Air Quality Modeling for Brame Energy Center for 1-Hour SO_2 Impact

CLECO Power, LLC

Pineville, Louisiana

Submitted to:
Louisiana Department of Environmental Quality
Baton Rouge, LA

Prepared by:

CB&I
2500 City West Boulevard, Suite 1700
Houston, Texas 77042
Telephone 281.531.3100

CB&I Project No: 631216841

July 22, 2016

Table of Contents

List of Tables

List of Figures

List of Appendices (in USB)

List of Acronyms and Abbreviations

$\mu g/m^3$	micrograms per cubic meter
AQS	Air Quality System
BEC	Brame Energy Center
BPIP	Building Profile Input Program
CEMs	continuous emission monitoring system
CLECO	CLECO Corporation
ft	feet
km	kilometers
LDEQ	Louisiana Department of Environmental Quality
m	meters
MMBTu/hr	Million British Thermal Units per Hour
NAAQS	National Ambient Air Quality Standard
SO_2	sulfur dioxide
TAD	Technical Assistance Document
USEPA	U.S. Environmental Protection Agency

1.0 Background

The U.S. Environmental Protection Agency (USEPA) issued the final primary National Ambient Air Quality Standard (NAAQS) for 1-hour sulfur dioxide (SO_2) on June 2, 2010 (2010 SO_2 standard). On August 5, 2013, the USEPA published a notice announcing designation of nonattainment for the 2010 SO_2 standards, based on certified ambient air quality monitoring data for the years 2009-2011 that showed these areas exceeding the standard. For all other areas, the USEPA developed and proposed a Data Requirements Rule that would require states to gather and submit additional information characterizing SO_2 in areas with larger SO_2 emissions. The information will be used by the USEPA for future area designations.

Separately, in a consent decree signed with the Sierra Club in the District Court in Northern California on March 2, 2015, the USEPA is required to complete area designations with available monitoring data within 16 months of date of the consent decree. Also, for areas without adequate monitoring data, the area designations are to be completed in two phases by December 31, 2020.

The first phase is for areas where the states have not installed a monitoring network by January 1, 2017 and the designations for these areas are scheduled by December 31, 2017, potentially using modeling. The second phase is for areas where the states have installed and operating monitoring network on or before January 1, 2017 and these areas will be allowed to collect data for three years and the designations will be finalized in 2020.

On behalf of CLECO Power LLC (CLECO) Brame Energy Center (BEC), CB&I conducted air modeling of the SO_2 sources in the facility to determine the 1-hour SO_2 air quality impact in the Rapides parish based on a modeling protocol submitted to the Louisiana Department of Environmental Quality (LDEQ) on June 30, 2016. The purpose of the modeling is to provide supporting information for future area designation in this parish for the 1-hour SO_2 NAAQS. This report presents the results of the modeling.

1.1 SO_2 Emission Sources in BEC

BEC operates four (4) electric generating units: Nesbitt 1 (Unit 1); Rodemacher II (Unit 2); Madison 3-1; and Madison 3-2. **Table 1-1** shows the details of the units**.** **Figure 1-1** shows the locations of the units at the facility.

Table 1-1 Description of Electric Generating Units at BEC

Unit	Capacity (MMBTu/Hr)	Fuel	Stack Diameter (ft)	Stack height (ft)
Unit 1 (Nesbitt 1)	4170	Natural gas (primary), Used fuel oil, Fuel oil 2 and 6	16.9	195
Unit 2 (RPS II)	5445	Coal (primary): startups with NG	18.0	250
Unit 3-1 (Madison)	3006	Petroleum Coke (primary): startups with NG	24.6	450
Unit 3-2 (Madison)	3006	Petroleum Coke (primary): startups with NG	24.6	450

1.2 Description of Surrounding Area

Figure 1-2 shows a Google Earth view of the area surrounding the facility, which is primarily rural in nature and heavily wooded on all sides except in the west and southwest where there is a large water body (Lake Rodemacher). The nearest city is Alexandria, Louisiana, approximately 28 kilometers (km) to the southeast of the facility. BEC is bound to the east by Interstate 49, to the south by Highway 121, and to the north by Highway 8.

CLECO owns a large tract of land surrounding the facility shown in red outline in **Figure 1-3**. These areas are not fenced and can be accessed without going through the facility (lake, railroad, interstate, Bayou Jean de Jean). There are guard gates to the north and west of the facility restricting access.

1.3 SO_2 Emission Sources in Rapides Parish

BEC is the largest SO_2 emission source in the Rapides parish. **Figure 1-4** shows the locations of permitted SO_2 emission sources in the Rapides parish and **Figure 1-5** shows the SO_2 emissions sources within 20 km radius of BEC. The nearest large emission source for SO_2 is Martco Chopin Mill - approximately 18 km east of the facility in the adjacent Natchitoches parish.

Table 1-2 shows the actual emissions of SO_2 from sources within Rapides Parish for last three years of available data. **Table 1-3** shows actual emission of other SO_2 emissions from sources within 20 km of the BEC facility for the last three years of available data. The emissions include the Martco Chopin Mill in the adjacent Natchitoches parish.

Table 1-2 SO_2 Emissions within Rapides Parish

Facilities Within Rapides Parish	2015		2014		2013	
	tons/yr	% of Total	tons/yr	% of Total	tons/yr	% of Total
CLECO BEC	7131	99.75%	9711	99.82%	12524	99.86%
All Other Off-site Sources	17.7	0.25%	17.9	0.18%	18.0	0.14%
Total in Rapides Parish	**7149**	**100.00%**	**9729**	**100.00%**	**12542**	**100.00%**

Source: LDEQ EDMS

Table 1-3 SO_2 Emissions within 20 Km from BEC

Facilities	2015		2014		2013	
	tons/yr	% of Total	tons/yr	% of Total	tons/yr	% of Total
CLECO BEC	7131	99.44%	9711	99.58%	12524	99.68%
Off-site Sources in Rapides Parish (Boise Cascade)	0.33	0.82%	0.35	0.86%	0.30	0.75%
Off-site Sources in Adjacent Parishes (Martco Chopin Mill)	40.25	0.56%	40.69	0.42%	40.32	0.32%
Total	**7171**	**100.00%**	**9752**	**100.00%**	**12564**	**100.00%**

Source: LDEQ EDMS

The data shows that BEC is the largest source impacting the SO_2 ambient concentration in Rapides parish and a the modeled impact from the BEC would be representative of the ambient air quality data for SO_2 in this parish, which could be used for the area designation process for the 1-hour SO_2 NAAQS.

