DUKE ENERGY®

Duke Energy
Dan River Combined Cycle Station
864 South Edgewood Road
Eden, NC 27288
(336) 635-3000 OFFICE

July 29, 2014

Dr. Sergei Chernikov
State of North Carolina
Department of Environment and Natural Resources
Division of Water Resources
Water Quality Permitting Section - NPDES
1617 Mail Service Center
Raleigh, North Carolina 27699-1617

Subject: Duke Energy Carolinas LLC – NPDES Permit Modification
Dan River Combined Cycle Station - #NC0003468

Dear Dr.Chernikov:

Duke Energy Carolinas, LLC requests the following:

- The subject permit be modified to address ash dike seeps. Enclosed is information pertinent to the ash dike seeps. Please find attached a location map, flow measurements and analytical data.
- A new NPDES outfall be created that allows for wastewater generated from dredging the station intake to be discharged into the settling pond.
- Previous Outfall 009 needs to be re-evaluated for possible inclusion in the NPDES permit based on feedback received from NC DENR during a recent inspection. This outfall was removed from the NPDES permit on January 13, 2013.

A check in the amount of $1030 is also enclosed for the major permit modification fee.

Also enclosed is a revised groundwater monitoring plan, which includes a receptor survey, sampling & analysis plan and a flow directional map.

Thank you in advance for your assistance on this matter. Should you have questions regarding these requests, please contact Allen Stowe at (704) 382-4309 or Allen.Stowe@duke-energy.com.

Sincerely,

Glenn E. Harris

Glenn Harris
General Manager II, CC/CTs

Attachments

Check Date: Jul 18 2014	Vendor Number: 0000071949	Name: STATE OF NORTH CAROLINA DEPARTMENT OF			Check Number: 1000120726	
Invoice Number	**Invoice Date**	**Voucher ID**	**Gross Amount**	**Discounts Taken**	**Late Charge**	**Paid Amount**
NPDESPERMITNC0003468 NPDES PERMIT NC 0003468	Jul 14 2014	10659750	1,030.00	0.00	0.00	1,030.00

Check Number:	Date	Total Gross Amount	Total Discounts	Total Late Charges	Total Paid Amount
1000120726	Jul 18 2014	$1,030.00	$0.00	$0.00	$1,030.00

DUKE ENERGY NAME AND LOGO ARE ON BACK. HOLD AT AN ANGLE TO VIEW. VOID IF ABSENT.

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Duke Energy Business Services
400 South Tryon Street
Charlotte, NC 28285

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Corporate Accounts Payable
ST25B | 400 South Tryon Street
Charlotte, NC 28285

Date 7/18/14

Pay *One thousand thirty and xx / 100 Dollars*

$**1,030.00

To The Order Of
STATE OF NORTH CAROLINA DEPARTMENT OF
ENVIROMENT AND NATURAL RESOURCES
DIVISION OF WATER QUALITY
1617 MAIL SERVICE CENTER
Raleigh, NC 27699-1617

Authorized Signature

⑈1000120726⑈ ⑆021309379⑆ 601846561⑈

Dan River Combined Cycle Station
Ash Basin
Seep Monitoring – July 2014

Flow measurement devices were installed at seep sampling locations S-2 and S-3 to measure seepage flows and to provide sufficient depth to allow collection of water samples for laboratory analysis. Seep sampling locations S-1 and S-4 were collected without the installation of flow measurement devices (Figure 1).

The flow measurement devices were constructed to impound the seepage in a channel and to direct the collected flow into a PVC pipe for flow measurement. The flow measurement devices were inspected after installation and prior to sampling to confirm sufficient flow and depth for sampling, and to verify that only minimal leakage, if any, was present. Sufficient time was allowed for the impounded seepage flows to reach equilibrium discharge flow before flow measurement and sampling.

Descriptions of the seep sample locations are provided in Table 1.

Seep Flow Measurement Method

The seepage flows were measured using the timed-volumetric method. A volume of water was collected from the discharge of the PVC pipe or from the seep directly into an appropriately sized container. Volumes (in mL) were measured in the field utilizing a graduated container. The amount of time (in seconds) needed to collect the volume of water was recorded and flows (in MGD) were calculated for the timed-volume. The calculated flows (in MGD) at each seep location are presented in Appendix A.

Seepage flow is generally variable. Flow may increase or decrease depending on the amount of rainfall, groundwater levels, weather conditions, and other factors.

Seep Sample Collection Method

Water quality samples were collected at locations S-1, S-2, S-3, and S-4. To minimize effects of stormwater runoff, and infiltration of rainwater into seep flows, seep samples were collected during a period with minimal preceding rainfall. Samples were collected from the discharge flow of the flow measurement devices or directly from the seep into sample bottles while avoiding disturbing and entraining any soil/sediment.

Analytical parameters requested for analysis were: TSS, TDS, Oil & Grease, Cl, SO_4, F, COD, Al, As, B, Ba, Ca, Cd, Cu, Cr, Fe, Mn, Mo, Mg, Ni, Pb, Sb, Se, Tl, Zn, Hardness and Hg. Storage and preservation techniques of the samples after collection, and prior to analyses, were followed according to Appendix B. Analyses were conducted by Duke Energy's Huntersville analytical laboratory (NC Wastewater Certification #248) and Pace Analytical Laboratories (NC Wastewater Certification # 12). Laboratory analytical methods for each parameter are provided in Table 2 and analytical results are presented in Appendix A.

