Mainland Moose habitat is present inside and adjacent to the Project area, and mainland moose has been documented through a small number of observations of scat and browse inside the Project area. Further discussions are on-going with industry groups, government, the Mainland Moose Recovery Team, and other groups relating to future monitoring, research and other collaborative projects relating to the Mainland Moose.

Other developers in the wind industry have been approached through distribution of a Shear Wind letter in September 2011 through the Canadian Wind Energy Association (CANWEA) requesting sharing of information relating to the Moose and current monitoring efforts and results. In May 2011, Shear Wind contacted CANWEA to initiate collaboration with other wind power developers across Canada with regards to the Moose and its interactions with Wind projects. The contact at CANWEA is Lijla Latifovic. She requested that Shear Wind provide a letter for distribution to CANWEA membership. This letter was drafted and sent to CANWEA in May 2011 and is attached to this environmental assessment in Appendix IV.

Several months went by, with active communication on Shear Wind's part with CANWEA, but little action on CANWEA's part with respect to circulation of this letter. Eventually, in September 2011, they acted on the initial request of May 2011 and distributed the letter by email to its membership.

To date, three expressions of collaborative interest have been received by the project team from this distribution. The first was from a developer in New Brunswick who has indicated that they are completing some research regarding moose movements and habitat relating to an operational wind farm in New Brunswick. No sharing of information has actually taken place to date.

The owner of the Maryvale Wind Power Project in Antigonish County, Nova Scotia recently approached Shear Wind about sharing of monitoring information regarding the Mainland Moose. This sharing effort is currently being coordinated.

On Wednesday May 4, 2011 Shear Wind was contacted by a consulting company in Waterloo Ontario, which was in the process of completing a research/literature search on the effects of wind power projects on ungulates. The company asked if Shear Wind would provide the results of the mainland moose monitoring at the Glen Dhu Project. The information was subsequently provided to them. Since that time the company decided to write an anecdotal account of observations of moose in and around operational wind farms that they have monitored. They are working on submitting this to a wind magazine but will likely have an in press copy ready in January, but the publication date (if there is one) is unknown.

The Project team has discussed why the response has been perhaps been lower than expected to date from the CANWEA announcement. The following points were considered:

- The people who are contacted through CANWEA will be developers who will likely not have detailed information regarding Moose monitoring activities on their projects;

- Canadian wind developers, with the exception of those in Nova Scotia, are not being asked to complete significant monitoring/research effort into the potential effect of wind projects on ungulates or Moose specifically, given the abundance of this species across the country;
- Even if contact with the environmental manager within the environmental assessment teams was made through the mail out, these managers are still not likely to respond to the request, given the fact there is no financial compensation for them and no research interest in the moose across the country (as it is not at risk elsewhere).

Effects of the Project

While moose habitat preferences can change as the abundance of available habitat changes (Osko, Hiltz, Hudson, and Wasel, 2004) and habitat selection shows a high degree of variability among individuals (McLaren, Taylor and Luke, 2009), moose generally require large areas with diverse habitat types (Snaith and Beazley 2002). Moose habitat preferences are correlated with forage and cover requirements, as well as breeding behaviours (Peek, Urich, and Mackie, 1976). Early successional deciduous vegetation is the main source of moose forage, food types often associated with open or disturbed areas (Snaith et al. 2002; Snaith and Beazley 2002; Parker 2003). The presence of such early successional trees and shrubs is particularly important during the winter months (Parker 2003). Regenerating vegetation provides good moose browse for 5-40 years following disturbances such as fire, disease, timber harvest and wind-throw (Snaith et al. 2002; Snaith and Beazley 2002). Fire appears to be the most important disturbance in terms of providing quality moose habitat (Parker 2003 and references therein). Critical habitat for moose in Alberta was described as open lowlands providing high quality food early in the spring (Hauge and Keith 1981).

In Nova Scotia, the most important food species are red, sugar, and mountain maple, as well as yellow and white birch (Snaith and Beazley 2002). In the summer months, particularly in June, aquatic vegetation can be an important component of the diet of moose (Peek et al. 1976; Fraser, Arthur, Morton and Thompson, 1980), but the fact that moose have persisted in areas containing infrequent or unsuitable wetlands suggests that these areas are not essential foraging grounds for moose in Nova Scotia (Snaith and Beazley 2002). This is supported by the findings of Telfer (1967a) who observed no feeding of moose on aquatic vegetation in the Cobequid region. Water bodies such as streams, ponds, and lake shorelines can be important for relief from heat stress in the summer months (Parker 2003), because moose are not well adapted for temperatures above 14-20°C (Snaith and Beazley 2002). Moose have also been shown to preferentially select dense, mature forests with a closed canopy in the summer months (Schwab and Pitt 1991) because the canopy provides shade and heat relief. Dussault et al. (2004) determined that moose showed behavioural adaptations to avoid heat stress in the summer including using thermal shelters during the day and increasing nocturnal activity.

When female moose give birth to their calves in the spring of the year, they often select islands or peninsulas because of the protection from predators they afford, or areas of high elevation

because of visibility in availability of escape routes (Wilton and Garner 1991). In mountainous regions of British Columbia, however, only 52% of 31 GPS-collared female moose climbed to higher elevations to calve, while the other 48% changed little in elevation (Poole, Serrouya, and Stuart-Smith, 2007). These researchers found that those females that remained at lower elevations preferentially selected areas with increased forage, decreased slope, and in closer proximity to water. Langley and Pletscher (1994) characterized calving areas in Montana and British Columbia as having dense hiding cover and open patches with bare ground. Cederlund and colleagues (1987) found that all cows returned to the same summer range each spring, and Bogomolova and Kurochkin (2002) determined that cows returned to the same area of the forest every year before giving birth.
Although not considered critical habitat (Balsom, Ballard and Whitlaw, 1996), mature, conifer forests are extremely important for moose in Nova Scotia during the late winter months (Telfer 1967a; Peek et al. 1976; Parker 2003), because they provide protection from extreme weather and the canopy prevents snow from accumulating to depths hindering moose movement (Snaith and Beazley 2002). Travelling in areas where they sink into the snow can cause moose to expend much energy (Lundmark and Ball 2008) at a time when adequate forage may be scarce. Ideal winter habitat also includes regenerating, mixed woods that provides both hardwood and softwood browse (Parker 2003). In the winter months, moose in northern Nova Scotia concentrate in small areas known as "yards" and move very little (winter range of 2.6 km^2), particularly when the yard is contains good browse as in the Cobequid region (Telfer 1967a,b). In Quebec, the vast majority of these winter yards were less than 0.5km^2 in area (Guertin, Doucet, and Weary, 1984). Prescott (1968) determined that the use of winter yards by moose in northeastern Nova Scotia was influenced most heavily by having a variety of vegetation types, and that food availability was more important than cover in determining the attractiveness of winter habitat to moose (summarized from Parker 2003). Moose yards in Quebec were characterized by gentle sloped with southern exposure, with pure or mixed stands of black spruce and adjacent patches of white birch, young balsam fir, and alder (Guertin et al. 1984). Other important winter food items include willow, which accounted for 35% of the winter diet of moose in northern British Columbia (Goulet 1985).

A similarly restricted winter range of moose was determined from studies in Minnesota (Ballenberghe and Peek 1971; Phillips, Berg and Siniff, 1973). Phillips et al. (1973) found that the late winter ranges of all tracked moose were distinct in habitat from the areas used at other time of year, and that the summer-fall and early winter ranges were much larger. Furthermore, they determined that most moose returned to the same wintering area each year, and that they used similar travel routes each year between seasonal habitats. Geist (1963) suggested that moose return every year to their accustomed summer range. Seasonal movements between winter and summer ranges were reported in moose in Alberta, with individual movement of up to 20km observed (Hauge and Keith, 1981). Even greater migrations between winter and non-winter ranges of up to 75km were observed in British Columbia, with non-winter ranges being twice as large as winter ranges (Demarchi, 2003). If the habitat in an area is diverse and provides the necessary interspersion of open areas for foraging and dense, mature forests for cover and relief from snow, seasonal ranges need not be widely separated (Snaith and Beazley 2002). For example, only 22% and 38% of adult moose in Michigan migrated between distinct summer and winter ranges in 1999 and 200, respectively. In Alaska, 43% of bulls and cows had distinct winter and summer ranges and distance between ranges were up to 17km (Bangs, Bailey and Porter, 1984).In southwestern Nova Scotia, however, the mean home range of moose was found to be large (55.2 km^2) because the rocky, barren conditions mean the moose must range farther to obtain resources (see Snaith and Beazley 2002). When moving between seasonal ranges, moose use well established routes and travel corridors (Neumann 2009). In terms of activity within seasons, daily movement rates of moose are higher in the summer than in the winter (McLaren et al. 2009).

Table 15. Habitat preferences for Mainland moose in Nova Scotia (from Snaith and Beazley 2002)

SPRING/EARLY SUMMER	SUMMER	FALL/EARLY WINTER	LATE WINTER
- Open or disturbed areas with plenty of forage, calving areas, and forest cover - Aquatic vegetation may provide needed nutrients if it is available	- Dense forest cover for protection from heat stress - Forage rich areas to provide energy for growth, lactation, and fat storage - Water bodies - Interspersion of dense forest stands and mixed or disturbed forests with open canopies or mature forests with well a developed understory (for forage)	- Forage rich areas still important - Cover less important because heat stress and snow depth are at low levels - Open or disturbed habitat with early successional vegetation	- Densely forested areas for relief from snow accumulation - Interspersion of forage-rich areas (disturbed areas, forest edges) in close proximity to cover

MOOSE BEHAVIOUR

Moose become preoccupied with breeding in the fall, a period known as the “rut”. During this period, large, bulls can completely abandon foraging (Miquelle 1990), and will stand motionless beside a potential mate for hours on end (Altmann 1959). Either prior to or following the rut, normally solitary male moose congregate in groups in which breeding status is determined through belligerent interactions (Dodds 1958; Peek, LeResche, and Stevens 1974). During this rut, aggressive interactions between established and intruding cows are also common (Altmann 1959; Geist 1963). As they form groups and move into open areas at the onset of the rut, bull moose become particularly susceptible to harvest (Bangs et al. 1984).

Adult females about to give birth increase their movements greatly nearing parturition (Bogomolova and Kurochkin 2002; Poole et al. 2007), and aggressively drive away yearlings before giving birth. After giving birth to their calves in late May or early June, cows show a tendency to withdraw from disturbances in the distance and to actively defend their calf from disturbances in close proximity (Geist 1963). The formation of a defended territory around a calf was similarly reported in moose in Wyoming (Altmann 1959). The annual survival rate of marked moose calves in Alberta was 0.27, with the likelihood of survival increasing greatly after the first month (Hauge and Keith 1981). Similar survival (0.26) of calves was reported in an Alaskan population (Testa 2004), and in this case high mortality due to wolf and brown bear predation was implicated. In an area of Michigan where predation was not an important mortality factor, calf survival was considerably higher at 0.71 (Dodge, Winterstein, Beyer, and Campa 2004), and calf survival in New Hampshire was found to be 0.45 (Musant, Pekins, and Scarpitti. 2010).

HISTORY OF MOOSE IN NOVA SCOTIA

The native population of moose in Nova Scotia is limited to approximately 1000 individuals in isolated herds/groups across the mainland. The population has declined by at least 20% over the past 30 years with much greater reductions in distribution and population size over more than 200 years, despite extensive hunting closures since the 1930's. The decline is not well understood but may involve a complex of threats including: historic excessive hunting, poaching, climate change, parasitic brainworm, increased road access to moose habitat, spread of white-tailed deer, possible high levels of cadmium and dietary deficiencies (e.g. cobalt), unknown viral disease, and disturbance.

Based on moose densities in similar habitats, under comparable circumstances, it is estimated that before European settlement, there may have been approximately 15,000 moose in Nova Scotia (Parker 2003). The accelerated European colonization of the New England states in the 1700s-1800s led to habitat loss and over-hunting, resulting in a moose population decline to several thousand and a reduction in distributional range. The trend continued slowly into New Brunswick and Nova Scotia so that in 1875 there had been a tremendous decline in both provinces, initiating game laws to restrict hunting. Subsequently, moose began to recover and were once again plentiful in mainland Nova Scotia, perhaps approaching a number close to that before European colonization. However, moose had already been extirpated from Cape Breton and did not become established again until the introduction of eighteen moose from Alberta in 1947 and 1948 (Dodds 1974; Corbett 1995). Moose hunting was closed in Nova Scotia in 1937, but the population continued to decline.

MOOSE RESPONSE TO DISTURBANCE

Linear Disturbances

Moose are affected by a variety of disturbance types, and in a variety of ways. The removal of moose habitat to create linear disturbances can decrease foraging and cover habitat and decrease connectivity of the landscape (MEG Energy Corp. 2010). One such linear disturbance in moose habitat is roads. Much recent research, for example, has been dedicated to the issue of moose-vehicle collisions on highways (Seiler 2005; Dussault, Poulin, Courtois and Ouellet, 2006; Leblond, Dussault, Ouellet, Poulin, Courtois and Fortin, 2007a,b; Danks and Porter 2010). The presence of roads can affect moose behaviour and habitat usage as well. Laurian and colleagues (2008) observed that moose usually avoided approaching within 500m of highways and forest roads, although 20% of moose periodically browsed sodium-rich vegetation along road ways. This general avoidance of roads and surrounding areas by moose was interpreted by the authors as meaning that the moose perceived these areas as low-quality habitat. Neumann (2009) determined that moose rarely utilized habitats in close proximity to roads in Sweden. Rudd and Irwin (1985) found the mean distance of bedding and feeding sites from the nearest travelled road to be 1283m and 1101m, respectively, which appears to be in accordance to the findings of et al. (2008). Goldrup (2003) detected no such avoidance of roads or trails by moose in the Prince Albert National Park in Saskatchewan, finding moose to be indifferent to their presence. Similarly, Belant and colleagues (2006) determined that overall moose did not avoid the main park road in Denali National park and Preserve in Alaska. Thus, it appears that the response of moose to roads is highly variable and it most likely situation specific.

Dussault and colleagues (2007) determined that moose did not cross highways frequently, which may suggest that habitat may become fragmented into discontinuous units on opposite sides of the road. In Sweden, a major highway acted as a barrier to moose migration, causing moose to accumulate in habitats on one side of the highway while unable to access wintering ground near the coast (Seiler et al. 2003). In another Swedish study, Neumann (2009) observed that moose seldom crossed roads, but did increase their rates of crossing during migration. In Alaska, individual moose crossed a six lane highway up to 8 times per year (McDonald 1991), and Timmerman and Racey (1989) concluded that the presence of a highway running parallel to a lake did not limit moose access to this aquatic habitat. Moose in Québec were more likely to cross roads during the night when traffic level was at its lowest (Dussault, Ouellet, Laurian, Courtois, Poulin and Breton, 2007). Dussault and colleagues (2007) found that topography, vegetation, and the presence of brackish pools were the most influential characteristics determining the locations of crossing points where they did occur. Silverberg and colleagues (2003), when studying moose behaviour at roadside salt-licks, found that stimuli that decreased feeding and increased incidences of fleeing included trucks passing, suggesting that the noise generated by these vehicles generated a disturbance sufficient to elicit a response by the moose. This same pattern was observed by Rudd and Irwin (1985), who found that trucks caused the greatest escape distance, displaced the greatest percentage of moose, and caused the greatest level of disturbance to moose of the factors examined. These researchers determined that whether or not an access road was adjacent to a forest stand was a key factor in determining the presence/absence of moose in that stand, and went on to suggest that preferred moose habitat should be avoided when selecting the location of drilling rigs and access roads.

In an example of a more indirect effect, roads associated with forestry operations can increase hunter access to moose habitat, leading to higher mortality of the moose within the area (Timmerman and Gollat 1983; Ontario Ministry of Natural Resources 1988; Rempel, Elkie, Rodgers, and Gluck, 1997; Burrows 2001).

Not all road effects are negative however, as Van Ballenberghe and Peek (1971) suggested that the road system in their study area allowed moose to extend their movements into areas that would have been otherwise inaccessible. Numerous moose trails associated with old logging roads in Ontario were noted by Timmerman and Racey (1989), and these trails were all longer and better used than those not associated with old roads.

Beazley and colleagues (2002) discussed the impacts of roads on moose populations in Nova Scotia, and stated that moose avoid areas of high road density, and that road density affects moose habitat suitability. Furthermore, they associated the presence of highway 101 with the isolation of the small moose population in southwestern Nova Scotia. These authors suggest that to properly manage moose populations in Nova Scotia, areas with no roads or low road densities containing suitable moose habitat should be maintained in such a state. Beazley and colleagues (2008) found a higher road density in southeastern Cape Breton, Nova Scotia, and suggested that this factor could be related to the absence of moose in the region.

Railways are another type of linear disturbance which can have severe impacts on moose. Most of the research on this topic has dealt moose-train collisions (Child 1983; Anderson, Wiseth, Pederson and Jaren 1991; Becker and Grauvogel 1991; Jaren, Anderson, Ulleberg, Pederson and Wiseth, 1991), and little is known about the behavioural responses of moose to railways. According to Child (1983), winters of above average snowfall take a particularly heavy toll of moose populations, who frequent the plowed railways at these times. This is in accordance with the findings of Gundersen and colleagues (1998), who noted that the number of moose-train collisions in Norway increased with increasing snow depth.

Larger Disturbances

Large-scale disturbances, such as forestry operations, are particularly important from the perspective of moose management. The net effect of many forestry operations is the creation of open areas with early successional vegetation, areas which are necessary elements of moose habitat (Ontario Ministry of Natural Resources 1988). The quality of habitat created by forestry activities, however, can be related to the timing and management techniques employed in the area, as seen by Collins and Schwartz (1998) in the boreal forest of Alaska. These researchers found that the removal of the overstory and scarification of the soil, either through the logging activities themselves or by post-logging site preparation, achieved the best establishment of early successional hardwoods favoured by moose. In contrast, birch, balsam poplar, birch-spruce, and balsam poplar-spruce stands that were not scarified following logging usually developed into grassy areas that are not suitable for moose habitat. In addition, cutover areas that are too far away from suitable cover may not be utilized by moose (Eason 1985), and employing a cut and leave strategy (alternating cutover and undisturbed areas of $1km^2$) as opposed to continuous clearcutting may support higher moose populations through the provision of better cover (Eason 1985). Peek and colleagues (1976) correlated increases in the moose population in their Minnesota study area with logging activities that removed large stands of jackpine and replaced them with shrub communities interspersed with fir, aspen, and white birch. Lavsund et al. (2003) related clear-cutting practices in the Scandinavian countries to increased moose densities in these areas due to the provision of prime, early-successional habitat.

The attractiveness of a cutover area to moose may also depend on the type of stand. Courtois and colleagues (1998) observed that moose were selective of their habitat usage in recent cutovers (2-3 years) of coniferous stands, suggesting that only some of this area was suitable, while the moose showed no such selectivity in their usage of recently cutover mixed stands. In addition, and colleagues (2002) found a seasonal component to the usage of cutovers areas, as moose avoided recent clear-cuts except in early winter, when they increased their preference for these habitats.

In terms of possible effects of forestry on coarse scale habitat usage, Courtois and colleagues (2002) found that females increased the size of their home ranges in the presence of cutover areas, but that they did not increase their movements in accordance. Welch et al. (2000) reported an average distance between annual calving sites of 2.82 ± 2.37 km for cows inhabiting an area that had been logged using patch cuts, whereas this distance for cows inhabiting an area that was clearcut was 4.87 ± 3.62 km. They attributed these differences to “habitat heterogeneity in the size and distribution of cut and uncut patches”. From these results the authors concluded that small patch cuts producing smaller patches of disturbance than contiguous clearcuts result in stronger site fidelity for cows.

Crête (1988) noted that in addition to increasing hunter access to moose habitat through the creating of roads, the removal of cover increases the exposure of moose to hunters until regrowth occurs. This trend was observed in Ontario by Eason (1985), who reported a decline of 75% in the density of moose in a recently logged area due to overharvesting made possible by extensive road networks and greatly reduced cover. 7-11 years after clearcutting in Québec, forest stands had undergone substantial regeneration and featured high vegetative cover for moose (Courtois et al. 1998).

Potential changes in the density, productivity, and mortality of associated with clear-cut blocks of Québec forest were examined by Courtois and Beaumont (2002). Their results indicated that the presence/absence of cut-over blocks did not affect the number of calves produced per100 females, nor were there any significant changes in population structure after cutting.

The literature available on other response of moose populations to other types of large disturbance is sparse. In Norway, the installation of a hydro-electric dam created a lake in what was previously used as a migratory route and a summer range for the area's moose population (Anderson 1991). It was found in this case that although the creation of the lake caused only minor changes in migratory behaviour, some cows either completely or partly abandoned the area and summer home range size increased for those who remained.

The effects of mining, another large-scale disturbance type, have received little study. Westworth et al. (1989) studied the usage of habitat by moose in the vicinity of a copper mine in British Columbia. These researchers determined that habitat type had a more important influence on moose distribution than did distance from the mine site. Specifically, moose pellet densities were as high or higher within 300m of the mine site as they were 1000-2000m from the site. They concluded that moose in the area had habituated to the various disturbances associated with the mining operation, including noise.

The effects of oil and gas activity on moose in Wyoming were reviewed by Rudd and Irwin (1985). Most of the impacts associated with this development were as a result of roads intruding into moose habitat.

Human Development and Activity

While moose are considered more tolerant of human presence than are other ungulates (AXYS 2001), they are nonetheless sensitive to human proximity (Neumann 2009). Geist (1963) reported that the sight of humans at close range caused all moose to flee, although the sounds of powersaws and gunshots had little effect of moose behaviour. A number of human activities intrude on moose habitat. Anderson and colleagues (1996) determined that human sources of disturbance, as opposed to mechanical sources, elicit flight responses from further away and result in longer periods of elevated heart rates in moose. In this study, skiers and hikers caused moose to flush from as far away as 400m, while F-16 jets flying 150m overhead did not elicit any behavioural or physiological response. Hiking (Neumann 2009) and backcountry skiing (Nuemann et al. 2010) activities were found to elicit short-lived but considerable responses in moose, including increased movement rates following the disturbance and displacement from the site of the disturbance. Cross-country skiing was found to influence the winter distribution of moose in Alberta, as they moved away from area with heavily used trails during the ski season (Ferguson and Keith 1982). Nuemann (2009) reported a similar response to snowmobile activity within moose habitat, and Colescott and Gillingham (1998) noted altered behaviour of moose within 150m of snowmobile traffic on trails. Behavioural responses to the snowmobiles in this study included moving gradually away from the trail, possibly displacing them temporarily from preferred habitat. Tomeo (2000) examined the physiological response of moose to snowmobiles, and found higher levels of stress hormones in the feces of moose from areas with snowmobile traffic than those from areas with no snowmobile traffic.

In Norway, Anderson et al. (1996) found that moose increased their ranges in response to military exercises, and did not reduce their ranges to pre-disturbance sizes after the operations had ceased. The response of moose to approaching research helicopters was examined by Støenand colleagues (2010). The responses they observed were similar to those elicited by snowmobiles in other studies, namely increased movement rates for a period of several hours following the disturbance, but not an increase in the overall range of the moose. Upon approach of the helicopter, moose fled to cover rather than running large distances from the disturbance.

In interior Alaska, Maier and colleagues (2005) found that the densest moose populations occurred closer to towns, a trend which they attributed to either a greater availability of browse near the towns or a decrease in the number of predators in these areas. A similar pattern was detected by Schneider and Wasel (2000) in northern Alberta. In this study, a strong positive relationship between human settlement and moose density was observed, as well as a linear decline in moose density with increasing distance from areas of human settlement. The distribution of moose was not heavily influenced by human development in an Alaskan National Park, and their indifference to development was attributed to habituation due to no positive or negative reinforcement (ie no hunting) (Belant et al. 2006). Conversely, Lykkja and colleagues (2009) found that moose in Norway often avoided areas of high-density human settlement, and responded to increased human activity by withdrawing further from houses. Moose in the study area did use habitats close to human settlement, but only when humans were less active.

Wind Energy Development

There is little established literature pertaining to the response of moose to wind farm development. A wildlife monitoring report from the Searsburg wind project in Vermont reported that moose were using the area under a generating turbine (Multiple Resource Management Inc. 2006). A total of 23 images of moose were captured using a remote camera installed under the turbine, and of these, 61% occurred when the turbine was on and generating power. Observations of moose scat and of a single moose foraging were reported on the site of the Dokie Wind Energy Project in British Columbia (Jacques Whitford AXYS Ltd, UNBC 2008), meaning that moose continued to use the area after the wind farm was in operation.

A study of the response of elk, another ungulate, to wind-power development in Oklahoma was conducted by Walter et al. (2006). They determined that elk in the area were not adversely affected by the wind-power development, either through negative effects on diet or through changes in home range. The elk remained in the area throughout the construction and operation phases of the wind farm, and the access roads were no barrier to elk movement.

<u>Mitigation</u>

Turbines have been placed as densely as was technically feasible in order to limit Project sprawl. The overall footprint of the Glen Dhu North and Glen Dhu South Wind Power Project has minimized its footprint in order to reduce habitat fragmentation.

In locations where Mainland Moose observations have been documented, those areas have been avoided as much as possible as potential candidate sites for turbine placements, recognizing that moose home ranges average 25km^2. Turbine 28 was relocated to avoid a wetland that had obvious presence of Mainland Moose (several scat observations). A potential turbine location assessed early in 2011 was removed from the list of candidate sites (was located south of Turbine 25) due to the presence of a large wetland and observations of the Mainland Moose (scat).

Several small potential wetland alterations, where Mainland Moose might populate, will be required to accommodate individual turbine locations and access roads across the Project Lands. These proposed wetland alterations will fall under the Nova Scotia Wetland Alteration Approval process, and compensation will be developed in association with that process.

