HARD HAT SERVICES™
Engineering, Construction and Management Solutions

932 N. Wright Street, Suite 160, Naperville, IL 60563
Phone (877) 630-7428
www.hardhatinc.com

VIA EMAIL

October 16, 2020

Mr. Jeffrey Maxted
Alliant Energy – Environmental Services Manager
4902 North Biltmore Lane
Madison, WI 53718-2148

Re: Unstable Areas Determination CCR Surface Impoundments - §257.64
Wisconsin Power and Light Company
Columbia Energy Center
Pardeeville, Wisconsin

Mr. Jeffrey Maxted,

This Unstable Areas Determination has been prepared in accordance with the requirements of the United States Environmental Protection Agency (USEPA) published Final Rule for Hazardous and Solid Waste Management System – Disposal of Coal Combustion Residual (CCR) from Electric Utilities (40 CFR Parts 257 and 261, also known as the CCR Rule) published on April 17, 2015 (effective October 19, 2015) and subsequent amendments. This letter assesses the factors of both CCR units at Wisconsin Power and Light Company (WPL), Columbia Energy Center (COL) in Pardeeville, Wisconsin in accordance with the CCR Rule §257.64 Unstable Areas. For purposes of this Report, "CCR unit" refers to an existing or inactive CCR surface impoundment.

Background Information

In accordance with the requirements set forth in §257.64 of the CCR Rule a CCR unit must not be located in an unstable area. The owner or operator must consider all the following factors:

- On-site or local soil conditions that may result in significant differential settling,
- On-site or local geologic or geomorphologic features; and,
- On-site or local human-made features or events (both surface and subsurface).

Facility Specific Information

The WPL COL is located in Columbia County at W8375 Murray Road, Pardeeville, WI. Figure 1 provides both a topographic map and an aerial of the COL facility location, with the approximate property boundary of the facility identified. COL has two CCR surface impoundments, which are identified as follows (Figure 2):

- COL Primary Ash Pond (existing)
- COL Secondary Ash Pond (inactive)

Differential Settling

The COL Primary Ash Pond and COL Secondary Ash Pond are subdivided from a larger outer embankment constructed of compacted fine sand. The soil below the foundation of the embankment is medium dense fine sand from backwaters of the Wisconsin River underlain by very dense fine sand deposited by glaciation. Borings taken in 1971 indicated that rock is located at approximately 90 feet below the top of the embankments, Exhibit A.

In addition to the 1971 borings, borings were taken in the embankment in June of 2011 and indicate the embankment soil is dense fine sand (SP). Borings from 2015 were taken in the embankment between the COL Primary Ash Pond and COL Secondary Ash Pond for the installation of monitoring wells also indicates the embankments are dense sand, Exhibit A.

The boring logs from 1971 indicate that the foundation soil is the same as the embankment soil. However, the boring logs indicate that the upper part of the foundation sand is loose and transitions to very dense with depth. The results of the borings taken in 2015 indicate the embankment sand is dense to very dense.

The density observations from the soil borings were used to assign soil properties to the embankment and foundation soils using NAVFACS DM-7[1], Exhibit B. The internal friction angles selected based on the Standard Split Spoon (SPT) results reported on the borings are:

Soil Type	Internal Friction Angle °	Total Unit Weight (lb/ft3)
Embankment Sand	35	120
Foundation Sand	30	110

Based on the known geotechnical information, both the COL Primary Ash Pond and the COL Secondary Ash Pond are not susceptible to significant differential settlement. Additionally, annual inspections of the embankments for the last 4 years have indicated no observable areas of differential settlement on the embankments.

[1] Naval Facilities Engineering Command Design Manual DM-7, Figure 3-7 "Density versus Angle of Internal Friction for Cohesionless Soils", March 1971

Geologic and Geomorphologic Features

Columbia County Wisconsin consists mostly of glacial drift, while The Bedrock Geology of Wisconsin (Exhibit C) shows that the site likely contains underlying bedrock comprised of sandstone with some dolomite and shale[2]. A general bedrock stratigraphy of Columbia County is also included in Exhibit C[3].

While there are karst formations known to exist in Wisconsin, they are predominately in the east, south, and west parts of the state (Exhibit D[4]). This map shows that the COL impoundments are not located in an area susceptible to karst formation and/or paleosinks (sinkholes).

Several figures and tables have been included in Exhibit E from the COL Biennial Groundwater Monitoring Report for 2017-2018[5]. This document illustrates that the local groundwater direction is generally away from the impoundments toward the Wisconsin River. Additionally, the nested well water elevation data for MW-217/MW220RR and MW-48A/MW-48B suggests that there is very little downward gradient. As result, there is little risk for the formation of paleosinks.

Human-made Features or Events

Based on the information provided herein, both the COL Primary Ash Pond and the COL Secondary Ash Pond are not susceptible to anthropogenic activities that could exist in this area, which could include a large dam failure, failure due to improper cut and fill during construction, excessive drawdown of groundwater, extreme fluctuations in flooding from human-made changes, or failure due to underground mines.

Unstable Areas Determination

After review of the reasonably and readily available documentation, the following CCR Units are not located in unstable areas:

- COL Primary Ash Pond
- COL Secondary Ash Pond

[2] Geological and Natural History Survey, April 1961 Revised 2005, "Bedrock Geology of Wisconsin"
[3] Harr, C.A., L.C. Trotta, and R.G. Borman, 1978, "Ground-Water Resources and Geology of Columbia County, Wisconsin", University of Wisconsin-Extension Geological and Natural History Survey Information Circular 37, 1978.
[4] Bradbury, K.R., "Karst and Shallow Carbonate Bedrock in Wisconsin" University of Wisconsin-Extension Geological and Natural History Survey, Factsheet 02, 2009.
[5] SCS Engineers, "Biennial Groundwater Monitoring Report for 2017-2018", January 31, 2019

Qualified Professional Engineer Certification

The owner or operator of the CCR unit must obtain a certification from a qualified professional engineer attesting that the documentation as to whether a CCR unit meets the requirements 40 CFR 257.64(b).

To meet the requirements of 40 CFR 257.64(c), I Mark W. Loerop hereby certify that I am a licensed Professional Engineer in the State of Wisconsin; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in 40 CFR 257.64.

WISCONSIN
MARK W.
LOEROP
E-43783-6
NAPERVILLE
IL
PROFESSIONAL ENGINEER

By: [signature]

Name: MARK LOEROP

Date: OCTOBER 16, 2020

cc: Tony Morse, Alliant Energy

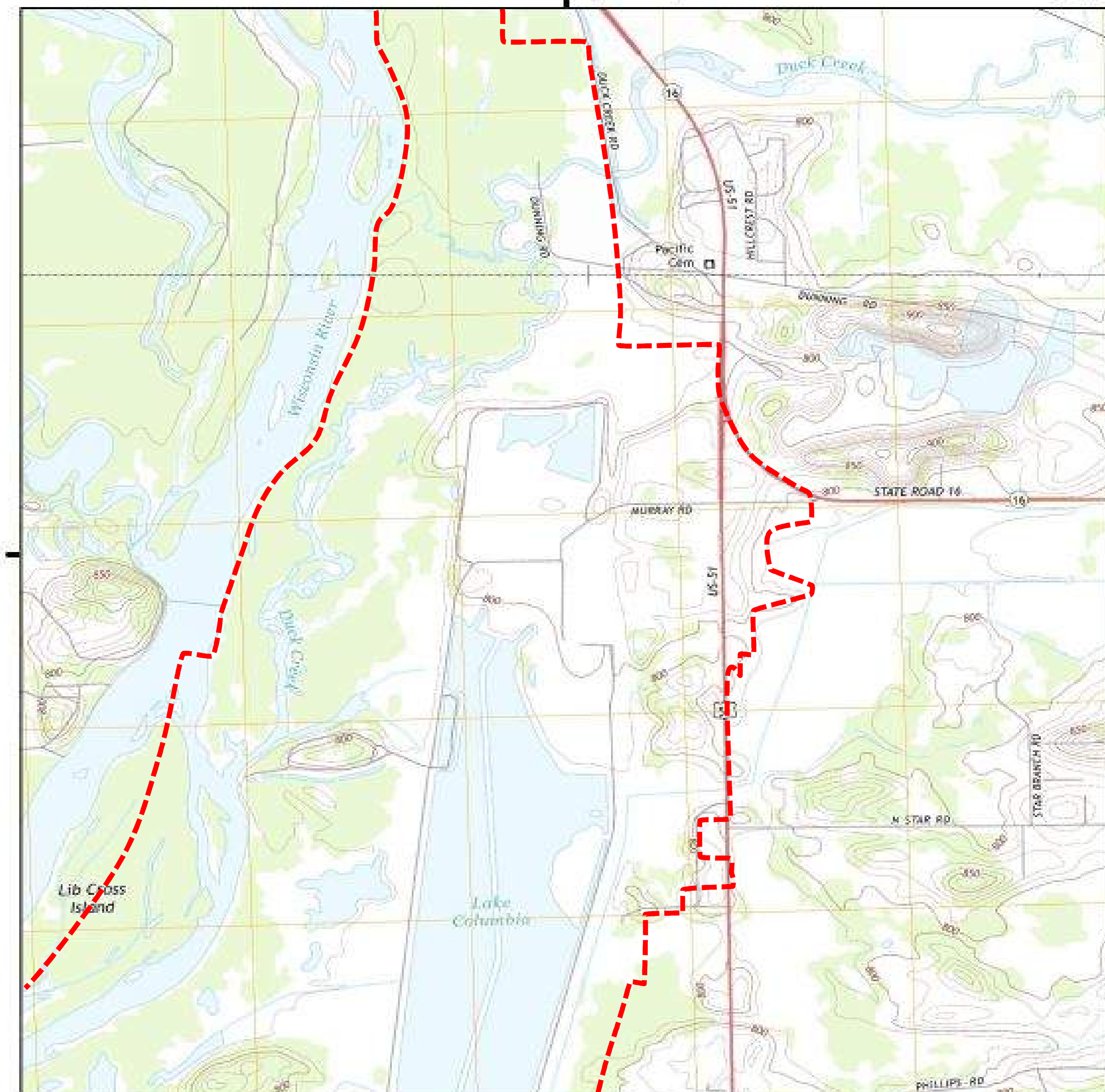
att: Figure 1 – Site Location
Figure 2 – Location of Critical Cross Sections
Exhibit A –Soil Boring Logs
Exhibit B – Soil Strength
Exhibit C – Bedrock Information
Exhibit D –Karst Information
Exhibit E – Groundwater Information

MWL/tjh/MWL
Z:\Shared\Projects\154 - Alliant Energy\154.018 - CCR Projects\022 - 2020 OGS & COL Unstable Conditions Determination\002 - COL UCD\Unstable Area Determination\COL Unstable Areas - FINAL.doc

FIGURES

Alliant Energy
Wisconsin Power and Light Company
Columbia Energy Center
Pardeeville, Wisconsin

Historical Topo Map 2013



Miles 0.25 0.5 1 1.5

This report includes information from the following map sheet(s).