Seep In-situ measurements

In-situ field parameters (temperature, pH, and specific conductance) were measured utilizing calibrated field meters either at the discharge of the seep directly, at the discharge of the flow measurement devices, or in the impoundment created by the device, if sufficient water depth did not exist at the device discharge.

Dan River and Ash Basin (in-process) Water Quality Sample Collection Method

Water quality samples and in-situ measurements from the Dan River were collected at a location upstream (Dan River-Upstream) and downstream (Dan River-Downstream) of the ash basin (Figure 2). Additionally, water samples and in-situ measurements were collected from an in-process ash basin location (Figure 1). The grab samples were collected from the river and basin's surface (0.3 m) directly into appropriate sample bottles. Preservation and analyses methods for the river and ash basin samples are provided in Table 2 and Appendix B.

Recommendations

The low volume of flow at each seep location coupled with the relatively low constituent concentrations in the samples, suggest that there is little potential to influence water quality in the Dan River. If reasonable potential analyses demonstrate that there is no potential to exceed water quality standards, then Duke Energy proposes to re-evaluate the DRCC seep locations listed in this document annually over the next 5-year permit cycle. These annual evaluations would be documented and would verify the condition of the existing seeps and determine the presence of new seeps. DWR will be promptly notified if any new seeps are identified or any significant changes are observed for the existing seeps. If any existing or newly identified seeps are determined to reach the Dan River and demonstrate reasonable potential to exceed a water quality standard, Duke Energy will do one of the following: 1) stop the seep, 2) capture and route the seep so that it is discharged through a NPDES permitted outfall or 3) address the seep using Best Management Plans approved by DWR.

Table 1 – Dan River Combined Cycle Station Ash Basin – Seep Locations and Descriptions

Seep ID	Location Coordinates[4]		Flow Description	Description
	Latitude	Longitude		
S-1	36.493	-79.711	Continuous	Located on west bank of Railroad Branch. Seepage is at the base of the bank. The flow is directly from the base of the bank toward the stream with no well defined channel.
S-2	36.493	-79.711	Continuous	Located east of the Secondary Cell and west of Railroad Branch along the natural gas line right-of-way above the bank of Railroad Branch, north of S-3. The seepage flows through a defined channel approximately 2-ft wide before its confluence with S-3 at the top of the bank on Railroad Branch.
S-3	36.493	-79.711	Continuous	Located east of the Secondary Cell and west of Railroad Branch along the natural gas line right-of-way above the bank of Railroad Branch, south of S-2. The seepage flows through a defined channel approximately 2.5-ft wide before its confluence with S-2 at the top of the bank on Railroad Branch.
S-4	36.486	-79.719	Continuous	Located at the southwest end of the Primary Cell. Seepage is routed to a concrete ditch which extends to the Dan River.

Notes:

1. Flow description for each seep sample location is based on observation during site visits performed by HDR Engineering, Inc. (HDR) in June and July 2014.
2. Flow measurements and analytical samples were collected on July 7 and 14, 2014.
3. Location coordinates for seep sampling locations are approximate.
4. Location coordinates (degrees) in NAD 83 datum.

Table 2 – Laboratory Analytical Methods

Parameter	Method	Reporting Limit	Units	Lab
COD	HACH 8000	20	mg/L	Duke Energy
Chloride	EPA 300.0	1	mg/L	Duke Energy
Fluoride	EPA 300.0	1	mg/L	Duke Energy
Sulfate	EPA 300.0	1	mg/L	Duke Energy
Oil and Grease	EPA 1664B	5	ug/L	Pace Analtyical
Mercury (Hg)	EPA 245.1	0.05	ug/L	Duke Energy
Aluminum (Al)	EPA 200.7	0.005	mg/L	Duke Energy
Barium (Ba)	EPA 200.7	0.005	mg/L	Duke Energy
Boron (B)	EPA 200.7	0.05	mg/L	Duke Energy
Calcium (Ca)	EPA 200.7	0.01	mg/L	Duke Energy
Hardness	EPA 200.7	0.19	mg/L ($CaCO_3$)	Duke Energy
Iron (Fe)	EPA 200.7	0.01	mg/L	Duke Energy
Magnesium (Mg)	EPA 200.7	0.005	mg/L	Duke Energy
Manganese (Mn)	EPA 200.7	0.005	mg/L	Duke Energy
Zinc (Zn)	EPA 200.7	0.005	mg/L	Duke Energy
Antimony (Sb)	EPA 200.8	1	ug/L	Duke Energy
Arsenic (As)	EPA 200.8	1	ug/L	Duke Energy
Cadmium (Cd)	EPA 200.8	1	ug/L	Duke Energy
Chromium (Cr)	EPA 200.8	1	ug/L	Duke Energy
Copper (Cu)	EPA 200.8	1	mg/L	Duke Energy
Lead (Pb)	EPA 200.8	1	ug/L	Duke Energy
Molybdenum (Mo)	EPA 200.8	1	ug/L	Duke Energy
Nickel (Ni)	EPA 200.8	1	ug/L	Duke Energy
Selenium (Se)	EPA 200.8	1	ug/L	Duke Energy
Thallium (Tl) Low Level	EPA 200.8	0.2	ug/L	Duke Energy
TDS	SM2540C	25	mg/L	Duke Energy
TSS	SM2540D	5	mg/L	Duke Energy

