HUMAN HEALTH AND ECOLOGICAL IMPACT ANALYSIS OF THE HILLSBOROUGH COUNTY RESOURCE RECOVERY FACILITY EXPANSION

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TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

ACRONYMS

ACI	activated carbon injection
APC	air pollution control
BACT	best available control technology
CAA	Clean Air Act
DEP	Florida Department of Environmental Protection
EPA	U.S. Environmental Protection Agency
FF	fabric filter
FIFRA	Federal Insecticide Fungicide and Rodenticide Act
LCA	life cycle analysis
MACT	Maximum Achievable Control Technology
MW	megawatts
MSW	municipal solid waste
MWC	municipal waste combustor
NOx	nitrogen oxides
PCBs	polychlorinated biphenyls
PCDD/PCDFs	polychlorinated dibenzo-p-dioxins and dibenzofurans
PPSA	Florida Electrical Power Plant Siting Act
PSD	Prevention of Significant Deterioration
RCRA	Resource Recovery and Conservation Act
RRF	resource recovery facility
RTF	Recycling Task Force
SDA	spray dryer absorber
SIP	State Implementation Plan
SNCR	selective non-catalytic reduction
SWMD	Hillsborough County Solid Waste Management Department
TECO	Tampa Electric Company
TEQs	2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) toxic equivalents
TPD	tons per day
TSCA	Toxic Substance Control Act
USCOM	U.S. Conference of Mayors
WERT	Waste to Energy Research Council
W-T-E	waste to energy

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EXECUTIVE SUMMARY

Hillsborough County is proposing to expand the solid waste processing capacity of its existing Resource Recovery Facility from 1,200 to 1,800 tons per day. Hillsborough County requested CPF Associates, Inc., an independent scientific research and consulting organization, to evaluate the potential for negative human health or ecological impacts associated with the expansion. CPF's evaluation was conducted by: (a) researching the scientific and regulatory literature regarding waste-to-energy facilities, (b) analyzing site-specific information concerning the proposed expansion project, including the information presented in the County's Power Plant Siting Act permit application, and (c) performing standardized risk assessment calculations and analyses. The results of CPF's analysis show that the proposed expansion project is unlikely to have a negative impact on human health or the environment if constructed and operated as stated in the County's permit application.

1.0 INTRODUCTION

1.1 The Proposed Expansion

Hillsborough County owns a 1,200 ton per day (TPD) resource recovery facility (RRF), which is operated as part of the County's Integrated Solid Waste Management System. The RRF, comprised of three 400 TPD combustion units, incinerates municipal solid waste (MSW), produces steam, and converts the steam to electricity, which is sold to the Tampa Electric Company. Due to residential and commercial growth in the County since the RRF became operational in 1987, the 1,200 ton per day capacity of the existing plant has become inadequate. The County Commission has concluded that it should increase the RRF's capacity to 1,800 tons per day. The proposed RRF expansion project would involve the addition of a new 600 ton per day boiler and certain ancillary equipment.

1.2 Objectives Of This Analysis

The permit process for the proposed fourth unit at the RRF will require the submittal of a number of application documents. These include a Site Certification Application to comply with the Florida Electrical Power Plant Siting Act (PPSA), and an application for a permit under the Prevention of Significant Deterioration (PSD) program to comply with the Clean Air Act. PPSA approval to construct the fourth unit will be determined by the State of Florida's Siting Board (i.e., Governor and Cabinet). The PSD permit will be issued by the Florida Department of Environmental Protection (DEP).

The Human Health and Ecological Impact Analysis presented in this document was performed to address questions related to human and environmental health that may arise during the course of the permit processes. This analysis is not a formal requirement of the permit processes for the County's expansion project, but was conducted to ensure that issues of potential concern related to the proposed RRF expansion were evaluated.

This Human Health and Ecological Impact Analysis was performed by CPF Associates, Inc., a Washington, D.C.-based scientific and regulatory consulting firm. Appendix A provides biographies of the CPF scientists who participated in this effort.

1.3 Methods Of This Analysis

This analysis consists of several parts. First, information regarding the operation of Hillsborough County's Solid Waste Management System, including the existing RRF and the proposed RRF expansion, was obtained and reviewed. Second, information about the regulatory context of waste-to-energy facilities is evaluated and the implications investigated for the proposed Hillsborough expansion. Following these activities, a scientific literature search and review was conducted to obtain information relevant to the analysis, including general information about analogous facilities and specific information about the west Florida environment. Hillsborough County's engineer, CDM, was requested to perform survey work to obtain site-specific information that was pertinent to the analysis. CDM also conducted air dispersion and deposition modeling to address the behavior of the RRF's stack emissions in the environment. The results of the modeling were used as inputs to a health risk assessment.

Risk assessment is an important tool that can be used to evaluate the probability of adverse effects from various types of activities or situations. This well-recognized method of analysis can assist in identifying the probability of adverse health effects occurring as a result of exposure to chemicals. It is also often used in a regulatory context, in which risk assessment results are compared to regulatory target risk levels. The U.S. Environmental Protection Agency (EPA), and numerous other regulatory and research organizations, including the National Academy of Sciences, have developed guidelines for the performance of risk assessments. These guidelines were followed in the assessment of the proposed expansion of the Hillsborough County RRF.

2.0 THE GENERAL CONTEXT OF WASTE-TO-ENERGY

In 2003, Americans generated 236.2 million tons of municipal solid waste (MSW) for a generation rate of 4.45 pounds per person per day (EPA 2005). Approximately 23.5% of this material was recycled and 7.1% was composted. The remaining 69.4% required disposal. The majority of the waste slated for disposal was landfilled (55.4%) and another 14% was combusted for energy recovery. This latter option is known as waste-to-energy, trash-to-energy, or resource recovery.

All methods of waste management involve some potential human health or environmental risks. In the United States, regulatory programs have been implemented to minimize the risks from MSW management activities. This section explores the use of waste-to-energy and places it in context at the federal, state, and county levels, with an emphasis on those regulatory factors relevant to the protection of human health and the environment.

2.1 Federal Regulations and Policies

At the national level, there are currently 89 waste-to-energy plants operating in 27 states (Norris 2005). They generate about 2,700 megawatts of electricity from the processing of 95,000 tons of MSW each day. The electricity generated meets the energy needs of about 2.3 million homes and may be viewed as a replacement for about 48 million barrels of oil each year.

At the federal level, the primary regulatory agency is the Environmental Protection Agency (EPA), which regulates both the management of MSW and the air emissions from waste-to-energy plants. The primary vehicles for regulation are the Resource Recovery and Conservation Act (RCRA) and the Clean Air Act (CAA).

RCRA defines solid and hazardous wastes and sets up an overall management strategy. Among other things, RCRA forbids the disposal of hazardous and medical wastes at MSW disposal sites. This ensures that hazardous and medical wastes will not be combusted at the Hillsborough RRF. RCRA also delegates specific regulatory programs for the management of MSW to the states. The federal role in this context is to establish minimum criteria that describe the best practicable environmental controls and monitoring requirements for solid waste disposal facilities. Other specific federal regulations that impact waste disposal in waste-to-energy plants include the Toxic Substance Control Act (TSCA), which bans the disposal of polychlorinated biphenyls (PCBs) with MSW, and the Federal Insecticide Fungicide and Rodenticide Act (FIFRA), which regulates the disposal of pesticides and pesticide containers. RCRA regulates the ash that is generated during the MSW combustion process at a resource recovery facility.

The CAA is the other primary vehicle for the regulation of waste-to-energy plants at the federal level. There are several provisions of the CAA that apply to the Hillsborough RRF, such as those regulating the prevention of significant deterioration (PSD) of air quality. In this case, the provisions of the CAA that are most relevant to the protection of human health and the environment are the New Source Performance Standards (NSPS) for new large MSW combustors, such as the Hillsborough RRF, which are contained in Subpart Eb of 40 CFR Part 60 ("Standards of Performance" for Large Municipal Waste Combustors for which Construction is commenced after September 20, 1994) (EPA 1995).

The overall objective of the NSPS in Subpart Eb is to ensure that emissions from waste-to-energy plants do not occur at levels that could pose a public health threat. The NSPS requires the implementation of Maximum Achievable Control Technology (MACT) to limit the amount and number of pollutants that may be emitted from a large MSW combustor. In the CAA, MACT is defined as the maximum degree of reduction in emissions of designated air pollutants, taking into consideration various factors. In the case of MSW combustors, the designated pollutants subject to MACT include dioxins and furans, cadmium, lead, mercury, particulate matter, hydrogen chloride, sulfur dioxide, nitrogen oxides, and fugitive ash emissions. In addition to the MACT controls on these specific pollutants, the NSPS require the use of good combustion practices (combustion efficiency) and imposes requirements for facility siting, operator training and certification, compliance and performance testing, and reporting and recordkeeping. Under the CAA, the State of Florida has a federally-approved State Implementation Plan (SIP) and the State has been delegated the authority to issue a permit under the NSPS Subpart Eb.

EPA (2002) examined the reductions in pollutant emissions from large waste-to-energy facilities as a result of the implementation of the NSPS. The following table compares emissions in the year 2000 to the year 1990 (Table 2-1).

Table 2-1
Reduction in Emissions Associated with NSPS

Pollutant	Reduction in %
Dioxins/furans	99.7
Mercury	95.1
Cadmium	93.0
Lead	90.9
Hydrochloric acid	94.3
Sulfur dioxide	86.7
Particulate matter	89.8

Based on these data, EPA (2002) concluded that the "performance of the MACT retrofits has been outstanding." The Agency also noted that "since 1990 (pre-MACT conditions), dioxin/furan emissions have been reduced by more than 99 percent, and mercury emissions have been reduced by more than 95 percent." Since the potential for public health impacts usually is proportional to the amount of emissions, these significant reductions in WTE emissions should provide a positive impact on public health.

In 2003, EPA concluded that the use of MACT at WTE facilities allows municipal solid waste to be used "as a clean, reliable, renewable source of energy." Further, EPA noted that WTE plants in the U.S. "produce 2800 megawatts of electricity with less environmental impact than almost any other source of electricity." (EPA 2003).

2.2 State Regulations and Policies

Increases in Florida's population have resulted in large increases in MSW generation. In 2000, for example, a total of 25.7 million tons of MSW were collected in Florida (DEP 2002). This represents a substantial increase (32%) from 1991, when the corresponding amount was 19.5 million tons. The per capita generation rates have also increased 6%, from 8.3 pounds per person per day in 1991 to 8.8 pounds per person per day in 2000. Hillsborough County ranks fourth in the state in waste generation rates. The largest component of Florida's MSW stream is paper (newspapers, corrugated paper, other paper) at 24.8%, followed by construction and demolition debris (23.2%) and yard trash (14%). In 2000, 5.56 million tons of MSW were processed by incineration, 7.05 million tons by recycling, and 14.87 million tons by landfilling.

Waste to energy capacity in Florida has grown from one plant in 1982 to 13 operating plants in 2002 (DEP 2002) with a total capacity of 19,176 tons per day. These plants generate about 534 megawatts of electricity daily. The waste-to-energy capacity in Florida is greater than any other state in the US. The primary reasons for the success of waste-to-energy in Florida are the vulnerability of groundwater resources to potential leachate emissions from landfills and the lack of suitable landfill space. In addition, the energy crisis of the mid-1970s led to increased reliance on alternative energy technologies. Current shortages and high costs of fossil fuels underscore the desirability of waste-to-energy compared with oil or natural gas. The largest operating waste-to-energy plant in the state is the Pinellas County Resource Recovery Facility (3,150 tons per day), followed by the Miami-Dade County Resources Recovery Facility, and Broward County's two resource recovery facilities.

The State of Florida regulates waste-to-energy plants under Chapter 403 of the Florida Statutes and Florida Administrative Code Chapter 62, which provides for the implementation of the NSPS (Subpart Eb 40 CFR 60). Under Florida law, a WTE facility must seek approval under the PPSA if the Facility will generate 75

MW or more electricity. A WTE facility that generates less than 75 MW may seek approval under the PPSA or seek individual permits. In either case, a WTE facility is subject to comprehensive and detailed review procedures to determine whether the facility will comply with all applicable local, state, and federal environmental regulations.

2.3 Non-governmental Organization Activity

Several non-governmental organizations have addressed questions regarding the utility of waste-to-energy facilities. In 2005, the U.S. Conference of Mayors (USCOM) adopted a resolution that supported the use of waste-to-energy as a component of a comprehensive solid waste disposal management strategy. The USCOM cited waste-to-energy as safe, environmentally sound, and efficient and noted significant benefits with respect to energy diversity and security in addition to the environmental benefits.

The Waste to Energy Research Council[1] (WERT) has sponsored a significant amount of research regarding the environmental, energy, and policy implications of waste-to-energy. WERT-sponsored research (published by Themelis & Millrath (2004)) reviewed the available information and concluded that waste-to-energy should be considered as a component of a renewable energy portfolio. The benefits of waste-to-energy cited by these researchers include low emissions, diversion of waste from landfilling, no impact on recycling rates, and energy generation.

2.4 Hillsborough County

Hillsborough County is located on the central west coast of Florida. The 2004 population was 1,115,960. About 2/3 of the population lives in unincorporated areas and the remainder in the incorporated cities of Tampa, Temple Terrace, and Plant City. The Hillsborough County Solid Waste Management Department (SWMD) is responsible for the operation of an Integrated Solid Waste Management System that provides for the collection, transportation, and disposition of solid waste within the County[2]. The SWMD service area consists of the unincorporated area of the County, but various services also are provided to Tampa and Temple Terrace. Facilities under the SWMD include (a) the current 1,200 ton per day waste-to-energy plant, (b) a Class I landfill, (c) two solid waste transfer stations, (d) solid waste collection, yard waste processing and community collection centers, (e) a household hazardous waste collection program, and (f) a waste tire processing program. In addition, the County operates several recycling programs, including drop-off recycling centers and programs for used oil recycling, scrap metal recycling, lead acid battery recycling, and waste reduction.

