CLECO POWER LLC
BRAME ENERGY CENTER

BOTTOM ASH POND AND
FLY ASH POND
LENA, LA

2018 Annual Groundwater Monitoring Report for the Coal Combustion Residuals Rule

January 2019

TABLE OF CONTENTS

1.0 INTRODUCTION

Cleco Power LLC (Cleco) hereby presents the 2018 Annual Groundwater Monitoring report for the Bottom Ash and Fly Ash Ponds at the Brame Energy Center (BEC) located in Lena, Louisiana (Figure 1). This report summarizes groundwater sampling and analysis activities completed in accordance with applicable portions of the U.S. Environmental Protection Agency (EPA) Coal Combustion Residuals (CCR) Rule.

2.0 FACILITY INFORMATION

Cleco owns and operates the BEC located at 275 Rodemacher Road, Lena, Louisiana 71447. The Bottom Ash and Fly Ash Ponds in service at the plant have been permitted to operate by the Louisiana Department of Environmental Quality (LDEQ) Waste Permits Division. The materials handled by these facilities are non-hazardous, on-site-generated materials only.

As required by the CCR Rule part §257.90, BEC has a groundwater monitoring well system to evaluate the groundwater quality conditions near the Bottom Ash and Fly Ash Ponds. The monitoring system consists of recently installed monitoring wells, in addition to monitoring wells installed previously to conduct groundwater monitoring required by BEC's LDEQ approved solid waste permits. A total of nine monitoring wells have been installed per applicable portions of §257.91. Locations of the monitoring wells can be found on Figure 2, and a table of monitoring well construction details can be found in Table 1.

3.0 FIELD ACTIVITIES

Groundwater sampling events were conducted by Cleco approved contract personnel in accordance with applicable portions of §257.93. Semi-annual detection monitoring sampling events were conducted in April and October 2018, while additional voluntary baseline sampling events were conducted in January and August 2018.

It is noted that due to flooding of the Red River during the spring of 2018, flood waters inundated monitoring well W-24. Redevelopment activities were initiated at W-24 prior to the April 2018 sampling event to ensure that representative groundwater could be purged and sampled.

Prior to purging and sampling activities, the depth-to-water below the top of each well casing was measured and recorded prior to purging each well during each sampling event. Water levels were measured to the nearest 0.01 foot from the top of casing using an electronic water level indicator. Total depth of each well was also measured to confirm that the screened interval was open to groundwater flow. Water level measurements were recorded in groundwater sampling forms. The water level measurements were subtracted from the top of casing elevations to obtain the groundwater elevations.

Groundwater purging and sampling activities were conducted using electric submersible pumps. These activities were conducted in accordance with applicable portions of Sections 6.1, 6.2, 6.3 and 8.1.4 of the *Standard Guide for Sampling Groundwater Monitoring Wells* (ASTM International, Publication D4448). Non-dedicated sampling equipment which came into contact with groundwater samples was decontaminated prior to sampling each well to reduce the potential for cross-contamination. Groundwater samples were collected by filling the sample containers directly from the disposable tubing connected to the pump or from a disposable bailer. Care was taken to minimize agitation of the samples. Samples were placed in laboratory-provided plastic containers with appropriate preservatives, per Section 9 of ASTM D4448. Samples were properly preserved on ice in the field and shipped to Pace Analytical Services, LLC of St. Rose, Louisiana, for analysis of the CCR groundwater detection monitoring parameters by the following methods: chloride, fluoride and sulfate by 300.0; total dissolved solids by 2540C; and metals by 6020. Full chain-of-custody protocols were observed during sample collection, transportation, and analysis. Sample shipment/transport procedures were conducted per Sections 9.9 through 9.11 of ASTM D4448.

4.0 GROUNDWATER FLOW EVALUATION

Horizontal groundwater flow was evaluated in the uppermost aquifer by construction of potentiometric surface maps (Figures 3 through 6) from data measured in monitoring wells at BEC. An evaluation of groundwater flow indicates that horizontal groundwater flow at BEC is consistently towards local surface water bodies with flow towards Lake Rodemacher in the power station portion of the property and towards Bayou Jean de Jean in the area of the Bottom Ash Pond, Fly Ash Pond, and Ash Management Area. Based on USGS topographic quadrangles of the Lake Rodemacher area, the spillway elevation of Lake Rodemacher is 100 feet NGVD. Groundwater elevations determined in monitoring wells near the lake are generally higher than this maximum lake elevation, supporting groundwater flow towards the lake.

Groundwater flow rate was evaluated using the groundwater flow equation, $v = [k\ (dh/dl)] / n_e$. For this equation, v is groundwater flow velocity in ft/day, k is hydraulic conductivity in ft/day, dh/dl is hydraulic gradient in ft/ft, and n_e is effective porosity (unitless).

Hydraulic conductivity (k) value ranging from 10 to 100 ft/day was assumed (Heath, 1989) based on the silty sand and fine- to coarse-grained sand observed in soil cuttings from soil borings completed at the site. Hydraulic gradient (dh/dl) value estimates from potentiometric surface maps representing each sampling event for the Ash Ponds areas are summarized below. An effective porosity (n_e) of 0.2 was assumed based on the soil types of the uppermost water bearing zone (Fetter, 2001). Using these values, the groundwater flow rates (v) are listed below.

