HOWARD F. CURREN ADVANCED WASTEWATER TREATMENT FACILITY ASSESSMENT OF CLASS I IMPACTS ON THE CHASSAHOWITZKA NATIONAL WILDLIFE REFUGE

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1.0 INTRODUCTION AND SUMMARY

1.1 INTRODUCTION

The City of Tampa is partnering with Tampa Electric Company (TEC) to construct and operate two internal combustion (IC) engine/generator sets (the Project) at its existing Howard F. Curren Advanced Wastewater Treatment Facility (HFCAWTF). The HFCAWTF project is located within the City of Tampa at 2700 Maritime Boulevard, Hillsborough County, Florida.

An air construction permit application for the proposed HFCAWTF project was submitted to the Florida Department of Environmental Protection (FDEP) in April 2000. In correspondence to TEC dated May 5, 2000, FDEP advised that an assessment of increment impacts on the Chassahowitzka National Wildlife Refuge (NWR) using the CALPUFF dispersion model is required.

The required Class I area impact assessments was conducted using the CALPUFF dispersion model in accordance with the recommendations contained in the *Interagency Workgroup on Air Quality Modeling (IWAQM) Phase 2 Summary Report and Recommendations for Modeling Long Range Transport Impacts* (U.S. Environmental Protection Agency [EPA], 1998). The CALPUFF dispersion model, including the CALMET and CALPOST pre- and post-processing programs, were employed to develop estimates of HFCAWTF impacts on the Chassahowitzka NWR for prevention of significant deterioration (PSD) increments. In addition to the requested PSD increment analysis these programs were utilized to develop estimates of impacts on regional haze, and deposition as well.

1.2 SUMMARY

The CALPUFF modeling assessment resulted in the following conclusions:

- Maximum HFCAWTF project sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and particulate matter less than or equal to 10 micrometers aerodynamic diameter (PM_{10}) impacts at the Chassahowitzka NWR, are projected to be well below the EPA Class I area significant levels for all pollutants and averaging periods. The critical averaging time and pollutant was determined to be the 24-hour average SO_2 impact. Maximum HFCAWTF project 24-hour average PM_{10} impact on the Chassahowitzka NWR is projected to be 0.004 micrograms per cubic meter ($\mu g/m^3$) or only 1.4 percent of the EPA PSD Class I significant impact level.

- Maximum change in beta extinction coefficient (β_{ext}) at the Chassahowitzka NWR due to HFCAWTF project emissions is projected to be 0.39 percent and a 0.039 change in deciview (dv). These visibility impacts are below the National Park Service (NPS) significance levels of a 5 percent change in β_{ext} and 0.5 change in dv.
- Maximum HFCAWTF project total (wet and dry) sulfur and nitrogen deposition rates are projected to be 0.000004 and 0.0045 kilograms per hectare per year (kg/ha/yr), respectively. These deposition impacts are only 0.007 and 0.9 percent of the NPS significance levels for sulfur and nitrogen deposition, respectively.

2.0 MODEL SELECTION AND USE

The nearest Class I area to the proposed HFCAWTF project is the Chassahowitzka NWR, located approximately 79 kilometers (km) to the northwest of the project site. Steady-state dispersion models do not consider temporal or spatial variations in plume transport direction nor do they limit the downwind transport of a pollutant as a function of wind-speed and travel time. Due to these limitations, conventional steady-state dispersion models, such as the Industrial Source Complex (ISC) models, are not considered suitable for predicting air quality impacts at receptors located more than 50 km from an emission source.

Because of the need to assess air quality impacts at PSD Class I areas, which are typically located at distances greater than 50 km from the emission sources of interest, the EPA and Federal Land Managers (FLMs) have initiated efforts to develop dispersion models appropriate for the assessment of long-range transport of air pollutants. The IWAQM was formed to coordinate the model development efforts of the EPA and FLMs.

The IWAQM work plan indicates that a phased approach would be taken with respect to the implementation of recommendations for long-range transport modeling. In Phase 1, the IWAQM would review current EPA modeling guidance and issue an interim modeling approach applicable to projects undergoing permit review. For Phase 2, a review would be made of other available long-range transport models and recommendations developed for the most appropriate modeling techniques. The Phase 1 recommendation, issued in April 1993, was to use the Lagrangian puff model, MESOPUFF II, for long-range transport air quality assessments.

