



Prepared For:

Recast Energy
Las Piedras, Puerto Rico

EIR Air Quality Impact Assessment

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1.0 INTRODUCTION

Environmental Resources Management, Inc. (ERM) is assisting Recast Energy (Recast) with evaluating potential air quality impacts of a proposed biomass-to-energy facility to be located in Las Piedras, Puerto Rico. As part of the required Environmental Impact Report (EIR), a study was performed to evaluate current air quality in the region of the proposed Project as well as any air quality impacts due to the proposed biomass-to-energy project. For this analysis, air quality in the region was compared against USEPA National Ambient Air Quality Standards (NAAQS) for criteria air pollutants. The NAAQS define air quality that USEPA (and PR EQB) have determined to be protective of human health and welfare including sensitive populations such as infants, children, asthmatics and the elderly. Measured or predicted air quality levels that are below the NAAQS levels established by USEPA are considered by definition protective of human health and welfare and therefore de minimis.

Existing air quality in the surrounding Las Piedras as well as predicted air quality including operation of the proposed biomass-to-energy project were determined in this study to be well within EPA's NAAQS, and therefore protective of human health and welfare.

The proposed project is of relatively small scale (<250 MMBtu/hr) and will be fueled with clean, chipped biomass such as used pallets and tree trimmings. The use of biomass to fuel the system will reduce reliance on imported fossil fuel helping to make the Island more self-sufficient, while embracing carbon neutral sustainability. The proposed combustion equipment would employ emission control technology to minimize air emissions of particulate, sulfur dioxide (SO_2), volatile organic compounds (VOC), oxides of nitrogen (NOx), carbon monoxide (CO) and other regulated air pollutants. All of these factors serve to mitigate adverse impacts to regional air quality and contribute to the finding that operation of the proposed biomass to energy Project will be fully protective of ambient air quality values in the region.

Puerto Rico EQB will require a detailed air permitting and approval process before any construction of the Project would be allowed. This permitting process may include additional air dispersion modeling demonstrations and will incorporate enforceable permit limitations on air emissions that will ensure protection of local air quality.

This report outlines the approach used for evaluating existing conditions and conservatively predicted impacts to ambient air quality in all areas surrounding the proposed Project. The study evaluated maximum potential impacts to air quality including emissions of fine particulate (PM_{10} and $PM_{2.5}$), SO_2, NOx, and CO from the proposed combustion of clean, chipped biomass.

2.0 *PROJECT DESCRIPTION*

Recast proposes to retrofit an existing but abandoned commercial industrial facility in Las Piedras for re-purposing as a new biomass-to-energy facility. Recast proposes to reuse existing buildings to store clean biomass indoors and to house the biomass-to-energy system equipment. This equipment will include enclosed biomass handling and feed equipment, a nominal 245 MMBtu/hr biomass combustion boiler and air pollution control systems as required by EQB. Additional equipment will be located outside the existing buildings, but within the developed area of the site, including evaporative cooling towers and a single freestanding stack. The existing buildings on the site are of relatively low profile, and Recast intends to reconstruct a portion of the developed facility to sufficient height (no more than 100 feet above grade) to accommodate the boiler and related equipment. All new structures and equipment are proposed to be constructed within the developed footprint of the current site. Clean biomass fuel is proposed to be delivered to the enclosed biomass storage area of the existing buildings already chipped and processed, via trucks that will be offloaded at the existing facility loading docks. The number of biomass trucks to be received at the facility is similar to the number of trucks that previously serviced the former industrial facility. Recast has committed to construct a new exhaust stack no greater than 199 feet in height, however it will seek to further reduce that stack height during the EQB air permitting process based on refined air dispersion modeling.

The proposed Project has been designed to provide direct benefits to its host community as well as the environment in general. For example, clean biomass when left to decay in the forest or in a landfill emits the potent greenhouse gas methane. By utilizing this indigenous fuel resource to produce power on-island, the Project will revitalize a currently unused commercial facility, create jobs, and produce clean, low carbon and inexpensive electricity to help meet the power needs of Island residents in a self-sufficient manner. These features are fundamental to the Project design and definition.

