3 TIERED SITE ASSESSMENT METHODOLOGY

In accordance with the USFWS Land-Based Wind Energy Guidelines ("USFWS Guidelines"; USFWS 2012), AWE has applied a tiered approach to assessing potential risk to avian and bat species associated with the proposed Antrim Wind Energy Project.

Preliminary site evaluation and site characterization assessments have been performed to determine site suitability, and are described herein (see Section 4). These assessments are consistent with Tier 1 and Tier 2 as described within the USFWS Guidelines. In accordance with Tier 3 of the USFWS Guidelines, numerous environmental field studies have also been performed; the scope, duration and results of these Tier 3 field studies and evaluations are also described herein (see Section 5). This ABPP describes how the results of Tier 3 studies have been and/or will be applied to inform project design, construction and operation.

Furthermore, this ABPP defines post-construction monitoring and reporting commitments consistent with Tier 4 of the USFWS Guidelines. Finally, an adaptive management plan is proposed for addressing potential changes and unexpected events over the life of the Project. This plan provides a framework for any unforeseen, future Tier 5 study considerations that may arise. It also provides a framework to assess and introduce any future technological advances that are financially feasible and that offer benefits to avian and bat species while preserving the Project's commercial viability.

4 PRELIMINARY SITE EVALUATION AND SITE CHARACTERIZATION

AWE's preliminary site evaluation and site characterization assessed numerous factors that are critical to the appropriate siting of an economically viable and environmentally benign wind project. These efforts have been conducted in a thorough manner and adequately address Tiers 1 and 2 of the USFWS Guidelines.

In general, the most viable wind sites include: sufficient projected wind speeds at turbine hub height to produce power in commercial quantities; proximity to adequate transportation; proximity to electric transmission or distribution infrastructure capable of handling the new generation; adequate setbacks from residences or other inhabited structures to ensure public safety; the absence of known sensitive ecological resources that may be disturbed such as critical wildlife habitats, major wetlands, and other sensitive areas ; and previous environmental impacts and/or commercial activities on site. Based on these criteria, the proposed site of the Antrim Wind Energy Project constitutes a well-sited wind power project location.

During its preliminary investigation, AWE confirmed that there are no current conservation restrictions on the site that would limit the development of the Project. In addition, desktop GIS review of known environmental factors did not reveal the presence of any known critical habitats or endangered species. Also, there are no known occurrences of species of habitat fragmentation concern, and there are no known critical areas of concentration for species of concern. In a letter summarizing the review by the USFWS, dated October 13, 2011, the USFWS confirmed that:

> *"Based on information currently available to us, no federally listed or proposed, threatened or endangered species or critical habitat under the jurisdiction of the U.S. Fish and Wildlife Service are known to occur in the project area(s). Preparation of a Biological Assessment or further consultation with us under section 7 of the Endangered Species Act is not required. No further Endangered Species Act coordination of this type is*

necessary for a period of one year from the date of this letter, unless additional information on listed or proposed species becomes available."

Importantly, the proposed Project site is located approximately ½ mile from a PSNH transmission corridor where the Project proposes to interconnect to the grid. This eliminates the need for a new transmission corridor and line, thereby avoiding numerous potential impacts associated with such development (e.g. avian electrocution, wire strikes, habitat alteration, edge effects, etc.) The site is also located approximately ¾ mile from Route 9, a substantial state highway that can handle transportation of turbine components and construction equipment. The proximity of this existing highway minimizes the need for extensive access improvements, again reducing the potential impacts associated with creating such access (such as habitat alteration, fragmentation, etc.).

Furthermore, the site does not support sensitive high elevation alpine habitats, thereby eliminating any potential impacts to such sensitive habitats. Finally, much of the northern slope of Tuttle Hill has been heavily logged in the past decade and, as recently as 2012, logging operations (unrelated to the Project) have impacted the site. The fact that much of the proposed Project area is already altered by industrial logging activity reduces the potential incremental impact of the Project on existing natural habitats.

In summary, the preliminary site assessment and site characterization validates AWE's conclusion that this is an appropriate site for continued development of a wind energy facility. When applied to Tier 1 and Tier 2 of the USFWS Guidelines, the findings of these preliminary assessments indicate that the overall probability of significant adverse impacts as a result of the proposed Project is likely low, with some deficiency in data to determine the specific risk to bird and bat species. As such, these findings indicate that advancement to Tier 3 studies is justified.

