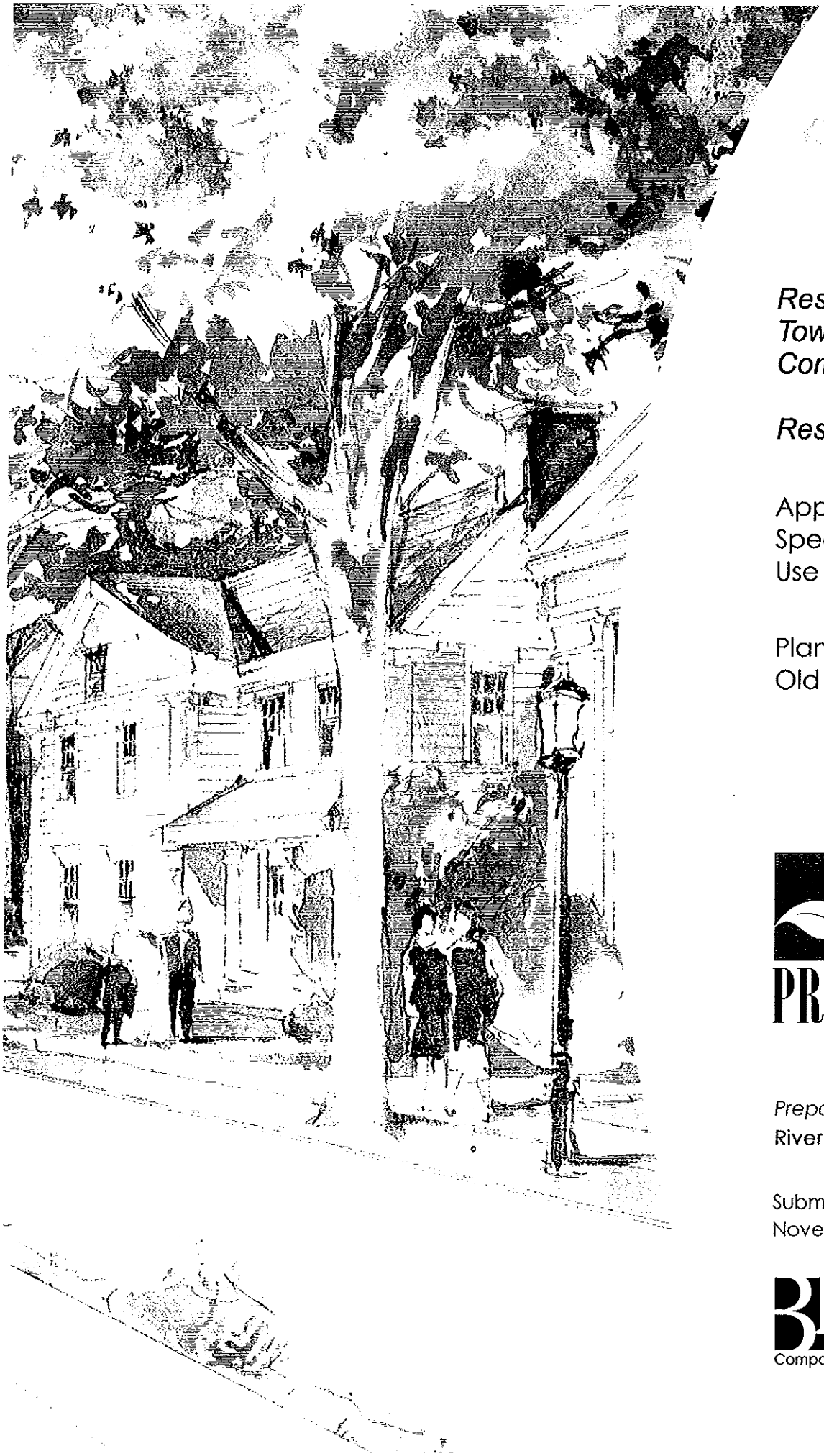

Response to Town Review Comments

Response #2

Application for Special Exception Use

Planning Commission
Old Saybrook, CT

THE PRESERVE

Prepared for:
River Sound Development LLC

Submitted
November 17, 2004

BL Companies

Introduction

Following is our second set of responses to comments received on the Conceptual Subdivision Plan (Yield Plan) and Preliminary Open Space Subdivision Plan.

As Attorney Brance pointed out in the last hearing session, the questions appropriate to this phase of the application process are three:

1. **What is the yield (unit count) for a Conventional Plan?**
2. **Compared to a conventional plan, is an Open Space Subdivision the proper development method for the property?**
3. **If an Open Space Subdivision is the proper development method, should the plan River Sound proposes be revised in any way?**

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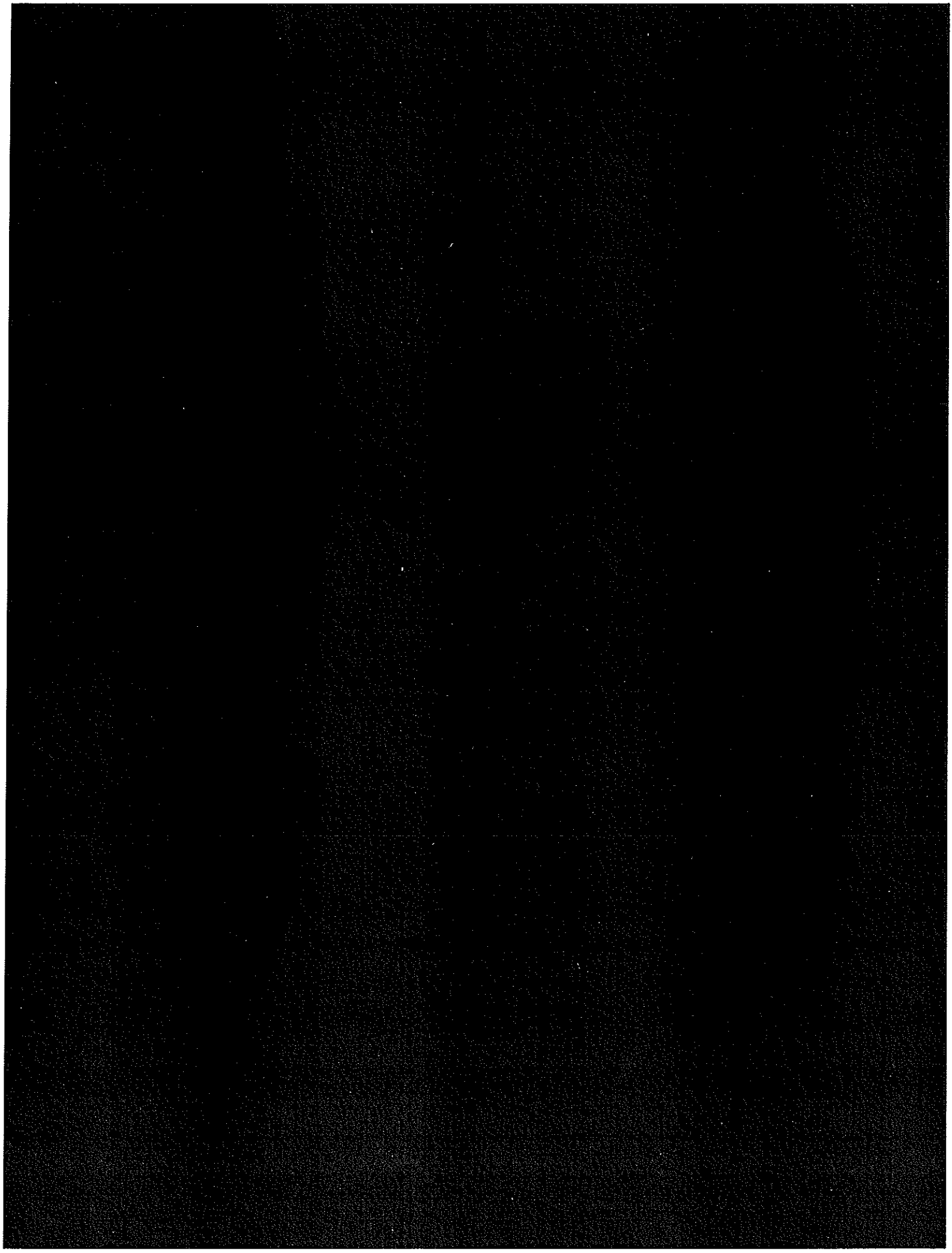


I. Response to Staff Comments – "Yield Plan"

In early 2002 the Planning Commission created a new zoning district with the goal of preserving as much undeveloped land as possible, particularly land with sensitive natural and cultural resources. The Commission opted to modify the existing Open Space Subdivision zoning regulation, because the Zoning Commission was familiar with that regulation. The Planning Commission recognized, however, that in order to have the new regulation work, it would need to remove those portions which had previously discouraged applicants from proposing an open space plan in the past. The most significant change involved removing the requirement that applicants conduct detailed on site testing and full engineering for their conventional subdivision plans, which had been required to determine the 'yield' of the property.

It was this very burdensome requirement that effectively discouraged any applicant from opting for this design alternative, during the life of that prior regulation.

River Sound has developed a Yield Plan conforming to the Town's newly modified regulation. This plan does take into account the extensive on-site soil testing that is NOT officially required for Conceptual Standard Plans. However, because River Sound opted to submit this information as part of its application, the staff has performed a more stringent review of the Yield Plan than the new ordinance language required or even intended to require. This review not only takes into account the MABL requirements, exclusive of testing (as provided under the code), but also considers site features, such as stone walls, and existing trails -- features that are encouraged for consideration but often sacrificed or modified in the conventional subdivision approval process.

In past conventional subdivision applications, the Commission and staff had only very limited tools with which to review plans for properties containing resources such as stonewalls, scenic areas and trails. When it was easy to do without losing lots, applicants generally modified their plans to conform to these requests. However if their lot yields could not be achieved, applicants typically resisted these suggestions.

We believe River Sound is being subjected to a level of review more appropriate to conventional plans submitted for actual approval – under the old regulations. This level of review is unnecessary and inappropriate for developing yield plans. It is also contrary to the letter and the intent of the Town's new regulation, which does not require applicants to spend time and resources to modify, sometimes in minute detail, Conceptual Standard Plans demonstrating protection of such features.

It is the specific goal of the Open Space Plan – not of a conventional plan - to preserve the most sensitive landscape elements and to subject them to a high level of scrutiny. Even though past conventional applicant made some revisions attempting to respond to such preservation issues, no conventional plan can ever preserve such features as meaningfully as can an Open Space subdivision.

An open space subdivision allows an applicant with the flexibility of layout and design in order to preserve these areas. This is why River Sound has proposed the plan it has developed. This is where scrutiny should occur, in general now, and in greater detail at the time of review of the Final Open space Subdivision Plan.

Furthermore, no density bonus is provided in the Open Space Subdivisions Regulation. It has been the history of conservation plans to receive such a bonus. This would normally be an incentive for an applicant to propose an Open Space subdivision since it has been foreseen by the planning

community that conservation plans preserve far greater landscape than does any conventional subdivision.