All other wetland areas, lakes and streams have been given a minimum 30m buffer in the design of the Project activities in order to maintain values associated with those habitat features, including mitigation of impacts to Mainland Moose that may use such habitats.

The use of existing logging roads as much as possible for access to turbine locations will reduce the amount of fragmentation of forests as a result of the Project. This Project area is already highly fragmented based on the presence of significant forestry activity and access road layout on the lands. During the planning stages of this Project and during final turbine siting exercises, special care was given to using existing roads wherever possible to minimize impact on Mainland Moose habitat. The network of proposed roads for the 62 priority turbine sites consist of 60% existing road infrastructure.

Shear Wind Inc. is committed to playing a role in continued monitoring and research associated with the Mainland Moose in Nova Scotia.

5.4.8 Avian Use Assessment

Baseline assessment for birds was completed as part of the environmental assessment process for the Glen Dhu Wind Power Project from June 2007 to July 2008 by John F. Kearney. This baseline assessment was completed across a Project area that encompassed both the original Glen Dhu WPP area as well as the Glen Dhu South Project area.

The entire baseline report is provided in Appendix III with detailed methodology and all results.

Follow up assessment was completed during the summer of 2010 and 2011 for breeding birds. These two reports are also included in Appendix III with methodology and results. Additional specific monitoring and follow up studies have been completed in support of the Glen Dhu North Project. Results of these studies are not discussed in this section. However, the list of these reports is included in Chapter 3 Methodologies.

5.4.8.1 Baseline Survey

In total 3,650 individual birds of 80 species were recorded during the autumn migration stop-over surveys. The highest numbers occurred during the periods, August 28 to September 6 and October 7 to 16. The diversity of bird species was highest during the 30-day period from August 28 to September 26. The highest counts were achieved when wind was calm, or with light winds from the northwest, west, and north. More birds were seen in the most disturbed habitats and with the most "edge", i.e., the "clearcut, regenerating, and early succession" habitat type. Twenty-four species demonstrated significant habitat relationships.

The before dawn descent of Hermit Thrushes was the most distinctive aspect of the autumn nocturnal passage counts. This species was heard on ten of sixteen nocturnal counts with the number of thrush notes heard ranging from 1 to 89 from September 11 – October 19. The highest number of calls was heard on October 1st.

Nine species of hawks and eagle were observed during the autumn diurnal passage surveys. These occurred in small numbers and irregularly at all observation points throughout the autumn. Thus, the study area does not appear to be an important site for diurnal raptor passage during the autumn migration. The most common of these raptors, the Bald Eagle, consisted of a local population that is not migratory. The Common Raven, also a local population, was the most frequently seen passerine species during the diurnal passage surveys. For woodpeckers and small to medium-sized passerines (i.e., excluding ravens), 49% of observations recorded a flight direction of west, compared to 18% for east, 13% for north, and 20% for south. This pattern of flight direction held for all wind directions.

Few birds wintered on the Pictou-Antigonish Highlands, especially on the higher elevations where winter conditions are the most extreme. The density of birds in winter increases with lessening amounts of edge and with rising amounts of forest cover. Thus clearcuts and early succession forest had the smallest densities of birds (0.55/hectare) and mature deciduous the largest (1.77/hectare). Only 19 species of birds were seen in the study area during the winter period. The most common bird was Black-capped Chickadee, occurring in all habitats but most abundantly in mature deciduous.

In total, 4,916 individual birds of 75 species were recorded during the spring migration stopover surveys. The data suggests that spring migration stop-over in the study area consists of three waves of decreasing intensity. In mid-April, the first wave in is dominated by American Robins, Dark-eyed Juncos, and Song Sparrows. The second wave in late April and early May consists largely of Yellow-bellied Sapsuckers, Northern Flickers, Ruby-crowned Kinglets, Hermit Thrushes, Yellow-rumped Warblers, and White-throated Sparrows. The third wave in mid to late May is made up of flycatchers, forest warblers, and Red-eyed Vireos. The peak in total birds occurred from April 11-30 with a peak in species diversity from April 21-30. The highest mean counts occurred when the night wind was from the southeast at 12 to 19 km/hour on average, the second highest mean counts when winds were from the south at 7 to 11 km/hour. Habitat relationships with birds were not as strong in the spring migration stop-over as in the autumn. One can discern, as in the autumn, the influence of the edge effect as mean total birds tends to decrease with decreasing edge and increasing forest canopy; from clearcuts to mature deciduous forest. Seventeen species demonstrated significant habitat relationships during the spring migration.

The nocturnal passage counts were much lower in the spring than in the fall. Very few Hermit Thrushes were heard, and the pattern of their sounds was different. Diurnal passage migration was also much less in the spring than in the fall. No birds were seen in twenty-four percent of the one-half hour observation blocks compared to only eight percent in the autumn. The mean number of birds seen per block was 3.00 birds in contrast to 7.08 birds in the autumn. Hawks, water birds, woodpeckers, and passerines were less diversified by species and less abundant in total numbers than in the autumn. Only the Red-tailed Hawk was seen more frequently in the spring (24% of time blocks) than in the autumn (12%). The locally resident Bald Eagles and Common Ravens were present in comparable numbers and frequency during the spring. Sixty-seven percent of woodpeckers and passerines were flying northeast or east. It is worth noting that the most common flight direction during the daytime in both the autumn and spring was 45 degrees from the prevailing nocturnal flight direction described for Maritime passerines, that is, west rather than southwest and east rather than northeast.

The breeding season surveys consisted of three components: crepuscular and nocturnal birds, early breeders, and peak season breeders. Twilight and nocturnal area searches detected breeding birds that are not normally seen during the daytime. These include American Woodcock, Great Horned Owl, Barred Owl, and Northern Saw-whet Owl. The three owl species were heard in a mix of forest habitats with the Barred Owl the most associated with mature Sugar Maple-Yellow Birch-Beech habitat. The American Woodcock was found almost exclusively in clearcut and regenerating areas, often near a wet area.

Bird species that began their nesting season before June 1 were considered early breeders in this study. The twenty-four point counts along the migration stop-over transects were used to survey these birds. The most abundant early breeder was White-throated Sparrow with a mean of 2.71 per point count station and occurring at 92% of the stations. It was closely followed by the American Robin with a mean of 2.54 and occurrence of 92%. Species occurring on two-thirds or more of the point count stations were in rank order, Ovenbird, Yellow-rumped Warbler, Dark-eyed Junco, Magnolia Warbler, Blue Jay, Black-capped Chickadee, Hermit Thrush, and Yellow-bellied Sapsucker.

There were significant differences in the use of habitat types by total number of early breeders. Highest counts were obtained in clearcuts, and early succession forest followed by mid to late succession mixed aged mixed forests. There were no significant differences between particular habitat types. Nine species of early breeders demonstrated significant habitat relationships.
The peak breeding survey consisted of 204 point counts dispersed throughout the study area.

Each point count was surveyed one time between June 3 and July 3. Red-eyed Vireo was the most common bird during the peak breeding season and was detected on 74% of all point counts. The White-throated Sparrow, American Robin, and Ovenbird maintained their ranking among the top four most common species and were detected on 57-61% of point counts. The Black-throated Green Warbler was also seen or heard on 57% of point counts. There were significant statistical differences in the total number of peak breeding birds according to habitat type. The highest counts were obtained on residential and agricultural habitat, followed by disturbed forest habitat to mature forests in decreasing order. There were also significant differences between individual habitat types.

The clearcut and early succession habitat had significantly greater number of birds than mature coniferous and deciduous. The clearcut and early succession alongside mature deciduous habitat and the mid to late succession habitat both had greater total birds than mature deciduous. Species diversity follows the same pattern relative to habitat use. There were significant differences in species diversity at the overall habitat level of analysis and between specific habitat types. Clearcuts and early succession forests were significantly more diverse in bird species than mid to late succession, mature coniferous, and mature deciduous. Clearcuts and early succession forests alongside mature deciduous, mid to late succession forests, and residential and agricultural land were more diverse than mature deciduous. Fifteen species showed significant preference for specific habitat types. For two species, their numbers were significantly higher in one habitat type than all five other habitats. These were Ovenbird for mature deciduous and Black-throated Green Warbler for mature coniferous. Among the other species showing statistically strong preferences for specific habitats were Alder Flycatcher, White-throated Sparrow, Song Sparrow, and Common Yellowthroat for clearcuts and early succession forests, Least Flycatcher, Mourning Warbler, and Common Yellowthroat for clearcuts and early succession alongside mature deciduous, and Red-eyed Vireo and Least Flycatcher for mature deciduous.

The mean number of birds seen at each of the point count stations was considerably higher in the early breeding season compared to peak breeding; nearly twice as high. This is due to the fact that the early breeding point counts in April and May were conducted repetitively. The mean of total of birds was highest with calm winds (13.38) and lowest at wind speeds up to 20-29/km/hr (11.25), but these differences proved to be not statistically significant; nor were the effects of visibility (fog). The number of birds detected was significantly less in light rain compared to no precipitation (8.69 vs. 12.23). The time of morning, from sunrise to 4 hours after sunrise, did not have significant effect on the mean total birds detected.

In total from June 2007 to July 2008, 90 species of breeding birds were found in the study area of which 28 were possible breeders, 34 probable breeders, and 28 confirmed breeders using the criteria of the Maritime Breeding Bird Atlas. Both the nocturnal passage and diurnal passage surveys in the autumn point to the need to evaluate the risk to migrating and commuting bird for collisions with wind turbines. The nocturnal passage surveys provided evidence that the American Woodcock and Hermit Thrush are descending to the ground in the dark from one hour to one-half hour before sunrise during their autumn migration. Those birds descending to ground in the immediate vicinity of wind turbines are thus potentially at risk from collisions with the rotating blades. It was also noted that these descents are of the greatest magnitude under calm wind conditions. Thus there might be a natural mitigation of this risk as the blades may not be rotating when the numbers descending are highest.

Wind turbines may also pose a threat to the American Woodcock during the time they are engaged in breeding flight songs. Male woodcocks will use almost any size open, relatively flat, area as a display ground, sometimes far from their preferred diurnal habitat. During the first couple of years after construction, it will be necessary to closely monitor this situation while cover is growing back. During the diurnal passage the species most likely to be flying at the height of the blade sweep are Bald Eagle (38% of observations), Sharp-shinned Hawk (33%), Red-tailed Hawk (33%), Common Raven (22%), warbler species unspecified (15%), American Robin (14%), passerine species unspecified (7%), and Yellow-rumped Warbler (6%). Of particular concern among these species are Bald Eagle and Common Raven. They are present throughout the spring and autumn and were among the species most often seen during the diurnal passage surveys, particularly the latter. The analysis suggests that soaring birds such as diurnal raptors, gulls, and corvids are more likely to be flying at blade height when the turbines are placed near steep cliff edges. These steep cliffs are largely absent on the Glen Dhu South Project lands. In addition, the data suggest that Bald Eagles are the most likely to fly at blade height due both to vertical air flows and a higher flying altitude, with or without air current assistance.

The two species listed as “special concern” by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), Peregrine Falcon and Rusty Blackbird were seen only once each in the study area in the autumn migration. The three species listed as “threatened” by COSEWIC were seen during the breeding season. These are Chimney Swift, Olive-sided Flycatcher, and Canada Warbler (COSEWIC 2007, COSEWIC 2008).

Two Chimney Swifts were seen together in flight in early July 2008 at the extreme southwest corner of the study area. While it is possible that Chimney Swifts will nest in large dead trees in mature forests, generally Chimney Swifts nest in towns or cities, and it is most likely these were foraging birds.

The Olive-sided Flycatcher was seen on 8 occasions during the spring migration and on 12 breeding point counts. This suggests the species is fairly widespread in the study area in suitable nesting habitat; clearcuts and early successional forests. The existence of large snags in clearcut or burned areas adjacent to forests appears to be a critical component of this species habitat. The causes of decline of this flycatcher are unknown and are puzzling since the availability of suitable habitat is increasing. Due to the unknown causes for the decline in the Olive-sided Flycatcher, it is difficult to assess the impact of a wind farm on its population in the study area. The construction of a wind farm should not negatively affect the habitat available to Olive-sided Flycatchers. Where wind turbines are placed in habitats suitable for this species, large snags should be cut down for at least 150 metres around their perimeter. This will help lessen the risk of collisions with rotating wind turbine blades.

The Canada Warbler was seen on four occasions. The first two were during the breeding season in 2007; one a single individual near Vamey's Lake and a pair in the southern portion of the study area. In 2008, a male accompanied by a female was singing near the edge of Vamey's Lake in their spring migration period, and a single male in the exact same location as in 2007 in the southern portion of the study area. The breeding habitat of the Canada Warbler is moist, mixed coniferous deciduous forest, with a well developed understory, often near open water. The decline of Canada Warbler is believed to be related to the loss or degradation of nesting habitat. Studies in New England and the Middle Atlantic States reported the Canada Warbler was one of the top five species most sensitive to forest fragmentation. At a more site-specific level, studies have shown that the clearing of brush and understory in forests, as well as grazing by ungulates, negatively affects their population. The clearing of land for turbine construction is not likely to impact the Canada Warbler since turbines are built on higher ground, way from moist woodlands. The construction or improvement of roads and the construction of ancillary structures should avoid removing forest understory in wet areas.

This study shows repeatedly the importance of a variety of forest habitat types for bird populations. Cleared and early successional forest habitats with a high degree of edge are critical for many birds during the migration and breeding periods. Mid to late successional and mature coniferous forests are the preferred habitat of a number of the most common breeding birds. Deciduous forests may be essential as overwintering areas and provide the habitat of the first and fourth most abundant birds in the study area during the peak breeding period, Red-eyed Vireo and Ovenbird. At this time, the greatest threat to the mature Sugar Maple-Yellow Birch-Beech hardwood forest and associated bird habitats on the Pictou-Antigonish Highlands is from harvesting for lumber and firewood.

For those species listed as "Yellow" status by the Province of Nova Scotia or as a "Priority Species" by Partners in Flight, recovery depends on a broad, concerted effort by all forest users. This is the approach recommended by Partners in Flight. Their plan focuses on conserving and restoring the populations of the Canada Warbler and Black-throated Blue Warbler since in doing so, the situation of all other stable or declining species would improve as well.

5.4.8.2 Breeding Bird Survey 2010

The five most abundant early breeding birds in 2010 were White-throated Sparrow, American Robin, Yellow-rumped Warbler, Hermit Thrush, and Dark-eyed Junco.

The Red-eyed Vireo was the most abundant peak breeding bird species in both 2008 and 2010. The remaining six most common birds on Glen Dhu South Project lands in both years was American Robin, White-throated Sparrow, Ovenbird, Black-throated Green Warbler, Hermit Thrush, and Magnolia Warbler.

Three species identified are classified as sensitive to human activities by the Nova Scotia Department of Natural Resources; the Northern Goshawk, Gray Jay, and Boreal Chickadee. Additional species identified are listed in Schedule 1 of Canada's *Species at Risk Act* (SARA). These include the Chimney Swift (threatened), Olive-sided Flycatcher (threatened), Canada Warbler (threatened), and Rusty Blackbird (Special Concern).

The Northern Goshawk has not been detected during a breeding point count but it is a probable breeder on Glen Dhu South lands where it has been seen during spring diurnal passage counts. A total of 9 Gray Jays have been seen on breeding point counts on Phase 2 lands in 2008 and 2010 combined, with a mean of 0.02 per point count. A total of 32 Boreal Chickadees have been seen on breeding point counts in 2008 and 2010 combined, with a mean of 0.07 per point count.
The Chimney Swift is a possible breeding bird where a pair of birds was seen on one occasion in 2008 but none in 2010.

Olive-sided Flycatchers were possible breeders in four locations in 2008 while none were seen there in 2010. A pair of Canada Warbler (probable breeder) was seen in 2008 but not in 2010. Rusty Blackbirds were not seen in 2008 but were seen at three point counts in 2010 including one pair carrying food to a nest, making it a confirmed breeder.

The 2010 study showed little change in breeding bird populations between 2008 and 2010 with the abundance of all species remaining the same or increasing with the exception of one species. Similarly this 2010 study demonstrated that there was no widespread change in forest habitat since 2008 with 79% of the point counts showing no to slight change and 11% substantial to total change. There was one major clearcut in the northeast section of the Glen Dhu South Project lands with a few much smaller cuttings scattered throughout the area. This relatively small degree of habitat change for breeding birds would equally apply to migrating birds in stop-over and winter residents.

5.4.8.3 Breeding Bird Survey 2011

In 2010, the five most abundant early breeding birds were White-throated Sparrow, American Robin, Yellow-rumped Warbler, Hermit Thrush, and Dark-eyed Junco. In 2011, the American Robin and White-throated Sparrow were again the two most abundant species, followed by Northern Flicker, Yellow-rumped Warbler, and Hermit Thrush.

While different survey methods were used in all three years (2008, 2010 and 2011) to analyze early breeding bird populations and gave quite different results in terms of the mean number of birds of each species at point count stations, the relative abundance of each species remains fairly constant from one year to the next.

A number of statistical tests indicated that the Yellow-bellied Sapsucker, Hairy Woodpecker, Blue Jay, and Golden-crowned Kinglet were declining in the years 2008 to 2011. Only the Ruby-crowned Kinglet was indicated as increasing. The tests showed a few other species with increasing trends from 2008 to 2011. These were Boreal Chickadee, Chestnut-sided Warbler, and Mourning Warbler. At the same time, the tests showed two species with declining trends, Cedar Waxwing and Black-throated Blue Warbler.

The declines of the four species described above are of some concern. They are all species ranked in the top 10 to 25 bird species in the forest ecosystem of the region in the peak breeding surveys. The Hairy Woodpecker, an early breeder, is ranked between 7 and 14 in the early breeding surveys. The causes for these declines are not known but this trend should be further studied. The woodpecker species, in particular, are considered "keystone" forest species since they provide nesting holes for other species and, in the case of Yellow-bellied Sapsucker, sap wells where other birds forage for sap and the insects attracted to it. It should also be noted that the three other forest woodpecker species, the Downy Woodpecker, the Pileated Woodpecker, and the Northern Flicker all showed declines in abundance between 2010 and 2011 but not to extent that could be demonstrated as statistically significant.

In total, between 2007 and 2011, 93 breeding species were found in the study area of which 35 are confirmed breeders, 31 are probable breeders, and 27 are possible breeders.

Three species that were identified are classified as sensitive to human activities by the Nova Scotia Department of Natural Resources; the Northern Goshawk, Gray Jay, and Boreal Chickadee. The second category is those species listed in Schedule 1 of Canada's *Species at Risk Act* (SARA). These include the Chimney Swift (threatened), Olive-sided Flycatcher (threatened), Canada Warbler (threatened), and Rusty Blackbird (Special Concern).

The Northern Goshawk has not been detected during a breeding point count but it is a probable breeder as it has been seen during spring diurnal passage counts. A total of 13 Gray Jays have been seen on breeding point counts in 2008, 2010 and 2011 combined. A total of 41 Boreal Chickadees have been seen on breeding point counts in 2008, 2010, and 2011 combined.

The Chimney Swift is a possible breeding bird on Glen Dhu South Project lands where a pair of birds was seen on one occasion in 2008, none in 2010, and again in the same place in 2011 when 3 birds were seen.

Olive-sided Flycatchers were possible breeders in four locations on Phase 2 lands in 2008, none were seen there in 2010, and 3 in 2011. A pair of Canada Warbler (probable breeder) was seen in 2008 but not in 2010 or 2011.

Rusty Blackbirds were not seen in 2008 but were seen at three point counts in 2010 including one pair carrying food, making it a confirmed breeder. Then in 2011, no Rusty Blackbirds were seen on the Glen Dhu South Project lands.

For those point counts where Canada Warblers, Rusty Blackbirds, or Olive-sided Flycatchers were seen in one year and not in a subsequent year, extra trips were made to those point counts and in some cases, recordings of their vocalizations were played.

Effects of the Project

There are no major concentrations of birds that occurred in the study area during the autumn and migration. Nonetheless, the area is an important migration stop-over for various species of woodland birds. The pre-dawn descent of Hermit Thrushes and the waves of migrating warblers in the autumn, and the woods filled with thrushes and sapsuckers during the spring migration make this area a noteworthy part of the avian ecology of Nova Scotia. However, these events occur over a wide area of the Pictou-Antigonish Highlands and are not unique or confined to the study area or specific turbine properties.

Wind turbines may pose a threat to the American Woodcock during the time they are engaged in flight songs. Male woodcocks will use almost any size open, relatively flat area, with bare ground, short grass, or even patches of snow, as a display ground, sometimes far from their preferred diurnal habitat (Keppie and Whiting Jr. 1994). During the first few years after construction, it will be necessary to closely monitor this situation until cover returns.

The nocturnal passage surveys provided evidence that the American Woodcock and Hermit Thrush are descending to the ground in the dark from one hour to one-half hour before sunrise during their autumn migration. Those birds descending to ground in the immediate vicinity of wind turbines are thus potentially at risk from collisions with the rotating blades. It was also noted that these descents are of the greatest magnitude under calm wind conditions. Thus there might be a natural mitigation of this risk as the blades may not be rotating when the numbers descending are highest. There is a need to understand this phenomenon more completely. There has been no woodcock mortality as of yet and a small amount of thrush mortality (4 birds). The acoustic study in 2009 confirmed that there was a significant descent of both of these species, and the acoustic study of 2011 will provide more comprehensive data. This monitoring needs to continue since we need to understand under what weather conditions this risk increases.

The species, for which there are more than 10 observations, most likely to be flying at the height of the blade sweep are Bald Eagle (38% of observations), Sharp-shinned Hawk (33%), Red-tailed Hawk (33%), Common Raven (22%), warbler species unspecified (15%), American Robin (14%), passerine species unspecified (7%), and Yellow-rumped Warbler (6%). Of particular concern among these species are Bald Eagle and Common Raven. They are present throughout the autumn and were among the species most often seen during the diurnal passage surveys, particularly the latter.

Soaring birds such as diurnal raptors, gulls, and corvids are more likely to be flying at blade height when the turbines are placed near steep cliff edges. In addition, the data suggest that Bald Eagles are the most likely to fly at blade height due both to vertical air flows and a higher flying altitude, with or without air current assistance. The 2009 soaring bird study included a risk assessment that estimated a mortality of 0 to 1.8 soaring birds per autumn season per turbine at the scarp face. During the first post-construction autumn at Glen Dhu North, there were no mortalities of soaring birds at any turbine.

The development plans for the Glen Dhu South Wind Power Project have been developed to avoid all wetlands to the extent possible, and none will be drained to eliminate the associated habitat. Although the proposed Project will not fragment the forest cover in the same manner as a large clearcut might, new roads (40% of total) and turbine openings will effectively diminish the forest continuity. The impact of this forest alteration on bird species is not fully understood. Overall, based on the findings of the various wildlife surveys, in addition to a myriad of research on the interaction of birds with turbines, it appears that there are no major constraints to affect development within the Project lands but some bird mortality will be expected.

Mitigation

Until additional research becomes available, serious consideration should be given to setting back wind turbines from steeply-inclined ridges where updrafts are most conducive for soaring. Again, the optimal set-back distance requires further study. Turbines at Glen Dhu North were set back 50 metres from ridge faces.

All turbines at the Glen Dhu South Project are located greater than 50 metres from ridge faces.

The barrier effect is a result of wind farms causing birds to alter their flight paths to avoid wind turbines. This positive behaviour can become a negative impact when avoiding the turbine arrays can cause birds to lose too much energy or create stress. The results of the diurnal passage surveys suggest that many passerine birds over the study area in the early morning are off-course or otherwise re-orienting to locate a migration corridor. After a night of migration, they may have a limited energy budget remaining to find a suitable landing location. For this and other reasons, the construction of wind turbines in clusters is considered one of the “best practices” of wind farm design and provides corridors for birds to fly through safely

To avoid destroying nesting or breeding species during breeding timeframes, clearing of vegetation will occur prior to April 15, 2012.

A follow-up monitoring program will be implemented after construction and will be designed in accordance with Canadian Wildlife Service and/or NSDNR requirements. The purposes of the follow-up monitoring are:

- to determine rates of mortalities occurring and, if so, to identify any possible mitigation measures; and,
- to inform future decisions about development or placement of wind turbines for the second phase of the Project.

If it appears that a high number of direct fatalities are occurring, attempts will be made to determine the nature of the fatalities, specific timing or seasonality, weather related effects at the time, so that mitigation such as modifications to turbine operations may be designed (i.e. change to cut-in wind speeds for turbine operation; change to lighting; other).

If a moving blade appears to be causing high bird mortality along a particular flight path, the turbine can be shut down during time periods, or weather conditions when risks are particularly high, to reduce the number of direct hits.

Mortality studies will be focused on the following animals and time frames:

1. Spring bird migration (April to 1st week of June);
2. Breeding Bird Season (June to mid-August);
3. Autumn bat migration (mid-August to early October);
4. Autumn bird migration (mid-August to late October);

The timing of the carcass searches for both birds and bats is based on the baseline studies for this wind power Project. After obtaining the required permits from federal and provincial agencies, searches will take place during the time frames given above. Searches will be more or less frequent depending on the results of the scavenger trials. Carcass searches will follow the protocols recommended by the Canada Wildlife Service (CWS 2007).