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[1] www.columbia.edu/cu/wtert
[2] www.hillsboroughcounty.org/solidwaste/disposition/home.cfm

The current waste-to-energy plant, known as the Hillsborough County Resource Recovery Facility (RRF), has been in operation since October 1987. The facility has 39 MW of electrical generating capacity and has a daily power output of about 29 MW (equivalent to the amount of electricity generated with 1,200 barrels of oil). Air pollution control equipment currently used at the plant consists of (a) a spray dryer absorber (SDA) to remove large particles, sulfur dioxide and acid gases, (b) a fabric filter (FF) to remove small particles, (c) an activated carbon injection (ACI) system to remove mercury, and a selective non-catalytic reduction (SNCR) system to reduce nitrogen oxide (NOx) emissions. Continuous monitors installed at the outlet of the boilers and inlet to the FFs are used to ensure proper combustion conditions and operation of emission controls.

The proposed RRF expansion project will increase the MSW processing capacity to 1,800 tons per day and the electrical generation capacity to 47 MW. Air pollution control equipment for the proposed fourth MWC unit will be similar to that used in the existing 3 MWC units: SDA, FF, ACI, and SNCR, in conjunction with continuous emission monitors. One notable exception is that the proposed fourth unit will use an "enhanced" SNCR system that will be capable of controlling NOx to lower levels than the existing three units. Section 3 of the PPSA application and the County's PSD application discuss these devices in greater detail and demonstrate that these systems reflect best available control technologies (BACT). Section 6 of the PPSA application demonstrates that the new MWC unit, as well as the proposed four-unit facility, will comply with the emissions requirements of the NSPS. Given these facts, it is anticipated that the facility will be able to meet EPA's environmental and public health goals with respect to pollutant emissions.

3.0 HUMAN HEALTH AND ENVIRONMENTAL IMPACTS OF WASTE-TO-ENERGY

A number of health studies and risk assessments have been conducted for waste combustion facilities. Arguably, the most important of these studies was the National Academy of Sciences/National Research Council's report on waste incineration and public health (NAS/NRC 2000) which reviewed all of the information then available on potential associations between incinerator emissions and public health[3]. Other studies, including numerous human health and environmental risk assessments have been conducted on specific facilities. These studies indicate that stack emissions from a modern MSW waste-to-energy plant regulated under the NSPS will not cause adverse health effects if it is designed and operated in accordance with current state and federal regulations. This section presents information from the scientific literature regarding potential environmental and health impacts associated with waste-to-energy plants and other waste combustion facilities.

3.1 Environmental Studies at Waste-to-Energy Plants

Monitoring studies have been conducted around numerous waste-to-energy plants and these have shown that emissions from a modern facility do not produce measurable changes in environmental chemical concentrations or the levels of chemicals in animal tissues. Samples have been collected from ambient air, soil, cow's milk, vegetation, and human blood and milk.

The EPA conducted an intensive study of ambient air quality in the area of a 240 ton per day waste-to-energy plant in Rutland, Vermont (EPA 1991). Ambient air monitoring locations for dioxins and particulate matter were selected based on wind patterns in the facility area and air dispersion modeling. The EPA concluded from the monitoring results that the facility was not the primary source of dioxins in ambient air in the vicinity of the facility. The study also found no correlation between the amount of waste combusted and ambient air particle concentrations.

Soil sampling for dioxins was conducted by scientists from the Ontario Ministry of Environment in the vicinity of a municipal solid-waste combustor in Hamilton, Ontario (McLaughlin et al. 1989). The soil sampling, conducted after 10 years of facility operation, was initiated due to airborne dioxin emissions in excess of Provincial guidelines. The 14 soil samples included 3 control sites and the predicted point of maximum impact. The authors concluded that there was no measurable change in surface soils in the plant vicinity as a result of stack emissions.

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[3] This report dealt with hazardous waste and medical waste incineration in addition to MSW combustion.

Scientists from Cornell University and the Horticultural Research Institute of Ontario analyzed vegetation around a municipal solid waste combustor for metals and PCBs (Bache et al. 1991). The incinerator had been in operation for approximately 7 years prior to sample collection. Statistical analyses of the sampling results indicated that PCBs and 5 of the 6 metals evaluated, including mercury, were not significantly higher than background concentrations.

The Connecticut Agricultural Experiment Station analyzed cow's milk samples for chlorinated dibenzodioxins and furans near a new waste-to-energy plant before and 1 year after the facility went into operation (Eitzer 1995). The data showed no statistically significant differences between pre-operational and post-operational concentrations.

The State of Massachusetts conducted a study of metal concentrations in soil around the SEAMASS waste-to-energy plant in Rochester after the facility had been operating for several years (MDEP 1996). The combustor's emissions had no detectable effect on mercury concentrations in either air or soil around the facility.

Scientists from the Institute of Toxicology in Germany collected samples of blood and human milk from persons living 8 or more years in the vicinity of a municipal solid waste combustor that had been in operation for 13 years (Deml et al. 1996). The authors concluded that living in the vicinity of the incinerator did not result in a higher body burden for dioxins and furans.

The topic of global climate change has emerged as an important environmental issue of the 21st Century. In essence, scientists believe that increased emissions of greenhouse gases associated with human activity may result in changes in the earth's climate. The most discussed consequence of this is the phenomenon of global warming – i.e., the temperature of the atmosphere will increase to the extent that there could be impacts to both the human and natural environments. Human impacts could range from a rise in coastal waters to a shift in the ability of various regions to produce crops. The potential impact of waste to energy on greenhouse gas emissions relative to other waste management activities such as landfilling has been evaluated by several scientists (Batchelor et al. 2002, Eschenroeder 2001, Thorneloe et al 2002). These studies show that waste-to-energy is associated with a reduced environmental impact compared to landfilling when potential effects on the global climate are concerned. There are several reasons for this result, however, the most significant reasons are the fact that waste-to-energy plants emit carbon dioxide, which has less of an impact on global climate than the methane emitted from landfills, and that waste-to-energy displaces the need to generate electricity from fossil fuels.

An alternative mode of evaluating health and environmental impacts is through life cycle analysis (LCA). LCA looks at the entire life cycle of a product or process. For example, it could be used to compare recycling, waste-to-energy, and landfilling for the management of different components of MSW such as paper, various plastics and other materials. Although full scale LCAs have not been performed for MSW, the available data (Dewuld & van Langenhove 2002) suggest that waste-to-energy is similar to recycling with respect to the energy impacts of the life cycle of combustible materials.

3.2 Epidemiologic Studies

Researchers at the University of North Carolina studied whether living near waste combustion plants increases the occurrence of respiratory health effects (Shy et al. 1995). The study focused on people living near a biomedical waste incinerator, a waste-to-energy plant, and an industrial furnace fueled by liquid waste. The authors concluded that there was no difference in acute or chronic respiratory symptoms or lung function between the communities living near the waste combustors and the comparison communities. The also concluded that particle and acid gas emissions from the three waste combustors contributed trivial amounts to air concentrations in adjacent neighborhoods. In a follow-up study (Hu et al. 2001), the authors again found no significant associations between exposures for any of the waste combustion facilities and lung function tests. One result for the waste-to-energy facility did show a statistically significant relationship for lung function but this result was only observed for one of the three years of the study and when using only one of the four different types of exposure estimation methods.

The National Academy of Sciences (NAS/NRC 2000) evaluated available epidemiological data regarding waste incineration and health effects in surrounding communities and concluded that waste combustion facilities that are in compliance with EPA's Maximum Achievable Control Technology (MACT) requirements pose minimal or negligible risks to surrounding communities. NAS also noted that for modern, well-controlled waste combustors, risk assessments show that potential cancer effects even for the most highly exposed persons in the surrounding areas are generally small to negligible.

Two recent health studies have been published in Europe. Although European standards for waste-to-energy plants are similar to those in the United States, there are differences with respect to the implementation dates, methods of calculating the emissions, and the emission levels themselves. Thus, the European studies should be used only in a supporting or confirmatory sense to the U.S. studies. Rabl and Spadaro (2002) reviewed the potential for human health and environmental impact assuming all MSW was incinerated under the new European regulations that were promulgated in December 2000. These authors looked at several different indicators of environmental performance including:

- Increase in chemical concentration compared to background,

- Increase in chemical concentration compared to health guidelines,
- Health risks of various pollutants compared to each other,
- Increased damage cost (monetary value of health impacts) compared to the cost of incineration itself,
- Difference in emissions compared to other emission sources, and
- Difference in years of life lost due to MWCs compared to other risks of everyday life.

They concluded that the health impacts of MSW incinerators were insignificant using any of these comparisons as long as the European standards were met.

Enviros/University of Birmingham (2004) undertook a systematic review of epidemiological studies of the public health effects of waste incinerators. Specifically, these investigators looked at evidence for ill-health in people who might possibly be affected by emissions from MSW processes. They concluded that health effects in people living near waste management facilities were either generally not apparent or the evidence was not consistent or convincing.

3.3 Recent Environmental Monitoring Studies

Detailed environmental monitoring studies have been undertaken at two Covanta waste-to-energy facilities – the Montgomery County facility in Dickerson, Maryland, and the Union County facility in Rahway, New Jersey. Since Covanta operates the Hillsborough County RRF, the information gained from these studies can yield useful insights about Covanta's operations and the Hillsborough County facility.

The Montgomery Country facility consists of three 600 TPD combustion units. The air pollution control equipment and electrical generating capacity of the Montgomery County facility are similar to those at the Hillsborough County facility. Each unit has a separate flue and is equipped with a dry scrubber and fabric filter baghouse, direct lime injection into the furnace, ammonia injection at the top of the furnace, and activated carbon injection at the scrubber inlet (Rao et al. 2003). The Montgomery County facility has been operating since 1995. Although the population of Montgomery County is approximately 800,000 people, the land use around this facility is semi-rural, and includes residential units, agricultural (including dairy) operations, and fishery resources. Roy F. Weston, Inc. was contracted by Montgomery County to conduct an ambient air monitoring study (Weston 1998) and a non-air monitoring study (Weston 2000).

Weston (1998) evaluated both air toxics and meteorologic data before the facility went into operation (pre-operation) and after the facility had been operating for approximately two years (post-operational). Air toxics monitoring included dioxins/furans, polycyclic aromatic hydrocarbons, polychlorinated biphenyls, formaldehyde, arsenic, cadmium, chromium, lead, mercury, and nickel. Particulate matter was also monitored. Numerous long-term and short-term measurements were obtained. The number of post-operational measurements ranged from 20 for PCBs to 79 for dioxins and furans. The primary monitoring site was situated near the maximum point of annual ground-level air and dry deposition concentrations, as predicted by air dispersion/deposition modeling. Weston concluded that no major differences in air quality were observed at any operating sites when pre-operational and post-operational measurements were compared. Additionally, Weston concluded that the facility did not have a significant impact on air quality in the surrounding region.

The non-air media report (Weston 2000) evaluated chemical concentrations in soil, earthworms, cow's milk, forage/hay, vegetables, surface water and sediment, and fish tissue. The monitoring locations were selected based on local meteorology, air modeling, and the results of a human health risk assessment. Pre-operational sampling was conducted in 1994 and post-operational sampling was conducted in 1996 and 1998. The samples were analyzed for dioxins/furans, PAHs, PCBs, arsenic, beryllium, cadmium, chromium, lead, mercury, and nickel. The results showed that there were no statistically significant or consistent patterns detected between the pre-operational and post-operational phases of the study. Many of the environmental media sampled during the post-operational phase had concentrations approximately equivalent to or less than the pre-operational conditions. In some media, the concentrations increased; however, the investigators felt that this change was a reflection of scientific uncertainty rather than an actual impact. The study concluded that the operation of the facility had not caused unacceptable increases in target compound concentrations.

The Union County, New Jersey facility is a 1,440 TPD resource recovery facility that has been operating since 1994 in Rahway. The land use around the facility is highly industrial, dominated by heavy industry and transportation uses. The Union County Utilities Authority contracted with Paulus, Sokolowski and Sartor, Inc. (PSS) and HDR Environmental Engineering, Inc. (HDR) to conduct on-going monitoring studies in the air and other media around this facility (PSS 1993, PSS 1997, HDR 1998). As with the Montgomery County facility, these studies consisted of both pre- and post-operational monitoring. The chemicals of potential concern included PCBs, dioxin (2,3,7,8-TCDD), arsenic, beryllium, cadmium, chromium, lead, mercury, and nickel. In addition to ambient air, soil, sediment, surface water, food crops (lettuce, radishes, tomatoes) and fish have been evaluated periodically, both pre- and post-operationally. The post-operational data show that the chemicals of potential concern are present at levels consistent with those anticipated for an urban industrial environment. Additionally, the reports suggest that the post-operational samples are consistent with the pre-operational samples. This program is continuing.

The results of these two recent studies, based on operating Covanta facilities similar to the Hillsborough County RRF, show that the RRF facilities do not cause any discernable impact on the local environment with respect to the chemicals that are considered to be the most significant trace components of waste-to-energy emissions. These results are consistent with the results that are reported elsewhere in the literature. They suggest that similar results would likely be obtained in Hillsborough County.

3.4 Risk Assessments

Risk assessments are formal scientific evaluations of information regarding the potentially hazardous effects of exposure to chemicals in the environment. Risk assessments of waste-to-energy facilities are often used to determine if these facilities are capable of meeting regulatory or statutory goals with respect to protection of human health and the environment. Although risk assessments of waste-to-energy plants have been performed for several decades, they have become standardized since the early 1990s (Hattemer-Frey & Travis 1991, CARB 1990). This standardization allows risks associated with different regulatory schemes and air pollution control technologies to be extrapolated from plant to plant. Most recently, risk assessors have further standardized the process by relying on EPA guidelines for performing hazardous waste incinerator risk assessments (EPA 1998a). These assessments are based on a highly standardized approach that allows regulators to readily use their results to make environmental health decisions.