The Zoning Enforcement Officer in her review comments of November 12, 2004 raised the question whether each lot has demonstrated the ability to meet the requirements for the Minimum Area of Buildable Land (MABL) as defined in Section 7.2 of the Zoning Regulations. For the purpose of the Conceptual Standard Plan, each MABL square is delineated on the plans and is clearly labeled. Significantly, none of the MABL squares contain any wetlands, and all lots exclude wetlands from calculation of minimum lot area.

All plans labeled SB-1 thru SB-69 clearly show steep slopes in excess of 20%. Slopes are clearly delineated on the Legend of Sheet SB-1. In fact, slopes greater than 20% were not only measured across 40 feet horizontally but also were measured between two-foot contours -- as generated by detailed computer modeling.

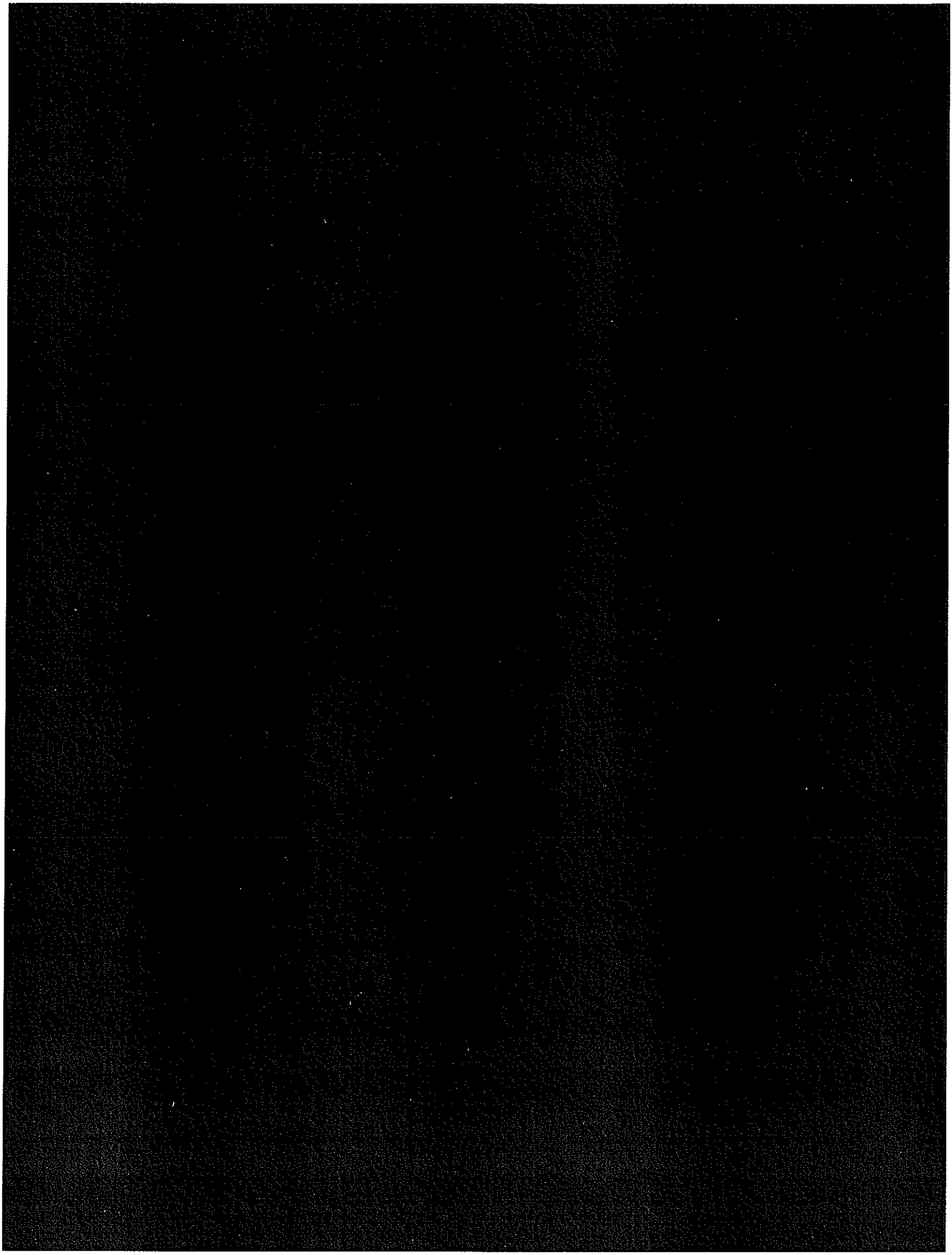
All MABL squares meet the requirement limiting areas containing slopes greater than 20% as delineated by this detailed analysis.

The applicant feels this is a very conservative approach. The bottom line is that all 293 lots meet or exceed these criteria.

Additionally the issue of including the golf course in the conventional yield plan has been addressed in responses submitted on November 10, 2004. It is not the purpose of the Conceptual Standard Plan under the Town's regulation to be a PROPOSAL for conventional development – either with or without a golf course. The purpose of the Conceptual Standard Plan, under the Town's codes, is ONLY to "determine the number of lots that constitute a reasonable subdivision of the land conforming to these [Zoning] Regulations and Subdivision Regulations (hereafter "total lots")".

The concerns associated with future development on the Pianta Parcel remain an item in question and have been addressed by several reviewers. To clarify this matter the applicant has submitted an Amended Statement of Use (dated 11/10/04) which was included in Section II of our Response to Town Review Comments dated November 10, 2004.

It should be remembered that the Pianta parcel was NOT included in the lot density calculation. It will, however, be included within the PRD for the entire River Sound property, and is proposed for cluster housing development under Section 55. The entry road and adjacent bike/pedestrian path are both included as part of the Preliminary Open Space Plan.



II. Response to Staff Comments – Activity within Upland Review Areas

Under the Conceptual Standard Plan (yield plan) Town staff has raised the concern associated with the amount of activity within the upland review areas and its permissibility with respect to the town's wetlands agencies regulatory authority. As a point of clarification we would like to make the following points with respect to the yield plan:

1. There are no homes depicted within the 100' review area
2. There are no septic systems within the 100' review area
3. There is no clearing or grading for home lots within the upland review areas

In fact, the only disturbances within the upland review area are associated with roadway crossings and potentially stormwater basins. This is consistent with passed subdivisions and site plans approved – recently – by the wetlands agency. Past approved projects and their percent of disturbance within the regulated area is as follows:

Pashbeshauke:

Area of 100' Upland Review Area: 28,517 sf
Total Disturbed of Upland Review Area: 3,484 sf **(8.2% of Upland review area)**

North Cove Crossing:

Area of 100' Upland Review Area: 56,822 sf
Total Disturbed of Upland Review Area: 30,115 sf **(53.0% of Upland review area)**

North Cove Landing:

Area of 100' Upland Review Area: 18,176 sf
Total Disturbed of Upland Review Area: 7,678 sf **(42.2% of Upland review area)**

Jorgensen:

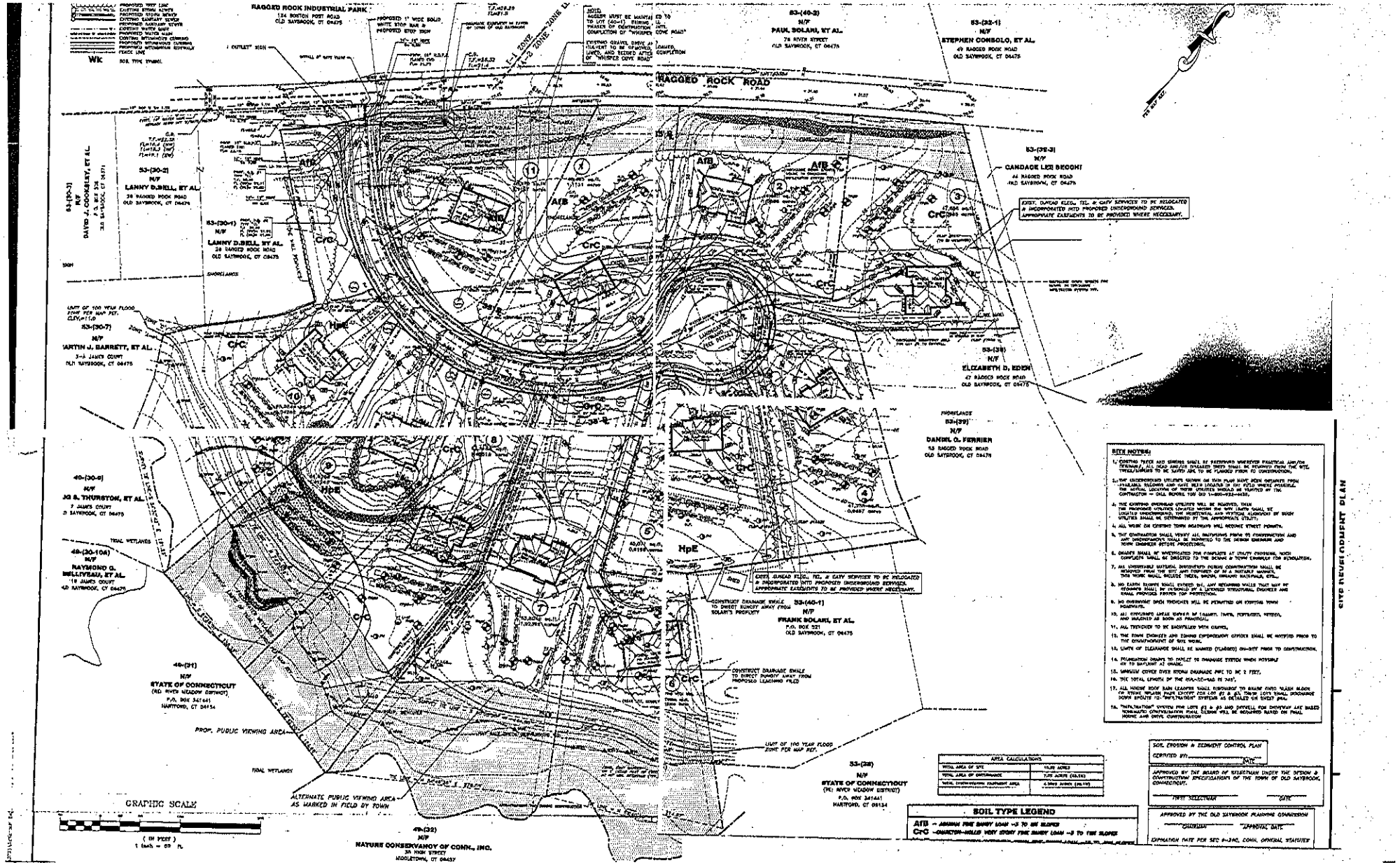
Area of 100' Upland Review Area: 36,230 sf
Total Disturbed of Upland Review Area: 18,426 sf **(50.8% of Upland review area)**

The proposed yield plan is consistent with the past-approved projects.

