Appendix D

Horse Butte Wind Programmatic Eagle Take Permit
Resource Equivalency Analysis Summary

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D.1 Overview

This appendix provides details on the resource equivalency analysis (REA) developed by the U.S. Fish & Wildlife Service (Service) to estimate the number of high-risk power poles that would need to be retrofitted to offset any loss of bald and golden eagles. The REAs outlined in this appendix were executed for the specific purpose of estimating the number of high-risk power pole retrofits that would need to be implemented, should a permit be issued, to offset the predicted take at the Horse Butte Wind Project.

This REA is based on a modeling approach used in natural resource damage assessments to ensure that environmental impacts are mitigated. It is a tool used to account for environmental debits, in this case predicted eagle fatalities, and credits, in this case high-risk power pole retrofits. As described in the Eagle Conservation Plan Guidance (ECPG) (USFWS 2013), the REA operates under assumptions derived from the current understanding of golden eagle and bald eagle life histories. These assumptions are utilized to help calculate direct losses, indirect losses, total debits, productivity of mitigation, and total credits owed to achieve no net loss. Additional information, including assumptions inherent in the REA that are not fully explained here, can be found in Appendix G of the ECPG (USFWS 2013).

We ran the REA for each species (accounting for different fatality predictions for each species). For each REA, it was assumed that a permit, if issued, would be issued by 2018 and that all retrofits would be in place before the beginning of the 2020 breeding season. It was further assumed that those retrofits would remain implemented and effective for 30 years through an agreement with the applicant's partner utilities. Making these assumptions, only the annual permitted take (Table 1) input was changed for each model run. Each of the REAs calculated the following:

1. The total debit (Tables 3 and 5) in bird-years associated with a five-year permit, including indirect loss from forgone reproduction from eagles killed.
2. The relative productivity of the mitigation, including avoided reproductive loss from eagles saved (Tables 6 and 7). Because the same time frame for implementation for each alternative was assumed, this did not change between REAs.
3. The credits owed (i.e., number of high-risk power poles retrofitted) to ensure there is no net loss to the population (Tables 8 and 9).

Values in yellow were used as inputs into each species-specific REA.

Table 1. Summary of Annual Permitted Take Calculations

	Golden Eagle			Bald Eagle		
	Annual Fatality Prediction	*# Eagles Authorized Over 5 Years*[a]	*Annual Permitted Take*[b]	*Annual Fatality Prediction*	*# Eagles Authorized Over 5 Years*[a]	*Annual Permitted Take*[b]
Alternative 2	3.5	18	3.6	1.2	6	1.2

a. Derived by multiplying the annual fatality prediction by the permit tenure (in this case five years), and then rounding up to the nearest whole integer if necessary.

b. Derived by dividing the eagles to be authorized by the permit tenure (in this case five years) and is the input for annual predicted take in each REA. *Note: this value may not necessarily be the same at the annual fatality prediction, as it divides the eagles to be authorized, **after** rounding up to the nearest integer.*

D.2 Model Results

D.2.1 Total Debit Calculation

Total debits are influenced by the annual permitted take. As such, total debits vary by species.

D.2.1.1 Golden Eagles

Table 2. Lost Bird-Years, 1-year Permitted Take of Golden Eagles

Source of Bird Years	Present Value Bird-Years
Direct Loss	21.74
Indirect Loss Subtotal (1st Gen + 2nd Gen)	26.45
Indirect Loss – 1st Generation	*(17.12)*
Indirect Loss – 2nd Generation	*(9.33)*
Total Debit (Direct + Indirect)	**48.19**

Table 3. Total Debit, 5-year Permitted Take of Golden Eagles

Year[a]	Present Value Bird-Years[b]
2018	48.19
2019	46.78
2020	45.42
2021	44.10
2022	42.82
Total Present Value Bird-Years	**227.32**

a. Start year of take: 2018.

b. Debit present value bird-years: 48.19.