The Phase 2 recommendations, issued in December 1998, are contained in the *Interagency Workgroup on Air Quality Modeling (IWAQM) Phase 2 Summary Report and Recommendations for Modeling Long Range Transport Impacts*. The Phase 2 IWAQM recommendation is to apply the CALPUFF modeling system to assess air quality impacts at distances greater than 50 km from an emission source. The CALPUFF modeling system consists of three main components: (a) CALMET, (b) CALPUFF, and (c) CALPOST. Each of these components is described in the following sections.

2.1 CALMET

CALMET is a meteorological model that develops hourly wind and temperature fields on a three-dimensional gridded modeling domain. The meteorological file produced by CALMET for use by CALPUFF also includes two-dimensional parameters such as mixing height, surface characteristics, and dispersion properties.

CALMET requires a number of input data files to develop the gridded three- and two-dimensional meteorological file utilized by CALPUFF. The specific meteorological data and example file names, provided as input to the CALMET program, include:

- Penn State/NCAR Mesoscale Model gridded, prognostic wind field data (terrain elevation, land use code, sea level pressure, rainfall amount, snow cover indicator, pressure, temperature/dew point, wind direction, and windspeed) [MM4.DAT].
- Surface station weather data (windspeed, wind direction, ceiling height, opaque sky cover, air temperature, relative humidity, station pressure, and precipitation type code) [SURF.DAT].
- Upper air sounding (mixing height) data (pressure, height above sea level, temperature, wind direction, and windspeed at each sounding) [UP1.DAT].
- Surface station precipitation data (precipitation rates) [PRECIP.DAT].
- Overwater data (air-sea surface temperature difference, air temperature, relative humidity, overwater mixing height, windspeed, and wind direction) [SEA1.DAT].
- Geophysical data (land use type, terrain elevation, surface parameters including surface roughness, length, albedo, Bowen ratio, soil heat flux, and vegetation leaf area index, and anthropogenic heat flux) [GEO.DAT].

The above CALMET input files for calendar year 1990, with the exception of precipitation data, were obtained from FDEP for use in assessing air quality impacts at the Chassahowitzka NWR. Further details regarding the specific surface and upper air stations used in the CALMET program are provided in Section 3.0, Meteorological Data.

The various CALMET program options are implemented by means of a control file. CALMET options selected for the HFCAWTF project Chassahowitzka NWR impact assessments conform to the recommendations contained in the IWQAM Phase 2 report. The product of the CALMET program is a large (approximately one gigabyte) unformatted file that is provided as input to the CALPUFF program. CALMET Version 5.0, Level 990228 was used in the HFCAWTF project Chassahowitzka NWR air quality impact assessments.

2.2 CALPUFF

CALPUFF is a transport and puff model that advects "puffs" of material from an emission source. These "puffs" undergo various dispersion and transformation simulation processes as they are advected from an emission source to a receptor of interest. The simulation processes include wet and dry deposition and chemical transformation. CALPUFF typically uses the gridded meteorological data created by the CALMET program. CALPUFF, when used in a screening or "Lite" mode, can also utilize non-gridded meteorological data similar to that used by a steady-state Gaussian model such as the ISC dispersion model. The distribution of puffs by CALPUFF explicitly incorporates the temporal and spatial variations in the meteorological fields, thereby overcoming one of the main shortcomings of steady-state dispersion models.

Data provided as input to the CALPUFF program included the CALMET output file and a control file. There are a number of optional CALPUFF input files which were not used for the HFCAWTF project Chassahowitzka NWF impact assessments. These include time-varying emission rates, hourly ambient ozone data, user-specified deposition velocities and chemical transformation conversion rates, complex terrain receptor and hill geometry data, and coastal boundary data.

CALPUFF generates output files consisting of hourly concentrations, deposition fluxes, and data required for visibility assessments for each receptor. These CALPUFF output files are subsequently processed by the CALPOST program to provide impact summaries for the pollutants and averaging periods of interest.

Similar to the CALMET program, the various CALPUFF program options are implemented by means of a control file. CALPUFF options selected for the HFCAWTF project Chassahowitzka NWR impact assessments conform to the recommendations contained in the IWQAM Phase 2 report. An electronic copy of a CALPUFF output file, 90GAS.PUL, is included in Appendix A. This file lists each CALPUFF option selected as well as the specific emission source data for the HFCAWTF project during oil-firing operations. CALPUFF Version 5.0, Level 990228 was used in the HFCAWTF project Chassahowitzka NWR air quality impact assessments.