The Preserve Yield Plan:

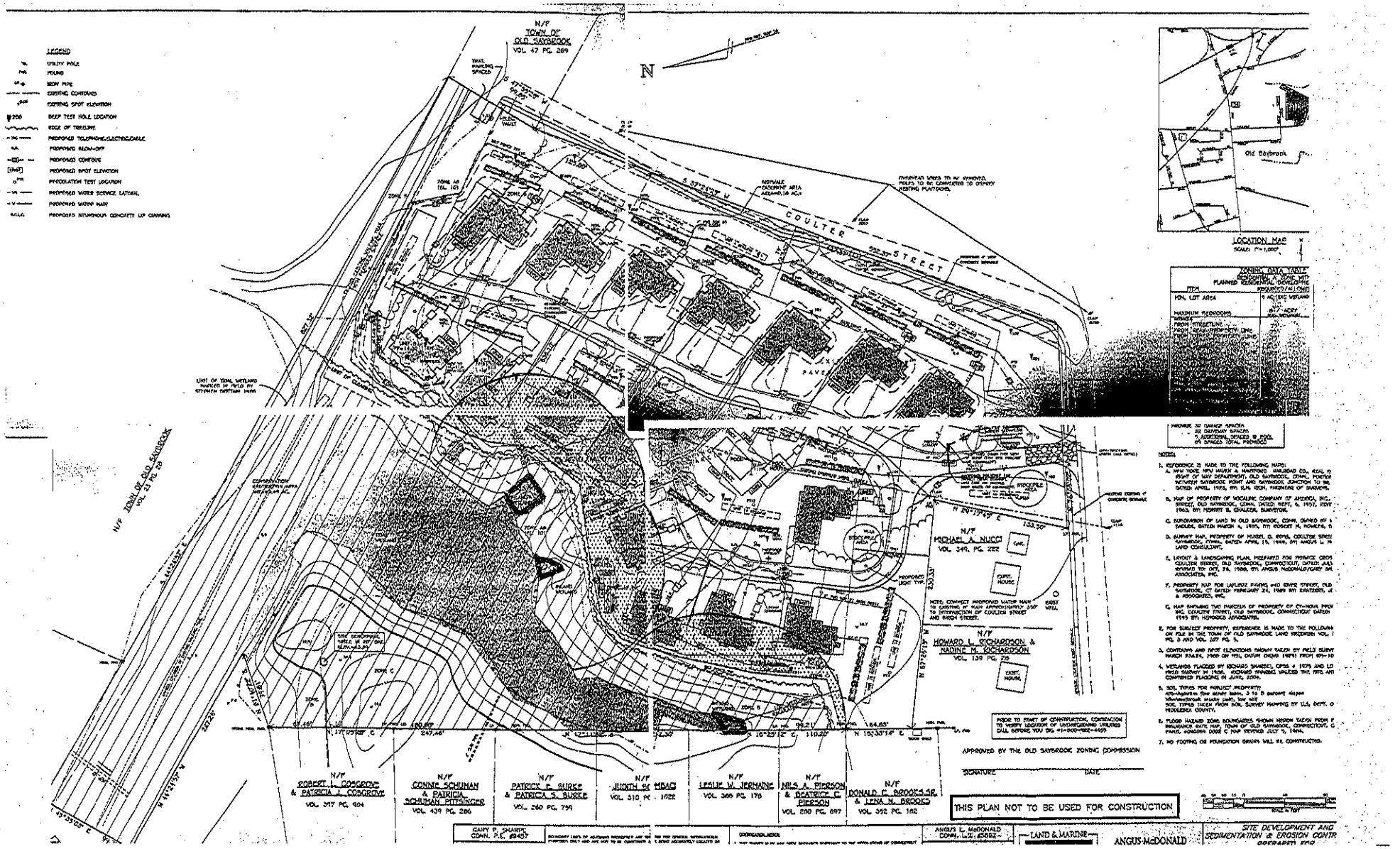
Total Upland Review Area: 233 AC
Total Disturbance of Upland Review Area: 9 acres **(3.8 % of Upland Review Area)**

The Purpose of this comparison is simply to demonstrate that the "yield plan" exceeds current regulatory requirements and that the upland review area is not a "no build" area. In each of the above examples the applicant was required to demonstrate that either no impact occurred or was mitigated. The same will occur with respect to our open space subdivision plan.



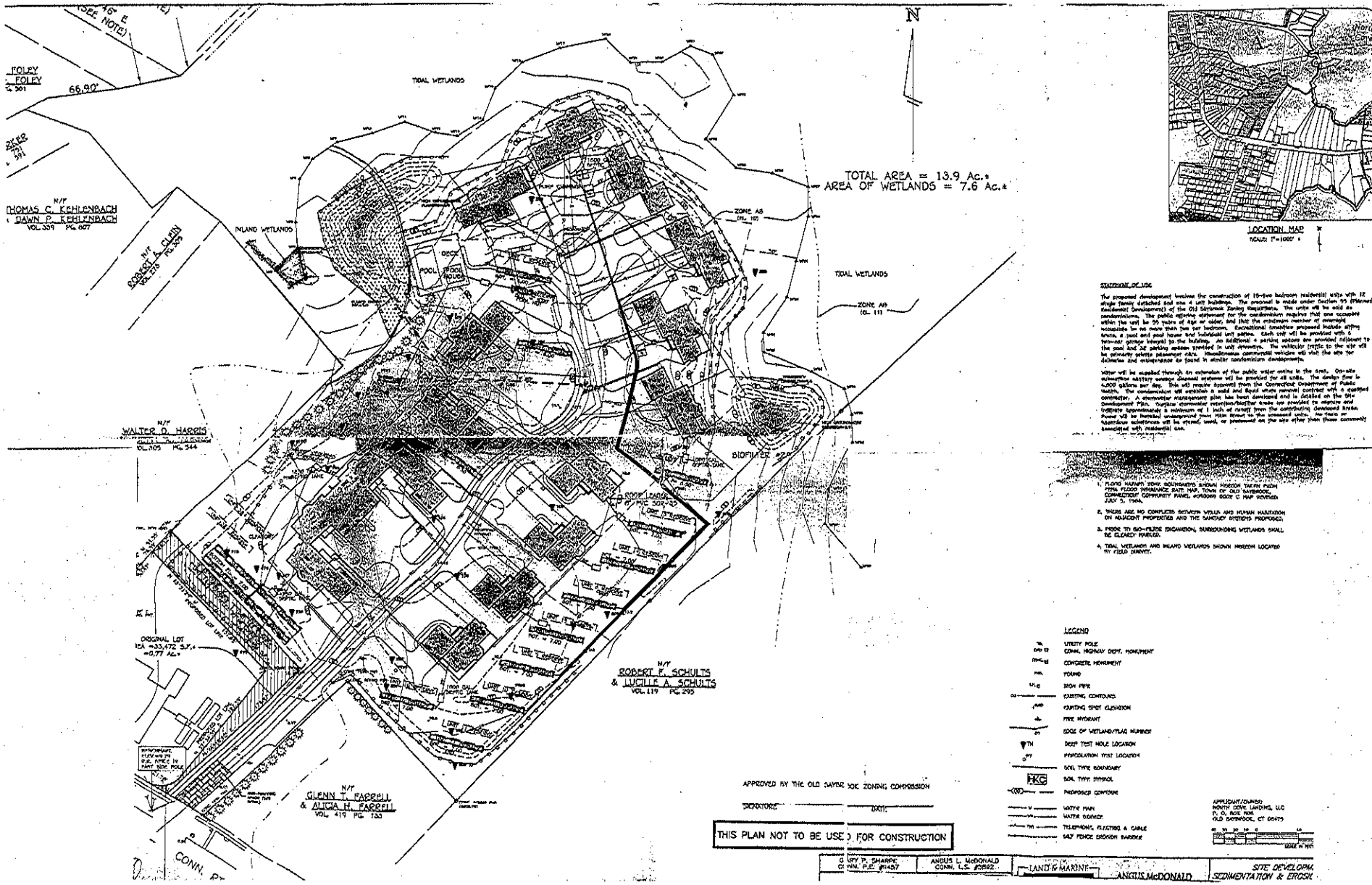
PASHBESHAUKE

N.T.S.



NORTH COVE

N.T.S.



LOCATION MAP
SCALE: 1"=1000' ±

STATEMENT OF USE

The proposed development involves the construction of 15-two bedroom residential units with 12 single family detached and one 4 unit buildings. The proposal is made under Section 99 (Planned Residential Development) of the Old Saybrook Zoning Regulations. The units will be sold as condominiums. The public attorney statement for the condominium requires that one occupant within the unit be 55 years of age or older, and that the maximum number of overnight occupants be no more than two per bedroom. Recreational amenities proposed include sitting knolls, a pool and pool house and individual unit patios. Each unit will be provided with a two-car garage integral to the building. An additional 4 parking spaces are provided adjacent to the pool and 26 parking spaces provided in unit driveways. The vehicular traffic to the site will be primarily private passenger cars. Miscellaneous commercial vehicles will visit the site for deliveries and maintenance as found in similar condominium developments.

Water will be supplied through an extension of the public water mains in the area. On-site subsurface sanitary sewage disposal systems will be provided for all units. The design flow is 4,800 gallons per day. This will require approval from the Connecticut Department of Public Health. The condominium will maintain a solid and liquid waste removal contract with a licensed contractor. A stormwater management plan has been developed and is detailed on the Site Development Plan. Surface stormwater retention/detention areas are provided to capture and infiltrate approximately a minimum of 1 inch of runoff from the contributing developed areas. Power will be furnished underground from Main Street to the proposed units. No toxic or hazardous substances will be stored, used, or processed on the site other than those commonly associated with residential use.

1. FLOOD HAZARD ZONE INFORMATION SHOWN HEREON TAKEN FROM FEMA FLOOD INSURANCE RATE MAP, TOWN OF OLD SAYBROOK, CONNECTICUT COMMUNITY PANEL NUMBER 0002 C MAP REVISED JULY 2, 1984.
2. THERE ARE NO CONFLICTS BETWEEN WELLS AND HUMAN HABITATION ON ADJACENT PROPERTIES AND THE SANITARY SYSTEMS PROPOSED.
3. PRIOR TO NON-FLEXIBLE EXCAVATION, SURROUNDING WETLANDS SHALL BE CLEARLY MARKED.
4. TIDAL WETLANDS AND INLAND WETLANDS SHOWN HEREON LOCATED BY FIELD SURVEY.