3.0 SITE LOCATION

Recast is proposing to retrofit an existing, currently unused former commercial industrial site located at Road 183 KM 20, Barrio Montones, Las Piedras, Puerto Rico 00771. The site is situated in a historically industrial and commercial, semi-urban area in eastern Puerto Rico. While adjacent properties are zoned commercial and industrial, sensitive residential areas are located to the northeast, southeast, and to the west. Air quality impacts in the areas of nearby residences were deemed to be of particular importance in performing this study.

While the topography surrounding the site to the north, east, and west is relatively flat, elevated terrain features exist southwest and northeast of the site. **Figure 3-1** is an aerial view of the locus of the existing industrial facility proposed to be repurposed for the Recast Project. **Figure 3-2** shows terrain elevations within a few kilometers of the site. UTM coordinates of the center of the site are approximately 194920 E 2011888 N (zone 20Q).

Figure 3-1 Location of the existing unused industrial complex and proposed Recast facility

Figure 3-2 Terrain Elevations in Project Vicinity

4.0 *EXISTING AIR QUALITY*

As required by EQB Air Regulations as well as the Federal Clean Air Act, the maximum potential impacts of five criteria air pollutants for which EQB and USEPA have established protective air quality standards were evaluated. These are nitrogen oxides (NOx and NO_2), sulfur dioxide, (SO_2), carbon monoxide (CO), particulate matter with an aerodynamic diameter less than or equal to 10 micrometers (PM_{10}), and particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers ($PM_{2.5}$). While lead (Pb), sulfuric acid mist (H_2SO_4) and ozone (O_3) are also criteria air pollutants, they are not associated with emissions from clean biomass combustion and/or are predicted to have negligible impacts on air quality within the region. Greenhouse gas emissions are now treated as a regulated air pollutant, but are associated with global impacts relative to climate change rather than local air quality. Woody biomass that would otherwise be allowed to decompose is considered either carbon neutral or GHG beneficial as its decomposition product methane is a more potent greenhouse gas than the CO_2 that will be returned to the global balance if combusted.

Table 4-1 presents available measured background concentrations for the five criteria air pollutants in comparison to the national ambient air quality standards (NAAQS). Monitored data quality and availability varies widely throughout Puerto Rico. A single consistent and complete set of three recent years of monitoring data was not available for the pollutants analyzed, however conservatively estimated values (values that overstated the actual average concentrations) were extracted based on multiple data sets. Table 2-1 summarizes the available information identified by monitoring station and year of analysis; the highest value for each averaging period has conservatively been used to characterize existing conditions for purposes of this analysis. As NAAQS levels are typically based on average levels composited over several years, the use of the highest values found in each data set provides a level of conservatism to this analysis. For purposes of demonstrating that the Project will not cause or contribute to any exceedence of the NAAQS, maximum potential emission impacts from the proposed Project were added to the conservative existing air quality background levels using the EQB and USEPA recommended air dispersion model, AERMOD. The resulting screening approach indicates that the project will not cause or contribute to a NAAQS exceedence and therefore no further model refinements were necessary to demonstrate NAAQS compliance under worst case conditions.

Table 4-1 Highest (Conservative) Ambient Air Quality Monitoring Data from Applicable Monitoring Locations in Puerto Rico

Pollutant	Averaging Period	Monitoring Site	Year	Concentration ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
CO	1-hr	San Juan	2008	4,353	40,075
	8-hr			3,208	10,305
NO_2	1-hr	Cataño	2006	72	188
	Annual			19	100
SO_2	1-hr	Barceloneta	2005	87	196
	3-hr			39	1,309
PM_{10}	24-hr	Guaynabo	2011	78	150
$PM_{2.5}$	24-hr	Adjuntas	2008	11	35
	Annual			5	15

4.1.1 REGULATIONS AND POLICY

The proposed Project will not be allowed to commence construction without first obtaining an authorization to construct (Air Permit) from EQB. In order to receive such an approval, Recast Energy will be required to demonstrate that the Project will meet or better all applicable EQB and USEPA air regulations and requirements, including a demonstration that operation of the proposed biomass-to-energy project will be protective of ambient air quality for every resident of Puerto Rico. EQB will issue permits to construct and operate with very specific enforceable conditions and operational limitations to ensure ongoing compliance with all applicable air Rules and Regulations.