NW N NE
W E
SW S SE

TP, Poynette, 2013, 7.5-minute
N, Portage, 2013, 7.5-minute

SITE NAME: Columbia Energy Center
ADDRESS: W8375 Murray Road
Pardeeville, WI 53954
CLIENT: Environmental Site Assessors

N

4555570 - 7 page 4

Historical Aerial Photo 6/12/2014

Approximate Property Boundary

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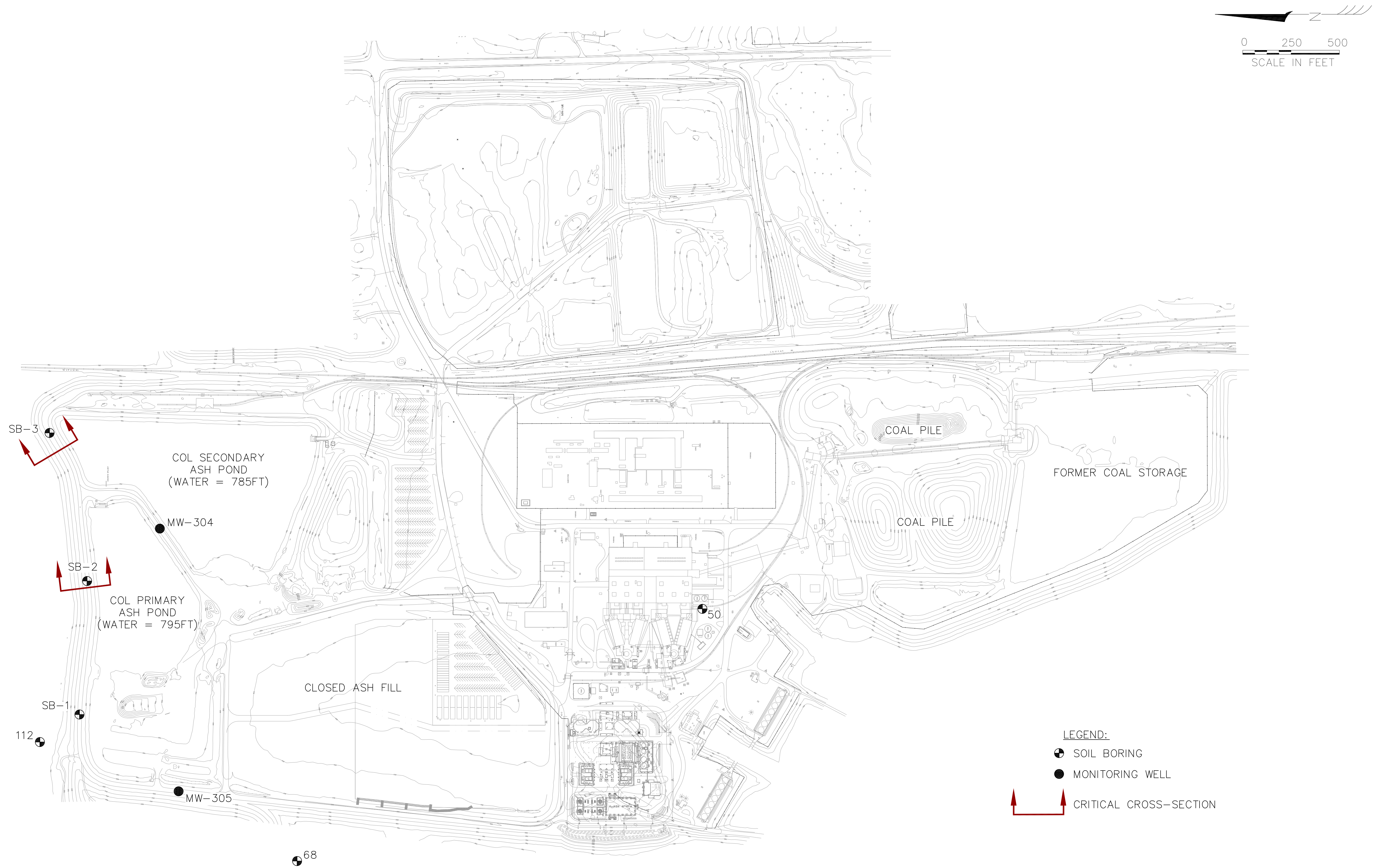
Site Location Columbia Energy Center Wisconsin Power and Light Company	Drawing Figure 1	Date 7/12/2016



REV	DATE	BY	DESCRIPTION
5			
4			
3			
2			
1			

hard hat™ SERVICES

SCALE:	AS SHOWN
DATE:	8-22-16
DRAWN BY:	JFD
CHKD BY:	TJH
APRVD BY:	MWL

CLIENT / LOCATION
WISCONSIN POWER AND LIGHT (WPL) COMPANY
COLUMBIA ENERGY CENTER
PARDEEVILLE, WISCONSIN

DRAWING DESCRIPTION
SAFETY FACTOR ASSESSMENT REPORT
SITE PLAN

JOB 154.010.025
SHT. FIGURE 2
DWG. 154.010.025-SFA

EXHIBIT A –SOIL BORING LOGS

Alliant Energy
Wisconsin Power and Light Company
Columbia Energy Center
Pardeeville, Wisconsin

Unstable Area Determination

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122 Rev. 7-98

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name: WPL-Columbia SCS#: 25215135.00	License/Permit/Monitoring Number:	Boring Number: MW-304	
Boring Drilled By: Name of crew chief (first, last) and Firm: Kevin Durst, Badger State Drilling	Date Drilling Started: 11/12/2015	Date Drilling Completed: 11/12/2015	Drilling Method: hollow stem auger
WI Unique Well No.: VY703 / DNR Well ID No.: / Common Well Name:	Final Static Water Level: Feet	Surface Elevation: 802.50 Feet	Borehole Diameter: 8.5 in.
Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒ State Plane 544671 N, 2122897 E /C/N; 1/4 of 1/4 of Section 27, T 12 N, R 9 E	Lat ° ' " Long ° ' "	Local Grid Location: Feet ☐ N ☐ S; Feet ☐ E ☐ W	
Facility ID: / County: Columbia	County Code: 11	Civil Town/City/ or Village: Portage	

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Pocket Penetration (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				TOPSOIL.	TOPSOIL									
			1	SILTY SAND, mostly fine, brown/tan (10YR 5/6).										
S1	24	7 8 10 12	2							M				
			3											
			4	Same as above except, trace gravel, brown tan to grey (top to bottom) 10YR 5/4.										
S2	24	14 22 26 31	5							M				
			6	Same as above except, brown/tan/grey assorted coloring.										
S3	24	16 18 22 24	7							M				
			8		SM									
			9	Same as above except, black/grey/brown, saturated area about 2" thick.										
S4	24	11 15 15 14	10							M				
			11	Same as above except, 10YR 5/3.										
S5	24	23 31 30 29	12							M				
			13											
			14	trace gravel.										
S6	20	9 10 7 5	15							M				

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: [signature] for Zach Watson
Firm: SCS Engineers, 2830 Dairy Drive Madison, WI 53711 Tel: (608) 224-2830 Fax:

SOIL BORING LOG INFORMATION SUPPLEMENT

Form 4400-122A

Boring Number MW-304 Use only as an attachment to Form 4400-122.

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties: Pocket Penetration (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			16	SILTY SAND, mostly fine, brown/tan (10YR 5/6).										
S7	4		17							W				dropped spoon
			18	Same as above except, 10YR 6/3.										
			19		SM									
S8			20							W				
			21											
			22											
			23	End of boring at 23 ft bgs.										

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION

Form 4400-122 Rev. 7-98

Route To: Watershed/Wastewater ☐ Remediation/Redevelopment ☐ Waste Management ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
WPL-Columbia SCS#: 25215135.00		MW-305

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Kevin Durst Badger State Drilling	11/13/2015	11/13/2015	hollow stem auger

WI Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
VY716			Feet	803.95 Feet	8.5 in.

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 544776.1 N, 2121537 E S/C/N
1/4 of 1/4 of Section 27, T 12 N, R 9 E
Lat ° ' " Long ° ' "
Local Grid Location ☐ N ☐ S Feet ☐ E ☐ W Feet

Facility ID	County	County Code	Civil Town/City/ or Village
	Columbia	11	Portage

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Pocket Penetration (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			0–1	TOPSOIL	TOPSOIL									
			1	SILTY SAND, mostly fine, brown/tan 10YR 5/8.										
S1	18	5 8 9 7	2							M				
S2	18	2 3 3 4	4–5							M				
			6	Same as above except, trace gravel, tan 10YR 6/8 at bottom.	SM									
S3	18	2 8 9 8	7							M				
			9	Same as above except, light tan 10YR 6/6, trace gravel, some large gravel chunks.										
S4	20	5 7 6 5	10							M				
			11	POORLY GRADED SAND, tan (10YR 6/8), trace gravel, some saturated areas.	SP									
S5	20	9 12 17 22	12							M				
			13.5	SILTY SAND, trace gravel, tan (10YR 5/6).	SM									
S6	24	16 19 22 34	15							W				

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature	Firm	
[signature] for Zach Watson	SCS Engineers 2830 Dairy Drive Madison, WI 53711	Tel: (608) 224-2830 Fax:

This form is authorized by Chapters 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats. Completion of this form is mandatory. Failure to file this form may result in forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on this form is not intended to be be used for any other purpose. NOTE: See instructions for more information, including where the completed form should be sent.

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number MW-305 Use only as an attachment to Form 4400-122.

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Pocket Penetration (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
S7		31 30 41 50/2	16 17 18	SILTY SAND, trace gravel, tan (10YR 5/6), some large dolomite chunks.	SM					W				
				End of boring at 18 ft bgs.										

Boring Log Legend

Sample
No: (Number) Soil samples are numbered consecutively from the ground surface. Core samples are numbered consecutively from the first core run.

Type:	A= Auger Cuttings	CR= Core Run	MS= Modified Spoon	PB= Pitcher Barrel
	PT= Piston Tube	ST= Shelby Tube	SS= Split Spoon (2" O.D.)	WC= Wash Cuttings

Interval: The depth of sampling interval in feet below ground surface

Blow Count
The number of blows required to drive a 2-inch O.D. split-spoon sampler with a 140 pound hammer falling 30-inches. When appropriate, the sampler is driven 18 inches and blow counts are reported for each 6-inch interval. The sum of blow counts for the last two 6-inch intervals is designated as the standard penetration resistance (N) expressed as blows per foot.

Recovery in Inches
The length of sample recovered by the sampling device.

U.S.C.S. Soil Type
The Unified Soil Classification System symbol for recovered soil samples determined by visual examination or laboratory tests. Refer to ASTM D2487-69 for a detailed description of procedure and symbols. Underlined symbols denote classifications based on laboratory tests (i.e. ML), all others are based on visual classification only.

Percent Moisture
Natural moisture content of sample expressed as percent of dry weight.

q_u TSF
Unconfined compressive strength in tons per square foot obtained by hand penetrometer. Laboratory compression test values are indicated by underlining.

Contact Depth
The contact depth between soil layers is interpreted from significant changes in recovered samples and observations during drilling. Actual changes between soil layers often occur gradually and the contact depths shown on the boring logs should be considered as approximate.