The results of recent comprehensive risk assessments conducted for the waste-to-energy facilities in Montgomery County, Maryland, the City of Spokane, Washington, and Lee County, Florida, also provide insight into the potential risks associated with the Hillsborough County facility (Rao et al. 2003, Pioneer 2001, Clement 1992, CPF 2002). These risk assessments are pertinent because these facilities are state-of-the-art plants operated in accordance with the NSPS, as is the Hillsborough County facility.

3.4.1 Montgomery County, Maryland

The Montgomery County facility risk assessment relied on measured stack emission rates since 1995 and on-site meteorological data to calculate potential risks through multiple exposure pathways for 19 selected chemicals of potential concern, including PCDD/PCDFs and mercury. As noted above, this facility is operated by Covanta and it has similar electrical generating capacity and equipment as the Hillsborough facility. Risks for the Montgomery County facility were calculated for a typical resident at two maximum impact locations, as well for a subsistence farmer, a subsistence fisherman, and a pond fishing scenario. The excess lifetime cancer risks were calculated to range from 14 to more than 400 times less than the one in 100,000 (1E-5) target cancer risk level. The predominant compounds contributing to the cancer risks were PCDDs/PCDFs. The non-cancer hazard index values were calculated to be equivalent to or below a target hazard index value of 1, with mercury accounting for the majority of the risk results. Based on the risk assessment, it was concluded that no adverse non-cancer health effects are expected, and that cancer risks are lower than 1 in one million, as a result of exposure to facility-related emissions (Rao et al. 2003).

3.4.2 Spokane, Washington

The Spokane, Washington facility is comprised of two MWC units, each capable of managing roughly 800 TPD of municipal solid waste. The air pollution controls on each unit consist of lime slurry spray dryer absorbers followed by fabric filter baghouses. A carbon injection system also is used. An anhydrous ammonia, thermal DeNox, selective non-catalytic system is also used for nitrogen oxides control.

The risk assessment utilized 10 years of measured emissions data to calculate potential risks through multiple exposure pathways at a maximum off-site impact point. Risks were evaluated at this point for a typical resident, a subsistence farmer, a subsistence fisher and infants. The results were determined to be below Washington state target risk levels (i.e., a non-cancer hazard index below 1 and an excess lifetime cancer risk below one in one hundred thousand). The predominant chemicals contributing to the non-cancer risk results were hydrogen chloride via inhalation and methyl mercury via ingestion of fish. The predominant compounds contributing to the cancer risks were PCDDs/PCDFs due to ingestion of animal products.

3.4.3 Lee County, Florida

The risk assessment performed for the Lee County Solid Waste Energy Recovery Facility (ERF) is particularly relevant to the proposed Hillsborough RRF expansion for a number of reasons. There are similarities between these two facilities in waste stream composition, emission controls, land use, climate, and state regulatory programs. In addition, the Lee ERF project involved a 600 TPD expansion of an existing facility, unlike the Montgomery County or Spokane projects, which were newly constructed. In addition, the Lee County and Hillsborough County combustion facilities are both operated by Covanta. These similarities mean that the Lee County risk assessment, which will be presented in the remainder of this section, is uniquely applicable to the Hillsborough County project and can indicate the likelihood of potential risks associated with the Hillsborough County proposal.

Municipal solid waste from Lee County and Hendry County is processed at the Lee County Solid Waste Energy Recovery Facility, which began operation in 1994. Lee County proposed to add a third combustion unit to the ERF to accommodate excess municipal solid waste that is being generated. A series of studies over more than a 10 year period were used in the Lee County ERF risk assessment process.

Two studies conducted in 1992 evaluated the potential human health and ecological impacts of the currently operating Lee County ERF. These studies concluded that construction and operation of the facility would not adversely affect humans or threatened or endangered species. Lee County also initiated a biological monitoring program in 1993 to determine if operation of the facility was correlated with mercury levels in aquatic life. The program results suggest that mercury concentrations in aquatic life in the area are generally similar to the levels typical of South Florida and not associated with operation of the ERF.

The risk assessment for the expanded facility relied on air dispersion and particle deposition modeling conducted to calculate air concentrations and deposition rates associated with the proposed ERF (i.e., operation of the two existing units plus the proposed third unit). This information was then used in EPA environmental fate and transport models to calculate chemical concentrations in soil, produce, surface water, beef and fish. Air concentrations were calculated for all of the chemicals regulated under the facility's air permit. Mercury and polychlorinated dibenzodioxin and dibenzofuran (PCDD/PCDF) concentrations were calculated for the other environmental media. The model inputs included a substantial amount of local site-specific data. Overall, the models and input assumptions are expected to provide conservative (i.e., health protective) calculations of potential environmental concentrations.

The calculated environmental concentrations associated with stack emissions from the proposed three-unit Lee County ERF were compared with typical environmental levels. These comparisons showed that the environmental concentrations associated with the proposed three-unit ERF are consistent with or below typical environmental concentrations, thus the proposed expansion will not measurably increase the typical concentrations of chemicals in the environment.

The human health risk assessment was conducted following current EPA guidance and is summarized below:

- Potential human health risks were evaluated in two types of risk assessments. An inhalation risk assessment was performed for all chemicals currently regulated under the facility's air permit using permit limit-based emission rates. A more refined multiple pathway risk assessment was also performed for mercury and PCDDs/PCDFs using emission rates based on long-term stack gas measurements.

- In the inhalation risk assessment, inhalation exposures were calculated for two hypothetical groups of people, an adult resident and a child resident. In the multiple pathway risk assessment, exposures were calculated for 12 different hypothetical groups of people, including adults, children and infants. The exposure pathways considered in the multiple pathway assessment were inhalation, soil ingestion, ingestion of produce, beef and fish, and ingestion of breast-milk.

- A variety of evaluations were performed in the human health risk assessment. Chronic long-term excess lifetime cancer risks were found to be at least 10 times lower than EPA's combustion risk assessment target risk level of $1x10^{-5}$ (one in 100,000) and did not exceed Florida's common target risk level of $1x10^{-6}$ (one in 1,000,000). Chronic long-term noncancer effects were predicted not to occur, with a large margin of safety (i.e., calculated exposures were at least 10 times lower than the common regulatory noncancer target exposure levels). An analysis of short-term acute inhalation adverse effects showed that these effects will not occur with a large margin of safety (i.e., calculated short-term air concentrations were at least 100 times lower than health-based reference air concentrations).

An ecological risk assessment was also conducted in accordance with EPA guidelines and is summarized below.

- The ecological assessment focused on mercury and PCDDs/PCDFs which, among the compounds present in MSW combustion facility emissions, are expected to be of greatest potential concern to aquatic and terrestrial wildlife of the area.

- The ecological risk assessment evaluated potential impacts to wildlife species that were considered to be at greatest risk based on habitat use, exposure potential and population status. The species selected for evaluation consisted of aquatic life, the wood stork, the snail kite, the white pelican, and the river otter.

- Adverse impacts to aquatic and terrestrial wildlife were predicted not to occur, with a large margin of safety (i.e., exposures to ecological receptors were at least 10 times lower than comparison toxicity reference values).

In conclusion, the risk assessment showed that potential risks from stack emissions from the expansion of the Lee County ERF, in its proposed configuration with three combustion units, were below regulatory and other target risk levels for both human health and ecological receptors. Additionally, the environmental concentrations in air, soil, surface water, beef and fish associated with emissions from the proposed three-unit ERF facility were calculated to be consistent with or below typical environmental levels and would not measurably increase the typical concentrations of chemicals in the environment.

3.4.4 Lessons Drawn from Risk Assessments

Although there are site-specific differences among these three facilities, there are many common threads both from risk assessment and regulatory points of view. First and foremost, all three of these facilities were designed to comply with the

NSPS. All contain state-of-the art emission controls that are designed to fit the criteria for maximum achievable control technology. Since EPA's overall objective in promulgating the NSPS was protection of human health and the environment, it should be anticipated that facilities compliant with the NSPS would have a negligible environmental health impact. Second, the risk assessments show that the risks associated with operating these facilities are below risks of concern to regulatory and public health agencies. Third, the results of the risk assessments show that, although the risks are low, they are dominated by exposure to dioxins and furans as potential human carcinogens and mercury as a neurotoxin. Last, the risk assessments also show that indirect exposure pathways, such as the consumption of fish, are the most significant sources of exposure, regardless of the absolute value of the risks.

4.0 SIGNIFICANT CHARACTERISTICS OF THE PROPOSED EXPANSION

4.1 Waste Composition

Hillsborough County has a very aggressive recycling program and solid waste management program that reduces the introduction of unwanted materials in the solid waste at the RRF, thereby helping to reduce unwanted emissions.

The waste composition is controlled in part through programs designed to prevent unwanted materials from reaching the RRF. For example, the RRF does not accept for combustion a wide variety of wastes, including: lead acid batteries, hazardous waste, nuclear waste, radioactive waste, sewage sludge, explosives, beryllium-containing wastes, untreated biomedical waste, segregated loads of biological waste, mercury containing devices, and materials prohibited by state or federal law. The County's successful lead acid battery recycling program promotes drop-off of batteries at community collection centers in the area, and has resulted in the recycling of roughly 5,000 batteries per year. The household chemical collection program also encourages delivery of household chemicals (paints, fertilizers, etc.) at household community collection centers. Items received at the household chemical collection sites are either managed as a hazardous waste or recycled. Virtually all of the tires received in the County's waste disposal system are shredded in a waste tire processing facility and do not enter the RRF. The County's used oil recycling program consists of seven drop-off locations for use by residents, and recycles approximately 26,000 gallons of used oil per year. Roughly 1,849 tons of scrap metal are recycled per year in the County. Moreover, the County sponsors a waste reduction program through the Hillsborough County Cooperative Extension Service. The County's solid waste profile program further ensures that unacceptable waste will not enter the RRF by requiring potential customers to submit information on waste to be delivered.

At the RRF facility, waste deliveries are monitored in several ways. Access at the scale house is controlled through initial screening of solid waste deliveries, including notation of the customer and type of waste. On the tipping floor of the RRF, a County employee (spotter) inspects waste loads as they are dumped to ensure that no unacceptable items are present.

Hillsborough County manages an extensive program that collects and recycles a variety of materials, including newspaper, glass, aluminum cans, plastic bottles, steel cans, yard trash, tires, and white goods (e.g., refrigerators, dishwashers). Annually, the County recycles over 500,000 tons of solid waste. The County achieved a 32% recycling rate in 2002. The County also provides support to the not-for-profit Recycling Task Force (RTF), which coordinates county-wide recycling activities. The RTF includes representatives from the County, the cities of Tampa, Plant City and Temple Terrace, the School Board, the Cooperative Extension Service, local commercial recyclers and haulers, local businesses, environmental and civic groups, and interested citizens. Recycling not only reduces the amount of waste requiring disposal, but also can increase the heating value of waste fed into the RRF by removing low-Btu materials from the waste stream (e.g., glass and metal).

4.2 Environmental Controls

The environmental controls in use at the Hillsborough RRF, and proposed for the County's fourth unit, are essentially identical to those in place at the Lee County RRF. These controls consist of a combination of air pollution control equipment and operating practices that reflect best available control technologies and minimize potential emissions of concern. The pollution controls at the Hillsborough and Lee County facilities include the following: spray dryer absorbers with fabric filters to remove particles, sulfur dioxide and acid gases; activated carbon injection to remove mercury; and selective non-catalytic reduction to reduce NOx emissions. The APC combination of spray dryer absorber, fabric filter and activated carbon injection have also been shown to reduce emissions of dioxins and furans.

4.3 Emissions

Emission limits have been proposed for the expanded Hillsborough RRF, as described in the County's PSD and PPSA permit applications, based on consideration of the air pollution control equipment to be used (as determined through a Best Available Control Technology (BACT) evaluation), the NSPS, experience with the existing Hillsborough combustion units, and emission limits that have been most recently specified for new municipal waste combustor units in the U.S. The MSW combustion units most recently permitted in the U.S. consist of the Camden County, New Jersey RRF (a 350 TPD unit), the Harrisonburg, Virginia RRF (a 100 TPD unit) and the Lee County, Florida RRF (a 600 TPD unit). Among these three, the new unit recently permitted at the Lee County RRF is most similar to the unit being proposed for Hillsborough and, in fact, is essentially identical with respect to operation, equipment, and general location in the U.S.