LEGEND

- UTILITY POLE
- CONN. HIGHWAY DEPT. MONUMENT
- CONCRETE MONUMENT
- FOUND
- IRON PIPE
- EXISTING CONTOURS
- EXISTING SPOT ELEVATION
- FIRE HYDRANT
- EDGE OF WETLAND/FLAG NUMBER
- DEEP TEST HOLE LOCATION
- PERCOLATION TEST LOCATION
- SOIL TYPE BOUNDARY
- HKC SOIL TYPE SYMBOL
- PROPOSED CONTOURS
- WATER MAIN
- WATER SERVICE
- TELEPHONE, ELECTRIC & CABLE
- SILT FENCE/EROSION BARRIER

APPROVED BY THE OLD SAYBROOK ZONING COMMISSION

SIGNATURE _____ DATE: _____

THIS PLAN NOT TO BE USED FOR CONSTRUCTION

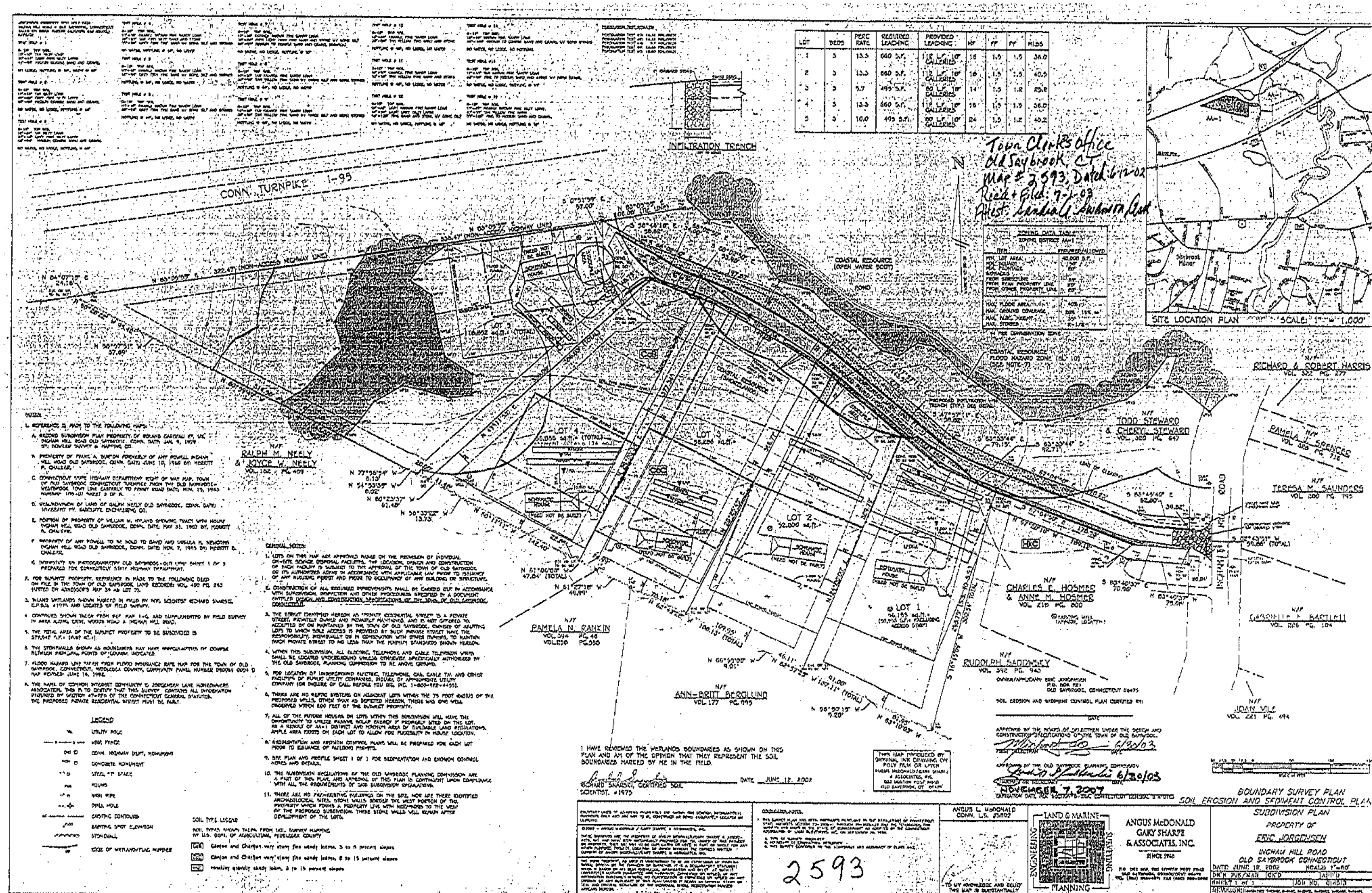
APPLICANT/OWNER:
NORTH COVE LANDING, LLC
P. O. BOX 908
OLD SAYBROOK, CT 06475

GARY P. SHARPE, JR. P.E. #14457	ANGUS L. McDONALD CONN. L.S. #8892	LAND & MARINE	SITE DEVELOPM. SEDIMENTATION & EROSI.

ANGUS McDONALD

NORTH COVE LANDING

N.T.S.



JORGENSEN

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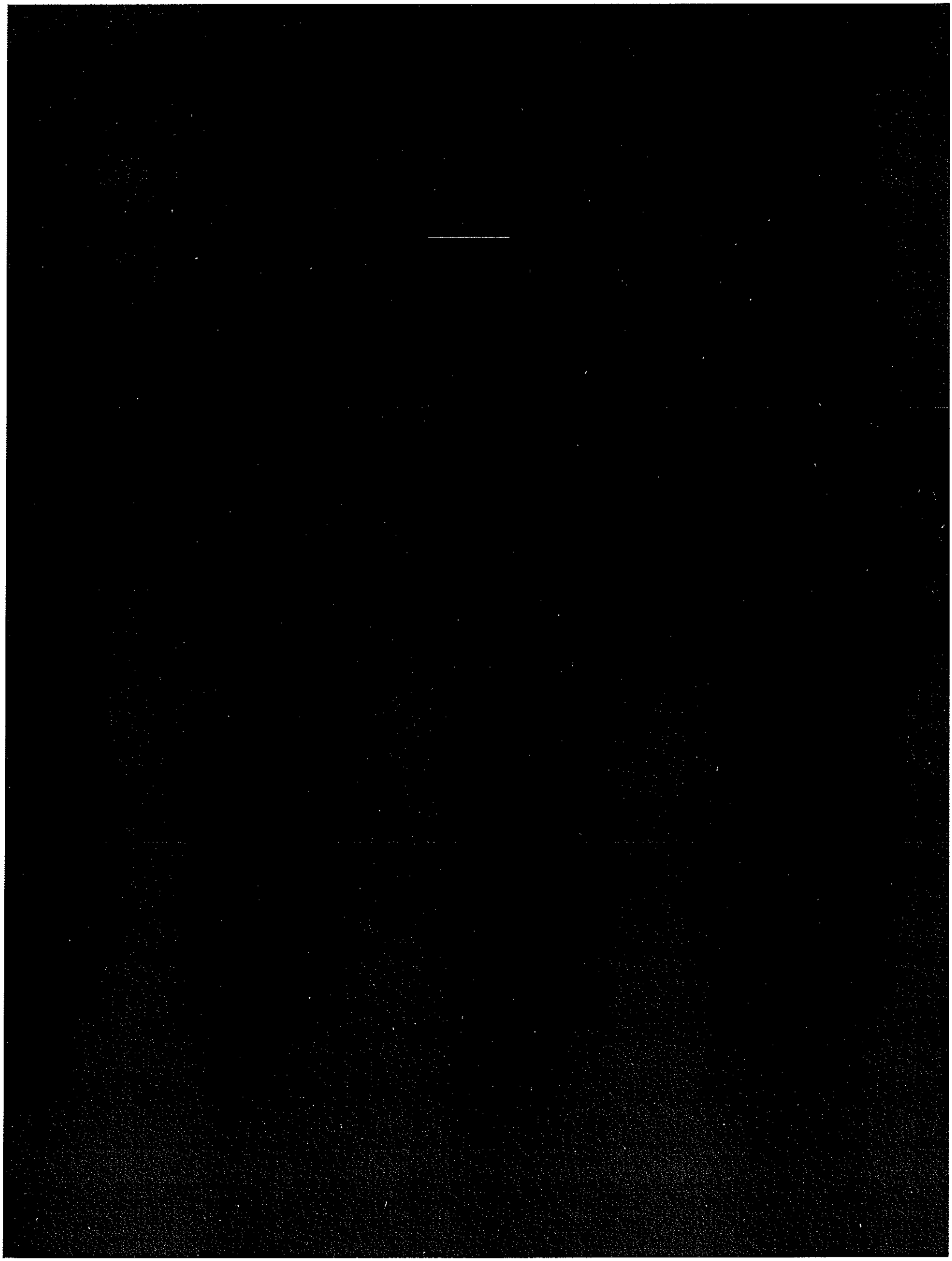


III. Response to Public Comment - On Site Flora and Fauna Studies

This response has been prepared by Michael Klein and James Cowen of Environmental Planning Services, West Hartford, CT.

Geoff Hammerson- It is unfortunate that Dr. Hammerson delivered his comments to the Board and public prior to reading our reports, which address his concerns. As you heard, EPS has been conducting biological surveys at the site for the past two growing seasons, starting in April of 2003, and concluding in August of 2004. My staff and I have spent approximately 200 hours on the detailed surveys, not including initial reconnaissance surveys, incidental observations during other work, wetland delineation and functional assessment at the Pianta property, etc. As your attorney has pointed out, the issues before your Commission are limited in scope, as follows:

1. What is the yield (unit count) for a Conventional Plan?
2. Compared to a conventional plan, is an Open Space Subdivision the proper development method for the property?
3. If an Open Space Subdivision is the proper development method, should the plan River Sound proposes be revised in any way?

The biological survey provides more than enough detail to support your deliberations on those three issues.

With respect to his specific comments, we would note the following:

* The wildlife and plant survey work is NOT preliminary or cursory in nature. We have identified individuals of approximately 500 different species at the site. This level of detail in support of a proposed development in Connecticut is unprecedented in my experience.
* The avian survey was completed using a very specific and scientifically defensible protocol, at the appropriate season to identify breeding birds. Thirty-four (34) survey stations were occupied on five (5) transects across the site. The bird survey route covered approximately thirty (30) miles across the property.
* Given the relatively uniform, second-growth forest cover at the site, the survey effort was appropriate to describe the bird use at the site. As noted in the report

