APPLICATION REVIEW

submitted to the

**OLD SAYBROOK
PLANNING COMMISSION**

for the

**"THE PRESERVE"
RIVER SOUND DEVELOPMENT, LLC
OLD SAYBROOK, CONNECTICUT**

prepared by

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Town of Old Saybrook
Planning Commission
302 Main Street
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RE: ***THE PRESERVE***
Final Review of Application by River Sound Development, LLC
Old Saybrook, Connecticut

REMA Job # 04-923-OSY7

Dear Commissioners:

At the request of the Connecticut Fund for the Environment (CFE), Rema Ecological Services, LLC (REMA) is providing herein supplemental testimony regarding the above-referenced application. This testimony is organized as follows:

1. The testimony presented at the December 8th, 2004 public hearing (see *"Presentation Outline & Summary of Outstanding Issues, for The Preserve: Old Saybrook, Westbrook, and Essex, Connecticut*). Clarifications are added, as footnotes, to the summary of findings in response to rebuttal testimony presented by the applicant in their December 21st, 2004 submission.

2. A detailed response to the December 21st, 2004 *"Critique of George T. Logan Testimony"* memorandum, authored by Attorney Dwight H. Merriam of Robinson & Cole (R&C) (also see Attachment A).

3. Discussion regarding landscape ecology and the use of landscape-level metrics (GIS-assisted) to compare and evaluate The Preserve proposal with a preferred alternative.

4. A critique of the Integrated Pest Management (IPM) plan and related materials submitted by the applicant (see Attachment B).

1.0 SUMMARY OF FINDINGS

The following summarizes our review of The Preserve Application before the Planning Commission, which was submitted on December 8th, 2004.

- In a landscape setting undergoing steady suburbanization, and **fragmentation**, with preservation of only moderate-sized woodlots and open space tracts, very large forested tracts are regionally of high importance from a conservation standpoint, **for all species**, not just rare or uncommon ones. The proposed development design fails to set aside at least one substantial large tract.

- Very large tracts are reservoirs of **genetic diversity**, for regional metapopulations of fauna and flora. A widely known principle of population genetics is the tendency for small, isolated populations to become increasingly homogeneous, genetically, losing alleles by **random drift**.

- Small populations often suffer genetic problems due to **inbreeding**. This is a particular problem for the larger mammals such as mustelids (weasels), which already occur at low densities.

- Small populations are **less able to adapt to environmental changes**. An example would be adaptation to global warming. Genes to prevent flowering in a winter warm spells, might currently be present in a large population of a plant species at a low level, but would increase in frequency in response to climate change. This gene would likely be absent from a small plant population, which would, therefore, go extinct in the face of climate change. If there is a large population in the region, it can be a **source of genetic variability**, for the multitude of smaller habitat blocks.[1]

- Large tracts are especially important for preserving genetic diversity of species that naturally occur at low densities such as the wood warbler (worm-eating and hooded warblers) or orchids, documented at the site.

- A very large undeveloped tract is a **source for repopulation in the larger landscape.** Small populations are more likely to go extinct or reach dangerously low levels in the face of environmental perturbations (e.g. a series of dry summers with salamander reproductive failure). If there is emigration from a nearby source population loss of biodiversity can be prevented.

- With avians the presence of **source populations** is especially critical, because suburban woodlots are **sinks** for a large proportion of our songbirds. Many migratory songbird species, ranging from the common red-eyed vireo to the rare hooded warbler, experience elevated rates of predation and nest parasitism near forest edges in small to moderate-sized woodlots. Estimates of the distance that increased rates of nest failure extend from the forest edge range from 190 feet (Paton 1994) to 600 feet (Temple 1988). A forest such as that at the Preserve **replenishes** the depleted populations in smaller tracts in the region.

- Some bird species such as hooded warbler have **behavioral avoidance of even moderate sized tracts** <400 acres, based on extensive bird survey experience of REMA staff, including compilation and analysis of data volunteer surveys by experienced birders (Gadwa 2003) (attached)[2]. These species will disappear from the local landscape unless a very large tract is preserved. The population levels of the wood warbler species, or of other forest migrants at this site, are also entirely consistent with REMA experience, *not* unusually or "surprisingly" low as suggested by EPS.

[1] EPS in their rebuttal concerning the effects for habitat fragmentation upon genetic diversity remarked that we were incorrectly using island biogeography theory. Yet the scientific literature is replete with examples of this phenomenon, as further explained in Section 3.0 of this report.
[2] As pointed out in the EPS rebuttal, according to the ornithological literature, Hooded Warbler breeds in much smaller forests in core portions of its range, where it is more abundant. Based on REMA field experience in Connecticut, they have been limited to very large tracts; the range of this species does not extend into northern Connecticut. It is susceptible to nest losses on forest edges in a fragmented landscape, according to the Nature

- The applicant's consultant provided only a table of the latitude and longitude coordinates of the bird survey points and **did not do any analysis of the distribution** of the avian populations. No breakdown of raw survey data by point was provided by EPS, but REMA has done so (see Tables 1 and 2; attached).

- Note that Route 3, with the largest numbers of area-sensitive forest songbirds including hooded warbler[3], worm-eating warbler, and American redstart, is located on the ridge bordering Pequot Swamp Pond, which would become a narrow forested strip sandwiched between the pond and the proposed housing cluster, under the proposed plan. The footprint of the northernmost building is in close proximity to Plots 3-5 and 3-6 with the hooded warbler.

- Based on the applicant's own avian consultant more than one third of the site was not covered during the breeding bird survey (see Figure 2, attached). More importantly a large forested block within eastern section of the site, roughly 300 acres, was not surveyed for breeding birds. Also, there is general **under-representation of breeding bird data points at or near the edges of forested wetlands**, where typically, based on REMA staff experience, both diversity and abundance of avian species (and other wildlife) is much higher.

- Interestingly, the aforementioned +/- 300-acre forested block, with significant wetland resources (e.g., headwater seeps, vernal pools, etc.), was also under-represented for mammalian species, including bats (see "Mammal Species" table in EPS Biological Survey report). Unfortunately, **a large proportion of the proposed development** (i.e. housing and golf course) is proposed within this habitat block.