2.3 CALPOST

CALPOST is a post-processing program used to process the concentration, deposition, and visibility files generated by CALPUFF. The CALPOST program was formulated to average and report pollutant concentrations or wet/dry deposition fluxes using the hourly data contained in the CALPUFF output files. CALPOST can produce summary tables of pollutant concentrations and depositions for each receptor for various averaging times and can develop ranked lists of these impacts. For visibility-related modeling (e.g., regional haze), CALPOST uses the CALPUFF-generated pollutant concentrations to calculate extinction coefficients and other related indicators of visibility.

For visibility assessments, background conditions were estimated using 1994–1998 seasonal, clear-day, speciated particulate matter (aerosol) profile data collected at the Chassahowitzka NWR Interagency Monitoring of Protected Visual Environments (IMPROVE) monitoring site. The IMPROVE data for the visibility assessments, which were obtained from the NPS' Web site, are conservative in that the cleanest 10 percent visibility data were used. The IWQAM Phase 2 report recommends use of the cleanest 20 percent background visibility data as representing clear-day conditions. However, the 20 percent profile data are not available at the NPS Web site. The Chassahowitzka NWR

IMPROVE monitoring site seasonal aerosol data are summarized on Table 2-1. CALPOST was then used to compute background extinction coefficients using the available aerosol data and the IWQAM-recommended extinction efficiency for each species.

The various CALPOST program options are implemented by means of a control file. CALPOST options selected for the HFCAWTF project Chassahowitzka NWR impact assessments conform to the recommendations contained in the IWQAM Phase 2 report. Electronic copies of CALPOST output files are included in Appendix A. These files list each CALPOST option selected for each air quality assessment; e.g., PSD increments, visibility, and deposition. CALPOST Version 5.0, Level 990228 was used in the HFCAWTF project Chassahowitzka NWR air quality impact assessments.

Table 2-1. Chassahowitzka NWR IMPROVE Data 1994-1998 10th Percentile

Species	Concentrations (µg/m³) Winter	Spring	Summer	Autumn
Sulfate (as ammonium sulfate), $(NH_4)_2SO_4$	2.10	2.70	1.80	1.90
Nitrate (as ammonium nitrate), NH_4NO_3	0.31	0.27	0.21	0.19
Organic Carbon, OC	1.30	1.40	1.20	1.30
Soil	0.10	0.26	0.24	0.15
Elemental Carbon, EC	0.28	0.35	0.14	0.26
PM_{10}	10.00	13.00	12.00	12.00
$PM_{2.5}$	5.10	6.70	5.40	5.10
Coarse Particulate Mass, PMC*	4.90	6.30	6.60	6.90

*Estimated as the difference between PM_{10} and $PM_{2.5}$

Sources: NPS, 2000.
ECT, 2000.

3.0 RECEPTOR GRID

Consistent with prior FDEP modeling guidance, the CALPUFF receptor grid consisted of 13 discrete receptors that define the boundary of the Chassahowitzka NWR. Specific modeled receptors are as follows:

Receptor No.	X UTM Coordinate (km)	Y UTM Coordinate (km)	Ground Elevation (m)
1	340.3000	3165.7000	0.000
2	340.3000	3167.7000	0.000
3	340.3000	3169.8000	0.000
4	340.7000	3171.9000	0.000
5	342.0000	3174.0000	0.000
6	343.0000	3176.2000	0.000
7	343.7000	3178.3000	0.000
8	342.4000	3180.6000	0.000
9	341.1000	3183.4000	0.000
10	339.0000	3183.4000	0.000
11	336.5000	3183.4000	0.000
12	334.0000	3183.4000	0.000
13	331.5000	3183.4000	0.000

4.0 METEOROLOGICAL DATA

Meteorological data for calendar year 1990 provided as input to the CALMET program consisted of 6 surface stations, 3 upper air (mixing height) stations, and 19 precipitation stations. The location (city and county), station identification number, UTM coordinates, and relative locations of the meteorological stations to the Chassahowitzka NWR and HFCAWTF project are provided in Table 4-1. The location of each meteorological station is shown on Figure 4-1.

With the exception of the precipitation data, all meteorological data files were provided by FDEP. Precipitation data for 1990, in TD3240 format, for the 19 stations shown on Table 4-1 were obtained from the National Climatic Data Center (NCDC). The NCDC data were processed using the PXTRACT program included with the CALPUFF modeling system. PXTRACT is a meteorological preprocessor program which extracts data for stations and time periods from a fixed length, formatted precipitation data file in NCDC TD-3240 format. PXTRACT allows data for a particular model run to be extracted from a larger data file and creates a set of station files that are used as input files to the second-stage precipitation preprocessor program, PMERGE.