5 PRE-CONSTRUCTION AVIAN AND BAT ASSESSMENTS

In the spring of 2011, AWE initiated consultation with various regulatory agencies to identify the scope of wildlife studies to be performed relevant to the Project, consistent with Tier 3 of the USFWS Guidelines.. Consulting agencies included USFWS, NHFGD, New Hampshire Natural Heritage Bureau (NHNHB), New Hampshire Department of Environmental Services (NHDES), United States Army Corps of Engineers (USACE), and United States Environmental Protection Agency (USEPA). As a result of this consultation, the following pre-construction biological studies were identified as necessary to assess the potential impacts of the proposed Project on avian and bat species:

- Breeding bird surveys;
- Diurnal raptor migration surveys;
- Radar surveys for nocturnal avian migration;
- Rare raptor nesting surveys;
- Acoustic bat monitoring; and
- Bat mist nesting surveys.

All of the above listed studies have been completed as of fall, 2011. In addition (as a result of further consultation with NHFGD and USFWS in April 2012), a Tier 3 study to assess eagle use within the area of proposed development will be performed in 2012.

All pre-construction studies were designed to be consistent with the methods and protocols typically recommended by state and federal regulatory agencies for proposed wind power projects. They were also designed to be consistent with surveys conducted in the past at other similar projects in New Hampshire and throughout New England. The specific protocol for each study was designed in consultation with USFWS and NHFGD. The scope, duration and results of avian and bat studies associated with the proposed Antrim Wind Energy Project are described in the following subsections (5.1, 5.2). A summary of potential risks to specific species as a result of the Project's construction and operation is provided in Section 5.3.

The results and findings of pre-construction studies have been compiled in stand-alone formal reports which will be included with Antrim Wind Energy, LLC's Application for a Certificate of Site and Facility submitted to the New Hampshire Site Evaluation Committee (SEC). The results and findings of these studies have been incorporated into the Project's preliminary planning and design (e.g. wetlands have been avoided, which provide important habitat and foraging opportunities for avian and bat species). They will also be accounted for, to the extent necessary and feasible, during the Project's final design and construction plans to avoid, reduce, and minimize potential impacts on birds and bats.

The findings of these Tier 3 studies will also provide the baseline, pre-construction reference data upon which the Tier 4 post-construction monitoring, reporting and adaptive management efforts will be based.

5.1 Avian monitoring

5.1.1 Breeding Bird Surveys

A breeding bird survey for the Antrim Wind Energy Project was performed in June of 2011. The goal of this survey was to document the pre-construction presence, diversity and relative abundance of breeding bird species in the proposed area of development. The specific objectives of the breeding bird survey were to:

- produce a comprehensive list of breeding bird species in the Project area;
- compile a species index and relative abundance for birds breeding in the Project area;
- calculate frequency of occurrence for each species;
- characterize habitat that is available for species which occur in the Project area; and
- qualitatively assess the general patterns of breeding bird use in the vicinity of the proposed Project.

The breeding bird survey used point count methods based on those used for the Vermont Institute of Natural Science's *Mountain Birdwatch* program (VINS 2005) and Bird Studies Canada's *High Elevation Landbird Program (HELP)* (Whittam & Ball 2002, and 2003).

Point counts were conducted at 12 locations along the ridge of Tuttle Hill and Willard Mountain. Point count locations were spaced at least 250 m apart and were located in representative habitat types within and adjacent to the proposed Project area . Six of the points were located in close proximity to areas that will be directly disturbed by the proposed development; the other six were located outside of the area of direct disturbance. Each point count location was visited twice during the study period. All surveys were conducted at dawn (between 4:30 AM and 8:30 AM).

Habitat parameters associated with point count locations were quantified using methods described by James and Shugart (James and Shugart 1970), who developed a methodology specifically for making habitat measurements associated with estimating bird populations. This methodology is still used by the national Breeding Bird Survey (USGS 2009), as well as other current studies.

A total of 131 individual birds, representing 25 different species, were documented during the formal breeding bird surveys. Biologists observed an additional 14 species incidentally while present in the Project area to perform the breeding bird survey, but not during the formal survey procedure. These observations constitute a total of 39 bird species recorded in the Project vicinity during the breeding season of 2011. Table 2 below summarizes the list of breeding bird species identified formally during breeding bird surveys, as well as the incidental observations.

