GOLF COURSE MANAGEMENT:

ENVIRONMENTAL ISSUES

A Final Report to the United States Golf Association: Green Section on the Manuscript Submitted to Lewis Publishers Inc.

October 4, 1991

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Project Director: James C. Balogh, Ph.D.
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Contract Performance Period: 3/29/91 to 9/29/91
Completion Date: 10/4/91
1.0 Scope and Objectives of the Project

A report on the environmental effects of golf course and
turfgrass management was originally developed by Spectrum Research,
Inc. for the United States Golf Association: Green Section (USGA).
With growing public concern over environmental, water use, water
quality, and health related issues, the USGA recognized the need for
accurate and unbiased information on the potential effects of
certain turfgrass management practices. With their active
commitment to resource conservation and mitigation of potential
adverse environmental effects of turfgrass systems, both the USGA
and Spectrum Research, Inc. recognized the need to disseminate this
report to turfgrass managers, other scientists, and the public. To
meet this objective Spectrum Research, Inc. substantially revised
and improved the original report for publication by Lewis
Publishers, Inc.

The final manuscript for the book titled "Golf Course
Management: Environmental Issues", was submitted to Lewis
Publishers, Inc. on October 4, 1991. The manuscript significantly
updates and augments the original report. The book is a summary and
assessment of the technical and scientific research on the
environmental effects of turfgrass management and to a smaller
extent golf course construction. This book is intended as an
introduction to the concepts of the nonpoint source environmental
impacts of turfgrass management for turfgrass scientists and
specialists, landscape and golf course architects, developers of
turfgrass systems and golf courses, golf course superintendents,
environmental scientists, and land use regulators.

The manuscript is organized into eight chapters. The
introduction provides an overview and historical perspective
regarding turfgrass management and environmental quality. The
second chapter discusses the relationship of turfgrass management to
the critical issues of water resources. This chapter focuses on the
issues of water use, water quality, soil and water conservation, and
movement within the water cycle. Chapters three and four provide a
state-of-the-art scientific review and assessment of the literature
regarding the environmental effects of nutrient and pest management
practices. The fifth chapter provides an introduction to concepts
necessary for development of integrated management systems for
turfgrass. Chapter six covers the direct and indirect effects of
golf course management and construction on wildlife and aquatic
organisms. The seventh chapter is an introduction to the critical
issues of conservation and protection of wetlands which is emerging
as a critical environmental concern of the 1990s. Chapter 8
contains tables of toxicity tests related to the effect of chemicals
used for turfgrass management. Each of the chapters includes a
section on research and information needed to resolve the issues
surrounding the positive and potentially adverse effects of
turfgrass management. An outline of the manuscript is provided in Section 2.0.

Many individuals made significant contributions in preparing this publication. The contributors and reviewers included staff members of Spectrum Research, Inc., the staff of the USGA; members of the USGA research committee; scientists from Environmental Chemistry and Lockheed Engineering & Sciences Company; and academic scientists (Table 1). All of the contributors were cooperative and made timely contributions to the quality of the publication. Several authors and reviewers were pivotal in enhancing the quality of the book. Spectrum Research, Inc. specifically acknowledges the outstanding efforts by Michael P. Kenna, James R. Watson, Victor A. Gibeault, James T. Snow, and Anne R. Leslie in making this publication possible. In addition to authorship, their reviews and professional guidance were greatly appreciated by the editors and co-authors.

Ultimately, the objective of this project is to objectively distribute information regarding the environmental effects of golf course management. This will be an ongoing process for the USGA environmental research program. The staff of Spectrum Research, Inc. believes the book, Golf Course Management: Environmental Issues, will make a positive contribution to the long term goals of the research efforts of the USGA.

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2.0 Outline of the Publication

Chapter 1  BACKGROUND AND OVERVIEW OF ENVIRONMENTAL ISSUES

James C. Balogh, Victor A. Gibeault, William J. Walker, Michael P. Kenna, and James T. Snow

1.1 Introduction

1.2 Environmental Issues and Turfgrass Management: A Historical Perspective

1.3 Scope of the Turfgrass Industry

1.4 Environmental Benefits of Turfgrass Systems

1.5 Identification of Environmental Impacts and Nonpoint Pollution Problems in Turfgrass Systems

1.6 Benefits of Implementing Integrated Turfgrass Management Strategies

1.7 Objectives and Sources of Information
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James C. Balogh and James R. Watson

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2.2 Components of the Water Cycle, Soil, and Turfgrass Systems

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  2.3.2 Groundwater
  2.3.3 Water and Chemical Movement in the Unsaturated Zone
  2.3.4 Soil Properties Affecting Movement of Turfgrass Chemicals
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2.4 Soil and Water Conservation in Turfgrass Management
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William J. Walker and Bruce Branham

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James C. Balogh and James L. Anderson

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James C. Balogh, Anne R. Leslie, William J. Walker, and Michael P. Kenna

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Patricia A. Kosian, Mary E. Balogh, and Roberta M. Tietge

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Sheila R. Murphy

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