Appendix A
Seep Flows and Analytical Results

Seep Flows and Analytical Results
Dan River Seep Monitoring
July 2014

Parameter	Units	S-1	S-2	S-3	S-4	NPDES Outfall 002	Dan River-Upstream	Dan River-Downstream
Oil & Grease	mg/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5
COD	mg/l	< 20	< 20	< 20	< 20	< 20	< 20	< 20
Cl - Chloride (00940)	mg/l	13	14	14	12	9.4	9.3	8.8
Fluoride	mg/l	< 1	< 1	< 1	< 1	< 1	< 1	< 1
SO4 - Sulfate (00945)	mg/l	120	50	52	150	34	6	4.8
Hg - Mercury (71900)	µg/l	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Al - Aluminum (01105)	mg/l	2.35	3.87	2.68	0.231	0.038	1.87	1.9
Ba - Barium (01007)	mg/l	0.069	0.083	0.091	0.074	0.114	0.027	0.026
B - Boron (01022)	mg/l	0.269	0.277	0.268	0.76	0.15	0.199	0.194
Ca-Calcium	mg/l	23.5	21.1	21.9	63.9	18.8	7.43	7.16
Hardness	mg/l ($CaCO_3$)	88.1	81.1	78	209	72	30.1	29.1
Fe - Iron (01045)	mg/l	3.03	8.56	3.46	4.72	0.116	2.26	2.3
Mg-Magnesium	mg/l	7.13	6.91	5.66	12.1	6.11	2.8	2.72
Mn - Manganese (01055)	mg/l	0.518	0.854	0.552	0.694	0.063	0.052	0.05
Zn - Zinc (01092)	mg/l	0.006	0.017	0.007	0.014	< 0.005	< 0.005	0.019
Sb - Antimony (01097)	µg/l	< 1	< 1	< 1	< 1	1.01	< 1	< 1
As - Arsenic (01002)	µg/l	7.21	8.24	3.1	154	33.6	< 1	< 1
Cd - Cadmium (01027)	µg/l	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Cr - Chromium (01034)	µg/l	2.47	2.1	2.85	< 1	< 1	1.5	1.62
Cu - Copper (01042)	µg/l	2.24	5.57	7.08	< 1	< 1	1.7	1.46
Pb - Lead (01051)	µg/l	3.24	2.57	2.37	< 1	< 1	< 1	< 1
Molybdenum (Mo)	µg/l	15.2	9.59	13.6	56.6	14.7	< 1	< 1
Ni - Nickel (01067)	µg/l	2.66	2.31	2.93	1.36	1.83	< 1	< 1
Se - Selenium (01147)	µg/l	< 1	< 1	< 1	< 1	2.88	< 1	< 1
Tl - Thallium (01059)	µg/l	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
TDS - Total Diss. Solids (70300)	mg/l	170	170	230	330	120	87	85
TSS-Total Suspended Solids	mg/l	450	49	120	8	< 5	16	15
pH	s.u.	6.27	7.26	6.17	7.38	6.93	6.56	6.53
Temperature	°C	18.2	20.7	19.8	24	27.7	23.9	24.6
Specific conductance	µS/cm	219.2	214.7	213.8	449	202.5	86.9	82.2
Flow	MGD	0.0015	0.0002	0.0009	0.0012	0.2	405	405

Notes:

1. Flow measurements and analytical samples were collected on July 7 and 14, 2014.
2. Flow at locations upstream and downstream of DRSS in the Dan River is the summation of USGS Dan River-Wentworth and USGS Smith River Eden daily average flows for the date of river sampling