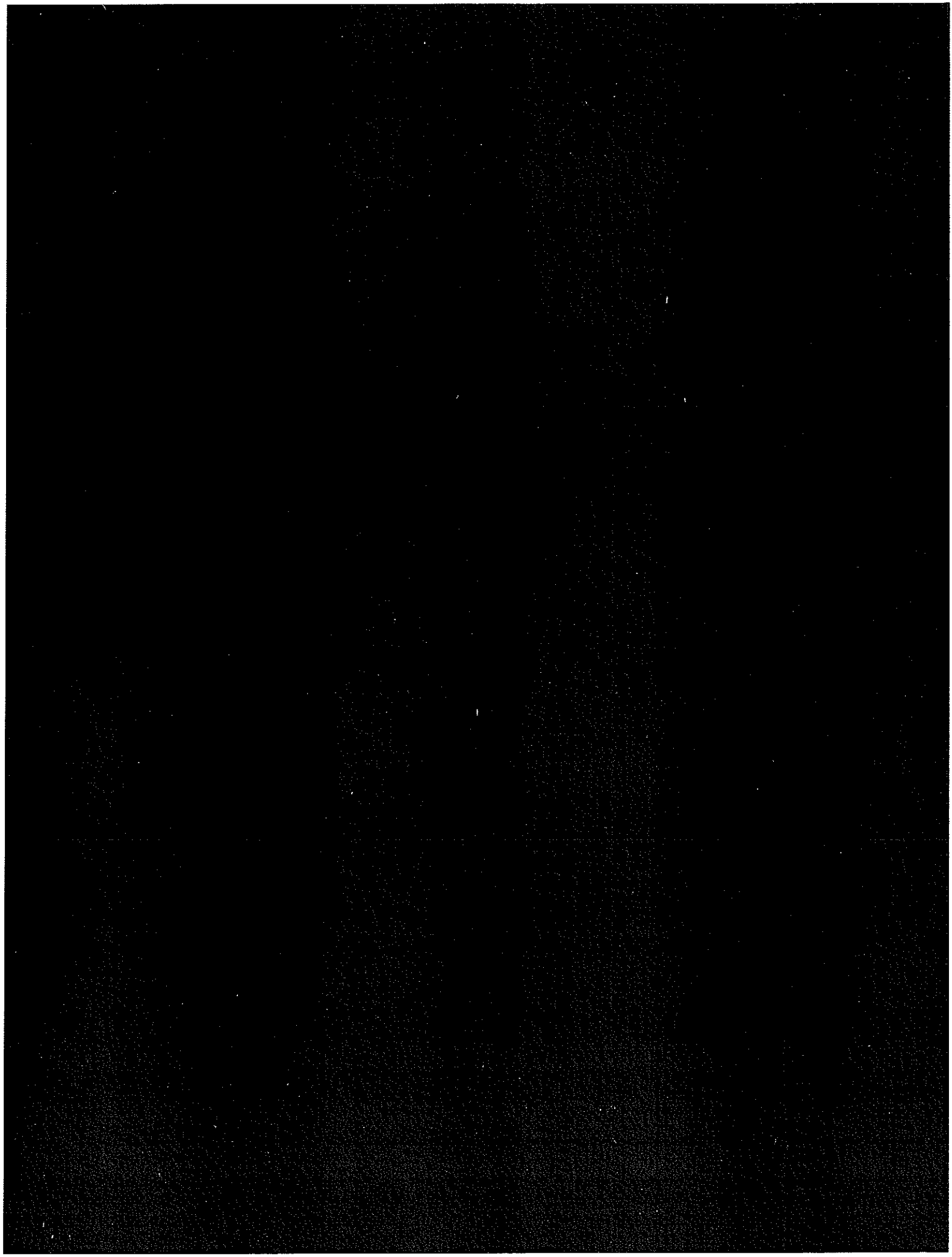
> "the protocol was designed to maximize species and individuals detected. This is appropriate for determining avian diversity and density on a site but is not the best protocol for long-term population studies. Long-term studies must set survey points that do not change from year to year and are not based upon bird activity but rather on a set location. This study was designed for a short-term appraisal of avian species on the subject property. The early June time frame chosen for this survey protocol ensures that virtually all breeding birds migrating through Connecticut have passed by and the locally breeding birds are producing maximum levels of song and territorial defense. It is generally assumed that any singing male detected represents the occurrence of a breeding pair of that avian species. For diurnal species activity is greatest during the period of dawn till approximately 9:30AM. This is particularly true for avian vocalizations, which constitutes the great majority of collectable data. So each route was covered as early in the day as possible and all routes except one were completed prior to 9:30AM. Each survey point entailed remaining at the point and recording all bird activity detected over a 10 minute span. No prompting was used to elicit responses. All recorded data was visually observed activity or

vocalizations. For nocturnal species the site was walked between 3:00AM and dawn and owl and nightjar imitations and recordings were used to elicit responses."

* An invertebrate survey was not performed. This is not required under your regulations, and beyond the scope of the biological surveys typically performed in support of detailed site design, let alone an approval of a preliminary Open Space subdivision concept. Furthermore, listed invertebrates are typically associated with rare plant communities. The vast majority of this site is second growth mixed hardwood forest, maintained utility right-of-way, and forested (Red Maple) wetlands. These are very common plant communities in Connecticut. We are not proposing any work in the Atlantic White Cedar Swamp or in Pequot Swamp Pond, the only uncommon habitat types present. Since these habitats will be preserved, their invertebrate fauna will also be preserved.
* CFE's reliance on the Natural Diversity Database (NDDB) and the 1999 ERT report to support their contention that state-listed plants occur at the site is incorrect. The ERT report is based on the NDDB maps, which document occurrences at random locations within 2000' diameter disks. Some of these disks intersect the site. This does not indicate a documented occurrence of a listed species at the site, merely that there is an historic or current record within approximately 2000 feet of the site. The documentation provided by the NDDB makes it clear that their data is not a substitute for detailed, site-specific surveys. We have completed those surveys, and reported the results. The Open Space plan can be developed with no adverse impact on state-listed plants or animals.

Richard Snarski- We will show the location of *Carex lupuliformis* that the DEP identified as a "historical record" on the Preliminary Open Space Plan, when it is revised in response to all of the Town's comments. We were aware of the previous sighting at Vernal Pool 17 and surveyed the area on several occasions. We were not able to re-confirm the prior sighting. No work is planned in that area (or any of the locations at which we confirmed *C. lupuliformis* in 2003 or 2004). With respect to its location, distribution, and conservation status at this site, and in the State as a whole, we would note the following:

* All of the locations we identified at the site were in full sun or partial shade. The more robust populations were in full sun. The distribution of this plant shifts between patches of optimal habitat as the forest canopy closes and opens up in response to logging, forest fires, post-agricultural succession, etc.
* Because of this facet of its ecology, we would expect that this is one of the taxa at the site that would respond positively to the change in forest cover associated with the development of the golf course at the site. The population in the managed right-of-way area will provide a stable seed source for natural dispersal throughout the site, and the canopy removal in the "play-over" areas will provide the habitat.
* The listing status of *C. lupuliformis* has changed since the ERT report was submitted. Enough additional populations were identified in Connecticut to allow this plant to be removed from Endangered status, and downlisted to Special Concern. Mr. Cowen from my office has identified two populations, himself, in the last two years. One is in Newtown and the other is in Marlborough (indicating wide-ranging distribution in Connecticut). The Newtown population was reported to the state Natural Diversity Database as required at the end of 2003 and the Marlborough population will be included in our required 2004 year-end report (it was identified only this year, and thus has not yet been factored into the determination of the plant's status).



IV. Response to Public Comment – Turf Management

This response has been prepared by Stuart Cohen, PhD of Environmental & Turf Services, Inc

The purpose of this response is to address, briefly, several concerns and questions that were raised within our area of expertise. The subjects follow in the approximate order in which they were raised in the hearing. I believe these issues are only indirectly related to the Preliminary Open Space Plan questions being considered by the Board.

The Feasibility of "Organic" Golf Courses. The opposite of 'organic' is not automatically 'environmentally destructive'. There is a wide range of possible approaches between these two polarities. We feel strongly that the advantages of providing a purely 'organic' approach need to be carefully weighed against the disadvantages—and every case is different. In the case of the Preserve, an approach that uses a combination of 'organic' and other EPA- approved products is the recommended approach.

We advocate the use of several different "organic" products as part of a good integrated pest management program. However, it is not feasible to maintain a high quality, frequently used golf course in this region of the country that exclusively uses "organic" products. We produced a white paper on this issue for a project in New York (Cohen et al., 2002 (attached), and we reached the same conclusion for that project. We estimate that no more than 0.1% of the nation's 18,300 golf courses are truly organic. (I have visited the two-year-old Martha's Vineyard organic golf course indicated in opposition testimony. It has required extensive use of tractors to apply 'organic' products, the traffic has impacted the turf, and disease and weed pressure is evident.)

Pesticide Inert Ingredients. It was stated that pesticide inert ingredients are not regulated. This is not true (Federal Register, 52, pp. 13305ff, 4/22/87 (attached)). It was stated that formaldehyde is one of the permitted inerts. This is no longer true (www.epa.gov/opprd001/inerts/.). It was stated that xylene is an inert. Xylene is still listed as an inert, but it is highly unlikely that it would be a component of any product applied to turf at The Preserve. Voluntary phase-out of xylene use in turf pesticides began approximately 10 years ago, and all or almost all golf turf pesticides are applied in water solutions or as granular products.

Soils. A concern was raised that the microbial population of the forested soils will change after the conversion to a golf course. This is likely true, but it is a phenomenon that has likely occurred countless times when forested areas have been successfully converted to farmland, golf courses, playing fields, etc. The reverse process also occurs during forest re-growth following a forest fire and during post-agricultural succession. It may be a fact, but it does not constitute environmental concern.

Native Grasses. Concerns were expressed that native vegetation planned for the site may not be truly native. An extensive mitigation plant list is appended to the biological survey submitted by Environmental Planning Services into the hearing record. In addition, the same speaker asked whether soil amendments would be used for the native vegetation. It is possible that some nutrients as well as some water might be needed for the establishment of some of the plants in the far roughs and out-of-play areas, depending on site-specific soil chemistry, but no amendments nor water would be needed once the plants are established. Native vegetation restoration is an environmentally sound program that is successfully implemented at golf courses nationwide.

The Potential for Organic Turf Management at The Stony Point Golf Course: A Scientific Evaluation

for

Clough, Harbour & Associates LLP
Albany, New York

by

Environmental & Turf Services, Inc.

Stuart Z. Cohen, Ph.D., CGWP
Study Directory
Wheaton, Maryland

Michael O'Connor, CGCS
Agronomist
Williston, Vermont

Karen Olson
Geologist
St. Paul, Minnesota

Stephen S. Reid
Environmental Scientist
Wheaton, Maryland

May 31, 2002

EXECUTIVE SUMMARY

The Town of Stony Point is constructing an upscale, 18-hole golf course in Rockland County, New York. It is designed by Jacobson Golf Course Design. It is intended to be a high-end, public, daily-fee facility.

The Town desires to operate the golf course in an environmentally sound manner. To that end, Clough Harbour drafted a turf management plan that was reviewed by Dr. Petrovic at Cornell. The Town also asked us to examine whether it would be feasible to manage this golf course with no synthetic pesticides or fertilizers while using only natural organic materials. Thus the purpose of this white paper is to explore that option.

Under the federal pesticide law, a pesticide is "any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest." Thus naturally organic products can be considered pesticides as well as synthetic organics.

Turf managers must keep in mind the fact that soil and turf are part of an ecosystem. Thus decisions about particular pesticides and fertilizers should be made as part of a holistic approach to turf management.

Less than 0.1% of the nation's 17,100 golf courses have a reputation as being all organic and pesticide free. In fact, a much smaller subset of this fraction is truly pesticide free. We could find no golf course that is pesticide free, has a good quality playing surface, and carries a substantial amount of play. With one exception, none of the pesticide-free facilities carry anything close to the 50,000 rounds/yr anticipated for this facility.*

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* Statement revised 11/7/02.

However, there are many naturally organic products on the market that can play an important role in an effective integrated pest management program. For example, the microbial fungicide BioTrek® has worked well in the past against three diseases likely to be a problem at the Stony Point golf course. Similarly, the parasitic nematode product Exhibit® may be effective against insect grubs at the site. Seven other natural organic pesticide products are recommended herein.

There is a very large number of natural organic products on the market. Unfortunately, rigorous scientific testing results are not available for many or most of these products, so their use should be viewed with intelligent skepticism for this high-end facility. The products we recommend are backed up by years of experience and/or scientific studies. They are meant to be used as part of, not as a replacement for, a holistic integrated pest management program. Pesticide-free is not a viable option, but sound environmental stewardship is.

I. INTRODUCTION AND PURPOSE

The Town of Stony Point is constructing an upscale, 18-hole golf course in Rockland County, New York. It is designed by Jacobson Golf Course Design. According to the DEIS, 50,000 rounds/yr are anticipated.