The most frequently observed bird species, in terms of relative abundance, were ovenbird and blackburnian warbler: 17 individuals of each species were observed, constituting a 12.98% relative abundance for each. The next most abundant species were red-eyed vireo (n=14) and myrtle warbler (n=12), at 10.69% and 9.16% relative

abundance, respectively. The relative abundance of each species documented is presented in Table 2.

The assemblage and relative abundance of birds observed is typical for New England, given the habitats found within and adjacent to the study area. No rare birds or birds of conservation concern were observed during formal breeding bird surveys. Incidental observations of the common nighthawk, a state listed endangered species, were made in the vicinity of Willard Mountain and Tuttle Hill in June of 2011. One of these observations was auditory and consisted of aerial vocalizations in the area of Willard Mountain. The other observation was visual and auditory, and consisted of several nighthawks foraging over the valley to the north of Tuttle Hill. All of the nighthawks heard and observed at both locations were outside of the proposed Project area.

Table 2: Breeding Bird Species Identified Within the AWE Project Vicinity

Breeding Bird Species Observed within the Antrim Wind Energy Project Vicinity				
Common Name	**Latin Name**	**Residence***	**Number Observed**	**Relative Abundance**
Species Observed During Formal Breeding Bird Surveys				
American Goldfinch	*Carduelis tristis*	L/US	1	0.76%
Black and White Warbler	*Mniotilta varia*	NT	5	3.82%
Blackburnian Warbler	*Dendroica fusca*	NT	17	12.98%
Black-capped Chickadee	*Poecile atricapillus*	L	2	1.53%
Black-throated Blue Warbler	*Dendroica caerulescens*	US/NT	10	7.63%
Blue Jay	*Cyanocitta cristata*	US/L	4	3.05%
Cedar Waxwing	*Bombycilla cedrorum*	L/US	2	1.53%
Chesnut-sided Warbler	*Dendroica pensylvanica*	NT	2	1.53%
Common Yellowthroat	*Geothlypis trichas*	NT	2	1.53%
Eastern Wood Pewee	*Empidonax*	NT	4	3.05%
Golden-crowned Kinglet	*Regulus calendula*	L/US	2	1.53%
Hairy Woodpecker	*Picoides villosus*	L	6	4.58%
Hermit Thrush	*Catharus guttatus*	US	9	6.87%
Magnolia Warbler	*Dendroica magnolia*	NT	3	2.29%
Morning Dove	*Zenaida macroura*	US/L	1	0.76%
Myrtle Warbler	*Dendroica coronata*	US/NT	12	9.16%
Ovenbird	*Seiurus aurocapillus*	US/NT	17	12.98%
Purple Finch	*Carpodacus purpureus*	L/US	1	0.76%
Red-breasted Nuthatch	*Sitta canadensis*	L/US	2	1.53%
Red-eyed Vireo	*Vireo olivaceus*	NT	14	10.69%
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	NT	3	2.29%
Scarlet Tanager	*Piranga olivacea*	NT	3	2.29%
Slate-colored Junco	*Junco hyemalis*	L/US	5	3.82%
Winter Wren	*Troglodytes troglodytes*	US	2	1.53%
Veery	*Catharus fuscescens*	NT	2	1.53%
Total Species Observed During Formal Surveys		***25***		
Total Individuals Observed During Formal Surveys			***131***	
Species Recorded as Incidental Observations during Summer 2011				
American Redstart	*Detophaga ruticilla*	NT		
Barred Owl	*Strix varia*	US/L		
Blue-headed Vireo	*Vireo solitarius*	US/NT		
Broad-winged Hawk	*Buteo platypterus*	NT		
Brown Creeper	*Certhia americana*	na		
Common Nighthawk	*Chordeiles minor*	NT		
Cooper's Hawk	*Accipiter cooperii*	US/L		
Least Flycatcher	*Empidonax minimus*	NT		
Pileated Woodpecker	*Picadae*	L		
Red-tailed Hawk	*Buteo jamaicensis*	US/L		
Ruffed Grouse	*Bonasa umbellus*	L		
TurkeyVulture	Cathartes aura	US		
Wild Turkey	*Meleagris gallopavo*	L		
Yellow-bellied Sapsucker	*Sphyrapicus varius*	US		
Total Species Observed Incidentally		***14***		
Total Breeding Bird Species Recorded in 2011		***39***		