Appendix B

Sample Preservation and Hold times

Parameter name	Container[1]	Preservation[2,3]	Maximum holding time[4]
Table IB—Inorganic Tests:			
1. Acidity	P, FP, G	Cool, ≤6 °C[18]	14 days.
2. Alkalinity	P, FP, G	Cool, ≤6 °C[18]	14 days.
4. Ammonia	P, FP, G	Cool, ≤6 °C[18], H_2SO_4 to pH <2	28 days.
9. Biochemical oxygen demand	P, FP, G	Cool, ≤6 °C[18]	48 hours.
10. Boron	P, FP, or Quartz	HNO_3 to pH <2	6 months.
11. Bromide	P, FP, G	None required	28 days.
14. Biochemical oxygen demand, carbonaceous	P, FP G	Cool, ≤6 °C[18]	48 hours.
15. Chemical oxygen demand	P, FP, G	Cool, ≤6 °C[18], H_2SO_4 to pH <2	28 days.
16. Chloride	P, FP, G	None required	28 days.
17. Chlorine, total residual	P, G	None required	Analyze within 15 minutes.
21. Color	P, FP, G	Cool, ≤6 °C[18]	48 hours.
23-24. Cyanide, total or available (or CATC) and free	P, FP, G	Cool, ≤6 °C[18], NaOH to pH >10[5][6], reducing agent if oxidizer present	14 days.
25. Fluoride	P	None required	28 days.
27. Hardness	P, FP, G	HNO_3 or H_2SO_4 to pH <2	6 months.
28. Hydrogen ion (pH)	P, FP, G	None required	Analyze within 15 minutes.
31, 43. Kjeldahl and organic N	P, FP, G	Cool, ≤6 °C[18], H_2SO_4 to pH <2	28 days.
Table IB—Metals:[7]			
18. Chromium VI	P, FP, G	Cool, ≤6 °C[18], pH = 9.3-9.7[20]	28 days.
35. Mercury (CVAA)	P, FP, G	HNO_3 to pH <2	28 days.
35. Mercury (CVAFS)	FP, G; and FP-lined cap[17]	5 mL/L 12N HCl or 5 mL/L BrCl[17]	90 days.[17]
3, 5-8, 12, 13, 19, 20, 22, 26, 29, 30, 32-34, 36, 37, 45, 47, 51, 52, 58-60, 62, 63, 70-72, 74, 75. Metals, except boron, chromium VI, and mercury	P, FP, G	HNO_3 to pH <2, or at least 24 hours prior to analysis[19]	6 months.
38. Nitrate	P, FP, G	Cool, ≤6 °C[18]	48 hours.
39. Nitrate-nitrite	P, FP, G	Cool, ≤6 °C[18], H_2SO_4 to pH <2	28 days.
40. Nitrite	P, FP, G	Cool, ≤6 °C[18]	48 hours.
41. Oil and grease	G	Cool to ≤6 °C[18], HCl or H_2SO_4 to pH <2	28 days.
42. Organic Carbon	P, FP, G	Cool to ≤6 °C[18], HCl, H_2SO_4, or H_3PO_4 to pH <2	28 days.
44. Orthophosphate	P, FP, G	Cool, to ≤6 °C[18,24]	Filter within 15 minutes; Analyze within 48 hours.
46. Oxygen, Dissolved Probe	G, Bottle and top	None required	Analyze within 15 minutes.
47. Winkler	G, Bottle and top	Fix on site and store in dark	8 hours.
48. Phenols	G	Cool, ≤6 °C[18], H_2SO_4 to pH <2	28 days.
49. Phosphorous (elemental)	G	Cool, ≤6 °C[18]	48 hours.
50. Phosphorous, total	P, FP, G	Cool, ≤6 °C[18], H_2SO_4 to pH <2	28 days.
53. Residue, total	P, FP, G	Cool, ≤6 °C[18]	7 days.
54. Residue, Filterable	P, FP, G	Cool, ≤6 °C[18]	7 days.
55. Residue, Nonfilterable (TSS)	P, FP, G	Cool, ≤6 °C[18]	7 days.
56. Residue, Settleable	P, FP, G	Cool, ≤6 °C[18]	48 hours.
57. Residue, Volatile	P, FP, G	Cool, ≤6 °C[18]	7 days.
61. Silica	P or Quartz	Cool, ≤6 °C[18]	28 days.
64. Specific conductance	P, FP, G	Cool, ≤6 °C[18]	28 days.
65. Sulfate	P, FP, G	Cool, ≤6 °C[18]	28 days.
66. Sulfide	P, FP, G	Cool, ≤6 °C[18], add zinc acetate plus sodium hydroxide to pH >9	7 days.
67. Sulfite	P, FP, G	None required	Analyze within 15 minutes.
68. Surfactants	P, FP, G	Cool, ≤6 °C[18]	48 hours.
69. Temperature	P, FP, G	None required	Analyze.
73. Turbidity	P, FP, G	Cool, ≤6 °C[18]	48 hours.

[1]"P" is for polyethylene; "FP" is fluoropolymer (polytetrafluoroethylene (PTFE); Teflon®), or other fluoropolymer, unless stated otherwise in this Table II; "G" is glass; "PA" is any plastic that is made of a sterilizable material (polypropylene or other autoclavable plastic); "LDPE" is low density polyethylene.

[2]Except where noted in this Table II and the method for the parameter, preserve each grab sample within 15 minutes of collection. For a composite sample collected with an automated sample (e.g., using a 24-hour composite sample; see 40 CFR 122.21(g)(7)(i) or 40 CFR Part 403, Appendix E), refrigerate the sample at ≤6 °C during collection unless specified otherwise in this Table II or in the method(s). For a composite sample to be split into separate aliquots for preservation and/or analysis, maintain the sample at ≤6 °C, unless specified otherwise in this Table II or in the method(s), until collection, splitting, and preservation is completed. Add the preservative to the sample container prior to sample collection when the preservative will not compromise the integrity of a grab sample, a composite sample, or aliquot split from a

composite sample within 15 minutes of collection. If a composite measurement is required but a composite sample would compromise sample integrity, individual grab samples must be collected at prescribed time intervals (e.g., 4 samples over the course of a day, at 6-hour intervals). Grab samples must be analyzed separately and the concentrations averaged. Alternatively, grab samples may be collected in the field and composited in the laboratory if the compositing procedure produces results equivalent to results produced by arithmetic averaging of results of analysis of individual grab samples. For examples of laboratory compositing procedures, see EPA Method 1664 Rev. A (oil and grease) and the procedures at 40 CFR 141.34(f)(14)(iv) and (v) (volatile organics).

[3]When any sample is to be shipped by common carrier or sent via the U.S. Postal Service, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR part 172). The person offering such material for transportation is responsible for ensuring such compliance. For the preservation requirement of Table II, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid (HCl) in water solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater; Nitric acid (HNO_3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H_2SO_4) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or greater); and Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).

[4]Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before the start of analysis and still be considered valid. Samples may be held for longer periods only if the permittee or monitoring laboratory has data on file to show that, for the specific types of samples under study, the analytes are stable for the longer time, and has received a variance from the Regional Administrator under Sec. 136.3(e). For a grab sample, the holding time begins at the time of collection. For a composite sample collected with an automated sampler (e.g., using a 24-hour composite sampler; see 40 CFR 122.21(g)(7)(i) or 40 CFR part 403, Appendix E), the holding time begins at the time of the end of collection of the composite sample. For a set of grab samples composited in the field or laboratory, the holding time begins at the time of collection of the last grab sample in the set. Some samples may not be stable for the maximum time period given in the table. A permittee or monitoring laboratory is obligated to hold the sample for a shorter time if it knows that a shorter time is necessary to maintain sample stability. See 136.3(e) for details. The date and time of collection of an individual grab sample is the date and time at which the sample is collected. For a set of grab samples to be composited, and that are all collected on the same calendar date, the date of collection is the date on which the samples are collected. For a set of grab samples to be composited, and that are collected across two calendar dates, the date of collection is the dates of the two days; e.g., November 14-15. For a composite sample collected automatically on a given date, the date of collection is the date on which the sample is collected. For a composite sample collected automatically, and that is collected across two calendar dates, the date of collection is the dates of the two days; e.g., November 14-15. For static-renewal toxicity tests, each grab or composite sample may also be used to prepare test solutions for renewal at 24 h, 48 h, and/or 72 h after first use, if stored at 0-6 °C, with minimum head space.

