Warren Corridor Conservation Area:

Ecological Inventory and Assessment

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Table of Contents

1 Introduction

In 2015, the Warren Conservation Commission requested an ecological inventory and assessment of the Warren Corridor Conservation Area (previously known as the Top Gas Parcel, owned by Bruce Jacobs) in Warren, Vermont. This ~61 acre parcel was recently donated to the Town of Warren, and proposals have been put forth for developing recreational and other uses on the property.

In order to evaluate potential uses, the Warren Conservation Commission wishes to understand the conservation and ecological values of the parcel and to receive recommendations on uses that are compatible with wildlife and natural features that may be present on, or passing through, the site. The current report describes Arrowwood Environmental's assessment of this parcel and provides recommendations on these natural resources.

2 Project Components & Methodology

Arrowwood Environmental (AE) conducted an ecological assessment for the town of Warren in 2007-2008 (AE, 2008). In 2014, AE completed an assessment of several potential wildlife corridors within the Town of Warren (AE, 2014). The results of these previous projects were incorporated as base data for the inventory of the Warren Corridor Conservation Area (WCCA).

Arrowwood employed several techniques to investigate and assess the ecological function, wildlife habitats, and natural communities of the WCCA. Initial investigation of site data was conducted remotely utilizing geographic information system (GIS) mapping and analysis tools. During this phase, existing data was reviewed as were findings from previous habitat and environmental assessment projects.

Existing data and maps were distilled into relevant components and employed in field maps and on handheld GPS devices to guide field evaluations conducted from February 2015 through August 2016.

Field evaluations on the WCCA parcel were conducted on 5 separate days as detailed in Table 1.

Table 1. Field Visits

Date	Activity	Conditions	Comments
Feb. 14, 2016	Tracking, Camera deployment (1&2), Habitat investigation		
March 4, 2016	Tracking , Camera deployment (4) Camera download (1&2), Habitat investigation	Very limited snow cover	Tracking not effective due to lack of snow
March 30, 2016	Camera Download, Habitat investigation		
May 20, 2016	Camera retrieval, Bird Habitat assessment, River observations	Sunny, 60s. Spring leaf-out begun	
Aug. 19, 2016	Natural Community & Wetland Assessment	Sunny	Good conditions for mapping natural communities

2.1 Winter Wildlife Tracking

Winter wildlife tracking was initially proposed as a major component of this project with the intended goal of developing an understanding of animal diversity, abundance, habitat utilization, and spatial distribution within the WCCA parcel. Unfortunately the winter of 2015/2016 was largely snow-free, resulting in very few opportunities for effective winter tracking.

Repeated winter tracking exercises are typically conducted over the course of the winter tracking season, ideally 2-3 days following a fresh snowfall. This insures the tracker is able to identify repeated patterns, ongoing animal behavior, and temporal species presence without re-encountering tracks previously detected. Because so little snow fell in 2015/2016, and when it did it quickly melted, appropriate opportunities for tracking were extremely limited.

While tracking, an attempt to cover as much of the WCCA parcel as possible was made. All species tracks larger than that of small rodents (mice, moles, shrews) were recorded. In general bird tracks were not identified, except those of the Eastern turkey as well as any sign of forest avian predators such as hawks and owls. Tracks were identified to species based on tracks size, gait, and to a lesser extent, the behavior of the animal. Attempts were made to distinguish between tracks left by multiple animals and those left repeatedly by the same animal, but this determination was not always possible. Game trails, utilized by multiple animals were recorded as such and cardinal directions of the trails were noted. The relative age of tracks, trails, bedding areas, cratering in the snow, tree scrapings, and other signs of wildlife were assigned. The current and past weather conditions such as ambient temperatures and precipitation history aided in assigning age of animal sign.

2.2 Wildlife Remote Trigger Camera Deployment

AE employs remote trigger cameras, commonly referred to as "trail cameras" or "game cameras" for the detection of wildlife present in a local area over the course of time. Cameras are a low impact method of identifying what type of wildlife inhabit a particular area, and to a certain extent, the relative commonness or density of a particular species, guild of species or wildlife in general.

Remote cameras function by pairing a camera with a trigger device such that an animal passing in front of the camera triggers a photo or video. AE used Bushnell 8MP Trophy Cam HD Trail Cameras for the WCCA study. The Bushnell cameras record 8 megapixel digital images, are triggered by a passive infrared motion sensor and uses infrared LED flash for nighttime photos without the disturbance of a visible-light flash. The cameras record date and time for each photo taken.

Remote camera deployment can be used in two primary ways to detect wildlife. First, is placement of a camera at a known travel corridor, focused habitat or previously identified feature where wildlife presence can be documented. Second, is to use bait to draw animals in the vicinity to within trigger range of the camera.

For this initial assessment of the WCCA, AE used the bait method. Because we were unfamiliar with the wildlife patterns on the parcel and wanted to develop an initial overall understanding of what wildlife may be present on site, this was determined to be the best approach. As tracking activities and habitat investigations inform an understanding of wildlife movement and habitat utilization on the parcel, cameras on established travel paths might provide additional information.

The cameras were baited with butcher meat scraps placed in wire mesh bags approximately 12-16' in front of the cameras that were strapped to tree trunks approximately 4' off the ground. The scent from meat bait scraps does not travel long distances so it is likely that the baited animals were already on the WCCA parcel or in relatively close proximity to the property. The camera placements were chosen to capture three distinct areas of the parcel- low elevation near the river, mid elevation/central at a stream corridor and wetland complex, and upper elevation near a small stand of American beech trees.