* L – Local year round resident; US – Migrates within US; NT – Neotropical migrant

5.1.2 *Diurnal Raptor Migration Surveys*

Surveys for diurnal migrating raptors were performed during the spring and fall seasons of 2011. The purpose of these migration surveys was to document the numbers, species, and flight patterns of migrating raptors within and immediately adjacent to the proposed Project area. The main objectives of daytime avian migration surveys were to:

- Assess species composition, relative abundance, distribution, and spatial patterns of use by raptors migrating during daytime hours in and around the proposed Project area;
- Identify routes used by daytime migrating raptors passing through/near the proposed Project area;
- Document flight heights and use of topographical features in and near the proposed Project area;
- Evaluate potential impacts of project development and operation on migrating raptors; and
- Evaluate potential for collisions at proposed turbine sites.

The protocol for diurnal raptor migration surveys at the proposed Antrim Wind Energy Project followed standards set forth by the Hawk Migration Association of North America (HMANA 2011), and by HawkWatch International (HawkWatch International 2011, Hoffman and Smith 2003). The study methods were also consistent with similar studies conducted at other proposed wind energy facilities in New Hampshire.

Spring surveys for migrating raptors were performed in mid March through late May, 2011. Fall surveys were performed between mid September and late November, 2011. Early survey dates (in March), and late survey dates (in November) were intended to capture the passage of species, such as bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*), whose migration period is temporally extended.

Surveys were performed on multiple survey dates during each season. Sampling was performed based upon favorable weather for migration. In spring, fair weather days

with southerly or southwesterly winds were favored. In fall, surveys favored fair weather days with strong north to northwest winds, particularly following the passage of a cold front.

On each survey date, data was generally collected for eight consecutive hours between 9 AM to 5 PM. This timeframe encompasses the peak hours of thermal development and associated raptor movement. Detailed raptor observation data were collected continuously during each survey onto specialized data sheets; the flight path of each raptor observed was also recorded on a topographical map of the survey area. Weather conditions (including wind speed and direction, temperature, cloud cover, visibility, etc.) were also recorded at the commencement of and periodically throughout daily observations.

The spring 2011 diurnal raptor migration survey for the proposed Antrim Wind Energy Project consisted of 65 total hours of observation across 9 dates between March 25 and May 15. The fall survey consisted of 147.5 total hours of observation across 21 dates between September 1 and November 20.

In spring, a total of 441 individual raptors[2], representing eleven species were identified within the immediate vicinity of the proposed Antrim Wind Energy Project. The vast majority of individuals observed were turkey vultures, which comprised 54% (n=237) of all observations. The next most abundant species observed were broad winged hawks and red-tailed hawks at 18% (n-77) and 14% (n=60) relative abundance, respectively. Table 3 lists all species observed in spring 2011and their relative abundance.

In fall, a total of 978 individual raptors, representing 10 species were identified. The vast majority of these were broad-winged hawks, which comprised approximately 70% (n=689) of all observations. A total of 471 of these individuals were recorded on one date: September 18. The majority of these broad-wings passed in a few large aggregations ("kettles"). For a relative comparison, on the same date (September 18),

[2] For the purpose of this study, the term "raptors" refers to all members of Order Falconiformes; this order currently includes the family Cathartidae (New World vultures), which includes turkey vultures.

Carter Hill Observatory (in Concord, NH) recorded a total of 7,212 broad-winged hawks and Pack Monadnock Observatory (in Peterborough, NH) recorded 5,208. Large, temporally concentrated fall movement of broad-winged hawks is typical in New England. Red-tailed hawks and turkey vultures were the next most frequently observed species at approximately 8% and 6% relative abundance, respectively. Table 3 lists all species observed and their relative abundance.

Table 3: Species List and Relative Abundance of Diurnally Migrating Raptors, Spring and Fall 2011.

