Appendix G – Resource Equivalency Analysis Modeling

APPLICATION OF THE RESOURCE EQUIVALENCY ANALYSIS MODELS

The species-specific Resource Equivalency Analysis (REA) models developed by the U.S. Fish and Wildlife Service (USFWS) in Region 3 were used to calculate the impact of the taking for Indiana bats (*Myotis sodalis*), northern long-eared bats (*Myotis septentrionalis*), and little brown bat (*Myotis lucifugus*). The impact of the taking is represented by the number of females that could potentially be lost over the term of the Incidental Take Permit (ITP) due to the take from the Covered Activities and the lost reproductive potential of the portion of the take attributed to female bats. The REA model output represents the mitigation debt for each species (number of lost females) and the mitigation necessary to offset the impact of take (acres of habitat or bats in maternity colonies).

The following models were used: *Region 3 Indiana Bat Resource Equivalency Analysis Model for Wind Energy Projects* (USFWS 2016a, *in review*) and *Region 3 Northern Long-Eared Bat Resource Equivalency Analysis Model for Wind Energy Projects* (USFWS 2016c, *in review*) and *Region 3 Little Brown Bat Resource Equivalency Analysis Model for Wind Energy Projects* (USFWS 2016d, *in review*).

Resource equivalency analysis models are not currently available for tri-colored bats (*Perimyotis subflavus*) or bald eagles (*Haliaeetus leucocephalus*); therefore, the impact of take for tri-colored bats and bald eagles were assessed qualitatively in the HCP (Sections 4.2 and 4.3 of the HCP).

MODEL INPUTS

Inputs for the REA models included: (1) the amount of estimated female take for each Covered Bat Species (Section 4.2 of the HCP) and (2) characteristics of a generic mitigation project. Generic mitigation project inputs (Table 1) were used for each Covered Bat Species' REA model to provide initial assessments of the mitigation debt and the level of mitigation credit that may be attained through protection of various amounts of habitat.

The models were run for both the Implementation Take (mean with a 35% reduction) and the Authorized Take (90th CI with a 35% reduction). The models were also run for the Authorized Take over the first three years of the ITP (Table 2) to assess initial mitigation projects.

Table 1. Resource Equivalency Analysis model input values for northern long-eared bats, Indiana bats, and little brown bats for the Implementation Take and Authorized Take levels.

Northern long-eared bat	
Implementation Take – take/year (mean with 35% reduction)	9
Authorized Take – take/year (90th CI with 35% reduction)	21
% female	50%
permit duration	30 years
permit start year	2017
mitigation start year	2017
mitigation end year	2057
population status	stationary
habitat function	roosting and foraging
threat level (protection)	habitat is not managed for bats
existing % forest cover (restoration)	≤30%
valid “fill the gaps” restoration?	Yes
Indiana bat	
Implementation Take – take/year (mean with 35% reduction)	10
Authorized Take – take/year (90th CI with 35% reduction)	25
% female	75%
permit duration	30 years
permit start year	2017
mitigation start year	2017
mitigation end year	2057
population status	stationary
habitat function	roosting and foraging
threat level (protection)	habitat threatened
existing % forest cover (restoration)	≤20%
Little brown bat	
Implementation Take – take/year (mean with 35% reduction)	640
Authorized Take – take/year (90th CI with 35% reduction)	736
% female	50%
permit duration	30 years
permit start year	2017
mitigation start year	2017
mitigation end year	2057
population status	stationary
habitat function	roosting and foraging
threat level (protection)	habitat not managed for bats
existing % forest cover (restoration)	≤20%

Table 2. Resource Equivalency Analysis model input values for northern long-eared bats, Indiana bats, and little brown bats at the Authorized Take levels for the first three years of the Incidental Take Permit.

Northern long-eared bat	
Authorized Take – take/year (90th CI with 35% reduction)	21
% female	50%
permit duration (ITP Years 1-3)	3 years
permit start year	2017
mitigation start year	2017
mitigation end year	2057
population status	stationary
habitat function	roosting and foraging
threat level (protection)	habitat is not managed for bats
existing % forest cover (restoration)	≤30%
valid "fill the gaps" restoration?	Yes
Indiana bat	
Authorized Take – take/year (90th CI with 35% reduction)	25
% female	75%
permit duration (ITP Years 1-3)	3 years
permit start year	2017
mitigation start year	2017
mitigation end year	2057
population status	stationary
habitat function	roosting and foraging
threat level (protection)	habitat threatened
existing % forest cover (restoration)	≤20%
Little brown bat	
Authorized Take – take/year (90th CI with 35% reduction)	736
% female	50%
permit duration (ITP Years 1-3)	3 years
permit start year	2017
mitigation start year	2017
mitigation end year	2057
population status	stationary
habitat function	roosting and foraging
threat level (protection)	habitat not managed for bats
existing % forest cover (restoration)	≤20%

MODEL OUTPUTS

Outputs of the REA models include: (1) the amount of lost reproduction due to the female take of each bat Covered Species (combined with the female take, this represents the impact of the take, i.e., mitigation debt); and (2) the amount of habitat that would offset the impact of take (i.e., provide sufficient mitigation credit) given the generic mitigation project characteristics used in the inputs. The REA model outputs for the ITP term (Table 3) represent an estimate of the amount of mitigation that may offset the impact of the take for each of the Covered Species and serve as a basis for the consideration of potential mitigation projects. REA model outputs were also generated for the Authorized Take over the first three years of the ITP (Table 4); these represent an estimate of the amount of mitigation that may offset the impact of the first three years of take for each of the Covered Species and serve as a basis for consideration of the initial mitigation projects.