Figure1. Remote camera attached to tree

Baited cameras are most effective during the winter months as freezing temperatures retard the rotting of the bait and the bait odor stays more locally contained. However, winter camera deployment will only capture animals that are active during the winter months. In addition, the choice of bait will draw certain animals over others. AE utilized butcher scraps specifically to capture the

presence of wide-ranging carnivores which can be considered umbrella species- i.e. Their presence can suggest healthy distribution of wildlife down the food chain. Even so, the activity around carnivore bait stations can result in photo captures of local herbivores as well as they come by to investigate the increased presence of other species or unfamiliar smells.

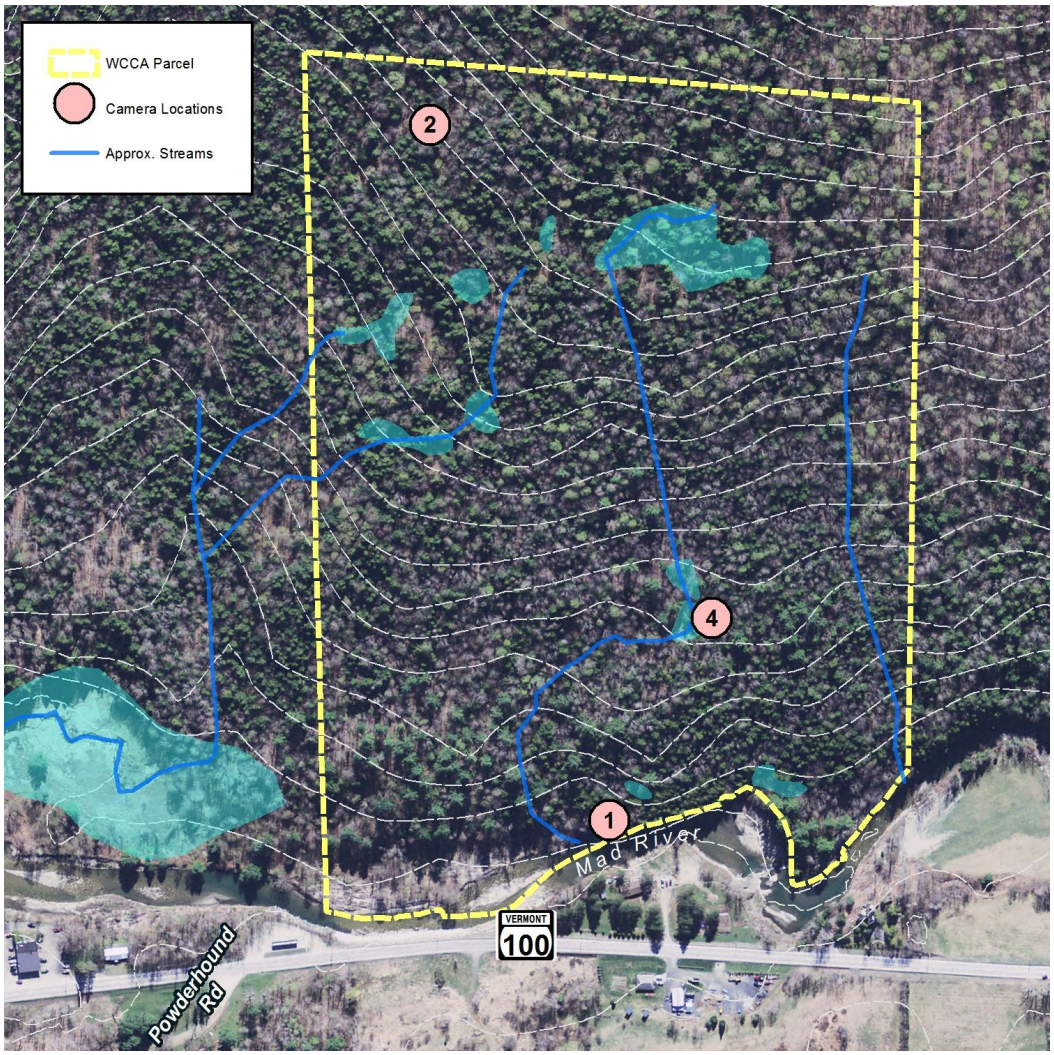

Figure 2. Map of Remote Camera locations

The cameras have removable memory cards that can hold many photos, so they do not need to be checked often. Camera memory cards were downloaded and camera operation checked twice following deployment, and once when they were removed in May, 2016.

Three cameras were deployed throughout the WCCA parcel. Cameras are identified by their internal numbering (1,2 and 4), which also appears in the timestamp on each photo.

2.3 Deer Winter Habitat Assessment

White-tailed deer living in those regions of Vermont with long, cold winters and snow depths exceeding 18" during winter months yard up in specific habitats dominated by forests consisting of larger stature (generally over 35') evergreen needle-leaved trees.

Effective deeryard forest structure consists of mature or mixed-age evergreen trees or mixed hardwood-evergreen trees with an overhead forest cover of at least 70% coniferous closed canopy. Eastern hemlock, northern white cedar, and spruce-fir trees are preferred by deer and provide deer the best protection from the winter elements. South-facing and west-facing deeryards are generally favored by deer, although active deeryards can occur on all aspects.

To determine actual winter use of a deeryard, deer pellet piles on top of the snow are noted and can be quantified. Areas of winter browsing by deer of woody stems are also noted and can be quantified. In addition, the relative amount of bark stripping activity on hardwood trees is noted and recorded. Deer digging or "cratering" down to the forest floor to gain access to potential foods is recorded. Well-used deer trails and beds (day and evening) are recorded. The amount of the above signs of active or past deer use can be assessed as either high (many), moderate (more than 1-2), or low (1-2) and as current (dating from the current winter) or historic (more than 1 year old).