Soil Description and Remarks
Soil descriptions include consistency or density, color, predominant soil types and modifying constituents.

Cohesive Soils			Cohesionless Soils	
Consistency	q_u (TSF)	Blows/ft.	Density	Blows/ft.
Very Soft	less than 0.25	0-1	Very Loose	4 or less
Soft	0.25 to 0.50	2-4	Loose	5 to 10
Medium Stiff	0.50 to 1.00	5-8	Medium Dense	11 to 30
Stiff	1.00 to 2.00	9-15	Dense	30 to 50
Very Stiff	2.00 to 4.00	15-30	Very Dense	Over 50
Hard	more than 4.00	Over 30		

Particle Size Description

Boulder =	Larger than 12 inches
Cobble =	3 to 12 inches
Gravel =	0.187 to 3 inches
Sand =	0.074 to 4.76 mm
Silt and Clay =	smaller than 0.074 mm

Definition of Terms

Trace =	5 to 12 percent by weight
Some =	12 to 30 percent by weight
And =	Approximately equal fractions
( ) =	Driller's observation

Piezo.
(Piezometer) Screened interval of the piezometer installation is denoted by cross-hatching.

General Note
The boring log and related information depicted subsurface conditions only at the specified locations and date indicated. Soil conditions and water levels at other locations may differ from conditions occurring at these boring locations. Also the passage of time may result in a change in the conditions at these boring locations.

Soil Test Boring Refusal
Defined as any material causing a blow count greater that 50 blows/6 inches. Such material may include bedrock, "floating" rock slabs, boulders, dense gravel seams, hard pan clay, or cemented soils. Refusal is usually indicated in fractional notation showing number of blows as the numerator and inches of penetration as the denominator.

BORING LOG

CABENO
Environmental Field Services, LLC

CLIENT: Aether dbs
COORDINATES: *N NOT SURVEYED* *E NOT SURVEYED*
PROJECT: Alliant Columbia Station
BORING NO.: *SB1*

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Chris Sullivan*
DATE BEGAN: *06-01-11*
DATE FINISHED: *06-01-11*
GROUND SURFACE ELEVATION:

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	POCKET PENETROMETER (TONS/FT2)	CONSISTENCY vs. DEPTH	DEPTH IN FEET	PROFILE	DESCRIPTION
						0		SAND & GRAVEL; light brown to orange; fine to coarse grained; well graded; dry to moist. (Fill)
	SP1	4.7'/5'						SAND; light brown; fine grained; poorly graded; moist. (Fill)
						-5		
	SP2	5'/5'						
▽								@ 8.5' grades wet
						-10		
	SP3	4'/5'						@ 13' grades yellow to light tan
						-15		@ 15' grades fine to coarse, well graded
	SP4	5'/5'						@ 17' grades fine sand w/ well rounded gravels, trace silt/clay
						-20		Bottom of boring @ 19'
						-25		

CABENO

Environmental Field Services, LLC

BORING LOG

CLIENT: Aether dbs

COORDINATES: *N NOT SURVEYED* / *E NOT SURVEYED*

PROJECT: Alliant Columbia Station

BORING NO.: ***SB2***

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Chris Sullivan*
DATE BEGAN: *06-01-11*
DATE FINISHED: *06-01-11*
GROUND SURFACE ELEVATION:

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	POCKET PENETROMETER (TONS/FT2)	CONSISTENCY vs. DEPTH	DEPTH IN FEET	PROFILE	DESCRIPTION
						0		SAND; light brown to orange; fine grained; poorly graded; dry to moist; trace gravels. (Fill)
	SP1	5'/5'						
						-5		@ 5' grades trace silt
	SP2	5'/5'						
						-10		@ 10' to 13', very hard & dense; seems overconsolidated; more recovery than push
	SP3	5'/3'						
						-15		Bottom of boring @ 13' Boring advanced W/ Geoprobe Model 6610DT using 60-inch Macrocore sampling system. Boring backfilled to groundsurface w/ bentonite chips on 06-1-11.
						-20		

CABENO

Environmental Field Services, LLC

BORING LOG

CLIENT: Aether dbs

PROJECT: Alliant Columbia Station

COORDINATES: *N NOT SURVEYED* / *E NOT SURVEYED*

BORING NO.: ***SB3***

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Chris Sullivan*
DATE BEGAN: *06-01-11*
DATE FINISHED: *06-01-11*
GROUND SURFACE ELEVATION:

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	POCKET PENETROMETER (TONS/FT2)	CONSISTENCY vs. DEPTH	DEPTH IN FEET	PROFILE	DESCRIPTION
						0		SAND; light brown to orange; fine grained; poorly graded; dry to moist; trace gravels. (Fill)
	SP1	5'/5'						
						-5		
	SP2	5'/5'						
						-10		
	SP3	5'/5'						
						-15		
▽								@ 16' grades gray and wet.
	SP4	5'/5'						
						-20		
	SP5	5'/5'						
						-25		PEAT; brown; dry; non-plastic. (PT)
	SP6	1'/1'						Clayey SILT; gray; non-plastic; hard; moist. (ML)
								Bottom of boring @ 26' Boring advanced w/ Geoprobe Model 6610DT using 60-inch Macrocore sampling system. Boring backfilled to groundsurface w/ bentonite chips on 06-1-11.
						-30		

50 USED 54'-0" OF CASING

EL. 823'-0"

SILTY SAND

6/12

4/12 ORANGE-BROWN FINE SAND, LITTLE TO TRACE OF SILT & MEDIUM SAND, TRACE OF SMALL GRAVEL.

9/12

FIRM

34/12

HARD

74/12

82/12 LIGHT BROWN TO GRAY, FINE TO MEDIUM SAND, LITTLE TO TRACE OF COARSE SAND, TRACE OF SILT, OCCASIONAL SMALL TO MEDIUM GRAVEL & STONE CHIPS.

120/11

118/12

120/10

W.L. @ 11 DAYS

120/11

W.L. WHILE DRILLING

120/9

120/7

120/6

LACKING GRAVEL & STONE CHIPS

120/6

DROVE CASING

100/6

100/8

BOULDER

200/5

6" BLACK GRANITE

100/3

100/6

LIGHT BROWN TO WHITE FINE TO MEDIUM SAND.

100/2

250/3

200/1½

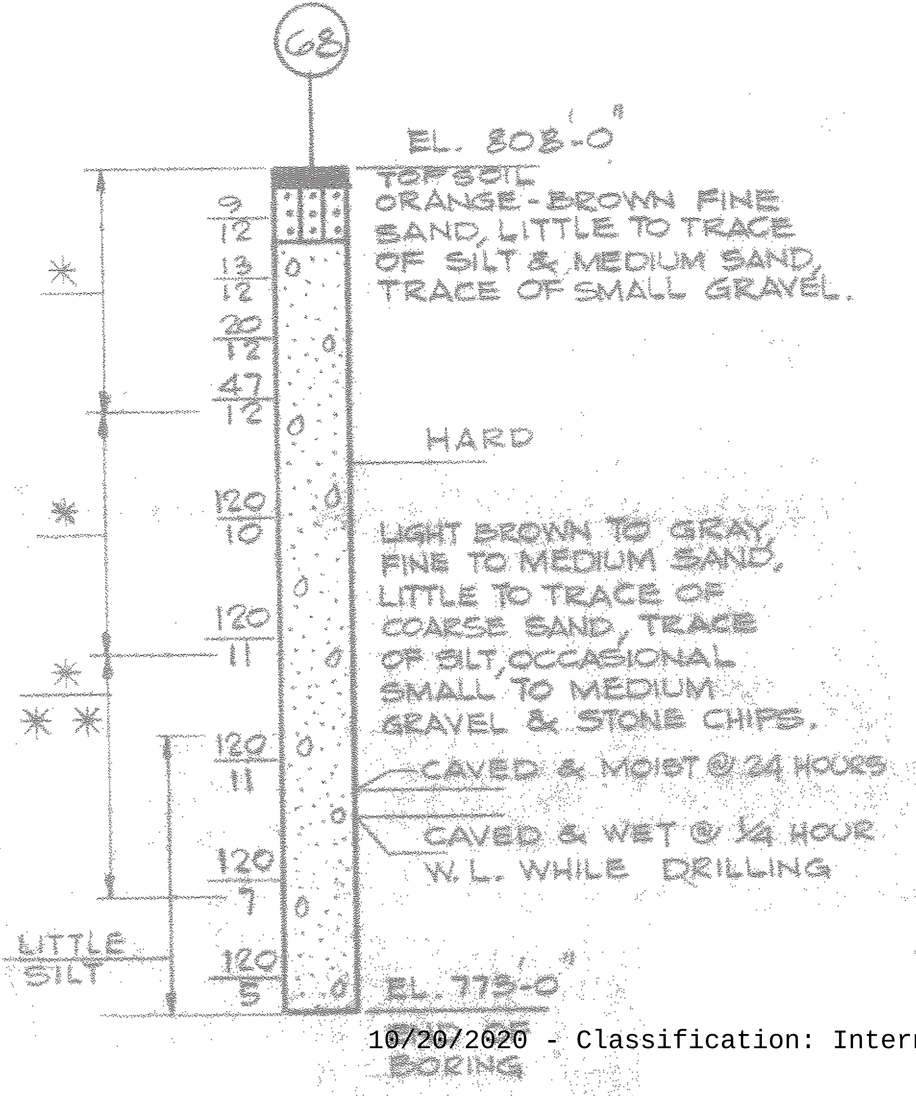
PROBABLE SANDSTONE

100/1½

EL. 714'-0"

400/1

END OF BORING


68
EL. 803'-0"
TOPSOIL
ORANGE-BROWN FINE SAND, LITTLE TO TRACE OF SILT & MEDIUM SAND, TRACE OF SMALL GRAVEL.
9/12
13/12
20/12
47/12
HARD
120/10
LIGHT BROWN TO GRAY, FINE TO MEDIUM SAND, LITTLE TO TRACE OF COARSE SAND, TRACE OF SILT, OCCASIONAL SMALL TO MEDIUM GRAVEL & STONE CHIPS.
120/11
120/11
CAVED & MOIST @ 24 HOURS
CAVED & WET @ 1/4 HOUR
W.L. WHILE DRILLING
120/7
LITTLE SILT
120/5
EL. 779'-0"
END OF BORING