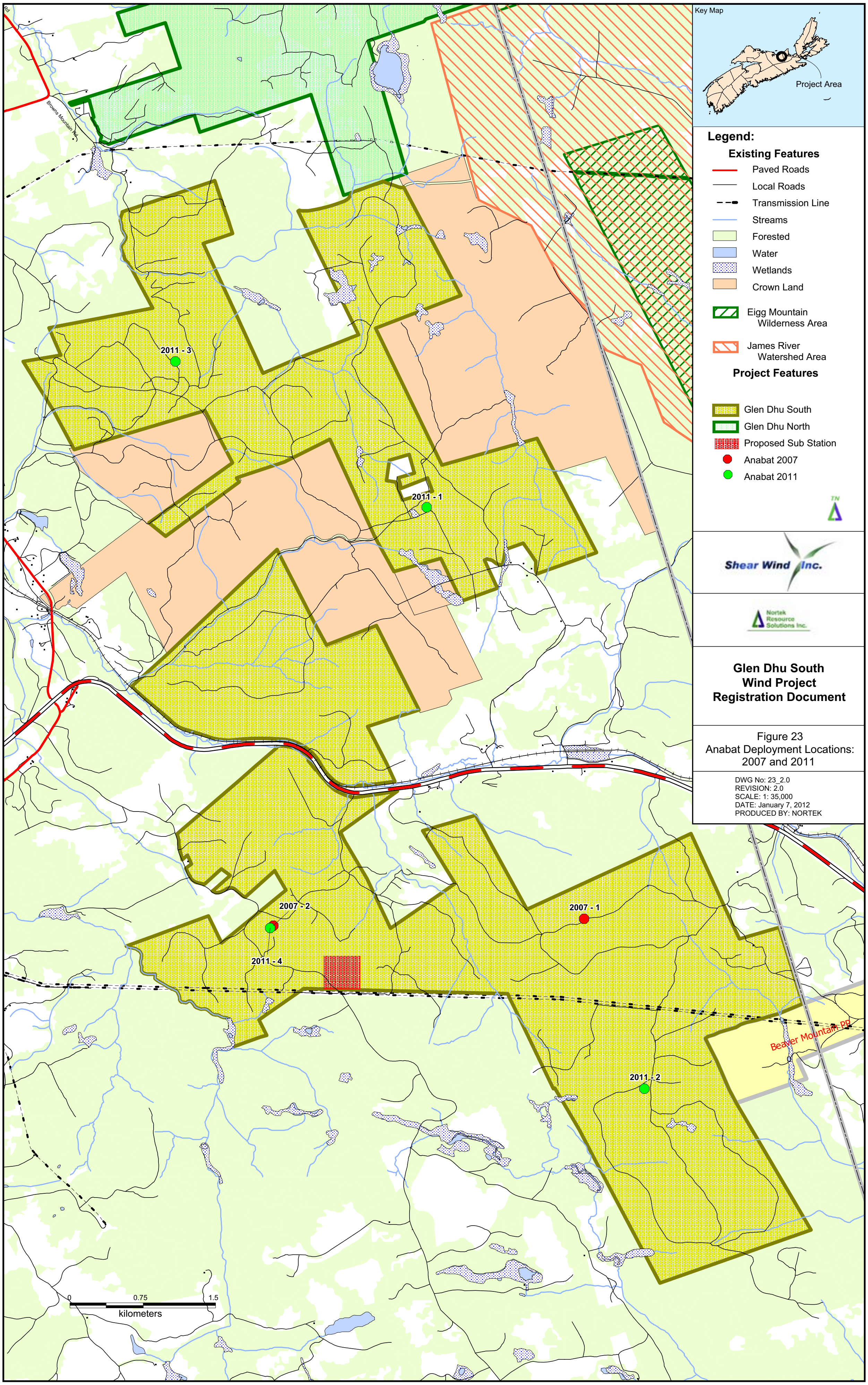
Similarly, scavenger trials will also follow the recommendations of the Canadian Wildlife Service. These trials estimate the time it takes for large scavengers such as foxes, raccoons, and ravens to remove dead birds or bats from the area surrounding the turbine base.

5.4.9 Bat Use

An assessment of bat species composition and activity for the Glen Dhu South Project was completed by Dr. Hugh Broders of Saint Mary's University. The following is a direct summary of his assessment and findings, taken from directly from the report. The complete report is presented in Appendix VIII. Figure 23 shows deployment locations for Anabat Detectors in 2007 and 2011.

Consistent with the requirements as set out by the Nova Scotia Department of Environment (Nova Scotia Environment, 2007) the following four objectives were established for the proposed Glen Dhu South Wind Power Project:

(1) To review of the potential impacts of wind turbine developments on bats;
(2) To provide a summary of the ecology of the bat species that are likely to be present in the area that is relevant to the proposed development;
(3) To assess whether there are any known bat hibernacula within 25 km of the proposed development site; and,
(4) To conduct a survey to determine local species richness and assess the level of bat activity levels at the site.



Key Map
Project Area
Legend:
Existing Features
Paved Roads
Local Roads
Transmission Line
Streams
Forested
Water
Wetlands
Crown Land
Eigg Mountain Wilderness Area
James River Watershed Area
Project Features
Glen Dhu South
Glen Dhu North
Proposed Sub Station
Anabat 2007
Anabat 2011
Shear Wind Inc.
Nortek Resource Solutions Inc.
Glen Dhu South Wind Project Registration Document
Figure 23
Anabat Deployment Locations: 2007 and 2011
DWG No: 23_2.0
REVISION: 2.0
SCALE: 1: 35,000
DATE: January 7, 2012
PRODUCED BY: NORTEK
2011 - 3
2011 - 1
2007 - 2
2011 - 4
2007 - 1
2011 - 2
Beaver Mountain PP
0
0.75
1.5
kilometers

In Nova Scotia there are occurrence records for seven bat species (each of the 6 mentioned above as well as the big brown bat, *Eptesicus fuscus*) (Broders et al., 2003; van Zyll De Jong, 1985), and each have been documented to have experienced fatalities at wind turbine sites (Arnett et al. 2008). Nova Scotia is at, or near the periphery of the current known range for each of these species, except the northern long-eared bat and the little brown bat (van Zyll De Jong, 1985). These two species, as well as the tri-colored bat, appear to be the only bat species with significant populations in Nova Scotia (Broders et al., 2003; Farrow and Broders 2011). Little brown bats and northern long-eared bats are widespread in Nova Scotia but the population of tri-colored bats appear to be restricted to southwestern region (Broders et al., 2003; Farrow and Broders 2011; Rockwell, 2005). The low number of echolocation recordings of migratory species (i.e., red, hoary and silver-haired bats; 15 out of 30 000 echolocation sequences) by Broders (2003) and other unpublished work suggests there are no significant populations or migratory movements of these species in southwest Nova Scotia. As for big brown bats, there is only one unconfirmed observation of 2 individuals of this species hibernating at Hayes Caves, there are no other confirmed records (Moseley, 2007; Taylor, 1997).

Table 16. Bat species previously recorded in Nova Scotia

Species	Overwintering Strategy	Documented fatalities at wind farms?	Global ranking[2]	ACCDA status[3]
Little brown bat	Resident hibernator (NS and NB)	Yes	G5	S4
Northern long-eared bat	Resident hibernator (NS and NB)	Yes	G4	S2
Tri-colored bat	Resident hibernator (NS and NB)	Yes	G5	S1?
Big brown bat	Resident hibernator (NB)	Yes	G5	N/A
Hoary bat	Migratory	Yes	G5	S2?
Silver-haired bat	Migratory	Yes	G5	S1?
Eastern red bat	Migratory	Yes	G5	S2?

1 Bat species documented in fatality events from carcass surveys conducted at wind energy development sites in N.A.
2Global ranking based on the NatureServe Explorer, G5= **Secure**—Common; widespread and abundant: G4= **Apparently Secure**—Uncommon but not rare; some cause for long-term concern due to declines or other factors.
3Atlantic Canada Conservation Data Centre ranking, based on occurrence records from NB and NS; S1= **Extremely rare**--May be especially vulnerable to extirpation (typically 5 or fewer occurrences or very few individuals; S2= **Rare**--May be vulnerable to extirpation due to rarity or other factors (6 to 20 occurrences or few remaining individuals); S4= **Usually widespread--** fairly common and apparently secure with many occurrences; (?) qualified as inexact or uncertain.

5.4.9.1 Potential for hibernacula in Project area

The guide to wind development prepared by the Nova Scotia Department of Environment and Labour (NSDEL, 2007, updated September 2009) states that wind farm sites within 25 km of a known bat hibernaculum have a 'very high' site sensitivity. There is only one site mentioned by Moseley (2007) as a potential hibernaculum. This site (McLennan's Brook Cave) is a limestone cave that is approximately 25 kms from the proposed area and has a length of 85m. Moseley (2007) mentions that there was late summer activity at the site which is indicative of a swarming site but there was no winter count to confirm it was a hibernaculum. Randall (2011) conducted an acoustic survey at the site in the fall of 2010 and never identified the area as a significant site for swarming. This suggests the site may not be a significant hibernaculum.

There are ≥25 government records of abandoned mine openings within 25 kms of the proposed development site, but only 3 of these have original depth records >50 m (COP-1-006, COP-001 and COP-1-005). To my knowledge, none have been surveyed for bats.

5.4.9.2 Acoustic Detection Results

Echolocation surveys were conducted on the site from 12 August until 24 October 2011. In total there were 140,037 acoustic files recorded. However, only 4,685 of these were bat-generated ultrasound; the remaining were extraneous noise. Each of the echolocation sequences recorded were attributable to Myotis species bats (i.e., *Myotis lucifugus* or *M. septentrionalis*), none were consistent with any of the other species recorded in Nova Scotia. As stated, there was no attempt to identify each of the Myotis species sequences to species because of the difficulty in achieving defensible identifications. However, there were echolocation sequences with characteristics that were consistent with both northern long-eared and little brown bat. This is supportive of my expectation that both species are present in the area.

Overall, the average number of bat passes per night was 21.4, but for ground based detectors the average was 28.4 per night. Site number 3 have significantly more bat activity that each of the other sites. Activity within the study area dropped significantly after the first few nights of sampling (around mid-August) and then there was another marked drop in activity at around 30 August and activity was consistently low after that point. There was very little bat activity at 30 m AGL with echolocation activity recorded on only 2 of 54 nights (4 echolocation sequences altogether). It seems likely that there was little bat activity at this height but there were also 84,858 acoustic files recorded at this location that were all extraneous noise. The extent to which these "junk" files impacted the sampling of bats is likely low because it is expected that there would be more "junk" files on windy nights when there is less likely to be bats. However, the relationship was not empirically examined.

To place the relative magnitude of activity recorded at Glen Dhu into context, in 129 nights of monitoring along 5 forested edges from June-August 1999 in the Greater Fundy National Park Ecosystem, the average number of sequences per night was 27 (SD = 44) (Broders, unpublished data). The comparable level of activity recorded in the Glen Dhu Project area (i.e., 28.4) was the same as the nightly magnitude of activity found during the summer in southern New Brunswick.

5.4.9.3 Discussion

There was no acoustic evidence of a significant movement or concentration of bats at the study sites during the late summer and fall migration season. The magnitude of activity recorded was comparable to activity levels recorded, during the summer in a forested landscape in southern New Brunswick. All of the echolocation call sequences recorded for this Project were attributable to the two Myotis species known to occur in Nova Scotia, the little brown bat and the northern long-eared bat. This was expected as these species are the most common species in the province and are two of only three bat species with significant populations in the province (Broders et al., 2003). Although we did not distinguish the calls of Myotis species, the majority of the sequences recorded at all locations likely represent the little brown bat because the northern long-eared bat has low intensity calls and is thus not recorded as well as the little brown bat (Broders et al., 2004; Miller and Treat, 1993). Further, the northern long-eared bat is a recognized forest interior species (Henderson et al., 2008; Jung et al., 1999a), and is less likely to use open areas for foraging and commuting (Henderson and Broders, 2008). There were no echolocation sequences that were attributable to the tri-colored bat. This species is only abundant in southwest Nova Scotia and the proposed development area is outside the species distribution (Broders et al., 2003; Farrow and Broders 2011). Also, there were no echolocation sequences that were attributable to either hoary bat, red bat, silver-haired bat, or big brown bat. Current data would suggest that these species do not occur in the area in large numbers but it will be not be surprising for these species to occur in the area irregularly, especially during the migration season.

Effects of the Project

Myotis bats are relatively new to the list of bat fatalities at wind turbine sites. The first large scale wind developments were located in western North America typically in agricultural and open prairie landscapes (reviewed in Johnson, 2005). Fatalities of these non-migratory species were largely absent from these sites. It is likely that this reflects the location of these wind development sites in open non-forested landscapes. These species may be under represented in the bat communities in these open areas due to an association with forested landscapes. More recently however, evidence of Myotis fatalities from wind turbines have been noted at sites in eastern North America (reviewed in Arnett et al., 2008; Jain et al., 2007b; Johnson, 2005). Therefore, although documented fatalities of Myotis are fewer than for migratory species there is still risk.

Other than bat mortality directly as a result of turbines, there is also a high likelihood that disruption of the forest structure (removal and fragmentation of trees for road building and deployment of turbines, etc.) for the development will degrade the local environment for colonies/populations that reside in the area during the summer. This can occur by the elimination of roost trees, the isolation of trees left standing, as well as the elimination or degradation of foraging areas. This negative aspect will almost certainly occur and will add to the cumulative effect of loss of bat habitat that is occurring throughout the range of these species.

Mitigation

Minimize project footprint – Minimize the direct loss of bat habitat resources (e.g., wetlands, riparian areas, mature deciduous-dominated forest stands) and minimize the extent of bat habitat affected.

Retain undeveloped key bat habitat - Undeveloped bat habitat should be identified and retained in the Project area to continue to support existing summer colonies/populations. Retention of these bat habitat resources should be in a spatial manner that provides connectivity in the Project area and larger landscape to ensure foraging and roosting areas remain well connected. Consideration of the potential of fragmentation to bat habitat resources should also be given to the development of road networks and transmission lines in the Project.

Follow up on effects and adaptive management – A rigorous post-construction monitoring program to quantify bat fatality rates is of utmost importance. These surveys need to be appropriately designed to account for searcher efficiency and scavenger rates and need to be conducted over an entire season (April to October), but especially during the fall migration season from mid-August to late-September, for at least the first 2 years. Should fatalities be found, these should be investigated with respect to spatial distribution of fatalities, turbine lighting, weather conditions and other site specific factors which can then be analyzed and operations adjusted in an adaptive management framework. In this manner, mitigation can be focused on any identified high risk areas/infrastructure to minimize any more such fatalities. These data are also essential for assessing potential risks at future developments in the region. It is critically important that the results of these surveys be appropriately reported.

Return to pre-project state upon decommissioning – The Project area should be returned to the state that existed prior to the development of the site. This should include planning to ensure the continuity of forest stand succession to provide and maintain appropriate roost trees well in the future as existing trees die off. By incorporating the retention of current young forest stands in the Project site, this will provide mature trees for bat roosting resources in the future.

Remain up to date with current research - There is presently an abundance of on-going research aimed at determining the impacts of wind energy developments on populations of bats. Other studies are focusing on a number of potential mitigation methods, including the effects of weather on activity patterns and collisions, various mitigation treatments or possible deterrents (including acoustic and radar emissions). As these are active areas of research it is essential that the most current guidelines and studies are used to guide management and development plans for wind projects.

Project Response to Recommended Mitigation

Minimize project footprint – As per the discussions regarding how site optimization, constraints analysis and field assessments were used for Project layout – refer to Section 4 (above) of this report, this mitigation strategy has been employed from initial Project stages.

Retain undeveloped key bat habitat – The Project has included methods for constraints analysis and field assessments in order to incorporate this mitigation strategy. Any further assessments of potential Phase II components of the Project will continue to incorporate this mitigation strategy.

Follow up on effects and adaptive management – A post-construction monitoring program to document any bat fatalities will be completed as per Canadian Wildlife Services and/or NSDNR requirements and results will be made available to the appropriate parties.

Return to pre-project state upon decommissioning – The Project area will be returned to the state that existed prior to the development of the site.

Remain up to date with current research – Data collected from the Project will be made available to interested researchers to assist in future determination of the potential impact of windfarms based on real time data.

5.4.10 Wildlife Habitat

Habitat is as described in previous sections above. Yellow birch, sugar maple and beech were the predominant original tolerant hardwood forest on the uplands. Pockets of red spruce, white spruce, balsam fir and hemlock were scattered on the upland flats, and formed stands of conifers on the lower slopes and valley bottoms. The habitat supports the thermal, cover and security requirements for wildlife species listed in previous sections.

Habitat within the Project area is currently significantly fragmented by logging roads, ATV trails and forestry operations. The Project area experiences significant forestry activity on a yearly basis, and has an extensive system of existing roads (average 6 m wide plus shoulder) running throughout the area. The access roads are, to a great extent, on private land and are maintained on an as needed basis by the land owners. For approximately the past 150 years, the Project area has been logged a number of times and wood harvesting operations are presently conducted on many wood lots. The network of roads has developed over the years with various sized culverts to provide drainage.

These roads are not typical woods roads that left alone, would re-vegetate and grow over. The existing roads that have been targeted for turbine access roads are significant gravel roads that are permanent on the landscape and used regularly by the local community with trucks, ATVs, snowmobiles and walking.

Photo 12: Typical Existing Road Present in Project Area

Photo 13: Typical Existing Road in Project Area- note significant shoulder

The following table summarizes the existing breakdown of habitat types available within the Project lands.

Table 17. Habitat types and area within the Project Lands.

Habitat Type	Area (ha)	% of Total
Wetlands	5.6	0.2%
Beaver Flowage	1.5	0.1%
Treed Bog	7.8	0.3%
Lake Wetland	0.7	0.0%
Inland Water Lake/River	0.7	0.0%
Alders < 75% Cover	1.8	0.1%
Alders > 75% Cover	4.5	0.2%
Productive Forest	1681.1	61.2%
Old Field Regenerating	0.5	0.0%
Dead Standing < 25%	0.2	0.0%
Dead 26-50%	0.4	0.0%
Silviculture	8.2	0.3%
Plantation	739.9	27.0%
Clear Cut	189.4	6.9%
Partial Cut	4.1	0.1%
Disturbed areas not suitable for habitat (i.e. residential, gravel pits, roads, etc…)	98.8	3.2%

It is clear from the Table 17 there are mixed habitat types within the Project lands. Approximately 62% of the dominant habitat available for wildlife species is forested. An additional 27% of the lands are Plantation – suitable for habitat for species that require a single species of overstory vegetation. The third largest habitat type is clear cut. Clear cuts do provide usable habitat for animal species, however sub-optimal it may be.

Effects of the Project

How wildlife are affected by habitat availability, use, or fragmentation is determined by species habitat requirements (i.e. thermal, cover, security) and rates of movement through various habitats (With and Crist, 1995). Fragmentation of a particular species habitat implies a loss of habitat, reduced patch size and/or increasing distance between patches. However, fragmentation may also suggest an increase of new habitat (Andren, 1994). Then, the effect of habitat fragmentation on a species (population) would be primarily through not only habitat loss, but habitat changes. Habitat patches are parts of the landscape mosaic and the presence of a species in a patch may be a function not only of patch size and isolation, but also of the neighboring habitat (With and Crist, 1995). In landscapes with more than 30% of suitable habitat, fragmentation is primarily habitat loss (With and Crist, 1995). Habitat generalists may survive in very small patches because they can also utilize resources in the surroundings. Furthermore, the total species diversity across habitats in a given landscape may increase when new patches of habitat are created within the continuous habitat, since new species may be found in these new habitats, even if they are human-made (Andren, H. 1994).

Habitat selection by wildlife is primarily a response to security, thermal comfort and forage needs. Wildlife must balance these conflicting requirements. Habitat selection is species-specific and choices will depend on physiological constraints and social needs of the species. Literature in conservation biology indicates that maintenance of movement corridors of suitable habitat between population centres is fundamental to wildlife health (Bentz, Saxena and O'Leary, 1994).

Although security and thermal cover are important, habitat selection is strongly influenced by relative foraging opportunities (Renecker and Hudson 1991). Diet and habitat selection in wildlife results from the differential scaling of metabolism and digestive capacity which forces smaller animals to feed more selectively (Renecker and Hudson 1991).

Requirements for security vary seasonally and are greatest when animals feel threatened. Wildlife is vulnerable at parturition and when accompanied by neonates, a condition that is exacerbated when the mother is in poor condition. To off-set this disadvantage, wildlife select habitats consistent with their physical attributes and cryptic coloration. For example, escape cover is forests for a white-tailed deer (Renecker & Hudson, 1988).

The thermal environment is defined by ambient temperature, short-wave and long-wave radiation, wind and humidity. The operational environment which integrates these meteorological parameters is modified by habitat structure in complex ways (Renecker & Hudson, 1991). Closed canopy forests reduce cold stress during winter but shade provided by poplar and aspen forests during late spring is attractive during periods of high ambient temperatures (Renecker & Hudson, 1991).

Studies completed by Buckmaster and colleagues (1999) indicate that wildlife populations may be expected to disperse from the area during periods of construction. However, this displacement is generally of short temporal disturbance as most cases reveal that wildlife have returned rapidly after human activity has ceased (Shank 1979).

SPATIAL DISTURBANCE

Spatial boundaries were defined as the area where all potential impacts associated with the proposed development could potentially be observed. Physical disturbances and stimuli caused by all phases of development were considered, some which may extend for distances into adjacent habitat.

Ultimately the spatial boundaries of the assessment include the boundaries of the Project lands. GIS analysis indicates that the total Project area encompasses approximately 2745 hectares.

Table 18. Calculations of Project Disturbance (hectares)

	Hectares
Total Area Available within Project Area	2745
Available Habitat (from Table 17)	2646
New Project Access Roads (19.41 km x 20m wide)	38.82
Project Turbines (50 sites x 0.81 ha)	40.5
Temporary Areas	4
Substation	4
Habitat Remaining following Project Construction	2559
% Natural Conditions Remaining	93%
Habitat Loss as a result of Project Construction	3%

Existing gravel roads are present throughout the Project lands. These are usually limited to 6 metre width and are randomly dispersed throughout. In addition, a local ATV/Snowmobile club has a series of smaller roads and trails throughout the area. Existing roads and trails account for 29 hectares of existing disturbance. Existing disturbance (which is existing agricultural, roads, houses, homesteads, hayland, etc…) accounts for 98.8 hectares (3.6%) of the total existing disturbance within the Project area.

For the purpose of this analysis, the areas directly affected by proposed Project related disturbances were defined as the disturbed portion of the turbine foundations, crane pads, the access roads, distribution lines (if they were outside the boundary of the access road), substation, and temporary disturbances such as staging areas, laydown yards, or borrow pits. The total NEW disturbance that will result from the Project is 87.32 hectares. This is an increase in disturbance of only 3.3%.

When all the above noted impacts are calculated, only natural areas remain. These included tracts of forests, wetlands, or stands of trees or other vegetation within the Project. These areas will continue to account for 93% of the land base. These forested natural areas are continuous, and provide suitable habitat, travelling corridors, thermal and security cover for wildlife, and are representative of forest systems throughout the Project area.

Based upon the vegetation characteristics in adjacent areas, and the conclusions of previous studies cited above, it is expected that displacement of populations will be temporary.

Development of the Project is expected to increase forage potential as grass and forb species re-establish during interim reclamation. Loss of thermal and security cover is unavoidable; however surrounding vegetation is expected to maintain these requirements.

The Project will create an additional 38 hectares of clearing for road upgrades and use. However, following construction only single daily visits will be required. Therefore the associated traffic increases into the area are not expected to be significant. Furthermore, all major access points to the Project lands are currently in use. Further road expansion required for the Project will be off these existing road networks to the Turbines.

Turbines are located between 350 metres and 700 metres apart within the same geographic areas (i.e. North of Highway 104). This separation is expected to allow continued movement of Moose from East/West through the lands. Habitat fragmentation will occur but remaining habitat areas are expected to provide suitable travel corridors during construction for travelling species.

Mitigation

Management actions that limit disturbing activities, through careful future planning and coordination with landowners to integrate disturbances into existing and future land uses has been done through exhaustive constraints and field verifications. This ensures best management practices across all lands to conserve the biological resources and maintain the ecological integrity of the area.

Further mitigation for habitat loss will include reducing the footprint of disturbance associated with the Project. For example, although roads will be surveyed to 20 metres, attempts will be made to minimize disturbance such that a 20 metre right-of-way is neither cleared nor needed. In some cases (to be determined), road clearings widths may be reduced (i.e. along straight stretches) to further reduce impacts.

5.4.11 Aquatic Habitats/Fisheries

There are no lakes in the Project area. The highlands are intersected by streams fed by tributaries originating in uplands areas. In some areas, the tributaries flow from small (less than 1 hectare) perched wetlands. Existing surface water drainage is constrained by private woods roads which crisscross the project area.

Surface water drainage is maintained by culverts of various sizes in the roads. The locations of culverts and bridges have been determined by surface water drainage and the need for road access to forest stands. To a large extent, surface water flow is maintained by these culverts which have been placed to prevent or reduce erosion and undermining. In some areas, surface water drainage which is interrupted by the presence of the woods roads is directed down-gradient in road side ditches. In most cases, these ditches direct the drainage to a culvert or stream. Such anthropogenic activities have altered the natural habitat of the area and resulted in modifications to natural ecosystems.

The waterways on the upland areas of Pictou-Antigonish Highlands are headwater streams for relatively small watersheds, relatively sterile with respect to nutrient inputs, but nevertheless have good pH levels. There are few lakes or wetlands, and the aquatic habitats are mainly home to speckled trout and sticklebacks (Shear Wind Inc., 2008).

The cool atmosphere and relatively high rates of rainfall/snowfall make these upland streams good habitats and summer refuge for brook trout (also called speckled), (*Salvelinus fontinalis)*. Freshwater fish species found within the lower reaches of these watersheds include breeding populations of introduced brown trout (*Salmo trutta)*, occasional introduced rainbow trout (*Oncorynchus mykiss)* that have not developed self-sustaining populations, white sucker (*Catostomus commersoni)*, sticklebacks (Order Gasterosteiformes), golden shiner (*Notemigonus crysoleucas)*, yellow perch (*Percha flavescens)* and banded killifish (*Fundulus diaphanous)*. In addition to freshwater species, anadromous fish species include Atlantic salmon (*Salmo salar)*, brook and speckled trout, brown trout, rainbow trout, rainbow smelt (*Osmerus morda)*, and blueback herring (*Alosa aestivalis)*.