2.0 Modeling Methodology

The USEPA has published a Technical Assistance Document (2013 Modeling TAD) for modeling the SO_2 impacts from a source for area designation purposes (SO_2 NAAQS Designation Modeling Technical Assistance Document – Draft dated December 2013). This methodology was generally used in modeling the impact from BEC sources. The methodology is described below.

2.1 Modeling Domain and Receptor Network

A Cartesian receptor grid extending to 10 km from the BEC will be used in the modeling. The spacing of the receptor grid will follow 2013 Modeling TAD and LDEQ air modeling guidance as follows:

- Along property line – receptors spaced 100 meters (m) apart
- From property line to 1 km – receptors spaced 100 m apart
- From 1 km to 10 km – receptors spaced 1000 m apart

Figure 2-1 shows the receptor grid to be used in the modeling. Receptor elevations were obtained from national elevation dataset (NED) in the North American Datum 83 (NAD 83) format and processed with the latest version of AERMAP (v 11103).

CLECO owns a large tract of land surrounding the facility shown in red outline in **Figure 1-3**. These areas are not fenced and can be accessed without going through the facility (lake, railroad, interstate, Bayou Jean de Jean). However, public access is restricted in the facility by two (2) manned guard shacks and two (2) gates as shown in redlines in **Figure 2-2**. The receptor network extended in all directions from these restricted areas. There is a large water body (Lake Rodemacher) to the west and south west of BEC. There are also small islands within this lake. These areas have unrestricted public access and therefore were considered as ambient air.

2.2 Air Quality Model

The latest version of the USEPA's AERMOD model (version 15181) was used for the analysis using all regulatory default parameters.

2.3 Meteorological Data

The 2013 TAD requires modeling with at least three (3) years of meteorological data. The modeling used latest three (3) years of surface and upper air hourly meteorological data (2013-2015) from the National Weather Service station at the Shreveport Regional Airport in Shreveport, Louisiana (Station ID 13957). This weather station is approved by LDEQ for air impact modeling of sources in Rapides parish. The meteorological data was processed using the latest version of AERMET (v 15181). **Figure 2-3** shows the wind rose at the Shreveport meteorological station for these three years. The wind is predominantly from south, southeast, and southwest.

2.4 Stack Parameters and Emission Rates

BEC is the largest SO_2 emission source within Rapides parish accounting for >99% of the emissions in last three years of available data as shown in **Table 1-2**. Also, there are no major SO_2 emission sources within 20 km of BEC as shown in **Table 1-3**. Therefore, it was expected that the 1-hour SO_2 impacts in the Rapides parish will be influenced solely by emissions from BEC and that the other SO_2 emission

sources (such as the Boise Cascade facility near BEC and the Martco Chopin Mill facility in the nearby Natchitoches parish) were not required to be included in the modeling.

The HOUREMIS keyword in AERMOD was used to model actual hourly emission rates for calendar years 2013 through 2015. The data was obtained from the continuous emission monitoring systems (CEMS) installed on the units. The emission rates used in the model represent the the hourly raw data that has not been corrected for CEMS bias (i.e. the unbiased data).

The purpose of the analysis is to reflect actual impacts based on actual operating data over last 3 years; therefore, the following procedure was followed for filling in missing data:

- For the hours the emission data are unavailable due to CEMs malfunction but the units were running as evidenced by operating logs, the emission data were filled in using the Acid Rain Program data filling procedure in 40 CFR Part 75; and

- For the hours the units were shutdown as evidenced by the operating logs, these hours were excluded from modeling by entering an emission rate of zero in the AERMOD input file.

Hourly stack gas flowrate and stack gas temperatures concurrent with the hourly emissions will be used to develop realistic estimates of the hourly impacts. There were few hours for each unit in each year, where SO_2 emission rates were available but stack temperature and flow data were missing. The units were presumed to be operating at these hours and the missing data were presumed to be due to malfunction of the temperature and/or flow monitoring instruments. For these hours, the missing data were replaced by 3 year average value on a unit by unit basis.

Unit 1 (Nesbitt 1) does not have a flow monitor and therefore hourly stack flow data is not available. Stack test at 90% load was conducted for this unit in 2006. The stack test provided both stack flow rate and stack temperature. The stack flow rate for each hour was calculated based on this flow rate after adjusting for the change in hourly stack temperature. For all other units, the hourly stack flow data was obtained from the flow monitors. Because Nesbitt 1 uses pipeline quality natural gas as the primary fuel, the SO_2 emissions are orders of magnitude lower than the other units at BEC using solid fuels. Therefore, the effect on the modeled results due to the adjustments to the stack gas parameters as described above was expected to be insignificant.

The hourly data for input to model for each unit for 2011-2015 were the following:

- Hourly SO_2 emission rates
- Hourly stack temperature
- Hourly stack flow data

Appendix 1 includes the raw data from the CEMs and the data processing to convert the data suitable for input to AERMOD. This hourly data was used in the AERMOD via an external file using the HOUREMIS keyword. The HOUREMIS input data is also included in **Appendix 1**.

2.5 Building Downwash

Building downwash was considered in the modeling to obtain a realistic impact. All buildings and structures in the facility surrounding the units were included in the aerodynamic downwash calculations using the USEPA's Building Profile Input Program (BPIP). **Figure 2-4** shows the buildings and structure included in the downwash analysis.

2.6 Dispersion Coefficients

Figure 2-5 shows the area within 3 km radius from the facility. The area is mostly rural with large water body to the west and south. Based on the land use, rural dispersion coefficients were selected for the modeling.

2.7 Background Concentration

Hourly SO_2 background data is available for latest three (3) years (2013-2015) at the Shreveport, LA monitor. The Shreveport monitor is surrounded by several large SO_2 emission sources whereas the Brame Energy Center has no major SO_2 emission sources nearby. **Table 2-1** shows the actual annual SO_2 emissions within 10 km of the Shreveport monitor and the Brame Energy Center for the last three years of data available (2013-2015). Based on the data in **Table 2-1**, the background near the Brame Energy Center is expected to be significantly lower than the Shreveport monitor data. As a conservative approach, the Shreveport monitoring data was used for background concentration.