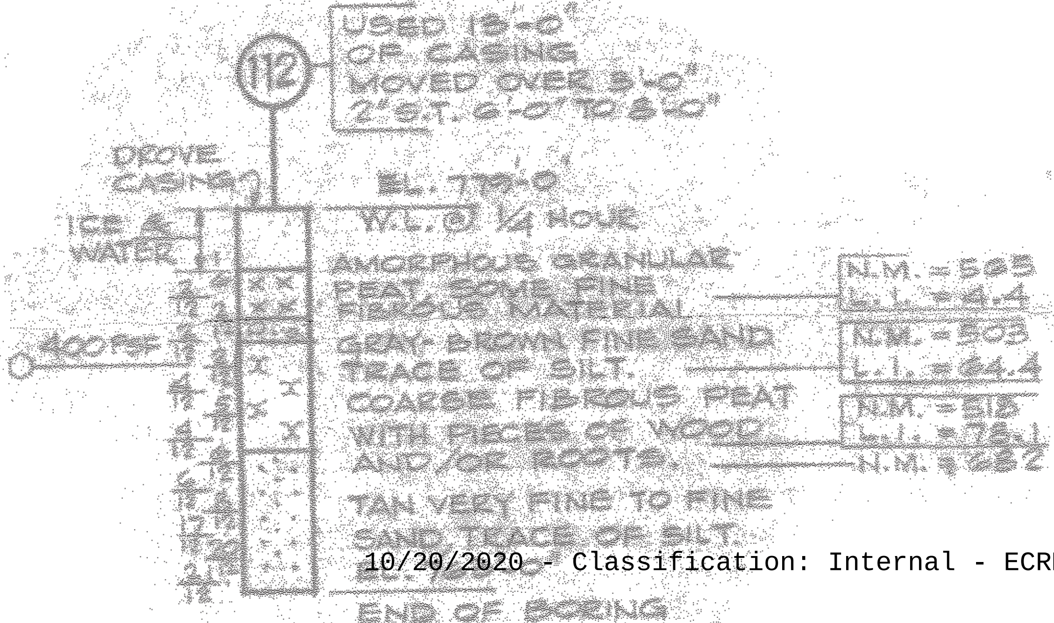

112
USED 18'-0"
OF CASING
MOVED OVER 3'-0"
2" S.T. 6'-0" TO 8'-0"
DROVE
CASING
EL. 779.0
W.L. @ 1/4 HOUR
ICE &
WATER
400 PSF
AMORPHOUS GRANULAR
PEAT, SOME FINE
FIBROUS MATERIAL
N.M. = 565
L.I. = 84.4
GRAY-BROWN FINE SAND
TRACE OF SILT.
N.M. = 303
L.I. = 64.4
COARSE FIBROUS PEAT
WITH PIECES OF WOOD
AND/OR ROOTS.
N.M. = 512
L.I. = 78.1
N.M. = 232
TAN VERY FINE TO FINE
SAND TRACE OF SILT.
END OF BORING

EXHIBIT B – SOIL STRENGTH

Alliant Energy
Wisconsin Power and Light Company
Columbia Energy Center
Pardeeville, Wisconsin

Unstable Area Determination

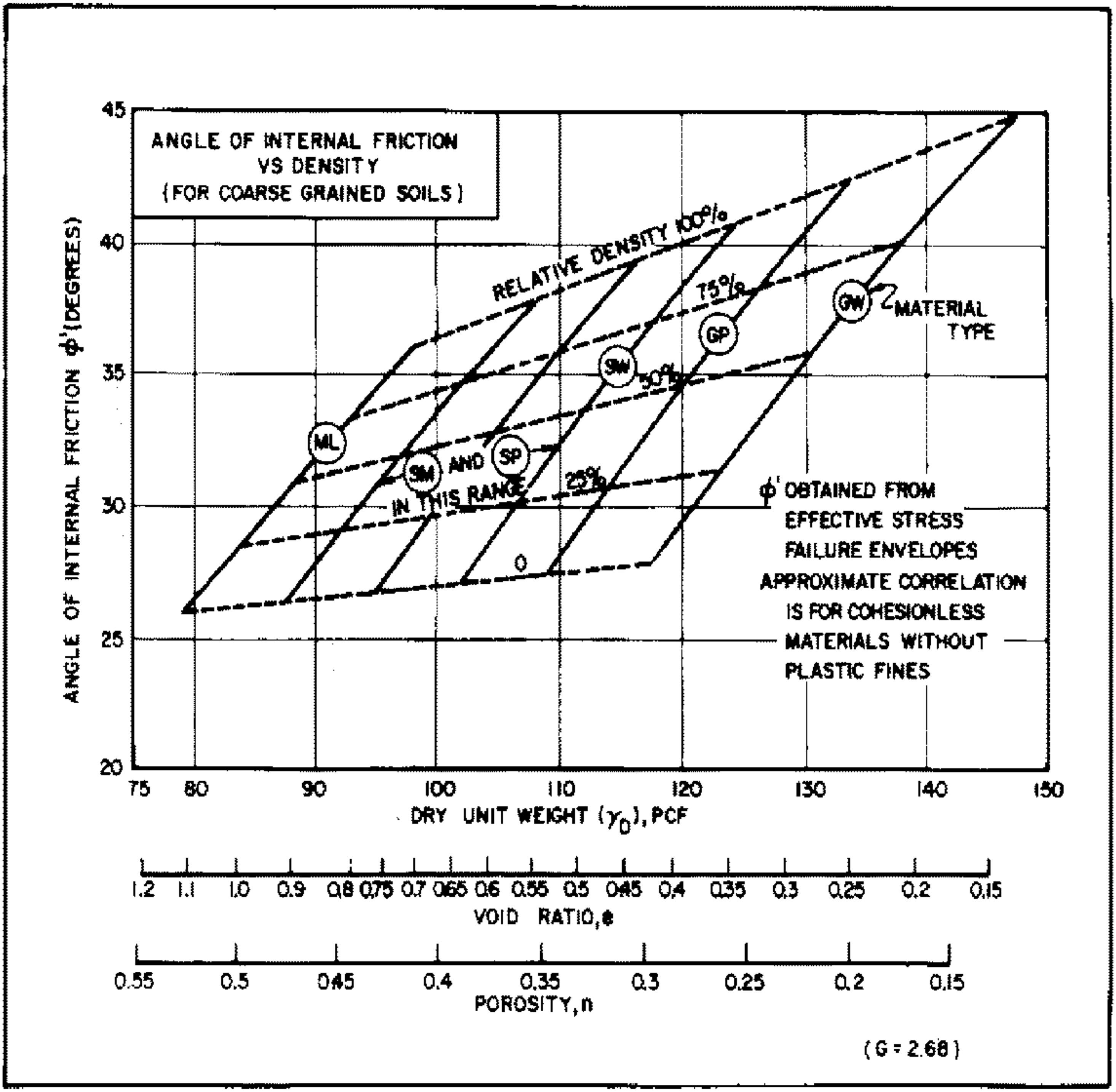


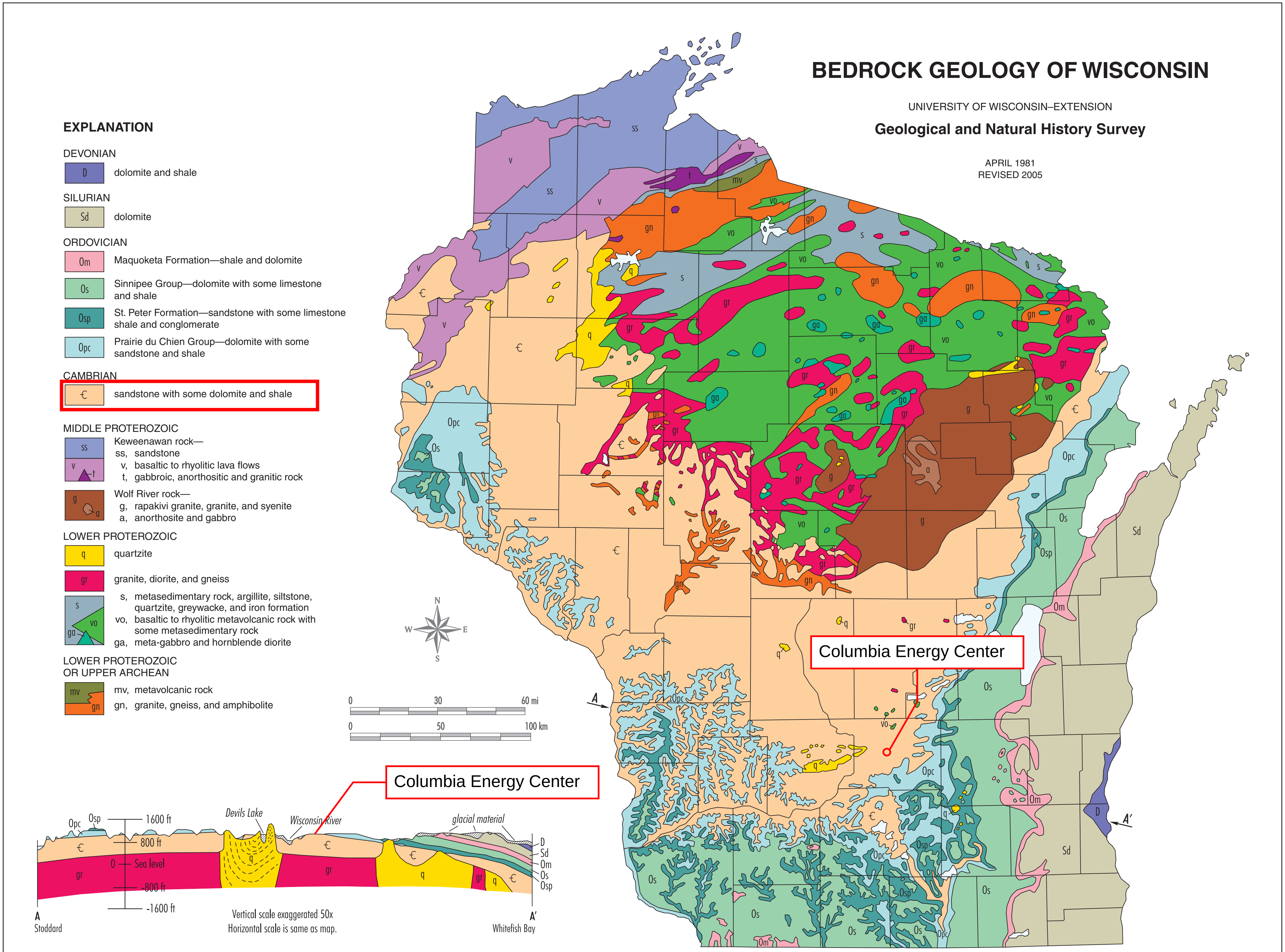
FIGURE 7

Correlations of Strength Characteristics for Granular Soils

EXHIBIT C – BEDROCK INFORMATION

Alliant Energy
Wisconsin Power and Light Company
Columbia Energy Center
Pardeeville, Wisconsin

Unstable Area Determination


BEDROCK GEOLOGY OF WISCONSIN
UNIVERSITY OF WISCONSIN–EXTENSION
Geological and Natural History Survey
APRIL 1981
REVISED 2005
EXPLANATION
DEVONIAN
D dolomite and shale
SILURIAN
Sd dolomite
ORDOVICIAN
Om Maquoketa Formation—shale and dolomite
Os Sinnipee Group—dolomite with some limestone and shale
Osp St. Peter Formation—sandstone with some limestone shale and conglomerate
Opc Prairie du Chien Group—dolomite with some sandstone and shale
CAMBRIAN
€ sandstone with some dolomite and shale
MIDDLE PROTEROZOIC
Keweenawan rock—
ss, sandstone
v, basaltic to rhyolitic lava flows
t, gabbroic, anorthositic and granitic rock
Wolf River rock—
g, rapakivi granite, granite, and syenite
a, anorthosite and gabbro
LOWER PROTEROZOIC
q quartzite
gr granite, diorite, and gneiss
s, metasedimentary rock, argillite, siltstone, quartzite, greywacke, and iron formation
vo, basaltic to rhyolitic metavolcanic rock with some metasedimentary rock
ga, meta-gabbro and hornblende diorite
LOWER PROTEROZOIC OR UPPER ARCHEAN
mv, metavolcanic rock
gn, granite, gneiss, and amphibolite
Columbia Energy Center
Columbia Energy Center
0 30 60 mi
0 50 100 km
N
S
E
W
A
A′
Devils Lake
Wisconsin River
glacial material
1600 ft
800 ft
0 Sea level
-800 ft
-1600 ft
A
Stoddard
A′
Whitefish Bay
Vertical scale exaggerated 50x
Horizontal scale is same as map.