[5]ASTM D7365-09a specifies treatment options for samples containing oxidants (e.g., chlorine). Also, Section 9060A of Standard Methods for the Examination of Water and Wastewater (20th and 21st editions) addresses dechlorination procedures.

[6]Sampling, preservation and mitigating interferences in water samples for analysis of cyanide are described in ASTM D7365-09a. There may be interferences that are not mitigated by the analytical test methods or D7365-09a. Any technique for removal or suppression of interference may be employed, provided the laboratory demonstrates that it more accurately measures cyanide through quality control measures described in the analytical test method. Any removal or suppression technique not described in D7365-09a or the analytical test method must be documented along with supporting data.

[7]For dissolved metals, filter grab samples within 15 minutes of collection and before adding preservatives. For a composite sample collected with an automated sampler (e.g., using a 24-hour composite sampler; see 40 CFR 122.21(g)(7)(i) or 40 CFR Part 403, Appendix E), filter the sample within 15 minutes after completion of collection and before adding preservatives. If it is known or suspected that dissolved sample integrity will be compromised during collection of a composite sample collected automatically over time (e.g., by interchange of a metal between dissolved and suspended forms), collect and filter grab samples to be composited (footnote 2) in place of a composite sample collected automatically.

[8]Guidance applies to samples to be analyzed by GC, LC, or GC/MS for specific compounds.

[9]If the sample is not adjusted to pH 2, then the sample must be analyzed within seven days of sampling.

[10]The pH adjustment is not required if acrolein will not be measured. Samples for acrolein receiving no pH adjustment must be analyzed within 3 days of sampling.

[11]When the extractable analytes of concern fall within a single chemical category, the specified preservative and maximum holding times should be observed for optimum safeguard of sample integrity (*i.e.*, use all necessary preservatives and hold for the shortest time listed). When the analytes of concern fall within two or more chemical categories, the sample may be preserved by cooling to ≤6 °C, reducing residual chlorine with 0.008% sodium thiosulfate, storing in the dark, and adjusting the pH to 6-9; samples preserved in this manner may be held for seven days before extraction and for forty days after extraction. Exceptions to this optional preservation and holding time procedure are noted in footnote 5 (regarding the requirement for thiosulfate reduction), and footnotes 12, 13 (regarding the analysis of benzidine).

[12]If 1,2-diphenylhydrazine is likely to be present, adjust the pH of the sample to 4.0 ±0.2 to prevent rearrangement to benzidine.

[13]Extracts may be stored up to 30 days at <0 °C.

[14]For the analysis of diphenylnitrosamine, add 0.008% $Na_2S_2O_3$ and adjust pH to 7-10 with NaOH within 24 hours of sampling.

[15]The pH adjustment may be performed upon receipt at the laboratory and may be omitted if the samples are extracted within 72 hours of collection. For the analysis of aldrin, add 0.008% $Na_2S_2O_3$.

[16]Place sufficient ice with the samples in the shipping container to ensure that ice is still present when the samples arrive at the laboratory. However, even if ice is present when the samples arrive, immediately measure the temperature of the samples and confirm that the preservation temperature maximum has not been exceeded. In the isolated cases where it can be documented that this holding temperature cannot be met, the permittee can be given the option of on-site testing or can request a variance. The request for a variance should include supportive data which show that the toxicity of the effluent samples is not reduced because of the increased holding temperature. Aqueous samples must not be frozen. Hand-delivered samples used on the day of collection do not need to be cooled to 0 to 6 °C prior to test initiation.

[17]Samples collected for the determination of trace level mercury (<100 ng/L) using EPA Method 1631 must be collected in tightly-capped fluoropolymer or glass bottles and preserved with BrCl or HCl solution within 48 hours of sample collection. The time to preservation may be extended to 28 days if a sample is oxidized in the sample bottle. A sample collected for dissolved trace level mercury should be filtered in the laboratory within 24 hours of the time of collection. However, if circumstances preclude overnight shipment, the sample should be filtered in a designated clean area in the field in accordance with procedures given in Method 1669. If sample integrity will not be maintained by shipment to and filtration in the laboratory, the sample must be filtered in a designated clean area in the field within the time

period necessary to maintain sample integrity. A sample that has been collected for determination of total or dissolved trace level mercury must be analyzed within 90 days of sample collection.

[18]Aqueous samples must be preserved at ≤6 °C, and should not be frozen unless data demonstrating that sample freezing does not adversely impact sample integrity is maintained on file and accepted as valid by the regulatory authority. Also, for purposes of NPDES monitoring, the specification of "≤°C" is used in place of the "4 °C" and "<4 °C" sample temperature requirements listed in some methods. It is not necessary to measure the sample temperature to three significant figures (1/100th of 1 degree); rather, three significant figures are specified so that rounding down to 6 °C may not be used to meet the ≤6 °C requirement. The preservation temperature does not apply to samples that are analyzed immediately (less than 15 minutes).