The catadromous American eel (*Anguilla rostrata)* inhabits the lower reaches of these watersheds, and also ascends these waterways to inhabit the upland brooks. In addition, speckled trout and sticklebacks inhabit the upland reaches of these watersheds. Brook trout populations above the scarps tend to be freshwater only and not anadromous in habit.

Fish passage from the valley or coastal plain below to upland headwater streams is frequently blocked by waterfalls (e.g. James River). Where fish passage exists, such as in Barney's River, upstream habitats become important summer thermal refuges for speckled trout, which prefer water temperatures in the range of 7.2 – 12.8 C and can tolerate 0.5 – 22.2 C. In the lower parts of these waterways, summer water temperatures in widened channels, combined with low water levels, can yield temperatures that reach beyond speckled trout upper tolerance limits and prove lethal to trout (Shear Wind Inc., 2008).

Surface water on the upland takes the form of brooks, streams and rivers. Principal waterways that drain from the candidate upland sites to the north and west into the Northumberland Strait are Baxter Brook, Middle Brook, McIver Brook, Bailey's Brook, Beaver Brook and Bear Brook. One waterway, Cameron's Brook, drains from the upland to the south and east.

There are many small intermittent streams within the Project area. Generally they all originate in a wetland, and usually flow between wetlands.

Several watercourses encountered within the Project boundaries are fish bearing.

During constraints mapping, known watercourses and/or waterbodies were mapped and a 30 metre setback imposed as a buffer. However, during final siting of turbine locations and access roads, all waterbodies will be assessed to determine if a relaxation of setbacks can occur (only if necessary).

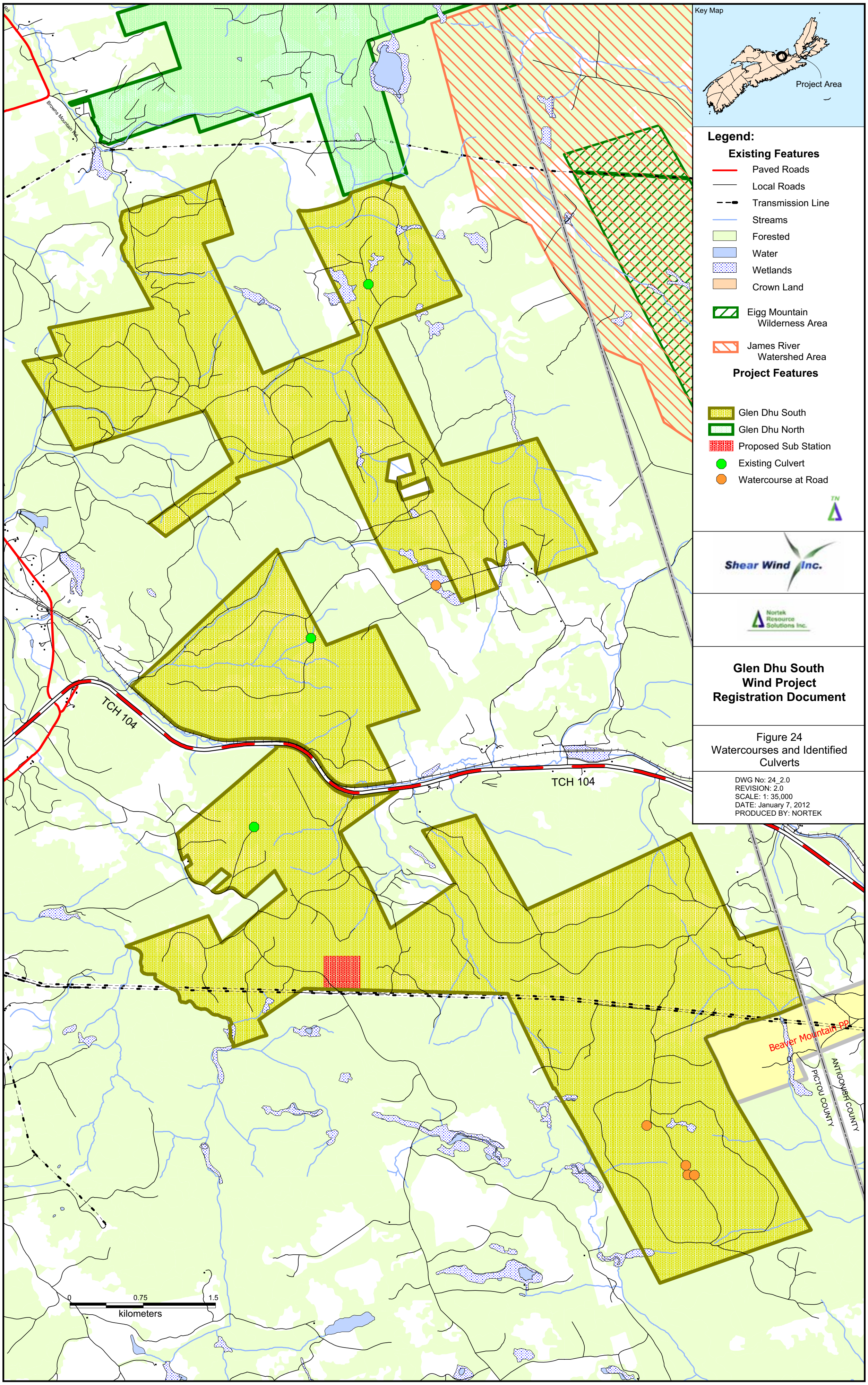
Figure 24 shows all major watercourses within and surrounding the Project area, as well as observations of culverts or watercourses identified during field assessments, especially on existing access roads across the Project area.

5.4.12 Water Course Crossings

As mentioned in previous sections, a significant network of logging and access roads are present throughout the Project area. These roads are located on private land and private landowners have installed cross culverts and stream culverts under these roads in order to reach areas for logging.

All watercourse crossing location characteristics fall within the parameters for either of the two classes identified under Section 11, Sections (2) & (3) of *Minor Works and Waters (Navigable Waters Protection Act) Order.* In numerous, but not all cases, existing culverts are present on watercourses that require crossing. As such, Shear Wind Inc. would be exempt from application for approval under the Navigable Waters Protection Act.

Culverts will be upgraded as necessary during project development and new crossings will also be identified on the few new roads that will be constructed. Any upgrades or new installations will be completed in accordance with the Nova Scotia Environment Watercourse Alteration approval process, and all appropriate applications for alteration will be sought prior to construction or upgrading as required.


Key Map
Project Area
Legend:
Existing Features
Paved Roads
Local Roads
Transmission Line
Streams
Forested
Water
Wetlands
Crown Land
Eigg Mountain Wilderness Area
James River Watershed Area
Project Features
Glen Dhu South
Glen Dhu North
Proposed Sub Station
Existing Culvert
Watercourse at Road
Shear Wind Inc.
Nortek Resource Solutions Inc.
Glen Dhu South Wind Project Registration Document
Figure 24
Watercourses and Identified Culverts
DWG No: 24_2.0
REVISION: 2.0
SCALE: 1: 35,000
DATE: January 7, 2012
PRODUCED BY: NORTEK
TCH 104
TCH 104
Browns Mountain Rd
Beaver Mountain PP
PICTOU COUNTY
ANTIGONISH COUNTY
0
0.75
1.5
kilometers

Effects of the Project

Provided all standard watercourse alteration mitigation strategies are integrated into design, all necessary NSE approvals are acquired, and crossing structures are sized according to 1:2 year design flow characteristics (temporary structures) and 1:100 year design flow characteristics (permanent structures) limited or no effects resulting from Project development should be expected.

Mitigation

- All temporary structures will be designed to meet, and installed in accordance with the requirements of the NS Watercourse Alteration Specifications;
- No fording of the crossing will occur during installation;
- All work will occur in the dry. Machinery used will be properly maintained and checked for any leaks/ maintenance issues prior to beginning work on the crossing activities;
- All temporary bridges will completely span the watercourse with abutments placed approximately 0.5 metres back from the bank and/or water edge;
- All bridges will only be constructed to allow passage of a single vehicle;
- Deck height on all temporary structures will be at least 250 mm above the bank height;
- During installation and removal, temporary bridges will be lifted in place and removed by the same method;
- Approach roads on both sides will be stabilized against erosion and to prevent rutting using Brush mats to a minimum distance of 30 metres from either side of the crossing;
- All temporary bridges will be constructed to prevent material from dropping through the bridge into the watercourse. Plastic sheeting will be placed between the bridge deck and bottom structures to prevent this;
- Any soils/debris on the surface of the bridges will be removed with shovels; brooms; etc to prevent material from falling into watercourses;
- Bridges will have vertical posts on either side to allow for skidding of salvaged timber over the bridge and to prevent timber from sliding/falling into the watercourse;
- The watercourse will not to be disturbed outside the footprint of the access boundaries;
- At no time will equipment be allowed to enter the watercourses;
- Sediment and erosion control structures will remain in place and intact until permanent vegetation has been established or the site is otherwise stabilized;
- Upon completion, all material used for bridge support will be removed and disposed of without entering watercourse (excavated soil, wood debris, excess rip rap);
- Upon removal of the bridges, brush mats will be left in place to maintain effective erosion control.

5.4.13 Wetlands

Wetlands are defined as "a swamp, marsh, bog, fen or other land that is covered by water during at least three consecutive months of the year." Wetland functions are the natural processes associated with wetlands and include water storage, pollutant removal, sediment retention and provision of nesting/breeding habitat. Functions may also include values and benefits associated with these natural processes and include aesthetics/recreation, cultural values, and subsistence production (Environment Canada, 2000). The discussions of wetlands presented herein primarily uses terminology associated with the Canadian Wetlands Classification System (Warner and Rubec 1997) or with the Nova Scotia methods for wetland delineation.

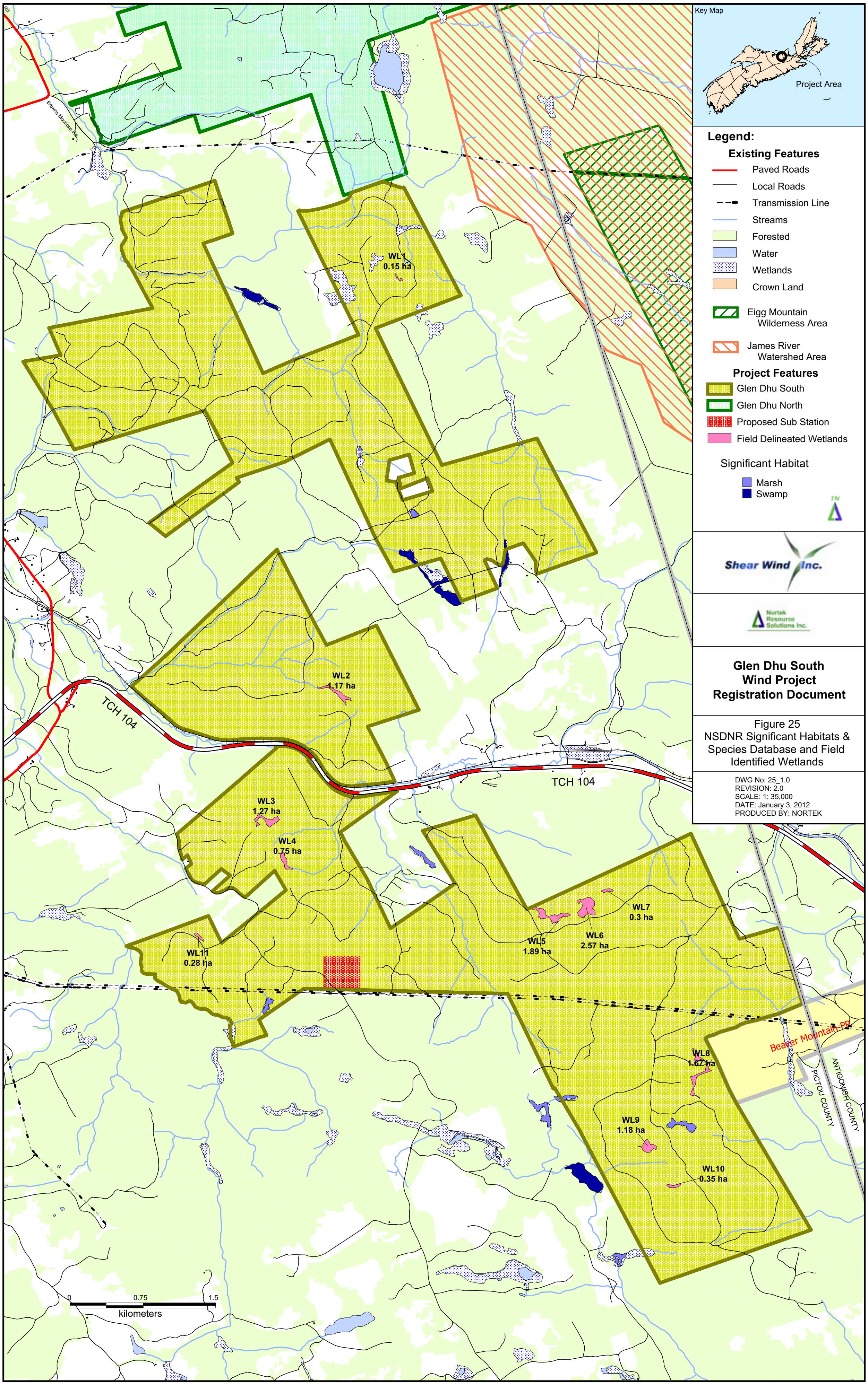
The discussions of wetlands presented herein primarily uses terminology associated with the Canadian Wetlands Classification System (Warner and Rubec 1997) or with the Nova Scotia Environment approved methods for wetland delineation.

Desktop Review: Results

The NSDNR Significant Species and Habitats Database (SSHD, 2010) was consulted and, based on the information in this database, 10 wetlands are identified from that source within the Project Area. Figure 25 shows the locations of all SSHD identified wetlands. These wetlands were all avoided when determining turbine locations.

Once field surveys at each candidate site and access routes began, a number of wetland features were identified and subsequently mapped and delineated. Some wetlands were observed, but will not be impacted by the development of the turbine pads and access roads and therefore were not delineated. A total of eleven (11) wetlands were delineated in the field during assessments in June and August 2011. These wetlands are also shown on Figure 25.

Turbines that were initially placed directly in or adjacent to identified wetland habitat during field assessments were moved in all cases. The current proposed candidate site locations (77) are all located in upland habitat. There are a few cases where wetland alteration may be necessary, either for development of a spur road, or widening of an existing road. Also, there a several cases where a suggested setback of 30 m from wetland habitat may not be maintained. These issues are discussed in Table 19.



Key Map
Project Area
Legend:
Existing Features
Paved Roads
Local Roads
Transmission Line
Streams
Forested
Water
Wetlands
Crown Land
Eigg Mountain Wilderness Area
James River Watershed Area
Project Features
Glen Dhu South
Glen Dhu North
Proposed Sub Station
Field Delineated Wetlands
Significant Habitat
Marsh
Swamp
Shear Wind Inc.
Nortek Resource Solutions Inc.
Glen Dhu South Wind Project Registration Document
Figure 25
NSDNR Significant Habitats & Species Database and Field Identified Wetlands
DWG No: 25_1.0
REVISION: 2.0
SCALE: 1: 35,000
DATE: January 3, 2012
PRODUCED BY: NORTEK
WL1 0.15 ha
WL2 1.17 ha
WL3 1.27 ha
WL4 0.75 ha
WL5 1.89 ha
WL6 2.57 ha
WL7 0.3 ha
WL8 1.67 ha
WL9 1.18 ha
WL10 0.35 ha
WL11 0.28 ha
TCH 104
TCH 104
Browns Mountain Rd
Beaver Mountain Rd
PICTOU COUNTY
ANTIGONISH COUNTY
0
0.75
1.5
kilometers

Although the largest wetlands approach 3ha, most are considerably less than one hectare in area, reflecting the character of their formation.

Table 19. Field identified wetlands within the Project Lands

Wetland	Preliminary Wetland Classification	Approximate Area (ha)	Description	Comments relating to wetland alteration
1	Graminoid marsh	0.15	Some fly-honeysuckle and alder, Ground cover was mainly sphagnum moss, with sensitive fern, hay-scented fern, bordered by red spruce and balsam fit. Although there were a few small areas of open water, this wetland was on the drier side, classified mainly by vegetation and topography. Rushes and cattails near the eastern edge by the road.	Turbine 11 is sited on upland habitat south of this wetland. However, additional wetland habitat is present in this area, and access to T11 may be difficult without some wetland impacts.
2	Shrub Swamp	1.17	Drainage channels flowing W, NW. Headwater wetland for Bear Brook. Thick alders, open and grassy at the western edge, with very little mossy ground cover. Towards the east, canopy coverage was higher, with less of a shrub layer, and more mossy ground cover. Sensitive fern, and oak fern present.	Current road layout intersects this wetland. Wetland alteration permitting will be required for road impacts
3	Treed Swamp	1.27	Collecting runoff from road, sometimes channeled by skidder tracks. Where the forest cover was left (in a clear cut area), there was little shrub layer, with groundcover dominated by sphagnum mosses and sensitive fern. Where trees were cleared, there was less moss, more graminoids and low shrubs like honeysuckle. Also present was hemp nettle, purple fringed orchis, green fringed orchis, turtle head	Turbine 28 was moved west to avoid this wetland. Evidence of the Mainland Moose and bear activity was identified (scat) in this wetland.
4	Treed Swamp	0.75	Forest cover of sugar maple, ground cover was mossy where drainage gathered along the base of hills and old skidder trails	Access road to Turbine 29 intersects wetland 4. Wetland alteration permitting will be required for road impacts.
5	Graminoid	1.89	Surrounding upland vegetation of	Turbine T42 was moved

	marsh		dense young red spruce. Open habitat, mossy, often with cattails and several species of ferns including sensitive fern. Spotted touch-me-not was also common throughout this wetland, with occasional alder. Open water pond located SW of the wetland	to avoid this wetland, and the access road re-routed to eliminate impacts to the wetland. 100 m buffer will not be maintained (road and turbine location)
6	Graminoid marsh	2.57	Similar to Wetland 5 described above. Some sections of graminoid marsh, surrounded by treed swamp sections.	Turbine 43 was moved east to avoid the wetland during micro-siting planning
7	Graminoid marsh	0.3	Small graminoid marsh with sensitive fern, spotted touch-me-not and alders.	
8	Treed swamp	1.67	Narrow treed swamp (black spruce) with small open areas dominated by cattails.	Turbine 36 is located just north of this wetland. The 100m buffer will not be maintained from turbine pad
9	Treed swamp wetland/upland mosaic	1.18 Interior not delineated	Treed swamp with undulating topography creating conditions of a wetland/upland mosaic habitat. sensitive fern and spotted touch-me-not and purple violet present in the wetland habitat	Turbine 54 was moved north to avoid this area
10	Treed swamp	0.35	Small isolated treed swamp.	Turbine 57 was moved south to avoid this wetland habitat.
11	Graminoid marsh	0.28	Small graminoid marsh with outlet to north, with standing water in middle sections dominated with cattails, speckled alder, tall manna grass and sensitive fern.	Turbine 31 was moved to the west to avoid this wetland habitat

Virtually all of the wetlands identified have terrene landscape position, meaning they are located high in a watershed and serve as part of the headwater system. Field assessment suggests that the wetlands are typically formed in areas where rain and minimal surface flow collects in shallow depressions with bedrock located a short depth below the soil layers, creating a “perched” water table. The water source for most of the wetlands is seasonal channels or surface sheet flow that results from rainfall.

Wetlands at the Project area are all similar in that they have limited to no open water areas, are generally treed with minimal sapling/shrub understory, and have some depth of peat layer.

The wetlands scattered throughout the Project area and provide habitat for a diverse number of vascular plants and bryophyte species. Wet deciduous woods provide a habitat for more shade tolerant species such as Lady-Fern (*Athyrium filix-femina),* Woodland Horsetail*, (Equisetum sylvaticum),* Heartleaf Twayblade (*Listera cordata), and* Northern Blue Violet (*Viola septentrionalis).*

Photo 14. Treed swamp wetlands typical of the Project area.

Photo 15. Treed swamp wetlands typical of the Project area.

The characteristics of the wetland systems encountered within the Project boundaries were similar in the following respects:

- Soils display evidence of either periodic or sustained saturation;
- It is expected that the recharge wetlands within the Project boundaries, the surrounding lands watershed complex, and the surface topography contribute to the aquifer quality throughout the region. None of the encountered wetland areas are expected to contribute to aquifer water quality to a greater extent than surrounding areas;
- No water supplies are withdrawn from the wetlands;
- The quality and quantity of vegetation surrounding the wetlands (generally speaking) provide limitations to erosion potential of surrounding lands into the watershed system. Encountered wetlands do not appear to provide erosion control as a function;
- The quantity of vegetation, the low slopes surrounding the wetlands, and the lack of distinguishable flow channels which directly influence water levels suggests that

sediment flow to the wetlands are limited and sediment flow stabilization is not a significant characteristic of the wetlands encountered;

- During periods of low precipitation, the wetlands provide nutrient supplies to dependent wildlife. Wildlife indicators around assessed wetlands (i.e. tracks, browse utilization, visible sightings) suggest that the habitat is an integral requirement of species in the area. Vegetation is consistent with neighbouring wetland areas and as such the wetlands do not appear to provide regionally or locally unique habitat;
- The wetlands are a contributing factor to the extensive ecosystem complex associated with the Project area. The contributions of the wetlands to the ecosystem appear isolated geographically due to topography and the wetlands do not support the surrounding ecosystem, but form an integral portion of the system;
- Based upon the results of the public consultation and field assessments, there is no evidence to suggest that any social/commercial/or cultural values are influenced by the wetlands encountered.

Effects of the Project

Potential impacts to the wetland systems may result from construction, operation and maintenance of the Project that may result in infilling, encroachment by roads or turbine sites, and removal of vegetation within wetland areas. However, based upon the characteristics of wetlands within the Project area, a reasonable expectation of effects that may be anticipated would be limited to vegetation removal/alteration, wildlife displacement and effects to drainage.

There is a low likelihood of contamination as the Project requires minimal use of gasoline, diesel, motor oil, and hydraulic oil, all of which is contained according to appropriate regulations. No vehicles transporting large volumes of TDG regulated goods will be present.

Mitigation

Once wetlands were identified during field assessments, subsequent access road routing and final turbine site selection was made in order to avoid wetlands and maintain a minimum 30m (100m preferable) setback wherever feasible within the other constraints posed by the Project.

Applications for approval for alteration of required wetlands will undergo a review and evaluation by the Department of Environment.

As a function of the wetland alteration application, a mitigative sequence approach will be used. This is a step-wise approach that achieves wetland conservation through the application of a hierarchical process of alternatives as follows:

1) avoidance of impacts;
2) minimization of unavoidable impacts; and
3) compensation for residual impacts that cannot be minimized.

5.4.14 Groundwater

The Project area is underlain principally by soils of the Thom catena. These have developed from a dark grayish-brown sandy loam till derived from shales, gray conglomerate and metamorphic material. Details associated with the groundwater resource in the Project area were identified through a review of the NS well logs database (NSDNR- http://www.gov.ns.ca/nse/groundwater/welldatabase.asp). This database provides information on more than 100,000 water wells in the province, including information on well locations, geology and well construction, well depth and yield. A search of this database was completed for the Barney's River area in Pictou County. A total of 42 well logs were available for review. General conclusions relating to the groundwater resource in the Project area were derived from this information.

The geology of the Project area was described from the drilling processes as consisting of sand, and clay with minor rock and gravel overlying siltstone and sandstone rock. The average depth to bedrock based on drilling data was generally 20 feet (or more in many cases). Wells appeared to be drilled to an average depth of 125 feet below grade, and were constructed as 6 inch wells with standard 50-60 feet depths of casing. Information provided on depth of water bearing fractures during drilling activities indicated that the average depth to the shallowest water bearing fractures was approximately 75 feet below grade. Static water levels were not always recorded in the well logs, but information that was provided indicated an average static depth to water of 25 feet. A general review of water yields for these wells indicated an average yield of approximately 10 imperial gallons per minute (igpm).

Groundwater resources within the Project area are not used to supply residential potable water. According to the information available in the Well Logs Database, the nearest (drilled) groundwater well used for potable purposes is located approximately 150 m away from the Project area (located on the John Munroe Road) and over 900 m away from the nearest turbine. Please note however that the location of wells in the well log database does not provide exact geographic coordinates. Older references indicate a map number only. Newest references are accurate within 50 m. The well referenced above is accurate to 50 m, and wells that appear on the drawing to be located directly inside the Project area may in fact not be anywhere near the area. This well log database also only identifies drilled wells. Dug wells may be present in closer proximity to the turbine locations. Please refer to Figure 26 for the location of domestic potable wells surrounding the Project area.