The PEMERGE program, which is also included with the CALPUFF modeling system, was then used to read, process, and reformat the precipitation files created by the PXTRACT program. The output of the PMERGE program is a file (PRECIP.DAT) that is used as input to the CALMET program.

Table 4-1. HFCAWTF Project CALMET Meteorological Stations

City	County	Station No.	UTM Coordinates X (km)	UTM Coordinates Y (km)	Location Relative to Chassahowitzka NWR Distance (km)	Location Relative to Chassahowitzka NWR Direction[1] (o)	Location Relative to HFCAWTF Distance (km)	Location Relative to HFCAWTF Direction[2] (o)
A. Surface Stations (6)								
Daytona	Volusia	12834	495.1	3,228.1	166.4	251	194.6	225
Ft. Myers	Lee	12835	413.7	2,940.4	246.2	342	158.8	340
Gainesville	Alachua	12816	377.4	3,284.1	116.6	200	195.7	186
Orlando	Orange	12815	469.0	3,146.9	134.3	282	124.5	242
Tampa	Hillsborough	12834	349.2	3,094.2	81.2	352	10.6	117
Vero Beach	Indian River	12843	557.5	3,058.4	248.7	298	201.3	279
B. Upper Air Stations (3)								
Apalachicola	Franklin	12832	110.0	3,296.0	258.0	118	323.3	130
Tampa	Hillsborough	12842	349.2	3,094.2	81.2	352	10.6	117
West Palm Beach	Palm Beach	12844	587.9	2,951.4	335.3	312	267.6	301
C. Precipitation Stations (19)								
Brooksville	Hernando	81048	358.0	3,149.6	32.3	321	60.2	179
Cross City	Dixie	82008	290.3	3,281.8	117.2	156	204.2	160
Daytona	Volusia	82158	494.2	3,227.4	165.3	251	193.5	224
Deland	Volusia	82229	470.8	3,209.7	137.7	255	164.5	223
Dowling Park	Lafayette	82391	283.5	3,348.4	182.1	163	269.8	164
Ft. Myers	Lee	83186	413.7	2,940.4	246.2	342	158.8	340
Gainesville	Alachua	83322	355.4	3,284.2	111.1	189	194.9	179
Inglis	Levy	84273	342.6	3,211.7	37.5	188	123.4	173
Lakeland	Polk	84797	409.9	3,099.2	104.4	316	52.2	259
Lisbon	Lake	85076	423.6	3,193.3	88.0	258	122.6	212
Lynne	Marion	85237	409.3	3,230.3	90.8	232	149.8	200
Orlando	Orange	86628	469.0	3,146.9	134.3	282	124.5	242
Parrish	Manatee	86880	367.0	3,054.4	123.7	346	35.9	346
Saint Leo	Pasco	87851	376.5	3,135.1	55.4	315	49.1	201
St. Petersburg	Pinellas	87886	339.6	3,072.0	102.5	359	25.7	48
Tampa	Hillsborough	88788	349.2	3,094.2	81.2	352	10.6	117
Venice	Sarasota	89176	357.6	2,998.2	177.5	354	91.1	1
Venus	Highlands	89184	467.3	3,001.3	216.4	323	139.9	309
Vero Beach	Indian River	89219	554.3	3,056.5	246.7	299	198.4	280

[1] Vector direction from meteorological station to Chassahowitzka NWR.

[2] Vector direction from meteorological station to HFCAWTF.

Sources: FDEP, 2000.
ECT, 2000.
NCDC, 2000.

