



*Suffolk County Vector Control &
Wetlands Management Long Term Plan &
Environmental Impact Statement*

**TASK 3: TASK REPORT
LITERATURE SEARCH**

Submitted to:

**Suffolk County Department of Environment and Energy
Suffolk County Department of Health Services
Suffolk County Department of Public Works
Suffolk County, New York**

Prepared by:

CASHIN ASSOCIATES, P.C.
1200 Veterans Memorial Highway, Hauppauge, NY

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**SUFFOLK COUNTY VECTOR CONTROL AND WETLANDS MANAGEMENT
LONG - TERM PLAN AND ENVIRONMENTAL IMPACT STATEMENT**

PROJECT SPONSOR

Steve Levy
Suffolk County Executive



Department of Environment and Energy

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Deputy Commissioner

Department of Health Services

Brian L. Harper, M.D., M.P.H.
Commissioner
Vito Minei, P.E.
Director, Division of Environmental Quality

PROJECT MANAGEMENT

Project Manager: Walter Dawydiak, P.E., J.D.
Chief Engineer, Division of Environmental Quality, Suffolk County Department of Health Services

**Suffolk County Department of
Public Works, Division of Vector**

Control

Dominick V. Ninivaggi
Superintendent
Tom Iwanejko
Entomologist
Mary E. Dempsey
Biologist

**Suffolk County Department of
Health Services, Office of Ecology**

Martin Trent
Chief
Kim Shaw
Bureau Supervisor
Robert M. Waters
Bureau Supervisor
Laura Bavaro
Senior Environmental Analyst
Erin Duffy
Environmental Analyst
Phil DeBlasi
Environmental Analyst
Jeanine Schlosser
Principal Clerk

SUFFOLK COUNTY LONG TERM PLAN CONSULTANT TEAM

Cashin Associates, P.C.	Hauppauge, NY
Subconsultants	
Cameron Engineering, L.L.P.	Syosset, NY
Integral Consulting	Annapolis, MD
Bowne Management Systems, Inc.	Mineola, NY
Kamazima Lwiza, PhD	Stony Brook University, Stony Brook, NY
Ducks Unlimited	Stony Brook, NY
Steven Goodbred, PhD & Laboratory	Stony Brook University, Stony Brook, NY
RTP Environmental	Westbury, NY
Sinnreich, Safar & Kosakoff	Central Islip, NY
Bruce Brownawell, PhD & Laboratory	Stony Brook University, Stony Brook, NY
Anne McElroy, PhD & Laboratory	Stony Brook University, Stony Brook, NY
Andrew Spielman, PhD	Harvard School of Public Health, Boston, MA
Richard Pollack, PhD	Harvard School of Public Health, Boston, MA
Masahiko Hachiya, PhD	Harvard School of Public Health, Boston, MA
Wayne Crans, PhD	Rutgers University, New Brunswick, NJ
Susan Teitelbaum, PhD	Mount Sinai School of Medicine, NY
Zawicki Vector Management Consultants	Freehold, NJ
Michael Bottini, Turtle Researcher	East Hampton, NY
Robert Turner, PhD & Laboratory	Southampton College, NY
Christopher Gobler, PhD & Laboratory	Southampton College, NY
Jerome Goddard, PhD	Mississippi Department of Health, Jackson, MS
Sergio Sanudo, PhD & Laboratory	Stony Brook University, Stony Brook, NY
Robert Cerrato, PhD	Stony Brook University, Stony Brook, NY
Suffolk County Department of Health Services, Division of Environmental Quality	Hauppauge, NY

This Task Report was prepared by Cashin Associates (personnel including Kim Somers and David Tonjes, PhD).

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1. Introduction

A detailed search of the scientific, medical, and public health literature was conducted in order to support the development of the Long-Term Plan and its associated environmental review. This search included a review of the collective experience of vector control experts and researchers in related environmental and human health disciplines. Major databases such as MedLine and ToxLine were accessed to support the toxicological reviews. Environmental research used certain data base searches available through the Stony Brook University library. Interlibrary loans and electronic journal availability through Stony Brook University were important resources for this work.

Research was coordinated through Cashin Associates, PC. (CA). Certain elements of the work were conducted with relative independence:

- Book 2 Part 2, Harvard School of Public Health
- Book 6 Part 2, Dr. Teitelbaum
- Book 9 Parts 1 and 2, Dr. Goodbred

Other reports were more collaborative efforts.