GEOLOGIC HISTORY OF WISCONSIN'S BEDROCK

INTRODUCTION

The bedrock geologic record in Wisconsin is divided into two major divisions of time: the Precambrian, older than 600 million years, and the Paleozoic, younger than 600 million years. The Precambrian rocks are at the bottom and consist predominantly of crystalline rocks. They are overlain by Paleozoic rocks which consist of relatively flat-lying, in some cases fossil-bearing, sedimentary rocks.

Precambrian rocks form the bedrock beneath the glacial deposits in northern Wisconsin and occur beneath the Paleozoic rocks in the south (see the cross section on the reverse side). Paleozoic rocks may once have covered northern Wisconsin, but if they did, they have been removed by erosion. Glacial deposits, including clay and sand and gravel, cover bedrock in the northern and eastern three-fifths of the state.

In areas covered by glacial deposits, surface outcrops are so sparse that details of the bedrock geology are obscured. In such areas the only clues to the underlying rocks are obtained from rock cuttings and cores obtained from drill holes and from geophysical surveys which disclose magnetic and gravity variations.

Precambrian Eon

The Precambrian is divided into two eras, the older Archean and the younger Proterozoic. Each is subdivided into three periods—Early, Middle, and Late.

Archean

Rocks older than 2,500 million years are termed Archean. The oldest Archean rocks are gneisses (gn), or banded rocks. These are more than 2,800 million years old and are in Wood County. Similar old ages have been determined for rocks south of Hurley, where recognizable volcanic rocks (mv) have been intruded by 2,700 million year old granite (gn). All of these rocks have been extensively deformed, and in many areas they are so highly altered that their original nature and origin are extremely difficult to interpret. Because of this difficulty, the older gneisses and some younger (Proterozoic) gneissic and crystalline rocks are combined on this geologic map.

Proterozoic

There are four principal groups of rocks in the Proterozoic. The oldest are around 1,800 to 1,900 million years old. These Early Proterozoic rocks consist of sedimentary (s) rocks including slates, greywacke and iron formation, and volcanic (vo) rocks. The sedimentary rocks dominate in the north, with volcanic rocks becoming more abundant in central Wisconsin. These layered rocks were intruded by gabbros (ga), diorities, and granites (gr) about the same time that they were being folded and deformed.

Quartz-rich Early Proterozoic sedimentary rocks (q) occur as erosional remnants, or outliers, on the older Proterozoic rocks; they were deformed about 1,700 million years ago. The Barron Quartzite in the Blue Hills of Rusk and Barron Counties, the Baraboo Quartzite in Sauk and Columbia Counties, and Rib Mountain Quartzite in Marathon County are some of the major remaining areas of once widespread blankets of sandstone.

The oldest Middle Proterozoic rocks include the granites, syenites, and anorthosites (g, a) of the Wolf River complex. This extensive body of related granitic rockswas intruded into Lower Proterozoic volcanic and sedimentary rocks around 1,500 million years ago.

The youngest Proterozoic rocks in Wisconsin are about 1,100 million years old and are called Keweenawan rocks. At the time of their formation a major rift or fracture zone split the continent from Lake Superior south through Minnesota and into southern Kansas. Keweenawan rocks can be divided into two groups: an older sequence of igneous rocks including lavas (v) and gabbros (t); and a younger sequence of sandstone (ss). These rocks occur in northwestern Wisconsin. In central Wisconsin diabase dikes were also emplaced at this time.

At the close of the Precambrian, most of Wisconsin had been eroded to a rather flat plain upon which stood hills of more resistant rocks such as the quartzites in the Baraboo bluffs.

Phanerozoic Eon

The Phanerozoic is divided into three eras. They are from the oldest to the youngest: the Paleozoic (old life), Mesozoic (middle life), and Cenozoic (most recent life). The Paleozoic is represented by a thick sequence of sandstones, shales, and dolomites (dolomite is similar to limestone); the Mesozoic, possibly by gravels; and the Cenozoic, only by glacier-related deposits.

In the Paleozoic Era the sea advanced over and retreated from the land several times. The Paleozoic Era began with the Cambrian Period (€) during which Wisconsin was submerged at least twice beneath the sea. Sediments eroded by waves along the shoreline and by rivers draining the land were deposited in the sea to form sandstone and shale. These same processes continued into the Ordovician Period (Opc, Osp, Os, Om) during which Wisconsin was submerged at least three more times. Animals and plants living in the sea deposited layers and reefs of calcium carbonate which are now dolomite. Deposits that built up in the sea when the land was submerged were partially or completely eroded during the times when the land was elevated above sea level. At the close of the Ordovician Period, and in the succeeding Silurian (Sd) and Devonian (D), Wisconsin is believed to have remained submerged. There are no rocks of the Paleozoic Era younger than Devonian in Wisconsin. Whether material was deposited and subsequently removed by erosion, or was never deposited, is open to speculation.

Absence of younger Paleozoic rocks makes interpretation of post-Devonian history in Wisconsin a matter of conjecture. If dinosaurs roamed Wisconsin, as they might well have in the Mesozoic Era some 200 million years ago, no trace of their presence remains. Available evidence from neighboring areas indicates that toward the close of the Paleozoic Era the area was gently uplifted and it has remained so to the present. The uplifted land surface has been carved by millions of years of rain, wind, running water, and glacial action. With the possible exception of some pebbles about 100 million years old, no Mesozoic age bedrock has been identified in Wisconsin.

In the last million years during a time called the Pleistocene, glaciers invaded Wisconsin from the north and modified the land surface by carving and gouging out soft bedrock, and depositing hills and ridges of sand and gravel as well as flat lake beds of sand, silt, and clay. In this manner, the glaciers smoothed the hill tops, filled the valleys, and left a deposit of debris over all except the southwestern part of the state. The numerous lakes and wetlands which dot northern Wisconsin occupy low spots in this Pleistocene land surface. Glacial deposits are not shown on the map of bedrock geology. A separate glacial deposits map is available.

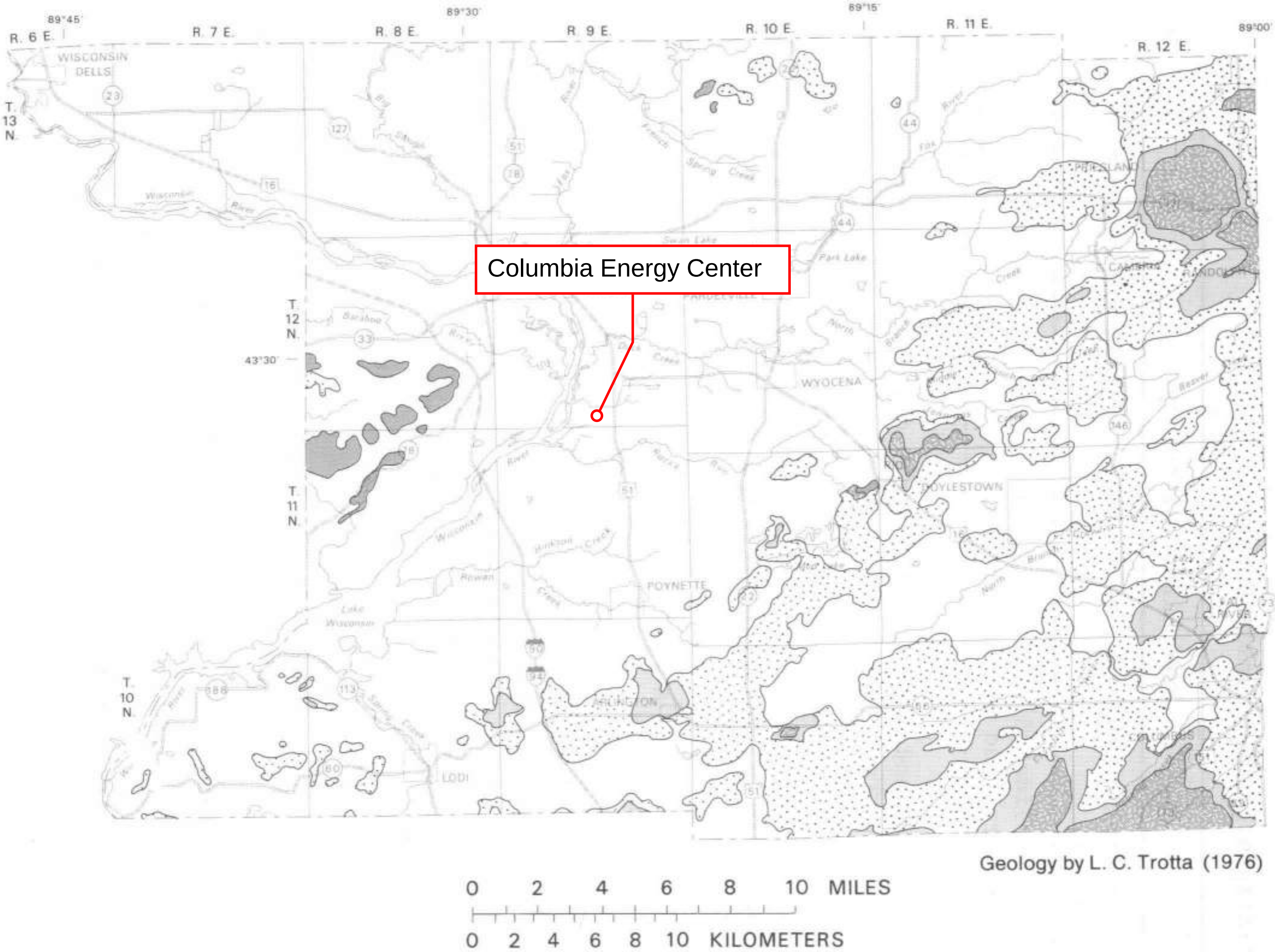
Cross Section

To assist in understanding the bedrock geology of Wisconsin, a cross section has been prepared (see reverse side). A cross section represents a vertical slice of the Earth's crust showing the subsurface rock layers in much the same way as a vertical slice of cake shows the layers of cake and frosting. The Wisconsin cross section shows the subsurface geology along a line from Stoddard in Vernon County, through Devils Lake near Baraboo in Sauk County, to Whitefish Bay in Milwaukee County. The horizontal scale is the same as that of the geologic map, but the vertical scale is exaggerated to that vertical thicknesses are expanded 50 times compared to horizontal distances. The Paleozoic rocks are show as layers, the younger units lying above the older units. They are also shown dipping to the west in the western part of the state and dipping east in the eastern part of the state, thus forming an arch. The center and oldest parts of this arch are found in the Baraboo bluffs, where the Baraboo Quartzite is exposed at the surface. As shown in the cross section by fines lines in the quartzite, the Baraboo area was folded into a U-shaped structure, or syncline, before the Paleozoic rocks were deposited. Quartzite and granite underlie the Paleozoic rocks along this section.