Date	Hydraulic Gradient (feet/feet)	Estimated Groundwater Flow Velocity (feet/day)
January 2018	0.0007 to 0.001	0.01 to 0.5
April 2018	0.0002 to 0.001	0.035 to 0.5
August 2018	0.001	0.05 to 0.5
October 2018	0.0001 to 0.00005	0.0025 to 0.05

It is important to note that this is an advective rate and does not take into account potential hydrogeological heterogeneities such as adsorption, biodegradation, dispersion, or other retarding factors in the groundwater flow in this zone. Additionally, variations in the advective flow may occur due to potential lateral geological heterogeneities.

5.0 ANALYTICAL RESULTS

Groundwater samples collected at BEC were analyzed for the CCR Rule detection monitoring parameters pH, boron, calcium, chloride, fluoride, sulfate, and total dissolved solids (TDS) using appropriate EPA approved analytical methods. Results show frequent detections of all parameters in both up- and downgradient monitoring wells at BEC. Analytical results are presented in Table 2.

6.0 STATISTICAL EVALUATION

Statistical evaluations of groundwater data have been performed per applicable portions of §257.93.f. The goal of the statistical evaluation is to determine if there is statistically significant evidence to show that facility operations may have adversely affected groundwater quality. Statistical evaluations are conducted to determine if there are any statistically significant increases (SSIs) between groundwater quality upgradient and groundwater quality downgradient of the Bottom Ash and Fly Ash Ponds.

Statistical evaluations at BEC were performed using interwell prediction limits for pH. The interwell prediction limits were performed using the Sanitas v9® software package. Prediction limits were constructed from the upgradient well data and based on the distribution of that data for each parameter. Normal distributions of data values use parametric methods. Non-normal distributions use non-parametric methods, in which case, the prediction limit is based on the highest value in the background data set. The most recent result for each downgradient well for each parameter was compared to the applicable prediction limit.

Results of the interwell prediction limits for the 2018 detection monitoring sampling events at BEC indicated that no SSIs were generated for pH.

Due to statistically significant variation found in upgradient monitoring well data, all detection monitoring parameters except pH were statistically evaluated using intrawell prediction limits. Intrawell tests are within well comparisons. In the case of limit-based tests, historical data from within a given monitoring well for a given parameter are used to construct a limit. Compliance points are compared to the limit to determine whether a change is occurring on a per-well/per-parameter basis. Normal distributions of data values use parametric methods. Non-normal distributions use non-parametric methods, in which case, the prediction limit is based on the highest value in the background data set.

Intrawell limit-based tests are recommended when there is evidence of spatial variation in groundwater quality, particularly among upgradient monitoring wells, as it is inappropriate to pool those data across monitoring wells for the purpose of creating interwell limits for comparison with compliance monitoring well data. Intrawell tests may be used at both new and existing facilities. Data used in the intrawell limit-based tests were screened for outliers, which, if found, were removed from the background data set prior to constructing limits for each well/parameter pair.

Verification resampling for SSIs is only conducted for SSIs generated in downgradient wells via intrawell methodology. Intrawell statistics have been performed on all wells; however, since the goal of the statistical evaluation is to determine if there is statistically significant evidence to show that facility operations may have adversely affected groundwater quality downgradient of the facilities, only downgradient wells are subject to verification resampling.

Intrawell statistical analysis of the 2018 detection monitoring groundwater data showed that no confirmed SSIs were generated in downgradient wells at BEC. As stated above, verification resampling will not be conducted for intrawell SSIs generated in upgradient wells.

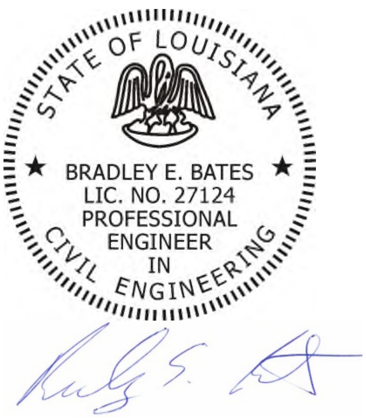
7.0 CONCLUSIONS AND RECOMMENDATIONS

- Cleco BEC has a monitoring well system to monitor groundwater quality at the Bottom Ash and Fly Ash Ponds per applicable portions of §257.91. The network consists of five upgradient and four downgradient monitoring wells.