- Regarding the herpetological studies conducted by Dr. Michael Klemens and his team, we note the following:

  - It is unclear if the herpetological data collected by Evans Environmental Consultants in 1999, by Robert Russo in 1999 and 2000, and by Edward

Conservancy Species Management Abstract. The Hooded Warbler (*Wilsonia citrina*), 1999, The Nature Conservancy. 4245 North Fairfax Drive, Suite 100, Arlington, VA 22203.

[3] EPS is correct that the scientific literature shows Hooded warbler occurring on small to moderate size tracts in portions of their range where they are relatively common. Based on REMA field experience in Connecticut, they have been limited to very large tracts; the range of this species does not extend into northern Connecticut. It may be that very large tracts, with less nest predation and parasitism, are preferred and utilized first. It is susceptible to nest losses on forest edges in a fragmented landscape.

Pawlak in 2002, were used in analyzing distribution and abundance of vernal pool fauna. It is highly beneficial to use data from several years to arrive at conclusions for vernal pool conservation. We recommend that all the data be included into the record, particularly Mr. Pawlak's raw data[4].

- There is **lack of specific information on each of the 31 vernal pools.** Apart from egg mass counts and species presence, we know little or nothing on the hydrology, substrate, vegetation structure and diversity, water quality and invertebrate base.

- The vernal pools were not visited in the summer to document productivity of obligates, particularly spotted salamanders.

- Many of the "non-conserved" vernal pools, such as #5, #9, #19, #23, #3, and #22 are clearly Tier 1 pools, which according to the Calhoun and Klemens (2002) methodology are worthy of conservation. This brings into question the future of the methodology in Connecticut.

- Several "non-conserved" pools, such as #3, #4, #21, #24, and #26, have comparatively moderate numbers of spotted salamander and wood frog egg masses, but also contain marbled salamanders. Due to the lack specific information it is **impossible** to ascertain if any of these pools are **important marbled salamander** pools.[5] Very often productive marbled salamander breeding pools have lower numbers of the other obligates, since the former predate on the latter.

[4] Dr. Klemens responded that Mr. Pawlak's data was incorporated with his data. The only way to understand how the data was used would be for Dr. Klemens or the applicant to produce Mr. Pawlak's raw data. It is not fair to state that another competent professional's data was used in some fashion, without allowing the reviewers to analyze the data.

[5] The need for surveys of larval salamander densities, especially of marbled salamanders, is a point also made in the review by Wendy Goodfriend of the Southeast Conservation District. Dipnetting is an effective way to obtain approximate information on relative densities and reproductive success among a group of pools. Because salamanders are so long lived (up to 30 years according to Pope, 1928), it is very possible for a large healthy population of adults to continue laying numerous egg masses, *after* some ecological change, either natural or anthropogenic, has significantly diminished the reproductive success of the pool. This could be decomposition of a log that had previously served as a dam, raising the water level a few inches high and delaying pool drying a few weeks; arrival of a predator such as snapping turtle; or a reduction in water quality. One first hand example was a vernal pool in East Hampton, stocked with fish several years ago, where REMA scientists observed over fifty egg masses and corresponding numbers of very large adults (all over 9"), but <u>no</u> small size classes of salamanders.

- The Klemens report claims that Stuart Z. Cohen, PhD, was specifically retained to address specific issues of amphibian conservation as it relates to golf course design, turf management, and IPM issues. If this is an **integral part of the best management and conservation program** proposed, why have not Mr. Cohen's reports and recommendations been submitted into the public hearing record?[6]

- There is **no discussion about the expected population size and structure, and distribution of the Eastern Box Turtle** on the site, although several turtles were observed and marked. As Dr. Klemens points out this species is in decline due to habitat fragmentation and loss of long-lived adults to mortality and collection. Any Open Space subdivision should account for such a fragmentation sensitive species, one which is "listed" as a Species of Special Concern." [7]

- It is our opinion, that none of the productive Tier 1 vernal pools should be sacrificed to development, without further analysis and substantiation. Based on the data and analysis provided thus far, the golf course layout is inappropriate as an Open Space at this large site, which, by the applicant's own admission is a "relatively intact forest habitat."

➢ The floristic inventory provided for the site is fairly comprehensive. However, there are **insufficient distributional data**, particularly regarding rare and uncommon flora, such as the various orchids and mikworts observed. Moreover, there is little or no description on the potentially botanically more diverse areas with uncommon and rare species, such as hilltops with bedrock outcrops[8], and headwater wetland seeps. Without this kind of information it is not possible to ascertain if such areas will be protected.

[6] The IPM plan has now been reviewed (see Attachment B).
[7] In particular, site planning to minimize turtle road mortality issues should be addressed, for spotted turtle as well, a species that is particularly vulnerable to fragmentation since it moves from one vernal pool or stream system to another, as food supplies wax and wane. See also Habitat Fragmentation Section of this Report.
[8] Although EPS responded that bedrock outcrops were addressed in the narrative, this was done only in one short paragraph.

- There are **no entomological surveys** of the property. With a forested parcel this size it is highly likely that "listed" insects and arthropods could exist on the property, which should be afforded conservation.

2.0 RESPONSE TO THE MERRIAM MEMORANDUM

We deal carefully and respectfully with the "critique" of our testimony authored by Attorney Dwight H. Merriam of Robinson & Cole (R&C), hereafter referred to as the "Merriam Memorandum.[9]" At the outset we must emphatically state that at a personal level we (i.e., Sigrun Gadwa and George Logan) have never, in 31 years of collective professional experience, come across such an undignified diatribe based on misinformation and twisting of facts. We are both perplexed and saddened, given the fact that we have held Attorney Merriam in high regard. Moreover, this time-consuming effort on his part has, in our opinion, failed to produce the sought after effect by the applicant, which was to bring into question our testimony, and to shift the focus away from the facts, via a thinly disguised *ad hominem* attack.

As will become abundantly clear in the following pages, Rema Ecological Services, LLC, and by association George T. Logan and Sigrun N. Gadwa, have been entirely consistent in their positions regarding potential impacts to natural resources, including wildlife populations, wetlands and watercourses. These positions are reinforced by the scientific literature and our extensive professional experience.

We would respectfully suggest that since Attorney Merriam neither holds degrees and certifications, nor has experience in natural resources sciences, that his "critique" is unfounded and should be disregarded.