The protectiveness of the emission limits proposed for the Hillsborough facility can best be evaluated by comparison with the NSPS and the Lee County facility, which is most similar to the Hillsborough unit and the most recently permitted MSW combustion unit in the U.S. Table 4-1 presents the existing and proposed emission limits for the Lee County RRF and the Hillsborough County RRF, along with the NSPS for new MWC combustion units. As can be seen from this table, the emission limits proposed for the new MWC unit at Hillsborough are equivalent to or

Table 4-1
Comparison of Emissions Limits

Facility Name:	Lee County Waste-to-Energy Facility, FL		Hillsborough County Resource Recovery Facility, FL			
Combustion Unit Type:	New 3rd Unit (291.5 MMBtu/hr)	Existing two units (275 MMBtu/hr)	New 4th Unit (260 MMBtu/hr)	Existing three units (150 MMBtu/hr)	NSPS Subpart Eb (40 CFR 60)	NSPS Subpart Cb (40 CFR 60.33)
MSW Throughput:	600 TPD	600 TPD	600 TPD	400 TPD		
Compound	Emission Limit (c)	Emission Limit Per Unit (d)	Emission Limit (a)	Emission Limit Per Unit (b)	Emission Limit (a)	Emission Limit (e)
Particulate Matter	20.6 mg/dscm[1] (for both PM and PM10)	24 mg/dscm (0.01 gr/dscf) (for both PM and PM10)[1]	20.6 mg/dscm (0.009 gr/dscf) (for both PM and PM10)[1]	27 mg/dscm (0.012 gr/dscf)[1]	24 mg/dscm (0.01 gr/dscf)[1]	27 mg/dscm (0.011 gr/dscf)[1]
Nitrogen Oxides	110 ppmdv (12-mo rolling average)[1]; 150 ppmdv (24-hr average)[1]	180 ppmdv (24-hr average)[1]	110 ppmdv subsequent years 150 ppmdv (24-hour average)[1]	205 ppmdv[1]	180 ppmdv 1st year; 150 ppmdv subsequent years[1]	
Sulfur Dioxide	26 ppmdv or 80% control[1]	30 ppmdv (24-hr average) or 80% control[1]	20 ppmdv or 80% control[1]	29 ppmdv or 75% control[1]	30 ppmdv or 80% control[1]	31 ppmdv or 75% control[1]
Carbon Monoxide	80 ppmdv (30-day rolling avg.); 100 ppmdv (4-hr avg.)[1]	100 ppmdv (4-hr average)[1]	80 ppmdv (12-mo rolling average) 100 ppmdv (4-hr average)[1]	100 ppmdv[1]	100 ppmdv (4-hr average)[1]	
Cadmium	--		0.02 mg/dscm	0.04 mg/dscm[1]	0.02 mg/dscm[1]	0.04 mg/dscm[1]
Mercury	0.028 mg/dscm or 85% control[1]	0.07 mg/dscm or 85% control[1]; 0.0379 lb/hr	0.028 mg/dscm or 85% control[1]	0.07 mg/dscm or 85% control[1]	0.08 mg/dscm or 85% control[1] Florida limit 0.07 mg/dscm	0.08 mg/dscm or 85% control1
Lead	0.2 mg/dscm[1]	0.165 lb/hr (0.66 tons/yr)	0.2 mg/dscm[1] (0.243 tons/yr)	0.44 mg/dscm[1]	0.2 mg/dscm[1]	0.44 mg/dscm[1]
Arsenic	--	0.0025 lb/hr (0.01 tons/yr)				
Beryllium	--	3.7E-5 lb/hr (1.47E-4 tons/yr)	1.73E-4 tons/yr			
Hydrogen Chloride	25 ppmdv[1] or 95% control	25 ppmdv or 95% control[1]	25 ppmdv or 95% control[1]	29 ppmdv or 95% control[1]	25 ppmdv or 95% control[1]	
H_2SO_4	15 ppmdv[1]	9.85 lb/hr (39.3 tons/yr)	15 ppmdv[2] (74.4 tons/yr)	0.072 gr/dscf[2] or 0.2 lb/ton	--	
Hydrogen Fluoride	3.5 ppmdv[1]	5 ppmdv[1]	3.5 ppmdv[1]	6.74 ppmdv[1]	--	
PCDD/PCDF	13 ng/dscm (total)[1]	30 ng/dscm (total)[1]	13 ng/dscm (total)[1]	30 ng/dscm (total)[1]	13 ng/dscm (total)[1]	30 ng/dscm (total)[1]
Volatile Organic Compounds		37 ppmdv[1] (5.8 lb/hr, 23 tons/yr)	0.1 lb/ton, 12 tons/yr	0.2 lb/ton (or 0.01 gr/dscf[2])		
Visible Emissions						
Fugitive PM (ash)						
Metals	20.6 mg/dscm[1]					
Ammonia	50 ppmdv[1]	50 ppmdv[1]	50 ppmdv[1]	--	--	

(a) Data in this column obtained from Table 2-2, Table 2-3 and Table 3-3 of Air Permit Volume III in Hillsborough County Expansion Permit Application
(b) Data in this column obtained from Table 3-3 of Air Permit Volume III in Hillsborough County Expansion Permit Application
(c) Data in this column obtained from Table 3-1 of Air Permit Volume III in Hillsborough County Expansion Permit Application and Lee County Solid Waste Energy Recovery Facility permit (dated 10/8/2003)
(d) Data in this column obtained from Lee County Solid Waste Energy Recovery Facility permit (dated 10/8/2003)
(e) The NSPS in Subpart Cb apply to large MWC units that were constructed before December 19, 1995.

[1] Limits shown are corrected to 7% oxygen.
[2] Limits shown are corrected to 12% CO2.

-- = no limit.

more stringent than both the NSPS and permit limits in place for the additional Lee County unit. All of the proposed emission limits for the fourth unit at Hillsborough are more stringent than the comparable limits for the existing three units at the facility.

Stack test measurements collected over recent years at the existing Hillsborough facility demonstrate that emissions of the two classes of compounds of most concern to human health and the environment, dioxins/furans (PCDD/PCDFs) and mercury, are and will continue to be maintained below the facility's proposed permit limits. [4]

[4] After the retrofit of the facility in 1999, all of the stack tests for dioxin demonstrated compliance with the MACT standard. After the retrofit, the MACT emission limit for mercury was exceeded once (July 21, 1999) in Unit 3, but this event appears to be an anomaly. All of the subsequent stack tests for mercury emissions from Unit 3, including tests conducted on July 29-30, 1999, demonstrated compliance with the MACT standard. All of the stack tests for mercury emissions from the facility's other MWC units also demonstrated compliance with the MACT standard.

5.0 SITE-SPECIFIC CHARACTERISTICS OF THE FACILITY

5.1 Project Environment

The Hillsborough County RRF is located in southwest Florida, several miles east of Tampa, at 350 N. Falkenburg Road (see Figure 5-1). The area is characterized by low and level terrain and a mild and often humid climate.

5.2 Land Use

The RRF is located on a 50.4 acre site within a 353 acre tract of land (hereafter referred to as the "property") that is owned by Hillsborough County. The property includes the existing RRF and a water treatment facility, and is zoned for "Planned Development" (PD-1) to accommodate multi-use public developments, such as the RRF and the water treatment plant. The property is located within an Urban Service Area (USA) identified in the County's future comprehensive land use plan as a location where the County plans a substantial amount of urban infrastructure.

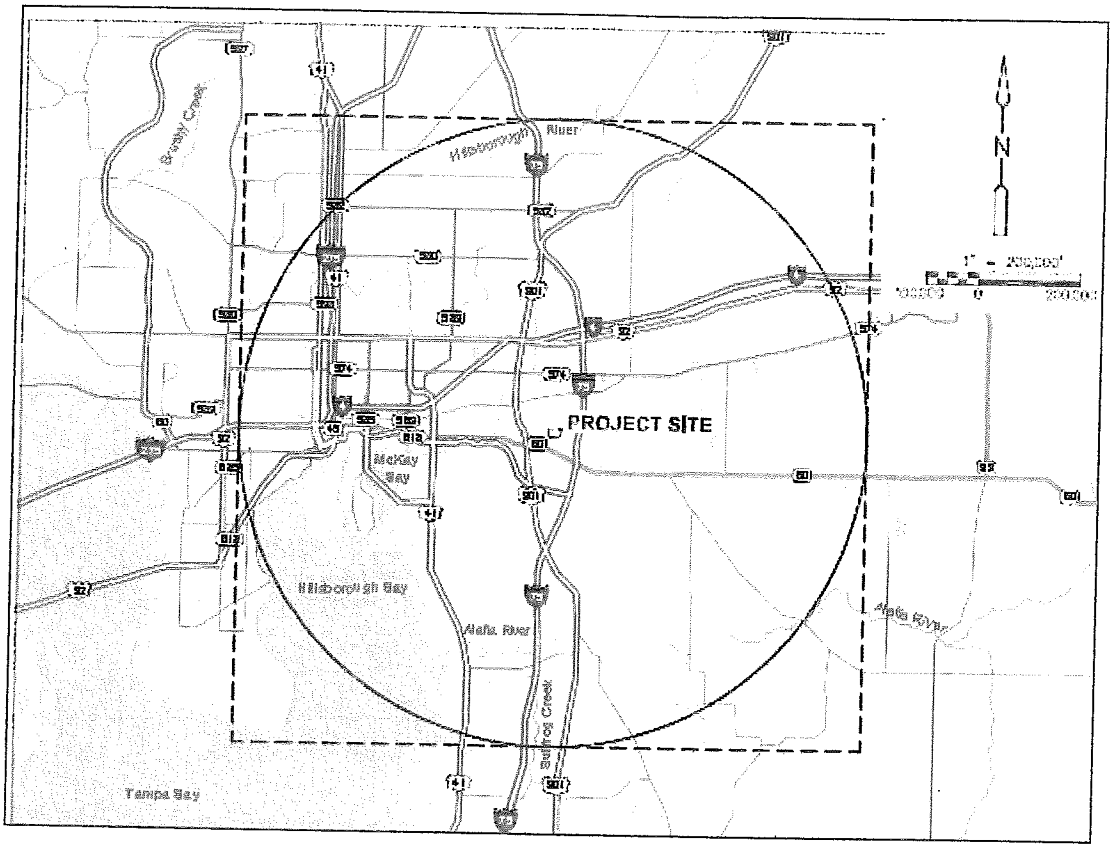
On its immediate borders, the property is surrounded to the north and west by land owned by Hillsborough County and Tampa Bay Water. To the north, on Hillsborough County property, is the Falkenburg Jail, County Animal Services and the District 2 Sheriff's office. The Seaboard System railroad borders the property to the south, a Tampa Electric Company (TECO) electrical transmission line easement borders on the west, and Falkenburg Road borders the property to the east (see Figures 5-2 and 5-3).

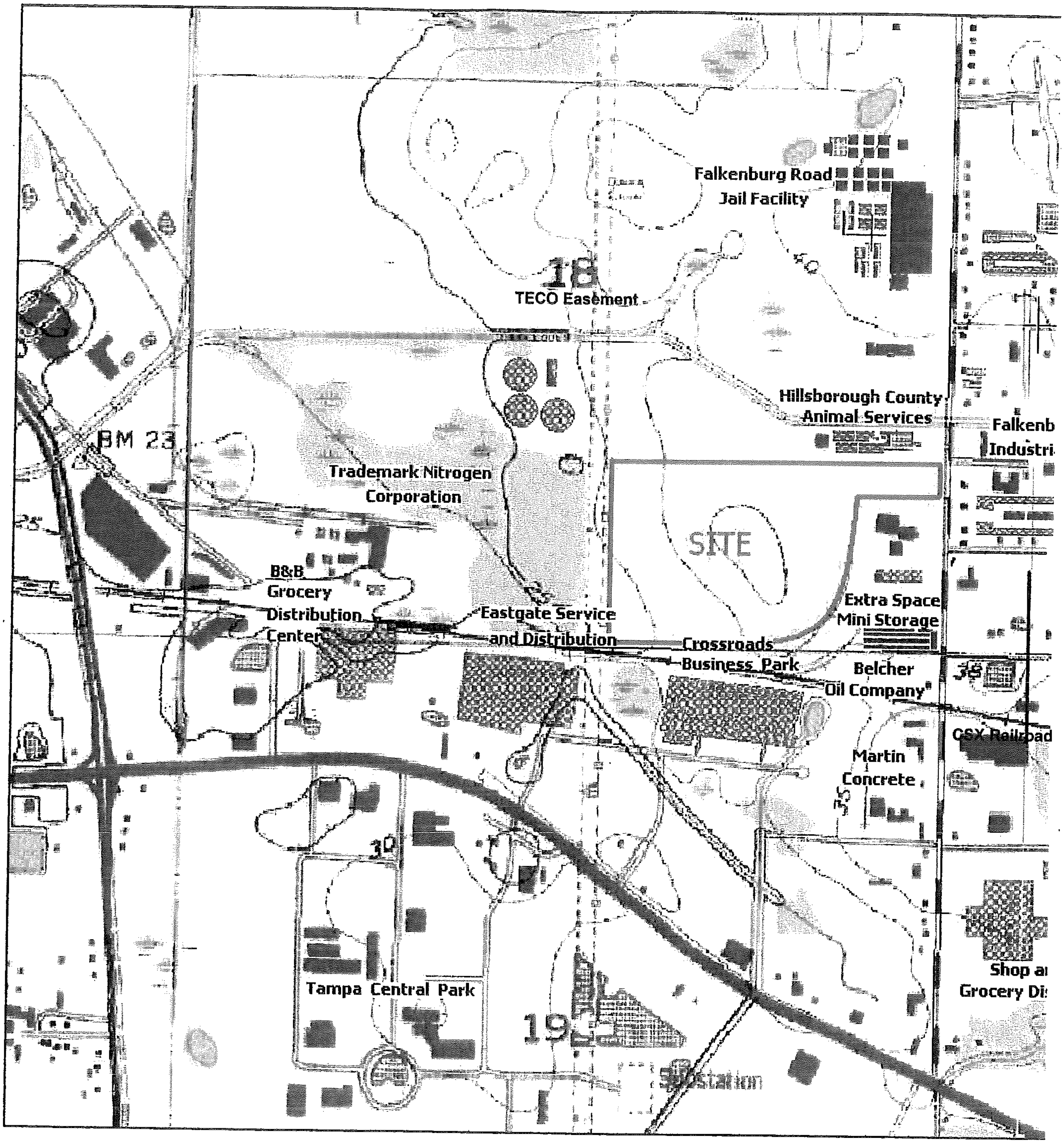
Almost all the land within 1 mile (1.6 kilometers) of the property is zoned or currently used for commercial and industrial purposes. The nearest residential area is located east of Falkenburg Road in Woodberry Estates, about ½ mile away (about 0.8 km) from the property boundary and about 0.8 miles (about 1.3 km) from the RRF. Residential development is more prevalent beyond 2 miles from the facility.