Additionally, the little brown bat REA model was used to account for benefits to this species that would be accrued from mitigation habitat for northern long-eared bat and Indiana bat (Table 1). The three bat species considered in these analyses, and all four of the Covered Bat Species, have life-history similarities, occupy the same habitats, and have overlapping ranges. Mitigation efforts

for one species will also benefit the other species where they co-occur on the landscape. Therefore, the mitigation projects for northern long-eared and Indiana bat in Iowa will benefit little brown bat and tri-colored bat. To get credits for multiple species for a single mitigation project, the USFWS has requested that an additional 10% be applied for each additional species. The mitigation requirements for northern long-eared and Indiana bat with an additional 10% added for each species amount to a total of 1,309 acres and MidAmerican Energy intends to deliver 1,309 acres of mitigation for the Implementation Take (See HCP Section 5.3.3.1). Based on the little brown bat REA model, 1,309 acres provides a credit of 2,772 female little brown bats. These values were deducted from the original impact of take estimate to determine the residual mitigation needed to fully offset the impacts to little brown bat (Table 5). This approach uses the implementation take mitigation values and does not account for any additional mitigation required through adaptive management.

Table 3. Resource Equivalency Analysis model output values for northern long-eared bats, Indiana bats, and little brown bats at the Implementation Take and Authorized Take levels.

Northern long-eared bat	
Implementation Take (mean with 35% reduction*)*	
lost females	135 female bats
lost female pups	257 female bats
total lost females	392 female bats
gained females	392 female bats
summer habitat protection (natural habitat)	349 acres
summer habitat protection (artificial habitat)	388 bats in maternity colony(ies)
summer habitat restoration	471 acres
Authorized Take (90th CI with 35% reduction)	
lost females	315 female bats
lost female pups	599 female bats
total lost females	914 female bats
gained females	914 female bats
summer habitat protection (natural habitat)	813 acres
summer habitat protection (artificial habitat)	904 bats in maternity colony(ies)
summer habitat restoration	1,099 acres
Indiana bat	
Implementation Take (mean with 35% reduction*)*	
lost females	225 female bats
lost female pups	428 female bats
total lost females	653 female bats
gained females	653 female bats
summer habitat protection	742 acres
summer habitat restoration	560 acres
Authorized Take (90th CI with 35% reduction)	
lost females	563 female bats
lost female pups	1.069 female bats
total lost females	1,631 female bats
gained females	1,631 female bats
summer habitat protection	1,854 acres
summer habitat restoration	1,399 acres
Little brown bat	
Implementation Take (mean with 35% reduction*)*	
lost females	9,600 female bats
lost female pups	34,254 female bats
total lost females	43,854 female bats
gained females	43,854 female bats
summer habitat protection (natural habitat)	20.709 acres
summer habitat protection (artificial habitat)	22,510 bats in maternity colony(ies)
summer habitat restoration	15,630 acres
Authorized Take (90th CI with 35% reduction)	
lost females	11,040 female bats
lost female pups	39,392 female bats
total lost females	50,432 female bats
gained females	50,432 female bats
summer habitat protection (natural habitat)	23,816 acres
summer habitat protection (artificial habitat)	25,887 bats in maternity colony(ies)
summer habitat restoration	17,974 acres

Table 4. Resource Equivalency Analysis model output values for northern long-eared bats, Indiana bats, and little brown bats at the Authorized Take levels for the first three years of the Incidental Take Permit.

Northern long-eared bat	
Authorized Take (90th CI with 35% reduction) ITP Years 1-3	
lost females	32 female bats
lost female pups	60 female bats
total lost females	91 female bats
gained females	91 female bats
summer habitat protection (natural habitat)	35 acres
summer habitat protection (artificial habitat)	37 bats in maternity colony(ies)
summer habitat restoration	36 acres
Indiana bat	
Authorized Take (90th CI with 35% reduction) ITP Years 1-3	
lost females	56 female bats
lost female pups	107 female bats
total lost females	163 female bats
gained females	163 female bats
summer habitat protection	92 acres
summer habitat restoration	70 acres
Little brown bat	
Authorized Take (90th CI with 35% reduction) ITP Years 1-3	
lost females	1,104 female bats
lost female pups	3,939 female bats
total lost females	5,043 female bats
gained females	5,043 female bats
summer habitat protection (natural habitat)	794 acres
summer habitat protection (artificial habitat)	863 bats in maternity colony(ies)
summer habitat restoration	599 acres

Table 5. Resource Equivalency Analysis model output values for little brown bats after accounting for credit gained from habitat mitigation for other Covered Bat Species.

Little brown bat	
*Implementation Take (*after accounting for 1,309 acres of mitigation*)*	
total lost females	41,082 female bats
gained females	41,082 female bats
summer habitat protection (natural habitat)	19,400 acres
summer habitat protection (artificial habitat)	21,087 bats in maternity colony(ies)
summer habitat restoration	14,642 acres
Authorized Take (after accounting for 1,309 acres of mitigation	
total lost females	47,660 female bats
gained females	47,660 female bats
summer habitat protection (natural habitat)	22,507 acres
summer habitat protection (artificial habitat)	24,464 bats in maternity colony(ies)
summer habitat restoration	16,986 acres

LITERATURE CITED

U.S. Fish and Wildlife Service (USFWS). 2016a, in review. Region 3 Indiana Bat Resource Equivalency Analysis Model for Wind Energy Projects.

U.S. Fish and Wildlife Service (USFWS). 2016b, in review. Region 3 Little Brown Bat Resource Equivalency Analysis Model for Wind Energy Project

U.S. Fish and Wildlife Service (USFWS). 2016c, in review. Region 3 Northern Long-eared Bat Resource Equivalency Analysis Model for Wind Energy Projects

U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS). 1996. Habitat Conservation Planning and Incidental Take Permit Processing Handbook. November 4, 1996.