The Technical Advisory Committee (TAC) and Citizens Advisory Committee (CAC) were afforded review opportunities for most reports prior to general public release. The TAC also commissioned reviews of some specific reports. CA was blinded on these reviews, in that it was not informed of the identity of the reviewer. In particular, reviews were made of the following reports:

- Book 4 Part 2
- Book 5 Part 3
- Book 6 Part 1
- Book 6 Part 2
- Book 7
- Book 8 Part 1
- Book 8 Part 2

- Book 9 Part 1
- Book 10 Part 1

Reviews of all reports could be characterized as positive (that is, the reviewers generally thought the research was appropriate for the task being considered), with one exception. Freshwater Wetlands (Book 10, Part 1) was not well received by either peer reviewer. Instead of rewriting the report, CA only used excerpts from it for ongoing environmental analyses, and kept the comments of the reviewers in mind while preparing work relating to fresh water wetlands.

Peer reviewers for the Literature Search were:

- Roger LeBrun
- Elizabeth Lewis-Michls
- Matthew Mauer
- Tsutomu Nakatsugawa
- Michael Newman
- James Perry
- Jason Rohr
- Charles Roman
- John Teal
- Winsor Watson
- Dennis Whigham
- Roger Wolfe
- He Zhong

The TAC specifically approved of the credentials of each selected peer reviewer for the reports in question.

All reports have been submitted to the County for review, and have been posted on the website (www.suffolkmosquitocontrolplan.org).

2. Task Participants

The following details the project participants, and the reports where they made substantial contributions:

Wayne Crans, PhD (Rutgers University): Book 1, Book 4 Part 2

Andrew Spielman, DSc (Harvard School of Public Health): Book 2 Part 2

Richard Pollack, PhD (Harvard School of Public Health): Book 1, Book 2 Part 2

Masahiko Hachiya, PhD (Harvard School of Public Health): Book 2 Part 2

Jerome Goddard, PhD (Mississippi Department of Health): Book 4 Part 2

Susan Teitelbaum, PhD (Mount Sinai School of Medicine): Book 6 Part 2

Steven Goodbred, PhD (Stony Brook University): Book 9 Parts 1 and 2

Integral Consulting: Book 6 Part 1, Book 7

Suffolk County Department of Health Services: Book 6 Parts 1 and 3, Book 7

RTP Environmental: Book 5 Part 3

Cameron Engineering: Book 1, Book 3, Book 4 Parts 1 and 3, Book 5 Parts 1 and 2, Book 8 Parts 1, 2, 3, and 4

Cashin Associates: Book 2 Parts 1, 3, and 4, Book 4 Parts 2 and 3, Book 6 Part 3, Book 8 Parts 2 and 4, Book 9 Parts 3 and 4, Book 10 Parts 1 and 2

Cashin Associates reviewed and edited all of the Literature Search.

3. Written Reports

Book 1. LONG ISLAND MOSQUITOES

This report states that forty-one native species and one recently introduced species of mosquitoes have been observed in Suffolk County, Long Island, New York, and are assumed to be resident in 2004¹. Twelve of the species that are considered to be of concern with regard to impacts on human lifestyles as a vector of human disease are named. The report includes the classification of mosquitoes, mosquito ecology, and the life cycle of mosquitoes. It also contains an appendix that consists of pictures of typical mosquitoes found on Long Island. The report was completed October 2004 by Cameron Engineering, Wayne Crans, PhD, and Richard Pollack, PhD, and is 54 pages long.

Book 2. MOSQUITO-BORNE DISEASES

Part 1. DISEASES TRANSMITTED BY MOSQUITOES

This report discusses mosquito-borne diseases found across the world, the US, and Suffolk County. Mosquito-borne disease is a threat to human health. Mosquito-borne diseases can, or have, wreaked havoc through epidemics and other disease events. The report names malaria, yellow fever, five types of encephalitis, and other known diseases as the greatest problems. The report also states that Suffolk County has declared public health emergencies due to mosquito-borne diseases. The report was completed in September of 2004 by Cashin Associates, and is 19 pages long.

Part 2. MOSQUITO-BORNE DISEASE HEALTH IMPACTS

This report analyzes the potential for the transmission of mosquito-borne infection in Suffolk County and examines the forces that determine risk of infection and the efficacy of the existing abatement efforts that are practiced there. The main focus of the report is mosquito-borne diseases of concern in Suffolk County. These diseases are named and discussed in detail. The report goes on to say that vector-borne infections are linked to environmental degradation and to the importation of novel pathogens, vectors, or reservoir hosts. This report was prepared by Harvard School of Public Health, was completed in September 2005, and is 67 pages in length.