[19]An aqueous sample may be collected and shipped without acid preservation. However, acid must be added at least 24 hours before analysis to dissolve any metals that adsorb to the container walls. If the sample must be analyzed within 24 hours of collection, add the acid immediately (see footnote 2). Soil and sediment samples do not need to be preserved with acid. The allowances in this footnote supersede the preservation and holding time requirements in the approved metals methods.

[20]To achieve the 28-day holding time, use the ammonium sulfate buffer solution specified in EPA Method 218.6. The allowance in this footnote supersedes preservation and holding time requirements in the approved hexavalent chromium methods, unless this supersession would compromise the measurement, in which case requirements in the method must be followed.

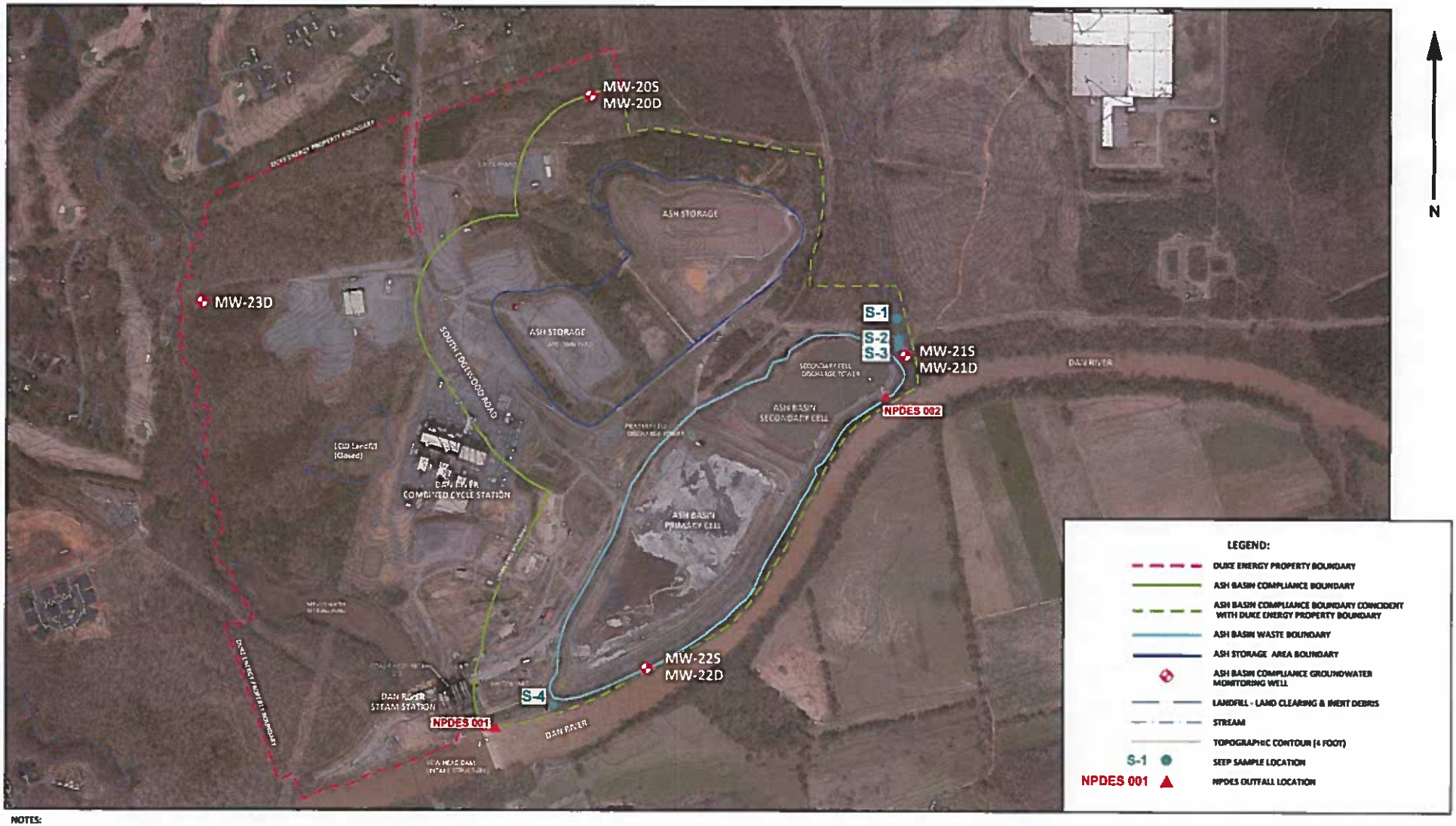
[21]Holding time is calculated from time of sample collection to elution for samples shipped to the laboratory in bulk and calculated from the time of sample filtration to elution for samples filtered in the field.

[22]Sample analysis should begin as soon as possible after receipt; sample incubation must be started no later than 8 hours from time of collection.

[23]For fecal coliform samples for sewage sludge (biosolids) only, the holding time is extended to 24 hours for the following sample types using either EPA Method 1680 (LTB-EC) or 1681 (A-1): Class A composted, Class B aerobically digested, and Class B anaerobically digested.

[24]The immediate filtration requirement in orthophosphate measurement is to assess the dissolved or bio-available form of orthophosphorus (*i.e.*, that which passes through a 0.45-micron filter), hence the requirement to filter the sample immediately upon collection (*i.e.*, within 15 minutes of collection).