The gray unit shown at the top of the rock sequence in the eastern part of the cross section represents glacial materials which do not occur to the west.

UW Extension

Wisconsin Geological and Natural History Survey
3817 Mineral Point Road; Madison, Wisconsin 53705-5100; 608/263.7389; FAX 608/262.8086; www.uwex.edu/wgnhs/
James M. Robertson, *Director and State Geologist*



EXPLANATION

ORDOVICIAN

Galena Dolomite, Decorah, and Platteville Formations, undifferentiated
Mostly dolomite

St. Peter Sandstone
Mostly sandstone

Prairie du Chien Group
Mostly dolomite

CAMBRIAN

Trempleau Formation and Franconia, Galesville, Eau Claire, and Mount Simon Sandstones, undifferentiated
Mostly sandstone, some shale, siltstone and dolomite

PRECAMBRIAN

Crystalline Rock
Mostly quartzite and rhyolite

Figure 2. Bedrock geology.

Table 1.--Stratigraphy of Columbia County

System	Rock unit	Predominant lithology
QUATERNARY	Holocene deposits	Unconsolidated clay, silt, sand, gravel, and organic matter.
	Pleistocene deposits	Unconsolidated clay, silt, sand, gravel, cobbles, boulders, and organic matter.
ORDOVICIAN	Galena Dolomite, Decorah Formation, and Platteville Formation, undifferentiated	Dolomite and some slightly shaly dolomite, light-gray to blue-gray.
	St. Peter Sandstone	Sandstone, dolomitic in some places, shaly at base in some places, white, light-gray, or pink, fine- to medium-grained.
	Prairie du Chien Group	Dolomite, tan, gray, or white; some sandstone and sandy dolomite.
CAMBRIAN	Trempealeau Formation	Sandstone, dolomitic, very fine- to medium-grained; dolomite interbedded with siltstone, light-gray.
	Franconia Sandstone	Sandstone, dolomitic, very fine- to medium-grained; siltstone, dolomitic.
	Galesville, Eau Claire, and Mount Simon Sand-stones, undifferentiated	Sandstone, light-gray, fine- to coarse-grained, mostly medium grained.
PRECAMBRIAN	Precambrian rocks, undifferentiated	Crystalline rocks, mostly quartzite and rhyolite.

EXHIBIT D – KARST INFORMATION

Alliant Energy
Wisconsin Power and Light Company
Columbia Energy Center
Pardeeville, Wisconsin

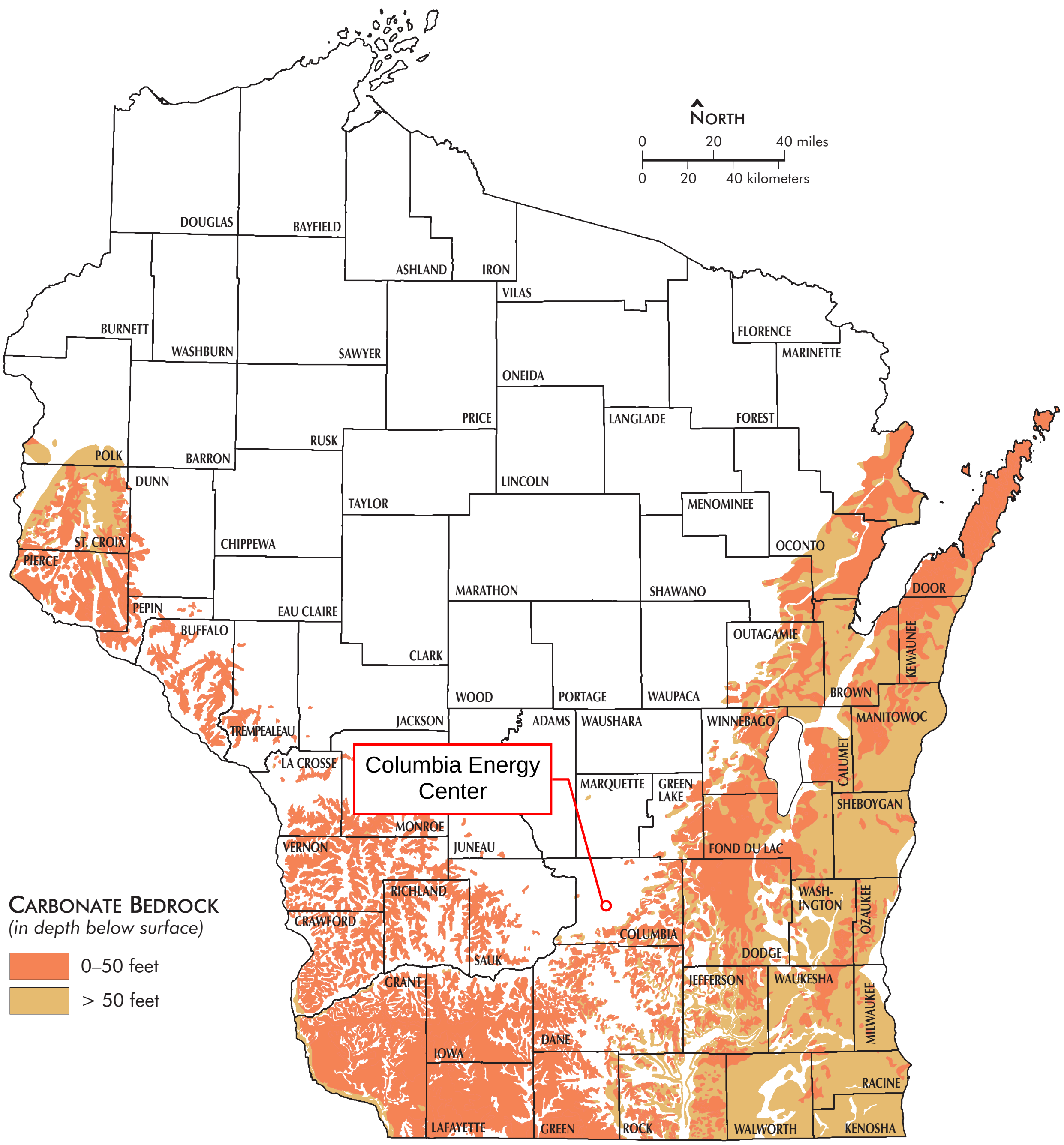
Unstable Area Determination

Karst and shallow carbonate bedrock in Wisconsin

Wisconsin Geological and Natural History Survey

Factsheet 02 | 2009

Areas with carbonate bedrock within 50 feet of the land surface are particularly vulnerable to groundwater contamination.



UW Extension
University of Wisconsin-Extension

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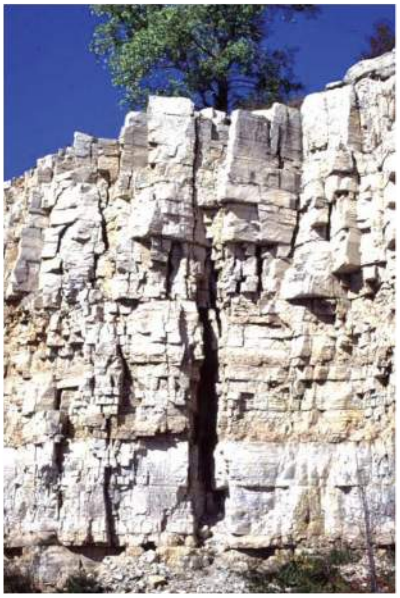
Director and State Geologist: James M. Robertson



Fracturing and bedding in an exposure of carbonate bedrock near Sturgeon Bay in Door County.

Karst and shallow carbonate bedrock in Wisconsin

Wisconsin Geological and Natural History Survey

Factsheet 02 | 2009

Carbonate bedrock, rock formations composed primarily of limestone or dolomite, underlie the southern third of Wisconsin in a V-shaped belt (see map on other side). These rocks are commonly fractured, with the fractures providing primary pathways for groundwater movement.

Carbonate rocks are soluble, and percolating surface water can enlarge fractures to form conduits, caves, and sinkholes that are the hallmarks of a **karst** system and its related karst landscape.

In Wisconsin, karst landscapes are direct evidence of underlying shallow, fractured carbonate bedrock. But the lack of classic karst features in a landscape does not mean that shallow fractured carbonate bedrock is absent, or that the groundwater is potentially any less vulnerable to contamination.

Carbonate bedrock and groundwater contamination

Carbonate formations are important aquifers in Wisconsin. These aquifers supply water for homes, farms, cities, industries, and other human uses as well as maintaining water levels in lakes and wetlands and flows in streams and springs.

Carbonate aquifers are exceptionally vulnerable to contamination for two reasons:

- Groundwater flow in fractured rocks and karst systems can be extremely rapid—tens to hundreds of feet per day.
- Carbonate rocks are poor at filtering or otherwise removing contaminants.

Some site-specific questions to ask about carbonate aquifers

Carbonate aquifers are particularly vulnerable where overlying soils are thin or absent. There are numerous examples of groundwater contamination of carbonate aquifers in such settings in Wisconsin. Consequently, land-use activities in areas of carbonate rock must be carefully managed to avoid the release of contaminants to groundwater.

Types of questions to ask:

- Is carbonate bedrock present in the subsurface?
- How deeply is it buried? In other words, what is the thickness of the overlying material?
- What is the nature of the overlying material? For example, what is its origin, composition, grain size, etc?

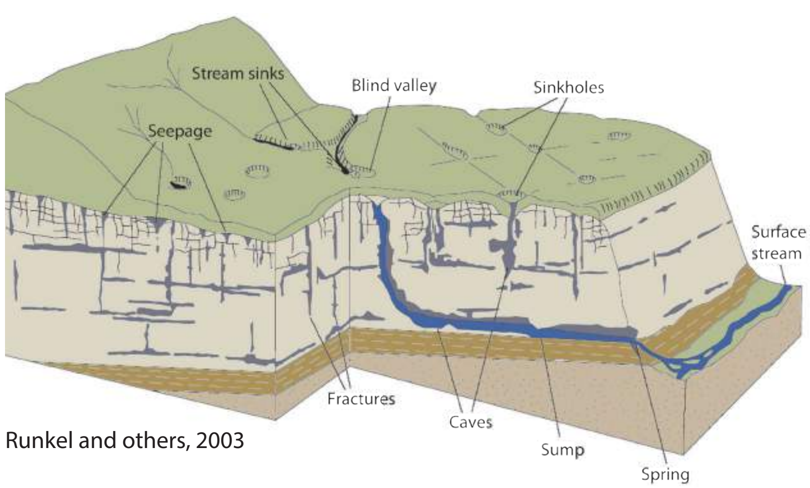
Water- and land-use management plans in areas with carbonate bedrock should always address these sorts of questions as they seek to protect groundwater quantity and quality.