Our response is summarized as follows and expanded in Attachment A to this report:

First, the <u>landscape setting</u> of a particular project and the <u>size of the habitat parcel</u> to be developed are of utmost importance to the value of the wildlife community it supports and to the ecological significance of a given level of fragmentation impacts or wetland setbacks of a given width. None of the five (5) REMA development projects cited in the Merriam

[9] The memorandum is dated 12/21/04 from Dwight H. Merriam, FAICP, CRE, to Robert A. Landino, P.E., regarding a "Critique of George T. Logan Testimony."

Memorandum have a level of ecological integrity that even approaches that of The Preserve. Three (3) are traversed or bordered by a major interstate highway. REMA had provided this information, which is pointedly omitted in the Merriam Memorandum. Comparing a wildlife impacts assessment for The Preserve with one for the Willowbrook Golf Course in densely residential South Windsor is truly an "apples to oranges" comparison.

Second, a major emphasis of the Merriam Memorandum revolves around our past positions regarding vernal pools, yet only one of the five referenced projects (i.e., Waterford) has a viable, although only moderately productive, vernal pool in an area to be developed. The Milford project, which was not a golf course project, has a potential (former) vernal pool that is non-viable because it is dewatered each summer to irrigate a major greenhouse operation. The Merriam Memorandum omits this key fact from the text excerpts on the vernal pool setbacks for the Milford project. The site plan for the Middlebury golf course by design places the only two productive vernal pools deep within a contiguous +/- 84-acre portion of the site where no development is proposed.

Third, it is in the design phase where River Sound Development, LLC differs greatly from REMA, which follows an ecological constraints analysis approach based on site-specific wildlife, vegetation, and habitat data to minimize losses to ecological integrity and to biodiversity. Projects for which REMA has provided consulting services may indeed follow a similar "standard of development" in some areas, such as design of a wetland bridge for a golf cart path or for "flyover" zones where wetland vegetation is maintained at a low height. In Section 3.4, the Merriam Memorandum excerpts descriptions of a key design procedure still used by REMA: site-specific buffer width determination, taking into account soils, slope, resource sensitivity, and special conditions such as "listed" species or sensitive wildlife resources. The summaries of ranges of buffer widths provided for several REMA projects cannot be evaluated outside their site-specific context, or compared to the setbacks in The Preserve design.

Fourth, all the report excerpts cited in the Merriam Memorandum were taken from submissions or testimony before Inland Wetlands and Watercourses Agencies (IWWAs), not before Planning and/or Planning and Zoning Agencies. Ecological Assessment reports produced by REMA for the five referenced projects were submitted either prior to the AvalonBay v. Wilton Conservation Commission decision by the Connecticut Supreme court or after the amendment to the Wetlands Act which became law in June 2004, allowing IWWAs to consider impacts to wetland wildlife, with certain limitations. Discussions of potential impacts on upland wildlife species, including birds, due to upland forest fragmentation or habitat alteration were typically included, as ancillary information, because wetlands impacts were the primary focus (and the jurisdiction) of the IWWAs. Therefore, for each of the five REMA development proposals cited in the Merriam Memorandum upland wildlife considerations could not be the driving force for those site designs. By contrast, the Old Saybrook Planning Commission can consider the entire site and all of its natural features (i.e. wetlands and uplands) as well as its ecological integrity in deciding whether The Preserve proposal is sufficiently protective of existing resources.

3.0 LANDSCAPE-SCALE STUDY OF THE PRESERVE

3.1 Introduction

The Connecticut Fund for the Environment (CFE), and its experts, have conducted a landscape-scale study of the subject property to put forth an alternative development scenario that would be protective of its natural features and unique biodiversity. This GIS-assisted study is based on the link between the disciplines of ***conservation biology*** and of ***landscape ecology***, in terms of the preservation of biodiversity.

This approach facilitates comparison of The Preserve development proposal with an alternative, in terms of the extent to which it protects a variety of natural resources that are closely related habitat to fragmentation: wildlife corridors and contiguous open space; large woodlands and mature forests, particularly those areas with significant habitats for fragmentation-sensitive wildlife, including several state-listed species. It shows how the proposed alternative better protects scenic vistas from hilltops, and also wetland buffer zones, which are so important for maintaining water quality and for maintaining wetland wildlife. It also shows how the level of direct impacts to wetlands, stream floodplains, and steep slopes can be reduced.

3.2 Conservation Biology and Landscape Ecology

3.2.1 Introduction

Biodiversity losses and ecosystem degradation have become issues not only of global but also of regional concern. In the past two decades regional and local planners throughout our region have attempted to deal with these issues; initially with mostly reactive approaches. In recent years, two scientific disciplines have come together to offer understanding and approaches that are preventative (Beatley 2000)[10]. These sciences are conservation biology and landscape ecology. As we will elucidate below, the disciplines of conservation biology and landscape ecology share parallel perspectives on ecosystem health and biological diversity and offer similar solutions.

Conservation biology is a relative new scientific discipline that emerged in the 1980s. It can be said that is a response by the scientific community to the biodiversity crisis. It deals with the diversity of life in ecosystems, and recognizes that humans can have tremendous effects on this diversity. Conservation biology considers these effects, and how our impacts can be altered to sustain diverse and healthy ecosystems. Conservation biology encompasses a wide range of biological sciences such as genetics, evolution, and physiology, as well as a wide range of ecological sciences such as biodiversity, competition, predator/prey relations, and long-term dynamics.

After roughly two decades of research and study, conservation biology has established a strong link between the size of a natural area, its edges, its disturbances, its level of biological diversity, and the general health of an ecosystem (Soule 1991)[11]. It has also found interdependency between biodiversity, ecosystem health, and social well being (Meffe 1997)[12].

Ecology is the study of the interrelationships between organisms and their environment (Ricklefs 1979)[13], while ***landscape ecology***, also a relatively young scientific subdiscipline of ecology, is the study of how ***landscape structure*** affects the abundance and distribution of organisms, while acknowledging that human activity plays an integral role. Landscape ecology has also been defined as the study of the effect of pattern on ecological processes, where pattern here refers specifically to landscape structure (Turner 1989)[14].