4.1.2 AIR QUALITY ASSESSMENT

As part of the required Environmental Impact Report (EIR), a study was performed to evaluate current air quality within 400 km of the Project site in all directions as well as any potential air quality impacts due to operation of the proposed biomass-to-energy project. For this analysis, air quality in the region was compared against USEPA National Ambient Air Quality Standards (NAAQS) for criteria air pollutants. The NAAQS define air quality that USEPA (and EQB) have determined to be protective of human health and welfare, including sensitive populations such as infants, children, asthmatics and the elderly. Measured or predicted air quality levels that are below the NAAQS

levels established by USEPA are considered by definition protective of human and health and welfare and therefore *de minimis*.

Existing air quality as well as predicted air quality including operation of the proposed biomass-to-energy project in the project area were determined in this study to be well within EPA's NAAQS, and therefore protective of human health and welfare.

4.1.3 SENSITIVE RECEPTORS

Recast Energy and EQB's primary concern is protection of the health and welfare of all residents of Puerto Rico, and especially infants, children, asthmatics and the elderly. For this reason, a fine grid of modeled locations was established in all directions around the proposed project site, especially including residential areas where people live, work and play. This fine grid locus captures schools, playgrounds, hospitals, nursing homes, churches and other "sensitive receptors" such that the air dispersion model results cover all of greater Las Piedras. Air quality impacts from any single emission source are quickly reduced with greater and greater distance from the source (referred to as "dispersion") and this effect is reflected in the computer model. The modeling also predicted maximum impacts on hilltops (elevated terrain) to the West as well as a far field receptor grid out to 10 km from the site. This inclusive receptor grid was incorporated to cover far field impacts as well as near field.

4.1.4 EMISSION INVENTORY

The proposed biomass-to-energy facility is to be sited within the developed area of an existing, but abandoned, industrial facility. Recast intends to re-use and re-purpose the existing buildings and structures to house major components of the proposed project (although certain modifications to the height of the existing buildings will be required). Recast proposes to construct a free-standing stack, evaporative cooling tower and other facility features that will be located outside the existing buildings, but will be entirely constructed within the already developed footprint of the site. This grounds the location of the proposed stack and building tiers to a specific area of the existing developed site. The computer model is relatively insensitive to small changes in stack location (i.e.+/- 25 m) but is quite sensitive to stack height. Recast has modeled the maximum stack height together with maximum potential emission rates, understanding that further optimization may occur during the EQB air permitting process which may enable a lower stack height once a final Engineering/Procurement and Construction (EPC) contractor is selected. Recast commits that the ambient air quality impacts modeled will not be exceeded in the final design (but might be reduced in the final design). Finally, Recast notes that the air dispersion modeling performed to support this EIR is purposefully designed to over-

predict the actual air quality impacts due to the Project. Actual air quality impacts can therefore be expected to be lower than those predicted in this screening level modeling. Recast has modeled its maximum potential stack height of 199′ above grade, but reserves the option to reduce the project stack height and/or alter its air emissions signature in order to construct a lower stack through a more refined air modeling demonstration during the EQB air permitting process.

Modeling results are based on the potential pollutant emission factors from the biomass-fired boiler and cooling towers. The cooling towers would be a source of fine particulate matter (those solids that may escape the cooling tower mist eliminators in liquid droplets) but are not associated with emissions of NO_X, CO, or SO_2; only fine particulate emissions were therefore modeled for the proposed cooling towers.

4.1.5 BUILDING DIMENSIONS INPUT TO THE MODEL

The proposed maximum 245 MMBtu/hr biomass-fired boiler will be designed with a single, freestanding stack with a height no greater than 199 feet. A stack lower than 199 feet would not be constructed without a revised modeling demonstration showing compliance with all NAAQS and approval from EQB. The associated cooling towers will include 2 cells each able to operate independently of the others and each having a single fan. Each of the 2 cells will exhaust from a fan deck outlet at no less than 41.5 ft. above grade.

Existing site buildings will be modified to accommodate the new Recast operations. For purposes of air dispersion modeling, we have included the existing buildings as-is with the exception of an added 100 foot tier to the roof of one existing building to house the new steam boiler and its equipment.