Table 2-1 SO_2 Emissions within 10 Km – Shreveport Monitor and BEC

Center of Area	2015	2014	2013
	tons/yr	tons/yr	tons/yr
Shreveport Monitor	178.0	169.3	202.2
CLECO BEC [(1)]	0.33	0.35	0.30

[(1)] *Excludes CLECO BEC emission sources because these emission sources were being modeled explicitly. The other emission source within 10 km is Boise Cascade*

Hourly SO2 monitoring data was obtained from the Shreveport monitoring station. A seasonal design background value was determined for each hour of day in each of the four (4) seasons by averaging the 99th percentile of the 3 year values for each hour of day for each season. These seasonal design values are shown in **Table 2-2** and were used for the respective hour-of-day for each season for all three years. The seasonal design values were used in the AERMOD using the BACKGRND keyword. The derivation of the seasonal background concentrations is included in **Appendix 2**.

Table 2-2 Seasonal Hourly SO_2 Design Background Concentrations from Shreveport Monitor

Hour of Day	Season			
	Winter	Spring	Summer	Fall
1	6.46	6.72	6.81	5.50
2	7.42	6.81	7.51	4.98
3	7.86	6.46	6.90	5.50
4	7.51	6.38	6.99	6.20
5	7.60	6.29	6.90	5.50
6	6.99	6.55	6.81	5.15
7	6.11	6.99	7.25	4.89
8	6.38	8.30	13.54	7.07
9	8.47	9.96	24.45	9.96
10	7.16	11.53	24.89	13.80
11	13.27	11.18	17.99	18.25
12	15.89	11.70	16.16	12.14
13	16.86	10.83	12.31	9.61
14	13.36	9.61	10.04	11.00
15	11.00	8.65	9.78	8.03
16	10.83	7.77	11.88	10.04
17	9.69	8.47	9.69	7.95
18	8.12	8.21	9.43	8.82
19	8.21	7.60	11.00	8.56
20	7.42	7.16	9.17	7.07
21	9.78	6.99	8.21	5.59
22	8.30	8.21	7.16	5.33
23	10.13	9.17	9.96	5.50
24	8.12	7.69	7.25	6.11

3.0 Results

Table 3-1 shows the results of the air modeling as described in earlier sections. Detailed input/output of the model runs are included in Appendix 3.

Table 3-1 Predicted 1-Hour SO_2 Impact from Brame Energy Center Sources

Emission Source	Design Concentration [1] + Design Background Concentration [2] (ug/m^3)	NAAQS [3] (ug/m^3)	Is the Impact less than NAAQS? (Yes/no)
Brame Energy Center	147	196	YES

(1) *Highest 3-year average of 99th percentile of daily maximum 1 Hour SO_2 concentration across all receptors*

(2) *Seasonal hourly background concentration from 3 years (2013-2015) of data from Shreveport monitor*

(3) *3-year average of 99th percentile of daily maximum 1-hr SO_2 concentration*

The results indicate that the impact of the SO_2 emission sources within the BEC will be significantly lower than the 1-hour SO_2 NAAQS and therefore Rapides parish is expected to be in attainment status.

Appendix 1
Hourly Emission and Stack Parameters Used in Modeling (in USB)

Appendix 2
Derivation of Seasonal Hourly Design Background Concentration From Shreveport, LA Monitor (In USB)

Appendix 3
Model Input/output Files
(in USB)

Figures

DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
E. Schlegel	--	--	631215357-B1-1

DESIGNED BY	DATE
--	5/16/16

Document Path: O:\PROJECT\631215357\631215357-B1-1.mxd

CB&I Environmental & Infrastructure, Inc.
2790 Mosside Boulevard
Monroeville, PA 15146-2792

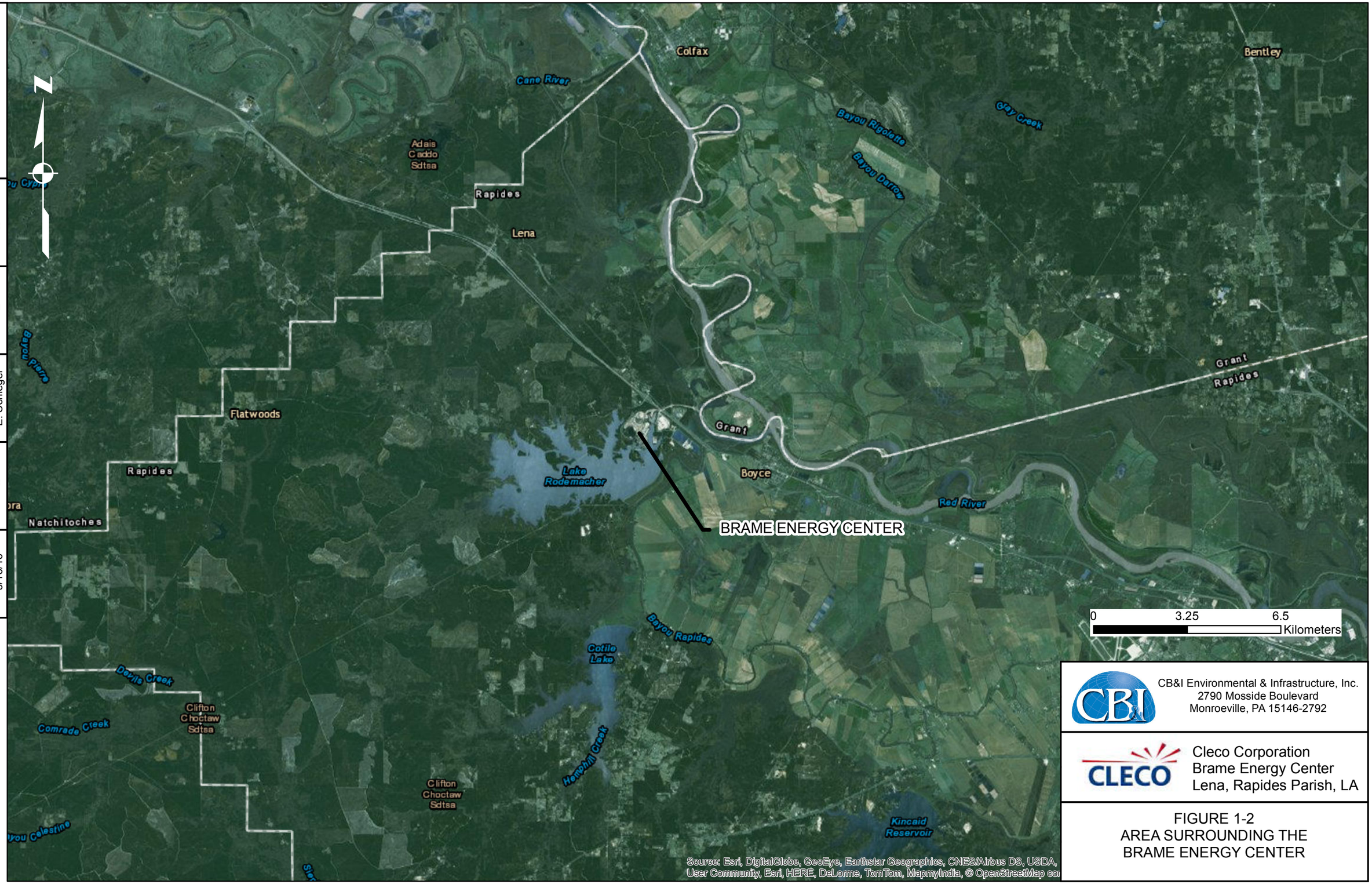
Cleco Corporation
Brame Energy Center
Lena, Rapides Parish, LA