Structure and pattern imply ***spatial heterogeneity***, which in turn has two components: the amounts of different possible entities (e.g. habitat types), and their spatial arrangements. In

[10] Beatley, T. 2000. Preserving Biodiversity: Challenges for Planners. APA Journal. 66:1.
[11] Soule, M.E. 1991. Land Use Planning and Wildlife Maintenance: Guidelines for Conserving Wildlife in an Urban Landscape. APA Journal, Summer 1991, pp. 313-315.
[12] Meffe, G.K. 1997. Principles of Conservation Biology, Sunderland, MA. Sinauer Associates, p. 7
[13] Ricklefs, R.E. 1979. Ecology. Chiron Press, New York, NY, USA.
[14] Turner, M.G. 1989. Landscape Ecology: the effect of pattern on process. Annual Review of Ecology and Systematics 20:171-197.

landscape ecology these have been labeled landscape composition and configuration, respectively. The amount of forest or wetland, the length of forest edge, or the density of anthropogenic features, such as roads, houses and golf course fairways, are elements of landscape composition. The juxtaposition of different landscape elements and measures of habitat fragmentation per se (independent of amount) are aspects of landscape configuration (McGarigal and McComb 1995)[15]. Landscape ecologists look at the regional requirements of ecosystems in terms of the flow of species, nutrients, and water and how these flows contribute to the improvement or degradation of the health of ecosystems.

3.2.2 Key Concepts

Several key concepts and theories offered understanding as to how to go about preserving biodiversity. First, experiencing a major paradigm shift, ecologists realized that the survival of ecosystems is not dependent on preserving a certain ecosystem equilibrium where the right amount of organisms would live in a large enough area with the right amount of resources. Rather it is also dependent on maintaining the flow of animals, plants, nutrients, water and energy within the ecosystem. This "new ecosystem theory" cast doubts on large ecological preserves as the sole effective long-term solution to preserve biodiversity and ensure ecosystem health. What land use planners have realized from this is that any proposed development should have minimal effect on ecological flows. Preserving only "samples" of ecosystems can only have a minimal benefit to biodiversity.

Second, Paine (1966)[16] introduced the concept of "keystone species," which is a species that could drastically alter the interactions among other species within a given ecosystem. Subsequent research has refined or expanded on this model with concepts such as keystone predators, keystone food sources, and keystone habitat modifiers (Meffe 1997). The general term "ecologically dominant species" is now often used to call attention to species, or even groups of species (e.g. vernal pool amphibians), which are important to ecosystem structure and function. Land use planners should, therefore, identify the main "keystone species" of a natural area, and knowing their habitat and ecological requirements try to accommodate them.

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[15] McGarigal, K. and W.C. McComb. 1995. Relationships between landscape structure and breeding birds in Oregon coast range. Ecological Monographs. 65:235-260.
[16] Paine, R.T. 1966. Food web complexity and species diversity. American Naturalist. 100:65-75.

Third, research has shown that the current pattern of urban development results in the fragmentation of natural ecosystems into "patches." Furthermore, habitat isolation resulting from fragmentation is the main cause of biodiversity loss and ecosystem degradation. To explain the loss of biodiversity that is caused from habitat isolation, MacArthur and Wilson (1967)[17] developed the theory of island biogeography. The main principle of island biogeography is that the rate of species extinction in an isolated patch of habitat is inversely related to its size. Therefore, smaller natural patches in our rural-suburban landscape experience a greater rate of local species extinction that larger patches because they are unable to sustain ecological flows, and are more vulnerable to environmental perturbations. Conservation biologists refer to this phenomenon as ***area effect***, which explains the deleterious effects of decreasing patch size on biotic systems (Soule 1991).

Another important element of island biogeography theory is the ***edge effect***, also associated with ***habitat fragmentation***.[18] Edges or ecotones occur at the intersection of a habitat with a significant physical element such as a roadway, a housing development, an agricultural field, and a golf course fairway. Conservation biologists believe that induced edges, overall, are detrimental to the maintenance of native species diversity. Soule (1991), and many others, identify a variety of major ecological consequences as a result of induced or anthropogenic edges, including, higher rates of predation, and a higher probability of nest parasitism on bird nests. This edge effect is directly influenced by the size of the remaining patch of habitat: the ration of edge habitat to interior or "core" habitat increases as the fragment size decreases.

As habitat continues to erode within the landscape matrix and the distance between remnant patches of natural areas increases, wildlife (or plant[19]) movement between patches becomes more difficult. This phenomenon is referred to as ***distance effect*** and shows the inverse relationship between isolation and species movement. When species cannot effectively disperse to find food, shelter and mates, or escape from predators, they increase their risk of local extinction. Reduce connectivity between habitat patches, also reduced the genetic diversity of isolated, small populations.

[17] MacArthur, R.H. and E.O. Wilson. The Theory of Island Biogeography. Princeton University Press.
[18] We will deal more extensively and specifically with habitat fragmentation, which is the major thrust of our landscape-level study, in a following section.
[19] Plants move between patches via a variety of natural mechanisms which allows for "gene flow."

These aspects of island biogeography theory have been demonstrated in numerous studies throughout the world (Soule 1991). They reinforce these concepts and show how biodiversity preservation and ecosystem health is directly related to land use practices.

3.2.3 Planning Guidelines that Preserve Biodiversity

Soule (1991) employs biological principles, including those demonstrated by island biogeography, to formulate five planning guidelines to preserve biodiversity within the urbanizing landscape.

Guideline No. 1: Since the probability of extinction is inversely proportional to the size of a natural habitat, planners should protect the largest possible open space areas to preserve a high level of biodiversity. Larger habitat fragments exhibit less edge effect than smaller ones. Species diversity can only be preserved in undisturbed interior habitats that are found in large contiguous habitat areas.

Guideline No. 2: Land planners should understand that a single contiguous habitat area is far superior to several smaller fragments. This might not apply to all species but will apply to some "keystone species" that travel on the ground, to some plants, and to "area-sensitive" bird species that cannot effectively breed in small habitat patches due to nest parasitism and predation by edge species.

Guideline No. 3: Land planners should identify and attempt to retain "keystone species" or groups, which are important to ecosystem structure and function. The removal or deleterious impact upon such species can cause the extinction of other species and reduce the overall flow of ecological elements within the ecosystem.[20]

[20] At The Preserve some of the "keystone" species or groups of species include, but are not limited to, the fisher and bobcat, the area-sensitive neotropical migrant birds, such as the scarlet tanager, hooded warbler, veery, wood thrush, and worm-eating warbler, the vernal pool amphibians, such as the spotted and marbled salamanders, wood frog, and a reptile, the spotted turtle. It should be noted that The Preserve offers suitable habitat for fishers, which have recently expanded their range into south-central Connecticut (Hammerson, G.A. 2004. Connecticut Wildlife: Biodiversity, Natural History, and Conservation. University Press of New England). Fishers are important predators in forest ecosystems and do well in appropriate, undisturbed habitat.