5.3 Human Receptors

The population of Hillsborough County has grown over the past decade in similar fashion to other parts of the state. The County-wide population was estimated by the U.S. census to grow by about 1% from 2000 (population 998,948) to 2004 (population 1,101,261). Based on 2000 census data, the population in census tracts partially or wholly within 5 miles of the RRF was 157,572 (about 16% of the County population). The dominant types of employment in the County include professional and business services, other services, and healthcare and social

Figure 5-1
General Facility Area



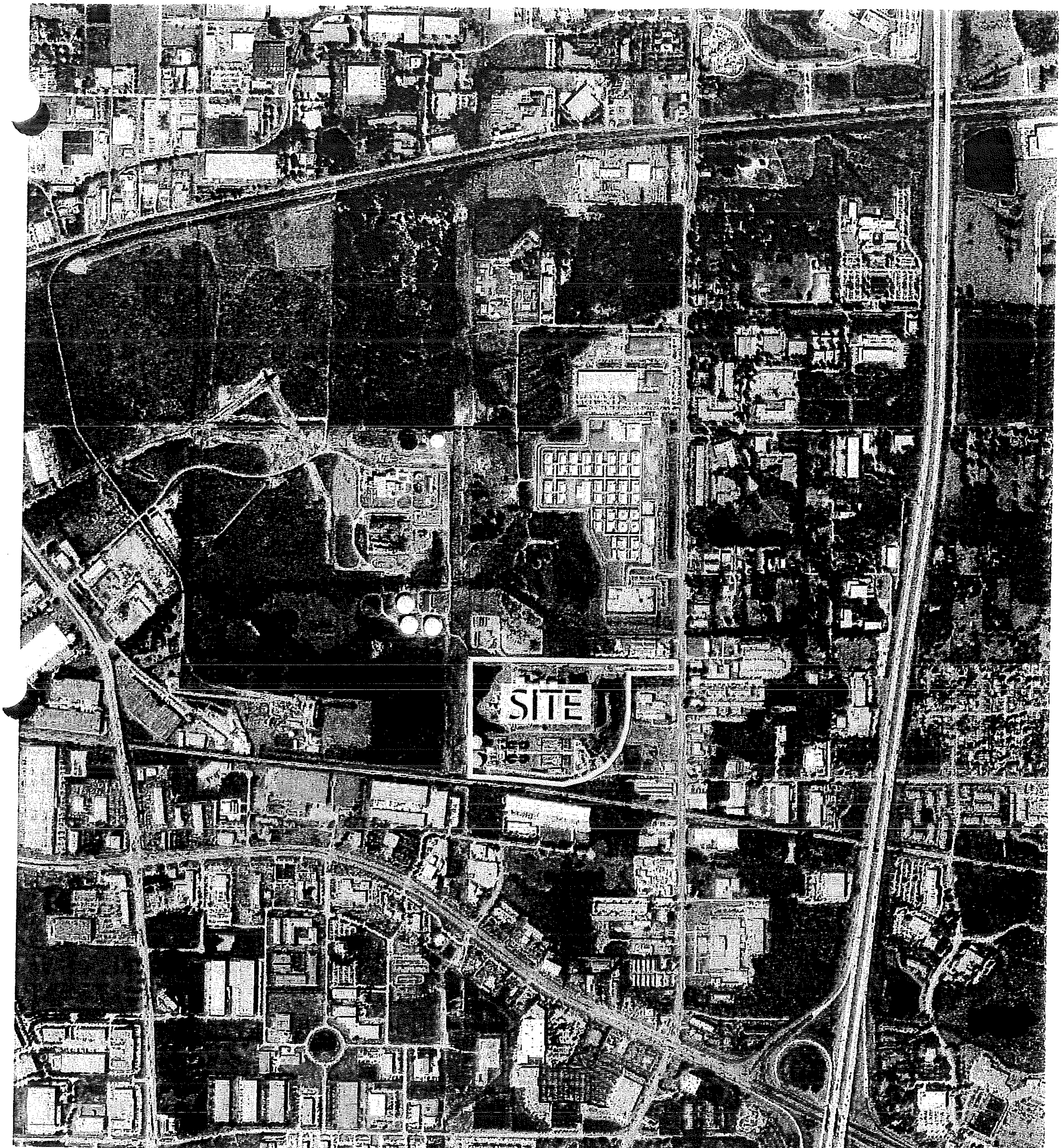


N

Hillsborough County
Energy Recovery Project

Scale
NTS

Figure 5-2
Facility Location



Hillsborough County Energy Recovery Project

Scale

0 1500'

N

Figure 5-3
Aerial Photograph of Site

Aerial Taken (11/2003)

assistance, accounting for about 23%, 23% and 9%, of the workforce, respectively. Roughly 2% of the labor force is employed in agriculture, natural resources and mining.

As noted above, most of the land in the facility vicinity is zoned, or used, for commercial and industrial activities. Residential areas do not occur within about 0.8 miles from the RRF and are limited in extent within 2 miles. In addition to residential, commercial and industrial land uses, County land is used for agricultural purposes. According to the Florida Agricultural Statistics Service, there were about 2,900 farms in Hillsborough County in 2002, down 19% from the number present in 1997. The highest market value agricultural commodities in the County in 2002 were fruits/berries. The top livestock type was cattle and the top crop item was oranges, a predominance that also applies to Lee County, Florida. A driving/windshield survey was conducted within an 8-mile radius of the Hillsborough RRF to determine the specific types of agricultural and livestock land uses in this part of the County. The windshield survey identified a variety of agricultural and livestock land uses, consisting of cattle grazing at 17 locations, two dairy farms, 23 orange groves, nine strawberry farms and one tomato farm. Cattle grazing was observed in various locations to the south, northwest and north of the facility at least 4 miles away. The orange groves and strawberry farms were only to the north and northeast of the facility and at least 4 miles away. The two dairy farms were further from the facility than the cattle grazing areas, located 5.7 miles to the south-southwest and 5.3 miles to the north. The tomato farm was located about 8 miles to the northeast of the facility. Home gardens may also be maintained by residents in the County.

Fishing is a popular activity in Florida, including Hillsborough County. In general, fishing may occur in rivers, canals, lakes and ponds. The water bodies closest to the RRF that may be used for fishing include the Hillsborough River, Palm River, Six Mile Creek (which flows into Palm River), the Alafia River, a variety of lakes including Woodbury, Gornto, Chapman, and Tenmile, and ponds scattered throughout the facility area. Fishing is prohibited in the Tampa Bypass Canal, which flows into Six Mile Creek.

Groundwater is used for domestic, industrial, irrigation and public water supply purposes in the County. Roughly two dozen municipal supply wells draw groundwater from areas within 5 miles of the facility; the nearest of these wells is about 1.5 miles east of the RRF facility. The majority of the wells draw from the deep Floridan aquifer with a much smaller percentage using water from the surficial aquifer. In most areas of the County, including the RRF facility vicinity, the surficial aquifer is underlain by a clay layer that separates the surficial aquifer from the Floridan aquifer.

5.4 Ecological Receptors

A detailed description of the ecology and vegetation in the RRF facility area is provided in Volume I of the PPSA application. The following paragraphs provide a brief summary of the information in the PPSA application.

There are no federally-designated wildlife refuges or critical habitats within 5 miles of the RRF site. While portions of the site appear to be within the habitat range of federally-listed species, including the Florida golden aster and wood stork (endangered), and the bald eagle, eastern indigo snake and Florida scrub jay (threatened), critical habitats have not been defined within the facility area for any of these species. Appendices to the PPSA application list wildlife species in various habitats in the general facility area. Species discussed in some detail in the PPSA application that are common to Hillsborough County and southwest Florida include the bald eagle, the burrowing owl, the Florida sandhill crane, the Southeastern American kestrel, a variety of wading birds, American alligators, gopher tortoises, Sherman's fox squirrel, the Florida scrub jay and the black bear. The PPSA application indicates that the proposed project would not create conflicts with any species listed by the U.S. Fish and Wildlife Service and the Florida Game and Fresh Water Fish Commission, nor would it have any effects on area ecology. The impact assessment in the PPSA application also concludes that the RRF expansion project will not have impacts on existing non-aquatic species populations, relative abundance, species composition, distribution or dominance, or gradient distribution.

A detailed description of vegetation and land uses in the facility area is provided in Volume I of the PPSA application. As noted in that document, there are no natural wetlands located within the facility site, although there are two conveyance ditches along the northern and eastern boundary. These ditches are highly disturbed and contain predominantly nuisance species, but they do meet the regulatory definitions for wetlands. The conveyance ditches connect on-site retention ponds with outflow ditches off-site.

6.0 RISK ASSESSMENT

This section presents a description of the methods used for, and results of, a risk assessment of the proposed Hillsborough RRF. The risk assessment was composed of two parts, a multiple pathway human health risk assessment and an ecological evaluation of the potential impacts of facility emissions. The risk assessment evaluated the potential impacts of the RRF with all four MWC units in operation on a continuous basis (8760 hours per year).

6.1 Multiple Pathway Human Health Risk Assessment

A multiple pathway risk assessment was conducted for the proposed expansion of the Hillsborough RRF, focusing on mercury and PCDDs/PCDFs, the compounds that, as discussed earlier in this report, have been shown to dominate the results of other solid waste combustion facility risk assessments. This assessment for Hillsborough County RRF was conducted according to guidance recommended by EPA (1998a) and it followed the same multiple pathway risk assessment methodology applied in the Lee County RRF risk assessment (CPF 2002).

6.1.1 Hazard Identification

The risk assessment evaluated the potential for long-term chronic risks, both excess lifetime cancer risks and the potential for noncancer effects. Toxicological criteria for both cancer and chronic noncancer effects were compiled for mercury and PCDDs/PCDFs from EPA's Integrated Risk Information System (IRIS) and other sources cited in EPA's guidance for risk assessments of hazardous waste combustors (EPA 1998a). These criteria are presented Table 6-1.

6.1.2 Exposure Assessment

Based on a review of local land use information, discussed above, and regulatory guidance, a set of hypothetical exposure pathways was identified for evaluation in the risk assessment. The matrix of pathways is shown in Table 6-2. It addresses several general receptors (adults, children, and infants), different categories of behavior (typical resident, beef farmer, and fisher), and a number of routes of exposure (inhalation, soil ingestion, produce ingestion, fish ingestion). Each adult or child receptor was hypothesized to be simultaneously exposed through multiple pathways (e.g., the child resident was exposed via inhalation, soil ingestion, and ingestion of locally-grown produce). Each adult receptor was also assumed to be the mother of a breast-fed infant.

The information needed to calculate exposures through each of these pathways includes environmental concentrations in ambient air, soil, produce, beef and

Table 6-1
Chronic Toxicity Criteria for the Hillsborough County Facility Project

Chronic Oral and Inhalation Toxicity Criteria

	Non-Cancer Toxicity Criteria					Cancer Toxicity Criteria				
Chemical	Chronic Oral Reference Dose (mg/kg/day)	Chronic Inhalation Reference Concentration (mg/m^3)	Safety Factor (oral/ inhalation) (a)	Toxicological Endpoint (oral/ inhalation)	Reference Dose/ Concentration Source	Oral Cancer Slope Factor $(mg/kg/day)^{-1}$	Inhalation Cancer Unit Risk Factor $(ug/m3)^{-1}$	Tumor Type or Target Tissue (oral/ inhalation)	USEPA Weight of Evidence (b)	Slope Factor and Unit Risk Source
Mercury										
Divalent (c)	3.0E-04	3.0E-04	1000 / 30	immunological / neurological	IRIS	NA	NA	NA	C	IRIS
Elemental	--	3.0E-04	-- / 30	-- / neurological	IRIS	NA	NA	NA	D	IRIS
Methyl	1.0E-04	--	10 / --	neurological & developmental / --	IRIS	NA	NA	NA	C	IRIS
PCDDs/PCDFs (as 2,3,7,8-TCDD)	NA	NA	--	--	--	1.5E+05	3.3E+01	liver	B2	EPA 1998/ EPA 1999

Notes:
NA = Not applicable
-- = No data available
IRIS = Integrated Risk Information System (10/2002)

EPA 1998 = U.S. Environmental Protection Agency. 1998. Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. Peer Review Draft. Solid Waste and Emergency Response. EPA 530-D-98-001A. July 1998.

EPA 1999 = U.S. Environmental Protection Agency. 1999. Errata to the 1998 Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. Memorandum from B. Johnson, Economics, Methods and Risk Analysis Division. August 2, 1999.

(a) Safety factors are the products of uncertainty factors and modifying factors. Uncertainty factors used to develop reference doses generally consist of multiples of 10, with each factor representing a specific area of uncertainty in the data available. The standard uncertainty factors include the following:
A 10-fold factor to account for the variation in sensitivity among the members of the human population; a 10-fold factor to account for the uncertainty in extrapolating animal data to humans; a 10-fold factor to account for uncertainty in extrapolating from less than chronic NOAELs to chronic NOAELs; and a 10-fold factor to account for the uncertainty in extrapolating from LOAELs to NOAELs. Modifying factors are applied at the discretion of the reviewer to cover other uncertainties in the data.
(b) USEPA Weight of evidence classification scheme for carcinogens:
A--Human Carcinogen, sufficient evidence from human epidemiological studies; B1--Probable Human Carcinogen, limited evidence from epidemiological studies;
B2--Probable Human Carcinogen, inadequate or no evidence from epidemiological studies and adequate evidence from animal studies;
C--Possible Human Carcinogen, limited evidence in animals in the absence of human data; D--Not Classified as to human carcinogenicity; and E--Evidence of Noncarcinogenicity.
(c) The inhalation RfC for elemental mercury was used for divalent mercury per USEPA 1998 guidance (which recommends this practice due to lack of available toxicity data).