The Project area is near to the James River Watershed which supplies water for the Town of Antigonish, which is approximately 25 km east of the Project boundary. The Project will not require access to or use of groundwater. The James River water supply protection area lies to the east of the Project site. The upper reaches of the northwest tributary and the water supply protection area are in close proximity to the eastern boundary of the Projects leased properties. Figure 26 shows the Project property lines and the natural and protected boundaries of the watershed property. The boundary of the watershed lies outside the Project boundary

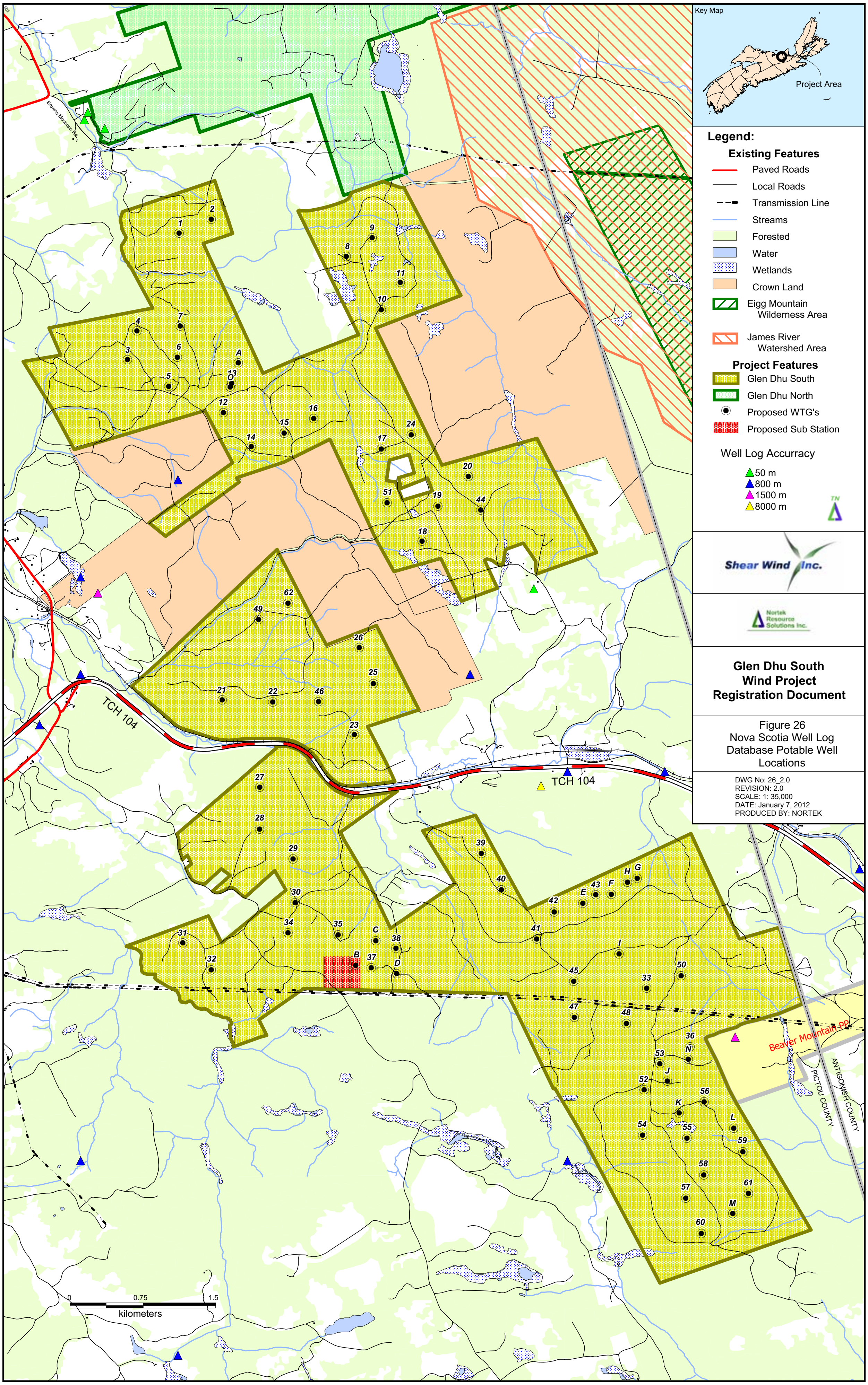
Effects of the Project

The proposed Project is not expected to impact the groundwater resources in the area. No drilling or blasting will be completed into the bedrock at depths where the water bearing fractures have been identified, or at depths where static levels of groundwater have been recorded. Blasting activities will be completed in accordance with the Nova Scotia General Blasting Regulations and any wells within an 800 m radius will be subjected to a pre-blast survey to confirm conditions and ensure the blasting does not negatively affect the well and property dwelling.

There will be no effect on the James River Protected Watershed area to the east of the Project area. The Project will have little to no effect on surface water or surface springs. There will be very low potential for contamination of surface or groundwater during construction and operation of the Project as there will be no short or long term storage of petroleum products on site or any other potential contaminant.

Mitigation

As no effects to groundwater are expected, no mitigation will be required.



Key Map
Project Area
Legend:
Existing Features
Paved Roads
Local Roads
Transmission Line
Streams
Forested
Water
Wetlands
Crown Land
Eigg Mountain Wilderness Area
James River Watershed Area
Project Features
Glen Dhu South
Glen Dhu North
Proposed WTG's
Proposed Sub Station
Well Log Accurracy
50 m
800 m
1500 m
8000 m
TN
Shear Wind Inc.
Nortek Resource Solutions Inc.
Glen Dhu South Wind Project Registration Document
Figure 26
Nova Scotia Well Log Database Potable Well Locations
DWG No: 26_2.0
REVISION: 2.0
SCALE: 1: 35,000
DATE: January 7, 2012
PRODUCED BY: NORTEK
TCH 104
TCH 104
Beaver Mountain PP
PICTOU COUNTY
ANTIGONISH COUNTY
0
0.75
1.5
kilometers

6.0 Archaeological Resources

Two phases of the archaeological resource impact assessment were completed for the Glen Dhu South Wind Power Project. The first, Phase I, was a historical assessment of the potential for archaeological resources to be present inside the Project area. The second, Phase II, was the field reconnaissance program. The results are described below.

6.1 Phase I

Nine archaeological sites were recorded in the Maritime Archaeological Resource Inventory near the study area, eight of which date to the historic period and one for which a date is not known, comprised of possible human skeletal material. This last site was reported in 1929 at Barney's River Bridge, possibly at the mouth of Barney's River, and no analyses were done on the material; nor was any archaeological excavation carried out in the area to suggest cultural affiliation. Given the fact that Merigomish Harbour and its tributary, Barney's River were touted as a "major Micmac [sic] camping ground"5, it is possible that these remains were from an Aboriginal burial.

The eight historic sites were recorded in 2004 by archaeologist Michelle LeLièvre. Although within the vicinity of it, none of these historic sites are located directly within the development area. These sites represent some of the industrial features in the area associated with the railway as well as sites and structures related to grist and saw mills. The absence of recorded archaeological resources within or immediately adjacent the proposed development area is likely an indication that this area was not subjected to previous archaeological assessments.

The historic background study indicates that both pre-contact and historic First Nations as well as historic Euro-Canadian archaeological resources may exist in the study area. A Mi'kmaq encampment has been historically documented at the "foot" of Barney's River, presumably in the area of Barney's River Station. Land grants were made in the area as early as 1765 with many more settlers arriving throughout the remainder of the 18th century and continuing into the 19th century with the large-scale immigration of Scots. Barney's River, Kenzieville, and Marshy Hope were fairly densely settled by the early 19th century and later maps of the area attest to that.

As a result, it was recommended that an archaeological reconnaissance be conducted once the locations of the turbines, access roads, and other necessary infrastructure were known, and before any ground disturbance (Phase II).

6.2 Phase II

In July 2011, Davis MacIntyre & Associates Limited was contracted by McCallum Environmental Ltd. to conduct the second Phase of the archaeological resource impact assessment for the proposed Glen Dhu South Wind Power Project in Pictou County. The purpose of the assessment was to determine the potential for archaeological resources within the development zone and to provide recommendations for further mitigation if deemed necessary.

The field reconnaissance was conducted in September and November 2011 and the "assessment was conducted under Category C Heritage Research Permit A2011NS90 issued by the Nova Scotia Heritage Division." The report conforms to the standards required by the Heritage Division under the Special Places program."

Research and field reconnaissance in the study area has revealed the presence of only a few confirmed archaeological sites. A house foundation of moderate significance and an unidentified stone feature near the John Munro Road have both been identified, and avoidance is recommended by means of improving the adjacent access road on its south side rather than the north in both cases.

Two stone walls have been located which may be impacted by the construction of access roads. They are not themselves of high archaeological significance. However, their presence suggests that homesteads and associated archaeological resources such as middens, privies, and barn foundations may be nearby. It is recommended that archaeological monitoring of any clearing and grubbing activities in proximity to each feature be undertaken to ensure that no significant archaeological resources are disturbed during construction.

Finally, it is recommended that a collection of stone mounds in proximity to turbine candidate site 53 be tested by a professional archaeologist to determine their origin and significance, should candidate site 53 be chosen in the final turbine layout.

The report in its entirety can be found in Appendix IX.

7 MI'KMAQ ECOLOGICAL KNOWLEDGE STUDY (MEKS)

The MEKS for the Glen Dhu South Wind Power Project was completed in 2011. The results, discussion and conclusions are summarized in this section however the report in its entirety can be found in Appendix X.

Table 20. Significance of Potential Project Impacts on Mi'kmaq Land and Resource Use

6.01 The historic review of Mi’kmaq use and occupation documents Mi’kmaq use and occupation in the study area, and potentially the Project area. A potential impact of the Project is the disturbance of archaeological resources and burial site.	7.2.01 Mi’kmaq archaeological resources are extremely important to Mi’kmaq as a method of determining Mi’kmaq use and occupation of Mi’kma’ki and as an enduring record of the Mi’kmaq nation and culture across the centuries. Archaeological resources are irreplaceable. Any disturbance of Mi’kmaq archaeological resources is significant. The Burial sites are not located within the proposed Project site, therefore, impact of the Project is not likely significant.
6.02 Several species of significance to Mi’kmaq have been identified in the study areas. Permanent loss of some specimens is an impact of the Project.	7.2.02 The plant species of significance to Mi’kmaq identified within the study area exist within the surrounding area. The destruction of some specimens within the study areas does not pose a threat to Mi’kmaq use of the species. The impact of the permanent loss of some specimens of plant species of significance to Mi’kmaq is evaluated as not likely significant.

Conclusions

In the event that Mi’kmaw archaeological deposits are encountered during construction or operation of the Project, all work should be halted and immediate contact should be made with Laura Bennett, Special Places Co-ordinator, at the Nova Scotia Museum and Janice Maloney, Executive Director, KMKNO (Kwilmu’kw Maw-klusagn Negotiation Office).

There are no land claims registered with the Specific Claims branch of Indian and Northern Affairs Canada in Ottawa for any of the Mi’kmaq communities in Nova Scotia within the Project area. However, that does not suggest that any other Mi’kmaw claimants for this area may not submit land claims in the future.

8 SOCIO-ECONOMIC CONDITIONS

The Project is located in Pictou County, Nova Scotia, proximal to the border between Pictou and Antigonish counties. Although the Project location is entirely contained in Pictou County, impacts and benefits will be attributed to communities in both counties. Background on the area and populations of the counties and nearby centres are summarized below.

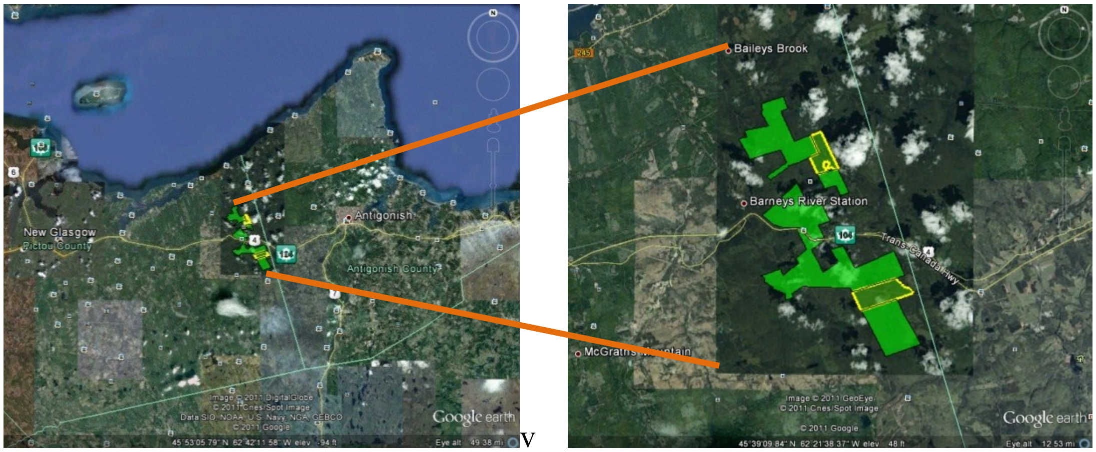


Figure 3: Geographic placement of the Project.
Above left: Geographic placement within Pictou County.
Above right: Detail with Pictou / Antigonish border

8.1 Population and Demographics – Pictou County

Pictou County, the 5th most populous county in Nova Scotia, had a total population of 46,513 in the year 2006, approximately 5.0% of the Provincial population. Over the past ten years, the population of the county has declined 3.5% while the population for the Province increased by 0.9%.

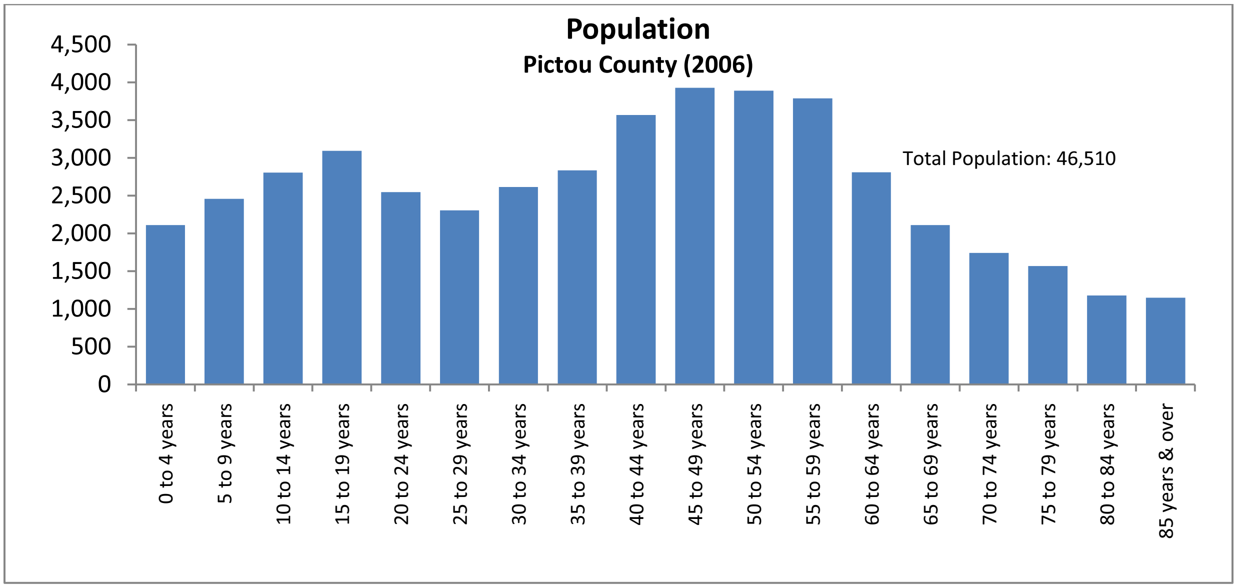
Pictou County has several main towns, the largest being New Glasgow. Stellarton (in close proximity to New Glasgow), Pictou, Westville, and Trenton are all less than half the population of New Glasgow, which had a population in 2006 of 36,288, 1.2% lower than that of 2001.

Table 21. Population and Demographics

	New Glasgow	Pictou County
Population in 2006	36,288	46,513
Population in 2001	36,735	46,965
2001-2006 Population Change (%)	-1.2	-1.0
Total private dwellings (2006)	16,348	21,768
Total number of households (2006)	15,055	19,290
Population density per square km (2006)	17.6	16.3
Land area (square km) (2006)	2,066.44	2,845.26
Median Age of the Population (2006)	43.1	43.6

The population of Pictou County has a median age of 43.1 years, slightly older than that of the province as a whole, which has a median age of 41.8.

Figure 4: Population by Age Cohort, Pictou County



Source: Statistics Canada 2006 Census of Population Community Profiles

Median income in New Glasgow (2006) for persons 15 years and older with income was $20,611. Sixty-eight percent of income came from earnings, while 17.8% came from Government Transfers. In Pictou County (2006), median income was $19,544, with earnings accounting for 67.5% of income and 17.7% coming from Government transfers.

8.2 Health, Industry and Employment

The town of New Glasgow is served by the Pictou County Health Authority, which is served by the Aberdeen Hospital. Other facilities include the Sutherland Harris Memorial Hospital in the town of Pictou. Programs include addiction services, mental health services, primary health care, and public health services. Some 800 staff members and 65 medical staff are employed by the District Health Authority.

Table 22. Labour Force by Industry, Pictou County

Industry	Total	Male	Female
Total experienced labour force 15 years and over	22,905	12,220	10,685
Agriculture and other resource-based industries	1,320	1,085	235
Construction	1,335	1,165	170
Manufacturing	3,805	3,190	615
Wholesale trade	555	415	145
Retail trade	3,430	1,410	2,020
Finance and real estate	650	320	325
Health care and social services	2,675	295	2,380
Educational services	1,350	475	875
Business services	4,220	2,355	1,865
Other services	3,555	1,500	2,055

Source: Statistics Canada 2006 Census of Population

Fifty three percent of the experienced labour force in Pictou County is male. In 2006, the majority of the labour force worked in the service producing industries. The “Other Services” industry is the largest employer, and would tourism and accommodation, which would also be supported by the Wholesale and Retail trade industries. Twenty two percent of the labour force in the county worked in the construction and manufacturing industry combined. The county’s economy (specifically the manufacturing sector) has changed focus in recent years, with the closure of the Trenton Works railcar plant and the subsequent opening of the Daewoo Shipbuilding and Marine Engineering (DSME) plant, which manufactures parts for wind power turbines. Other manufacturing employers are Northern Pulp (Pictou) and Michelin Tire (New Glasgow).

The participation rate (the percentage of working age population in the labour force) in 2006 for the county was 60.5%, slightly lower than the provincial average of 62.9%. The unemployment rate for Pictou County in 2006 was 9.5%, close to the provincial average.

8.3 Tourism and Pictou County

Nova Scotia markets itself as a tourism destination, with a tourism industry that contributes more than $1 billion to the provincial economy and supporting over 30,000 direct and spinoff jobs. Seasonal tourism is also important to Pictou County. For example, recent investments in a revamped waterfront have made the town of Pictou a key tourist destination. Tourism revenues in Pictou County accounted for $44.9 million in the economy (Pictou Regional Development Authority, n.d.). Pictou County is also the port for the Caribou Ferry to Prince Edward Island.

8.4 Property Values

There were 19,290 private dwellings in Pictou County in 2006, with an average value of $114,744 (27.4% lower than the Provincial average). Seventy-seven percent of dwellings in Pictou County were owned, and the majority (79%) of dwellings was constructed prior to 1986.

8.5 Population and Demographics - Antigonish County

Antigonish County, the 6th smallest county in Nova Scotia by population, had a total population of 18,836 in the year 2006, approximately two percent of the provincial population. The county, like many other rural counties, is experiencing a decline in population, with 3.8 per cent fewer people compared with 2001.

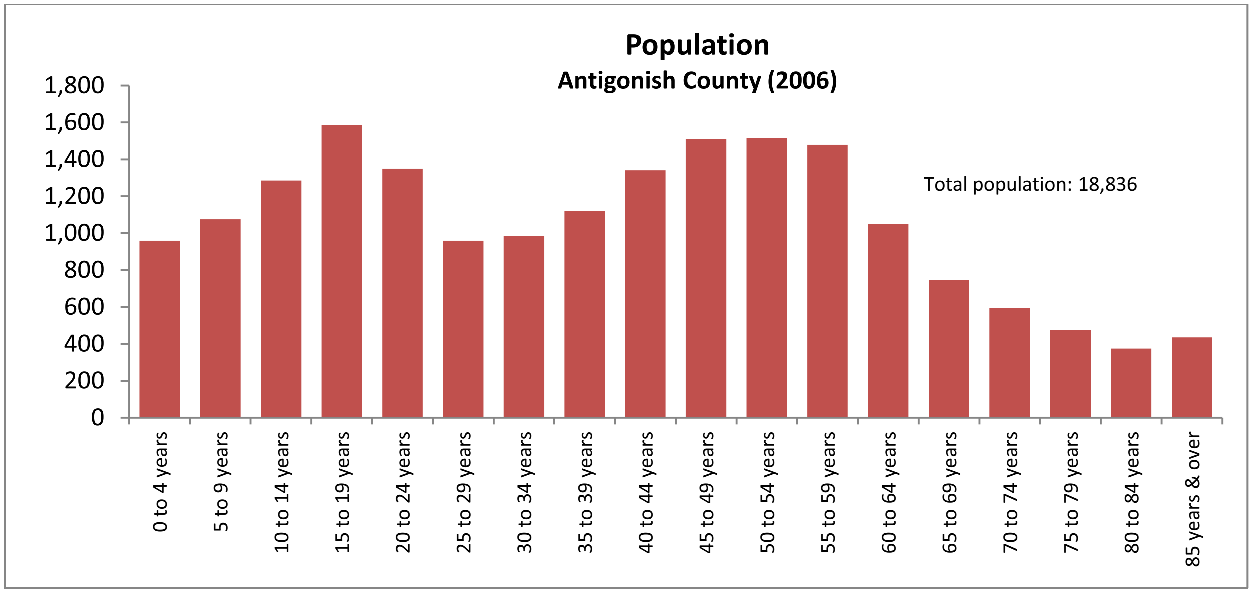
Antigonish County has several smaller centres, the main being the town of Antigonish, which is the home of St. Francis Xavier University, which has an enrollment of over 4,200, and which greatly impacts the population of the town during the university terms.

Table 23: Population and Demographics

	Antigonish (town)	Antigonish County
Population in 2006	4,236	18,836
Population in 2001	4,754	19,578
2001-2006 Population Change (%)	-10.9	-3.8
Total private dwellings (2006)	1,828	7,225
Total number of households (2006)	1,825	7,225
Population density per square km (2006)	823.3	12.9
Land area (square km) (2006)	5.15	1,457.82
Median Age of the Population (2006)	44.0	40.4

The population of Antigonish County has a median age of 40.4 years, slightly younger than that of the province as a whole, which has a median age of 41.8.

Figure 5: Population by Age Cohort, Antigonish County



Source: Statistics Canada 2006 Census of Population Community Profiles

Median income in Antigonish County (2006) for persons 15 years and older with income was $22,511. Seventy-one percent of income came from earnings, while 15.8% came from Government Transfers.

8.6 Health, Industry and Employment

Antigonish County is part of the Guysborough Antigonish Strait Health Authority (GASHA). Within the district health authority there are four hospitals which serve the nine municipal units in GASHA's area: St Martha's Regional Hospital (in Antigonish), the Strait Richmond Hospital (in Evanston, Richmond County), the Guysborough Memorial Hospital (in the town of Guysborough), St Mary's Memorial Hospital (in Sherbrooke, Guysborough County) and Eastern Memorial Hospital (in Canso, Guysborough County). The Antigonish Town and County Community Health Board serves the Antigonish County population. Addiction services, public health, and mental health services are available within the health authority.

Table 24. Labour Force by Industry, Antigonish County

Industry	Total	Male	Female
Total experienced labour force 15 years and over	10,005	5,170	4,830
Agriculture and other resource-based industries	1,170	890	280
Construction	810	765	45

Manufacturing	665	555	105
Wholesale trade	250	165	80
Retail trade	1,315	590	720
Finance and real estate	260	100	155
Health care and social services	1,245	195	1,045
Educational services	1,415	565	855
Business services	1,045	615	430
Other services	1,835	730	1,110

Source: Statistics Canada 2006 Census of Population

The experienced labour force in Antigonish County is 51.7% male. The County's industrial mix is dominated by the service producing industries, especially health care, social services, and educational industries. Some Agriculture and primary industry endures in the county. Construction and manufacturing make up only 14.7% of the employment in the county, though because of the proximity of the Project area to the Antigonish border, county residents can easily commute to fulfill labour requirements during the Project time frame.

The participation rate (the percentage of working age population in the labour force) in 2006 for Antigonish county was 65.7%, higher than the provincial average. This is likely due to a high proportion of full time jobs in the education and health care and social services sectors. The unemployment rate for Antigonish County in 2006 was 9.5%, higher than but close to the provincial average.

8.7 Property Values

There were 19,290 private dwellings in Antigonish County in 2006, with an average value of $145,442 (7.9% lower than the Provincial average). Seventy-nine percent of dwellings in Antigonish County were owned, and the 67% of dwellings were constructed prior to 1986.

Effects of the Project

Economic

SWI has provided the expected economic outcomes based on the actuals which occurred from the existing Glen Dhu WPP. The reader should note that Project is 62.1 MW in size with 27 turbines. Variations in the proposed Project size (i.e. 80 MW – 53 turbines) may see an increase in the values presented. However as the following values are confirmed amounts they are provided for use.

This Project represents an investment of approximately $150 million. This includes:

- Option, lease, and royalty payments to landowners. Royalty payments alone are expected to be in excess of $150,000;
- 175,000 person – hours of work during the permitting, construction and operation;
- 83% Nova Scotia labour content;
- 32% Pictou/Antigonish labour content;
- Over $2,000,000 in direct worker spending in the local area;
- $38,000,000 in construction spending with Nova Scotia companies, with $22,000,000 spent on companies in Pictou & Antigonish Counties;
- $900,000 in royalty payments to Pictou County;
- 55 companies from Pictou and Antigonish could be employed on the Project.

As per the permitting stages of the Project, the intent is to fulfill construction and operations contracts/positions with local personnel wherever possible. However, due to the specialized nature of wind turbine delivery, erection, and energization, if local personnel cannot be found, personnel may be required from other municipal, provincial, national, or international firms.

