 (30,642–37,927)
Savannah Sparrow	617	1.04	23.20 (20.85–25.82)	33,929 (30,498–37,747)
Fox Sparrow	1,413	1.00	41.02 (38.46–43.74)	60,259 (56,504–64,262)
Lincoln's Sparrow	74	1.00	1.98 (1.48–2.63)	2,904 (2,182–3,866)
White-crowned Sparrow	1,121	1.02	34.53 (32.03–37.23)	50,734 (47,055–54,701)
Golden-crowned Sparrow	118	1.02	4.31 (3.37–5.50)	6,328 (4,957–8,079)
Unidentified sparrow	37	1.30	1.05 (0.68–1.63)	1,547 (999–2,395)

Common Name	n	Average Flock Size	Density: Birds/km^2 (95% Confidence Limits)	Total Estimated Birds (95% Confidence Limits) [a]
Dark-eyed Junco	548	1.06	16.87 (15.16–18.77)	24,787 (22,277–27,581)
Rusty Blackbird	16	1.30	0.28 (0.15–0.52)	418 (230–762)
Common Redpoll	34	1.16	1.19 (0.75–1.87)	1,746 (1,107–2,753)

Notes:

a. Estimated number of breeding birds in the 2-mi buffer study area used for the point-count surveys.

b. Results shown for these species are based on male-only detection-function models (see text).

APPENDIX H: AVERAGE DETECTION PROBABILITIES FOR EACH DETECTION GROUP AND ASSOCIATED MODEL COEFFICIENTS USED IN DETECTION FUNCTION MODELING AND DENSITY CALCULATIONS FOR LANDBIRDS, 2013.

				Model Covariate Values												
Detection Group	Model [a]	Average Detection Probability	Standard Error [b]	Intercept	Closed Habitat	Open Habitat	Noise	Observer 1	Observer 2	Observer 3	Observer 4	Observer 5	Observer 6	Observer 7	Observer 8	Observer 9
All Birds																
Grouse	Habitat type	0.271	0.032	4.205		0.376										
	No covariates	0.279	0.028	4.552												
	Habitat Type + Observer	0.163	46,518.750	4.192		0.370		0.133	-0.309	0.448	0.291		0.355	0.125	-0.101	-1.644
	Observer	0.171	213,476.600	4.536				0.124	-0.282	0.405	0.318		0.382	0.152	-0.178	-1.794
	Habitat Type + Noise	0.271	0.033	4.205		0.377	-0.013									
Chickadees	**Habitat Type + Observer**	0.022	1,151.856	3.566		0.412		-0.151	-1.512	-0.464	0.964	-0.353	-1.575	-0.077	0.012	-0.011
	Habitat Type + Observer + Noise	0.021	597.111	3.435		0.416	0.078	-0.045	-1.444	-0.370	1.017	-0.247	-1.475	0.053	0.092	0.034
Corvids	**Habitat Type**	0.090	4.824	2.225	1.856	2.116										
	Habitat Type + Noise	0.090	4.705	2.280	1.815	1.815	-0.027									
Thrushes	Habitat Type + Observer	0.173	0.135	3.162	1.154	1.327		-0.181	-0.257	0.131	-0.209	-0.077	-0.116	-0.099	0.294	0.395
	Habitat Type + Observer + Noise	0.172	0.179	3.065	1.260	1.433	-0.023	-0.186	-0.249	0.129	-0.202	-0.083	-0.110	-0.100	0.298	0.404
Sparrows	**Habitat Type + Observer + Noise**	0.135	0.002	3.257	0.799	0.984	-0.029	0.073	0.056	0.130	0.009	0.140	0.245	-0.288	0.092	0.103
Males Only [c]																
Warblers	**Habitat Type + Observer + Noise**	0.087	0.002	3.237	0.681	0.830	-0.037	-0.029	0.110	0.123	-0.021	0.001	-0.121	-0.054	0.067	0.132
Flycatchers	**Observer + Noise**	0.007	1,942.585	3.372			0.316	0.275	-1.463	-1.147	0.842	-1.473	-1.463		0.365	-0.053
	Habitat + Observer + Noise	0.259	3.484	4.641		-0.083	0.117	-0.155	0.354	-0.633	0.004	-0.113	0.280		-0.038	

Notes:

a. All models within two integer AIC values of the lowest AIC value are presented (see Table 5.1-3); the best model selected for density estimation in each detection group (see text) is in bold.

b. Standard error for the average detection probability.

c. Detection models for warblers and flycatchers were based on observations of males only.