Table 6-2
Exposure Pathways and Receptors
Considered in the Hillsborough Multiple Pathway Risk Assessment

Exposure Pathway	Receptor				
	Adult and Child Resident	Adult and Child River Fisher	Adult and Child Pond Fisher	Adult and Child Beef Farmer	Breast-Fed Infant (a)
Inhalation	✓	✓	✓	✓	
Incidental Soil Ingestion	✓	✓	✓	✓	
Ingestion of Locally-Grown Produce	✓	✓	✓	✓	
Ingestion of Fish from Palm River		✓			
Ingestion of Fish from Typical Pond			✓		
Ingestion of Locally-Raised Beef				✓	
Ingestion of Breast-milk					✓

(a) A breast-fed infant exposure to PCDD/PCDFs was evaluated for each adult receptor consistent with EPA (1998a) guidance.

fish. The methods used to calculate these concentrations were based on EPA fate and transport models and were the same as those used for the Lee County RRF risk assessment (CPF 2002). In general, these methods involve combining air dispersion and deposition modeling results and emission rates with EPA fate and transport algorithms. The fate and transport algorithms used to calculate concentrations of mercury and PCDDs/PCDFs in air, soil, produce, and beef were obtained from EPA (1998a) guidance for combustion risk assessments. The algorithms used to calculate PCDD/PCDF concentrations in fish were also from EPA (1998a) guidance. However, the algorithms used to calculate mercury concentrations in fish were obtained from EPA's refined mercury model (IEM-2M). IEM-2M models individual chemical species of mercury and, unlike the default approaches in EPA (1998a), includes specific transformation rates affecting mercury compounds in soil, water and sediments. The IEM-2M model was developed by EPA, applied in EPA's Mercury Report to Congress, and used by the Agency in developing the MACT rule for waste combustors (EPA 1997, 1999a, Lyon et al. 1998). The IEM-2M model has also been used for numerous waste combustion facility risk assessments in the United States.

Air dispersion and deposition modeling provides the information necessary to calculate ambient air concentrations and deposition rates for the selected chemicals of concern, which are in turn used in the fate and transport modeling. Dispersion and deposition modeling for the Hillsborough RRF was performed by CDM for the proposed four-unit facility. CDM performed the modeling using EPA's Industrial Source Complex Short-Term (ISCST) model. The model was applied across a 20 km-by-20 km modeling domain with the facility stack at its center. The ISCST modeling was conducted using a unitized emission rate of 1 g/sec, which produced two types of unitized results - air concentrations in $\mu g/m^3$ per 1 g/sec and deposition rates in g/m^2-sec per 1 g/sec. The unitized modeling results used in the risk assessment for each exposure pathway are presented in Table 6-3. A more detailed description of CDM's modeling is provided in the PPSA and PSD applications.

Chemical-specific ambient air concentrations and deposition rates were then calculated by multiplying the unitized ISCST modeling results by the chemical-specific emission rates. CDM developed emission rates for mercury and PCDDs/PCDFs for the proposed four-unit facility based on stack gas concentrations measured in 2000-2002 from the existing facility (see Table 6-4). Emission rates were based on average stack gas concentrations, instead of permit limits, to more accurately reflect long-term operating conditions and thus allow a more refined estimate of potential long-term risks.

Table 6-3
Unitized Long-Term Average Air Concentrations and Deposition Rates Modeled for the Hillsborough County Energy Recovery Facility Risk Assessment (Combined Impacts of Existing and Proposed Units)

Receptor and Location	Input Modeling Data for Multiple Pathway Risk Assessment (a)						Modeling Area or Location
	Vapor Phase Air Concentration [(µg/m^3)/(1 g/sec)] (Cyv or Cywv)	Particle Phase Air Concentration [(µg/m^3)/(1 g/sec)] (Cyp)	Wet Deposition from Vapor [(g/m^2-yr)/(1 g/sec)] (Dywv or Dywwv)	Dry Deposition from Particle - Surface Area weighted (e) [(g/m^2-yr)/(1 g/sec)] (Dydp)	Wet Deposition from Particle - Surface Area weighted (e) [(g/m^2-yr)/(1 g/sec)] (Dywp)	Combined Wet and Dry Deposition from Particle - Surface Area weighted (e) [(g/m^2-yr)/(1 g/sec)] (Dytwp)	
Surface Water Locations							
Pond Watershed Area	0.0048	0.0051	0.0035	0.000048	0.00196	0.0020	Average calculated across several km area surrounding the stack within the modeling domain and beyond the property boundary. (b)
Palm River Watershed Area	0.0055	0.0058	0.0050	0.000051	0.0026	0.0026	Average calculated across Palm River watershed area within the modeling domain and beyond the property boundary.
Maximum Impact Point							
Maximum deposition impact point - assumed farm & residence	0.000005	0.000005	0.13	0.000005	0.057	0.057	Maximum model results were identified within the modeling domain, beyond the property boundary and excluding nearby industrial and commercial zoned areas, at 0.3 km (0.2 miles) north of the stack. Note that there is no farm or residential use currently at this location. (c)
Cattle Grazing Location							
Beef cattle grazing area	0.0031	0.0034	0.0013	0.00003	0.00092	0.00094	Average calculated by CDM across a nearby area used for cattle grazing, and also located within the modeling domain and beyond the property boundary. (d)

(a) The dispersion and deposition modeling was performed and analyzed by CDM. The results reflect the combined impact of the County's three existing municipal solid waste combustion units in addition to the proposed fourth combustion unit. The listed model results are annual averages based on 1988 meteorological data because maximum total deposition rates (which have a greater impact on potential risks than air concentrations) occurred for 1988 data, out of the five years that were modeled (1986-1990), for receptors beyond the property boundary and excluding nearby commercial and industrial zoned areas. Meteorological data used in the modeling was obtained from Tampa International Airport (National Weather Service Station #12842).
(b) The pond area includes a range of typical ponds in the facility area.
(c) The listed values are based on the maximum impact point for total deposition rates, which occurs roughly 0.3 km (0.2 miles) to the north of the stack. Maximum values for air concentrations and dry deposition occur at a different location than these values, at roughly 2.5 km (1.3 miles) west of the stack.
(d) The grazing area is located roughly 7 km (4.3 miles) north-north-west of the facility and was identified based on a drive-through land use survey performed by CDM. Modeling results for 1988 (the maximum total deposition rate year) were lower for other areas used for grazing that were also identified during the land use survey.
(e) Surface area weighted means that the particle size distribution used in the ISCST modeling was weighted based on particle surface area. This treatment of particle size data in ISCST modeling is recommended for mercury and PCDDs/PCDFs by USEPA (1998).

Table 6-4
Chemical Emission Rates Used in the Multiple Pathway Risk Assessment for the Hillsborough County Facility (Emission Rates Based on Stack Test Measurements)

Chemical	Chemical Emission Rate (Existing and Proposed Units Combined) (g/sec) (a)
Mercury	
Total mercury	8.63E-04
Total mercury: locally available (b)	2.16E-04
Divalent (vapor phase): locally available (c)	1.76E-04
Divalent (particulate phase): locally available (c)	3.11E-05
Elemental: locally available (c)	5.18E-06
PCDDs/PCDFs (d)	
2,3,7,8-TCDD	3.72E-10
1,2,3,7,8-PeCDD	1.45E-09
1,2,3,4,7,8-HxCDD	1.79E-09
1,2,3,6,7,8-HxCDD	6.11E-09
1,2,3,7,8,9-HxCDD	4.20E-09
1,2,3,4,6,7,8-HpCDD	6.20E-08
OCDD	1.54E-07
2,3,7,8-TCDF	3.09E-09
1,2,3,7,8-PeCDF	4.97E-09
2,3,4,7,8-PeCDF	6.08E-09
1,2,3,4,7,8-HxCDF	5.52E-09
1,2,3,6,7,8-HxCDF	6.11E-09
2,3,4,6,7,8-HxCDF	7.39E-09
1,2,3,7,8,9-HxCDF	1.73E-09
1,2,3,4,6,7,8-HpCDF	1.65E-08
1,2,3,4,7,8,9-HpCDF	3.03E-09
OCDF	7.11E-09
Total for 2,3,7,8-PCDDs/PCDFs	2.91E-07
Total for all PCDDs/PCDFs (e)	7.50E-07

(a) The emission rates for the new and 3 existing MWC units are based on 2000-2002 average stack test results for the existing Hillsborough County RRF MWC Units 1-3. For the new unit, the average emission rates were also multiplied by a factor of 1.5 (660 tpd/440 tpd) to account for the increased capacity of the new Unit 4.

(b) The portion of total mercury emitted that was assumed to remain locally available for the risk analysis was calculated based on the assumed speciation of mercury in the stack gas plus EPA guidance on the portion of each species expected to remain locally available. CDM assumed that total mercury emissions would be comprised of 60% elemental mercury, 30% divalent vapor phase mercury and 10% divalent particle phase mercury, based on data for large municipal waste combustors in U.S. EPA's Mercury Report to Congress. Additionally, the fraction of each species not expected to enter the global Hg cycle and thus be available for local impacts was identified, per U.S. EPA 1998 Combustion Risk Assessment Guidance (Section 2 and Figure 2-4), as 0.01 for elemental Hg, 0.68 for divalent vapor phase Hg, and 0.36 for divalent particle phase mercury. Accordingly, the fraction of total mercury expected to remain locally available was calculated as: [(0.68*30%)+(0.36*10%)+(0.01*60%)]/100% = 0.25

(c) The total mercury emission rate (6.84E-3 lb/hr = 8.63E-4 g/sec) was divided by CDM between the mercury species as follows: 60% elemental mercury, 30% divalent vapor phase mercury and 10% divalent particle phase mercury. The emission rates were also adjusted to for the fraction of each species expected to not enter the global Hg cycle and thus be available for local impacts (i.e., 0.01 for elemental Hg; 0.68 for divalent vapor phase Hg; and 0.36 for divalent particle phase mercury based on U.S. EPA 1998 Guidance, Section 2 and Figure 2-4). For example, the divalent vapor phase emission rate = 8.63E-04 g/sec*0.3*0.68 = 1.76E-04 g/sec.

(d) The PCDD/PCDF emission rates were calculated from a total PCDD/PCDF emission rate of 1.71E-05 lb/hr and a fractional distribution of congeners based on two years of stack test measurements (Ogden Energy Group, Report No. 2554, 9/8/00 and Covanta, Report No. 2686, 8/29/01).

(e) Includes all congeners (i.e., non-2,3,7,8-congeners as well as 2,3,7,8-congeners).

A variety of site-specific information was used in the fate and transport algorithms, as shown in Table 6-5. The site-specific information was compiled by CDM based on review of local information and contacts with local officials. With the exception of site-specific data shown in Table 6-5, all other parameters used to calculate environmental concentrations were EPA default values either presented in the Agency's combustion risk assessment guidance (EPA 1998a) or provided in the Agency's documentation for the IEM-2M mercury model (EPA 1997, EPA 1999a, Lyon et al. 1998).

Potential human exposures were calculated from the environmental concentrations in each environmental medium and exposure assumptions describing the rates of exposure for each pathway (e.g., vegetable ingestion rates, soil ingestion rates, beef ingestion rates), and data on body weight, exposure frequency (i.e., days/year exposed) and exposure duration (i.e., total years exposed). All of the exposure assumptions were defaults obtained from EPA (1998a) for each of the hypothetical receptor types evaluated in this assessment - adults, children and infants. These parameter values were intentionally derived by EPA to produce a conservative (i.e., health protective) estimate of exposure. For example, an important EPA default value assumes that beef farmers obtain 100% of the beef they ingest from their own locally raised beef cattle, which have, in turn, obtained 100% of their food from locally-grown feed crops. This assumption is not supported by local official information, but was evaluated to ensure that the health risk assessment conservatively addressed potential risks.

6.1.3 Health Risk Assessment Results

Potential long-term risks associated with exposure to mercury and PCDDs/PCDFs through the multiple pathways were calculated by combining calculated exposures with toxicity values for cancer and noncancer effects.

Excess Lifetime Cancer Risks and Potential for Noncancer Effects

Table 6-6 presents the excess lifetime cancer risks for oral and inhalation exposure pathways separately and combined for each receptor. The specific exposure pathways included for each hypothetical receptor are also presented.

All of the excess lifetime cancer risks were at least 10 times below EPA's target cancer risk level of $1x10^{-5}$ and did not exceed Florida's target risk level of $1x10^{-6}$. The total excess lifetime cancer risks ranged from $8x10^{-8}$ for the hypothetical child resident or child of a beef farmer to $1x10^{-6}$ for the hypothetical adult pond fisher scenario.

Table 6-5
Site-specific Input Parameters for
Hillsborough County Facility Risk Assessment

Parameter Name	Value	Units	Source
Input Parameters Used to Calculate Soil Concentrations			
Ambient air temperature	295	K	Identified by CDM for the Tampa International Airport from Gale Research, Climate of the States, 3rd Ed., 1951-1980 period of record (72°F)
Average annual recharge	5.1	cm/yr	The recharge rates in the modelling area varies from 0-2 inches/year. Recharge rate data were provided by Southwest Florida Water Management District.
Average annual runoff from pervious areas	20	cm/yr	Value calculated by CDM based on stormwater modeling using site-specific precipitation data.
Time period over which deposition occurs	30	yr	Assumed facility lifetime
USLE rainfall (or erosivity) factor (Used to calculate Unit Soil Loss using Universal Soil Loss Equation)	500	yr^{-1}	Site-specific data provided in Hillsborough County Soil Survey, USDA May 1989 and TMDL USLE Software Program US EPA 2001
USLE erodibility factor (Used to calculate Unit Soil Loss using Universal Soil Loss Equation)	0.12	ton/acre	Site-specific data provided Hillsborough County Soil Survey, USDA May 1989 and TMDL USLE Software Program US EPA 2001
USLE length-slope factor (Used to calculate Unit Soil Loss using Universal Soil Loss Equation)	0.18	none	Site-specific data provided Hillsborough County Soil Survey, USDA May 1989 and TMDL USLE Software Program US EPA 2001
USLE cover management factor (Used to calculate Unit Soil Loss using Universal Soil Loss Equation)	0.08	none	Site-specific data provided Hillsborough County Soil Survey, USDA May 1989 and TMDL USLE Software Program US EPA 2001
USLE supporting practice factor (Used to calculate Unit Soil Loss using Universal Soil Loss Equation)	1	none	Site-specific data provided Hillsborough County Soil Survey, USDA May 1989 and TMDL USLE Software Program US EPA 2001
Palm River Input Parameters			
River: Total watershed area receiving deposition	2.66E+07	m^2	Watershed area was calculated by CDM using data from USGS topographic maps and County GIS data (10.3 square miles)

Table 6-5
Site-specific Input Parameters for
Hillsborough County Facility Risk Assessment