FIGURE 1-1
LOCATION OF SO2 EMISSION SOURCES
IN BRAME ENERGY CENTER

DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
E. Schlegel	--	--	631215357-B1-2

DESIGNED BY	DATE
--	5/16/16

Document Path: O:\PROJECT\631215357\631215357-B1-2.mxd



CB&I Environmental & Infrastructure, Inc.
2790 Mosside Boulevard
Monroeville, PA 15146-2792

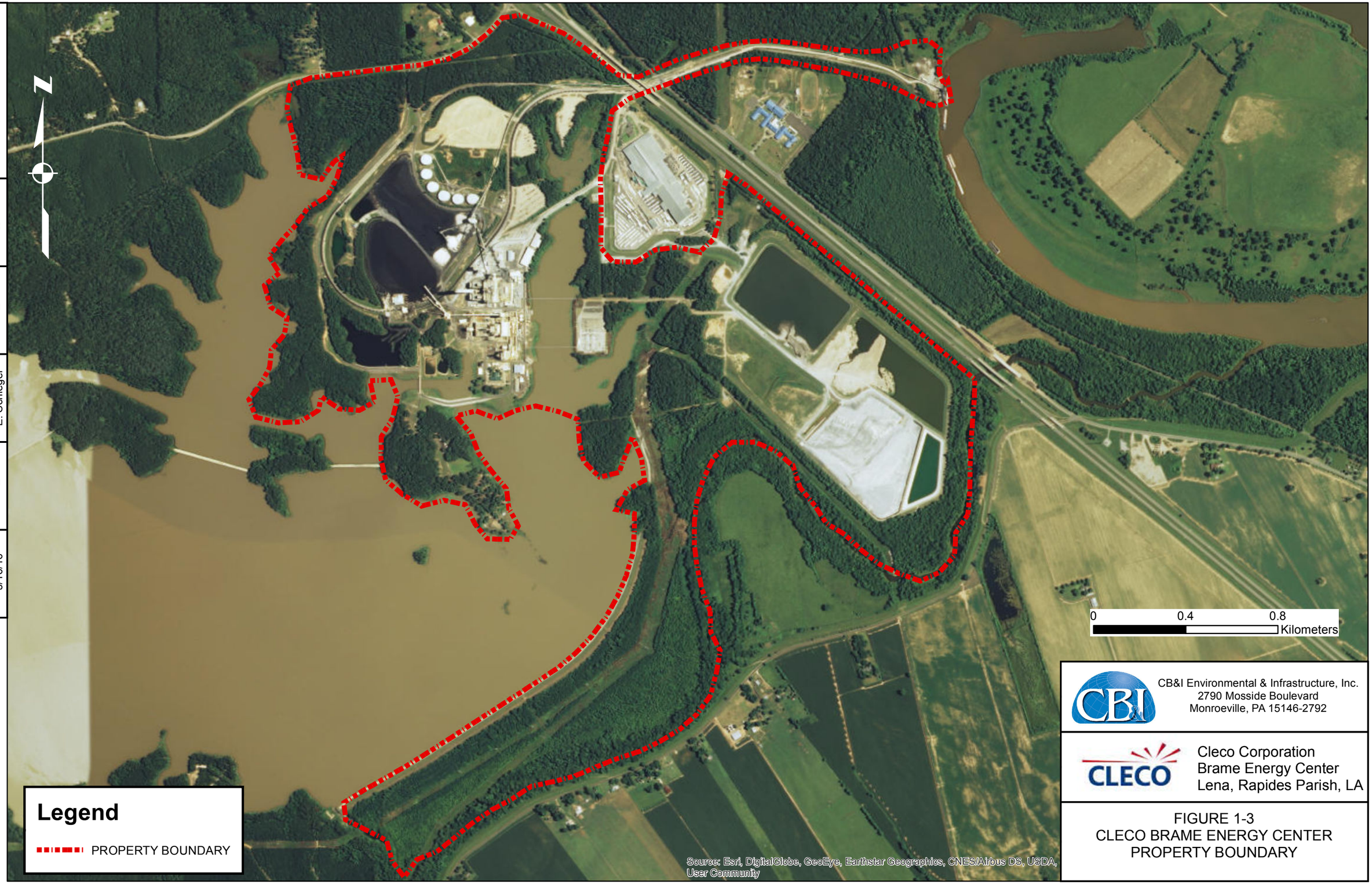
Cleco Corporation
Brame Energy Center
Lena, Rapides Parish, LA

FIGURE 1-2
AREA SURROUNDING THE
BRAME ENERGY CENTER

DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
E. Schlegel	--	--	631215357-B1-3

DESIGNED BY	DATE
--	5/16/16

Document Path: O:\PROJECT\631215357\631215357-B1-3.mxd



CB&I Environmental & Infrastructure, Inc.
2790 Mosside Boulevard
Monroeville, PA 15146-2792