¹ This report spurred the Suffolk County Department of Health Services Arthropod-Borne Disease Laboratory to revisit data collected in the County regarding resident mosquito species. The current evaluation, as reported in the project Draft Generic Environmental Impact Statement, is that the County has 50 resident mosquito species.

Part 3. SUSCEPTIBILITY OF OTHER ORGANISMS TO WEST NILE VIRUS

This report focuses on the effects of West Nile Virus (WNV) on non-human vertebrate species, and some of the indirect impacts on both human and non-human species that may result. The report states that the impacts of WNV on animal species and their habitats are important due to the inextricable links between vector and hosts. The role of birds, mammals, and reptiles in regards to WNV is discussed. This report also concentrates on potential ecological impacts, potential impacts to humans, and indirect impacts of WNV. This portion of the literature search was completed in January 2005 by Cashin Associates. It is 31 pages long.

Part 4. SEROSURVEYS FOR WEST NILE VIRUS

This report gives background information on WNV, including the history of the disease as well as the standards for medical reporting. Past WNV serological surveys are discussed in detail. Human serologic surveys are conducted in order to determine the rate of infections in humans. This data is helpful to make a simple estimate of the annual risks for a population exposed to WNV infection. This report was completed in January 2005 by Cashin Associates, and is 20 pages in length.

Book 3. MOSQUITO MONITORING

This report discusses the goals of a sound surveillance program. These goals include monitoring the distribution and abundance of larval and adult mosquitoes and the prevalence of mosquito-borne diseases. This is accomplished by a variety of mechanisms, including trapping mosquitoes, monitoring their breeding, analyzing them for viral activity, and monitoring other species. This report was completed in October 2004, and had been prepared by Cameron Engineering and Wayne Crans, PhD. It is 42 pages in length.

Book 4. OVERVIEW OF MOSQUITO CONTROL

Part 1. INTEGRATED MOSQUITO MANAGEMENT

This report provides an in depth look at mosquito control in the United States, from the reliance on insecticide application for control of adult mosquitoes to Integrated Pest Management (IPM). IPM program elements discussed in detail include surveillance, source reduction, larvicide application, and biological control, as well as public outreach and education. Control rationales and triggers for larvicide and adulticide applications are also discussed. This document provides

the understanding that a reliance on a wide-ranging surveillance program is key to optimizing treatments, to both maximize mosquito control and minimize pesticide usage. This report was prepared by Cameron Engineering, and was completed in March 2005. It is 71 pages in length.

Part 2. INNOVATIONS IN AND UNCONVENTIONAL MOSQUITO MANAGEMENT

This report contains descriptions of many widely used, standard approaches to mosquito control and the innovations that are being developed by private industry and mosquito control districts. New products and techniques available to mosquito control agencies for regional control efforts, or marketed to individuals for smaller scale efforts, and the role of natural or augmented predation as a means of controlling mosquito populations are also addressed. This report was prepared by Jerome Goddard, PhD, Cashin Associates, and Wayne Crans, PhD. It was completed in November 2004. It is 71 pages in length.

Part 3: HOUSEHOLD AND PERSONAL MOSQUITO AGENTS

This report addresses the personal measures that can be taken to interfere with the ability of a mosquito that is seeking a blood meal to find and become attracted to humans. This section of the Literature Review discusses some of the unsupported claims regarding the effectiveness of many mosquito repellent measures commonly used today. This report was prepared by Cameron Engineering with assistance from Cashin Associates. It was submitted in December 2004. It is 28 pages in length.

Book 5. OVERVIEW OF MOSQUITO CONTROL PESTICIDES

Part 1. MOSQUITO CONTROL AGENTS

This report presents the findings of a survey of Mosquito Control agencies outside Suffolk County. This survey was conducted to develop a list of agents used to control mosquito populations. Particular effort was placed on regional mosquito control programs. Other areas of the country were included to examine the spectrum of mosquito control agents utilized under a variety of environmental conditions. Information collected on particular mosquito control agents served as the source for the chemicals that were studied in the toxicological literature search, and for the quantitative analysis in the risk assessment. This report was completed in its final form in January 2005 by Cameron Engineering (the first draft was used early in 2004 to select agents to be discussed by other elements of the Literature Search). It is 16 pages in length.