[38 FR 28758, Oct. 16, 1973



NOTES:

1. PARCEL DATA FOR THE SITE WAS OBTAINED FROM DUKE ENERGY REAL ESTATE AND IS APPROXIMATE.
2. ASH BASIN WASTE BOUNDARY AND ASH STORAGE AREA BOUNDARIES ARE APPROXIMATE.
3. AS-BUILT MONITORING WELL LOCATIONS PROVIDED BY DUKE ENERGY.
4. SHALLOW MONITORING WELLS (S) - WELL SCREEN INSTALLED ACROSS THE SURFICIAL WATER TABLE.
5. DEEP MONITORING WELLS (D) - WELL SCREEN INSTALLED IN THE TRANSITION ZONE BETWEEN COMPETENT BEDROCK AND THE REGOLITH.
6. ORTHOPHOTOGRAPHY WAS PROVIDED BY DUKE ENERGY (DATED 2014).
7. TOPOGRAPHIC CONTOURS WERE OBTAINED FROM NCDOT WEB SITE (DATED 2010) AND ARE APPROXIMATE.
8. THE ASH BASIN COMPLIANCE BOUNDARY IS ESTABLISHED ACCORDING TO THE DEFINITION FOUND IN 15A NCAC 02L .0107 (a.)
9. HYDROGRAPHY WAS OBTAINED FROM THE USGS NATIONAL MAP VIEWER AND DOWNLOAD PLATFORM ON JULY 8, 2014 (http://nationalmap.gov/viewer.html)
10. SEEP SAMPLING LOCATIONS ARE APPROXIMATE.
11. NPDES OUTFALL AND WATER QUALITY SAMPLE LOCATIONS PROVIDED BY DUKE ENERGY.

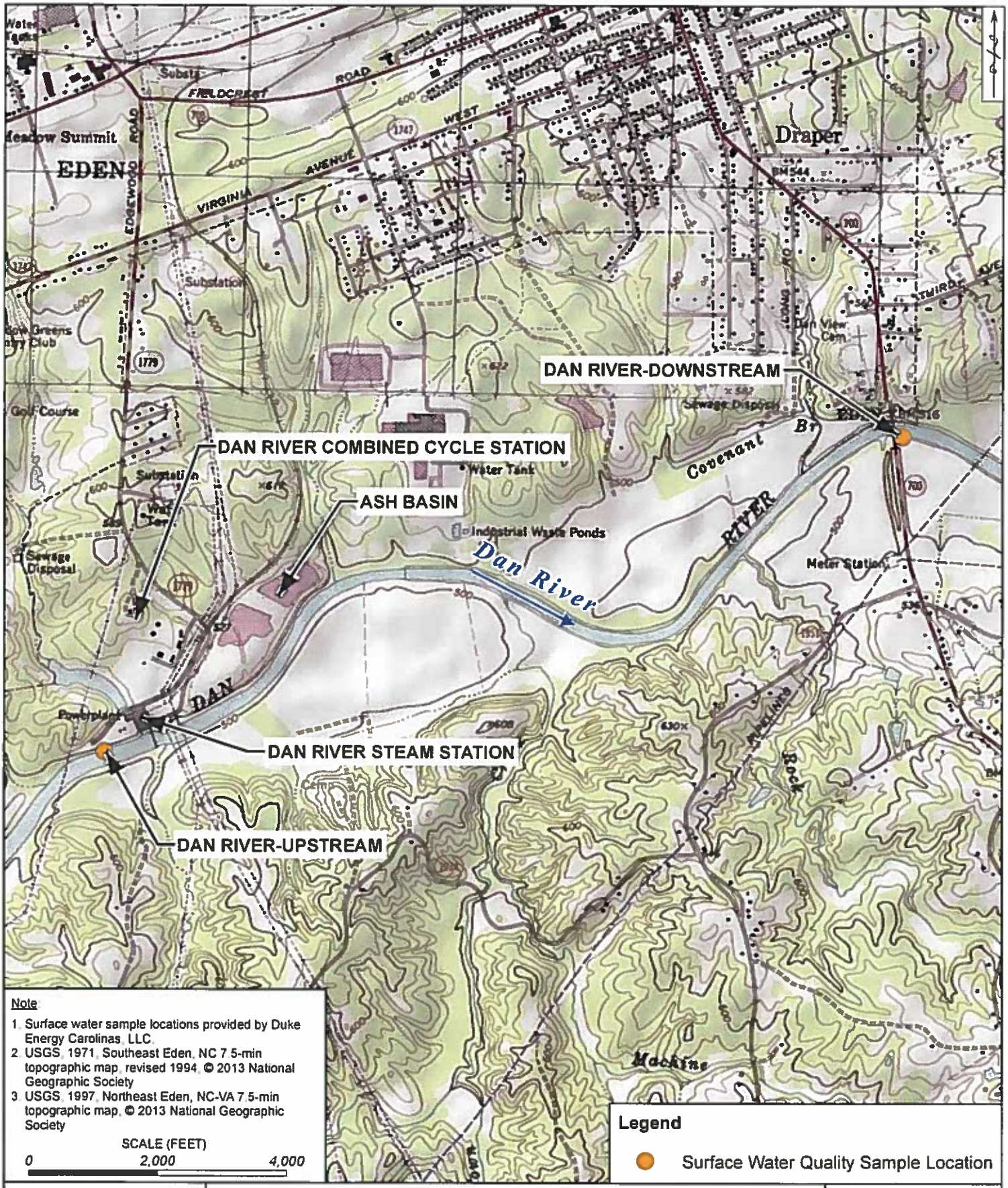
SCALE (FEET)
300' 0 300' 600'
1" = 600'

