ATTACHMENT B:

A REVIEW

Of the

INTEGRATED PEST MANAGEMENT PROGRAM

AND SUPPORTING DOCUMENTATION

for the

Proposed golf course at "the Preserve Country Club"

in an

Application for a Special Exception Use Permit

submitted to the

Old Saybrook Planning Commission,

on

December 8, 2004

by

River Sound Development, LLC

1.0 INTRODUCTION

Rema Ecological Services, LLC (REMA) has reviewed the Integrated Pest and Turf Management Plan proposed for the Golf Course at The Preserve, including accompanying appendices and in attachments, in the Response to the Planning Commission ("the Commission"). Most of this information is in the applicant's report *Response to Town Review Comments* dated December 8, 2004. Supplemental Information was submitted as Appendix H on December 23, 2004.

The review objective was to assess the extent to which the plan is consistent with the third in the list of *Principles for Golf Courses in the US*:

> "to recognize that every golf course must be developed and managed with consideration for the unique conditions of the ecosystem of which it is a part. " (emphasis added)

We considered the applicant's proposed fairway layout in relationship to the site's wetland and watercourse resources and their unique characteristics on this site (to the extent that they were provided by the applicant or others reviewing the application). Evaluation in the context of the larger golf course industry was facilitated by the review paper by Cohen et al in Appendix B (Tab V) of the report Water Quality Impacts by Golf Courses" Journal of Environmental Quality 28: 798-809. The 1995 publication by Grant and F. Rossi paper, *Evaluation of reduced chemical management systems for putting green turf*[1] provided a realistic description of challenges and successes with this approach. Finally the report was compared to another golf course IPM plan in Connecticut recently reviewed by REMA[2], hereafter referred to as Plan "B." Internet pesticide databases (PAN, Extoxnet, USDA–WIN-PST) provided information on toxicity levels and pesticide properties.

2.0 RISK ASSESSMENT MODELING

2.1 Overview

The applicant screened 53 candidate pesticides with two EPA screening models (GREENEC for ecological risks and SCI-GROW for groundwater risks). Screening by the models resulted in elimination of three products and placement of nine products with high aquatic toxicity and significant risk levels into a "restricted use" category. **Fifty** is the total

[1] USGA Turfgrass and Environmental research on Line 3(4): 1-3 TGIF Record Number: 95002.
[2] REMA is not at liberty to divulge the name of the golf course or the consulting firm that prepared the plan until it becomes part of a public record.

number of pesticides, of which ten (10) are insecticides. A number of the unrestricted products also pose a risk to aquatic (and terrestrial) invertebrates or birds. This is a very large number of pesticides for an IPM plan. By comparison, another golf course IPM plan recently reviewed by REMA has a list of only twelve (12) pesticides of which only two are insecticides, with none on "The Preserve" high risk restricted list.

2.2 Toxicity (LC 50) Parameter

Spot checking of parameters inputted into the model, such as solubility and half life, showed consistency with other published databases. However, the report did not clarify *which organism*(s) were used for the LC50[3] value, a key parameter for the GREENEC model. The ratio of the LC 50 value to projected concentrations in runoff was used to quantify risk level. The LC50 value appears to have been derived from fish data, based on comparisons with published for fish in the Extoxnet database, and the low risk assigned by the model to several mobile insecticides with high toxicity to aquatic insects, but low fish toxicity (Imidacloprid and carbaryl). This is a ***fundamental flaw*** in the model, since impacts to invertebrates are so important from a food chain and overall biodiversity perspective.

2.3 Large Number of Pesticides in Plan

It is surprising to see so many (nine) products identified as "high risk" in the IPM plan, considering the high biodiversity and sensitivity of the wildlife and aquatic resources at this particular site. The restricted, high risk products would include six (6) insecticides (bifenthrin, chlorpyrifos, cyfluthrin, fluvalinate, isofenphos, lamda-cyfluthrin), 1 fungicide (thiram), 1 herbicide (trifluralin), 1 nematicide (fenamiphos), all with high aquatic toxicity. Use of a very large number of different pesticides also increases the complexity of the procedures for mixing chemicals and rinsing/cleaning of sprayers and shrouds, and disposal of rinse waters, increasing the possibility of accidents and errors. Note the elaborate schematic diagram for a modular pesticide mixing system on p. 54 of Attachment 6.