Part 2. OVERVIEW OF MOSQUITO CONTROL PESTICIDES

This report provides information on history of pesticide use, the types of pesticides utilized by mosquito control agencies in this country, the labeling requirements for commercial distribution, and those pesticides used specifically by the Suffolk County Department of Public Works, Division of Vector Control (SCVC). Pesticides utilized for mosquito control historically and presently include the following classes:

- Organochlorines (e.g.-DDT);
- Organophosphates (e.g.-Malathion);
- Pyrethroids (e.g.-Resmethrin, Sumithrin);
- Insect Growth Regulators (e.g.-Methoprene);
- Microbials (e.g. - Bacillus thuringiensis israelensis [Bti])
- Synergists (e.g.-Piperonyl Butoxide).

Information is also provided on Suffolk County's pesticide applications, including non-vector control pesticides. The report further discusses the County's groundwater monitoring program for pesticides and other chemicals of concern. This report was prepared by Cameron Engineering. It was completed in January 2005. It is 44 pages in length.

Part 3. ATMOSPHERIC DISPERSION AND DEPOSITION MODELING

This report provides a summary of the progress that has been achieved by various groups working toward sustainable vector control management techniques. It also defines the key variables that must be analyzed before accurate and representative estimates of how and when to apply pesticides can be realized. It discusses what techniques are currently available to assist vector management programs in making application decisions. Finally, it provides some data that validates recommended techniques, as well as suggestions for additional research that would be helpful in improving model predictive accuracy and completeness. This report was prepared by RTP Environmental. It was completed in February 2005. It is 40 pages in length.

Book 6. VECTOR CONTROL PESTICIDES HUMAN HEALTH IMPACTS

Part 1. HUMAN HEALTH AND DOMESTIC ANIMAL TOXICITY

This report provides a review of impacts associated with pesticides used in vector control activities on human health and domestic animals. The pesticides that are included in this literature review are those that were selected as the primary list of mosquito control agents. Information for each pesticide is presented individually, with a summary of studies that have been conducted and a table of various criteria that have been developed. The Human Health Toxicity Review is presented first, followed by the Domestic Animal Toxicity Review, which represents information specific to domestic animals (e.g., dogs, cats and horses). This report was prepared by Suffolk County Department of Health Services, with extensive oversight by Integral Consulting. It was completed in February 2005. It is 182 pages in length.

Part 2. MOSQUITO CONTROL PESTICIDES, BREAST CANCER, AND CHILDHOOD ILLNESSES

This report focuses on epidemiological research that has been conducted regarding potential links between vector control pesticides and breast cancer, and on children's illnesses. Scientific literature was thoroughly reviewed for studies relating 15 specific chemicals and chemical groups to breast cancer and childhood illnesses. The overall result of the scientific literature search does not provide support for an association between the vector control pesticides and breast cancer, childhood cancer, childhood neurological problems, or childhood respiratory illness. On the other hand, the literature did not provide evidence against an association between the vector control pesticides and breast cancer or childhood diseases. The methodologies used to conduct these studies make it impossible to draw conclusions with certainty in either direction. This report was prepared by Susan Teitelbaum, PhD. It was completed in January 2005. It is 29 pages in length.

Part 3. SUFFOLK COUNTY REPORTS OF ECOLOGICAL IMPACTS FROM LARVICIDING AND ADULTICIDING

This report presents information regarding the ecological effects of larvicides and/or adulticides used for mosquito control in Suffolk County. A total of 54 agencies, organizations, and interested parties were contacted to solicit information regarding local impacts from these

pesticides. This report discusses the findings from two legal claims and three scientific inquiries on local effects of pesticide usage. The scientific inquiries address the following topics: the effects of mosquito control applications on sheepshead minnows; the 1999 lobster die-off in the Long Island Sound and the impacts of larvicides on salt marsh organisms. The studies indicate that detected adverse impacts to organisms were likely due to environmental stressors. Mosquito control adulticides or larvicides could not be linked to the ecological adverse effects to these organisms. This report was prepared by Suffolk County Department of Health with assistance from Cashin Associates. It was completed in October 2004. It is 18 pages in length.