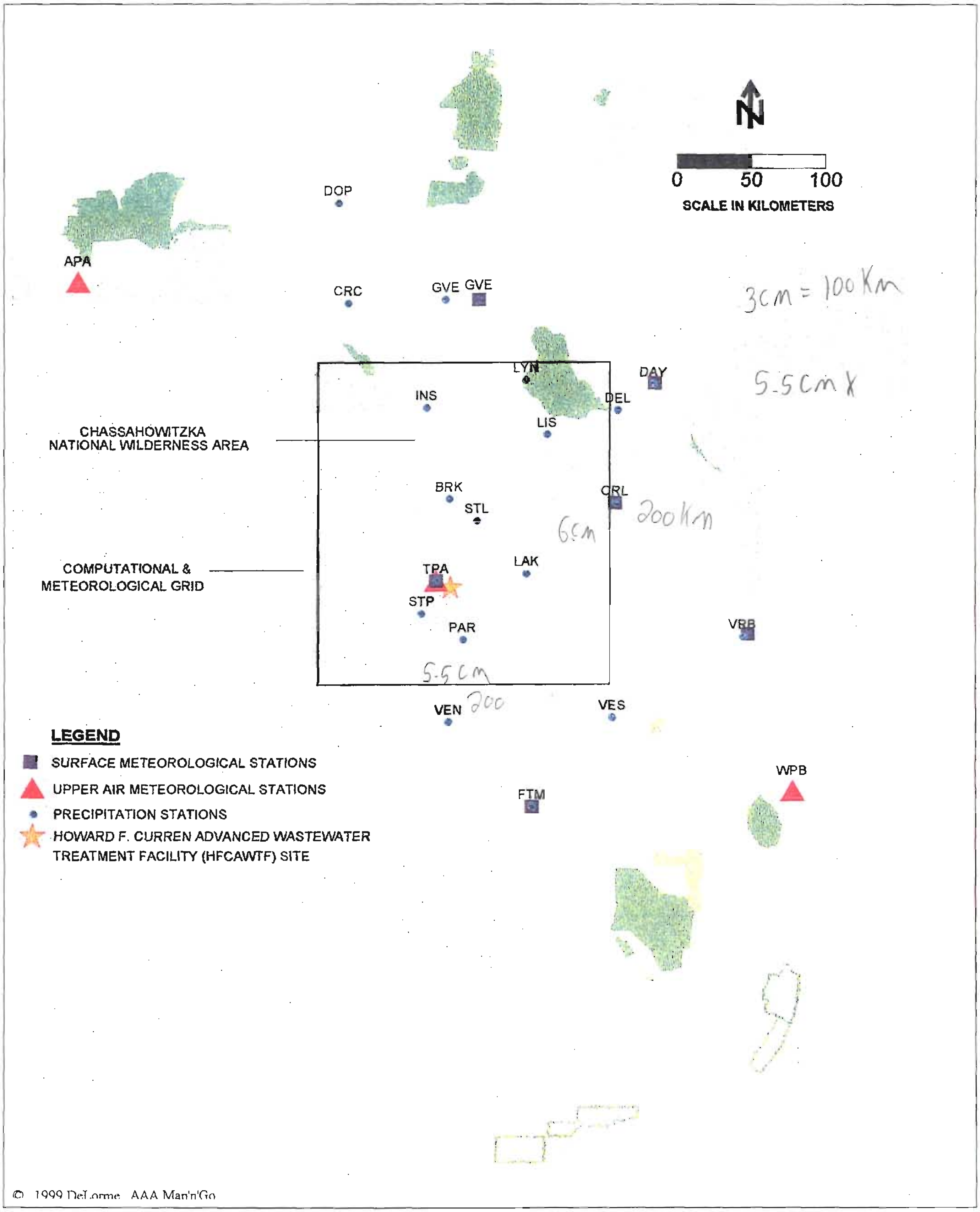

FIGURE 4-1.

CALPUFF METEOROLOGICAL AND COMPUTATIONAL GRID

Source: FDEP, 2000; NCDC, 2000; ECT, 2000; DeLorme, 1999.

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5.0 MODELED EMISSION SOURCES

The modeled emission sources consisted of the two IC engine/generator sets proposed for the HFCAWTF project. CALPUFF runs were conducted for the only fuel source, i.e. natural gas.

To reduce CALPUFF run-time, the two IC engine/generator sets were conservatively modeled assuming that emissions from both IC engine/generator sets are released from one stack. The dimensions of the modeled IC stack were not changed; e.g., the original stack exit diameter was used.

Specific HFCAWTF project emission source characteristics used in the CALPUFF modeling assessments summarized in Table 5-1.

Table 5-1. HFCAWTF project CALPUFF Emission Source Data Gas-Fired IC Engine/Generator Sets (Per IC Engine Generator Set)

Parameter	Units	Value
Stack Height	ft	35.0
Stack Diameter	ft	2.3
Stack Velocity	ft/sec	88.0
Stack Temperature	^{o}F	731.0
SO_2 Emissions	lb/hr	0.03
NO_x Emissions	lb/hr	1.76
PM_{10} Emissions	lb/hr	0.9

Source: ECT, 2000.