Cleco Corporation
Brame Energy Center
Lena, Rapides Parish, LA

FIGURE 1-3
CLECO BRAME ENERGY CENTER
PROPERTY BOUNDARY

DRAWING NUMBER 631215357-B1-4

APPROVED BY --

CHECKED BY --

DRAWN BY E. Schlegel

DESIGNED BY --

DATE 5/16/16

Document Path: O:\PROJECT\631215357\631215357-B1-4.mxd

BOISE CASCADE WOOD PRODUCTS
ALEXANDRIA ENGINEERING WOOD
PRODUCTS FACILTY

COLUMBIA GULF TRANSMISSION
ALEXANDRIA COMPRESSOR STATION

PQ CORP-PINEVILLE PLANT

PROCTOR & GAMBLE MANUFACTURING

BRAME ENERGY CENTER

ACADIAN GAS PIPELINE SYSTEM
CHENYVILLE COMPRESSOR STATION

Natchitoches
Grant
La Salle
Concordia
Catahoula
Vernon
Rapides
Avoyelles
Beauregard
Allen
Evangeline

0 5 10 Kilometers

LEGEND:

SO2 EMISSION SOURCES

CB&I Environmental & Infrastructure, Inc.
2790 Mosside Boulevard
Monroeville, PA 15146-2792

Cleco Corporation
Brame Energy Center
Lena, Rapides Parish, LA

FIGURE 1-4
SO2 EMISSION SOURCES
IN RAPIDES PARISH

DRAWING NUMBER	APPROVED BY	CHECKED BY	DRAWN BY	DESIGNED BY	DATE
631215357-B1-5	--	--	E. Schlegel	--	5/16/16

MARTCO LLC - CHOPIN MILL

BOISE CASCADE WOOD PRODUCTS
ALEXANDRIA ENGINEERING WOOD
PRODUCTS FACILTY

BRAME ENERGY CENTER

Natchitoches

Grant

La Salle

Rapides

Vernon

LEGEND:

SO2 EMISSION SOURCES

0 5 10 Kilometers

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, User Community, Esri, HERE, DeLorme, TomTom, MapmyIndia, © OpenStreetMap co

CB&I Environmental & Infrastructure, Inc.
2790 Mosside Boulevard
Monroeville, PA 15146-2792