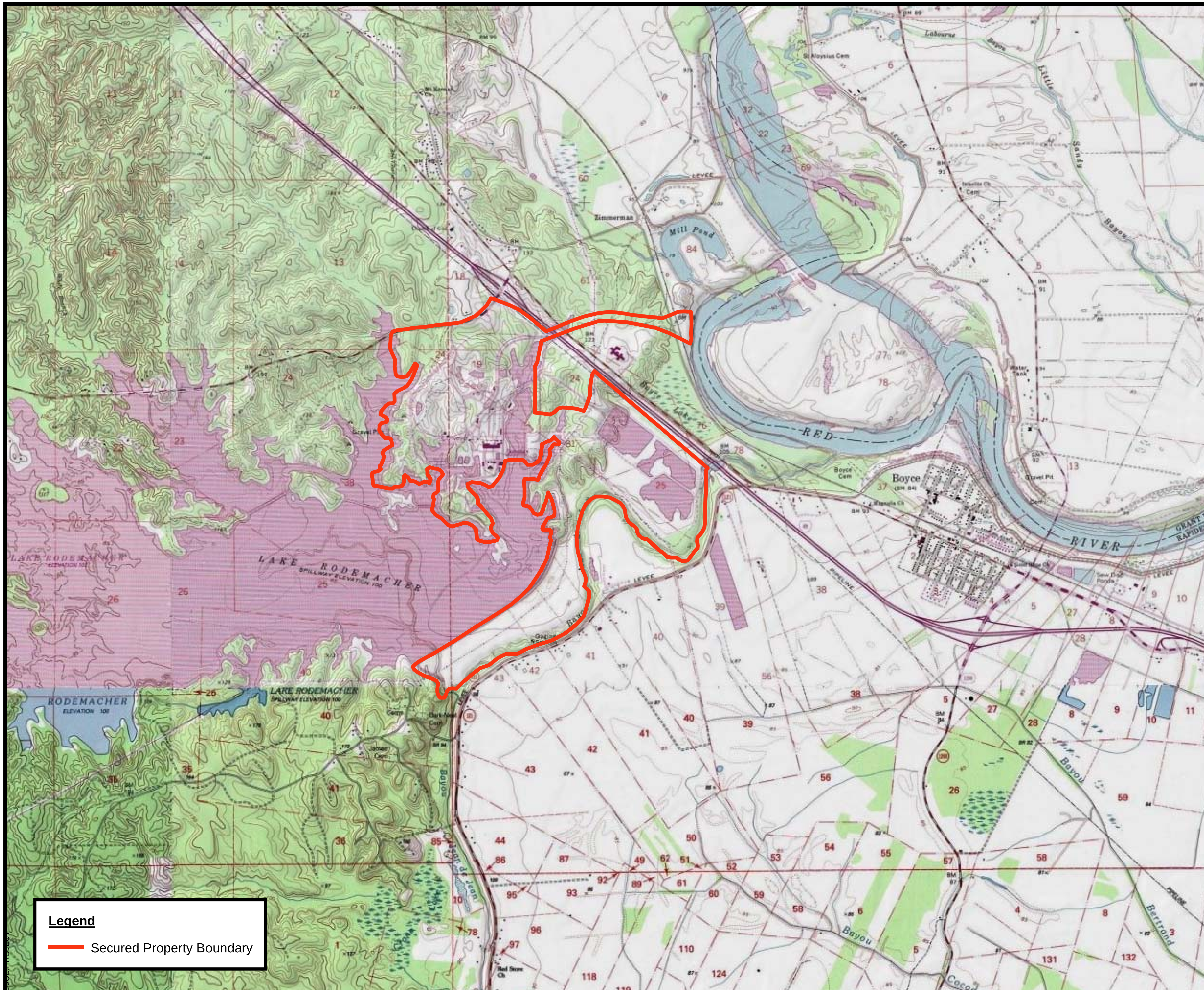
- Cleco conducted sufficient detection monitoring sampling events, per applicable portions of §257.93 and §257.94.
- Potentiometric surface evaluation at BEC indicates consistent groundwater flow towards local surface water bodies.
- Statistical evaluations of data conducted per applicable portions of §257.93 indicate that no SSIs have been generated in downgradient wells.
- Semi-annual detection monitoring sampling events are tentatively scheduled for April and October of 2019. Data generated during these sampling events will be included in the next annual report.

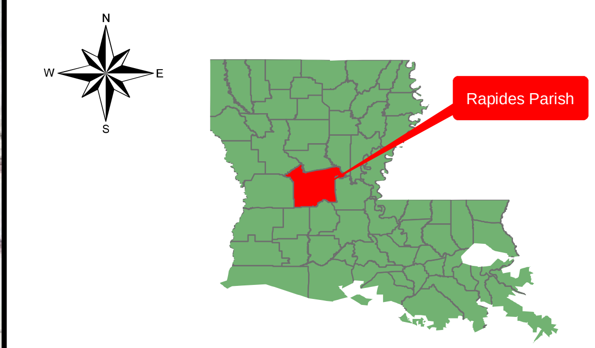
8.0 CERTIFICATION

I hereby certify this annual groundwater monitoring report for Cleco Power LLC. I am a duly licensed Professional Engineer under the laws of the State of Louisiana.



	27124
Signature	**PE Registration Number**
Bradley E. Bates	*Professional Engineer*
Name	**Title**
Eagle Environmental Services, Inc.	*12/13/2018*
Company	**Date**





0 1,500 3,000 6,000 9,000 Feet

Reference

U.S.G.S. TOPOGRAPHIC MAPS "LENA, LOUISIANA", "BOYCE, LOUISIANA", "JERICHO, LOUISIANA", AND "GARDNER, LOUISIANA."