6.0 MODEL RESULTS

Refined CALPUFF/CALPOST modeling results for Class I PSD increments, visibility, and deposition impacts at the Chassahowitzka NWR are discussed in the following sections.

6.1 PSD CLASS I INCREMENTS

Maximum annual, 3-hour, and 24-hour NO_2, SO_2, and PM_{10} impacts for the HFCAWTF project are summarized on Tables 6-1, 6-2, and 6-3, respectively. These tables provide the highest impact for each pollutant and averaging period, the location of the highest impact, and the time of occurrence for short-term (3- and 24-hour averages) impacts.

The critical pollutant and averaging period was determined to be the 24-hour average PM_{10} impact. The maximum HFCAWTF project 24-hour average PM_{10} impact at the Chassahowitzka NWR is projected to be 0.004 $\mu g/m^3$ or 1.4 percent of the EPA PSD Class I significant impact level.

The CALPUFF/CALPOST results demonstrate that maximum HFCAWTF project impacts at the Chassahowitzka NWR will be below the EPA Class I PSD significant impact levels for all pollutants and averaging periods.

6.2 REGIONAL HAZE

Maximum 24-hour regional haze impacts are summarized in Table 6-4. This table provides the emission source beta extinction coefficient, β_{ext}, for each species as well as the total emission source β_{ext}, background β_{ext} based on the Chassahowitzka NWR IMPROVE speciated aerosol data, background visual range in units of km and dv, and the highest changes in β_{ext} and dv as calculated by the CALPOST program.

The maximum change in β_{ext}, is projected to be 0.39 percent or 7.8 percent of the NPS significant impact level.

Table 6-1. CALPUFF Model Results—Annual Average Impacts, Chassahowitzka NWR, 1990 Meteorology

Maximum Annual Impacts	NO_2	SO_2	PM_{10}
Modeled Impact (µg/m^3)	0.0008	0.000004	0.00014
PSD Class I Significant Impact (µg/m^3)	0.1	0.1	0.2
Exceed PSD Class I Significant Impact (Y/N)	N	N	N
Percent of PSD Significant Impact (%)	0.8	0.004	0.1
Receptor UTM Easting (km)	340.3	340.3	340.3
Receptor UTM Northing (km)	3,165.7	3,165.7	3,165.7
Distance From HFCAWTF (km)	79	79	79
Direction From HFCAWTF (Vector ^{o})	347	347	347

Source: ECT, 2000.

Table 6-2. CALPUFF Model Results—3-Hour Average Impacts, Chassahowitzka NWR, 1990 Meteorology

Maximum 3-Hour Impacts	NO_2	SO_2	PM_{10}
Modeled Impact (μg/m^3)	0.142	0.0004	0.014
PSD Class I Significant Impact (μg/m^3)	N/A	1.0	N/A
Exceed PSD Significant Impact (Y/N)	N/A	N	N/A
Percent of PSD Significant Impact (%)	N/A	0.04	N/A
Receptor UTM Easting (km)	340.3	340.3	340.3
Receptor UTM Northing (km)	3,165.7	3,165.7	3,165.7
Distance From HFCAWTF (km)	79	79	79
Direction From HFCAWTF (Vector °)	347	347	347
Date of Maximum Impact	2/17/90	2/17/90	2/17/90
Starting Hour of Maximum Impact	8	8	8
Julian Date of Maximum Impact	48	48	48

Source: ECT, 2000.

Table 6-3. CALPUFF Model Results—24-Hour Average Impacts, Chassahowitzka NWR, 1990 Meteorology

Maximum 24-Hour Impacts	NO_2	SO_2	PM_{10}
Modeled Impact ($\mu g/m^3$)	0.028	0.0001	0.004
PSD Class I Significant Impact ($\mu g/m^3$)	N/A	0.2	0.3
Exceed PSD Significant Impact (Y/N)	N/A	N	N
Percent of PSD Significant Impact (%)	N/A	0.1	1.4
Receptor UTM Easting (km)	340.3	340.3	340.3
Receptor UTM Northing (km)	3,165.7	3,165.7	3,165.7
Distance From HFCAWTF (km)	79	79	79
Direction From HFCAWTF (Vector °)	347	347	347
Date of Maximum Impact	2/17/90	2/17/90	2/17/90
Julian Date of Maximum Impact	48	48	48

Source: ECT, 2000.