Cleco Corporation
Brame Energy Center
Lena, Rapides Parish, LA

FIGURE 1-5
SO2 EMISSION SOURCES WITHIN
20 KM OF BRAME ENERGY CENTER

Document Path: O:\PROJECT\631215357\631215357-B1-5.mxd

DRAWING NUMBER 631215357-B2-1

APPROVED BY --

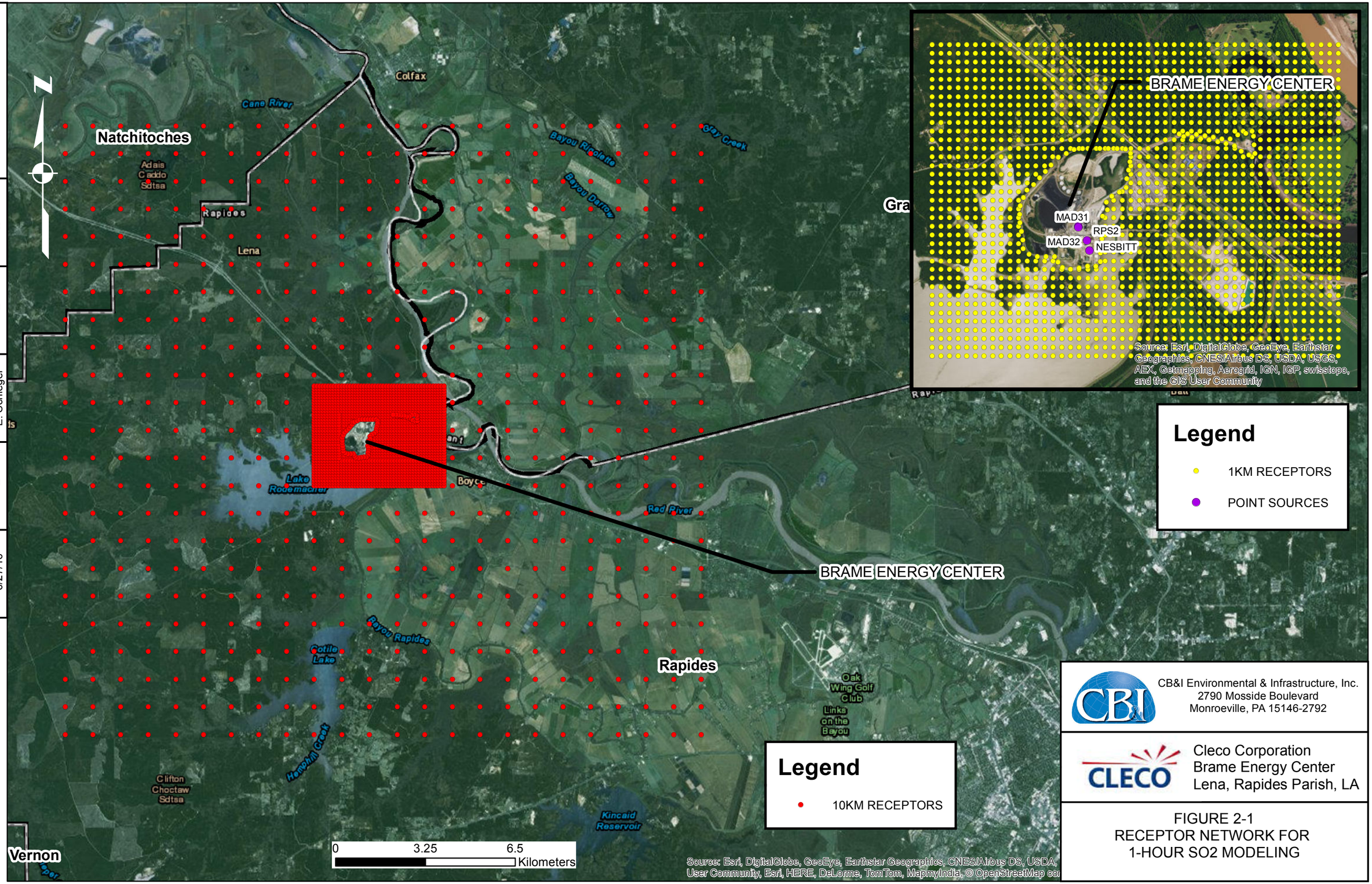
CHECKED BY --

DRAWN BY E. Schlegel

DESIGNED BY --

DATE 6/27/16

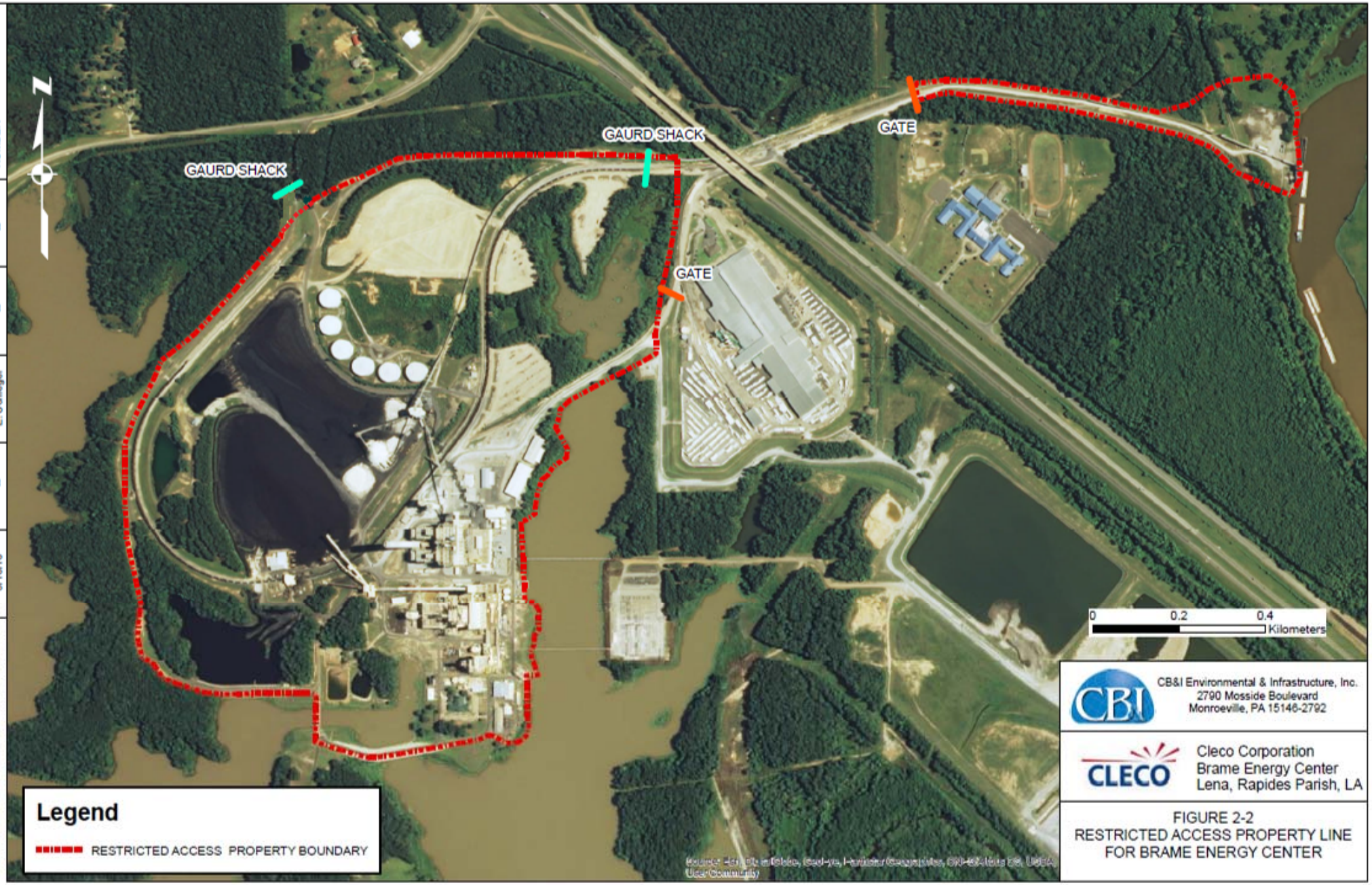
Document Path: O:\PROJECT\631215357\MXD\631215357-B2-1.mxd



CB&I Environmental & Infrastructure, Inc.
2790 Mosside Boulevard
Monroeville, PA 15146-2792