As with the existing Glen Dhu WPP, SWI and their sub-contractors will hold a job fair to determine availability of local labour and equipment for construction and operation of the Project.

Property Values

The concern that property values will be adversely affected by the Project is a concern raised at other WPP throughout North America. In 2009 a study was commissioned by the U.S. Department of Energy to determine if this impact does in fact exist. (Hoen, Wiser, Cappers , Thayer, & Sethi, 2009) The study collected data on almost 7,500 sales of single family homes situated within 10 miles of 24 existing wind facilities in nine different U.S. states. (Hoen, Wiser, Cappers , Thayer, & Sethi, 2009) In addition, the study reviewed a number of data sources and published material. Although that reviewed information addressed concerns about the possible impact of wind energy facilities on the property values of nearby homes, Hoen et al. found that "the available literature that has sought to quantify the impacts of wind projects on residential property values has a number of shortcomings". The list of shortcomings identified in that study (Hoen, Wiser, Cappers , Thayer, & Sethi, 2009) are as follows:

1. Studies relied on surveys of homeowners or real estate professionals, rather than trying to quantify real price impacts based on market data;
2. Studies relied on simple statistical techniques that have limitations and that can be dramatically influenced by small numbers of sales transactions or survey respondents;
3. Studies used small datasets that are concentrated in only one wind project study area, making it difficult to reliably identify impacts that might apply in a variety of areas;
4. Many studies had no reported measurements of the statistical significance of their results;

5. Many studies have concentrated on an investigation of the existence of Area Stigma, and have ignored Scenic Vista and/or Nuisance Stigma;
6. Only a few studies included field visits to homes to determine wind turbine visibility and collect other important information about the home (e.g., the quality of the scenic vista); and,
7. Only two studies have been published in peer-reviewed academic journals.

Ultimately, the Hoen et al. study indicated that "none of the models uncovers conclusive evidence of the existence of any widespread property value impacts that might be present in communities surrounding wind energy facilities. Specifically, neither the view of the wind facilities nor the distance of the home to those facilities is found to have any consistent, measurable, and statistically significant effect on home sales prices. Although the analysis cannot dismiss the possibility that individual homes or small numbers of homes have been or could be negatively impacted, it finds that if these impacts do exist, they are either too small and/or too infrequent to result in any widespread, statistically observable impact." (Hoen, Wiser, Cappers , Thayer, & Sethi, 2009)

Critiques have been developed in response to the Hoen report, notably by Wayne Gulden at Wind Farm Realities (2010) and Albert Wilson in 2010. These reports both outline concerns with methodology in the Hoen report including the conclusion that the analytical methods can not be shown to be reliable or accurate (Gulden 2010 and Wilson 2010). Another study completed by Gardner Appraisal Group Inc. in Texas, USA (Gardner 2009) states that " market data and common sense tell us property values are negatively impacted by the presense of wind turbines." (Gardner 2009). This study was completed for a conference in February 2009.

Further review of available literature did not find significant additional studies to aid in determining effect of wind porjects on surrounding property values. Based on this fact, it is appropriate to conclude that further study will aid in fully understanding the potential effect of wind power projects on property values.

Tourism

In 2002, MORI (Market & Opinion Research International) completed an independent research study on the "Economic Impacts of wind farms on Scottish tourism" for the British Wind Energy Association (BWEA) and the Scottish Renewables Forum. (Market & Opinion Research International, March 2008) MORI interviewed 400 tourists visiting Argyll and Bute, Scotland, an area chosen because, at the time, had the greatest concentration of wind farms in Scotland. In addition the tourism industry in the region has a strong reliance on the area's high landscape value (the study indicates that 48% of the respondents who came to the area reporting doing so for the scenery). (Market & Opinion Research International, March 2008)

The MORI study indicates that forty (40%) percent of tourists interviewed were aware of the existence of wind farms in the area and when asked whether this presence had a positive or negative effect, 43% indicated that it had a positive effect, while a similar proportion (43%) felt it made no difference. 8% felt that it had a negative effect.

In comparison, a 2003 study was completed for the Wales Tourist Board (NFO World Group, 2003) in response to an inquiry from the Welsh Assembly to “assess the effects of renewable energy, and particularly wind farms, on tourism.” (NFO World Group, 2003) This study used a 266 person sample size and found that overall 78% of respondents were positive or neutral towards wind farms, with 21% negative, and 1% with no opinion.

Although the effects of the Glen Dhu Project on local tourism and tourist perceptions cannot definitively be known until the Project is implemented, past research in the Scottish and Wales examples indicates that the dominant perceptions of the Project will likely either positive or neutral.

Mitigation

At present, no mitigation is available for impacts resulting from Project Effects and none will be implemented.

9 SOUND

Construction and Decommissioning

Construction and decommissioning activities will generate noise from the use of heavy machinery and vehicles, and potential blasting if necessary during the construction period and decommissioning phase. These impacts will be short in duration, and given the rural location of the Project, will not be significant on the surrounding communities.

Baseline Sound

No noise measurements have been carried out for the Glen Dhu South Project. GL GH has estimated the baseline noise levels for GDS receptors based on documentation from other jurisdictions and professional experience from similar wind projects.

First, The Ontario Ministry Of Environment (MOE) (MOE October 2008) published a noise guideline to assess the impact of wind farms in Ontario. In this document, one can find a discussion about the background sound level measured at a particularly quiet site. The effect of the wind speed is also documented. The document shows a background sound level of 30 dBA for a 4 m/s wind speed (at 10 m AGL).

Second, the Alberta Utilities Commission (AUC) noise guideline (AUC February 2010) in Alberta (AUC rule 12) explicitly states that the assumed nighttime ambient sound level (ASL), defined as "the average sound environment in a given area without the contribution of noise from any energy-related facility", is 35 dB(A).

From GL GH professional experience in performing background noise level in rural and sparsely inhabited areas of Quebec, measurement of background noise level (L90) show results in the 30 to 35 dBA range. Sound level below 30 dBA can be measured in very quiet areas between 1 and 3 AM (no wind blowing).

Therefore, GL GH considers that an appropriate baseline noise level for the GDS Project is between 30 dB(A) and 35 dB(A).

Operation

A Noise Impact Assessment (NIA) has been completed for this Project by GL GH and Associates Ltd. (GL GH). This report can be found in Appendix XI. This NIA was completed using the specifications of the GE1.6-100MW turbine. As identified in Chapter 4 of this document, Shear Wind Inc. has committed to changing the turbine to a higher capacity turbine to reduce the overall footprint of the project. **Once final turbine selection has been completed, the NIA will be adjusted to reflect this turbine's specifications to ensure compliance with regulatory requirements of 45 dBA at a receptor for sound. Based on the reduction in overall number of turbines Shear Wind and the GLGH engineering team do not expect a significant change of results and expect that the current layout will continue to meet the 45 dBA requirement.**

The NIA determined that no sensitive receptors (hospitals, schools, elderly care facilities, daycares) are present within a 2 km radius from the Project area. All residential receptors present within a 2 km radius of the Project area were identified during field assessments in 2011. Parameters of each residence (number of stories, permanent residence, seasonal, hunting camp) were recorded.

The noise level at each Point of Reception within 1500 m of any turbine of the Glen Dhu South Project is tabulated below. For each receptor, the following information is provided:

- The distance to the closest wind turbine;
- The sound pressure level at the receptor location at the applicable receptor height;
- The sound level limit for that receptor;
- Whether or not the noise levels at the receptor comply with the prescribed limit (for continued reference, compliance is confirmed for all receptors).

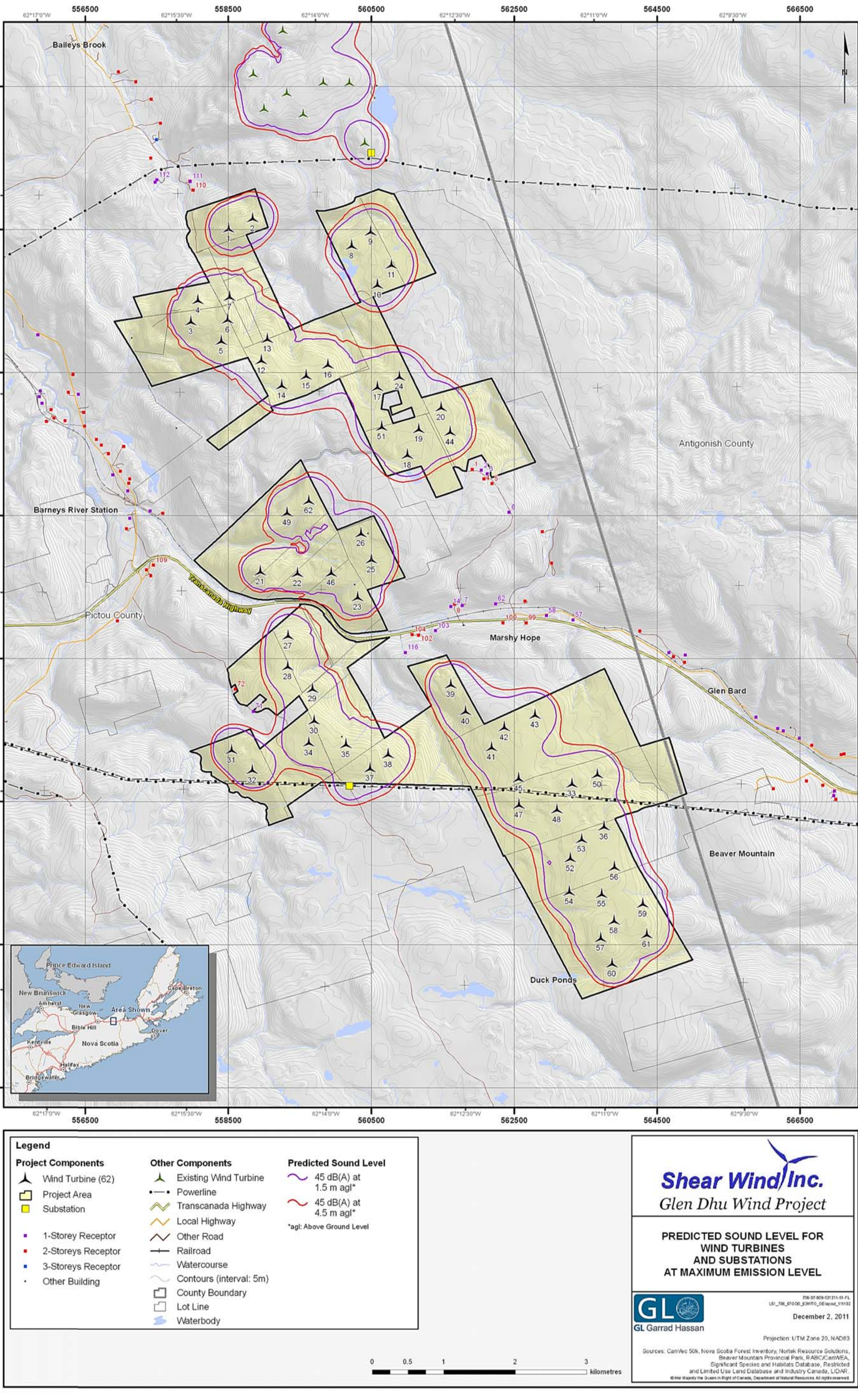
The closest distance between a Glen Dhu South wind turbine and a Point of Reception is 609 m between receptor H71 and Turbine 31. A summary of the receptors, distance to nearest turbine, and associated calculated sound level is provided in the table on the following page. The table is taken directly from the NIA.

The results show that the Glen Dhu South Project complies with the applicable environmental sound guidelines of 45 dBA. A noise iso-contour map illustrating the contribution of the all wind turbines and the transformer is shown in the following Figure 30.

Table 6-1: Wind Turbine Noise Impact Assessment Summary – Glen Dhu South Wind Farm (Including Adjacent Wind Farms)

Point of Reception ID	Receptor Height agl. [m]	Distance to Nearest Turbine [m]	Nearest Turbine [ID]	Calculated Sound Pressure Level at Receptor [dB(A)]	Applicable Noise Limit [dB(A)]	Compliance With Limit (Yes/No)
1	4.5	622	44	41.6	45	Yes
2	1.5	704	44	39.0	45	Yes
3	1.5	798	44	38.1	45	Yes
4	4.5	823	44	39.6	45	Yes
5	4.5	944	44	38.4	45	Yes
6	1.5	1410	44	34.6	45	Yes
7	1.5	1100	39	35.0	45	Yes
8	4.5	1109	39	36.9	45	Yes
14	1.5	1074	39	36.0	45	Yes
57	1.5	1419	43	32.1	45	Yes
58	1.5	1382	43	32.6	45	Yes
62	1.5	1280	39	33.8	45	Yes
71	1.5	609	31	41.8	45	Yes
72	4.5	803	28	41.1	45	Yes
99	4.5	1277	43	34.9	45	Yes
100	4.5	1120	39	33.8	45	Yes
102	4.5	807	39	39.9	45	Yes
103	1.5	764	39	36.2	45	Yes
104	4.5	867	39	39.6	45	Yes
109	4.5	1494	21	33.9	45	Yes
110	4.5	718	1	39.7	45	Yes
111	1.5	837	1	37.4	45	Yes
[illegible]	1.5	1204	1	35.1	45	Yes
[illegible]	1.5	763	39	39.1	45	Yes

Table 25.



Baileys Brook
Barneys River Station
Pictou County
Transcanada Highway
Antigonish County
Marshy Hope
Glen Bard
Beaver Mountain
Duck Ponds
Prince Edward Island
New Brunswick
Amherst
New Glasgow
Area Shown
Cape Breton
Bible Hill
Kentville
Nova Scotia
Dover
Halifax
Bridgewater
556500
558500
560500
562500
564500
566500
62°17'0"W
62°15'30"W
62°14'0"W
62°12'30"W
62°11'0"W
62°9'30"W
Legend
Project Components
Wind Turbine (62)
Project Area
Substation
1-Storey Receptor
2-Storeys Receptor
3-Storeys Receptor
Other Building
Other Components
Existing Wind Turbine
Powerline
Transcanada Highway
Local Highway
Other Road
Railroad
Watercourse
Contours (interval: 5m)
County Boundary
Lot Line
Waterbody
Predicted Sound Level
45 dB(A) at 1.5 m agl*
45 dB(A) at 4.5 m agl*
*agl: Above Ground Level
0
0.5
1
2
3
kilometres
Shear Wind Inc.
Glen Dhu Wind Project
PREDICTED SOUND LEVEL FOR WIND TURBINES AND SUBSTATIONS AT MAXIMUM EMISSION LEVEL
GL Garrad Hassan
December 2, 2011
Projection: UTM Zone 20, NAD83
Sources: CanVec 50k, Nova Scotia Forest Inventory, Nortek Resource Solutions, Beaver Mountain Provincial Park, RABC/CanWEA, Significant Species and Habitats Database, Restricted and Limited Use Land Database and Industry Canada, LIDAR.

When modeled according to the ISO 9613 standard and the conditions specified in this report, the predicted sound level produced by the wind farm and substation was found to be within the permissible sound level of 45 dBA for all the noise receptors in Pictou County. The results are therefore compliant with Health Canada requirements.

Effects of the Project

Construction and Decommissioning

Construction and decommissioning activities will generate noise from the use of heavy machinery and vehicles. The contribution to noise levels is only expected on site – a low population density area – and during a short period, i.e. the few months of planned work during the construction/decommissioning periods. Increased truck transport is not expected to significantly increase ambient noise levels on existing roadways, due to the already existing truck traffic on these roads. Increased noise levels will be of medium magnitude on the municipal access roads, but of short duration, intermittent and local.

Overall, the effect of construction on ambient noise levels is of low concern and considered not significant.

Operation

When modeled according to the ISO 9613-2 method "*Acoustics – attenuation of sound during propagation outdoors*," all receptors will experience noise levels below 45 dB(A).

The following conclusions and conditions are also listed:

- Tonality penalties do not apply to the turbine noise emission levels;
- The Glen Dhu South transformer substation was assumed to generate a conservative noise level of 103 dB(A), in accordance with CAN-CSA-C88-M90;
- A modeled turbine sound power level of 106 dB(A) was used for the GE 1.6 - 100;
- Surrounding terrain is consistent with a ground factor of 0.7;
- Conservative atmospheric conditions for least impeded noise propagation were used for the calculations;
- No acoustic shielding or damping specifically from vegetation or buildings etc. is used;
- Receptors were modeled as points 1.5 m above ground level for 1 storey receptors and 4.5 m above ground level for 2 storey receptors at the centre of the residences.

Conservative assumptions have been selected for the turbine noise emission level, Point Of Reception (POR) height, and atmospheric conditions. In addition, the presence of crops, foliage, and other sound impeding obstacles were not modeled. Therefore the results of the calculations performed for this report are considered to be conservative.

Should the final turbine selection be different than the model used in the NIA, the NIA will be re-run with the selected turbine to ensure compliance with Health Canada guidelines.

Mitigation

Construction and Decommissioning
In order to minimize any effects during construction, The Proponent will limit major construction activities to daytime and early evening hours, and implement a construction and traffic management plan. Nearby residents will also be advised of significant truck transportation passing through, and all internal combustion engines will be fitted with appropriate muffler systems.

Construction activities will be limited to daytime and early evening hours and vehicle speeds on access roads will be limited to 40 km/h. Nearby residents will be advised of significant noise-causing activities and these events will be scheduled to reduce disruption to them.

Operations
In the event noise complaints are received, appropriate mitigation will be implemented and may include:

- The Project provides, and will continue to provide, periodic newsletter updates to the community and residents. This will act as a conduit to what is deemed to be a successful, and ongoing, public consultation process;
- The Project will typically operate from 7:30 a.m. (arrival of personal vehicles), with heavy equipment in operation from 7:00 a.m. to dusk, 5 days a week. . During certain construction activities, such as the turbine foundation concrete placement and the erection of the turbine, the work hours and number of days worked per week may be extended;
- The Project has an *Inquiry & Complaint Reporting Procedures* in place in the event any complaints are received. The *Inquiry & Complaint Reporting Procedures* outlines a methodology for handling complaints. If complaints cannot be resolved through communication with the complainant, on-site monitoring can be carried out at the site in question in order to assess the extent of the problem.

On-site Noise Monitoring Protocol

On-Site Noise Monitoring may include the following work:

- Scheduled Monitoring, at the residence of concern;
- Responsive monitoring when required as part of complaint resolution;

Scheduled/Background Noise Monitoring will be performed by a qualified technician within 15 metres of the residence (with the landowners' permission) during which overall A-weighted sound levels will be measured and recorded. Scheduled/Background Noise Monitoring will be undertaken over a one week sampling period to allow for the meaningful assessment of variations in wind speed, wind direction, and humidity. One-hour average (Leq) sound levels will be recorded continuously, when weather conditions are suitable, for at least 48 hours over the one-week sampling period. At least 24 hours of nighttime measurements will be recorded.

Responsive Noise Monitoring will be performed when conditions are representative of the conditions identified by the complainant at the earliest opportunity after the complaint is received. Conditions surrounding the complaint including wind speed, wind direction, wind shear (the difference between wind speeds at the nacelle and at ground level), temperature, atmospheric pressure, relative humidity, and time of day will be documented to ensure that monitoring is completed under similar conditions. The monitoring will be performed over a 4 to 24 hour period with at least 3 hours of representative data collected.

Results from the Responsive Noise Monitoring will be compared with the predictive noise modeling. When the Responsive Noise Monitoring exceeds the predictive noise modeling, but noise from the wind farm is not considered to be responsible for the exceedance, a further assessment using an appropriate background and ambient noise analysis technique may be carried out to separate the facility noise contribution from the Responsive Noise Monitoring. This will, in effect, separate noises not related to the facility.

Measurement Instruments used to conduct both the Scheduled/Background Noise Monitoring and the Responsive Noise Monitoring surveys will meet the minimum technical specifications in the International Electro-technical Commission (IEC) publication 60804 or its latest revision for Type II sound level metres.

If public complaints are received, it may be appropriate to monitor for low frequency noise. This determination will be based upon the nature of the complaint received. If this occurs, as per ANSI S12.2-1995 Standard B criteria for Evaluating Room Noise, sound levels in the 63 Hz octave band will be compared to 70 dB to indicated or deny the presence of low frequency noise.

Reporting

Reporting will summarize the results of any noise complaints received, any on-site noise monitoring, additional mitigation recommended or implemented, and steps taken to resolve the complaints. The following information will be included in the Post-Construction Noise Monitoring Report:

- distance and direction of dwelling from the wind turbines, including a map;
- record of calibration results;

- environmental conditions during monitoring period (wind speed and direction etc.) and the source of the data;
- operating conditions for wind farm turbines included in the survey;
- graphs showing measured noise levels and any ambient analysis; and,
- summary table including the predicted noise levels for residences, measured sound level, ambient analysis results, and valid hours of the survey.

10 RECREATION

In areas without active timber harvesting, land use is dominated by hiking, camping, use of seasonal cabins/accommodations, fishing, and water recreation. Consultation with one of the landowners within the Project area indicated that there is active hunting throughout the Project lands.

There is some opportunity within the Project area for public access for hiking and walking, however, there are no public trails present inside the Project area.

All-Terrain Vehicles (ATV) and Snowmobiles use is widespread within the Project area and there is a myriad of interconnected trails, stopping locations, and tracks suggesting continuous and extensive use. All trails appear to be used by public riders. Numerous trail signs are present. The trails are operated and maintained by the Antigonish Snowdogs. They have been involved in consultation during the planning stages of the Project and are aware of the Project. To date no concerns have been raised.

No other public recreational lands exist within the Project boundaries.

Beaver Mountain Provincial Park is located to the east of the Project boundaries. The Beaver Mountain Park website (http://www.antigonishcounty.ns.ca/BeaverMountain/amenities.html) indicates the park is for motorists looking for a picnic enroute or perhaps a chance to stretch, relax or enjoy the scenic countryside. Visitors can enjoy a day trip to the Park to enjoy a refreshing change of scenery or partake in recreational opportunities.

The Park's interpretive centre offers a panoramic view of the two distinctive landscapes (the lowlands and broad hills) that make up the Park's vista. Four interpretive panels detail the natural history of the area, the history of the park and the hiking trails. Eight picnic tables and two picnic shelters are provided, as well as water and wheelchair accessible toilets.

The park has a wheelchair accessible paved loop that is 1 - 1.6 kilometers in length. There are two easy to moderate trails 3 and 6 kilometers in length that cut through the interior and the back ridge of the park that are ideal for long hikes.

The Park is opened from mid-May to mid-October annually. Although officially closed during the winter season, people are encouraged to use the Park.

No overnight camping spots are permitted.

Effects of the Project

The construction and operation of the Project will result in modified use by ATVs, hikers, general users or landowners. Although some ATV trails will be lost due to access road construction, the access roads, by definition, will continue to allow access by ATVs or other recreational users, but such access will still be subject to permission from the private landowners.

Unless gates are placed on access roads to prevent public access, increased access to the Project lands may occur. However as all primary access points used for the Project already exist, the addition of the Project will not increase access capability to the area.

Mitigation

Unless access restrictions (i.e. gates) are requested by landowners, no mitigation will be implemented as no significant or long term impacts to recreational uses are expected. Signs will be placed to ensure people are aware they are entering an active wind power project.

11 VISUAL

Any loss of aesthetic value associated with the Project may be as a result from the physical presence of new turbines, trails, increased traffic, and changes in vegetation and wildlife communities.

Currently, no data is available which indicates how wind power Project visual thresholds are defined or exceeded. Therefore it is assumed that much of the aesthetic value is perceived by residents and visitors to the area. In order for the public and regulatory personnel to effectively estimate the visual effect of the Project, the following was completed:

1. A visual representation of the Project from 8 vantage points surrounding the Project Area. The visual representations were provided in poster board format to the public during an Open House on December 14, 2011 in the community of Kenzieville. They are found in Appendix XIII.

2. Visual zone of influence analysis. This study uses line of site analysis and incorporates topographic features collected from 1:50,000 base maps, turbine characteristics (hub height, rotor diameter), Global Positioning System (GPS) coordinates for turbines, and GPS coordinates for receptors (i.e. homes), and analyzes how many turbines will be seen

from a geographic area (within which a specific receptor may be located). This map is included in Appendix XIII.

The photomontages and visual zone of influence were completed with the specifications of the GE1.6-100 turbine. **Once final turbine selection has been completed, and if requested, the visual model will be adjusted to reflect this turbine's specifications. The proponent and engineering team do not expect a significant change of results, based on the reduction in overall number of turbines.**

In addition to visual impacts and aesthetics experienced by residents, the Project will affect the visual characteristics and, therefore, opinions of visitors to the region. Nova Scotia markets itself as a natural, coastal destination. From a tourism perspective, the question of how the Project will impact the visitor experience from the local scenic perspective is unknown, as that experience highly subjective. However, the Project is located between the primary east/west travel corridor (Highway 104) heading towards Cape Breton and Eastern Nova Scotia. Most turbines will not be visible from the Highway, with the exception of a few locations.

Effects of the Project

Currently, no data is available which indicates how wind power Project visual thresholds are defined or exceeded. Therefore it is assumed that much of the aesthetic value is perceived by residents and visitors to the area and is subjective to the individual.

Mitigation

SWI has completed a visual model, with photos taken in select locations surrounding the Project area. In addition, SWI has reviewed the visual zone of influence model. No further mitigation will be implemented.

12 SHADOW FLICKER

A shadow flicker assessment was completed by GL Garrard Hassan (GL GH) and is attached to this document as Appendix XIV.

13 AIR QUALITY

Air Quality has been selected as a VEC because of its intrinsic importance to the health and well being of humans, wildlife, and vegetation both at a Project level, community level, regional, and provincial levels. Air quality will be assessed in the context of Project-related emissions and ground-level concentrations for particulate matter (PM; total suspended particulate (TSP); dust). No major industrial operations are located within the immediate air shed.