Parameter Name	Value	Units	Source
River: Impervious watershed area receiving deposition	1.70E+06	m^2	Calculated by CDM based on an analysis of land use categories (e.g residential, rural) and the percentage of impervious area within each category for the watershed area
River: Waterbody surface area	1.0E+06	m^2	GIS analysis performed by CDM was used to determine the Palm river surface area within the modeling domain and beyond the facility boundary
River: Waterbody temperature	298	K	Average value calculated based on data collected by the Southwest Florida Water Management District
River: Average volumetric flow rate through water body	1.80E+08	m^3/yr	Annual average flow rate was estimated by CDM based on the data collected by USGS for the Palm river flowing into the McKay Bay
River: Current velocity	0.02	m/s	An average value calculated based on data provided by CDM on: 1) the velocity at the Palm River monitoring data station S-160 (0.015 m/sec based on 5 years of data) and 2) The estimated velocity at the Palm River bridge (0.02 m/sec) based on the calculated river flow rate (1.8E+08 m3/yr) and cross sectional area (274.2 m2) at the bridge.
River: Depth of water column	3.9	m	Value based on analysis of typical Palm River water depth and rainfall data by CDM
River: Total suspended solids (annual average)	4.6	mg/L	Annual average value calculated by CDM based on the USGS Water Resources Data and SWFWMD data from a river gauging station on the Palm River and also within the modeling domain (20 km by 20 km box with stack at center of box)
Pond Input Parameters			
Pond: Total watershed area receiving deposition	3.8E+05	m^2	Watershed area was calculated by CDM using data from USGS topographic maps, County GIS data, and the Watershed Atlas (0.15 square miles)
Pond: Impervious watershed area receiving deposition	8.9E+04	m^2	Calculated by CDM based on an analysis of land use in the watershed area of a typical lake and the percentage of impervious area within each category for the watershed area

Table 6-5
Site-specific Input Parameters for
Hillsborough County Facility Risk Assessment

Parameter Name	Value	Units	Source
Pond: Waterbody surface area	4.11E+04	m^2	Average value calculated by CDM to be representative of lakes in vicinity of facility and within modeling domain, based on analysis of lakes shown on USGS topographical maps, watershed atlas and GIS analysis.
Pond: Waterbody temperature	296	K	Average value calculated based on data collected by the Southwest Florida Water Management District.
Pond: Average volumetric flow rate through water body	6.10E+04	m^3/yr	Flow rate was estimated by CDM based on the annual volume of water in the typical lake removed by either surface water flow or ground water flow.
Pond: Current velocity	4.7E-08	m/s	Velocity was calculated based on data provided by CDM on the typical pond flow rate (1.4E+5 m3/yr) and cross-sectional area of a typical pond bottom (5.4E+04 m2).
Pond: Depth of water column	1.2	m	Value based on analysis of typical lake water depth and rainfall data by CDM
Average annual wind speed	3.8	m/s	Identified by CDM for the Tampa International Airport from Gale Research, Climate of the States, 3rd Ed., 1951-1980 period of record (8.6 mph)
Pond: Total suspended solids	22.8	mg/L	Estimated by CDM based on analysis of data from Watershed Atlas and SWFMWD for the representative pond and surrounding ponds in the area
Beef Pathway Parameters			
Quantity of plant eaten by the animal each day - forage	8.6	kg plant tissue DW/day	Site-specific information based on input from interviews with local USDA officials by CDM.
Quantity of plant eaten by the animal each day - silage	0	kg plant tissue DW/day	Negligible intake of silage. Site-specific information based on input from interviews with local USDA officials by CDM.
Quantity of plant eaten by the animal each day - grain	0.44	kg plant tissue DW/day	Site-specific information based on input from interviews with local USDA officials by CDM.

Table 6-6
Summary of Excess Lifetime Cancer Risks
Hillsborough County - Human Health Risk Assessment:
Existing and Proposed Units Combined

Receptor	Total Excess Lifetime Cancer Risk (a)			Exposure Pathways Included	Evaluated Chemicals
	Oral	Inhalation	Total		
Adult Receptors					
Resident	1E-07	8E-13	1E-07	Soil ingestion, produce ingestion, inhalation	PCDDs/PCDFs
Beef Farmer	1E-07	8E-13	1E-07	Soil ingestion, produce ingestion, beef ingestion, inhalation	PCDDs/PCDFs
Fisher - Palm River	7E-07	8E-13	7E-07	Soil ingestion, produce ingestion, fish ingestion, inhalation	PCDDs/PCDFs
Fisher - Nearby Pond	1E-06	8E-13	1E-06	Soil ingestion, produce ingestion, fish ingestion, inhalation	PCDDs/PCDFs
Child Receptors					
Resident	8E-08	3E-13	8E-08	Soil ingestion, produce ingestion, inhalation	PCDDs/PCDFs
Beef Farmer	8E-08	3E-13	8E-08	Soil ingestion, produce ingestion, beef ingestion, inhalation	PCDDs/PCDFs
Fisher - Palm River (c)	1E-07	3E-13	1E-07	Soil ingestion, produce ingestion, fish ingestion, inhalation	PCDDs/PCDFs
Fisher - Nearby Pond	2E-07	3E-13	2E-07	Soil ingestion, produce ingestion, fish ingestion, inhalation	PCDDs/PCDFs

(a) A risk of 1E-6, for example, is equivalent to 1×10^{6} and equals a 1 in 1,000,000 excess lifetime cancer risk.

Table 6-7 presents the results of the chronic noncancer risk evaluation. The total hazard index is provided for oral and inhalation pathways separately and then combined for each evaluated receptor. All of the hazard index values were at least 20 times below the target hazard index of 1.0. The highest hazard index result was 0.05 for the adult pond fisher scenario.

Dioxin Exposure Evaluation

Maximum PCDD/PCDF average daily doses calculated for hypothetical child and adult receptors in this risk assessment were compared to typical background levels. The PCDD/PCDF doses were expressed as 2,3,7,8-TCDD toxic equivalents (TEQs), consistent with standard risk assessment practice. The maximum average daily doses predicted in this risk assessment were 0.02 pg TEQs/kg-day for both an adult and a child, both based on the hypothetical pond fisher scenario. This dose level is 50 times below EPA's current estimate of background PCDD/PCDF exposure of 1 pg TEQs/kg-day. As a result, TEQ exposures to people due to emissions from the proposed four-unit RRF will not cause a measurable change in typical background exposures.

Hypothetical infant exposures to PCDDs/PCDFs due to breast-milk ingestion were also calculated, and were found to range from 0.05 to 0.5 pg TEQs/kg-day, more than 100 times below the target exposure level of 60 pg TEQs/kg-day identified by EPA (1998a). These results show that infant TEQ exposures due to emissions from the proposed four-unit RRF facility will not cause a measurable change in typical breast-fed infant TEQ exposure levels.

6.2 Ecological Risk Evaluation

An ecological risk assessment was conducted to evaluate the potential impact of facility emissions on ecological receptors in the area. This assessment focused on mercury and PCDDs/PCDFs, the most important compounds from an ecological perspective associated with MSW combustion facility emissions. This assessment generally followed the same methodology applied in the Lee County RRF risk assessment (CPF 2002) and EPA guidance (EPA 1998b, 1999b).

6.2.1 Habitats and Selected Receptors

As described in the PPSA application, there are no federally-designated wildlife refuges or critical habitats within 5 miles of the site. The facility area, however, is within the habitat range of several federally-listed species. A detailed discussion of endangered, threatened, rare or special concern species in Hillsborough County is provided in Appendix 12 to the PPSA application. Based on information presented in the PPSA application, the detailed evaluation provided in the Lee County RRF risk assessment

Table 6-7
Summary of Potential for Noncancer Health Risks
Hillsborough County - Human Health Risk Assessment:
Existing and Proposed Units Combined

Receptor/ Health Endpoint	Total Hazard Index (a)			Exposure Pathways Included	Evaluated Chemicals
	Oral	Inhalation	Total		
Adult Receptors					
Resident				Soil ingestion, produce ingestion, inhalation	
Developmental	3.1E-05	--	3.E-05		methyl Hg
Neurological	3.1E-05	2.5E-09	3.E-05		methyl Hg, Hg0
Kidney	3.1E-04	2.5E-09	3.E-04		divalent Hg
Immune system	3.1E-04	2.5E-09	3.E-04		divalent Hg
Beef Farmer				Soil ingestion, produce ingestion, beef ingestion, inhalation	
Developmental	3.1E-05	--	3.E-05		methyl Hg
Neurological	3.1E-05	2.5E-09	3.E-05		methyl Hg, Hg0
Kidney	3.1E-04	2.5E-09	3.E-04		divalent Hg
Immune system	3.1E-04	2.5E-09	3.E-04		divalent Hg
Fisher - Palm River				Soil ingestion, produce ingestion, fish ingestion, inhalation	
Developmental	4.7E-02	--	5.E-02		methyl Hg
Neurological	4.7E-02	2.5E-09	5.E-02		methyl Hg, Hg0
Kidney	3.1E-04	2.5E-09	3.E-04		divalent Hg
Immune system	3.1E-04	2.5E-09	3.E-04		divalent Hg
Fisher - Pond				Soil ingestion, produce ingestion, fish ingestion, inhalation	
Developmental	4.6E-02	--	5.E-02		methyl Hg
Neurological	4.6E-02	2.5E-09	5.E-02		methyl Hg, Hg0
Kidney	3.1E-04	2.5E-09	3.E-04		divalent Hg
Immune system	3.1E-04	2.5E-09	3.E-04		divalent Hg
Child Receptors					
Resident				Soil ingestion, produce ingestion, inhalation	
Developmental	3.6E-05	--	4.E-05		methyl Hg
Neurological	3.6E-05	5.7E-09	4.E-05		methyl Hg, Hg0
Kidney	5.7E-04	5.5E-09	6.E-04		divalent Hg
Immune system	5.7E-04	5.5E-09	6.E-04		divalent Hg
Beef Farmer				Soil ingestion, produce ingestion, beef ingestion, inhalation	
Developmental	3.6E-05	--	4.E-05		methyl Hg
Neurological	3.6E-05	5.7E-09	4.E-05		methyl Hg, Hg0
Kidney	5.7E-04	5.5E-09	6.E-04		divalent Hg
Immune system	5.7E-04	5.5E-09	6.E-04		divalent Hg
Fisher - Palm River				Soil ingestion, produce ingestion, fish ingestion, inhalation	
Developmental	2.9E-02	--	3.E-02		methyl Hg
Neurological	2.9E-02	5.7E-09	3.E-02		methyl Hg, Hg0
Kidney	2.7E-03	5.5E-09	3.E-03		divalent Hg
Immune system	2.7E-03	5.5E-09	3.E-03		divalent Hg
Fisher - Pond				Soil ingestion, produce ingestion, fish ingestion, inhalation	
Developmental	2.9E-02	--	3.E-02		methyl Hg
Neurological	2.9E-02	5.7E-09	3.E-02		methyl Hg, Hg0
Kidney	2.7E-03	5.5E-09	3.E-03		divalent Hg
Immune system	2.7E-03	5.5E-09	3.E-03		divalent Hg

-- = Not applicable.

(a) In this table, for a given chemical, the oral and inhalation hazard quotients were conservatively added even if the target organ/endpoint was different for the two routes of exposure.

(CPF 2002), and consideration of several key criteria as they apply specifically to the Hillsborough County RRF area, receptors were selected for evaluation in this assessment. The criteria that were considered included habitat selectivity (if species could inhabit or use habitat in the facility area), foraging guild (preferential selection of species that are aquatic carnivores), trophic position (preferential selection of species at higher positions in the food web), population status (preferential selection of species that are endangered or threatened), and toxicity and data availability (preference for species with available toxicity and exposure characterization information).

Based on these considerations, three receptors were selected for evaluation: aquatic life, wood stork, and river otter. Aquatic life inhabiting rivers, ponds and wetlands in the area could be exposed to mercury and PCDDs/PCDFs emitted from the RRF. Benthic dwelling aquatic organisms were evaluated in this assessment because mercury and PCDDs/PCDFs tend to partition to sediments and thus benthic dwelling organisms are likely to be at greatest risk. The wood stork is a federally endangered species that has been observed in the general facility vicinity. The wood stork feeds almost exclusively on small fish from shallow water bodies and thus could be exposed to chemicals that have accumulated in fish. This species was selected as an indicator for all piscivorous birds (e.g., cormorant, tern). The river otter is an aquatic mammal with a diet that consists primarily of fish. Otter and other mustelids have a demonstrated sensitivity to a range of environmental pollutants, including mercury, and due to their dietary reliance on fish, may be exposed to bioaccumulative compounds such as mercury and PCDDs/PCDFs. This species was selected as an indicator for piscivorous mammals (e.g., weasel).

6.2.2 Toxicity Assessment

Toxicity reference values (TRVs) were derived for aquatic life, birds, and mammals to support the risk evaluation. The TRVs used in this assessment were obtained from published reviews and criteria documents developed by or on behalf of (in order of preference) the State of Florida, the U.S. EPA (EPA 1997, EPA 1999b), and the National Oceanic and Atmospheric Administration (NOAA). Table 6-8 lists the TRVs used for aquatic and terrestrial wildlife in this assessment. These values represent the maximum concentration or dose to which an organism could be exposed without adverse toxicological effects.

6.2.3 Exposure Assessment

Ecological exposures were evaluated using calculated concentrations of mercury and PCDDs/PCDFs in the environment. The environmental concentrations were calculated, as described above, using EPA (1998a) fate and transport models, and site-specific input parameters for a typical pond and the Palm River, where available.