2.4 Inadequate Restrictions On High Risk Products

Three across-the board restrictions are to be placed on use of on the products rated high risk, based on modeling, but they do not reduce risks to acceptable levels.

[3] LC50 is the concentration (ppb in the GREENEC model) that is lethal to 50% of a particular organism (unknown for GREENEC).

2.4.1 Restriction #1: *Apply no closer than 25 feet from a water feature*

Substantial risk of toxic runoff remains, especially with high intensity rains, due to the very narrow wetland buffers and numerous wetland crossings in the proposed course layout. (Wetland buffers near between 25 to 50 feet are widespread, as tabulated in Attachment A of this report.) Soluble pesticides would be most readily transported, but higher runoff velocities can dislodge and transport dried pesticide particles and surface sediment or thatch particles with adsorbed pesticide. This general (not site-specific) restriction does not take slope or seasonal factors into account. Risks are higher on steeper/longer slopes where runoff tends to concentrates, and erosive power is higher. Risks are also greater in the early spring (April) when frequently wet soils increase runoff rates, a season when insecticide applications are planned to control four pests, as shone on the insect pest control calendar on p. 76.

2.4.2. Restriction #2: *Treat no more than 20% of the entire course at one time*

This will not protect a particular resource located adjacent to a sprayed fairway, as reduction of application rates is not proposed, although, from a watershed perspective, it would reduce downriver pesticide loading. Individual on-site pools and streams are at still risk. Twenty-percent (20%) of an entire golf course is a very large area, not consistent with "spot treatment only" IPM philosophy. This philosophy is clearly laid out in Plan "B." but not in The Preserve Plan.

2.4.3 Restriction #3: *Limit number of treatments per year to one or two*

This restriction, based on product half life, limits build-up in groundwater, soils, or ponds, but not toxicity from particular runoff incidents. Build-up can still result from desynchronized treatments to multiple portions of the course that drain into the same wetland system (e.g. the eastern wetland complex).

2.5 Models' Lack of Site-Specificity

The models were run only at the more general Tier 1 and Tier 2 level, which uses only broad brush site data, not at the more site-specific Tier 3, level. The model did not generate outputs geared to particular fairways and adjacent wetlands. Proposed restrictions for pesticide and fertilizer use were no more stringent on the steeply sloping fairway next to Pequot Swamp or by wooded swamp with embedded vernal pools, than by red maple woods lacking surface water.

A more site-specific IPM plan could also identify receptors with limited dilution capacity, increasing potential concentrations. Modeling was described as conservative, overestimating application rates and concentrations in runoff. However, wetlands and streams vary widely and seasonally in their level of throughflow and flow volumes (dilution capacity). Release of a given quantity of pesticide would result in higher concentrations during a summer drought when stream and pool levels are low. Intense but localized summer thunderstorms also occasionally arrive unexpectedly, shortly after a pesticide or fertilizer application – despite an IPM policy of not spraying shortly before rain events. Infiltration is reduced overall in a golf course, and runoff rates increased, compared to a natural landscape, because soils are always moist in a well-irrigated golf course.

3.0 PESTICIDE RISKS: *An Ecological Perspective*

Some risk is clearly present, but at what level, if most of the toxic pesticide remains immobile on the turf unless dislodged by very intense rain or unusual erosive circumstances? It is the extremely toxic pesticides like the insecticide Fluvalinate and the fungicide triadimefon (to arthropods) that pose the highest risk, because impacts begin at very low concentrations. The value and significance of the adjacent resources must also be taken into account, in a decision as to what levels of environmental risk is acceptable.