For more information, contact

Kenneth R. Bradbury, Ph.D.
Wisconsin Geological and Natural History Survey
608.263.7921, krbradbu@wisc.edu

UW Extension
University of Wisconsin-Extension

Typical features of a karst sytem and landscape: Seepages, sinkholes, caves, fractures, springs, and stream sinks.

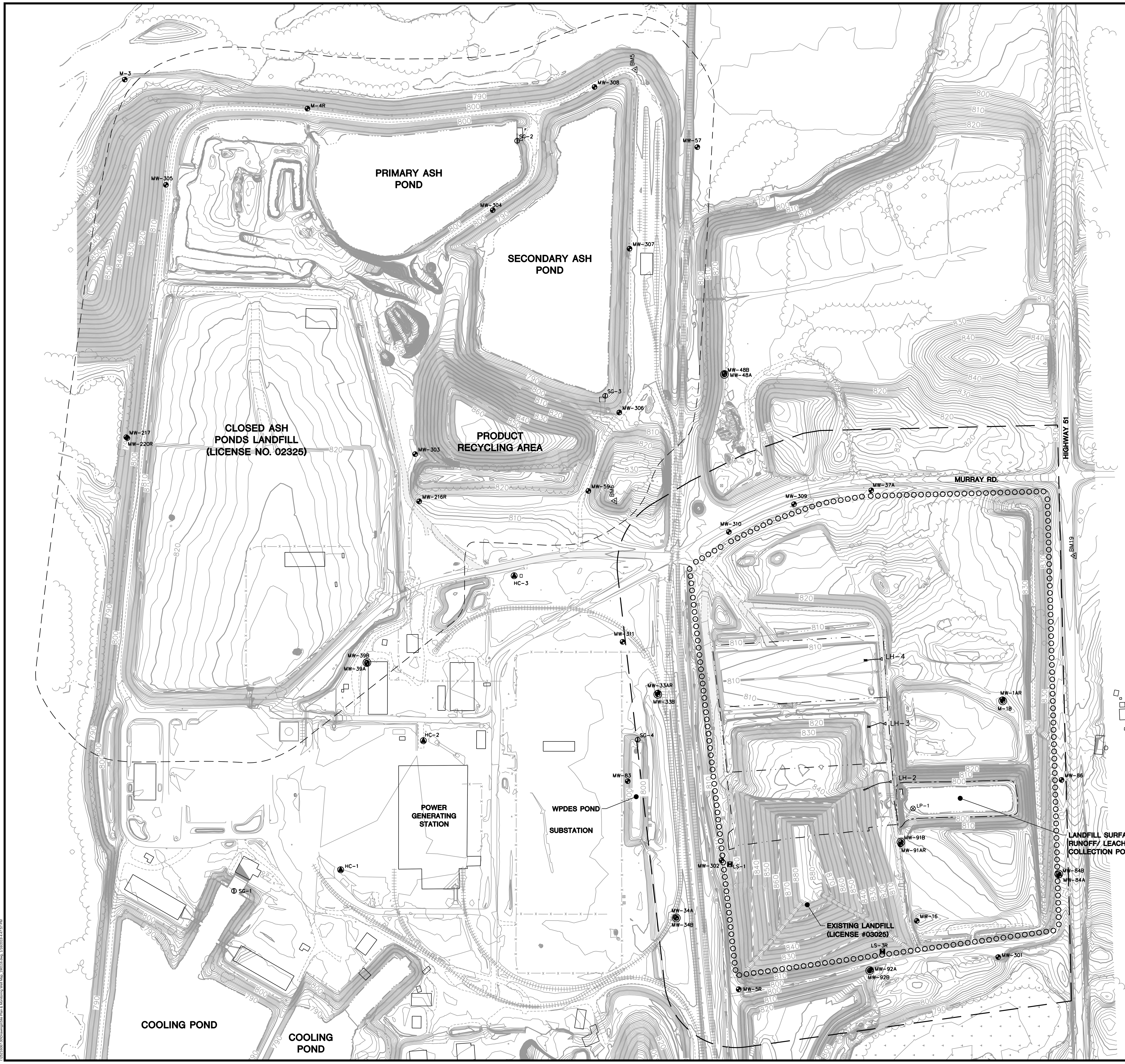


Runkel and others, 2003

EXHIBIT E – GROUNDWATER INFORMATION

Alliant Energy
Wisconsin Power and Light Company
Columbia Energy Center
Pardeeville, Wisconsin

Unstable Area Determination



LEGEND

- 810 EXISTING MAJOR CONTOUR (10' INTERVAL)
- EXISTING MINOR CONTOUR (2' CONTOUR)
- EXISTING FENCELINE
- EXISTING TRACKS
- EXISTING PAVED ROAD
- EXISTING UNPAVED ROAD
- EDGE OF WATER
- DESIGN MANAGEMENT ZONE
- APPROVED LIMITS OF WASTE
- CONSTRUCTED LIMITS OF WASTE
- WATER SUPPLY WELL
- STAFF GAUGE
- WATER TABLE WELL
- PIEZOMETER
- SURFACE WATER SAMPLE LOCATION
- LYSIMETER
- LEACHATE HEADWELL

NOTES:

1. BASE MAP CREATED FROM AERIAL SURVEY BY KBM, FLOWN DECEMBER 1, 2014, AND GROUND SURVEY BY SCS ENGINEERS IN MAY 2016, JUNE 2016, OCTOBER 2016, NOVEMBER 2016, APRIL 2017, NOVEMBER 2017, JULY 2018, AND AUGUST 2018.
2. MONITORING WELL LOCATIONS AND ELEVATIONS SURVEYED BY WISCONSIN POWER AND LIGHT, INC. IN DECEMBER 1994, NOVEMBER 1996, APRIL 2003, AND AUGUST 2012.
3. SUPPLY WELL LOCATIONS ARE APPROXIMATE AND ASSUMED BASED ON JANUARY 2013 DRAWINGS BY TRC.
4. THE LOCATIONS OF THE ASH PONDS FACILITY DESIGN MANAGEMENT ZONE DEMARCATION LINES ARE APPROXIMATE AND BASED ON THE WATER TABLE MAP (OCTOBER 2012) FIGURE BY RMT.
5. THE LOCATION OF THE ACTIVE DRY ASH LANDFILL DESIGN MANAGEMENT ZONE DEMARCATION LINE IS BASED ON A 300 FOOT OFFSET FROM THE DESIGN LIMITS OF ASH EXCEPT WHERE OFFSET WOULD EXTEND LINE BEYOND PROPERTY LINE.
6. SAMPLES COLLECTED BY SCS ON OCTOBER 22–25, 2018 AND ANALYZED BY PACE ANALYTICAL SERVICES OF GREEN BAY, WISCONSIN.

SHEET 1

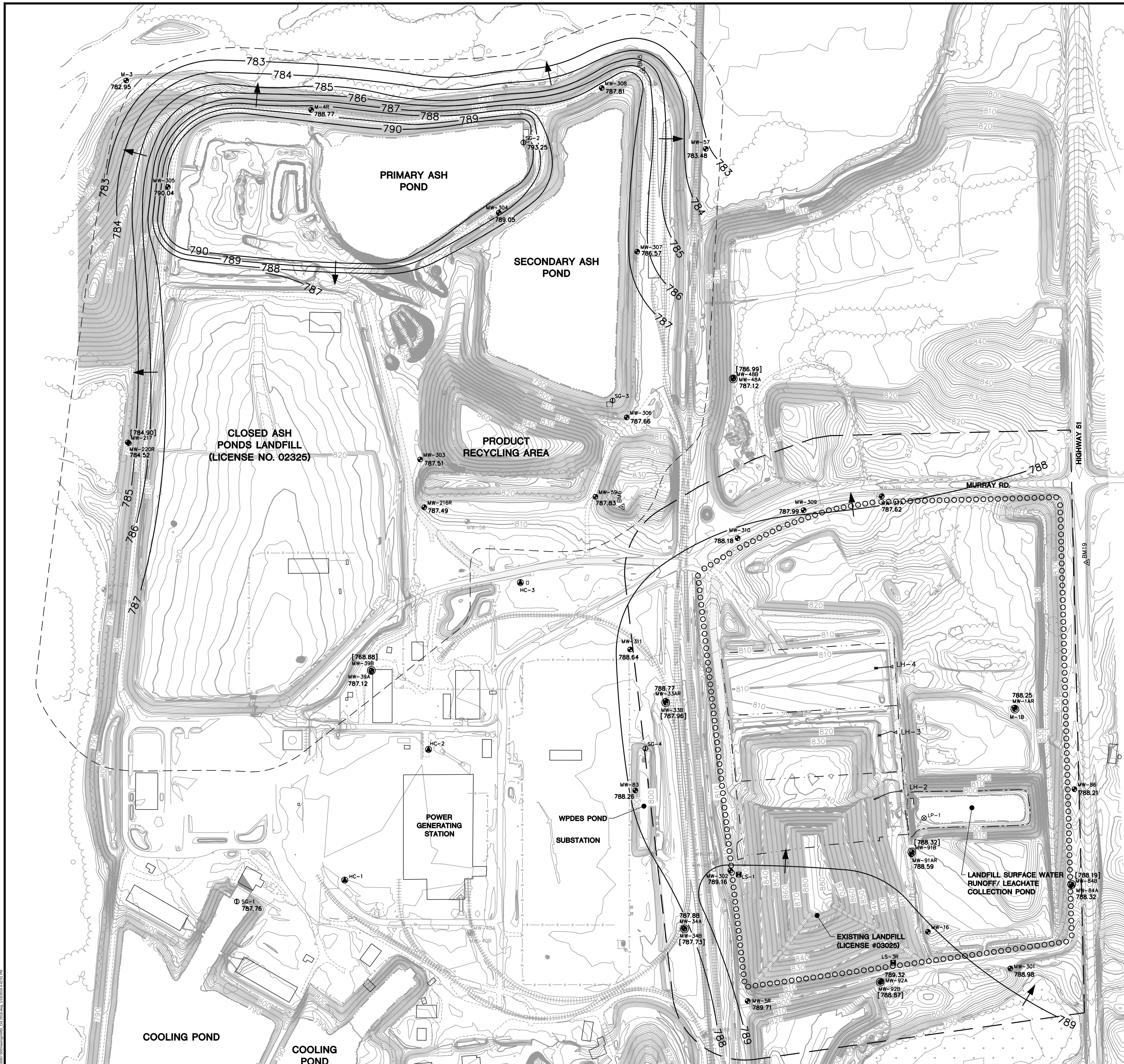
SITE PLAN AND MONITORING WELL LOCATION MAP

SITE: COLUMBIA ASH PONDS AND DRY ASH DISPOSAL FACILITIES

CLIENT: ALLIANT ENERGY, 4902 NORTH BILTMORE LN. #1000, MADISON, WI 53718

ENGINEER: SCS ENGINEERS, 2830 DAIRY DRIVE MADISON, WI 53718-6751, PHONE: (608) 224-2830

PROJECT NO.	25216.067.00	DRAWN BY:	KP
DRAWN:	01/03/19	CHECKED BY:	MDB
REVISED:	01/09/19	APPROVED BY:	