Deeryard assessment can be methodical and employ a grid sampling system or qualitative, where the observer notes the relative amount of the above mentioned deer sign while conducting a random search of an area. The assessment conducted at the WCCA was more qualitative and combined with other project objectives.

2.4 River Corridor Assessment

The River Corridor was evaluated based primarily on existing data collected as part of a Phase 2 Geomorphic Assessment by the Friends of the Mad River in 2006.

Data collected and recorded in the Vt. Agency of Natural Resources River Management Data Management System was reviewed for the river reach and segment adjacent to the WCCA parcel. In addition, mapped river channel, bank and corridor features were examined and compared to current observations of the general river corridor condition.

2.5 Wetland & Upland Natural Community Mapping & Assessment

Upland and wetland natural community mapping was conducted using a combination of remote landscape analysis and field work. The natural community map created for the 2007-2008 inventory was used as a base map for the WCCA parcel, but unlike the town-wide inventory, the entire parcel could be walked and field-verified.

Many of the wetlands on the parcel were too small to be detected during the remote landscape mapping process. Field work in March-May identified the locations of wetlands as well as collected data on upland natural community composition which was used in August of 2016 to guide field work for more in-depth assessment.

In August, the entire parcel was walked and more data collected on natural community boundaries, composition and structure. Boundaries of wetlands and data on upland natural communities were mapped using mapping-grade GPS equipment which were used to update the natural community mapping previously conducted. Natural community classification, assessment and ranking methodologies are based on standards adopted by the Vermont Natural Heritage Inventory (NHI).

3 Analysis & Discussion

3.1 General Wildlife Presence & Habitat

The WCCA parcel is situated on the western edge of a Forest Habitat Block of almost 1000 acres and bordered to the west by the Mad River. The WCCA parcel is surrounded by similar sized forested habitats along Route 100. This forested parcel is connected to the extensive forest habitat to the east within the Northfield Mountains and perhaps less directly connected to the Green Mountains across Route 100 to the west.

Noise from cars and trucks as well as occasional sounds from houses and people are prevalent throughout the WCCA parcel, but diminish somewhat as one moves further uphill away from the river. The noise appears to have less effect on wildlife than one might expect, perhaps owing to the relative safety of the river's barrier effect and the lack of regular intrusion by people into the forested area.

AE observed habitat, tracks, and direct photo observations of a wide variety of wildlife, including wildlife that reside in Vermont's deep, remote core forests on the WCCA parcel. Black bear, eastern coyote, bobcat, fisher, mink, and river otter were either directly observed, or captured on remote cameras.

Figure3. Fisher Grooming in front of Camera 2

Figure 4. Bear and cubs at Camera 2

Figure 5. Bobcat at Camera 2

Figure 6. Coyotes at Cameras 1(left) and 4(right)

Figure 7. Fisher at Camera 2 and Mink at Camera 1 (for size comparison)

Figure 8. 5 Racoons at Camera 1

AE identified significant wildlife habitat on the parcel, including deer over-wintering habitat, a small beech stand, at least one bear den (which was occupied by a black bear over the course of the 2015/2016 winter) and riverine

habitat for river otter and mink. This Mad River riparian habitat was also utilized extensively for travel by eastern coyotes.

The black bear den consisted of 2 large boulders leaning against each other creating a large empty space occupied by a hibernating black bear. The bear remained at this site as late as our March 30th site visit . Another possible bear den was identified in a hollow tree snag within the area mapped as a beech stand in the northeastern corner of the property.

Figure 9. Black bear denning in early March

Remote cameras detected 11 species of wildlife (not counting rodents, squirrels and songbirds) during the 3 months they were deployed. There were some 59 individual events where at least one photo of a wildlife species was recorded. In all, 528 photos of wildlife species were collected. Table 2 below displays the

total camera events by species and camera ID (see map above). Table 3 illustrates the total number of photos per species/camera.

Species distribution among the camera sites was relatively uniform, with 5 different species detected at Camera 1 (west edge near river), 8 at Camera 2 (north east corner) and 6 at Camera 4 (central). Black bear and bobcat were only recorded on camera at Camera 2. This location is the most remote and isolated from the noise of Route 100, however bear and their sign were observed elsewhere on the property. Mink was recorded only at Camera 1 along the river, suggesting they may not frequently travel upslope along the smaller streams, but stay within the Mad River riparian corridor most of the time. Porcupine was seen only at Camera 4, in the center of the parcel, and this is most likely due to nearby ledgy habitat. Ledgy habitat are often used by porcupine for den sites. Coyote, fisher and racoon were recorded frequently at all camera locations suggesting they are moving throughout the parcel with some regularity. Red fox were also captured in more than one camera location and also likely move throughout the parcel.

Camera data can be analyzed, among other ways, by visit events or photo counts. Photo counts are totals of all wildlife photos taken by a given camera and can be sub-totaled by species or temporally. Visit events take into account multiple photos taken during a single visit by a particular individual wildlife species. By reviewing timestamps and photographs, each distinct visit can be tallied separately. Analysis of visit events removes count bias from one animal that spends considerable time at the camera with many photos recorded. Neither photo counts nor visit events distinguish between individual animals and multiple events may or may not be the result of multiple visits by the same individual.