CLECO Power LLC

Brame Energy Center

Site Location Map

Rapides Parish, Louisiana

Drawn:	jbh
Checked:	JM
Approved:	RS
Date:	11/08/10
Dwg. No.:	01-10-0071-A003

EAGLE ENVIRONMENTAL SERVICES

Figure 1

Legend

- CCR Rule Compliance Wells
- CCR Rule Background Wells
- Secured Property Boundary

0 500 1,000 2,000 3,000 Feet

CLECO Power LLC

Brame Energy Center

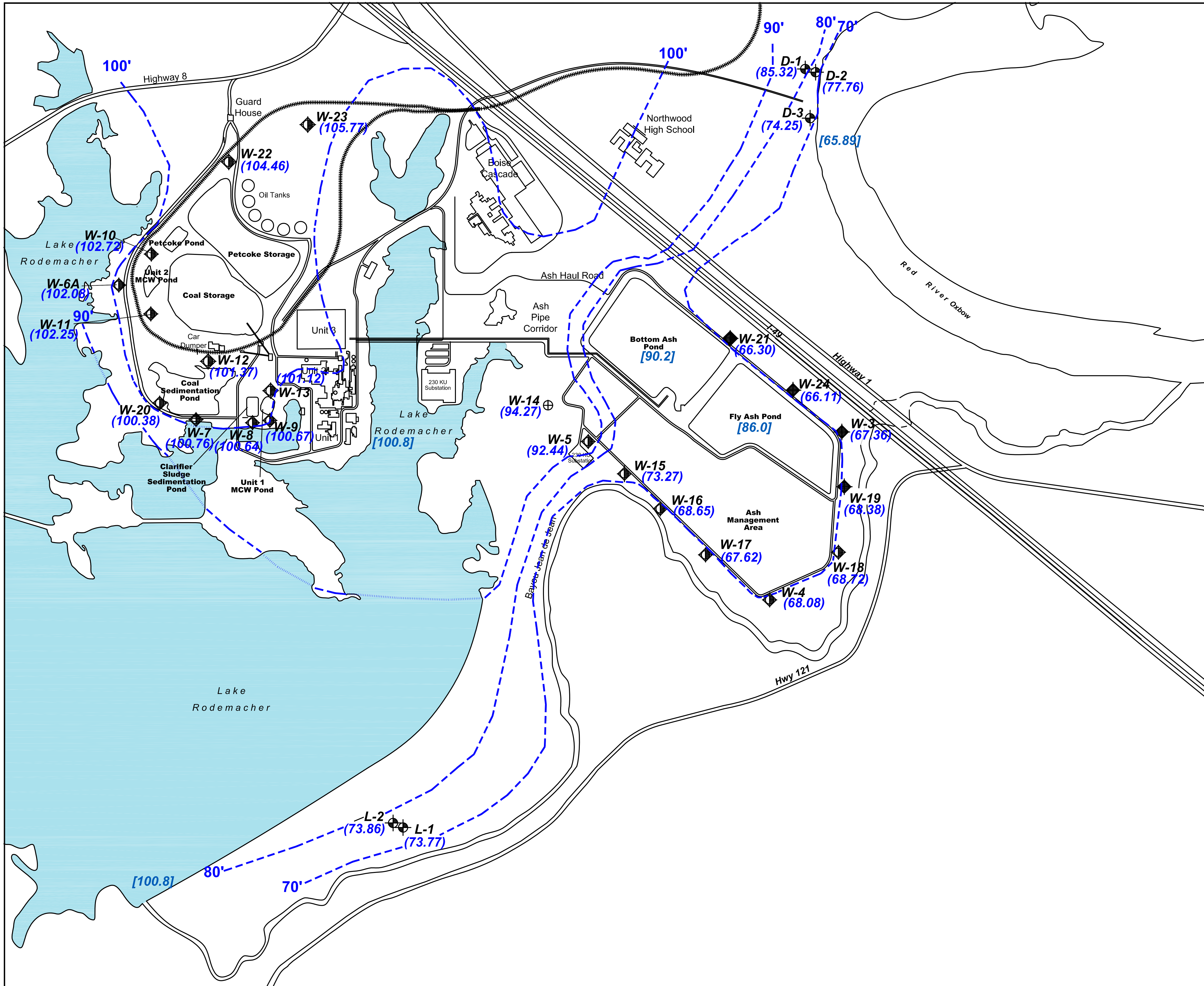
CCR Rule
Monitoring Well Location Map

Rapides Parish, Louisiana

E·A·G·L·E ENVIRONMENTAL SERVICES, INC.

Drawn:	JP
Checked:	RS
Approved:	JM
Date:	10/4/16
Dwg. No.:	01-16-0160-A003

Figure 2



N

Legend

- Railroad Tracks
- CCR Background Well Location
- CCR Compliance Well Location
- Non-CCR Piezometer Location
- (68.08) Potentiometric Surface Elevation, Ft. NGVD
- 70' Potentiometric Surface Elevation Contour, Ft. NGVD
- Inferred Potentiometric Surface Contour, Ft. NGVD
- [90.2] Surface Water Elevation, ft. NGVD

1,200 0 1,200

Scale: 1" = 1,200'