4.1.6 AIR QUALITY MODEL SELECTION

For this air quality analysis, ERM used the EQB and USEPA AERMOD dispersion model (version 12060), with screening level meteorological data preprocessed by the modeling algorithm MAKEMET. The base elevation and hill scale (terrain elevation) parameters for receptors used in the modeling analysis were assigned using EQB and USEPA's AERMAP (version 11103).

4.1.7 METEOROLOGICAL DATA

The use of the MAKEMET screening-level meteorological processor is a conservative approach to AERMOD modeling and will produce predicted concentrations at least equal to, but more likely greater than, the average

concentrations typically used. MAKEMET allows for user defined surface characteristics and ambient temperature parameters which enable generation of the needed meteorological data. **Table 4-2** provides the parameters used in the MAKEMET preprocessor.

Table 4-2 MAKEMET Input Parameters

Parameter	Value	Units
Anemometer Height	10	m
Minimum Wind Speed	0.5	m/s
# of Wind Directions	36	-
Wind Direction Increments	10	deg
Minimum Temperature	209.9	K
Maximum Temperature	305.4	K
Albedo	0.208	-
Bowen Ratio	1.625	-
Surface Roughness	1	m

Consistent with EQB and USEPA modeling guidance, default values contained in the guidance for anemometer height and minimum wind speed were used. Minimum and maximum temperatures were taken from historic monthly meteorological data for Las Piedras, Puerto Rico. Annual average values for urban land use were selected in conformance with EQB and USEPA modeling guidance for albedo, Bowen ratio, and surface roughness parameters.

4.1.8 RECEPTOR GRID

A tiered receptor grid extending in all directions from the proposed facility site was developed for this analysis to capture both near-field impacts at every location of the surrounding community as well as impacts further away including more distant hills and elevated terrain.

The following receptor spacing was used for this analysis:

- 100 m spacing from the center of the site to approximately 1 km
- 200 m spacing from 1 km to 5 km; and
- 400 m spacing from 5 km to 10 km.

Terrain elevations were assigned to each receptor, and a hill scale (elevation) was calculated with the EQB and USEPA approved AERMAP terrain processor. AERMAP is a companion program to AERMOD that uses the digitized US Geological Survey (USGS) digital elevation model (DEM) or Shuttle Radar Topography Mission (SRTM1) data files to assign elevations and hill scales to all receptors. The hill scale assigned to each receptor is used by AERMOD to

determine the appropriate terrain algorithm to use at each receptor. AERMOD calculates a critical dividing streamline height, based on the hill scale, that divides the approach flow towards the hill into two parts: 1) one that rises over the terrain obstacle, and 2) one that passes around the side of the obstacle. Based on the plume (the dispersing flue gas emitted from the stack) height relative to the terrain and relative to the receptor, AERMOD calculates concentration contributions from different parts of the plume following the different flow regimes. The receptor elevations used in this model were assigned using the SRTM1 for Universal Transverse Mercator (UTM) Zone 20, North American Datum (NAD) 1983

4.1.9 GOOD ENGINEERING PRACTICE (GEP) STACK HEIGHT ANALYSIS

Aerodynamic downwash (the phenomenon of eddy currents across the roof of a building dragging stack emissions downward) has the potential to increase ground-level concentrations from a stack emission point compared with the concentrations that would be predicted in the absence of these effects. Downwash is handled in air quality models through the use of arrays of direction-specific building dimensions, determined through the use of EQB and USEPA's approved Building Profile Input Program (BPIP). BPIP generates direction-specific building heights and widths for a given stack. BPIP also calculates a Good Engineering Practice (GEP) stack height, above which the downwash from the buildings do not significantly impact the emissions from the stack. A BPIP analysis was performed for the biomass-fired boiler stack and cooling tower cells.

Based on the modeled stack location and heights of the facility buildings, downwash was determined to not significantly affect predicted concentrations from the boiler stack, but to somewhat impact the dispersion of emissions from the proposed cooling towers. Results from the BPIP pre-processors have been included in the AERMOD dispersion model.

4.1.10 MODELED PARAMETERS

Emission rates, exit velocities, and exit temperatures within the model are based on the current design specifications for the proposed Project. In each case, these were selected to represent the worst-case scenario in terms of producing the maximum modeled concentrations for purposes of screening level air dispersion results. **Table 4-3** and **Table 4-4** provide the source parameters used within the dispersion model.