A comprehensive assessment of the effects of the nitrogen oxides (NO_x and NO_2) emissions from the Project was not conducted as the only emissions associated with the Project are related to vehicle and equipment emissions during construction and operations. No other industrial source emissions are associated with the Project.

Effects of the Project

The addition of Project emissions to regional airshed emissions is not expected to increase predicted maximum ambient concentrations. Therefore, the emissions will not have any adverse effects on the environment. It is concluded that predicted NO_2 ground-level concentrations in the area are dominated by existing baseline-background emissions sources.

As indicated previously, considerable heavy equipment will be used to clear the land thereby increasing the vehicular traffic in and around the Project site. Potential impact sources include fugitive dust emissions, vehicular/ heavy equipment exhaust and emissions from the diesel equipment used during construction.

Apart from this, impacts to air quality from these sources should not appreciably degrade the ambient air quality at the sites. Moreover, the anticipated construction phase for the Project is relatively short.

Blasting associated with quarry development (should one be established on site) or excavations for turbine bases can result in a concentrated plume of particulate matter, but the volume and time duration of such plumes are quite constrained. Even when blasts result in a visible plume, the contribution to 24-hour averages, as in the Air Quality Regulations, will be negligible. Much of the material in the initial plume is larger than the aerodynamic diameter of particles that can remain suspended in the air, and deposit within a relatively short distance (*e.g.*, 100 m) of the blast site. Nevertheless, a visible plume is often unacceptable to the public and regulators, and control is appropriate. Proper controlled blasting techniques are effective in reduction of the visible plume and other more serious potential effects.

Trucks moving off-site can also impact air quality by transporting mud and material on their tires that is deposited on public roads, where it can become airborne through the mechanical action of passing vehicles and the wind.

Mitigation

The anticipated mitigation measures for the potential air quality impacts during the Project involve both operational and engineered interventions. In order to limit the possible emissions, all vehicles and equipment will be turned off when not in use as well as prohibit vehicular and equipment idling. In addition the vehicles and equipment (generators) will be serviced and maintained in order to reduce any possible emissions. Water trucks will be used to spray water on the unpaved roads and cleared areas to reduce dust emissions. This will be further enhanced by the eventual upgrading of the road system. Trucks transporting materials will be covered to prevent any loose material from blowing away. Vehicular speeds on the Project site shall be limited to further reduce any possible fugitive dust emissions. Disturbed areas will be re-vegetated as soon as practicable to limit exposed areas of soil.

14 ELECTROMAGNETIC INTERFERENCE

Due to their large size, wind turbines can interfere with radio waves emitted from telecommunication and radar systems. In response to these potential conflicts, the Radio Advisory Board of Canada (RABC) and the Canadian Wind Energy Association (CanWEA) have issued a set of guidelines which describe the methodology for assessing magnetic interference (EMI).

EMI created by a wind turbine can be classified in two categories:

1. Obstruction - occurs when a wind turbine is placed between a receiver and a transmitter, creating an area where the signal is weakened and/or blocked; and,
2. Reflection - caused by the distortion between a signal and a reflection of the signal from an object. Included within reflection is a sub-category called Scatter. Scatter is a result of rotor blade movement.

The specific characteristics of a wind turbine will influence the type and magnitude of the interference. Furthermore, wind turbines affect different types of signals in various ways as some telecommunication signals are more robust to interference than others.

A preliminary investigation of the potential conflict between the proposed Project and communication systems has been completed. The results of the investigation are summarized as follows:

Table 25. EMI Systems and Proximity to the Project Area

System	Result
Point-to-Point	There are three point-to-point microwave links (>900 MHz) that transect the Project area. However, no turbine positions are within those point-to-point links.
Over-the-Air-Reception	The consultation zone is 2 km for TV Emitters, 2 km for FM Radios, 5 km for omnidirectional AM Radios, and 15 km fur directional AM Radios.

	There are no over-the-air-reception consultation zones that transect the Project area. Given that the wind farm will consist of 62 GE 1.6 100 turbines with a blade length of 50 m, the consultation zone should be 20 km around the Project area. Approximately 4365 dwellings are found within this 20-km consultation zone. The Community Profiles from the 2006 Census states that there are 2.9 people per dwellings in the counties of Pictou and Antigonish. Therefore, 12 650 people could potentially see the quality of their over-the-air reception affected by the presence of the wind turbines.
CBC Preliminary Report	To be compliant with the CBC guidelines, a mitigation program for CBC TV reception is recommended. This would be applied to households within the consultation zone for which interference from the wind farm is demonstrated.
Cellular Type Network	The consultation zone for cellular type network is 1 km. There are no cellular type network consultation zones that transect the Project area.
Satellite Systems	The consultation zone for satellite systems is 500 m. There are no satellite systems consultation zones that transect the Project area.
Land Mobile Networks	The consultation zone for land mobile networks is 1 km. There are no land mobile networks that transect the Project area.
Seismoacoustic Monitoring Equipment	The consultation zone for seismoacoustic monitoring equipment is 50 km. The closest seismoacoustic monitoring equipment is in Halifax, at 150 km from the Project area.
Traffic and Defense Radars	The consultation zone for radars is 60 km. The closest radar is located 72 km from the Project area. The Canadian Coast Guard, National Defense, NAV Canada, and Royal Canadian Mounted Police operate non-disclosed traffic and defense systems. They have been contacted. No conflict with the Project turbines is expected.

Weather Radars	The consultation zone for weather radars is 50 km. The closest weather radar is located 125 km from the Project area.

Effects of the Project

Until such time that the EMI consultation is completed, Project related effects cannot be determined.

Mitigation

Depending on the effects of the Project, mitigation may include a field validation of reception before and after turbine installation. In the case of diminished reception, mitigation techniques for broadcasting reception include relocation of reception towers, purchase of a taller reception tower/antenna structures for TV/radio, or the purchase of cable/satellite TV/radio for affected receptors. Finally, mitigation methods can be applied in both the planning stages of wind power facility and after the installation of the wind turbines.

15 HEALTH & SAFETY OF RESIDENTS

15.1 Country Foods

No known country foods are harvested on a commercial scale within the Project boundaries. A determination of the exact nature and extent of private gardens was not undertaken for this Project as all residences with permanent and sustained gardens appear to be located at least 600 metres from any single turbine.

Effects of the Project

The known waste products from a wind power Project are associated with dust, vehicle emissions, and garbage resulting from normal operations. No significant quantities of chemicals are present, will be stored, or used to a degree which poses the potential to impact surface soils, surface water, or groundwater.

In addition, the Project site is situated entirely within a forested ecosystem, with active logging operations. Other than wildlife, no food sources are present that may support human populations. As the by-products of normal operations at the Project do not pose known risks of contamination within the food chain, impacts to either human and/or wildlife populations is not expected to occur as no feasible operable, or transport pathways are currently known to exist.

Mitigation

As no impacts to community foods are expected no mitigation is deemed necessary.

15.2 Ice Throw

Wind turbines can accumulate ice under certain atmospheric conditions, such as temperatures near freezing (0°C) combined with humidity, freezing rain, or sleet. Since changing weather conditions may then cause this ice to be shed, there are safety concerns that must be considered during Project development and operation.

Any ice that is accumulated may be shed from the turbine due to warmer temperatures, gravity and the mechanical forces of the rotating blades.

In the event of ice throw the motion of the fragment is governed by specific forces. The ice fragment has an initial velocity due to rotation, while in flight the motion is constrained by gravity and aerodynamic forces.

Due to certification requirements which outline load cases which must be used in the design of wind turbines (including iced blades) manufacturers incorporate ice build up on the blades as a load resulting in additional vibration caused by both mass and aerodynamic imbalance. (LeBlanc, 2007)

Leblanc (2007) used defined methodologies and analyses to determine the probability that an ice fragment will land on a certain target or in a particular area in the range of the turbines. The probability of impact is then multiplied by the probability of ice throw. The final result is the probability that a target fixed at a certain range from the turbine will be hit in one year. If targets are not fixed, such as cars on a roadway, then the probability must be multiplied again by the probability that the target will be in position. Mobile targets are discussed in the analyses.

The calculated probabilities results of this risk analysis are provided in terms of Individual Risk (IR), which is defined as the probability of being struck by ice fragment per year. (LeBlanc, 2007) The results of the Leblanc's (2007) are as follows:

1. Scenario A – Fixed Dwelling: Based upon a location of 300 metres from an individual turbine, calculated risk is 1 strike per 500,000 years;
2. Scenario B – Road: Based upon a road location 200 metres from a turbine, with a 100 vehicles travelling 60 km/h along a 600 metre section of road, during 5 days of icing events, calculated risk is 1 strike per 260,000 years;

3. Scenario C – Individuals: Based upon one ever-present individual within 300 metres of a turbine, who does not impinge within 50 metres of the turbine base, calculated risk is 1 strike per 137,500,000 years.

The calculated strike risk does not factor in the following characteristics at the Glen Dhu South Project:

1. The presence of forest vegetation providing additional shelter;
2. Topographic variations, and;
3. Dominant wind direction which in the Glen Dhu South Project case is from the NE to the SW, away from roads and dwellings.

Effects of the Project

Although there is the risk of ice throw from the turbines on the Project, the analysis completed by Leblanc (2007) suggests that the safety risks to individuals associated with such an event are so low that the risk is almost non-existent.

Mitigation

All commercial wind turbines include vibration monitors, which will automatically shut the turbine down when vibrations exceed a pre-set level. This vibration safety shutdown feature is also effective when excessive ice builds up on the turbine blades thus further limiting the risk of ice throw. In addition, SWI commits to the installation of signs at public access points warning of the potential for ice throw. Operation and maintenance staff and contractors will be made aware of the risk of ice accumulation, throw, or falling as a function of SWI Safety Guidelines.

16 DISCUSSION OF IMPACTS

16.1 Impact Matrix

An impact matrix is a qualitative environmental impact assessment method, used to identify the potential environmental impact of a Project on the environment. The Leopold matrix is the best known matrix methodology available for predicting the impact of a Project on the environment. (FAO, 1996) The system consists of a matrix with columns representing the various environmental factors to be considered, and rows representing various Project components that will interact with the environment (Wikipedia, 2009). The use of this Matrix for the discussion of impacts has been discussed with Nova Scotia Environment for use in the environmental assessment process.

The intersections are filled in to indicate the magnitude (from -10 to +10) and the importance (from 1 to 10) of the impact of each activity on each environmental factor. Measurements of magnitude and importance tend to be related, but do not necessarily directly correlate. Magnitude can be measured fairly explicitly, in terms of how much area is affected by the development and how badly, but importance is a more subjective measurement. While a proposed development may have a large impact in terms of magnitude, the effects it causes may not actually significantly affect the environment as a whole (Wikipedia, 2009)

16.2 Limitations

The aforementioned Leopold matrix is not *selective*, and includes no mechanism for focusing attention on the most critical human concerns (Burton et al., 1977). The principle of a mutually exclusive method is not preserved in the Leopold matrix, and there is substantial opportunity for double counting (Burton et al., 1977). This is a fault of the Leopold matrix in particular rather than of matrices in general (Burton et al., 1977).

The Leopold Matrix can accommodate both quantitative and qualitative data. It does not, however, provide a means for discriminating between them. In addition, the magnitudes of the predictions are not related explicitly to the 'with-action' and 'without-action' future states (Burton et al., 1977).

Objectivity is not a strong feature of the Leopold matrix. Each assessor is free to develop his own ranking system on the numerical scale ranging from l to 10 (Burton et al., 1977). This typically results in extensive discussions regarding assessor rankings.

The Leopold matrix is not efficient in identifying interactions. However, because the results are summarized on a single diagram, interactions may be perceived by the reader in some cases (Burton et al., 1977).

Synthesis of the predictions into aggregate indices is not possible, because the results are summarized in a 1215 (27 x 45) cell matrix, with two entries in each cell – one for magnitude and one for importance. Thus the decision maker could be presented with as many as 2430 items for each alternative proposal for action (Burton et al., 1977).

16.3 Modifications for this assessment

As a result of the limitations explained by Burton et al. (1977), the Leopold matrix was modified for purposes of this assessment. The following matrix (Table 27) uses the same fundamental characteristics of the Leopold Matrix. However, instead of splitting each cell into magnitude and likelihood, each interaction between a *Project component* and E*nvironmental component* has been given one of three values:

- -1: Negative Effect: If this value is presented in a cell, it indicates that as a result of the Project component a negative effect will occur on the environmental component;
- 0: Neutral: If this value is presented in a cell, it indicates that the effect of the Project component on the environmental component will be neutral; and,
- +1: Positive Effect: If this value is presented in a cell, it indicates that as a result of the Project component a positive effect will occur on the environmental component.

These values do not take into account that the impact is temporary but only that it exists. The purpose of modifying the matrix this way is to reduce the required explanation for each cell. As each cell would require an explanation, the result would be 1215 items for discussion. However, as each cell now only contains one of three values, and each value can be easily interpreted by the reader, further explanation of each cell is not warranted as previous sections in the original environmental assessment should be used for reference.

The reader should note that for the purposes of this assessment, the Project has been broken into three timelines with specific durations:

1. Construction – duration of 2 years (7% of the total Project timeframe);
2. Operations – duration of 25 years (86% of the total Project timeframe); and
3. Reclamation – duration of 2 years (7% of the total Project timeframe);

As such the total estimated duration of the Project is 29 years.

16.4 Interpretation of the Table

The reader must note that in the interpretation of this matrix, they must keep in mind that the interaction between the *Project component* and the E*nvironmental component* is based upon the actual *Project component* listed in the column, and the outcome of that specific *Project* *component*. For example, the first *Project component* listed is Construction of Storage Yards. The first *environmental component* is Agricultural Land. Within the matrix, the value given is 0. In this case the construction of a storage yard will not involve loss of land use for agricultural purposes, as the storage yard is constructed outside of agricultural lands, and as such there is no effect. Whereas, further down the column, the effect of Reclamation of Surface Soils is +1 (positive) as the outcome of this is that Pasture land may be brought back into production by the landowner. Furthermore, the reader must also note that in the consideration of whether a *Project component* effect is negative, neutral, or positive, consideration has been given to mitigation to be used. Mitigation for each VEC has been described in previous sections.

Table 27. Environmental Impact Matrix (modified Leopold Matrix)

Environmental Component →		PHYSICAL ENVIRONMENT						BIOLOGICAL ENVIRONMENT												SOCIAL/CULTURAL ENVIRONMENT									
								FLORA				Fauna																	
Project Component ↓		Agricultural Land	Soils	Surface Water Quality	Ground Water Quality	Air Quality	Wetlands	Trees	Shrubs & Understory Vegetation	Aquatic Vegetation	Species at Risk - Vegetation	Birds (includes Species at Risk)	Bats	Ungulates	Carnivores	Small Mammals	Reptiles/Amphibians	Barriers to Movement	Corridor Creation	Residential	Noise	Historical Resources	Health & Safety (Public)	Recreation (i.e. hunting)	Scenic Qualities	Economics for Individual Landowners	Economics for community at large	Economics for Municipalities	
Construction																													**Mean**
General	Construction of storage yards	0	-1	0	0	-1	0	-1	-1	0	0	-1	-1	-1	-1	-1	0	-1	-1	-1	-1	0	0	-1	0	1	1	0	-0.44
	Construction of temporary work space	0	-1	0	0	-1	0	-1	-1	0	0	-1	-1	-1	-1	-1	0	-1	-1	-1	-1	0	0	-1	0	1	1	0	-0.44
	Erection equipment delivery	0	0	0	0	-1	0	-1	-1	0	0	0	0	-1	-1	-1	0	-1	-1	-1	-1	0	-1	-1	-1	1	1	0	-0.41
Turbines	Construction of access roads, approaches, water crossings	0	-1	-1	0	-1	-1	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	0	-1	0	1	1	0	-0.59
	Construction of temporary work space(s)	0	-1	-1	0	-1	0	-1	-1	0	0	-1	-1	-1	-1	-1	0	-1	-1	-1	-1	0	0	-1	0	1	1	0	-0.48
	Construction of Quarries	0	-1	-1	-1	-1	0	-1	-1	0	0	-1	-1	-1	-1	-1	0	-1	-1	-1	-1	0	0	-1	0	1	1	0	-0.52
	Site grading	0	0	0	0	-1	0	0	0	0	0	0	0	-1	-1	-1	0	-1	-1	-1	-1	0	0	-1	-1	1	1	0	-0.30
	Excavation of foundations	0	-1	0	-1	-1	0	0	0	0	0	-1	-1	-1	-1	-1	0	-1	-1	-1	-1	0	0	-1	0	1	1	0	-0.41
	Pouring of foundations	0	0	0	-1	-1	0	0	0	0	0	-1	-1	-1	-1	-1	0	-1	-1	-1	-1	0	0	-1	0	1	1	0	-0.37
	Tower/turbine erection and insulating	0	0	0	0	-1	0	0	0	0	0	-1	-1	-1	-1	-1	0	-1	-1	-1	-1	0	0	-1	0	1	1	0	-0.33
	Install Turbine Electrical & Padmount Transformers	0	0	0	0	-1	0	0	0	0	0	0	0	-1	-1	-1	0	-1	-1	-1	-1	0	0	-1	0	1	1	0	-0.26
	Removal of excess soils	0	1	-1	0	-1	-1	0	0	0	0	0	0	-1	-1	-1	0	-1	-1	-1	-1	0	0	-1	0	1	1	0	-0.30
	String Interconnection Conductors & Shield Wires	0	0	0	0	-1	0	0	0	0	0	0	0	-1	-1	-1	0	-1	-1	-1	-1	0	0	-1	0	1	1	0	-0.26
	Reclamation of pad sites and access roads as required	0	1	1	0	-1	0	0	0	0	0	0	0	-1	-1	-1	0	0	-1	-1	-1	0	0	-1	0	1	1	0	-0.15
Gathering Lines	Install & Connect U/G & O/H Collector System	0	0	0	0	-1	0	-1	-1	0	0	0	0	-1	-1	-1	0	0	-1	-1	-1	0	0	-1	0	1	1	0	-0.30
Substation	Establishment of temporary work space	0	0	0	0	-1	0	0	0	0	0	0	0	-1	-1	-1	0	-1	-1	-1	-1	0	0	-1	0	1	1	0	-0.26
	Removal of surface soils	0	-1	-1	0	-1	-1	-1	-1	-1	0	0	0	-1	-1	-1	0	-1	-1	-1	-1	0	0	-1	0	1	1	0	-0.48
	Construction of access road and approaches	0	-1	-1	0	-1	-1	0	0	-1	0	0	0	-1	-1	-1	0	-1	-1	-1	-1	0	0	-1	-1	1	1	0	-0.44
	Grading of site	0	0	0	0	-1	0	0	0	0	0	0	0	-1	-1	-1	0	-1	-1	-1	-1	0	0	-1	0	1	1	0	-0.26
	Installation of gravel pad	0	0	0	0	-1	0	0	0	0	0	0	0	-1	-1	-1	0	-1	-1	-1	-1	0	0	-1	0	1	1	0	-0.26
	Transformers & control building installation, wiring, finishing	0	0	0	0	-1	0	0	0	0	0	0	0	-1	-1	-1	0	-1	-1	-1	-1	0	0	-1	0	1	1	0	-0.26
	Reclamation of surface soils	0	1	1	0	-1	1	0	0	1	0	1	1	1	1	-1	0	1	-1	-1	-1	0	0	-1	1	1	1	0	0.22
	AVERAGE	0.00	-0.23	-0.18	-0.14	-1.00	-0.14	-0.36	-0.36	-0.09	0.00	-0.32	-0.32	-0.91	-0.91	-1.00	-0.05	-0.82	-1.00	-1.00	-1.00	0.00	-0.05	-1.00	-0.09	1.00	1.00	0.00	-0.33

Table 27. Environmental Impact Matrix (modified Leopold Matrix)

Environmental Component → / Project Component ↓		PHYSICAL ENVIRONMENT						BIOLOGICAL ENVIRONMENT												SOCIAL/CULTURAL ENVIRONMENT										
								FLORA				FAUNA																		
		Agricultural Land	Soils	Surface Water Quality	Ground Water Quality	Air Quality	Wetlands	Trees	Shrubs	Aquatic Vegetation	Species at Risk - Vegetation	Birds	Bats	Ungulates	Carnivores	Small Mammals	Reptiles/Amphibians	Barriers to Movement	Corridor Creation	Residential	Noise	Historical Resources	Health & Safety (Public)	Recreation (i.e. hunting)	Scenic Qualities	Economics for Individual Landowners	Economics for community at large	Economics for Municipalities	Weights	Mean
Operations & Maintenance																														
Turbines	Production of electricty by turbines	0	0	0	0	1	0	0	0	0	0	-1	-1	0	0	0	0	-1	-1	-1	-1	0	0	-1	-1	1	1	1	98.000%	-0.15
	Weed control	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0.286%	0.11
	Reclamation of disturbed soils	0	1	0	0	0	0	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0.286%	0.26
	Grading and road maintenance	0	0	0	0	0	0	0	0	0	0	-1	0	-1	-1	-1	0	-1	-1	-1	-1	0	-1	-1	-1	1	1	0	0.286%	-0.33
	Turbine maintenance	0	0	0	0	0	0	0	0	0	0	0	0	-1	-1	0	0	-1	-1	0	0	0	0	-1	0	0	1	0	0.286%	-0.15
Power lines/Transformer Station	Facility maintenance	0	0	0	0	0	0	0	0	0	0	0	0	-1	-1	0	0	-1	-1	-1	0	0	0	-1	0	0	1	0	0.286%	-0.19
	Testing of equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	-1	0	0	0	0	-1	0	0	1	0	0.286%	-0.07
	Line maintenance as required	0	0	0	0	0	0	0	0	0	0	-1	0	-1	0	0	0	-1	-1	-1	0	0	0	-1	0	0	1	0	0.286%	-0.19
	AVERAGE	0.00	0.01	0.00	0.00	0.98	0.00	0.00	0.00	0.00	0.00	-0.99	-0.98	-0.01	-0.01	-0.01	-0.00	-0.99	-0.99	-0.99	-0.98	0.00	-0.00	-0.99	-0.98	0.99	1.00	0.98		-0.15
Decommissioning																														**Mean**
Turbines & Access	Removal of tower and turbine infrastructure	0	0	0	0	-1	0	0	0	0	0	0	1	-1	-1	0	0	0	1	-1	-1	0	0	-1	-1	1	-1	1		-0.15
	Removal of transformers	0	0	0	0	-1	0	0	0	0	0	0	1	-1	-1	0	0	0	1	-1	-1	0	0	-1	-1	1	-1	1		-0.15
	Partial excavation and removal of cement base to depth >1.5 meters	0	0	0	0	-1	0	0	0	0	0	0	0	-1	-1	0	0	0	0	0	0	0	0	0	0	0	-1	1		-0.11
	Removal of gravel pads and gravel from access	0	0	0	0	-1	0	0	0	0	0	0	0	-1	-1	1	1	0	1	0	0	0	0	0	0	0	-1	1		0.00
	Recontouring of pad and access roads	0	0	0	0	-1	0	0	0	1	0	0	0	-1	-1	1	1	0	1	0	0	0	0	0	0	0	-1	1		0.04
	Reclamation of surface soils	0	1	1	0	-1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	-1	1		0.52
	Re-seeding/Re-vegetation	0	1	1	1	-1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	0	0	0	1	0	-1	-1		0.52
Power Lines/ Transformer Station	Removal of above ground poles and lines	0	0	0	0	-1	0	0	0	0	0	0	1	1	1	1	1	0	1	1	-1	0	0	-1	1	1	-1	1		0.22
	Removal of transformer station and associated infrastructure	0	0	0	0	-1	0	0	0	0	0	0	1	1	1	1	1	0	1	1	-1	0	0	-1	1	1	-1	1		0.22
	Removal of gravel pads	0	0	0	0	-1	0	0	0	0	0	0	1	0	1	1	1	0	1	1	1	0	0	0	1	0	-1	1		0.26
	Removal of interconnection lines and infrastructure	0	0	0	0	-1	0	0	0	0	0	0	1	1	1	1	1	0	1	1	-1	0	0	-1	1	1	-1	1		0.22
	Removal of access roads	0	0	0	0	-1	1	0	0	1	0	0	1	1	1	1	1	0	1	1	1	0	0	0	1	1	-1	1		0.41
	Recontouring of pad and access roads	0	0	0	0	-1	0	0	0	1	0	0	1	1	1	1	1	0	1	1	1	0	0	0	1	0	-1	1		0.33
	Reclamation of surface soils	0	1	1	0	-1	0	1	1	1	0	1	1	1	1	1	1	0	1	1	1	0	0	0	1	0	-1	1		0.52
	Re-vegetation	0	1	1	1	-1	0	1	1	1	0	1	1	1	1	1	1	0	1	1	1	0	0	0	1	1	-1	1		0.59
	AVERAGE	0.00	0.27	0.27	0.13	-1.00	0.20	0.27	0.27	0.47	0.00	0.13	0.80	0.27	0.33	0.80	0.80	0.13	0.93	0.53	0.13	0.00	0.00	-0.33	0.47	0.47	-1.00	0.87		0.23

Table 27. Environmental Impact Matrix (modified Leopold Matrix)

Environmental Component →		PHYSICAL ENVIRONMENT						BIOLOGICAL ENVIRONMENT												SOCIAL/CULTURAL ENVIRONMENT										
								FLORA				FAUNA																		
Project Component ↓		Agricultural Land	Soils	Surface Water Quality	Ground Water Quality	Air Quality	Wetlands	Trees	Shrubs	Aquatic Vegetation	Species at Risk - Vegetation	Birds	Bats	Ungulates	Carnivores	Small Mammals	Reptiles/Amphibians	Barriers to Movement	Corridor Creation	Residential	Noise	Historical Resources	Health & Safety (Public)	Recreation (i.e. hunting)	Scenic Qualities	Economics for Individual Landowners	Economics for community at large	Economics for Municipalities		
Project Timeline	**2012 - 2041**	**% of Project Timeline**																												
Construction	2 years	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%		7%
Operation	25 years	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%		86%
Reclamation	2 years	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%		7%
TOTAL	**29 years**																													
	Averages																													
	Construction	0.00	-0.23	-0.18	-0.14	-1.00	-0.14	-0.36	-0.36	-0.09	0.00	-0.32	-0.32	-0.91	-0.91	-1.00	-0.05	-0.82	-1.00	-1.00	-1.00	0.00	-0.05	-1.00	-0.09	1.00	1.00	0.00		-0.33
	Operation	0.00	0.01	0.00	0.00	0.98	0.00	0.00	0.00	0.00	0.00	-0.99	-0.98	-0.01	-0.01	-0.01	-0.00	-0.99	-0.99	-0.99	-0.98	0.00	-0.00	-0.99	-0.98	0.99	1.00	0.98		-0.15
	Reclamation	0.00	0.27	0.27	0.13	-1.00	0.20	0.27	0.27	0.47	0.00	0.13	0.80	0.27	0.33	0.80	0.80	0.13	0.93	0.53	0.13	0.00	0.00	-0.33	0.47	0.47	-1.00	0.87		0.23
	Weighted Average	**0.00**	**0.01**	**0.01**	**-0.00**	**0.71**	**0.00**	**-0.00**	**-0.00**	**0.03**	**0.00**	**-0.86**	**-0.81**	**-0.05**	**-0.04**	**-0.02**	**0.05**	**-0.90**	**-0.86**	**-0.88**	**-0.91**	**0.00**	**-0.01**	**-0.95**	**-0.82**	**0.95**	**0.86**	**0.90**		**-0.13**

LEGEND

Negative Effect	-1
Neutral (No perceived effect)	0
Positive Effect	1

The impact of different *Project component*s on a single *environmental component* has been tracked. In this example, we look at the outcome of all *Project components* on the *environmental component* Soils.