CLECO Corporation

Brame Energy Center

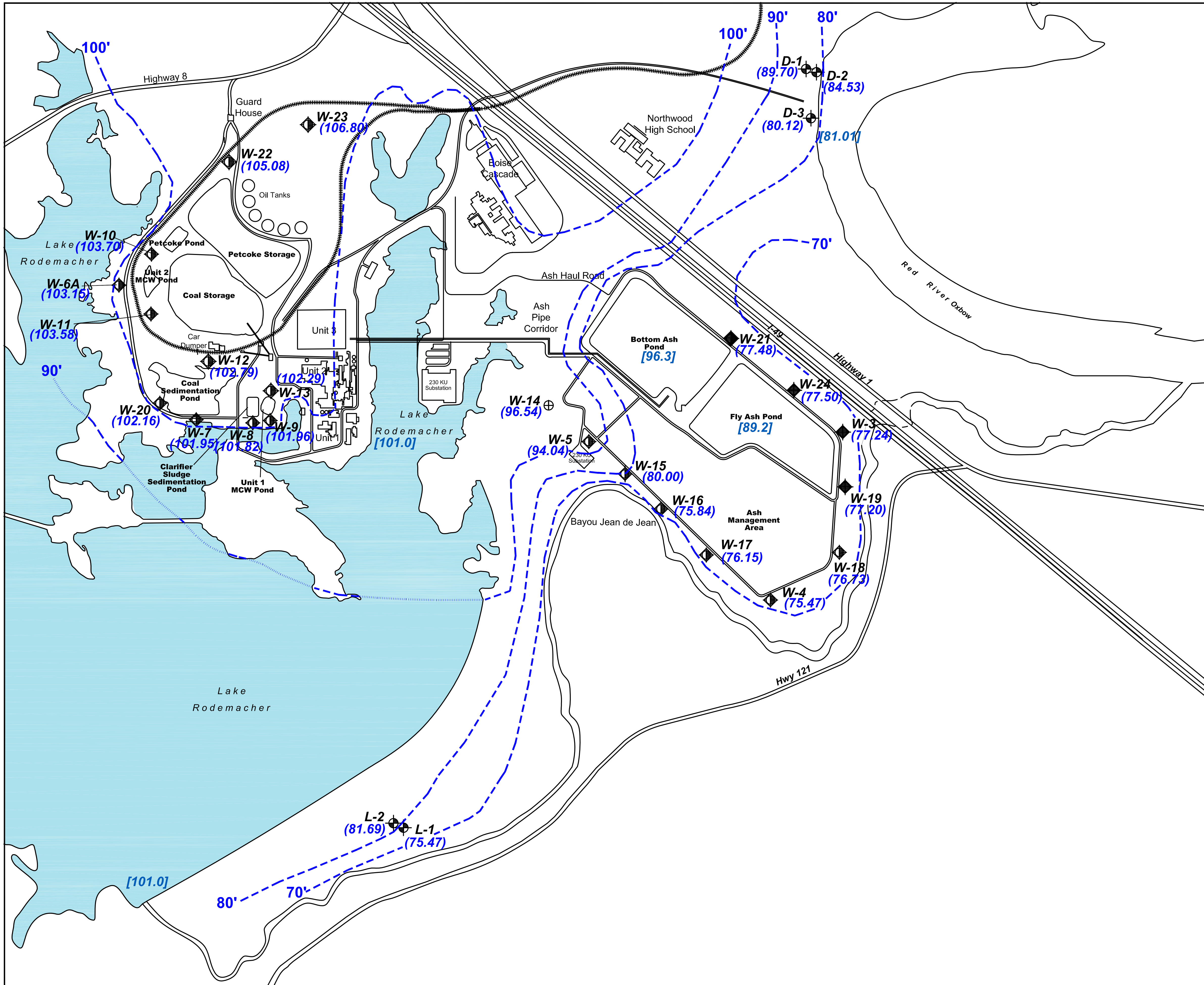
Cleco Brame
Potentiometric Surface Contour Map
January 2018

Rapides Parish, Louisiana

E·A·G·L·E ENVIRONMENTAL SERVICES, INC.

Drawn:	JP
Checked:	RB
Approved:	JM
Date:	1/24/18
Dwg. No.:	01-18-0169-A001

Figure 3



Legend

Railroad Tracks

CCR Background Well Location

CCR Compliance Well Location

Non-CCR Piezometer Location

(77.48) Potentiometric Surface Elevation, Ft. NGVD

70' Potentiometric Surface Elevation Contour, Ft. NGVD

Inferred Potentiometric Surface Contour, Ft. NGVD

[81.01] Surface Water Elevation ft. NGVD

1,200 0 1,200

Scale: 1" = 1,200'