Guideline No. 4: Urbanization results in habitat degradation (through direct take), fragmentation, and isolation, which disturbs the flow of natural elements, reduces the number of keystone species, and contributes to the area effect, the edge effect, and distance effect. All these result in ecosystem deterioration and biodiversity loss. Land planners should, therefore, promote development configurations that minimize these effects.

Guideline No. 5: Natural corridors maintain flow of animals, plants, nutrients, water, and energy within the ecosystem. They also reduce the area effect, the edge effect, and the distance effect. In specifying natural corridors between patches of habitat, land planners must consider the behavior and the needs of targeted species that would benefit from these areas that promote ecological connectivity.

3.3 Habitat Fragmentation

Habitat fragmentation, which is extensively studied in landscape ecology, involves two principal aspects: (1) the reduction of total area (habitat loss), and (2) the scattering of the residual fragments in a mosaic in which the remaining fragments are disjointed. The impacts of habitat fragmentation, including forest fragmentation, upon biodiversity[21] have been well known for some time, through a variety of studies (e.g. Lovejoy and Bierregaard 1986[22], Van Dorp and Opdam 1987[23], Wilcove et al. 1986[24]). According to Wilcox and Murphy (1985)[25]: *"Habitat fragmentation is the most serious threat to biological diversity and is the primary cause of the present extinction crisis'."*

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[21] "Biodiversity" or 'Biological diversity' means the variability among living organisms from all sources including, among other things, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems. Biodiversity can be expressed in different ways: genetic diversity, species diversity, and ecological diversity.

[22] Lovejoy, T.E., Bierregard, R.O. Jr., Rylands, A.B.., 1986. Edge and other effects of isolation on Amazon forest fragments. Chapter 12. In Conservation Biology: The science of scarcity and diversity. Edited by M.E. Soule, Sinauer Associates, Sunderland, MA.

[23] Van Dorp, D., Opdam, P.F.M. 1987. Effects of patch size, isolation and regional abundance on forest bird communities. Landscape Ecology 1:59-73.

[24] Wilcove, D. C. MacLellan, C.H. Dobson, A.P. 1986. Habitat fragmentation in the temperate zone. Chapter 11. In Conservation Biology: The science of scarcity and diversity. Edited by M.E. Soule, Sinauer Associates, Sunderland, MA.

Recent studies show that *"the magnitude of edge and patch size effects may depend on the extent of fragmentation in the regional landscape."*[26] For example the effect of landscape configuration on the diversity and distribution of avians, was very pronounced in a study set in the agricultural piedmont of North Carolina[27], more so than in Sallabanks' study in a region of extensive bottomland forest. Several classic studies by Askins[28], Whitcomb and others have showed declines over time, and/or local extinctions, for migratory forest songbird species, such as worm-eating warbler, scarlet tanager, and redstart in remaining forest fragments in suburban southern New England and the Mid-Atlantic States (see attached references list, which also address the problems of impacts on avians resulting from changes in landscape configuration and losses of forested habitat). ***Mechanisms for*** *losses of biodiversity due to habitat fragmentation* vary widely among different groups of organisms

3.3.1 Nest Parasitism and Predation

For forest avians an important *mechanism* is nest failure due to parasitism or predation near forest edges, as carefully documented in a classic paper on wood thrush in Pennsylvania (Hoover et al 1995)[29], among many others. A very large tract like The Preserve provides significant avian wildlife habitat because it is a productive ***source*** for both rare and common forest neotropical migrants, producing young birds which then disperse out to recolonize or replenish smaller tracts elsewhere in the region, which are population ***sinks*** due to a high degree of fragmentation. A guidance publication produced by the Cornell Lab of Ornithology (2003)[30] points out that a much larger forest block is needed to provide high quality breeding habitat for area- sensitive songbirds in a more severely fragmented landscape.

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[25] Wilcox, B.A., Murphy, D.D. 1985. Conservation strategy: the effects of fragmentation on extinction. American Naturalist 125:879-887.

[26] Sallabanks, Rex, J. Walters, and J. Collazo. 2000. Breeding Bird Abundance in Bottomland Hardwood Forests: habitat, edge, and patch size effects. The Condor. 102: 748-758.

[27] McIntyre, Nancy. 1995. Effects of forest patch size on avian diversity. Landscape Ecology. 10(2): 85-99

[28] Askins, Robert and M. J. Philbrick. 1987. Effect of changes in regional forest abundance on the decline and recovery of a forest bird community. Wilson Bulletin. 99(10:7-21.

[29] Hoover, J., Brittingham, M.C., and L. Goodrich. 1995. Effects of forest patch size on nesting success of woodthrushes. The Auk. 112(1): 146-155.

[30] Rosenberg, K.V., R.S. Hames, R.W. Rohrbaugh, Jr., S. Barker Swarthout, J.D. Lowe, and A.A. Dohndt. 2003. A Land Manger's guide to improving habitat for forest thrushes. The Cornell Lab of Ornithology.

3.3.2 Genetic impacts

Losses of ***genetic diversity*** occur when populations are reduced to low levels, which may cause local or even regional extinctions.[31] Even common species such as the common toad (*Bufo bufo*) have been shown to suffer reduced genetic heterozygosity and developmental abnormalities, when populations are small and isolated, set in a hostile matrix.[32] Genetic impacts are also a threat to many plant species, both common and rare, especially those with limited seed dispersal and/or host-specific pollinators, a group that includes numerous herbaceous species, including state-listed wildflowers and sedges. Genetic problems of small populations of rare plants are described by Godt et al. (1996).[33]

Reduced genetic diversity may result simply from *habitat losses (*reduced carrying capacity, as well as from reduced *habitat contiguity or connectivity.*[34]

The *quantity of proposed loss of forested habitat,* with a golf course *and* housing, is in itself of concern for all the more uncommon species on this site, even for good dispersers such as fisher, worm-eating warbler, redstart, yellow-billed cuckoo, and for small populations of plants, even those with excellent dispersal or wind pollination.