Common Name	Binomial Nomenclature	Total Individuals Observed		Percent Relative Abundance	
		Spring	Fall	Spring	Fall
Accipiter spp. (small)	(n/a)	2	23	0.45%	2.35%
American Kestrel	*Falco sparverius*	1	0	0.23%	0.00%
Bald eagle	*Haliaeetus leucocephelus*	3	11	0.68%	1.12%
Broad-winged hawk	*Buteo platypterus*	77	689	17.46%	70.45%
Buteo spp.	(n/a)	30	22	6.80%	2.25%
Cooper's hawk	*Accipiter cooperii*	3	15	0.68%	1.53%
Falcon spp.	(n/a)	1	1	0.23%	0.10%
Golden eagle	*Aquila chrysaetos*	0	3	0.00%	0.31%
Merlin	*Falco columbarius*	0	3	0.00%	0.31%
Northern Goshawk	*Accipiter gentilis*	1	0	0.23%	0.00%
Northern Harrier	*Circus cyaneus*	5	0	1.13%	0.00%
Osprey	*Pandion haliaetus*	5	5	1.13%	0.51%
Peregrine Falcon	*Falco peregrinus*	1	0	0.23%	0.00%
Raptor spp.	(n/a)	13	48	2.95%	4.91%
Red-shouldered hawk	*Buteo lineatus*	0	1	0.00%	0.10%
Red-tailed hawk	*Buteo jamaicensis*	60	75	13.61%	7.67%
Sharp-shinned hawk	*Accipiter striatus*	2	19	0.45%	1.94%
Turkey vulture	*Cathartes aura*	237	63	53.74%	6.44%
TOTAL		441	978		

The overall passage rate in spring 2011was 6.78 raptors per hour of effort (441 raptors/65 hours) with a range of 1.88 to 14.25. The overall passage rate in fall was 6.63 raptors per hour of effort (978 raptors/147.5 hours) with a range of 0 to 61.75. These passage rates were compared to data from the five most comparable (in terms of proximity and geographic similarity) hawk watch sites for which data was available across the same sampling period. The spring average at Antrim (6.78 raptors per hour of effort) is similar

to the spring average of 5.78 raptors per hour of effort among five regional hawk watch sites. The spring maximum of 14.25 raptors per hour of effort is well below the regional maximum of 49.08. The fall average of 6.63 raptors per hour of effort is well below the regional average of 21.83; likewise, the fall max of 61.75 raptors per hour of effort is significantly lower than the regional max of 730 raptors per hour of effort.

Flight height (above ground level) was estimated for raptors that used the ridge area and upper slopes of Tuttle and Willard Mountains, as these are the areas where potential development has been considered or proposed over the course of project development. The remaining birds were recorded as "outside" of the proposed Project area. Flight height estimates were grouped into 3 categories: 0-50 feet above the ground, 50-500 feet above the ground, and 500+ feet above the ground. Estimation of raptor elevation can be influenced by such factors as perspective, distance, topography, and individual observer perception. For this reason, the flight height categories were designed conservatively to produce the most conservative potential risk estimate, with field observers also erring on the side of caution around the 50-500-foot category.

Of 441 total raptors observed in spring 2011, 216 (49%) flew over the area of potential development. Of the birds that did fly over the area of potential development (n=216), 162 of them (or 37% of all birds observed) were judged to have flown within the 50-500-foot above ground range. Of the 162 birds that flew within this range, 108 of them were turkey vultures.

Of 978 total raptors observed in fall 2011, 460 of them (47%) were observed to fly over the area of potential development. Of the birds that did fly over the area of potential development (n=460), 296 of them (30% of all raptors recorded) were judged to have flown within the 50-500-foot above ground range. Of the 296 birds that flew within this range, 168 of them were broad-winged hawks; 104 of these passed in kettles on the single date of September 18.

Threatened or Endangered raptor species that were observed during spring and fall migration surveys for the proposed Antrim Wind Energy Project include:

- bald eagle (State Threatened);
- golden eagle (State Endangered);
- peregrine falcon (State Threatened); and
- northern harrier (State Endangered).

A total of 14 bald eagles were recorded (3 in spring and 11 in fall); 7 of these never flew within the proposed Project area. Of those bald eagles that did fly within the proposed Project area (n=7), 6 were judged to have passed within the 50-500 foot above-ground range. A total of 3 golden eagles were observed in the fall of 2011; one of these never flew within the proposed Project area. The remaining 2 golden eagles were judged to have passed within the 50-500 foot above-ground range within the proposed Project area. The single peregrine falcon that was observed in the spring of 2011 did not pass within the proposed Project area. Northern Harriers were documented on 5 occasions in the spring of 2011; three of these never flew within the proposed Project area, while 2 (a male and female together) were judged to have passed within the 50-500 foot above-ground range.