Table 6-4. CALPUFF Model Results—Regional Haze Impacts, Chassahowitzka NWR, 1990 Meteorology

Maximum 24-Hour Average Impacts	Units	Value
B_{ext-s} - SO_4	Mm^{-1}	0.000
B_{ext-s} - NO_3	Mm^{-1}	0.328
B_{ext-s} - PMC	Mm^{-1}	0.001
B_{ext-s} - Total	Mm^{-1}	0.329
B_{ext-b} - Background	Mm^{-1}	50.576
Visual Range, Background	km	77.3
Visual Range, Background	dv	16.2
No. of Days with B_{ext} >5.0 %	-	0.0
Largest B_{ext} change	%	0.39
NPS Significant Impact, Bext change	%	5.00
Exceed NPS Significant Impact	Y/N	N
Percent of NPS Significant Impact	%	7.8
No. of Days with Delta Deciview >0.5 %	-	0.0
Largest Delta Deciview Change	-	0.039

Source: ECT, 2000.

The CALPUFF/CALPOST results demonstrate that maximum HFCAWTF project regional haze impacts at the Chassahowitzka NWR will be below the NPS significant impact levels.

6.3 DEPOSITION

Maximum annual sulfur and nitrogen deposition rates are summarized in Table 6-5. This table provides the CALPUFF modeled deposition rates impact for each species (SO_2, sulfate [SO_4], NO_x, nitric acid [HNO_3], and NO_3) in units of micrograms per square meter per second ($\mu g/m^2/s$), the conversion factors used to convert the deposition rates from units of $\mu g/m^2/s$ to units of kg/ha/yr, and the total wet and dry sulfur and nitrogen deposition rates.

Maximum HFCAWTF project total (wet and dry) sulfur and nitrogen deposition rates at the Chassahowitzka NWR are projected to be 0.000004 and 0.00045 kg/ ha/yr, respectively. These sulfur and nitrogen deposition rates are 0.007 and 0.9 percent of the NPS significant impact level of 0.05 kg/ha/yr for sulfur and nitrogen deposition.

The CALPUFF/CALPOST results demonstrate that maximum HFCAWTF project sulfur and nitrogen deposition rates at the Chassahowitzka NWR will be below the NPS significant impact levels.

Table 6-5. CALPUFF Model Results - Annual Average Deposition Impacts
Chassahowitzka NWR, 1990 Meteorology

A. Dry Deposition

Maximum Annual Impacts	SO_2	SO_4	NO_x	HNO_3	NO_3	Totals
Modeled Impact ($\mu g/m^2/s$)	1.16E-08	3.76E-11	1.73E-06	1.72E-06	1.22E-08	
Conversions						
MW Ratio (S / SO_2)	0.5000	N/A	N/A	N/A	N/A	
MW Ratio (S / SO_4)	N/A	0.3333	N/A	N/A	N/A	
MW Ratio (N / NO_2)	N/A	N/A	0.3043	N/A	N/A	
MW Ratio (N / HNO_3)	N/A	N/A	N/A	0.2222	N/A	
MW Ratio (N / NO_3)	N/A	N/A	N/A	N/A	0.2258	
ug to kg	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09	
m^2 to ha	1.00E+04	1.00E+04	1.00E+04	1.00E+04	1.00E+04	
s to hr	3,600	3,600	3,600	3,600	3,600	
No. of Hours in Averaging Period	8,616	8,616	8,616	8,616	8,616	
Total Multiplier	1.55E+02	1.03E+02	9.44E+01	6.89E+01	7.00E+01	
Sulfur Dry Deposition (kg/ha/yr)	1.80E-06	3.89E-09	N/A	N/A	N/A	1.80E-06
Nitrogen Dry Deposition (kg/ha/yr)	N/A	N/A	1.63E-04	1.19E-04	8.54E-07	2.83E-04