Table 4-3 Source Parameters – Combustion

Pollutant	Emission Factor (lb/hr)	Temperature (°F)	Wet Exhaust Flow (acfm)	Exit Stack Diameter (ft)	Exit Stack Area (ft^2)	Exit Stack Velocity (ft/s)	Stack Height (ft)
CO	57	300	56,270	4.5	15.9	49.0	199
NO_2	41.24						
SO_2	5.88						
$PM_{2.5}$	5.88						
PM_{10}	5.88						

Table 4-4 Source Parameters – Cooling Towers

Pollutant	Emission Factor (lb/hr)	Temperature (°F)	Wet Exhaust Flow (acfm)	# of Cells	Exit Stack Diameter (ft)	Exit Stack Velocity (ft/s)	Stack Height (ft)
CO	0	Ambient	774,727 (total)	Two	26 (each)	24.3	41.5
NO_2	0						
SO_2	0						
$PM_{2.5}$	0.87						
PM_{10}	0.87						

5.0 AMBIENT AIR QUALITY IMPACTS

The maximum predicted results, for the respective averaging periods, overall years and receptors were identified for comparison to the NAAQS. The results are presented in both tabular format (see **Table 5-1**) and graphical format (see **Figures 5-1 through 5-5**).

Due to the use of conservative, screening meteorological data, only 1-hr averages were created within the AERMOD results. A ratio was then applied to the 1-hr results, in line with EQB and USEPA guidance, to determine the 3-hr, 24-hr, and annual averaging periods. This provides another level of conservatism in the analysis when combined with the highest predicted concentrations for each pollutant and averaging period as provided in Table 3-3.

Table 5-1 Predicted air quality impact results

Modeling Results					NAAQS	
Pollutant	Averaging Time [2]	Modeling Results	Background Concentration	Combined Concentration		
		($\mu g/m^3$)			($\mu g/m^3$)	ppb[1]
CO	1-hr	303	4,255	4,558	40,075	9,000
	8-hr	273	2,645	2,918	10,305	35,000
NO_2 [3]	1-hr [6]	112	72	184	188	100
	Annual	11	19	30	100	53
SO_2 [4]	1-hr	22	87	108	196	75
	3-hr	22	39	61	1,309	500
$PM_{2.5}$ [5]	24-hr	13	11	24	35	
	Annual Mean	2	5	7	15	
PM_{10}	24-hr	13	78	91	150	

1 - ppb values listed. To note some NAAQS values were converted from ppm to ppb for purposes of consistency.

2 - AERSCREEN only provides 1-hr haveraged values. To obtain 3-hr, 8-hr, 24-hr and annual results, ratios in accordance to EPA guidelens were applied:

- 3-hr: fixed ratio of 1.00
- 8-hr: fixed ratio of 0.90
- 24-hr: fixed ration of 0.60
- Annual: fixed ration of 0.10

3 - The 1 hour NO2 NAAQS is a not to exceed 1-hr daily maximum 98% averaged over 3 years. Screen modeling makes use of the highest 1 hr value, making this

4 - The 1 hour SO2 NAAQS is a not to exceed 1-hr daily maximum 99% averaged over 3 years. Screen modeling makes use of the highest 1 hr value, making this

5 - The 24-hr PM2.5 NAAQS is a 98th percentile averaged over 3 years. Screen modeling provides a conservative results in comparison.

6 - In accordance with available EPA guidance, a Tier 2 ARM analysis of NOx assumes that 80% of the total NOx with be NO2.

Based on the conservative approach described and the mitigation features built into the design of the Project (the small scale of the project, the use of only clean, chipped biomass for fuel, and the use of air pollution control technology to limit criteria pollutant air emissions) the air dispersion model demonstrates that the predicted air quality impacts for the proposed project are protective of human health and welfare, including for the most sensitive populations, for all five criteria air pollutants and at all residential (and other) locations in Las Piedras. The modelled results extend out to 10 km from the site, after which the emissions have become very well dispersed and decay to very low residual

concentrations. These modelled results are considered to be conservative – that is, they overstate the impacts expected to actually occur by a significant margin. These conservatisms include combining the conservative predictions of the AERMOD model for the proposed biomass-to-energy project added to the highest background levels measured, the sum of which demonstrate universal impacts below all of the applicable Puerto Rico and US National Ambient Air Quality Standards. The modelling performed demonstrates that air quality impacts from the proposed biomass-to-energy Project, using EQB and USEPA guideline modelling, will be protective of health and welfare at all locations.