In addition to the threatened and endangered species listed above, three state listed species of special concern were also observed; these are American kestrel, northern goshawk, and osprey. One American kestrel was observed in the spring: it did not fly within the proposed Project area. One northern goshawk was also observed in the spring: it did not fly within the proposed Project area. Ten total osprey were observed (5 in the spring and 5 in the fall). None of the 5 osprey recorded in the spring flew within the proposed Project area. In the fall, one osprey did not fly within the proposed Project area, one flew in the 0-50-foot above ground range, and 3 were judged to have passed within the 50-500 foot above-ground range.

Overall, the observed species assemblage, relative abundance, and passage parameters were as expected for southern New Hampshire. Potential risk to these species as a result of the proposed Project is discussed in Section 5.3.

5.1.3 *Nocturnal Migration Surveys*

Nocturnal radar surveys for avian migration were performed for the proposed Antrim Wind Energy Project in 2011. These studies served to assess and characterize nocturnal avian migration patterns in the proposed Project area. The objective of the study was to document the overall passage rates for nocturnal avian migration in the vicinity of the Project area, including the level of migration activity, and migrants' flight direction and flight altitude.

A Furuno 12 kilowatt (kW) X-band marine radar was operated from one location (near the meteorological tower on the northeastern end of Tuttle Hill) within the Project area from sunset to sunrise each survey night for the duration of each survey period as outlined below, weather permitting. Marine radars cannot detect targets in heavy or consistent rain, so sampling occurred on nights with generally clear weather.

Spring radar surveys were conducted from sunset to sunrise on 30 nights between April 18 and May 26, 2011 resulting in 284 total hours surveyed. Fall radar surveys were conducted during 30 nights between August 17 and October 8, 2011 resulting in 327 total hours surveyed.

Video samples were analyzed using specialized digital analysis software. Data analysis included the removal of insects based on flight speed and the calculation of migration passage (traffic) rates over the radar location. Passage rates (expressed in targets/kilometer/hour) were summarized hourly for each night as well as the overall mean and median nightly passage rates for the entire season. The mean flight direction of recorded targets was calculated for each night of data collected. These were also summarized by night and for the entire season. Mean flight height of targets and percentage of targets below maximum turbine height was determined using the vertical data and summarized by hour, night, and season.

Results from this study were compared to results from other similar studies performed in similar locations in the northeast to present the range of results found at publicly available pre-construction studies and show where Antrim falls within that range. Of these studies, further comparisons were made to those projects that were conducted at locations in the same region as Antrim (New England) and were conducted at projects that are now either permitted or operational. These include (but may not be limited to):

- Granite Wind Project in Errol, Coos County, New Hampshire (Stantec Consulting Services Inc. 2007a and b) – Permitted and under construction;
- Groton Wind Project in Groton, New Hampshire (Stantec Consulting Services Inc. 2008a and b) - Permitted;
- Lempster Wind Project in Lempster, New Hampshire (Woodlot Alternatives, Inc. 2006a and 2007a) – Permitted and Operational;
- Sisk Wind Project in Franklin County, Maine (Stantec Consulting Services Inc. 2009) - Permitted;
- Sheffield Wind Project in Caledonia County, VT (Woodlot Alternatives, Inc. 2006b) – permitted and operational; and
- Stetson Wind Project in Washington County, Maine (Woodlot Alternatives, Inc. 2007b) – permitted and operational.

Spring Results

The overall mean passage rate for the entire spring survey period was 223 ± 23 targets per kilometer per hour (t/km/hr), and nightly passage rates varied from 6 ± 3 t/km/hr on May 17 to 1215 ± 299 t/km/hr on May 20.

Individual hourly passage rates varied between nights and throughout the season, and ranged from 0 t/km/hr during various hours of various nights, to 2279 t/km/hr during the 7th hour of May 20. For the entire season, mean passage rates increased rapidly between hours one and two after sunset, then gradually increased to the 6th hour after sunset before steadily declining until sunrise.