The 295-acre site is generally rolling to hilly. It is on a town-owned parcel, which is bound to the west by the Palisades Interstate Parkway, to the south by Willow Grove Road (County Road 84), to the east by Knapp Road, and to the north by Pyngyp Drive.

The Town desires to maintain the golf course in a manner that is both agronomically and environmentally sound. To that end, the Town retained Clough, Harbour & Associates to draft a Turf Management Program. The Town also retained Dr. Marty Petrovic (Cornell) to peer-review the plan, and his comments have been incorporated.

There has been an increasing focus the last 10 years on 'organic' turf management. The goal of using naturally-based products is laudable, and in many cases doable. However, other factors to consider are the extent to which the 'organic' products impact the environment, the budget, labor (additional hours), and whether the resulting turf quality is appropriate for the target level of play. Regarding the latter factor, an additional consideration for daily fee courses is a potential reduction in revenues in the event that the quality of the playing surface declines.

However, this 'white paper' focuses more on the scientific and technical issues regarding organic golf course management and, for the most part, leaves the cost/benefit analyses for others. Thus the purpose of this study is to summarize the state of the science regarding natural 'organic' golf course management, to report on some golf courses that are managed with no synthetic fertilizers nor synthetic pesticides, and to recommend an 'organics'-based program for inclusion in the golf

course's management plan. In addition, important terms are defined prior to the technical review.

II. DEFINITIONS OF KEY TERMINOLOGY

It is critical that anyone involved in this issue have the correct understanding of key terminology. In this public, and often emotional debate, there is always room for respectful disagreement. But communication will be unsuccessful unless there is an agreement on the meanings of the terms that are being debated. Thus this section provides a framework for the rest of the report.

A. What is a Pesticide?

A pesticide is "any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest" (ϕ2(u) of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) (7 U.S. Code ϕ136(u)). The definition also includes plant growth regulators.

Thus federally regulated pesticides include herbicides, toilet bowl disinfectants, insect sex attractants (pheromones), fungicides, insect repellents, insecticides, and a wide variety of other natural and synthetic products, including certain microbes. Consequently, claims that certain golf courses are pesticide free are often incorrect.

B. Organic Turf Management

The approach to organic turf management is not based on any one product; rather, it can be thought of as a systems approach to managing turf and soil ecology in a sustainable manner. The recent book by Sachs and Luff (2002) does a good job describing the soil ecosystem as well as the concept of sustainable management. The volume edited by Leslie (1994) takes an even broader approach, and contains chapters written by scientific experts on a variety of topics that would help one reduce pesticide inputs: e.g., the use of turfgrasses that contain endophytic fungi which impart natural insect resistance (Hull, et al.; and Fraser and Breen); the use of turfgrass cultivars that

can withstand close mowing while growing a strong root system through prostrate growth (Hull, et al.); and the importance of soil nutrition management (Peacock).

A key to this discussion, as well as this paper, is the use of the term "organic." Following are some definitions that complete the remainder of the framework for this paper.

1. What Does "Organic" Mean?

The only scientifically rigorous definition of the term can be found in the field of chemistry: "organic" refers to a compound of carbon. Ultimately, all carbon-based compounds are derived from life forms. For example, the carbon backbone of the polyvinyl chloride in pipes can be synthesized from components of natural gas and/or petroleum cracking (ethylene), plus chlorine. The natural gas and petroleum arise from decayed living material.

For the last 30 years or so, however, the word has become a fuzzy term of art that can mean different things to different people. Some attempts have been made, however, to standardize the definitions, as follows.

2. Organic Fertilizers

The following definitions have been adopted by the Association of American Plant Food Control Officials and will be used here.

> Natural Organic Fertilizer. "Materials derived from either plant or animal products containing one or more elements (other than carbon, hydrogen and oxygen) which are essential for plant growth. These materials may be subjected to biological degradation processes under normal conditions of aging, rainfall, sun-curing, air drying, composting, rotting, enzymatic, or anaerobic/aerobic bacterial

action, or any combination of these. These materials shall not be mixed with synthetic materials or changed in any physical or chemical manner from their initial state except by manipulations such as drying, cooking, chopping, grinding, shredding, hydrolysis, or pelleting." (Definition T-13; AAPFCO 2002)

Organic Fertilizer. "A material containing carbon and one or more elements other than hydrogen and oxygen essential for plant growth." (Definition T-12; AAPFCO 2002) This can include natural organics as well as synthetic organics.

3. Natural Organic Pesticides

There appears to be no standard, technically valid definition of this term in the context in which it is usually used. For example, everyone would agree that an extract of red peppers would fit the definition. But would there be uniform agreement on potassium salts of fatty acids, which are the saponified (hydroloyzed) products of natural soaps? To most people, "organic pesticide" connotes nontoxic; yet natural products such as rotenone, nicotine, and pyrethrums can be highly toxic to mammals and/or aquatic organisms. The Merriam-Webster dictionary adopts the chemist's definition implied in subsection B(1) above: "a pesticide whose active component is an organic compound or a mixture of organic compounds."

The U.S. EPA recognizes a class of pesticides called "biopesticides" (www.epa.gov/pesticides/biopesticides; 2/27/02). They consist of microbes (e.g., bacteria and fungi), genetically engineered plant-incorporated protectants, and biochemical pesticides such as pheromones. The latter category (biochemicals) are usually close or identical to their naturally-occurring counterparts but they are synthetically derived.

In this paper, we interpret the term "natural organic pesticides" to include those pesticides derived from natural materials with only the degree of processing specified above at the end of the definition of "natural organic fertilizer"; i.e., drying, cooking, etc.

III. THE STATE OF THE SCIENCE

This section summarizes key aspects of the scientific literature regarding organic pest management at golf courses.

A. Scientific Studies vs. Anecdotes

Purveyors of organic pesticides and fertilizers can be quick to publicize anecdotal evidence that their product works, but positive results from controlled scientific studies are often lacking. One of the foremost researchers on natural organic turf management products, Dr. Eric Nelson (Cornell), was recently quoted as saying, "There are too many companies with products that have no research to back their claims, and that discourages [golf course] superintendents." (Ostmeyer, 1999).

A good scientific study will help ensure that a positive experience with a product is not an anomaly and can be replicated, it will examine the range of field conditions conducive to product efficacy, and it will attempt to elucidate the mechanism of action to enhance our knowledge of how and why the product works or doesn't work. Anecdotal reports generally do not meet these three goals. A related problem with anecdotal reports is that one cannot be sure that a positive result following the use of a product was due to the product, and not some other factor. For example, the discussion of the Bethpage study below (IV(A)) describes how six greens that received a layer of compost in the fall experienced no snow mold damage, but the 'control' greens also experienced no snow mold damage. Anecdotal reports usually do not compare the results of treated areas with untreated controls.

The most reliable scientific studies are published in the peer-reviewed literature, e.g., Crop Science and Phytopathology. In this process, the research paper is subject to a rigorous review by typically three anonymous reviewers who question and criticize heavily, ensuring the science stands up to the standards of the field. Anecdotal

evidence is subjected to no such scrutiny. The next most reliable sources after peer-reviewed journals are university bulletins and research reports from the USGA and universities.

Most of the discussions and recommendations below are based on technical articles written by researchers and people that direct the research. In addition, we also apply some of the experience we have had with over 100 golf course projects. Generally, we assign a higher priority to field results over lab results.

B. Organic Successes and Failures in the Field

The chief sponsor of scientific research on alternatives to synthetic chemical pesticides is probably the U.S. Golf Association (USGA). This is part of the USGA's program on integrated pest management (IPM). For example, it granted $947,409 to researchers on this topic from 1996 to 1998. The other principal funding source is the producers of the products. In almost all cases, the research is done by university scientists. The principal centers for this research have been Cornell, U. Kentucky, U. Georgia, U. Florida, Rutgers, and N.C. State. A good recent review of USGA-sponsored research in this area can be found in Kenna and Snow (2000).

The following discussion is organized into the topics of disease, insect, and weed suppression.

1. Disease Control

Disease management will be critical at this course due to its location and the anticipation that 50,000 rounds/yr will be played. More rounds played leads to more stress on the golf course, which can then lead to greater disease potential.

The two main types of natural-based disease control agents in turf management are microbial agents and natural organic fertilizers. There are also many biostimulant products on the market.

Microbial Agents and Innoculants. There have been many lab successes in this area, but few at the golf course scale. A wide variety of diseases have been studied: brown patch, dollar spot, pythium blight, pythium root rot, red thread, southern blight, take-all patch, typhula blight, summer patch, and spring dead spot (Kenna and Snow, 2000; Nelson, 1997).

Most of these products are unsuccessful at the golf course scale, for several reasons. First, the product must be an effective antagonist against the plant pathogen. These discoveries are usually made in the lab after much investigation.

Second, the product must be delivered to the target site. This may add constraints such as the need for an on-site fermentation reactor, or limiting applications to twilight or dawn when the microbes would not be harmed by the sun's ultraviolet rays. Further, some microbes may only be effective if they are delivered to the plant's root system, which is more challenging than routine foliar applications.

The final issue is competition. The introduced microbe must compete with the native populations. Nelson (1997) has tentatively reported that sustained microbial populations must usually exceed 1 million cells per gram of soil in order to effectively control disease. (Putting green sandy soils typically have 600,000,000 to greater than 1 billion colony forming units (CFUs) per gram of soil (Kenna, 2001).) This requires repeated applications, sometimes as often as daily, which adds to overall management costs.

Currently, the product BioTrek® (*Trichoderma harzianum*) is the microbial product with the best track record for control of dollar spot, brown patch, and pythium, three

diseases likely to occur at the Stony Point Golf Course. The microbial fermentation system Bio-Ject® might be considered at some time in the future for the control of dollar spot and brown patch if two conditions obtain: a fertigation system is installed, and a Cornell turf extension scientist feels confident it would be successful at this site.

Natural Organic Fertilizers/Compost Products. It is clear, based on the literature and our experience, that natural organic fertilizers can be very beneficial to turfgrass. They constitute a slow-release form of nitrogen, as well as phosphorus, potassium, and trace elements. However, a course that relies exclusively on these products for its source of nitrogen will lose a valuable tool by not using small amounts of synthetic water soluble nitrogen sources. Small amounts (spoon feeding) of these products may even be preferable to natural products in hot, humid conditions from an environmental and an agronomic perspective.

There is more variability in results, however, when compost is used to prevent and/or treat disease. There have been many success stories (e.g., Craft and Nelson, 1996; Sachs and Luff, 2002). However, there have been many failures as well. For example, a recent three-year study of disease occurrence and intensity in creeping bentgrass - - a common golf course turf - - found no benefits to mixed benefits from seven natural fertilizers and composts compared with urea and sulfur-coated urea (Davis and Dernoeden, 2002). The focus was on dollar spot, a disease likely to occur on the Bethpage golf course. These results were qualitatively similar to earlier results by Landschoot and McNitt (1997).

See also the experience encountered by the Bethpage researchers regarding the use of compost to control snow mold in section IV(A) below.

In general, the lessons to be learned from a large body of data and experience are as follows:

- compost can be a good source of N, and it can contribute to the overall health of the turf/soil ecosystem;

- it can effectively control various turfgrass diseases;

- its success in disease control is variable, and depends on the formulation and processing of the particular product, the site-specific conditions, and possibly other factors.