Figure 5-1. 1-hr CO Dispersion Modeling Results

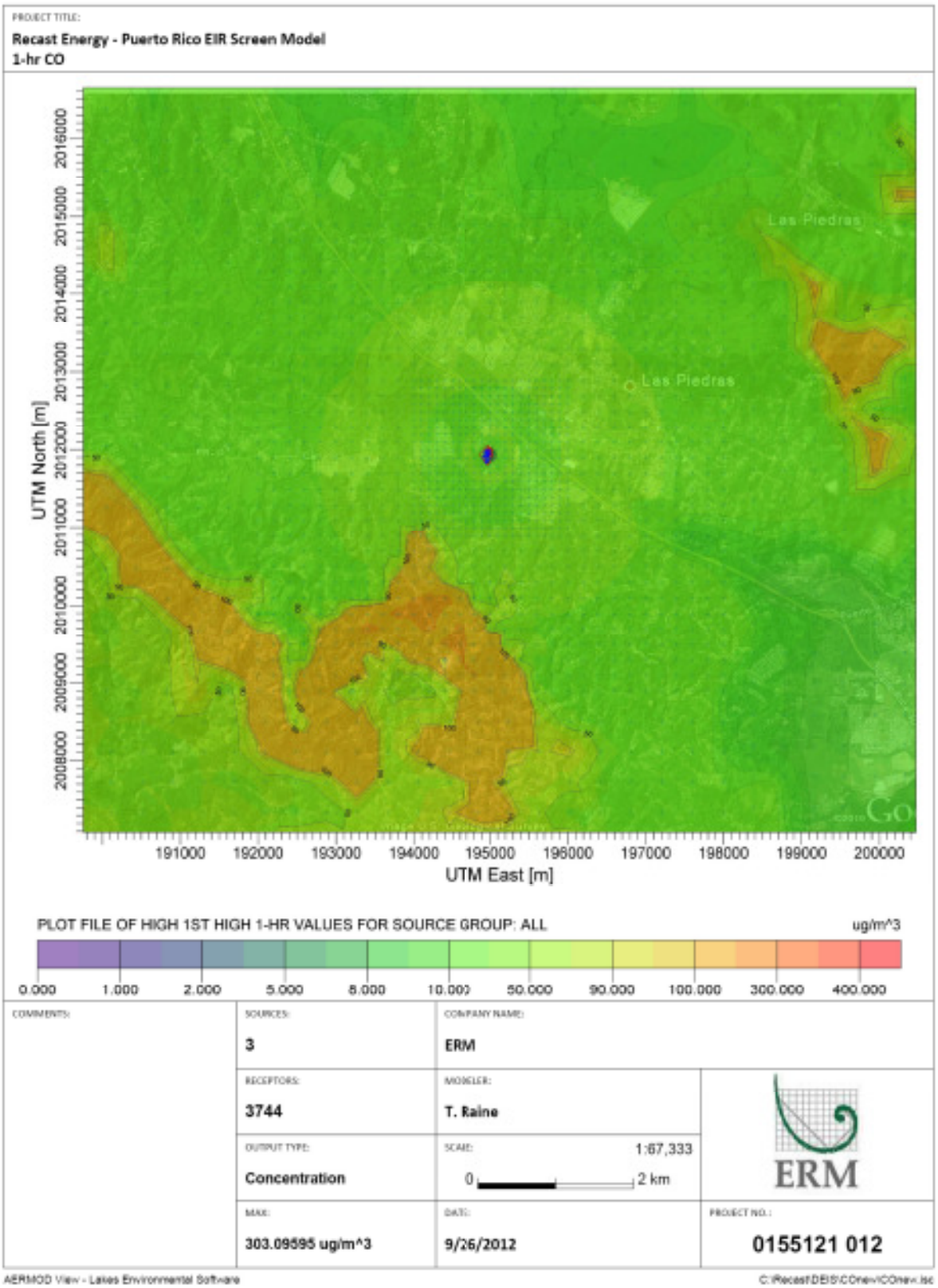

Figure 5-2. 