3.1 Toxicity of products on "Restricted" List

Most of the nine (9) products on the high risk, "restricted" list, based on the modeling, are toxic to multiple organism groups. Cyfluthrin is a synthetic pyrethroid insecticide that is very highly toxic to fish, insects, and zooplankton, slightly toxic to mollusks, and moderately toxic to mammals.

Another example is Trichlorphon (in Dursban), banned from use by homeowners and by many schools due to human health risks, toxic to fish and birds, and highly toxic to aquatic invertebrates. Although its physical characteristics would suggest very limited mobility[4], this is one of the compounds that *was* detected in the Cohen et al study (Appendix C of the Applicant's report.) exceeding acceptable concentrations in 9 of 13 samples. Most were detected in one runoff study, immediately following rain events, presumably washed off with particles in surface runoff. Fluvalinate is somewhat toxic to various organism groups, but extremely toxic to both fish and aquatic invertebrates, with an LC 50 for blue gill fish of 0.9 ug/l. Thiram is a fungicide on the "restricted" list with a high risk to humans with

[4] Its solubility is 0.4 mg/l and its soil sorption coefficient (KOC) is 6, 0 70.

an advisory level of 4 mg/l, and is also highly toxic to fish, but not birds. Bentazon is an herbicide on the "restricted" list due to human toxicity (a health advisory level of 20 ppb), which is also highly toxic to most mollusks. Snails are an important component of the biota in most ponds, and fingernail clams and other gastropods may be abundant in vernal pools, of which there are many at the site. Terrestrial snails are a major food item for eastern box turtles, which could be killed by pesticide drift into fairway edges, which is unavoidably at least 3% of what is sprayed.

Amphibian toxicity is not included in most databases, but their thin, permeable skin makes them especially vulnerable to dermal toxicity. Several studies have shown very high sensitivity to cholinesterase inhibitors, even transported by long distance pesticide drift in California. Potential hormonal impacts have not been well studied, but sex changes in frogs result from exposure to triazine herbicides at concentrations of a few ppb.[5] A matter of grave concern is pesticide toxicity (in addition to desiccation) for amphibians migrating across fairways in the vicinity of the productive vernal pools associated with both the eastern and the western wetland complexes, that is crisscrossed by fairways, especially to small-bodied dispersing juveniles. A careful study of juvenile migration by toads and spotted salamanders showed that juveniles are *not* able to select dispersal routes to minimize crossing distances over open fields.[6]

3.2 Non-target Insects

The dilemma with regard to control of pest insects is that effective insecticides are *also toxic* to a wide range of non-target insects, including stream bottom aquatic insects; insects in forest soils eaten by salamanders and shrews, and insects on foliage, flowers, and shrubs at the edges of fairways. The non-restricted insecticides not rated as high risk by the models may not be very toxic to fish, birds, or mammals, but they are toxic to non-pest insects, which are vital to the ecosystems at The Preserve. Two examples are the insecticides Imidacloprid and Carbaryl, which are both quite mobile[7], but not restricted based on the models. They may actually be applied within 25 feet of water features, according to the Preserve IPM Plan. Insecticide spray drift extending into fairway edges may negate most wildlife benefits of edge habitat creation.

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[5] Research on hormonal alteration by the triazine herbicide atrazine (not in the IPM plan) was conducted by Tyrone Hayes at the University of California at Berkley, and was reported in the April 2002 issue of Proceedings of the National Academy of Science. Doses as low as 0.1 ppb induced feminizing changes; 3 ppb is the drinking water standard for Atrazine.

[6] Rothermel, Betsie. October 2004. Migratory success of juveniles: a potential constraint on connectivity for pond-breeding amphibians. 14(5) 1535-47.

[7] Imidocloprid has a solubility in water of 510 mg/l and Carbaryl has a solubility of 120 mg/l.