Table 2. Visit Events by Species & Camera

Visits by Species & Camera				
Species	Camera ID			
	1	2	4	Total
Bear		5		5
Bobcat		1		1
Coyote	2	1	2	5
Deer		4	1	5
Fisher	3	20	1	24
Mink	1			1
Porcupine		1		1
Racoon	9	1	2	12
Red Fox		1		1
Skunk	1		1	2
Turkey			2	2
Total	**16**	**34**	**9**	**59**

Table 3. Photo Count by Species & Camera

Photo Count by Species & Camera				
Species	Camera ID			
	1	2	4	Total
Bear		158		158
Bobcat		9		9
Coyote	8	3	4	15
Deer		21	3	24
Fisher	15	183	9	207
Mink	3			3
Porcupine		15		15
Racoon	51	17	18	86
Red Fox		1		1
Skunk	3		2	5
Turkey			5	5
Total	**80**	**407**	**41**	**528**

Both visit events and photo counts were significantly greater in number at Camera 2, located furthest away from the noise and activity along the Route 100 corridor. 57% of the visit events and 77% of the photos taken were at Camera 2.

In total, a range of both more disturbance adapted (racoon, skunk) and more human averse (bear, bobcat, fisher) species were detected repeatedly throughout the WCCA parcel. This suggests that wildlife are moving freely throughout the area, but the shyer species appear to be focusing their activities on the more interior forest portions, away from the noise and human activity along Route 100. An exception was the location of the hibernating bear located a little more than 700 feet east of Route 100. The bear was under 2 rocks that, in a normal winter, would be insulated by snow, and the relatively dull but constant noise of moving cars would be largely obscured by the cover of snow and the constant low rumblings of the intervening Mad River.

When species were recorded at multiple cameras, it may suggest movement in an east-to-west direction through the parcel, or it might indicate general activity throughout the parcel, or the presence of different individuals of wildlife that have moved onto the parcel. Additional information would be required to better understand the movement within and through the parcel. A full tracking season with adequate snow cover would assist in this effort.

Wildlife tracking was very limited during the 2015-2016 winter. AE was able to conduct only one tracking day under good conditions, and a second under significantly sub-optimum conditions. What little tracking was conducted however, supports the conclusions from analysis of the remote camera data. A range of wildlife species, including forest interior specialists are utilizing the entire property. The map below shows the locations of all tracks identified during the 2 tracking field days.