1-hr NO_2 Dispersion Modeling Results

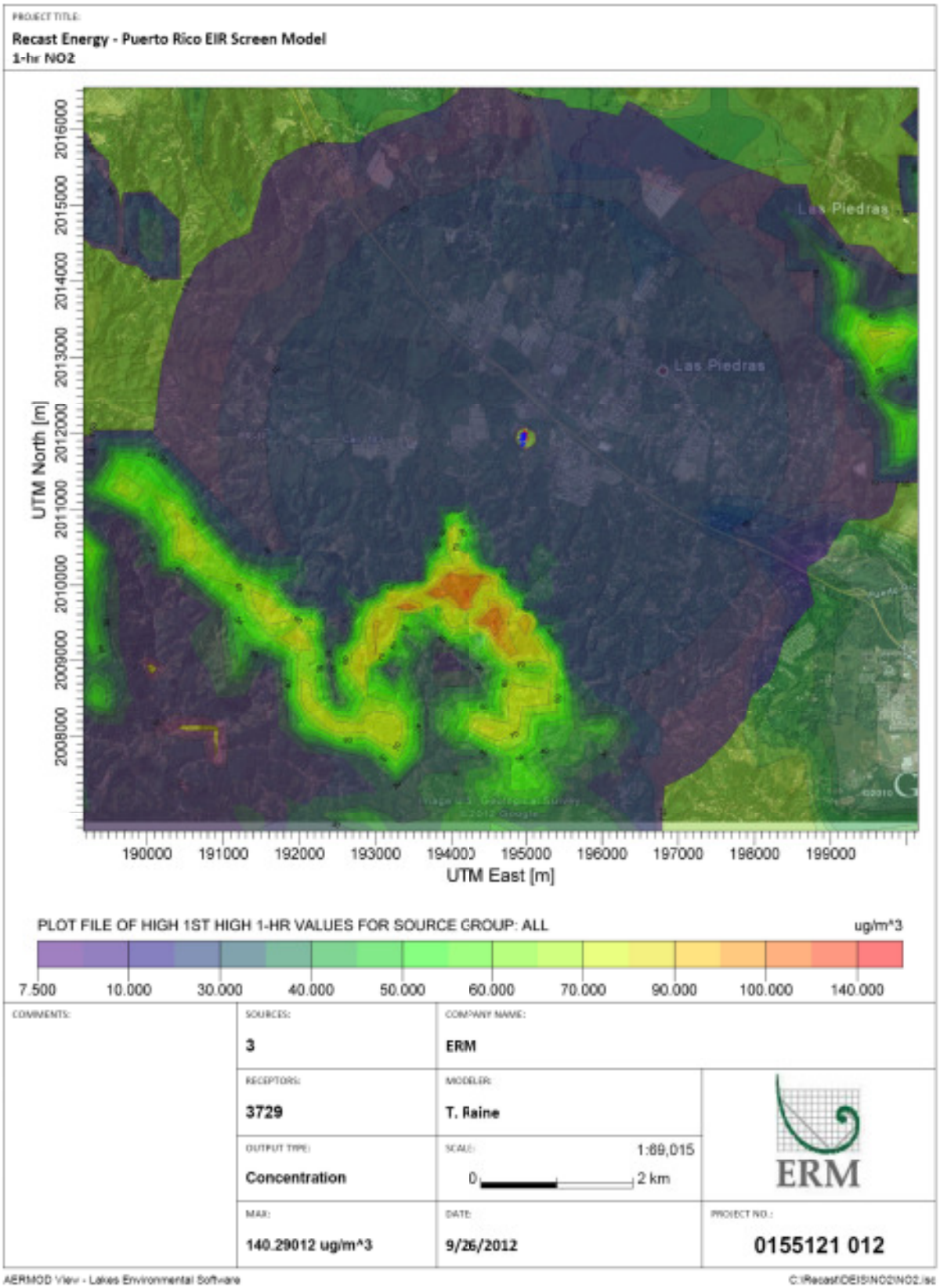

Figure 5-3. 1-hr SO_2 Dispersion Modeling Results