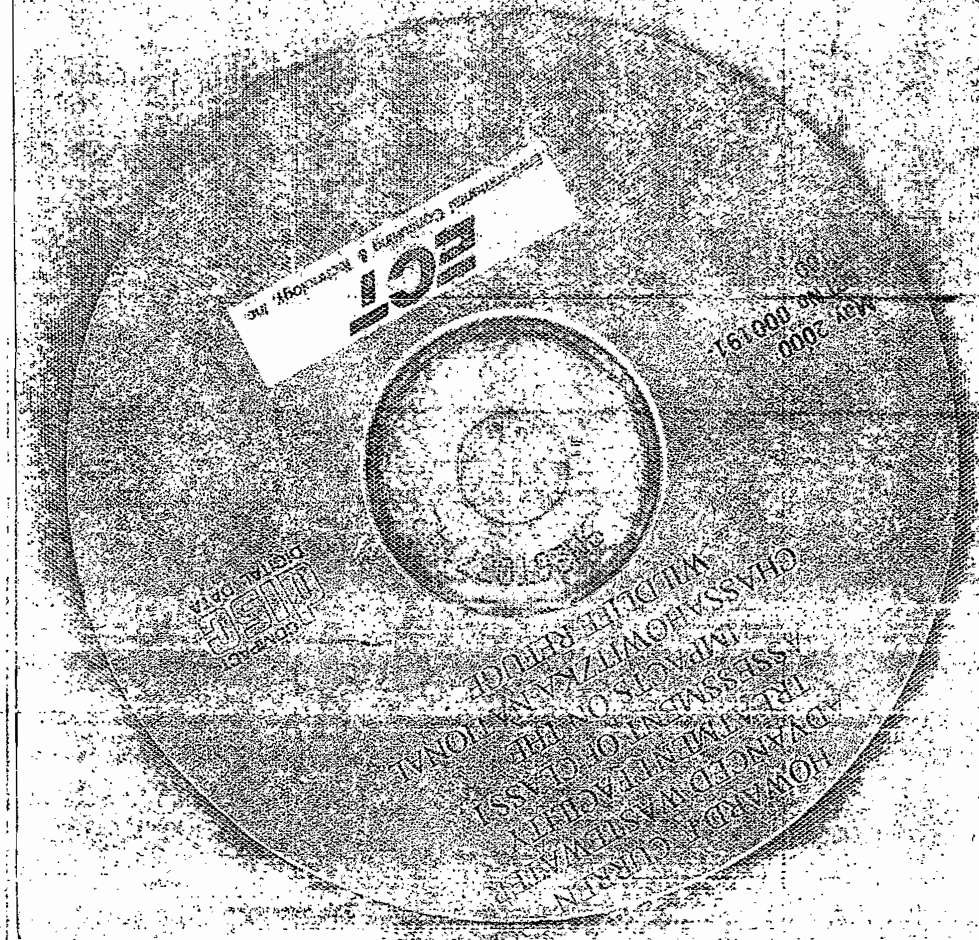
B. Wet Deposition

Maximum Annual Impacts	SO_2	SO_4	NO_x	HNO_3	NO_3	Totals
Modeled Impact ($\mu g/m^2/s$)	9.01E-09	3.56E-09	0.00E+00	1.71E-06	7.69E-07	
Conversions						
MW Ratio (S / SO_2)	0.5000	N/A	N/A	N/A	N/A	
MW Ratio (S / SO_4)	N/A	0.3333	N/A	N/A	N/A	
MW Ratio (N / NO_2)	N/A	N/A	0.3043	N/A	N/A	
MW Ratio (N / HNO_3)	N/A	N/A	N/A	0.2222	N/A	
MW Ratio (N / NO_3)	N/A	N/A	N/A	N/A	0.2258	
ug to kg	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09	
m^2 to ha	1.00E+04	1.00E+04	1.00E+04	1.00E+04	1.00E+04	
s to hr	3,600	3,600	3,600	3,600	3,600	
No. of Hours	8,616	8,616	8,616	8,616	8,616	
Total Multiplier	1.55E+02	1.03E+02	9.44E+01	6.89E+01	7.00E+01	
Sulfur Wet Deposition (kg/ha/yr)	1.40E-06	3.68E-07	N/A	N/A	N/A	1.77E-06
Nitrogen Wet Deposition (kg/ha/yr)	N/A	N/A	0.00E+00	1.18E-04	5.39E-05	1.72E-04
Total Dry and Wet Sulfur Deposition (kg/ha/yr)						0.000004
NPS Significance Level (kg/ha/yr)						0.05
Exceed NPS Significance Level (Y/N)						N
Percent of NPS Significance Level (%)						0.007
Total Dry and Wet Nitrogen Deposition (kg/ha/yr)						0.00045
NPS Significance Level (kg/ha/yr)						0.05
Exceed NPS Significance Level (Y/N)						N
Percent of NPS Significance Level (%)						0.9

Source: ECT, 2000.

APPENDIX A

ELECTRONIC FILES ON CD



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