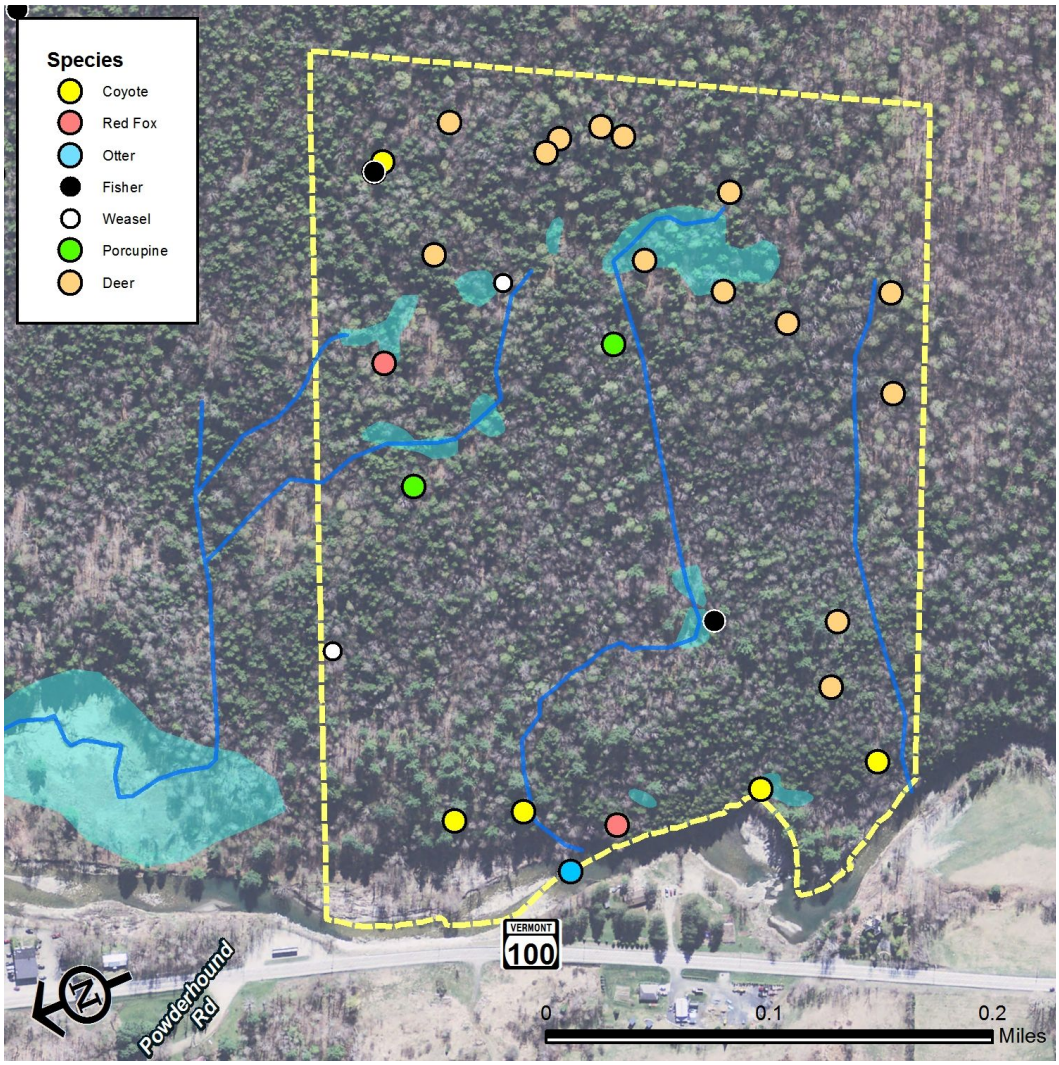

Figure10. Map of wildlife tracking results

Seven species were detected during the limited tracking season. All species were detected during both tracking days except otter. Notably, Coyote are seen utilizing the length of the river frontage, suggesting they may travel north/south along the river. Deer were prevalent, even in this low-snow winter, in the conifer dominated forest communities, particularly within the lower (western) and upper reaches (eastern). Not unexpectedly, otter sign was observed along the river. While a greater frequency of deer tracks were located to the east away from the road noise and activity along Route 100, this is most likely attributed to the denser conifer canopy cover in the eastern portion of the parcel. Interestingly,

other wide ranging mammals appear to show little preference with activity both near and far from the Route 100 corridor.

Table 4. Track Event Count (does not count multiple occurrence species at same location)

Track Count by Species & Date		
	2/15/2016	3/4/2016
Coyote	4	2
Deer	11	4
Fisher	1	1
Otter		1
Porcupine	1	1
Red Fox	1	1
Weasel	1	1

Additional tracking exercises under good conditions would be necessary to further understand and elaborate on the movement habits of wildlife within and through the WCCA parcel.

AE identified a small American beech stand located at the far northeastern corner of the WCCA parcel. The beech stand is located in a wide ravine dominated by a variety of broad-leaved trees. There are 8-9 bear-scarred American beech trees exhibiting both historic (greater than 3 years old) and recent (2013-15) bear climbing activity. Most of these trees had recent scars and nests left by bear that had climbed these trees for their beechnuts during the fall of 2015. While this stand is too small to be recognized as "Necessary Wildlife Habitat" under the auspices of Vermont's Act 250 -- it is an important food resource for bear(s) in the area.

Figure 11. Bear Nests in American Beech Tree

The May 20th, 2016 field visit included an observation of breeding birds at the site. Overall, the WCCA parcel appears to be providing habitat for several interior forest-associated bird species including the scarlet tanager, ovenbird, and yellow-bellied sapsucker. Bird species observed such as the black-throated green warbler, blue-headed vireo and blackburnian warbler show preference for coniferous or mixed forest types, and their presence was reflective of the healthy intact hemlock communities present on site. Closer to the river where edge and early successional habitat is present, a chestnut-sided warbler was singing to establish territory. Overall the birds present are indicative of a healthy interior forest and given the highly variable landscape throughout the region, this suite of species is supported by the high quality forest present.

Table 5. Bird species observed	
Chestnut-sided warbler	Ovenbird
Blue-headed Vireo	Hermit Thrush
Black-throated Green Warbler	Yellow-bellied Sapsucker
Scarlet Tanager	Yellow-rump Warbler
American Robin	Red-breasted Nuthatch
Winter Wren	

3.2 Deer Winter Habitat

Nearly the entire WCCA parcel contains the necessary coniferous forest canopy structure to support over-wintering white-tailed deer. The Hemlock, Hemlock - Northern Hardwood, and White Pine - Northern Hardwood (see Natural Community map, Figure 15) all exhibited sign of use by over-wintering white-tailed deer to varying degrees and contain the requisite forest canopy structure. The greatest amount of sign was recorded in the lower Hemlock Forest adjacent to the Mad River, and the higher elevation (above 1050') Hemlock and Hemlock - Northern Hardwood Forest. In these locations, browse, bark-stripping, significant winter deer scat, and extensive snow cratering were observed.

As expected, the use of these evergreen habitats by over-wintering white-tailed deer during the mild and largely snowless winter of 2015-2016 decreased as the snow on the ground all but disappeared for most of the winter.

Figure 12. Evidence of deer digging for food in Deer Winter Area

3.3 Wildlife Corridors

The WCCA parcel is centrally located within a roughly 1000 acre forest block and bordered by the Mad River on the west. In previous studies, AE has concluded there are likely to be several focused travel points across roads into and out of the forest block within which the WCCA parcel resides. Based on the information obtained and discussed above, it is likely that the WCCA parcel is utilized by a wide variety of wildlife, including those particularly sensitive to human disturbance, when moving across and within the forest block. Species distribution recorded within the WCCA parcel during the 2016 data collection is consistent with species recorded at the road crossing sites studied in 2014.

Also of note is the WCCA parcel's proximity to the Mad River. Data analysis from our fieldwork suggests wildlife are utilizing the river corridor to move north and south. The western bank of the Mad River is relatively heavily developed with significant disturbance in the form of both human activity and heavy traffic. The eastern bank, by contrast is almost entirely forested for a distance of almost 2

miles. The protected and undisturbed nature of this swath likely provides important safety and comfort to animals moving north and south along the river.

Figure 13. Otter tracks and slide at edge of Mad River

Additional tracking during the winter 2016-17 would allow AE to further analyze and understand wildlife and wildlife movement both within and surrounding the parcel. This might allow AE to add further resolution to the overall relative value of the WCCA parcel as wildlife habitat and to the importance of various areas within the parcel.