Table 6-8
Toxicity Reference Values (TRVs) for Ecological Receptors

Receptor	Mercury (a)				2,3,7,8-TCDD (a)			
	Value	Units	Basis	Source	Value	Units	Basis	Source
Aquatic Life								
Sediment	0.13	mg/kg dw in sediment	toxic effect level	MacDonald 1994	0.000035	mg/kg dw in sediment	Pond and river - upper effects threshold based on bioassays with *Hyalella azteca*; value calculated for pond assuming an foc of 0.04 (EPA 1998 default value)	NOAA 1999
Terrrestrial Wildlife								
Birds	0.026	mg/kg body weight	alteration of reproduction and behavior in mallard duck exposed for 3-generations; uncertainty factor of 3 applied to low-effect level	USEPA 1997	0.00001	mg/kg body weight	no-effect level in ring-necked pheasants subchronically exposed	USEPA 1999
Mammal	0.018	mg/kg body weight	histopathological lesions in nerve tissue of mink following subchronic exposure; uncertainty factor of 3 applied to no-effect level	USEPA 1997	0.000001	mg/kg body weight	reproduction no-effect level for chronic exposure in rat	USEPA 1999

(a) Aquatic TRVs based on total mercury; terrestrial TRVs for methyl mercury. The TRV for PCDDs/PCDFs is expressed in terms of 2,3,7,8-TCDD, because this is the congener for which the greatest amount of toxicity data is available, and it is the congener believed to be most toxic to fish and wildlife.

Sources:

MacDonald, D.D. 1994. Approach to the Assessment of Sediment Quality in Florida Coastal Waters. November 1994. Prepared for FDEP – Office of Water Policy by MacDonald Environmental Services Ltd., Ladysmith, British Columbia.

NOAA. 1999. Screening Quick Reference Tables (SQuiRTs). NOAA-reported value 0.0088 ug/kg was the lowest reliable value reported among Upper Effects Thresholds (UET) tests, and was calculated on a 1% TOC basis. Site-specific values calculated here using foc for pond and river.

USEPA. 1997, Mercury Report to Congress. Volume VI. An Ecological Assessment for Anthropogenic Mercury Emissions in the United States. EPA 452/R-97-008.

USEPA. 1999. Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities. EPA 530-D-99-001C.

Aquatic life exposures were evaluated using chemical concentrations in the sediment of the Palm River and a typical pond. Mercury sediment concentrations were expressed as total mercury and were calculated using EPA's combustion fate and transport algorithms (EPA 1998a) in conjunction with EPA's IEM-2M model (EPA 1997, 1999a), as noted above. PCDD/PCDF concentrations in sediment were calculated using EPA (1998a) fate and transport algorithms and expressed as 2,3,7,8-TCDD toxic equivalents (TEQs) using toxic equivalency factors for fish developed by the World Health Organization.

Wood stork exposures were evaluated using several very conservative assumptions that will overestimate risk results. First, exposures were calculated assuming that 100% of the bird's diet consisted of fish at the top of the food web (trophic level IV fish), although actual dietary intake includes a combination of prey at lower trophic levels characterized by lower potential tissue concentrations due to less bioaccumulation. This screening-level approach is, however, useful for using the wood stork as an indicator of piscivorous birds. In addition, this assessment assumed that all food was obtained from the water bodies in the facility area that were evaluated (i.e., Palm River and a typical pond). Piscivorous birds, however, are know to forage over very large areas, meaning that actual exposures related to facility emissions would be lower than calculated in this analysis. Fish tissue concentrations used to calculate wood stork exposures were calculated using TEQs for birds developed by the World Health Organization. The exposure assumptions used for the wood stork were based on input from the Fish and Wildlife Service's South Florida Ecological Services Office and were identical to those used in the Lee County RRF risk assessment (i.e., fish ingestion rate of 0.41 kg fresh weight/day and body weight of 2.38 kg).

River otter exposures were evaluated assuming that 100% of the mammal's diet consisted of fish at the top of the food web (trophic level IV fish), although actual dietary intake includes a substantial amount of prey at lower trophic levels. In addition, this assessment assumed that all food was obtained from the water bodies in the facility area that were evaluated (i.e., Palm River and a typical pond). Fish tissue concentrations used to calculate river otter exposures were calculated using TEQs for mammals developed by the World Health Organization. The exposure assumptions used for the river otter were based on EPA (1997) and were identical to those used in the Lee County RRF risk assessment (i.e., fish ingestion rate of 1.2 kg fresh weight/day and body weight of 7.4 kg).

6.2.4 Ecological Risk Assessment Results

Aquatic and terrestrial wildlife risks were evaluated using a hazard quotient approach, in which quotients less than 1 indicate that adverse effects from chemical-specific exposures are unlikely to occur, whereas quotients greater than 1 indicate that adverse effects are possible.

Tables 6-9 and 6-10 present the calculated hazard quotients for aquatic life, the wood stork and the river otter. As can be seen, the results are at least 25 times lower than the threshold level of 1, indicating that aquatic and terrestrial wildlife are not predicted to be at risk from adverse effects due to operation of a four-unit Hillsborough County RRF.

6.3 Discussion of Uncertainties

All risk assessments involve the use of assumptions, judgment and incomplete data to varying degrees. As a result, the results of any risk assessment inherently reflect uncertainty. This risk assessment, for example, involved the integration of many steps, each of which is characterized by some uncertainty. These steps include:

- the calculation of chemical emission rates,
- the modeling of potential air concentrations and deposition rates associated with chemical emissions,
- the calculation of chemical concentrations in the environment (e.g., soil, beef, fish and produce) using mathematical models in conjunction with many chemical/physical properties and assumed or site-specific information about the environment in the facility area,
- the calculation of potential exposures to humans, aquatic life and wildlife using a combination of standard and site-specific exposure parameters, and
- the calculation of potential risks using toxicity information derived using health-protective assumptions from experimental studies.

The human health and ecological risk assessment results presented above reflect the combination of these potential sources of uncertainty. Collectively, however, the assumptions used in this risk assessment are considered more likely to overestimate potential risks than underestimate them. For example, many conservative (i.e., health protective) assumptions, including reliance on default values and mathematical models specified in EPA guidance, were used in this risk assessment in an effort to ensure that potential risks would not be underestimated.

Table 6-9
Hazard Quotients for Aquatic Life in the Palm River and Pond

Chemical	TRV (mg/kg)		Sediment Concentration (mg/kg)		Hazard Quotient	
	River	Pond	Palm River	Pond	Palm River	Pond
mercury (total)	0.13	0.13	3.3E-03	3.1E-03	3.E-02	2.E-02
PCDDs/PCDFs (as TEQs)	3.5E-05	3.5E-05	5.0E-08	1.0E-07	1.E-03	3.E-03

TEQ = 2,3,7,8-TCDD toxic equivalents.

Table 6-10
Hazard Quotients for Terrestrial Wildlife Feeding in the Palm River and Pond

Wood stork (piscivorous bird)

Chemical	Fish Concentration (mg/kg fw)		Intake (mg/kg bw - day)		TRV (mg/kg bw)	Hazard Quotient	
	Palm River	Pond	Palm River	Pond		Palm River	Pond
PCDDs/PCDFs (as TEQs)	1.2E-08	2.5E-08	2.0E-09	4.3E-09	0.00001	2.E-04	4.E-04
Mercury (methyl)	4.1E-03	4.1E-03	7.2E-04	7.1E-04	0.026	3.E-02	3.E-02

River Otter (piscivorous mammal)

Chemical	Fish Concentration (mg/kg fw)		Intake (mg/kg bw - day)		TRV (mg/kg bw)	Hazard Quotient	
	Palm River	Pond	Palm River	Pond		Palm River	Pond
PCDDs/PCDFs (as TEQs)	6.1E-09	1.3E-08	1.0E-09	2.1E-09	0.000001	1.E-03	2.E-03
Mercury (methyl)	4.1E-03	4.1E-03	6.7E-04	6.6E-04	0.018	4.E-02	4.E-02

TEQ = 2,3,7,8-TCDD toxic equivalents
fw = fresh weight; bw = body weight
TRV = toxicity reference value

7.0 SUMMARY AND CONCLUSIONS

7.1 Introduction

This document presents a Human Health and Ecological Impact Analysis that was performed to address questions related to human and environmental health that may arise during the course of the permit process for the proposed fourth municipal solid waste combustion unit at Hillsborough County's RRF. This study is not a formal requirement of the permit process for the fourth MWC unit, but was conducted to ensure that issues of potential concern related to the proposed unit were evaluated.

This study was performed by CPF Associates, Inc., a Washington, D.C.-based scientific and regulatory consulting firm with over 20 years experience in evaluating the potential impacts of municipal solid waste management technologies.

7.2 Previous and Ongoing Studies

Studies of the potential human health and ecological impacts of the waste-to-energy facilities have been widely conducted and were reviewed in this report. These studies indicate that stack emissions from a modern municipal solid waste (MSW) waste-to-energy plant will not cause adverse health effects if it is designed and operated in accordance with current state and federal regulations.

7.3 Regulatory and Operational Evaluation

The combination of regulatory and operational requirements in place for W-T-E facilities at the Federal and State levels collectively ensures that that a modern W-T-E facility, including the Hillsborough County RRF, will operate in a manner protective of human health and the environment. The safety of the Hillsborough Facility is, in particular, enhanced as a result of EPA's New Source Performance Standards (NSPS) and associated emission limits in conjunction with requirements from the State of Florida, including a more stringent emission limit for mercury. In addition, Hillsborough County has a very aggressive recycling program and solid waste management program that reduces the introduction of unwanted materials in the solid waste to better control emissions.

The Hillsborough Facility is, and will be, equipped with Best Available Control Technologies, the same technologies that are in place at the Lee County W-T-E facility. These technologies include spray dryer absorbers with fabric filters to remove particles, sulfur dioxide and acid gases; activated carbon injection to remove mercury; and selective non-catalytic reduction to reduce NOx emissions. The air pollution control equipment combination of spray dryer absorber, fabric filter and activated carbon injection has also been shown to reduce emissions of dioxins and furans.

7.4 Human Health Risk Assessment

The human health risk assessment presented in this report evaluated potential risks associated with operation of four waste combustion units at the Hillsborough County RRF (three existing units and the proposed fourth unit). The risk assessment was performed following EPA guidance, including but not limited to EPA's 1998 *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities*. Where possible, the risk assessment also incorporated site-specific information.

Potential human health risks were evaluated in a refined multiple pathway risk assessment for mercury and PCDDs/PCDFs, the compounds that have been shown to dominate risk assessment results for WTE facility emissions. The multiple pathway risk assessment relied on emission rates based on stack gas measurements. The multiple pathway risk assessment calculated exposures for 12 different hypothetical receptors: four adult receptors, four child receptors and four breast-fed infant receptors. For example, the four hypothetical child receptors were: child resident, child of an adult beef farmer, child of an adult who fishes in the Palm River, and child of an adult who fishes in a typical pond. Each adult or child receptor was hypothesized to be simultaneously exposed through multiple pathways (e.g., the child resident was exposed via inhalation, soil ingestion, and ingestion of locally-grown produce). Each adult receptor was also assumed to be the mother of a breast-fed infant.

The risk evaluations that were performed in the risk assessment included chronic long-term excess lifetime cancer risks, the potential for chronic non-cancer health effects, a margin of exposure approach that compares calculated doses of PCDDs/PCDFs to typical background U.S. exposure levels, and a comparison of PCDD/PCDF infant exposures to a background infant intake level. The findings of the risk assessment were as follows:

- All of the excess lifetime cancer risks were at least 10 times below EPA's target cancer risk level of 1×10^{-5} and did not exceed Florida's target risk level of 1×10^{-6}. The total excess lifetime cancer risks ranged from 8×10^{-8} for the hypothetical child resident or child of a beef farmer to 1×10^{-6} for the hypothetical adult pond fisher scenario.

- All of the noncancer hazard index values were at least 20 times below the target hazard index of 1.0. The highest hazard index result was 0.05 for the adult pond fisher scenario.

- The maximum average daily doses to PCDDs/PCDFs were 50 times below EPA's current estimate of background PCDD/PCDF exposure of 1 pg TEQs/kg-day. As a result, TEQ exposures to people due to emissions from the proposed four-unit RRF will not cause a measurable change in typical background exposures.

- Hypothetical infant exposures to PCDDs/PCDFs due to breast-milk ingestion were more than 100 times below the target exposure level of 60 pg TEQs/kg-day identified by EPA. These results show that infant TEQ exposures due to emissions from the proposed four-unit facility will not cause a measurable change in typical breast-fed infant TEQ exposure levels.

7.5 Ecological Risk Assessment

The ecological risk assessment evaluated potential effects of modeled emissions on ecological receptors within the RRF area. The ecological risk assessment followed EPA guidelines for ecological risk assessment and combustion facility ecological assessment, including but not limited to EPA's 1999 *Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities* and incorporated regional-specific information on wildlife habitats and species use to identify species and habitats of concern. The ecological assessment focused on mercury and PCDDs/PCDFs as these compounds have been shown to dominate W-T-E facility risk assessment results.

The ecological risk assessment focused on potential impacts on the natural communities of the Palm River and freshwater ponds. The assessment focused on three indicator species, aquatic life, the wood stork, and the river otter, that were considered to be at greatest risk based on habitat use, exposure potential and population status and were considered to represent three broad classes of wildlife (aquatic life, piscivorous birds and piscivorous mammals).

Potential risks were evaluated by calculating hazard quotients which reflect the ratio of a predicted exposure level to a toxicity reference value (TRV) derived for the protection of fish or wildlife species. The ecological risk assessment showed that the hazard quotients for aquatic life and the selected terrestrial species were all less than the target level of 1.0 by at least a factor of 25. These results indicate that aquatic and terrestrial wildlife are not predicted to be at risk from adverse effects of exposures to chemicals released during the operation of the Hillsborough County ERF.

7.6 Conclusions

The Human Health and Ecological Impact Analysis presented in this document showed that potential risks from emissions from the Hillsborough County RRF, in its proposed configuration with four combustion units, were below regulatory and other target risk levels for both human health and ecological receptors. These conclusions are consistent with previous studies performed for other waste-to-energy combustion facilities in the U.S. and are considered to be a reflection of implementation of regulations, and strict operational and emission controls that are used for this type of facility. Based on this analysis, the proposed modification to the RRF is not anticipated to have an adverse impact on human health or the environment.