Book 7. ECOTOXICITY REVIEW OF THE LONG-TERM PLAN PRIMARY MOSQUITO CONTROL AGENTS

This report discusses the results of a comprehensive review performed to evaluate the toxicological characteristics of the 11 primary mosquito control agents. The ecotoxicological information provided in this document has been synthesized and summarized to support a subsequent ecological risk evaluation of the mosquito control agents consisting of microbial pesticide and insect growth regulator larvicides, adulticides, a synergist, and a repellent. The information on ecotoxicological characteristics were reviewed and summarized for each of the 11 agents. Ecologically relevant routes of exposure for terrestrial and aquatic wildlife, namely for oral and inhalation exposures, were the focus of this evaluation. Emphasis was placed on information relevant to effects following acute and shorter-term exposures, rather than longer-term chronic exposures. This report was prepared by Integral Consulting with research assistance from Suffolk County Department of Health Services. It was completed in January, 2005. It is 56 pages in length.

Book 8. MARINE AND NON-TARGET IMPACTS

Part 1. MOSQUITO CONTROL PESTICIDES AND FISH

This report discusses the toxicity to fish associated with pesticides that are being considered for use by the Long-Term Plan. Four larvicides were reviewed including temephos, methoprene, *Bacillus thuringiensis* variety *israelensis* (*Bti*), and monomolecular surface films (MSF). Very little information on *B. sphaericus* (*Bs*) was found, and so it was not specifically discussed. Adulticides reviewed included naled, malathion, pyrethrin, permethrin, resmethrin, and sumithrin, and the synergist, piperonyl butoxide. The barrier treatment, garlic oil, was not

researched, as it is generally found to be non-toxic to fish and invertebrates. This report was prepared by Cameron Engineering. It was completed in April 2005. It is 49 pages in length.

Part 2. MOSQUITO CONTROL PESTICIDES AND LOBSTER MORTALITY

This report addresses the lobster die off in the Long Island Sound and the possible link to pesticides used to control the 1999 WNV outbreak. Modeling was the only means of determining the level of exposure of pesticides to lobsters, since water samples were not taken at the time of the die-off. Strong evidence that other factors have had negative effects on lobster populations is presented. They include elevated water temperature, low dissolved oxygen concentrations, storm-related salinity effects, and possibly diseases such as shell disease, calcinosis, and parasites. These factors, alone or combined, may have been the primary or secondary agent responsible for the population decline. This report was prepared by Cameron Engineering with assistance from Cashin Associates. It was completed in August 2004. It is 47 pages in length.

Part 3. MOSQUITO CONTROL PESTICIDES AND MARINE INVERTEBRATES

This report discusses the potential toxicity of vector control pesticides on the aquatic environment, specifically to fish. Databases researched for this report include Pesticide Action Network (PAN), USEPA Extension Toxicology Network (EXTOXNET), and “Human Health and Environmental Relative Risks of West Nile Virus (WNV) Mosquito Control Products,” a document by the State of Maine’s Board of Pesticide Control (BPC). Larvicides reviewed included temephos, methoprene, and *Bacillus thuringiensis* variety *israelensis* (*Bti*), and monomolecular surface films (MSFs). The adulticides reviewed included naled, malathion, pyrethrin, permethrin, resmethrin, sumithrin, methoxychlor, and the synergist, piperonyl butoxide. This report was prepared by Cameron Engineering. It was completed in May 2005. It is 50 pages in length.

Part 4. MOSQUITO CONTROL AND THE FOOD CHAIN

This report addresses the affects of mosquito control on estuarine and freshwater organisms. Mosquito control can affect these organisms directly by unintended, non-target effects, or indirectly by impacting prey, competitor, or predator species. Reports discussing the direct and indirect impacts of pesticides and marsh management on species diversity and species inter-

relationships were reviewed. Cumulative and long-term impacts such as bioaccumulation, bioconcentration, and biomagnification were also assessed. This report was prepared by Cameron Engineering and Cashin Associates. It was completed in June 2005. It is 50 pages in length.

Book 9. SALT MARSHES AND MOSQUITO CONTROL

Part 1. SALT MARSH HEALTH

This report discusses the issues surrounding definitions of salt marsh health. The scope, cost, and success of any wetland assessment ultimately hinge on the chosen definition of a healthy marsh. The definition of salt marsh health must be constructed from a variety of parameters. This report focuses on salt marsh health characterized by the physical habitat stability through sediment erosion and deposition, the connectivity of the marsh with adjacent ecosystems, ecological communities within the marsh, and overall water quality. This report was prepared by Steven Goodbred, PhD. It was completed in December 2004. It is 46 pages in length.