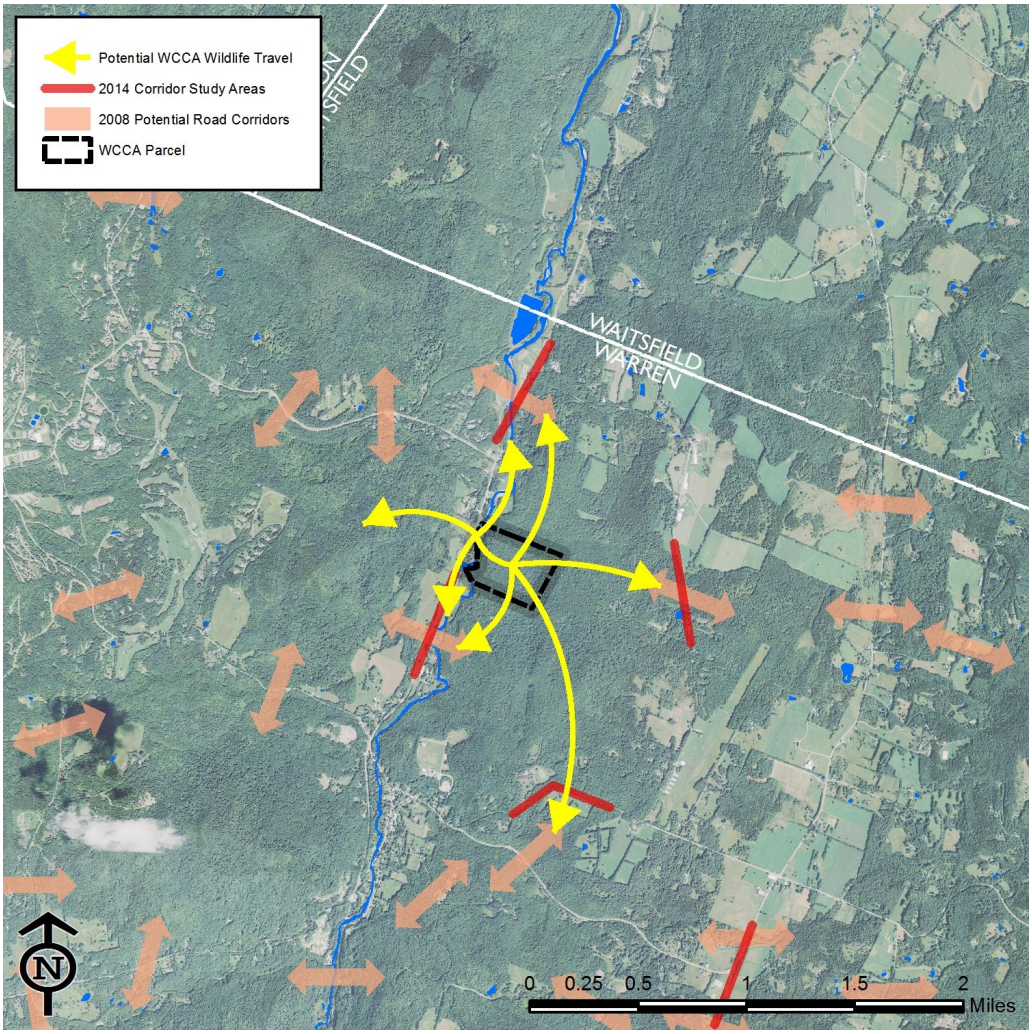

Figure 14. Wildlife Movement & Corridors

3.4 River Corridor

The general condition of the larger river corridor was assessed during a Phase 1 and Phase 2 Stream Geomorphic Assessment (SGA) conducted by the Friends of the Mad River in 2006 and 2007. The River adjacent to the WCCA parcel is within the M16 reach assessed in the SGA. M16 was found to be in Fair condition overall with a Sensitivity rating of Very High suggesting the river is in a state of adjustment away from "equilibrium" or it's natural geomorphic balance. The riparian Habitat Assessment found moderate amounts of in-stream sedimentation and bank instability, with vegetation significantly more healthy on

the right bank (east) than the left bank (west) resulting is a habitat condition assessment of Fair.

Portions of the corridor within the WCCA parcel are constrained by bedrock, which limits lateral movement and erosion on the property. More significantly though, the extensive forest cover contributes greatly to the stream stability while simultaneously helping shade and cool the waters, both of which are critical to the survival of cold-water aquatic species including brook trout.

There are areas of heavy invasive plant infestation along the shoreline on the WCCA parcel. This plant, Japanese knotweed (*Fallopia japonica*) spreads by vigorous root sprouting and by highly regenerative root rhizomes that grow new plants from tiny fragments of old. Knotweed in turn chokes out native vegetation and offers little to no return in terms of habitat, food resource or soil stabilization functions.

Despite the presence of knotweed, the WCCA shoreline participates in a significant stretch of forested corridor on one side of the Mad River. This is important because the western bank is occupied by Route 100, residential development and agricultural lands all of which limit and constrict the natural movement of this river reach. The natural conditions that exist on the eastern bank likely play an outsized role in maintaining the health of a river that must contend with significant constraints and impacts from activity on the other bank.

3.5 Natural Communities

The majority of the WCCA parcel is composed of three primary upland natural communities: Hemlock-Northern Hardwood Forest, Hemlock Forest and White Pine-Northern Hardwood Forest. The mixed hemlock type occupies the eastern ⅔ of the parcel while the white pine mixed type and the Hemlock Forest occur in the western ⅓. There is also a small area of early successional Northern Hardwood forest likely impacted by beaver activity along the Mad River in the northwestern corner of the parcel. It is likely that the White-Pine Northern Hardwood Forest at this location was formerly grazed pasture which is now reverting to forest. Neither the Northern Hardwood Forest of the White-Pine

Northern Hardwood forest are state significant examples of these natural communities.

Both the Hemlock Forest and the Hemlock-Northern Hardwood Forest, on the other hand, are B-ranked examples of their types. As such, they are considered state significant natural communities. This state significance designation takes into account the current size of the stands, condition of the natural community and its landscape context.