There is no consensus that compost tea can reliably and effectively control turfgrass diseases.

Biostimulants. Biostimulants include plant hormones, enzymes, carbohydrates, soil inoculants and conditioners, seaweed preparations, and other products. In most cases, the manufacturer can make a case that the ingredients are usually part of a healthy soil system. The assumption then follows that these components must be added to the system. It is difficult to establish whether these products work well as fertilizers, and it is even more difficult to establish whether these products suppress turfgrass diseases (M. Nelson, 1998; E. Nelson, 1997). Many superintendents believe these preparations have helped their courses. However, turf researchers have found little efficacy data to support the claims. In the case of the plant hormones, there is even a concern that their application may be harmful (Nelson, 1998).

2. Insect Control

There are many natural organic products that can effectively control insects. We recommend seven in Table 1. It is likely that only one or two synthetic insecticides would be needed to supplement this list.

3. Weed Control

There are very few naturally organic herbicides that would be appropriate and efficacious for a good quality golf course. Table 1 lists one product that seems to be effective for *Poa annua* (annual bluegrass) control (Xpo®), although, like most biocontrol agents, its effectiveness must be examined on a site-specific basis.

Corn gluten has been touted as a naturally organic pre-emergent herbicide, which can also serve as a nitrogen source (e.g., Sachs and Luff, 2000). However, we do not feel it could be a successful herbicide for this golf course.

Although the presence of weeds in any fairway is unavoidable, the principles of IPM require that the initial primary focus on weed control be on the underlying conditions that lead to the weeds. For example, Neal (1994 (Cornell)) discusses conditions conducive to growth of weeds, as does Table 5.2 in Sachs and Luff (2002), which is adapted from a Vermont table developed by Bosworth. However, it is certain that the use of synthetic chemical herbicides will be necessary at this high-end, daily fee golf course.

IV. SOME REPRESENTATIVE CASE STUDIES

A. Cornell Bethpage Golf Course Study

The U.S. Golf Association (USGA) has been funding a multi-year turf management research project at a golf course in Bethpage State Park. The project is a partnership between Cornell University, Bethpage State Park, and the USGA. The objective of the study is to compare three ways to manage pests:

1. unrestricted use of registered pesticides in accordance with the product labelling;

2. integrated pest management (IPM) with reduced pesticide use; and

3. a non-chemical approach using biological controls and cultural practices only (Grant, 2001; Grant & Rossi, 2001).

This study is being done at the Bethpage Green Course on Long Island. The focus is on the 18 greens on that course. Each of the three treatment regimes listed above is further delineated into one of two cultural management regimes, current standard and alternative cultural practices, e.g., increased mowing heights. The three greens managed with unrestricted use of registered pesticides and current standard cultural practices are being managed similar to the Bethpage Black Course, which will host the U.S. Open next month.

This is an excellent study that has much relevance to Stony Point for the following reasons. The three pesticide treatment regimes are all being done at the same site, rather than being scattered among different golf courses, which is the case when one compares anecdotal evidence from different superintendents. Two Cornell

scientists help ensure overall study quality. Finally, the involvement of Cornell helps increase the chances that the IPM and no-synthetic pesticide greens will succeed.

There was little difference early in the season among the different treatment regimes regarding insect, weed, and disease impacts. By August, however, all six non-chemical greens had failed. Two were closed, and the other four greens should have been closed in September, but that did not happen due to "concern for golfer dissatisfaction." The principal problems were the diseases dollar spot, anthracnose, rhizoctonia, and septoria. This often led to thin turf, which was then invaded by weeds.

Regarding economic impacts, the authors state the following.

> "Implementation of this project has probably already impacted the reputation and perhaps the revenues of the Green Course. Outings on the Green Course were cancelled after the temporary greens were established on 2 holes in late August. Bethpage State Park luckily has the unique situation of having 5 contiguous golf courses. The park superintendent believes that most golfers who are aware of and are upset by conditions on the Green Course, simply play an alternate Bethpage course. A solitary golf course with playing conditions similar to our non-chemical treatments would likely lose customers."

The good news is that the six greens in the IPM regime were successful. Pesticide use was reduced by approximately one third, relative to the unrestricted greens, yet the turf quality was similar.

In a recent update, Dr. F. Rossi (personal communication) stated that compost was applied in the fall to the non-chemical greens to prevent snow mold. The results were not favorable. The treated greens suffered from yellow patch disease, and the other greens did not. Although snow mold was not a problem, it was not a problem on

Many areas of our golf course, including specific turfgrass conditioning, would be considered unacceptable at a high-end public golf facility.

Question: *Why can't you operate the club all organic?*

Answer: The weather in the San Francisco area greatly influences the turfgrass. The course is 107 years old. Fairways were never replaced during the reconstruction and contain a mixed population of ryegrass, bluegrass, kikuyugrass, and some common bermudagrass mixed with broadleaf weeds. We would find the restrictions (including fertilizer) to be almost impossible to meet. We continue to work with our IPM program and do our best to limit product use.

Question: *How would you compare your facility to, say, a high-end public experience?*

Answer: We do not even attempt to compare ourselves with local area public facilities. We charge the same rates but our playing conditions, including mowing heights, are different. Our comment cards are horrible. We will never achieve championship quality on our course nor do we even try. We are able to compete solely because we are part of the national park service. We do not find ourselves reaching out to the core golfing group.

7. Resort at Squaw Creek

Much of the following information was obtained through an interview with Superintendent Mike Carlson (May, 2002).

The Resort at Squaw Creek's Robert Trent Jones Jr. Championship Golf Course is a high-end, daily-fee golf course located in the Sierra Nevada mountain range near Lake Tahoe, California. Built in 1991 and managed by Benchmark Hospitality, the Resort at Squaw Creek has been cited by Golf Magazine as one of the "Top Ten Courses You Can Play" in 1993. The golf course has Penncross greens and tees, and bluegrass/fescue fairways. About 14,000 to 18,000 rounds of golf are played annually in the five month long playing season (late May through late October).

The golf course was approved as a pesticide-free golf course as part of the permitting conditions. However, the golf course is not considered 'organic' because of the use of synthetic fertilizers. (The superintendent is currently in the process of shifting to the use of organic fertilizers.) Also part of the permit conditions was the implementation of a comprehensive ground water monitoring program that consists of 33 wells costing about $75K per year. The major concern during the permitting of the golf course was the protection of the drinking water aquifer located near the golf course.

The Resort at Squaw Creek sits in a valley surrounded by mountains, at an elevation of 6200 ft. This area enjoys cool, dry summers which lead to very low pest pressures. The major pest problem comes from snow mold every spring. About 60-70% of greens are damaged, and a total of 2 to 5 acres of turf are damaged depending on the amount of snowfall. Areas of the golf course have needed resodding due to snow mold damage. Other than a few weeds and cutworms, there are no other pest pressures.

The superintendent (Mike Carlson) has had difficulty controlling unacceptable pest damage in this low pest pressure area and has had to apply a herbicide (Confront®) for the first time last year due to unacceptable broadleaf weeds. Additionally, the golf course has requested approval to use a fungicide (azoxystrobin) to control the snow mold damage encountered every spring.

When discussing the use of pesticides to control pest outbreaks, Mike Carlson stated that he "doesn't think you could do it without the use of pesticides", especially in an area like New York, in which pest pressures are very high.

A golf review website (www.courseguide.golfweb.com) had reviews from 14 golfers who played the course. While reviews were highly variable, most players complimented the overall beauty and design of the golf course. However, many golfers commented that there was bad turf damage (specifically to the greens) from the previous winter. The average course rating was a 6.5 out of 10, with ratings ranging from 4 to 8.9.

V. NATURAL ORGANIC FERTILIZERS AND ORGANIC PESTICIDES FOR THE STONY POINT GOLF COURSE

A. Pesticides

Table 1 includes several newly introduced organic turfgrass pesticides, biorational biopesticides, and several newly registered products under the EPA "safer" (reduced risk) pesticide program. Bio pest control agents are naturally occurring or genetically modified agents that are distinguished from conventional chemical pesticides by their unique modes of action, low use volumes, and target species specificity. There are two major categories of bio pest control agents: the biochemical pest control agents and the microbial pest control agents. At the risk of confusing the reader, there are also biological products that are living organisms, e.g., parasitic wasps and parasitic nematodes.

Biochemical Pest Control Agents

- The chemical must exhibit a mode of action other than direct toxicity in the target pest (e.g. growth regulation, mating disruption, attraction). Pesticides such as strychnine, rotenone, nicotine, and pyrethrin which exhibit direct toxicity, are not considered biochemical pest control agents; and

- A biochemical must be naturally occurring, or if the chemical is synthesized by man, then it must be structurally identical to a naturally occurring chemical. For a synthetic chemical to be identical in chemical structure to a naturally occurring chemical, the molecular structure of the major component of the synthetic chemical must be the same as the molecular structure of the naturally occurring analog. Minor differences between the sterochemical isomer ratios (found in the naturally occurring compound compared to the synthetic compound) will normally not rule out a chemical being classified as a biochemical pest control agent

unless an isomer is found to have significantly different toxicological properties than another isomer.

The criteria to be used to determine whether the chemical is a biochemical pest control agent include:

- the chemical and toxicological significance of the differences in chemical structure;
- the mode of action of the synthetic analog in the target species as compared to the mode of action of the naturally occurring compound;
- differences in toxicity between the naturally occurring chemical and the synthetic analog (Food and Agriculture Organization of the United Nations, 1988).

Table 1. Biorational Pesticides

	Common Name	Rate of Application	Projected Number of Applications	Total Material per Ac	Areas Treated
Insecticides					
Azadirachtin	Turplex® (Neem)	0.70	2 x's/yr	1.40	T G F
Bacillus thuringiensis	Bio-bit®	0.25	2 x's/yr	0.50	F PR SR
Heterorhabditis bacteriophora	Cruiser®	1.00 or 1.5 B/Ac	2 x's/yr	2.00 or 3.0 B/Ac	F PR SR
Myrothecium verrucaria†	DiTerra-WDG®	TBD	TBD	TBD	T G F
Parasitic Nematodes‡	Exhibit®, BioShield®, BioVector 355®	1 B/Ac	2 x's/yr	2 B/Ac	T G
Potassium Salts of Fatty Acids#	M-Pede®, others	1.35	2 x's/yr	2.70	F PR SR
Spinosad	Conserve®	0.50	2 x's/yr	1.00	T G F
Herbicides/Biocontrols					
Xanthomonas campestris	Xpo/Bioject®	1 gal/Ac	11 x's/yr	11.00	T G
Organic Fungicides					
Trichoderma Harzianum	Companion/ Bio-Trek®	0.75	1 x's/yr	0.75	T G F

† Newly available biological nematicide for turfgrass. Registration and proposed rates pending.
‡ Includes the parasitic nematode products containing: *Heterorhabditis bacteriophora*, *Steinnernema glaseri* and *S. carpocapsae*.
# Non selective herbicide for use as a spot treatment only in Primary and Secondary Roughs.