Cleco Corporation
Brame Energy Center
Lena, Rapides Parish, LA

FIGURE 2-1
RECEPTOR NETWORK FOR
1-HOUR SO2 MODELING



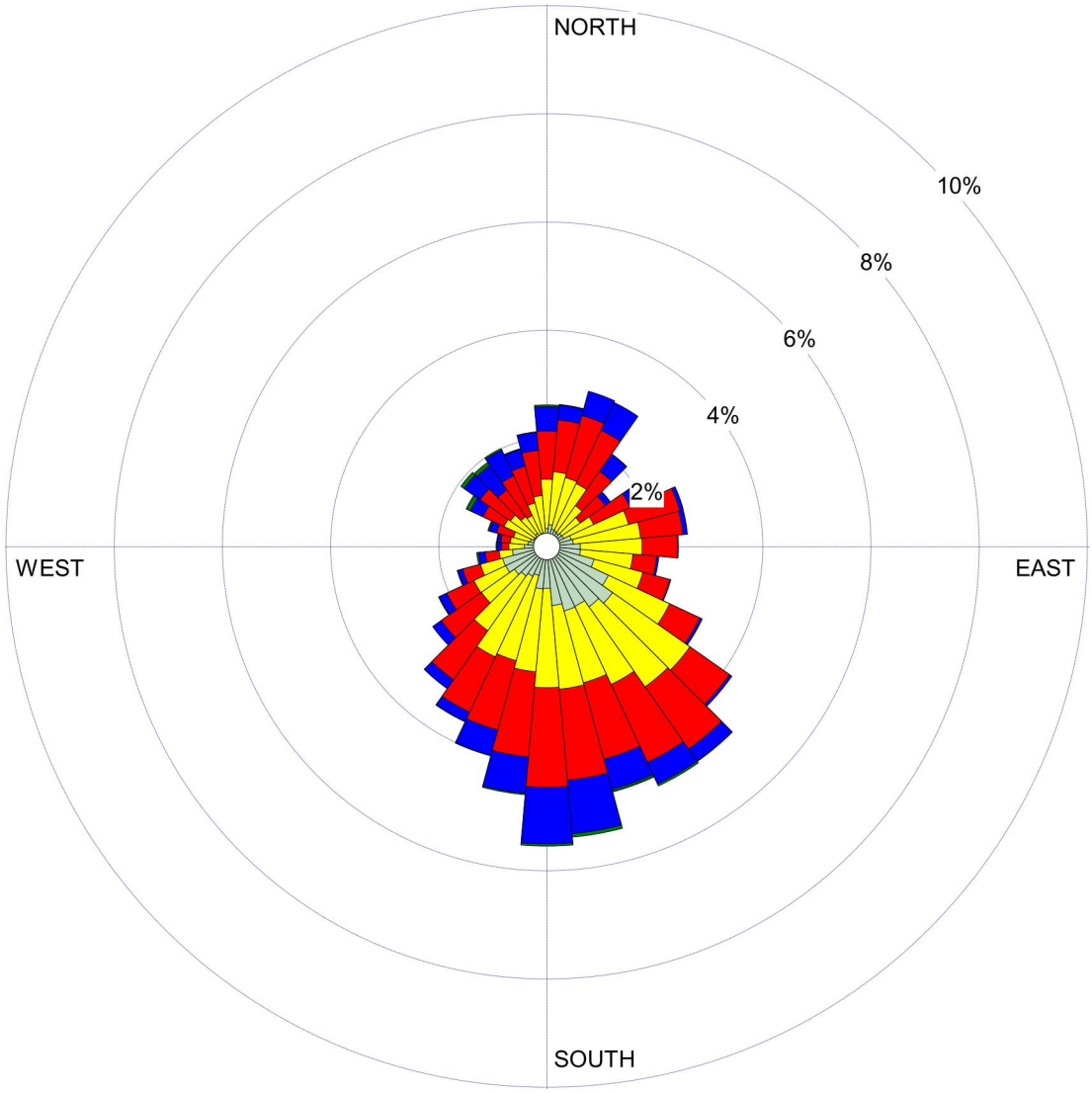
DRAWING NUMBER	APPROVED BY	CHECKED BY	DRAWN BY	DESIGNED BY	DATE
631215357-B2-2	–	–	E. Schlegel	–	5/16/16

Document Path: O:\PROJECT\631215357\631215357-B2-2.mxd

CB&I Environmental & Infrastructure, Inc.
2790 Mosside Boulevard
Monroeville, PA 15146-2792

Cleco Corporation
Brame Energy Center
Lena, Rapides Parish, LA

FIGURE 2-2
RESTRICTED ACCESS PROPERTY LINE
FOR BRAME ENERGY CENTER



DATA PERIOD:

START DATE: 1/1/2013 - 00:00
END DATE: 12/31/2015 - 23:59

CB&I Environmental & Infrastructure, Inc.
500 Penn Center Boulevard, Suite 1000
Pittsburgh, Pennsylvania 15235

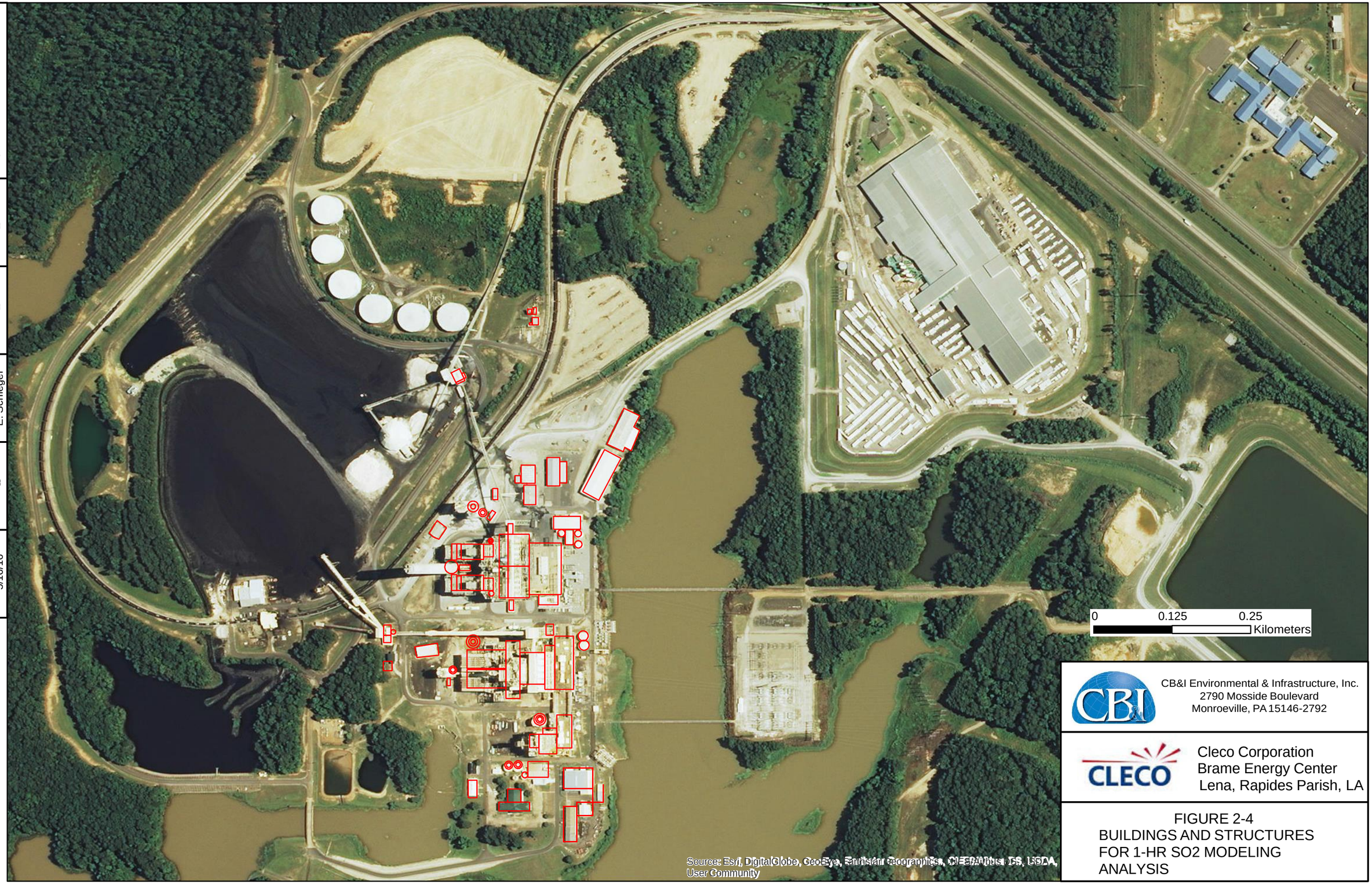
Cleco Corporation
Brame Energy Center
Lena, Rapides Parish, LA