In addition to these forested types, there are also two occurrences of Boreal Acidic Cliffs in the forest and numerous patches of River Cobble Shore along the banks of the Mad River. The cliff communities consist of bedrock outcrops which form ledges but are not large enough to be open cliffs without canopy cover. These occurrences are fairly common in the town and are not state significant natural communities.

The River Cobble Shore community consists of a dynamic shore community that changes size, position, and composition as the river changes throughout the year and over the years. These small patches of cobble shoreland are a part of the dynamic river system. The extensive River Cobble Shore sites that occur along the Mad River in this location are likely state significant examples of this community type, despite being infested with Japanese Knotweed in some areas.

The wetlands on the WCCA consist of nine Seep wetlands and a single "Wet Depression". The Wet Depression is a low area in the forest that has a locally impermeable substrate which has led to the development of wetland conditions. The Seep communities, in contrast, are wetlands that form in areas of ground water discharge and often form the headwaters of small mountain streams. These Seeps should be considered significant as natural communities but also for the functions and values that they perform. These wetland communities provide important wildlife habitat for stream salamanders throughout their lives as well as foraging habitat for deer, bear and moose. These Seep communities are important for water quality, forming the headwaters of streams and providing the Mad River with a source of cold, clean water.

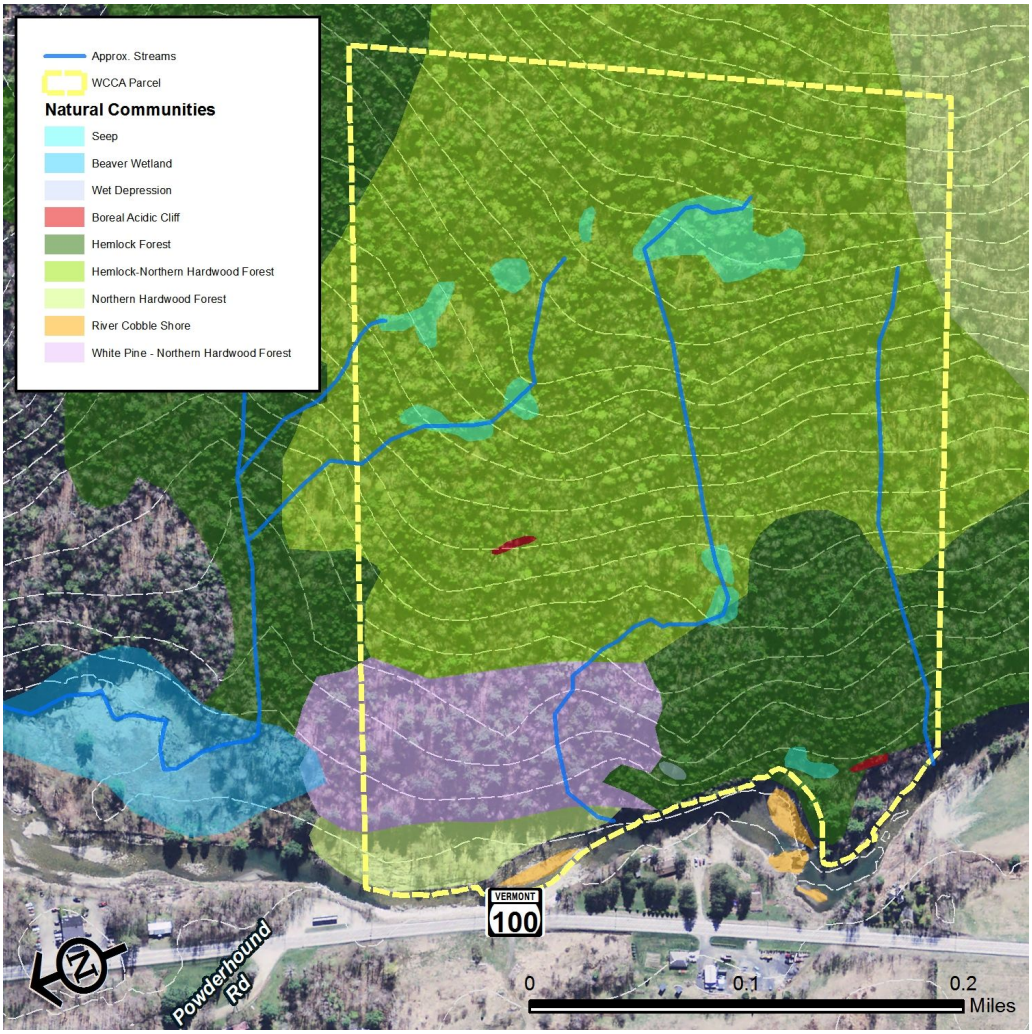

Figure 15. Natural Community Mapping

4 Recommendations

AE documented significant utilization of the WCCA parcel by interior forest-associated wildlife species that are sensitive to human activities. Based on our analysis, we believe utilization of the WCCA parcel for recreation on a scale above that at which it is currently used (occasional hunters, hikers, and explorers) would diminish the parcel's value to wildlife as both seasonal and year-round habitat. Repetitive and ongoing recreational activities such as mountain biking, hiking, dog walking and x-c skiing can have a detrimental effect on the behavior, physiology, and reproductive success of wildlife.

While occasional dispersed activity may pose little to no long-term harm to wildlife, human recreational activities that occur frequently and repeatedly such as x-c skiing, bicycling and hiking at times are not compatible with maintaining relatively high levels of protection of wildlife, wildlife movements, and natural communities. This is especially true in relatively small blocks of forest habitat where opportunities for avoidance of human disturbance is limited by the larger surrounding landscape.