Small effective population size also results from *reduced gene flow,* due to reduced *connectivity* in a fragmented landscape, with the greatest impact on species with more limited dispersal powers, for example, spotted turtle[35], Eastern box turtle, spotted salamander, red-backed vole, and many insects and sedges, and wildflowers. Gene flow for poor dispersers, whether plants, invertebrates, small mammals or amphibians, does occur slowly over time in a large contiguous forest, contrary to the EPS rebuttal statement on this topic. Dispersal of winged insects is limited to varying degrees by landscape barriers.

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[31] The various mechanisms by which this occurs, such as inbreeding and loss by random drift are explained in a short primer by F.A. Galbrath, 2000. Genetics of Small Populations. Canadian Botanical Conservation Network. (CBCN) @ McMaster University website www.science.mcmaster.ca/biology/CBCN.

[32] S.P. Hitchings and T.J.C. Beebee. 1998. Loss of genetic diversity and fitness in Common Toad (Bufo bufo) populations isolated by inimical habitat. Journal of Evolutionary Biology. 11(269-283.

[33] Godt, M.J., B. Johnson, and J.L. Hamrick. June 19965. Genetic Diversity and Population Size in Four Rare Southern Appalachian Plant Species. Conservation Biology. 10(3) 796-805.

[34] Joyal, Lias A., M. McCollough, and M.L. Huner, Jr. 2001. Landscape Ecology Approaches to Wetland Species Conservation: a Case Study of Two Turtle Species in Southern Maine. Conservation Biology. 15(6): 1755-1762

[35] EPS is correct that the scientific literature shows Hooded warbler occurring on small to moderate size tracts in portions of their range where they are relatively common. Based on REMA field experience in Connecticut, they have been limited to very large tracts; the range of this species does not extend into northern Connecticut. It may be that very large tracts, with less nest predation and parasitism, are preferred and utilized first. The edge effect on nesting success

Depending on scale, habitat fragmentation may be a dispersal barrier for poor fliers like beetles or the infrequent winged stages of many ants and aphids, or even for strong fliers.[36] One recent study of the regal fritillary, *Speyeria idlia*, demonstrated decreased genetic diversity in prairie remnant populations only recently isolated by row crops, compared to with a large population in contiguous habitat in the Great Plains, further to the west. This species is a strong flier, with naturally high rates of gene flow.[37]

Large populations of wildlife, plants, or invertebrates on large tracts of contiguous open space linked by substantial wildlife corridors are *significant* because they can maintain substantially greater genetic heterogeneity (diversity), than smaller populations of these species for which dispersal and gene flow are limited by fragmentation. As explained in the next section, and in the power-point presentation, the proposed alternative development plan has substantially more contiguous open space and better connectivity than the applicant's proposal.

At a given site, it is *the extent of connectivity*, not just the presence of some connectivity that determines the extent of impacts on dispersal and gene flow, which are closely tied to long-term biodiversity. EPS, in their rebuttal, states correctly that some connectivity would remain, post construction, for most organisms. However, REMA maintains that connectivity would be significantly reduced for many organism groups. It is correct that dispersal is not an issue for plant species with prolific wind-dispersed seeds or pollen, like birch species or rough goldenrod or for most birds.

3.3.3 Local Extirpation

Extinction is also more frequent in small populations, from random natural or human-related events, such as disease, pollution incidents, or weather stresses, regardless of dispersal powers and genetic isolation. Island Biogeography theory (also see above section) is indeed applied to a fragmented landscape setting, as stated in a recent review paper in *Conservation Ecology*[38], contrary to the statement in the EPS rebuttal.

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36 The EPS rebuttal argued that connectivity was not applicable to flightless beetles and ants.
37 Williams, Barry L., J.D. Brawn, and Ken N. Paige. 2003. Landscape scale genetic effects of habitat fragmentation on a high gene flow species: Speyeria idalia (Nymphalidae). Molecular Ecology. 12:11-20.
38 Melles, Stephanie, S. Glenn, and K. Martin. 2003. Urban Bird Diversity and Landscape Complexity: Species-environment Associations Along a Multiscale Habitat Gradient. Conservation Ecology 7(1):5.

"...island biogeography theory and metapopulation theory relate island isolation and habitat patch size to species richness, immigration, and extinction rates, and have been applied to habitat patch dynamics in fragmented urban areas (MacArthur and MacArthur 1961, MacArthur and Wilson 1967, Tilghman 1987, Soule et al 1988, Hanski 1999.

3.3.4 Community-level Impacts

Regardless of dispersal ability an organism will be impacted if it is dependent on *another* organism with poor dispersal, which is lost due to fragmentation. A study by Summerville and Crist (2003)[39] showed that landscape fragmentation does have deleterious effects on the community composition of lepidopterans (butterflies and moths) because it often impacts their host plants.

Wildlife habitat is degraded to a greater extent by *invasive plant species,* as a result of fragmentation. Invasive plant infestation is substantially more severe along newly cut forest edges, than in forest interiors. There is more seed dispersal by wind, deposition by birds feeding on fruiting edge species (e.g. cherries), and the greater light levels and higher soil temperatures promote seed germination and seedling establishment. Infestations often expand towards the forest interior, e.g. Morrows honeysuckle, burning bush, and Japanese barberry.[40] Edge creations results in alteration of forest habitat characteristics, for example by colonization from edges by *pioneer tree species*[41] that are prolific dispersers, e.g. birches, and by increased *spread of tree diseases* via windblown spores.[42]

A recent paper by Homan, Windmiller, and Reed (2004)[43] shows a close correlation between the extent of a vernal pool's upland buffer (with natural, native vegetation) and its occupancy by vernal pool species. This paper is based on a large body of field research (egg mass counts) and measurements of sizes of habitat blocks (i.e. using landscape-level metrics). Results are generally consistent with the Calhoun and Klemens (2002) methodology, calling for a 100 foot undisturbed buffer around a pool and a broad, 75%

[39] Keith Summerville and T. Crist determinants of lepidopteran community composition and species diversity in eastern deciduous forests: roles of season, ecoregion and patch size.
[40] S. Gadwa. Spring 2003. management of Invasive plants. Protecting Open Space and Wetlands: Tools for Land-Use Boards and Town Staff. 15(3):4-5.
[41] Franklin, Jerry F. and R. T.T. Forman. Creating landscape patterns by forest cutting: Ecological Principles and Cutting. 1987. Landscape Ecology. 1(1): 5-18. Page 12.
[42] Ibid, p. 10

naturally vegetated *vernal pool envelope* (wetland buffer) extending out 750 feet. This is a methodology which has not been consistently applied at The Preserve site.