Part 2. SALT MARSH FUNCTION AND VALUE

This report describes current understandings regarding functions provided by salt marshes, and thereby provides context for the description of the values that may be ascribed to these systems. The perception of salt marsh value and function has shifted with changes in demographics and land-use patterns. Salt marsh functions are discussed in detail with the goal of explaining their mechanisms and processes, relative significance to coastal ecosystems, and broader societal and environmental value. Ecological functions include high productivity, energy transfer, and nursery and other habitat values. This report was prepared by Steven Goodbred, PhD. It was completed in November 2005. It is 46 pages in length.

Part 3. NATURAL AND MANAGED SALT MARSHES

This report addresses the ecology and food chains of natural salt marshes, including the impacts and effects of traditional water management (grid or parallel ditching) and Open Marsh Water Management (OMWM). Careful research within and across sites shows the assumption of overall marsh process similarity to be an oversimplification for many of the important salt marsh attributes. It is clear that many important generalities ascribed to salt marshes as a class may not apply to particular systems or places. Where possible, the report includes discussions of

concepts and results that seem to indicate disagreement or a lack of scientific consensus. This report also provides details of the three basic OMWM design systems throughout the northeast: open systems; semi-open (sill ditch) systems and closed (full ditch blockage) systems. These design systems share the goal of improving insectivorous fish habitat on the marsh, and in improving access for the fish to mosquito breeding points. This report was prepared by Cashin Associates. It was completed in January 2005. It is 173 pages in length.

Part 4. LONG ISLAND WETLAND LOSSES

This report looks at wetland loss in the United States. Even though strict federal and state policy of “no net loss” of wetlands have been put into place, there appear to be places where marsh areas are still decreasing. Explicit filling and draining actions are generally not the cause any longer. Rather, marshes are being lost through natural processes or as a result of deliberate actions that are not intended to have impacts to the marshes. It may be that sweeping generalizations have been made based on biased, incomplete, or local studies. Continuing losses of vegetated marsh areas, if occurring on a widespread basis in Suffolk County, are an extremely important element for the future presence of these important resources. However, it may be that not enough information has yet been gathered to make firm judgments as to whether Suffolk County’s salt marshes are disappearing at an untoward rate or not, and if specific kinds of marshes are more threatened than others. This report was prepared by Cashin Associates. It was completed in March 2006. It is 78 pages in length.

Book 10. UPLAND HABITATS AND MOSQUITO CONTROL

Part 1. FRESHWATER WETLANDS

This report describes the freshwater habitats of Suffolk County, New York, and the associated plant and animal species found in riverine, lacustrine, and palustrine wetlands. In addition, this report characterizes wetlands communities found within several distinct ecological zones: the North Shore, South Shore Outwash Plain, Peconic River - Pine Barrens, and East End of Suffolk County. Ecological case studies identify and describe notable communities, such as red maple swamps, coastal plain ponds, and environmentally managed systems. Finally, this report describes the six mosquito genera of concern in the freshwater wetlands of Suffolk County, Long Island, and identifies their major habitats. This report was prepared by Cashin Associates. It was completed in November 2004. It is 70 pages in length.

Part 2. STORMWATER CONTROL AND MOSQUITOES

This report focuses on the control of stormwater as a means of minimizing environmental impacts. The primary means of accomplishing this has been described as “retention and detention”. This report discusses how standing water environments can also be prime mosquito breeding grounds, and how fostering the environmental goals of stormwater treatment could lead to increased mosquito breeding and potential disease transmission. This report provides information regarding the general regulatory setting for stormwater management, as regulated by USEPA under the federal Clean Water Act amendments of 1987. This report was prepared by Cashin Associates. It was completed in December 2004. It is 23 pages in length.

4. Budget Status

Work on this portion of the project proved to be much more substantial than anticipated. The budget lines for all participants were exhausted, and transfers of funds from other tasks were made.

Expenses under this task were also accrued for the development of Early Action projects, and so not all costs listed below were associated with the Literature Search. This is especially true for the Brownawell-McElroy line, for example, as all of their effort was in designing Early Action Projects.

The final totals for this task were as follows:

Subconsultant	Expenditures
CA-CE	\$145,527.78
Crans	\$11,000.00
Goddard	\$7,500.00
Goodbred	\$27,500
Sinnreich & Safar	\$62.50
HSPH	\$40,000.00
Integral	\$27,989.40
RTP	\$14,220.00
Teitelbaum	\$20,548.00
Brownawell-McElroy	\$7,590.00
SCDHS	\$0
Task Total	\$301,937.68