CLECO Corporation

Brame Energy Center

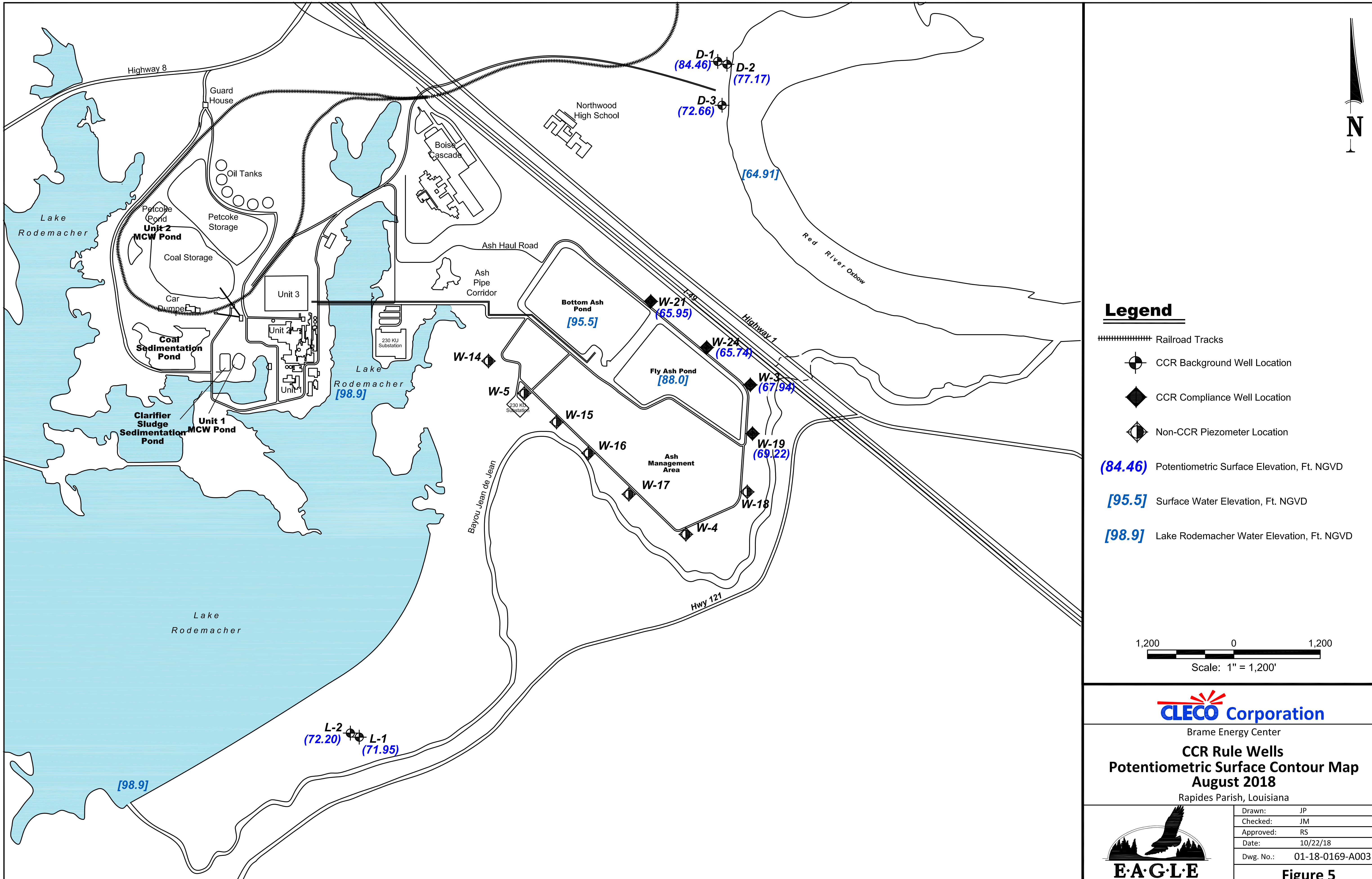
Cleco Brame
Potentiometric Surface Contour Map
April 2018