Biostimulant/stress management products will be considered for use on an as-needed basis. Many products are available and can be used when soil testing and monitoring detail the need for alternative strategies. Some serve to increase the plants' ability to resist disease pressures and environmental stress. Others can be useful for enhancement of soil microbes and/or drainage. Reducing stress and activating beneficial soil microorganisms, in turn, serve to increase the turfgrass' ability to counter disease, weeds, and insects, reducing the need for pesticides. However, considering the lack of scientific data on many of these products, we recommend that the superintendent seek the advice of the Cornell turf extension advisor or an experienced agronomist before applying these products, with the exception of the following:

The following materials are intended to provide stress-specific assistance in the management of turfgrass, and to assist the golf course superintendent in the reduction of pesticide usage. These alternative materials are particularly useful in the maintenance of high traffic areas such as tees and greens. As time progresses and the soil ages, the use of these modification materials may prove to be particularly beneficial for turfgrass hardiness.

The following is a short list of biostimulant/stress management products specifically produced for the turfgrass industry. The list contains a couple of products that were introduced during the formative years of the integrated pest management (IPM) movement. Initially, some of these materials were introduced to the turfgrass market with limited research and/or scientific studies. However, as more and more golf facilities were introduced to the benefits of these materials, additional science and research was conducted by the universities offering specific guidance to the golf course superintendent.

Bovamura is a liquid organic manure fertilizer that promotes deep root development and encourages tillering. It may be used for root development on newly

sodded areas. It supports the development of soil microorganisms and transforms nutrients to usable plant food. It is manufactured by the PBI Gordon Corporation.

Bio.Trek 22G now renamed **Companion** with the active ingredient *Trichoderma Harzianum* is the first commercially available biological disease control agent for turfgrass in the United States. The product is registered and suitable as a partial substitute for some turfgrass fungicides. The product is produced by Wilbur-Ellis in Fresno, California and is currently undergoing a label change for registration as Companion®.

Bio-Safe Organic 3 in 1 attacks insects by plugging their breathing tubes and causing asphyxiation. The product is registered for fleas, ticks, cockroaches, ants, scorpions, aphids, and beetles. The material is produced by American Wellness, Inc. in Carrollton, Georgia.

Cruiser is a bioinsecticide containing the host seeking *Heterorhabditis bacteriophora (Hb)* nematodes for effective control of Japanese beetle larvae and other white grubs in turf and flower beds. The product is produced by Ecogen, Inc.

Eco Soil Systems, Inc. produces a microbial injection golf course program for disease management, plant growth enhancement, sodium reduction and nematode suppression. The Bioject BioReactor is rented on an annual basis to inject large quantities of beneficial microbes directly into the golf course irrigation system. A developed strain of *Pseudomonas aureofaceans* plays an important role in the reduction of fungal diseases. **Tx-1** plays an important role in the reduction of fungal disease. *Azospirillum brasilense* micro-organisms are used to incorporate N_2 and release ammonia (NH_4) and nitrate (NO_3). The presence of *Azospirillum* provides for healthier turf through nitrogen fixation, production of plant growth regulators, and colonization on the rhizoplane.

Epoleon is an organic deodorizer and neutralizer. This product stabilizes compounds so they are not re-released into the atmosphere. It is manufactured by the Epoleon Corporation of America.

Essential contains a high percentage of carbon-rich organic materials and humic acid. The product contains intermediate metabolites, metabolites, simple sugars, peptides, amino acids, enzymes and amides, humate, lignin, organic chealates and cellulose fiber, all found in the natural stages of organic matter decomposition. The product is manufactured by Growth Products®.

Green-Releaf produces a group of natural microbes that form a symbiotic relationship with plant roots. Plant performance is enhanced by facilitating the uptake of nutrients and water while simultaneously aiding in pathogen defense. The products assist with reducing traditional fungicide applications.

GroZone is a calcined clay soil conditioner for the root zone. The material retains moisture to minimize stress from prolonged droughts and reduces watering requirements. It helps to increase nutrient retention, prevent compaction and creates a strong environment for healthy roots. It is manufactured by the American Colloid Company.

Isolite porous ceramic is a root zone modification material designed to improve water conservation and increase capillary porosity. It provides a low cation exchange capacity that will not tie up nutrients and helps to leach salts. It is typically used as a soil amendment during construction or aerification. It is manufactured by the Innova Corporation, an affiliate of Sumitomo Corporation of America.

Netlon mesh element may be used to increase macro-pores. The mesh is used to increase strength and provide increased stability on slopes. The filaments also open

continuous pore space and may be a potential amendment that may be rototilled into the soil. It is manufactured by Netlon, Ltd. England.

NoburN is an organic wetting agent that loosens compacted soils. It helps to alleviate localized dry spots and hydrophobic conditions but does not have to be watered in, unlike synthetic wetting agent materials. It is derived from the desert Yucca plant and is manufactured by Roots Inc.

Organica, Inc. produces plant growth activators, insect control agents, humic acids, insecticidal soaps and seaweed and kelp activators. The products are designed to assist turfgrass managers with alternative control agents. The company furnishes substantial information on product evaluation and field trials, with evaluations and test results for agricultural and greenhouse pests. The company is actively seeking expansion within the turfgrass industry and has been working in New York for specific pest controls in agriculture and related food crop activity.

PanaSea and PanaSea Plus use liquefied sea plant extract to stimulate root growth and aid in the reduction of thatch. Natural growth hormones (cytokinin) work to make the turfgrass more resistant to stress. The product works to speed release of the lemma during seed germination. It is manufactured by Emerald Isle Ltd.

P2 is a synthetic polymer which acts as a water absorbent and retention material. This can be used to help raise the waterholding capacity and help lower the bulk density of the soil. It is distributed by Broadleaf Industries.

Pro^2/Oxygen Plus provides oxygen to control stress encountered with anaerobic soils. There are several groups of anaerobic microorganisms which are pathogenic in plants. These organisms thrive in the absence of oxygen. The release of oxygen into the soil environment is a practical method for control. It is manufactured by Plant Research Laboratories.

Profile is a ceramic product engineered to solve and prevent soil problems. Profile increases water retention and nutrient holding because of the capillary pores and the cation exchange capacity. The product improves root zones by adding water, nutrient, and air holding capacity. It is designed to be used during construction, after aerification or to improve topdressing blends.

Sand-Aid is a natural organic sea plant soil conditioner. It may be used to decrease nutrient leaching and increase fertilizer efficiency. It may be incorporated into the soil mix of new green construction or applied as a topdressing constituent. It is also manufactured by Emerald Isle Ltd.

Spectrum is a mix of 24 species of live beneficial micro-organisms containing beneficial acids and amino acids that assist with decomposition of the soil and allows the plant to create greater resistance to pathogens and pests. The product is produced by Tainio Technology & Technique, Inc. in Cheney, Washington. The company produces a series of biological soil amendment and turf care products.

Turftech II uses nitrogen fixing bacteria (cyanobacteria) and may contribute as much as one pound of nitrogen per 1,000 square feet over a 60 day period. It may help to suppress disease causing fungi and bacteria and reduce the need to apply additional forms of nitrogen. Normal phosphorous and potassium is still required. It is manufactured by Soil Technologies Corporation.

While each of the products above offers important contributions to biostimulation and stress management, they are useful only within a comprehensive testing and conditioning program. Soil, plant tissue and water quality should be tested at least twice a year to obtain an ongoing evaluation of the nutrient and electrolytic balance. Testing will also provide answers on sodium content, pH, etc. of the soil which will guide the maintenance staff on the use of soil enhancements.

For example, the presence of a pH imbalance can make nutrient supplies unavailable through chemical insolubility or fixation. When this condition is found, the proper answer may be to address the pH level rather than to increase nutrients. Similarly, adequate nitrogen is needed to produce rapid enough growth to recover from traffic associated with play. Too much nitrogen, on the other hand, can increase thatch and create thin cell walls resulting in susceptibility to certain fungus. In the spring and fall, higher quantities of phosphorous are needed to increase root depth and mass. Higher potassium is needed in the summer to increase cell wall thickness. Too little nitrogen, potassium, phosphorous, micronutrients, etc., can lead to disease, which then requires more fungicides. All of these factors influence the selection of soil enhancements just as they determine the choice of fertilizers or other management chemicals.

B. Compost Used as Topdress Material

The discussion in section III(B)(1) above should be consulted first if compost is to be used to treat or prevent diseases.

A 1/4 inch 50/50 (sand/compost) topdress layer, covering a 5,000 ft^2 green, will require ~1yd^3 of compost material. Ensuring a good quality, disease suppressive compost requires a certain amount of analysis (at least until one gains ample experience) to determine if it is within acceptable parameters. These tests include measurements of organic matter, pH, conductivity, respiration, nitrate, nitrite, sulfide, ammonium, ammonia, C:N ratio, and biological activity (Sachs and Luff, 2002). When applying compost as a topdressing material on putting greens built to the United States Golf Association (USGA) specifications, additional security measures must achieve the proper "bridging and permeability" that is based on the physical and particle size testing parameters. We recommend the following additional soil and compost safety screening measures:

- All sands used in the blending process with compost materials must be of the same particle size, uniformity and distribution, as sands that were used in meeting the rootzone recommendations of the USGA.

- Additional soil testing should be conducted to determine bulk density and the influence of the other organic matter sources.

- The saturated conductivity should fall within the normal range per USGA.

- Peat and compost should be free of sticks, stones, and other debris and comply with the following: Peat shall have a total ash content of less than or equal to 15% and a moisture content of 40 to 70%. A compost should have a total ash content on no more than 40% , should be proven to be nonphytotoxic, and has preferably been aged for one year. The ratio of sand, topsoil, and peat or compost shall be based on laboratory testing and performance criteria defined in these specificiatons.

  The root zone mixture should have an organic matter content of 0.7 to 3% on a dry weight basis, as determined by Method 1 of ASTM F-1647. The sand-soil-peat or compost should be mixed off-site to a uniform consistency (Hummel, 1998).

Table 2: Particle Size Distribution of USGA Root Zone Mix
(Turf Diagnostics & Design, Olathe, KS)

Name	Particle Diameter	Recommendation (by weight)
Fine Gravel	2.0 - 3.4 mm	Not more than 10% of the total particles in this range, including a maximum of 3% fine gravel (preferably none)
Very Coarse Sand	1.0 - 2.0 mm	
Coarse Sand	0.5 - 1.0 mm	Minimum of 60% of the particles must fall in this range
Medium Sand	0.25 - 0.50 mm	
Fine Sand	0.15 - 0.25 mm	Not more than 20% of the particles may fall within this range
Very Fine Sand	0.05 - 0.15 mm	Not more than 5%
Silt	0.002 - 0.05 mm	Not more than 5%
Clay	less than 0.002 mm	Not more than 3%
Total Fines	Very fine sand + silt + clay	Less than or equal to 10%

We investigated seven golf courses that were alleged to be chemical-free courses, in addition to Cornell's special study at Bethpage. We suspect this represents at least half of all such courses in North America. (There are 17,100 golf courses in the U.S.) In every case, the course conditions were not close to the goal for Stony Point and/or the rounds played are only a fraction of what is projected for this golf course. In addition, at least three of the courses used one or more chemical pesticides in 2001.

The overall weight of evidence indicates that a chemical-free approach to the Stony Point Golf Course would not be feasible, but that an IPM approach should work.

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APPENDIX A. Animal Pest Management

(From Delaware Cooperative Extension Service)

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