FIGURE 2-3

3-YEAR COMPOSITE WINDROSE
FROM SHREVEPORT
METEOROLOGICAL STATION

OFFICE	DATE	DESIGNED BY	DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
Pittsburgh, PA	5/16/16	--	E. Schlegel	--	--	631215357-A5

File: O:\PROJECT\631215357\DWG\631215357-A5.dwg
Plot Date/Time: Jun 30, 2016 - 12:16pm
Plotted By: greg.jones
Xref:
Image: CBI-LOGO-cmyk.png
Cleco.png



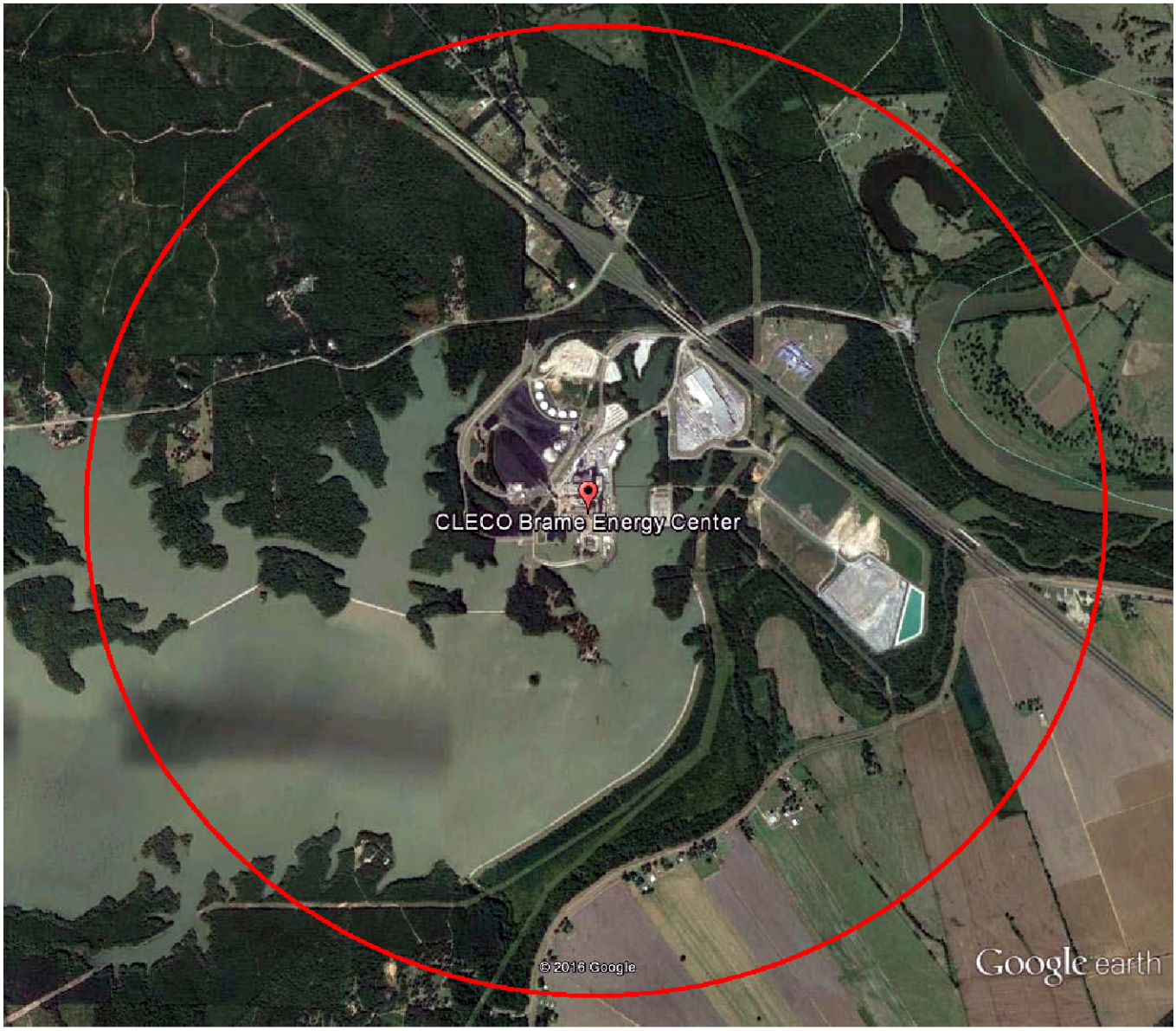
DESIGNED BY	DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
--	E. Schlegel	--	--	631215357-B2-4
DATE				
5/16/16				

Document Path: O:\PROJECT\631215357\631215357-B2-4.mxd

CB&I Environmental & Infrastructure, Inc.
2790 Mosside Boulevard
Monroeville, PA 15146-2792

Cleco Corporation
Brame Energy Center
Lena, Rapides Parish, LA

FIGURE 2-4
BUILDINGS AND STRUCTURES FOR 1-HR SO2 MODELING ANALYSIS



Google earth

miles 2
km 3

N

CB&I Environmental & Infrastructure, Inc.
4171 Essen Lane
Baton Rouge, Louisiana 70809

CLECO Corporation
Brame Energy Center
Lena, Rapides Parish, Louisiana

FIGURE 2-5
LAND USE WITHIN 3 Km OF
BRAME ENERGY CENTER