Rapides Parish, Louisiana

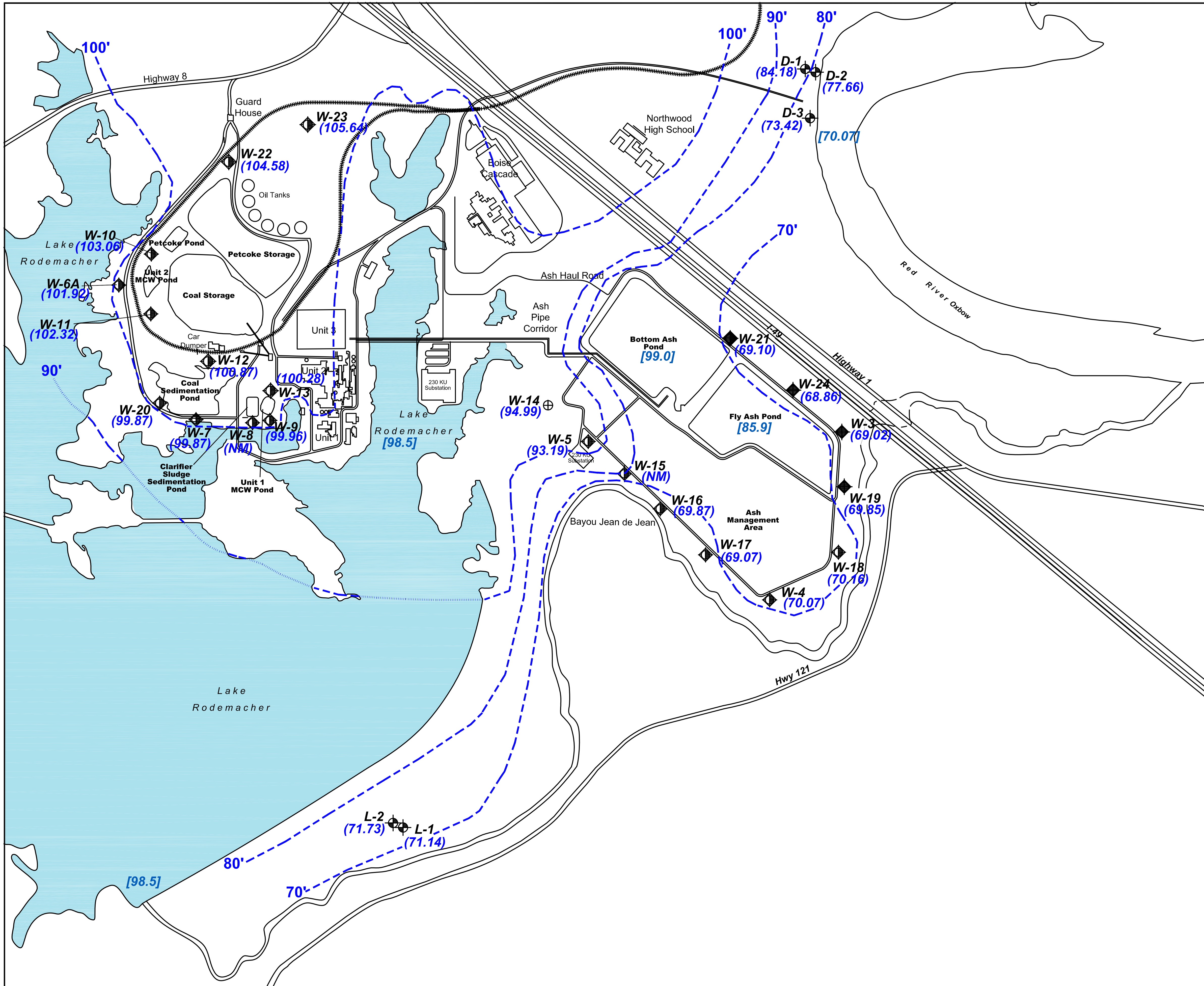
E·A·G·L·E ENVIRONMENTAL SERVICES, INC.

Drawn:	JP
Checked:	RS
Approved:	JM
Date:	5/10/18
Dwg. No.:	01-18-0169-A002

Figure 4



Highway 8
Guard House
Northwood High School
Boise Cascade
Oil Tanks
Petcoke Pond
Petcoke Storage
Unit 2 MCW Pond
Coal Storage
Car Dumper
Unit 3
Unit 2
Unit 1
Coal Sedimentation Pond
Clarifier Sludge Sedimentation Pond
Unit 1 MCW Pond
230 KU Substation
Lake Rodemacher
Lake Rodemacher
[98.9]
Lake Rodemacher
[98.9]
Ash Haul Road
Ash Pipe Corridor
Bottom Ash Pond
[95.5]
Fly Ash Pond
[88.0]
Ash Management Area
I-49
Highway 1
Hwy 121
Bayou Jean de Jean
Red River Oxbow
[64.91]
D-1
(84.46)
D-2
(77.17)
D-3
(72.66)
W-21
(65.95)
W-24
(65.74)
W-3
(67.94)
W-19
(69.22)
W-14
W-5
W-15
W-16
W-17
W-18
W-4
L-2
(72.20)
L-1
(71.95)
N
Legend
Railroad Tracks
CCR Background Well Location
CCR Compliance Well Location
Non-CCR Piezometer Location
(84.46) Potentiometric Surface Elevation, Ft. NGVD
[95.5] Surface Water Elevation, Ft. NGVD
[98.9] Lake Rodemacher Water Elevation, Ft. NGVD
1,200 0 1,200
Scale: 1" = 1,200'
CLECO Corporation
Brame Energy Center
CCR Rule Wells
Potentiometric Surface Contour Map
August 2018
Rapides Parish, Louisiana
Drawn: JP
Checked: JM
Approved: RS
Date: 10/22/18
Dwg. No.: 01-18-0169-A003
E·A·G·L·E ENVIRONMENTAL SERVICES, INC.
Figure 5



Legend

Railroad Tracks
CCR Background Well Location
CCR Compliance Well Location
Non-CCR Piezometer Location
(73.42) Potentiometric Surface Elevation, Ft. NGVD
70' Potentiometric Surface Elevation Contour, Ft. NGVD
Inferred Potentiometric Surface Contour, Ft. NGVD
[70.07] Surface Water Elevation ft. NGVD
NM Not Measured

1,200 0 1,200
Scale: 1" = 1,200'

CLECO Corporation
Brame Energy Center

Cleco Brame
Potentiometric Surface Contour Map
October 2018
Rapides Parish, Louisiana

E·A·G·L·E ENVIRONMENTAL SERVICES, INC.