3.3 Pesticide Ingestion

This IPM plan does not consider in-situ impacts on wildlife via the terrestrial food chain. Only a few pesticides are toxic to earthworms, because earthworms are important for healthy soils. However, because earthworms feed by ingesting soil, other wildlife that preys on earthworms may ingest and be exposed to pesticides in the soil, for example robins, Northern flickers, woodcock, and short-tail shrews. Chloropyrifos is highly toxic to birds, and may impact them via the food chain.

4.0 CONTROL STRATEGIES

4.1 Alternative Biological Controls

From an ecological standpoint, alternative biological insecticides have the advantage of much greater specificity than conventional insecticides, and do not threaten stream bottom insect fauna. However, the IPM plan for The Preserve County Club does not propose to use them as a front-line tool for pest control, just as an ancillary experimental tool. By contrast the "B" IPM plan, recently reviewed by REMA, would use controls like milky spore disease and entomopathic nematodes first, with insecticide use primarily as a "last resort".

Both the "inconsistencies" and strengths of biological controls are discussed in both IPM plans, but they are not a significant part of The Preserve Plan. Alternative green management, was described in the Grant and Rossi paper (1995), in Appendix H, with chemical treatments only as a "last resort." Although the intent of the authors appears to be to show the extra expense and difficulties with alternative control, one result is worth noting: infestation of dollar spot fungus, a major disease problem, was far less severe on the greens with alternative treatment, after several years. Also, golfers were surveyed regarding tee quality, and were not able to detect differences between tees treated alternatively and conventionally.

4.2 Action Thresholds

Table 17, insect pest density thresholds for control measures, calls for treatment at significantly lower densities than those in "IPM Plan B". The Preserve Plan calls for control of sod webworms on Fairways at densities of 4 to 8 grubs/square foot, and of *Ataenius* beetles at 6 – 12 grubs per square foot, compared to 30 to 60 grubs/ square foot for both of these pests in IPM Plan "B". The lower action thresholds will result in more frequent and extensive pesticide use.

4.3 Correcting Underlying Agronomic Imbalances

This is a key part of the philosophy of any Integrated Pest Management Program, but is not as well-developed as it could be in the narrative for the IPM Plan for The Preserve Country Club. For example, this plan does not emphasize slow- release *organic* fertilizers, which have a well documented ability to promote healthy microbial populations in soils, which increases disease resistance and speeds pesticide breakdown, and which also increase organic matter content in soils, resulting in denser, more weed-resistant turf. (At the Preserve daily "fertigation" (fertilizer dissolved in irrigation water) will be emphasized, which results in even fertilization and reduced leaching). The section on weed control lacks detail – e.g. allowing soil surface to dry between waterings to inhibit weed germination, and practical techniques for quantitative surveys of weed density (comparable to monitoring insect levels), to determine whether weed control is necessary at all in a given portion of the course.

5.0 EPISODIC ACUTE TOXICITY

Aquatic ecosystems are often degraded by episodic acute toxicity rather than chronic low level toxicity. These may be associated with runoff events, spills, or illegal discharges. This is one of the major reasons that stream health is so effectively assessed with bioassessments of the long-lived benthic insect community rather than chemical testing (e.g. by CTDEP water resources); the stream insect community integrates episodic toxicity over time. With the majority of toxic pesticides used at golf courses, which are *not* very mobile in soil, steady seepage into wetlands and streams from groundwater is *not* expected. It is not surprising that a relatively low proportion of samples tested positive for pesticides in the Cohen study, a compilation of 17 pesticide monitoring studies. However, as stated by Cohen et al. (1999) (Appendix C), pesticides "can run off to surface waters in the dissolved phase or when bound to small particles of eroded sediments." A large Michigan USGS study (1997)[8] found that several pesticides frequently exceeded EPA maximum contaminant levels (MCLs) in streams and small rivers during the spring season of heavy runoff.

Unless studies are specifically set up to sample after rain events, the probability of detecting pesticides resulting from runoff events into a flowing watercourse is small. Only two or three of the 17 studies were geared to stormwater runoff, based on the study objectives summarized in Table 2. Samples in one of these repeatedly tested positive for

[8] US Dept. of the Interior. Geological Survey. 1997. Pesticides in Surface waters. National Water quality Assessment (NAWQA), Pesticide national Synthesis Project. Fact Sheet FS 039-97.