An assessment of the potential impacts of human recreation on wildlife is typically broken into 4 categories (Knight and Gutzwiller, 1995):

- the type of activity
- the behavior of recreationists
- the frequency and magnitude of disturbance
- the timing and location of the disturbance

To this one might add the history and sensitivity of the species (Chapter 5, Knight and Gutzwiller, 1995). In most cases, the results of human recreation impacts are the displacement of wildlife. Displacement of wildlife then results in the temporary or long-term avoidance or decrease in the use of an area or loss in effectiveness of the habitat.

Many passive recreational activities involve the a relatively slow approach and long interaction times between wildlife and the recreationist (with the possible exception of mountain biking). Ferguson and Keith (1982) and Cassirer (et al. 1992) found that people are more likely to socialize and have accompanying dogs with them when conducting passive recreation and disturb wildlife even more than faster-moving recreation (like snowmobiles).

When addressing the appropriateness and timing of recreation, the Town of Warren must think in multiple temporal scales. The crepuscular hours (early in the morning and a few hours before and after dusk) are a time when many species of wildlife are on the move. The WCCA parcel likely sits within a wildlife movement landscape (or corridor). It might not be compatible to encourage recreationist to visit the WCCA parcel at times when wildlife might be utilizing the disparate wildlife habitats within the parcel or moving through the parcel.

In terms of the yearly seasons, more than minimal recreational use may be incompatible with some wildlife uses such as beechnut consumption (in the fall), and winter denning by bear. Extensive recreational activity may also be incompatible with the breeding activities of other wary species of wildlife, such as the fisher and bobcat.

Some species might be particularly sensitive to human activities because of a history of persecution by people and society. Deer and bear are hunted, bear are even pursued by dogs in Vermont, and these species are sensitive to the presence of humans. Bobcat and fisher are hunted and trapped in Vermont and they will avoid areas with extensive recreational activity.

One of the most important issues for Warren to consider regarding wildlife and recreation on the WCCA parcel is the presence of deer wintering habitat on the parcel. The white-tailed deer is near its northernmost limit in Vermont and requires specialized habitat to survive Vermont's cold and snowy winters. When temperatures turn cold and snow depths equal 18" on the ground deer move to these evergreen forest in an attempt to conserve energy. The evergreen needles catch the snow before it reaches the ground and snow depth in these habitats is greatly moderated. The forest canopy keeps temperatures on the ground warmer and the end result is that deer conserve energy in these overwintering habitats. The presence of people, pets, noise, skiers, and snowshoers add to the level of stress and energy expenditure of deer while in their overwintering habitat. Deer move about to avoid humans and may leave winter habitats altogether if bothered enough.

In addition to being deer winter habitat, both the Hemlock Forest and the Hemlock-Northern Hardwood Forest are considered state significant natural communities. The Hemlock Forest type typically occurs in smaller patches on the landscape. Logging operations other than thinning should be excluded from this community. Any logging within 100 feet of surface waters should also be excluded. For both of these hemlock forest types, limited non-motorized recreation is not likely to negatively impact that natural community condition or ranking. The same is true for the smaller natural communities (Cliff and Shores). The River Cobble Shore communities suffer from invasion by non-native invasive species. Control of these areas could be

considered, but since they are part of a larger river system, it may be unrealistic without a long term commitment and extensive effort.

The most vulnerable natural community on the WCCA parcel are the numerous Seep wetland communities which are important wetlands for water quality and wildlife habitat. With their organic soils and perennially wet conditions, they are also susceptible to disturbance. Rutting of these sites can easily occur from road or trail construction, which often result in the disruption of the local hydrology of the wetland and headwater stream system.

Trails, including well-used hiking and mountain biking trails, can create water quality issues for vegetation and wildlife. Where trails are found soil compaction is common. Decreased pore size and increasing soil density can lead to increased surface water runoff and erosion. If water resources such as wetlands, vernal pools, seeps, streams and ponds occur downgradient of eroding trails, these habitats can receive soil fines (silt and clay) covering small species of fish, amphibians, and mammals. Egg masses of fish and amphibians can suffocate as the fine soil particles prohibit oxygen from circulating through and around the egg masses. If any trails are to be considered for this parcel, they should maintain at least a 50' buffer from these water resources.

Trails tend to widen over time and encroach upon wild forestland adjacent to them. Muddy trails are avoided by recreationists and trails widened or local trees are cut to bridge these spots-ever widening the impact of trails by removing or altering habitat, food and cover for birds and other wildlife. Trail construction and use associated with it can lead to an overall decrease in vegetative height near trails, decreased flowering of plants, an increase in aggressive non-native plants, and a loss in soil moisture. These impacts on vegetation usually result in some impact on wildlife as well. There can be a change in bird species and small mammal composition resulting from impacts from extensive trail use.

Human recreation activities and the trails, noise and disturbance they bring must be weighed against the desires for the protection of increasingly rare remaining patches of unfragmented and undisturbed habitat. While we fully acknowledge the importance of recreational activities and encourage interaction with the natural environment, formal and focused recreational infrastructure is often most appropriate in locations where human

activity is already a dominating force on the landscape. In this case, Warren must ask itself if sufficient alternative recreational opportunities exist such that it is not worth risking the loss of one of the few remaining interior forest blocks and the relative safety and security it brings to the wildlife living here and ability to function effectively as a corridor helping to maintain the overall health of the larger wildlife populations. Chipping away at the smaller habitats may result in an overall loss of the natural world the recreationalists seek to enjoy.

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