3.3.5 Inhospitable Matrix

The *matrix* in which forest blocks are set is a very important factor. With The Preserve proposal a very large proportion of the matrix will be golf course fairways, which are not as hospitable to insect or small rodent dispersal as a pasture or meadow, and which are not a good food source of key meadow food sources: invertebrate prey, seeds, leafy foliage, and nectar, and which pose risks from pesticides (See Appendix B).

Betsy Rothermel, in a 2004 paper in Landscape Ecology cited in the IPM Plan review (see Attachment B) elegantly showed, using a drift fence trap array experimental design, that success of dispersal by juvenile spotted salamanders and toads across fields is directly related to field width. For the salamanders there was a 4.5 percent decrease in survivorship for every additional meter increase in field width. Less than 15% of toads and salamanders successfully crossed a 50-meter (i.e. 165 feet) wide field)[44]. The Rothermel study also showed that the juveniles *were not able to select* the shortest route from the breeding pool to a forest edge. Random dispersal behavior would make them unable to use narrow forest corridors, except occasionally, by chance. Migrating adults, hardwired to take a direct route to their natal pool, would also be behaviorally unable to move through woods around a fairway obstacle.[45] Manicured and managed golf course turf is expected to cause significantly higher mortality to dispersing or migrating amphibians from desiccation, dermal exposure to pesticides, and predation, than a meadow with some taller vegetation and is maintained by mowing every 3 to 5 years. Unfortunately such a mowing regime is contrary to those practiced a golf course.

The *matrix* for habitat patches may provide more of an obstacle to some species but not others. One study (Mech and Halliet 2000)[46] measured the degree of fragmentation impacts

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[43] Page 23 of Franklin, Alan B., B. Noon, and T. Luke George. 2002. What is Habitat Fragmentation? Studies in Avian Biology. 25: 20-29.
[44] It should be noted that the average width of golf fairways that would have to be crossed by amphibians at The Preserve is roughly 185 to 250 feet).
[45] Dr. Klemens was jointly involved with REMA in reviewing a ballfield project in Weston and presented testimony on the "hardwired" movement behavior of salamanders that would make them unable to use narrow hedgerows to move more safely across the athletic fields.
[46] Mech, Stephen and J. G. Halliett. April 2001. Evaluating the effectiveness of corridors: a genetic approach. Conservation Biology. 15(2): 467-74.

on gene flow, using a genetic index [Nei's genetic distance (D_s)] in red-backed vole (*Clethrionomys gapperi*) and deer mouse (*Peromyscus maniculatus*) in logged forested landscapes. Gene flow was significantly increased by forested travel corridors for red backed vole, but not for deer mouse, which can apparently disperse through recently logged habitat. Even deer mice may cross fairways to a very limited extent, since they are unsuitable habitat with high exposure to predators.

Several avian studies have also shown that moderate levels of gap and edge creation by selective logging do not negatively impact bird communities to a significant degree. However bird communities are impacted, when forests are bordered by a residential matrix. Friesen et al (1995)[47] showed in an Ohio study that:

> "the number of houses surrounding a forest severely undermined its suitability for Neotropical Migrants. Neotropical migrants consistently decreased in diversity and abundance as the level of adjacent development increased regardless of forest size."

The authors suggest that possible reasons for this could include higher levels of cats and gray squirrels (subsidized by bird feeders) or the bird's psychological need for maintaining distance from houses. The noise of lawnmowers, trimmers, vehicles, and play activity could also be a factor. A study by Reijnen et al. (1996) (see Attachment D), clearly shows the effect of road noise on bird communities in Holland.

Impacts on water quality and aquatic habitat are yet another mechanism by which forest fragmentation significantly impacts biodiversity, as documented by numerous watershed-landuse investigations, including the 1996 paper by Roth et al.[48] Large contiguous blocks of forest also result in a high percentage or even 100% protection of stream watersheds. Largely forested watersheds in Connecticut typically contain populations of native book trout and many more taxa of pollution sensitive aquatic insects (stoneflies, mayflies, and case-bearing caddisflies), species that are food for brook trout and dace. There is an excellent database for this community because the RBA (i.e., Rapid Bioassessment) is extensively used in Connecticut to assess stream health (Plafkin et al. 1989)[49]. For

[47] Friesen, Lyle E., P.F.J. Eagles, and R.J. Mackay. Effects of Residential Development on Forest Dwelling Neotropical Migrant Songbirds. 1995. Conservation Biology. 9(6): 1408-1414.
[48] Roth, Nancy, Allan, D, and D.L. Erickson. 1996. Landscape influences on stream biotic integrity assessed at multiple spatial scales. Landscape Ecology. 11(3): 14211-156.
[49] Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross and R.M. Hughes. 1989. Rapid Bioassessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates and Fish. USEPA EPA/440/4-89/001.

example, riffle habitat along the Salmon River in east-central Connecticut in minimally fragmented and typically has 20 to 30 taxa of insects. This is more than double the number of taxa recorded by CTDEP at the reference macroinvertebrate sampling station along a forested stretch on the Eight Mile River in the Quinnipiac River Watershed (south central Connecticut). Taxa richness of four or five is not uncommon for a stream in a suburban neighborhood with well maintained lawns, based on data from the QRWA Stream Team bioassessment program. With a forest matrix that includes a golf course with some deficiencies in its IPM plan (see Attachment B), water quality impacts are greater. The applicant has not provided any data on aquatic life or water quality in the streams and ponds at the site. Nevertheless one can expect high quality resources on this site.

The relatively large body of data available on the effects of ***forest fragmentation*** is now widely considered by land planners and managers who are called upon to conserve biodiversity. The goal of ***biological conservation*** is to maintain the identity and integrity of some biota to guarantee the presence of some communities and ecosystems. Because some species are sensitive to the size of the habitat in which they live, which is they are "area-sensitive," special attention must be given to the overall landscape.

3.4 Use of Landscape-Scale Metrics

Landscape-scale metrics or predictor variables to measure or to predict ecological responses and future biodiversity are commonly used throughout the country, both at the species level and at the population level (Fahrig 2003[50], Pope et al. 2000[51], Tucker et al. 1997[52], EPA 2002[53]). We have used several such metrics to measure the impacts to natural diversity at The Preserve and to make some relative comparisons and evaluations between what is being proposed and an alternative development scenario. Metrics that were chosen are: (1) Unfragmented, undisturbed Habitat Remaining, (2) Water Resources Impacts, (3) Natural Diversity or "Listed Species" Impacts, and (4) Vernal Pool Habitat Impacts. We call the sum of these indices the "Natural Resource Index."