LEGEND

810	EXISTING MAJOR CONTOUR (10' INTERVAL)
	EXISTING MINOR CONTOUR (2' CONTOUR)
	EXISTING FENCELINE
	EXISTING TRACKS
	EXISTING PAVED ROAD
	EXISTING UNPAVED ROAD
	EDGE OF WATER
	DESIGN MANAGEMENT ZONE
	APPROVED LIMITS OF WASTE
	CONSTRUCTED LIMITS OF WASTE
	WATER SUPPLY WELL
	STAFF GAUGE
	WATER TABLE WELL
	PIEZOMETER
	SURFACE WATER SAMPLE LOCATION
	LYSIMETER
	ABANDONED WATER TABLE WELL
	ABANDONED PIEZOMETER
	LEACHATE HEADWELL
787.62	WATER TABLE ELEVATION MEASURED OCTOBER 2018
[788.87]	POTIENTIOMETRIC SURFACE ELEVATION MEASURED OCOTBER 2018 (NOT CONTOURED)
	WATER TABLE CONTOUR
	APPROXIMATE GROUNDWATER FLOW DIRECTION

NOTES:

1. BASE MAP CREATED FROM AERIAL SURVEY BY KBM, FLOWN DECEMBER 1, 2014, AND GROUND SURVEY BY SCS ENGINEERS IN MAY 2016, JUNE 2016, OCTOBER 2016, NOVEMBER 2016, APRIL 2017, NOVEMBER 2017, JULY 2018, AND AUGUST 2018.
2. MONITORING WELL LOCATIONS AND ELEVATIONS SURVEYED BY WISCONSIN POWER AND LIGHT, INC. IN DECEMBER 1994, NOVEMBER 1996, APRIL 2003, AND AUGUST 2012.
3. SUPPLY WELL LOCATIONS ARE APPROXIMATE AND ASSUMED BASED ON JANUARY 2013 DRAWINGS BY TRC.
4. THE LOCATIONS OF THE ASH PONDS FACILITY DESIGN MANAGEMENT ZONE DEMARCATION LINES ARE APPROXIMATE AND BASED ON THE WATER TABLE MAP (OCTOBER 2012) FIGURE BY RMT.
5. THE LOCATION OF THE ACTIVE DRY ASH LANDFILL DESIGN MANAGEMENT ZONE DEMARCATION LINE IS BASED ON A 300 FOOT OFFSET FROM THE DESIGN LIMITS OF ASH EXCEPT WHERE OFFSET WOULD EXTEND LINE BEYOND PROPERTY LINE.

PROJECT NO.	25216067.00	DRAWN BY:	KP	
DRAWN:	01/03/19	CHECKED BY:	MDB	
REVISED:	01/09/19	APPROVED BY:		

ENGINEER: SCS ENGINEERS
2830 DAIRY DRIVE MADISON, WI 53718-6751
PHONE: (608) 224-2830

CLIENT: ALLIANT ENERGY
4902 NORTH BILTMORE LN. #1000
MADISON, WI 53718

SITE: COLUMBIA ASH PONDS AND DRY ASH DISPOSAL FACILITIES

WATER TABLE MAP
OCTOBER 2018

SHEET 2

2017-2018 Monitoring Results - Groundwater Monitoring Wells
Wisconsin Power and Light - Columbia Energy Center Ash Ponds Disposal Facility
SCS Engineers Project #25216067

Point Name	Reporting Period	Groundwater Elevation (ft AMSL)	Surface Water Elevation (ft AMSL)	Color, Field	Odor, Field	Turbidity, Field	Specific Conductance, Field (µmhos/cm)	pH, Field (Std. Units)	Temperature, Field (deg C)	Arsenic, Dissolved (µg/L)	Barium, Dissolved (µg/L)	Boron, Dissolved (µg/L)	Chromium, Dissolved (µg/L)	Sulfate, Dissolved (mg/L)
M-3	Apr-17	782.94	--	Lt. Brown	N	Slight	912	9.21	9.2	0.56 J	9.2	1,090	0.57 J	103
	Oct-17	780.93	--	Lt. Brown	N	Moderate	582	7.31	15.3	0.54 J	9.0	1,080	<1.0	102
	Apr-18	782.89	--	Lt. Brown	N	Moderate	536	7.77	7.4	0.90 J	8.7	597	1.5 J	40.8
	Oct-18	782.95	--	Lt. Brown	N	Moderate	491	7.62	13.80	0.78 J	10.8	678	<1.0	46.3
M-4R	Apr-17	787.95	--	N	N	N	1,212	7.55	11.7	0.13 J	24.6	499	<0.39	130
	Oct-17	787.04	--	N	N	N	7.39	7.2	15.9	<0.28	21.9	1,500	<1.0	180
	Apr-18	790.43	--	N	N	N	790	7.44	10.6	0.95 J	19.1	878	1.1 J	167
	Oct-18	788.47	--	N	N	N	819	7.13	16.40	0.40 J	26.8	1,580	<1.0	131
MW-39A	Apr-17	785.44	--	N	N	Slight	2,809	9.2	10.7	0.37 J	64.9	221	2.3	95.9
	Oct-17	783.35	--	Lt. Brown	N	Moderate	1,428	7.27	15.8	0.36 J	50.0	190	2.7 J	58.6
	Apr-18	782.86	--	Lt. Brown	N	Moderate	2,516	7.49	11.7	0.28 J	31.1	166	2.7 J	40.8
	Oct-18	787.12	--	Lt. Brown	N	Very	686	7.38	13.00	<0.28	55.5	289	1.5 J	68.9
MW-39B	Apr-17	785.20	--	N	N	N	1,208	10.0	10.9	0.28 J	33.6	259	<0.39	104
	Oct-17	783.18	--	N	N	N	1,124	7.06	13.0	0.39 J	35.3	267	<1.0	112
	Apr-18	782.87	--	N	N	N	1,144	7.1	12.8	0.51 J	36.5	296	<1.0	92.1
	Oct-18	786.88	--	N	N	N	871	7.40	12.60	0.31 J	24.9	227	<1.0	46.2
MW-48A	Apr-17	785.82	--	Lt. Brown	N	Moderate	1,031	7.12	12.7	0.28 J	25.8	26.9	1.7	17.2
	Oct-17	784.30	--	Brown	N	Moderate	1,040	6.72	11.9	0.37 J	26.6	34.5	<1.0	13.4
	Apr-18	783.14	--	Lt. Brown	N	Moderate	971	6.62	10.4	0.36 J	20.9	26.3	<1.0	10.2
	Oct-18	787.12	--	Lt. Brown	N	Very	1,079	6.90	10.20	0.39 J	25.8	31.8	1.1 J	18.7
MW-48B	Apr-17	785.69	--	N	N	Slight	750	7.20	12.3	0.29 J	22.7	148	0.67 J	32.1
	Oct-17	784.19	--	N	N	N	785	7.24	11.7	0.75 J	28.7	181	1.3 J	29.6
	Apr-18	783.09	--	N	N	N	846	7.16	11.3	0.30 J	27.2	179	<1.0	28.0
	Oct-18	786.99	--	N	N	N	880	7.07	11.40	0.30 J	27.9	213	1.2 J	21.9
MW-57	Apr-17	782.77	--	Brown	N	High	1,188	8.82	8.2	18.5	66.6	883	1.2	6.9
	Oct-17	782.37	--	Lt. Brown	N	Moderate	833	6.99	11.6	18.6	69.5	663	<1.0	12.7 J
	Apr-18	783.04	--	Brown	Slight	Slight	764	7.63	6.9	14.8	51.9	596	<1.0	22.8
	Oct-18	783.48	--	Gray	Yes	Slight	583	7.12	11.30	17.0	57.1	839	<1.0	17.1 J
MW-59	Apr-17	786.09	--	Pale White	N	Moderate	733	7.93	11.6	0.51 J	13.0	444	2.7	127
	Oct-17	784.23	--	Lt. Brown	N	Slight	425	7.53	11.6	1.3	13.0	233	2.7 J	59.9
	Apr-18	783.02	--	Lt. Brown	N	Slight	652	8.27	12.4	0.48 J	12.0	262	2.2 J	64.9
	Oct-18	787.73	--	Lt. Brown	N	Slight	191.9	7.48	10.80	0.34 J	17.4	284	1.8 J	25.7
MW-216R	Apr-17	785.95	--	Lt. Brown	N	High	1,033	9.10	11.0	0.46 J	11.4	1,390	6.3	128
	Oct-17	783.89	--	N	N	Moderate	697	7.69	12.5	0.59 J	12.8	1,260	6.3	143
	Apr-18	783.23	--	Lt. Brown	N	Moderate	603	7.21	11.6	0.50 J	11.1	1,160	4.1	102
	Oct-18	787.49	--	Lt. Brown	N	Slight	475	7.75	12.70	0.44 J	13.2	814	2.6 J	73.5
MW-217	Apr-17	784.29	--	N	N	N	1,088	9.76	8.9	2.4	8.5	1,900	1.1	281
	Oct-17	782.48	--	N	N	N	1,005	8.76	11.7	3.6	7.1	2,720	1.1 J	326
	Apr-18	783.26	--	Yellow	N	N	1,015	9.68	12.6	3.0	7.0	2,240	<1.0	286
	Oct-18	784.90	--	Yellow	Yes	N	880	8.97	11.70	2.9	5.0	2,450	<1.0	311
MW-220RR	Apr-17	784.09	--	Brown	Slight	High	669.3	10.35	9.1	5.6	32.4	202	11.9	27.8
	Oct-17	782.61	--	Brown	Slight	Moderate	651	7.2	13.5	6.5	25.5	641	11.0	12.5 J
	Apr-18	783.45	--	Brown	Slight	Slight	679	8.06	10.8	1.9	18.0	271	1.3 J	20.1
	Oct-18	784.52	--	Dark Brown	Slight	Moderate	359.4	7.22	13.90	3.4	25.9	151	4.1	15.3

Table 2. Summary of Calculated Vertical Hydraulic Gradients, 2017-2018
WPL - Columbia Dry Ash and Ash Ponds Disposal Facilities
Columbia County, Wisconsin / SCS Engineers Project #25216067

Date	MW-33AR/MW-33BR	MW-34A/MW-34B	MW-84A/MW-84B	MW-91AR/MW-91B	MW-92A/MW-92B	MW-39A/MW-39B	MW-48A/MW-48B	MW-220RR/MW-217
April 10-13, 2017	-0.014	-0.001	-0.006	-0.009	-0.012	-0.005	-0.005	0.009
October 3-5, 2017	-0.011	-0.002	NM(1)	-0.011	-0.019	-0.004	-0.004	-0.006
April 23-25, 2018	0.122	-0.040	-0.064	-0.008	-0.018	0.000	-0.002	-0.009
October 23-25, 2018	-0.027	-0.005	-0.008	-0.012	-0.018	-0.005	-0.005	0.017

Note:
A positive vertical gradient indicates upward flow potential, and a negative vertical gradient indicates downward flow potential.
NM = Groundwater elevation at one or both wells was not measured during this sampling event.
1: The groundwater elevation at MW-84A was not measured prior to purging for sampling during the October 3-5 sampling event. The level was allowed to return to static and was measured on 10/10/2017.

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