Trichlorphon, a nearly insoluble pesticide with very slow soil mobility through in soil. The study authors were surprised that there were more detections of immobile "high K_{OC} " pesticides in surface waters than of highly mobile "low K_{OC} " pesticides. We note also that many immobile pesticides are long-lasting and remain at the soil surface, where they could be eroded and transported long after application. For example, the half life of the restricted herbicide trifluralin is 60 days.

Even widely spaced, brief episodes of toxic pesticide runoff can effectively decimate the benthic macroinvertebrate community or kill the entire year's crop of amphibian larvae or tadpoles. They could possibly cause a fish kill or more likely diminish fish populations due to reduced food supply. The narrow wetland setbacks and many wetland crossings in the proposed layout significantly increase the risks of impacts from surface pesticide runoff, even of low mobility products. Discharge points from the proposed drainage system under the greens, would be point sources that could result in gully formation, and that would be carrying a heavier load of nutrients and pesticides from the rest of the course.

6.0 NUTRIENT IMPACTS

The studies quoted in Attachment 1 of the *Response to Town review Comments* and the results of the Cohen et al study are consistent with significant impacts from nutrient releases on the "low nutrient" (oligotrophic) wetlands, and likely on streams as well. The applicant has provided site-specific botanical data for Pequot Swamp Pond, which is a highly sensitive oligotrophic, boglike wetland with floating bog mats and plant species like sundews, which is to be closely bordered by fairways, with buffers under 25 feet at multiple locations. Headwaters forested wetlands to the east of the golf course, and embedded vernal pools, may also include oligotrophic seeps and plant communities, with associated amphibians and damselflies, as well as embedded vernal pools, and they may be located downgradient of the community leaching field. However, the applicant's botanical and wetland data is not location-specific within this very large eastern wetland complex. The presence of four toed salamanders north of Fairway #8 indicates nutrient sensitivity in that area.

Phosphate losses via surface runoff are predicted ranging from 6% to 23% (Linde et al, 1994, quoted in the phosphorus sections of Attachment 1). Proposed application rates are 1-5 lbs per year according to Tables 8 and 9, and the phosphorus concentration in a non-impaired stream is typically less than 0.1 mg/l. Phosphorus in runoff from the fairways in the swamp's watershed is expected to degrade Pequot Swamp into a rank, nutrient-rich swamp.

Significant nitrate-loading is also expected based on the Linde et al. study in Attachment 1 showing nitrate-nitrogen concentrations in leacheate at 80% of concentrations in irrigation water – a 20% loss. The Cohen et al. (1999) study, with over 768 samples, showed a median Nitrate-N concentration of 5.0 mg/ liter below golf courses, which, which although lower than the 10 mg/l drinking water standard, is ten times more than the 0.5 mg/l level "of concern to the ecological health of an ecosystem" (Attachment 1, Nitrogen section, from Wetzel 1993). This 0.5 mg/l threshold is consistent with water sampling in 2004 of several dozen oligotrophic wetlands by REMA. A large scale USGS study of water quality in 30 groundwater fed streams in the Croton watershed, (Paul Heisig 2002) showed nitrate-N concentrations under 1.5 mg/l for non-impaired streams. Proposed nitrate-N application rates are 3-6 lbs/1000 square feet per year.

7.0 CONCLUSION

Given the proposed fairway layout and the sensitivity and the value of the adjacent and downgradient open spaces, which include wetlands and watercourses, the level of risks and impacts to the natural resources is unacceptable. In terms of the numbers of high risk products to be used, and the emphasis on chemical controls in the overall control strategy, this IPM Plan puts forth a low standard. The articles attached by the applicant actually underscore and substantiate the risks from nutrient pollution and pesticides in surface runoff from golf courses.