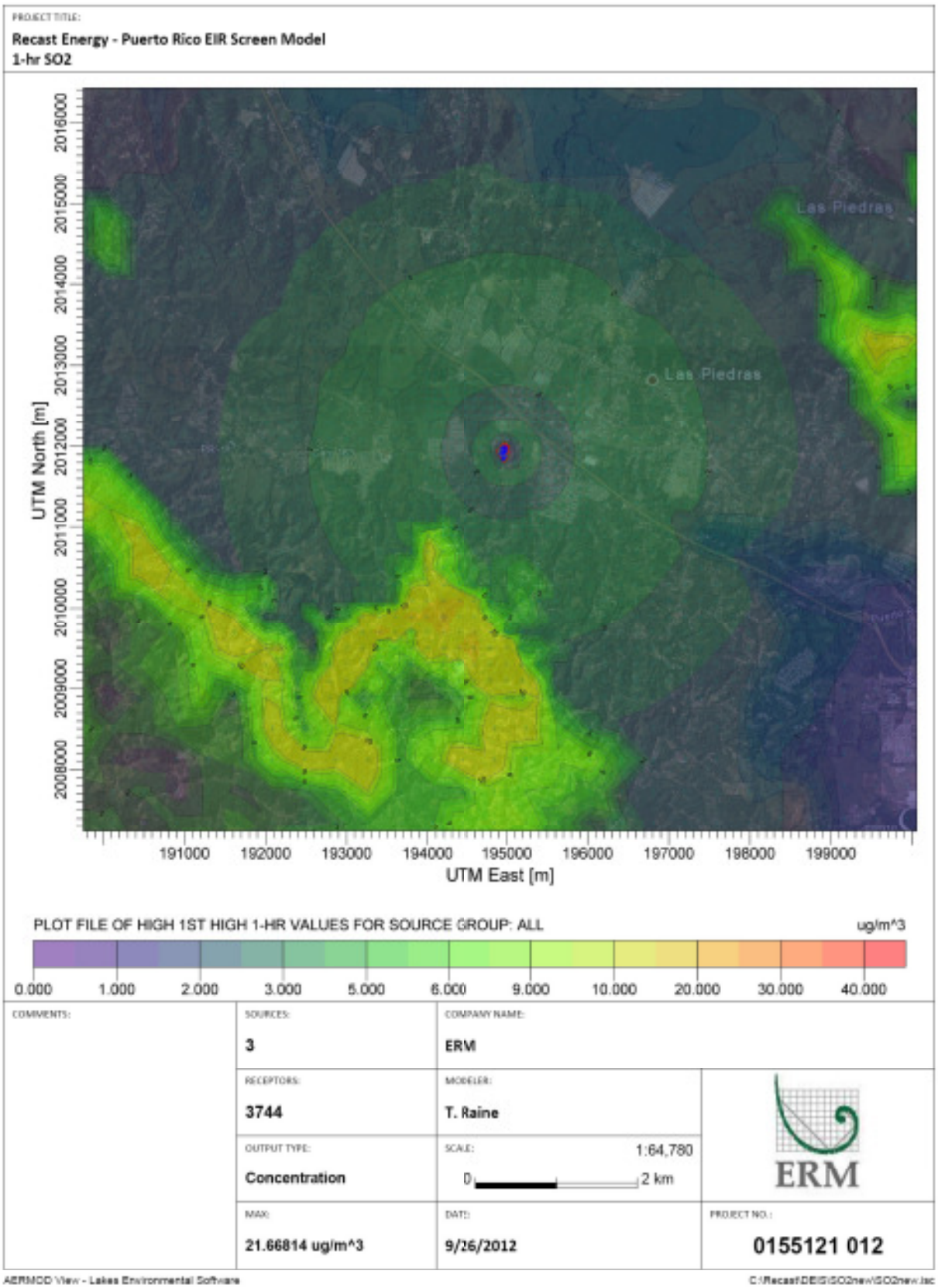

Figure 5-4. 1-hr $PM_{10}/PM_{2.5}$ Dispersion Modeling Results