1. In this column, the average effect of the all *Project component*s on Soils, for the construction duration only, is -0.23. This suggests that overall, the construction duration for the wind Project will have a negative effect on Soils. As this value (-0.23) is closer to 0 (neutral) than -1 (negative), the perceived effect is borderline neutral due to reclamation practices and mitigation which can be used, with some overall negative impacts (i.e. loss of soil integrity due to use during construction);

2. Continuing in this column, the average effect of the all *Project component*s on Soils, for the Operations duration only, is 0.0. That suggests, that overall, the operation duration for the wind Project will have a neutral effect on Soils. This is because following construction, areas that are no longer required will be reclaimed. In addition, weed control and re-seeding of disturbed sites will have a positive impact on Soils;

3. In the Soils column, the average effect of the all *Project component* for the Decommissioning duration only, is 0.27. That suggests, that overall, the reclamation duration for the wind Project will have a positive effect on Soils. This is because following operations, areas that are no longer required will be reclaimed and put back into forestry production;

4. At the bottom of Table 27, the reader should note that the averages for each Project stage (i.e. Construction, Operations, Reclamation) are summarized for each *environmental component* (columns);

5. Finally a weighted average has been determined for the overall Project, for each *environmental component*. The Weighted Average is necessary as different life cycle stages account for different percentages of the total Project timeline. Continuing with the previous example, the average impact of Construction on Soils is -0.23; the average impact of Operation on Soils is 0.0; and the average impact of Decommissioning on Soils is 0.27. However, both the Construction and Decommissioning stages each account for 7% of the total Project timeline (14% of the total Project timeline). Whereas the Operation stage accounts for 86% of the total Project timeline. As such, impacts associated with the Operation stage, are weighted accordingly as these impacts will be experienced for 86% of the total Project timeframe.

6. The resulting average impact of the overall Project on Soils is therefore calculated as 0.01. As such, the effect of the Project is considered neutral.

7. For Operation stages, a Weighted Average within the category is also necessary. This is due to the fact that the production of the wind energy by spinning turbine blades will likely account for 98% of operational activities on the site. The remaining components listed under Operational will account for 2% of the total time frame. As such, impacts associated with the production of electricity by spinning turbines are weighted accordingly as these impacts will be experienced for 98% of the total Project timeframe.

16.5 Discussion of Effects

16.5.1 Construction Phase

The results of the effects input into Table 27 indicate that throughout the Construction phase, impacts from the *Project components* on *environmental components* are negative; as one might expect. This is due to the extent of equipment, materials, labor, and construction requirements affecting most of the environmental components listed. The average impact across all *environmental components* is estimated at -0.33, suggesting an overall negative impact, with a slight skewness towards neutral.

The greatest negative impact on the Physical Environment will be associated with Air Quality due to the amount of emissions associated with construction from machinery, particulates and dust from roads and soils displacement during construction.

The greatest impacts on the Biological Environment will be on wildlife (as a result of displacement due to activity), establishment of barriers to movement for all wildlife, and corridor creation for wildlife. Neutral impacts will be associated with loss of vegetation as much of the impacts associated with vegetation loss will be mitigated.

The greatest impacts on the Social/Cultural Environment will be associated with effects to Residents, Noise, and Recreation of the area. All of these components will be negatively affected as a result of increased activity. For example, it is not anticipated that Safety or Health concerns will result directly from construction, however the increase in activity may increase the probability of an accident over what currently exists in the Project area. Economic effects are considered positive due to revenues and wages to local contractors, and effects to Historical resources are considered neutral as none were present or expected.

16.5.2 Operations Phase

The results of the perceived effects input into Table 27 indicate that throughout the Operations phase, the overall impacts from the *Project components* on *environmental components* are considered neutral, with a slight skew negative (-0.08).

With that in mind, weighted averages suggest that the greatest impacts on the Physical Environmental will be associated with Air Quality but will be positive. This is due to the lack of emissions associated with Project during operation, and the offset of equivalent emissions that would have occurred in the absence of the Project. This positive effect is more regional in nature.

The greatest negative impacts on the Biological Environment will be associated with Birds and Bats due to expected mortalities. Furthermore, spinning turbines will create barriers to movement to only Birds and Bats, and likely create corridors to movement for Birds and Bats. Limited negative effects to Small Mammals may occur as a result of road creation creating barriers to movement Neutral impacts will be associated with loss of vegetation as much of the impacts associated with vegetation loss will already be experienced during construction, and interim reclamation will re-establish disturbed areas. Neutral effects to other wildlife species are expected.

The greatest impacts on the Social/Cultural Environment will be associated with effects to Residents, Noise, Recreation, and Scenic Qualities of the area. All of these components will be negatively affected as a result of turbine operations. Economic effects are considered positive due to operational revenues associated with power sales, taxes, or other financial agreements to local Landowners, the Community at Large, and Municipalities.

16.5.3 Decommissioning Phase

The results of the perceived effects input into Table 27 indicate that throughout the Decommissioning phase, impacts from the *Project components* on *environmental components* are positive; as one might expect. This is due to the fact that the re-establishment of ecosystem components will result from the reclamation process, affecting most of the environmental components listed. The average impact across all *environmental components* is estimated at 0.23, suggesting an overall positive impact, with a slight skewness towards neutral.

The greatest negative impacts on the Physical Environment will be associated with Air Quality due to the amount of emissions associated with construction from machinery, particulates and dust from roads and soils displacement during reclamation. In contrast, the greatest positive impacts will be associated with the restoration of the lands within the Project boundaries.

All impacts on the Biological Environment are expected to be positive as the removal of equipment and reclamation of the ecological components will result.

The greatest impacts on the Social/Cultural Environment will be associated with negative effects to Recreation, Scenic Qualities, Economics for Landowners, Economics for Community at Large, and Economics for Municipalities. All of these components will be negatively affected as a result of increased activity. For example, economic effects are considered negative due to loss of operational revenues associated with power sales, taxes, or other financial agreements.

16.5.4 Overall Effects

The bottom of Table 27 summarizes the Weighted Averages of all *Project components* on individual *Environmental components.*

Within the Physical Environment, the greatest overall effect is associated with changes in Air Quality (+0.71). This is due to weighting of the regional effects of the reduction in Greenhouse Gas Emissions (GHG) from the Project when one considers if the production of the same amount of power over 25 years resulted from standard practices of Coal burning in the region. Over the timeframe of the Project, other effects are considered neutral.

Within the Biological Environment, the greatest overall effects are associated with negative impacts to Birds (-0.86) and Bats (-0.81). The Project is also expected to result in Barriers to Movement (-0.90) and Corridor Creation (-086). This is also due to weighting of the Operations Phase in the calculation of these averages. All other impacts effects are considered neutral.

Within the Social/Cultural Environment, the greatest overall effects are associated with negative impacts to Residential (-0.88), Noise (-0.90), Recreation (-0.95) and Scenic Qualities (-0.82). In contrast, significant positive impacts are associated with economic effects to local Landowners (+0.92), the Community at Large (0.86), and Municipalities (+0.84).

The overall Project effects are a weighted average of the effects of the Project on all components during Construction, Operation, and Reclamation. Overall impacts during Construction are -0.33, during Operation are -0.15, and during Decommissioning are +0.23. Due to weighting of the means, the overall Project effect is -0.13, negative, but almost neutral.

Table 26. Summary of Environmental Effects with Negative Outcomes

Project Activities	Environmental Components	Impacts	Mitigation	Residual Effects	Level of Residual Impacts
Construction	**Soil**	Removal of soils	Effective soil stripping and replacement in non essential areas	None	Low
	Air Quality	Increase in emissions at local level due to increased traffic Increase in Dust	Dust control implemented	None	Low due to lack of residents in area
	Vegetation	Removal of vegetation	None	None	High
	Birds	Removal of Habitat	Avoidance of habitat identified in EA; Clearing of vegetation outside nesting seasons	Habitat loss	High
	Bats	Removal of Habitat	Avoidance of habitat	Habitat loss	High
	Ungulates	Removal of Habitat	Avoidance of habitat Avoidance of clearing during reproductive periods	Habitat loss	High
	Carnivores	Removal of Habitat	Avoidance of habitat	Habitat loss	High
	Movement of Species	Removal of Habitat Increase in noise causing spp to avoid area	Avoidance of habitat	Habitat loss	High
	Residents	Increase in noise and disturbance due to increases in construction traffic	Avoid primary access near residents; Dust control; Maintain open communications and dialogue with effected residents;	None	Low
	Noise	Increase in noise and disturbance due to increases in construction traffic	Operations during normal working hours;	None	Low
	Recreation	Loss of recreation use of the area (i.e. hunting; ATV)	Consultation with public and local recreation groups;	None	Low

Project Activities	Environmental Components	Impacts	Mitigation	Residual Effects	Level of Residual Impacts
Operations	**Birds**	Bird strikes	Monitor and complete carcass searches. If large number of species or individuals being struck, mitigate in consultation with Canadian Wildlife Service. Mitigation may involve shut down periods, higher wind speed startup.	Complete monitoring and mitigation as required	Environmental assessment and monitoring at Glen Dhu North suggest impacts expected and appear to date to be Low.
	Bats	Bat strikes	Monitor and complete carcass searches. If large number of species or individuals being struck, mitigate in consultation with Canadian Wildlife Service. Mitigation may involve shut down periods, higher wind speed startup.	Complete monitoring and mitigation as required	Environmental assessment and monitoring at Glen Dhu North suggest impacts expected and appear to date to be Low.
	Residents	Noise Shadow flicker	Setbacks as per federal and provincial requirements maintained.	None	Low
	Noise	See Residents	See Residents	See Residents	See Residents
	Recreation (i.e. Hunting)	Loss of hunting habitat around turbines	Loss of hunting areas mitigated by fact new access will open previously inaccessible areas.	Ongoing	Low
	Scenic Qualities	Visual impacts to landscape	None available	Ongoing	Low – Moderate depending upon specific observer.
Decommissioning	**Air Quality**	Increase in emissions at local level due to increased traffic Increase in Dust	Dust control implemented	None	Low due to lack of residents in area
	Health & Safety of Residents	Increase in traffic at local level due to equipment requirements for decommissioning	All municipal, provincial, and federal transport regulations followed.	None	Low due to lack of residents in area

17 CONSULTATION SUMMARY

17.1 Public Consultation

Shear Wind believes that open, honest and transparent relationships are essential to their success. SWI also believes that communities have a right to know about its activities in those communities. To this end SWI attempts to structure its community involvement program to:

- Ensure all stakeholders have the opportunity to learn about operations, and Projects, and are able to provide input;
- Create a positive relationship with stakeholders through community involvement and community investment;
- Work within the Project timeline;
- Resolve issues in a timely, friendly manner; and
- Do the right thing and be seen doing the right thing.

Community involvement at the Glen Dhu Project has been on-going since the commencement of the planning process for Glen Dhu North in 2007. Shear Wind has had a real presence in the communities surrounding the Project since 2007 with a site office present since 2009. A community liaison committee was formed with the approval of the Glen Dhu North wind Project and newsletters have been distributed across the area for the past two years. Community involvement activities associated with the Glen Dhu South Project to date include:

- A Community Liaison Committee (CLC) has been formed for the proposed Glen Dhu South Project. The CLC is being coordinated by John Kearney, from Arisaig, and the committee chair is Mandy Dewar, from Marshy's Hope. The CLC had an introductory meeting on November 8, 2011. The purpose of this meeting was to review he Terms of Reference and to give a Project update. The committee members are:
  - John Kearney, Arisaig
  - Mandy Dewar, Marshy's Hope
  - Adam Williams, Barney's River Station
  - Jean Robertson, Weaver's Mountain
  - Ley Cheverie, Weaver's Mountain
  - Orville Mason, Barney's River
  - Kelly McVicar, Pictou County RDA and Area 1 Councillor

The majority of the CLC members also attended the Open House Session conducted by Shear Wind on September 19, 2011. The next meeting is planned for mid-January, 2012.

- Representatives from SWI provided letters and email updates to Landowners on a regular basis to provide all preliminary information on the Project and to afford the landowners an opportunity to provide feedback on the Project;

- On August 21, 2011, Shear Wind Inc. hosted a community picnic at the Lismore Community Centre to celebrate the community's integral role in the success of the Glen Dhu North Wind Power Project. SWI took the opportunity at this picnic to introduce the Glen Dhu South Wind Power Project to the local community with a series of poster boards, and updates on the environmental assessment process which was on-going.

- Shear Wind representatives are in continuous discussions with the local MLA, Clarrie MacKinnon, the regional development authority (RDA) and the local councilor, Kelly McVicar, Councillor District 1, Pictou County.

- On September 19, 2011, SWI hosted an open house at the Kenzieville and District Community Centre (1-3 pm, and 5-7 pm). This provided landowners, residents and other interested parties an opportunity to view and discuss with SWI representatives (3 in attendance) information on the Project and wind power in general. The Project was introduced to the community through a series of poster boards describing the Project, the environmental assessment process, bird and bat studies, and proposed and expected timelines and the role of the Request for Proposal process with the Government of Nova Scotia.
    - At least 33 people attended the Open House (as indicated by signatures on the sign in sheet provided at the front door);
    - Attendees were encouraged to fill out comment cards. 21 comment cards were received. 20 encouraged the Project, and 1 was against the Project.

Photo 16. Public Open House on September 19, 2011

- On December 14, 2011, SWI hosted a second open house at the Kenzieville and District Community Centre (5-8 pm). This provided landowners, residents and other interested parties an update on Project information including the results of sound assessments and possible turbine locations. SWI representatives (3 in attendance) were on hand to provide information on the Project and wind power in general. Details of the Project were shown to the community through a series of poster boards describing the Project, the environmental assessment process, bird and bat studies, sound assessment results, proposed turbine locations, and proposed and expected timelines and the role of the Request for Proposal process with the Government of Nova Scotia.

    - At least 23 people attended the Open House (as indicated by signatures on the sign in sheet provided at the front door);
    - Attendees were encouraged to fill out comment cards. 6 comment cards were received. All 6 encouraged the Project.

- In advance of each open house completed for Glen Dhu South, over 600 flyers (two time) were distributed by hand to properties in the surrounding communities. These flyers announced the open house dates and location, as well as opened the line of communication directly with the Shear Wind team if people had questions, comments or concerns, by providing each household with local contact information for Shear Wind.

At the time of submission of the environmental assessment registration document, no concerns have been expressed by the public to SWI, through direct contact and questions at open houses. Several local residents have asked questions relating to potential cumulative effects of turbine noise when the Glen Dhu South Project is constructed. SWI has assured these residents that the sound assessment was completed taking into consideration cumulative effects from Glen Dhu North and Glen Dhu South.

17.2 *Mi'kmaq Consultation & Traditional Use*

The following summarizes consultation which has been completed and the outcomes based upon issues identified during consultation(s).

1. In March 2011, SWI contracted the Confederacy of Mainland Mi'kmaq Environmental Services (Sid Peters) to complete a Traditional Ecological Knowledge Study (MEKS) for the Glen Dhu South Wind Power Project. This Project was completed in August 2011, and the results are reporting herein.
2. On July 19, 2011, Meghan Milloy spoke with Twila Gaudet, *Consultation Liaison Officer,* Kwilmu'kw Maw-Klusuaqn Negotiation Office Mi'kmaq Rights Initiative. At this time, Ms. Milloy provided a verbal update of the Glen Dhu South Project description,

indicated that a Traditional Ecological Knowledge Study (MEKs) was being undertaken by Confederacy of Mainland Mi'kmaq Environmental Services (Sid Peters), and requested an opportunity to present the Project to the Mi'kmaq chiefs or an equivalent group/forum;

3. On August 2, 2011, Meghan Milloy spoke with Jay Hartling, Director of Consultation at the Nova Scotia Office of Aboriginal Affairs (OAA) regarding the Glen Dhu South proposed wind power Project. Jay asked to ensure that communication was occurring with the KMK through Twila Gaudet and also suggested that a draft version of the environmental assessment registration document could be offered to the KMK for review.
4. On October 18, 2011, Meghan Milloy left a voice message for Twila Gaudet at the KMK to follow up on the conversation from July 2011 where Ms. Gaudet was going to talk to the chiefs to confirm an appropriate forum for SWI to introduce the wind power Project to the Mi'kmaq chiefs.
5. On November 10, 2011, Meghan Milloy spoke to Twila Gaudet to follow up regarding a forum to introduce the Glen Dhu South wind power Project to the Mi'kmaq chiefs. Ms. Gaudet indicated she'd follow up with the Project team the next week.
6. On November 16, 2011, Meghan Milloy left an additional message for Ms. Gaudet to contact us regarding Mi'kmaq consultation for the Glen Dhu South Project.
7. A copy of the draft environmental assessment registration document was shared with the KMK on December 27, 2011 (sent by email to Twila Gaudet and Melissa Nevin).

At the time of submission of the environmental assessment registration document, no concerns have been expressed by aboriginal people to SWI, through direct contact, questions at open houses and direct communication with the KMK.

18 CONCLUSIONS

The field data, regulatory information and subsequent conclusions presented within this assessment indicate there are no significant environmental concerns or impacts resulting from the Glen Dhu South Wind Power Project that cannot be effectively mitigated. The impacts that are expected to result from the Glen Dhu South Wind Power Project, in addition to the anticipated success of mitigation, continue to be demonstrated at the existing Glen Dhu WPP.

Standard construction mitigation methods will be implemented during all phases of the building of the Project to ensure there are no significant impacts of the Project on Valued Ecosystem Components (VEC). These methods were included in the development of the Environmental Protection Plan (EPP) which is included as part of this assessment.

The total NEW disturbance that will result from the Project is 87.32 hectares. This is an increase in disturbance within the Project lands of only 3.3%. The Project will create an additional 38 hectares of clearing for road upgrades and use. However, following construction only single daily visits will be required. Therefore the associated traffic increases into the area are not expected to be significant. Furthermore, all major access points to the Project lands are currently in use. Further road expansion required for the Project will be off these existing road networks to the Turbines.

As a result of consultation with NS DNR, SWI has agreed to adjust the placement of the turbines to reduce the overall footprint of the project. Revising the turbine placements for both the 50 MW and 80 MW layouts significantly reduce the overall footprint of the project by eliminating 977 ha of land base from the southeast section of the Project lands for the 80 MW layouts (35% of original land area) and 1425 ha of land base south of Highway 104 for the 50 MW layouts (52% of original land area).

Turbines are located between 350 metres and 700 metres apart within the same geographic areas (i.e. North of Highway 104). This separation is expected to allow continued movement of Moose from East/West through the lands.

Natural areas remaining following Project construction will continue to include disturbed and undisturbed tracts of forests, wetlands, or stands of trees or other vegetation within the Project. These areas will continue to account for 93% of the land base. These forested natural areas are continuous, and provide suitable habitat, travelling corridors, thermal and security cover for wildlife, and are representative of forest systems throughout the Project area. Habitat fragmentation will occur from the Project but remaining habitat areas are expected to provide suitable travel corridors during operation.

Species at risk inventories within the Project revealed that no flora species at risk are anticipated to be impacted. It is known that Mainland Moose use the Project Area. However, it continues to remain unknown how Mainland moose move through the area, at what times, or in what numbers. However, Shear Wind Inc. is committed to playing a role in continued monitoring and research associated with the Mainland Moose in Nova Scotia to help answer these questions.

There are no areas of cultural significance identified during assessments of historical resources. As well there are no adverse effects anticipated on health and socio-economic conditions, physical and cultural heritage areas, traditional land use, and traditional structures or sites as a result of environmental changes from the Project.

Shear Wind has exceeded all required Pictou County municipal setbacks from property lines and homes, with the closest home being located 609 metres from a turbine. Sound models indicate that the regulatory criteria of 45 dBA for sound at any of the receptors is not expected to be exceeded.

Both McCallum Environmental Ltd. and Shear Wind Inc. are confident that the community-at-large support the development of this Project. The continued work with the Community Liason Committee (CLC) for the existing Glen Dhu WPP, the establishment of a new CLC committee for this Project, past public consultation, ongoing consultation, and positive feedback received from the communities in proximity, for both the existing Glen Dhu WPP, and this proposed Project, suggest that community support for this Project is positive. Shear Wind Inc. will continue to conduct public consultation on this Project.

The magnitude of disturbance and risk associated with the Project are all considered minor given the abundance of similar VEC within the Project area and the mitigation techniques and technologies currently available. Furthermore this assessment concludes there are no significant environmental concerns and no significant impacts expected that cannot be effectively mitigated through well established and acceptable practices, or ongoing monitoring and response.

19 Limitations

Constraints Analysis

- On some maps, land use or land cover is defined everywhere to form a complete mosaic of polygons. On topographic maps landuse/landcover is depicted only in certain areas. The source data in some cases may need to be conditioned to allow the second type of depiction if it is a mosaic, and certain constraints will operate differently in each case (Agent Consortium, 2001); and,
- Conflicts that might exist between objects in a database are typically of a logical nature, such as topological inconsistencies or duplicate identifiers. We attempted to ensure that our database has addressed any potential inconsistencies, however inconsistencies may still occur. In map generalization, the vast majority of conflicts are physical, spatial consequences of reducing map scale. The greater the degree of scale change, the more cluttered an un-generalized map will be, and this signals the extents of potential conflicts in presentation of the data.

Limitations incurred at the time of the assessment include:

- McCallum Environmental Ltd. has relied in good faith upon the evaluation and conclusions in all third party assessments. McCallum Environmental Ltd. relies upon these representations and information provided but can make no warranty as to accuracy of information provided;

- There are a potentially infinite number of methods in which human activity can influence wildlife behaviors and populations and merely demonstrating that one factor is not operative does not negate the influence of the remainder of possible factors;
- The environmental assessment provides an inventory based on acceptable industry methodologies. A single assessment may not define the absolute status of site conditions;
- Effects of impacts separated in time and space that may affect the areas in question, have not been not been included in this assessment.

General Limitations incurred include:

- Classification and identification of soils, vegetation, wildlife, and general environmental characteristics (i.e. vegetation concentrations, and wildlife usage) have been based upon commonly accepted practices in environmental consulting. Classification and identification of these factors are judgmental and even comprehensive sampling and testing programs, implemented with the appropriate equipment by experienced personnel, may not identify all factors;
- All reasonable assessment programs will involve an inherent risk that some conditions will not be detected and all reports summarizing such investigations will be based on assumptions of what characteristics may exist between the sample points.

20 Glossary

Balance of Plant (BOP): the infrastructure of a wind farm Project, in other words all elements of the wind farm, excluding the turbines. Includes civil works, SCADA and internal electrical system. It may also include elements of the grid connection.

System Interconnection Study (SIS): A study that evaluates the impact of new generation to the interconnected transmission system, to confirm that it will have no negative reliability impact.

Wake Loss: Wind turbines extract energy from the wind and downstream there is a wake from the wind turbine, where wind speed is reduced. As the flow proceeds downstream, there is a spreading of the wake and the wake recovers towards free stream conditions. The wake effect is the aggregated influence on the energy production of the wind farm, which results from the changes in wind speed caused by the impact of the turbines on each other.

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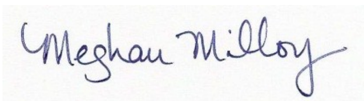
22 Certification

This Report has considered relevant factors and influences pertinent within the scope of the assessment and has completed and provided relevant information in accordance with the methodologies described.

The undersigned has considered relevant factors and influences pertinent within the scope of the assessment and written, and combined and referenced the report accordingly.



Meghan Milloy,
Sr. Project Manager
McCallum Environmental Ltd.

I have reviewed the information as submitted and completed this report in conformity with the Code of Ethics and the Duties of Professional Biologists and good industry practice.

Respectfully submitted,

Robert McCallum, P.Biol
President
McCallum Environmental Ltd.