D.2.1.2 Bald Eagles

Table 4. Lost Bird-Years, 1-year Permitted Take of Bald Eagles

Source of Bird Years	Present Value Bird-Years
Direct Loss	7.25
Indirect Loss Subtotal (1st Gen + 2nd Gen)	8.82
Indirect Loss – 1st Generation	*(5.71)*
Indirect Loss – 2nd Generation	*(3.11)*
Total Debit (Direct + Indirect)	**16.06**

Table 5. Total Debit: 5-year Permitted Take of Bald Eagles

Year[a]	Present Value Bird-Years[b]
2018	16.06
2019	15.60
2020	15.14
2021	14.70
2022	14.27
Total Present Value Bird-Years	**75.77**

a. Start year of take: 2018.

b. Debit present value bird-years: 16.06.

D.2.2 Relative Productivity of Mitigation Calculation

The productivity (avoided loss) per power pole retrofit is assumed to be the same for each eagle species. We also assumed that implementation of mitigation would be completed by the end of 2019 and agreements would remain in place to maintain retrofits for 30 years.

Table 6. Avoided Loss per Power Pole Retrofit Over One Year, Golden and Bald Eagles

Source of Bird Years	Present Value Bird-Years per Pole
Avoided Direct Loss	0.021
Avoided Indirect Loss Subtotal (1st Gen + 2nd Gen)	0.026
Indirect Loss – 1st Generation	*(0.017)*
Indirect Loss – 2nd Generation	*(0.009)*
Total Credit per power pole (Direct + Indirect)	**0.047**

Table 7. Relative Productivity of Mitigation

Year[a]	Present Value Bird-Years per Pole[b]
2019	0.047
2020	0.045
2021	0.044
2022	0.043
2023	0.042
2024	0.040
2025	0.039
2026	0.038
2027	0.037
2028	0.036
2029	0.035
2030	0.034
2031	0.033
2032	0.032
2033	0.031
2034	0.030
2035	0.029
2036	0.028
2037	0.027
2038	0.027
2039	0.026
2040	0.026
2041	0.024
2042	0.024
2043	0.023
2044	0.022
2045	0.022
2046	0.021
2047	0.020
2048	0.020
Total Present Value Bird-Years	**0.945**

a. Start year of mitigation: 2019.
b. Credit present value bird-years: 0.047.

D.2.3 Calculating Mitigation Credit Owed

The number of retrofitted power poles required to achieve no net loss to eagle populations was calculated by dividing the total debit (in present-value bird years), by the relative productivity of the mitigation (in present-value bird years). We assumed that avoided loss from retrofitted power poles would remain at 30 years, by agreement with the applicant's member utilities.

D.2.3.1 Golden Eagles

Table 8. Credit Owed for a 5-Year Permitted Take of Golden Eagles

Total debit	227.32	Present value bird-years.
Divided by relative productivity of lethal electric pole retrofitting.	0.945	Avoided loss of present value bird-years/pole.
= Credit owed	240.67	Poles to be retrofitted to achieve no net loss of golden eagle.

D.2.3.2 Bald Eagles

Table 9. Credit Owed for a 5-Year Permitted Take of Bald Eagle

Total debit	75.77	Present value bird-years.
Divided by relative productivity of lethal electric pole retrofitting.	0.945	Avoided loss of present value bird-years/pole.
= Credit owed	80.22	Poles to be retrofitted to achieve no net loss of golden eagle.

D.3 Summary

The REAs for each species estimate that 241 high-risk power poles would need to be retrofitted to achieve no net loss to golden eagle populations. Additionally, the REA estimates that 81 high-risk power poles would need to be retrofitted to achieve no net loss to bald eagle populations.

Table 10. Summary of Fatality Predictions, Authorized Take, and Retrofitted Power Poles

	Golden Eagle			Bald Eagle		
	Annual Fatality Pred.	*Take Authorized Over 5 Years*	*Poles Retrofitted to Achieve No Net Loss*[a]	*Annual Fatality Pred.*	*Take Authorized Over 5 Years*	*Poles Retrofitted to Achieve No Net Loss*
Alternative 2	3.5	18	241	1.2	6	81

a. Values have been rounded up to the nearest whole number.

As stated previously, these estimates assume that a) the eagle take permit in question, if issued, would be issued in 2018; b) all retrofits would be completed by the end of 2019; and c) in compliance with the agreement, all retrofitted poles would be maintained, and the effectiveness of each retrofit is ensured for 30 years after implementation.