[50] Fahrig, L. 2003. Effects of habitat fragmentation on biodiversity. Annual Reviews of Ecology and Systematics.
[51] Pope, S.E., L. Fahrig and H.G. Merriam. 2000. Landscape complementation and metapopulation effects on leopard frog populations. Ecology 81:2498-2508.
[52] Tucker, K., S.P Rushton, R.A. Sanderson, E.B. Martin, and J. Blaiklock. 1997. Modeling bird distributions- a combined GIS and Bayesian rule-based approach. Landscape Ecology. 12(2): 77-93.
[53] U.S. Environmental Protection Agency. 2002. Willamette Basin Alternative Futures Analysis. EPA 600/R-02/045(b).

Ecologists often develop models (or variations of published ones) to match their particular area of inquiry. The systems modeled are simplified compared to real systems, and input values are approximate, but they are underlain by research-based knowledge of ecological communities. The metrics used in the CFE alternative are underlain by site plan measurements (e.g. areas of forested blocks) and by the concepts supported by an extensive body of research on habitat fragmentation, habitat loss, and genetic isolation in natural systems, some of which is referenced above. This evaluation also takes into account the "five guidelines to preserve biodiversity" discussed in Section 3.2.3, above.

It should be noted that the calculation of the metrics and the resulting Natural Resource Indices were calculated by Planimetrics of Avon, using GIS. These calculations are being provided separately as a stand-alone document to the Old Saybrook Planning Commission.

3.5 Description of Alternative Development Plan and Ecological Planning

The alterative development that resulted from our landscape-scale study, as well as the summaries of the measured metrics is being presented separately to the Planning Commission. This section explains the alternative plan in narrative form components.

The alternative site plan is based on the landscape ecology principles which correspond to the selected GIS metrics, and also on site-specific ecological data, to the extent to which it was available in the application and public hearing record. The alternative also follows the basic design principle of minimization of construction on steep slopes.

Contiguous open space (unfragmented forest) has been increased over the applicant's design, by eliminating the golf course and also by eliminating the northwestern residential areas and roadway, although the alternative has the same total number of housing units (roughly 250). Exceptionally high bird diversity was documented in the northwestern forest, based on the applicant's bird data. This area is contiguous to off-site open space, in contrast to the western peripheral residential area, which is close to an existing neighborhood.

The placement of the village cluster east of Pequot Swamp Pond serves as an example of more site-specific, resource sensitive design. Moving the village cluster to the east took it out of the watershed of Pequot Swamp Pond, a sensitive, unusual, oligotrophic wetland resource which needs protection by a very wide wetland buffer. The applicant did employ the principle of avoiding steep slopes to some extent, for example, in placing the large village cluster on the plateau east of Pequot Swamp Pond. However, excessive project intensity resulted in development on steep slopes in key locations, for example portions of Fairway 10 and Fairway 18 on the steep eastern slope of this sensitive resource. Elimination of these fairways will protect the swamp's buffer, its water quality, and the valuable wildlife and plant habitat it provides.

Elimination of the rest of the golf course will similarly protect buffers and wildlife habitat in other wetlands, especially the large eastern wetland complex. Elimination of the hillside fairways will also maintain the unique natural vistas in the vicinity of Pequot Swamp Pond. Elimination of the southern four hundred to five hundred feet of the central village will also better maintain ecological connectivity between the eastern wetlands, Pequot Swamp Pond, and the western wetlands. A single roadway is much less of a barrier than concentrated housing. It may be possible to have the southern roadway limited to emergency vehicle use.

Fine points of site design, would benefit from site-specific information that is missing from The Preserve proposal. Rock outcrops serve as an example. The very short paragraph on this habitat type was very lacking in detail. Hilltops and knolls vary widely in their "uniqueness and heritage value." Some are mostly tree covered with a monotonous understory dominated by catbrier. Others offer a lovely long-distance vista as one emerges from the closed forest, and also a closer view of textured, subtle-hued carpets of lichens and mosses and low blueberry bushes, interesting rock formations, clusters of wildflowers, and stands of chestnut oak or shadbush with striking textured or patterned bark. Knolls also often provide striking vistas when viewed from below. The applicant plans to protect two knolls with the state-listed Prickly Pear Cactus, but did not provide information on the relative values of the other hilltops, knolls, and rock outcrops on the site. This is additional site-specific information needed for an optimally fine-tuned open space development design.

Proper ecological planning is also hampered by the lack of an inventory of the aquatic resources (marcobenthos, fish, etc.). Botanical data is sufficient to show that Pequot Swamp Pond needs a generous wetland buffer, as also recommended by Wendy Goodfriend. However, for the other swamps, streams, seeps[54], and pools on the site, data

[54] EPS sated that there were no seeps on the site, but this is inconsistent with the multiple observations of dusky salamanders, whose habitat, according to Dr. Klemens' report is: "clean, cool seepage areas."

would help to distinguish the exceptional resources, and would provide baseline data to assess the performance of stormwater practices and erosion controls post-construction. We also reiterate the need for additional summer data on the vernal pools, and especially the eastern wetlands, unless the entire area is to be protected as proposed in our alternative (see Summary of Findings).

In conclusion, it is our professional opinion that The Preserve plan as proposed is reasonably likely to have, the effect of unreasonably polluting, impairing or destroying the public trust in the air, water or other natural resources of the State. Moreover, the alternative development plan presented by CFE and described herein is a feasible and prudent alternative to the proposal.

Please call us if you have any questions on the above or need further assistance.

Respectfully submitted,

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Sigrun N. Gadwa, MS
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VIA E-MAIL & HAND-DELIVERY

Attachments:

- A: Rebuttal to Memorandum by Dwight H. Merriam, Esq. (with attachments)
- B: A Review of the Integrated Pest Management Plan and Supporting Documentation for the Proposed golf course at "the Preserve Country Club"
- C: Professional Resumes
- D: Selected Avian references; Figure 1: The Preserve (2000 Color Aerial Photo); Figure 2: The Preserve (USGS Topographic Map showing breeding bird survey points); Table 1: Breeding Bird Data from Preserve; Table 2: Breeding Bird Data – Trends