Drawn:	JP
Checked:	RS
Approved:	JM
Date:	10/22/18
Dwg. No.:	01-18-0169-A004

Figure 6

Table 1
Monitoring Well Information

Well Number	D-1	D-2	D-3	L-1	L-2
Background (B) or Compliance (C)	B	B	B	B	B
Latitude (dd°mm'ss")	31°24'23.84"	31°24'23.41"	31°24'17.52"	31°22'47.68"	31°22'48.17"
Longitude (dd°mm'ss")	92°41' 53.62"	92°41'52.12"	92°41'52.95"	92°42'53.61"	92°42'55.01"
Casing Elevation (ft NGVD)	99.38	99.36	97.37	86.15	86.68
Concrete Pad Elevation (ft NGVD)	96.59	97.10	94.50	83.05	83.73
Well Depth (ft bgs)	40	46	35.5	36	40
Screen Length (ft)	10	10	10	10	10
Top of Screen (ft NGVD)	67.2	61.7	69.3	58.8	54.6
Bottom of Screen (ft NGVD)	57.2	51.7	59.3	48.8	44.6
Screen Slot Size (inches)	0.010	0.010	0.010	0.010	0.010
Casing Diameter (inches) & Material	2" PVC	2" PVC	2" PVC	2" PVC	2" PVC

Well Number	W-3	W-19	W-21	W-24
Background (B) or Compliance (C)	C	C	C	C
Latitude (dd°mm'ss")	31°23'37.79"	31°23'30.48"	31°23'49.57"	31°23'43.05"
Longitude (dd°mm'ss")	92°41'48.33"	92°41'50.26"	92°42'05.00"	92°41'55.61"
Casing Elevation (ft NGVD)	92.07	94.99	87.86	83.71
Concrete Pad Elevation (ft NGVD)	88.87	92.47	85.23	81.03
Well Depth (ft bgs)	77	55	54.5	55
Screen Length (ft)	10	10	10	10
Top of Screen (ft NGVD)	25.7	48.0	41.2	38.4
Bottom of Screen (ft NGVD)	15.7	38.0	31.2	28.4
Screen Slot Size (inches)	0.010	0.010	0.010	0.010
Casing Diameter (inches) & Material	2" PVC	2" PVC	2" PVC	2" PVC

Notes:

bgs = below ground surface

PVC = polyvinyl chloride

Table 2
2018 Analytical Data Summary

Parameter/Well/Date		Boron (mg/l)	Calcium (mg/l)	Chloride (mg/l)	Fluoride (mg/l)	pH (S.U.)	Sulfate (mg/l)	TDS (mg/l)
D-1 (BG)	1/22/18	0.047	4.9	13.4	0.1	6.84	10.8	135
	4/10/18	0.049	8.7	13.3	0.15	7.55	8.8	120
	8/8/18	0.044	5.2	12.2	<0.1	7.61	10.5	150
	10/4/18	0.046	5.8	12.3	<0.1	6.57	10.7	110
D-2 (BG)	1/22/18	0.095	96	11.4	0.5	7.19	57.5	475
	4/10/18	0.11	109	8.3	0.35	7.35	89.1	435
	8/8/18	0.11	104	8.2	0.38	7.41	78.7	575
	10/4/18	0.11	108	6.8	0.4	6.81	88.4	525
D-3 (BG)	1/22/18	0.31	91.5	11.2	0.49	7.28	50.2	915
	4/10/18	0.31	93.2	12.6	0.54	7.58	53.5	740
	8/8/18	0.29	86.4	10.7	1	7.4	49.1	680
	10/4/18	0.26	87	10.4	0.6	7.01	47.9	455
L-1 (BG)	1/22/18	0.12	121	5.3	0.28	7.52	13.1	475
	4/11/18	0.11	106	5.2	0.16	8.22	29.6	200
	8/8/18	0.13	117	6	0.18	7.34	11.6	500
	10/4/18	0.12	110	5.9	0.21	6	4.8	440
L-2 (BG)	1/22/18	0.1	70.4	3.9	0.47	7.27	19.9	315
	4/11/18	0.092	74.7	3.5	0.24	7.9	20.4	235
	8/8/18	0.099	62.5	3.3	0.47	7.18	20.3	340
	10/4/18	0.093	62.8	3.2	0.48	6.87	20.4	370
W-3	1/23/18	0.17	67.5	161	0.43	7	<1	685
	4/11/18	0.18	69.9 / 65.2*	164	0.25	6.73	<1	595
	8/8/18	0.17	66.1	206	<1	7.31	3.9	910
	10/4/18	0.18	64	179	0.26	6.5	2.4	700
W-19	1/23/18	0.19	99.6	59.5	0.38	7.24	<1	620
	4/11/18	0.2 / 0.18*	110	58.1	0.41	7.37	1.3	495
	8/8/18	0.19	102	59.5	0.22	7.06	<1	690
	10/4/18	0.19	97.4	64.7	0.24	6.72	<1	630
W-21	1/23/18	0.36	125	56.8	0.51	7.17	180	1,280
	4/11/18	0.35	124	54.3	0.41	7.51	160	1,110
	8/8/18	0.39	124	51.3	0.42	7.73	172	1,120
	10/4/18	0.35	122	54	1.1	6.91	177	1,130
W-24	1/23/18	0.19	138	175	0.34	7.21	1	1,310
	4/11/18	0.18	140	108	0.56	7.5	2.5	750
	8/8/18	0.2	117	96.2	0.27	7.51	2.4	920
	10/4/18	0.2	122	145	0.37	7.11	1	1,150

* 5/25/18 resampling result.

Notes:
mg/l = milligrams per liter
S.U. = standard units