IDENTIFIED SEEPS AND WATER QUALITY SAMPLE LOCATION MAP

DUKE ENERGY CAROLINAS, LLC
DAN RIVER COMBINED CYCLE STATION ASH BASIN
NPDES PERMIT #NC0003468
ROCKINGHAM COUNTY, NORTH CAROLINA

DATE
JULY 31, 2014

FIGURE
1



Note:

1. Surface water sample locations provided by Duke Energy Carolinas, LLC.
2. USGS, 1971, Southeast Eden, NC 7.5-min topographic map, revised 1994. © 2013 National Geographic Society
3. USGS, 1997, Northeast Eden, NC-VA 7.5-min topographic map. © 2013 National Geographic Society

SCALE (FEET)

0 2,000 4,000

Legend

Surface Water Quality Sample Location

HDR

License Number: F-0116
440 South Church Street Charlotte NC 28202

SURFACE WATER QUALITY SAMPLE LOCATION MAP
DAN RIVER COMBINED CYCLE STATION
DUKE ENERGY CAROLINAS, LLC
ROCKINGHAM COUNTY, NORTH CAROLINA

DATE

July 31, 2014

FIGURE

2

Dan River Ash Basin (NPDES Permit NC0003468)
Groundwater Monitoring Program
Reports and Recommendations

Groundwater monitoring is conducted around the ash basin system at the Dan River Combined Cycle Station under NPDES Permit NC0003468. The following items are presented to describe potential on-site and off-site receptors, the nature of the groundwater flow regime around the Dan River site, and the Dan River groundwater monitoring program.

- **Item 1** - Receptor Survey Dan River Combined Cycle Station Ash Basin
- **Item 2** - Generalized Groundwater Flow Direction Figure
- **Item 3** - Groundwater Monitoring Program Sampling, Analysis, and Reporting Plan

The referenced items and documents are included to describe the current state of the groundwater monitoring program and any changes to the existing monitoring plan. Changes to the current program (including installation of additional observation or monitoring wells) which are proposed by Duke Energy in the future may be allowed following consultation with NC DENR and should not require a re-opening of the Dan River NPDES permit.

Item 1 - Receptor Survey Dan River Combined Cycle Station Ash Basin

A receptor survey has been completed to identify private water supply wells, public water supplies, surface water bodies, and wellhead protection areas (if present) within a 0.5-mile radius of the Dan River ash basin compliance boundary. The report presents the methodology and findings of the survey. This report is included as Enclosure 1.

Item 2 - Generalized Groundwater Flow Direction Figure

The Dan River ash basin site and the generalized groundwater flow directions for the shallow water table are presented in a figure contained in Enclosure 2. The figure presents the generalized groundwater flow direction around the ash basin with arrows depicting probable generalized groundwater flow directions for the shallow water table. These generalized flow directions were developed based on the site hydrogeologic conceptual groundwater flow model, site topography, and historic site groundwater elevation data.

Item 3 - Groundwater Monitoring Program Sampling, Analysis, and Reporting Plan

The groundwater monitoring program sampling, analysis, and reporting plan (Plan) was developed to support the requirement for groundwater monitoring around the Dan River ash

basin. The Plan describes the groundwater monitoring network, methodologies of field sampling, record-keeping protocols, analytical procedures, data quality objectives, data validation, and reporting that will be used to support the Dan River ash basin groundwater monitoring program. This document is included as Enclosure 3.

As stated in the Plan, it is recommended that sample reporting requirements be changed to require reporting within 60 days of the date of sample collection. It is recommended that the compliance monitoring wells at the Dan River site continue to be sampled at a frequency of three times per year and analyzed for the same constituents that have been historically analyzed for the NPDES-required groundwater monitoring.

We also plan to develop a groundwater flow model of the site predicting expected groundwater flow paths from areas around the ash pond system to the appropriate receiving water body. The groundwater flow model would be used to verify the current understanding of the groundwater flow directions at the site and could be used to evaluate exceedances if any are found to be related to impacts from the ash basin. We propose that model will be developed and the groundwater flow modeling report be submitted to NCDENR within 120 days of the NPDES permit being issued. As plans are made to develop the groundwater flow model, the installation of additional observation wells in or around the ash basin system may be beneficial to enhance the model. If Duke's evaluation deems additional observation wells to be beneficial, we will communicate our recommendations to NCDENR prior to well installation.

NCDENR Aquifer Protection Section (APS) developed a policy for compliance evaluation of groundwater results at ash basins with no prior groundwater monitoring and published a memorandum providing that policy on June 17, 2011. The memorandum titled *Policy for Compliance Evaluation of Long-Term Permitted Facilities with No Prior Groundwater Monitoring Requirements* outlined the process for evaluating compliance of groundwater monitoring results based on the requirements in 15A NCAC 2L .0106.

The memorandum acknowledges the factors that monitoring well placement and existing conditions at the ash basins have on determination of exceedances of 2L Standards in groundwater monitoring results at ash basins.

The memorandum included a flow chart showing the process for determining if a measured groundwater concentration greater than 15A NCAC 02L .0202 would cause the facility to be non-compliant and would result in implementation of corrective action.

Duke recommends continued utilization of the June 17, 2011, NCDENR memorandum to evaluate exceedances of 2L Standards at the Dan River ash basin. For exceedances that are not

the result of naturally occurring site conditions, the process prescribed in the memorandum requires the permittee to comply with corrective action requirements as specified in 15A NCAC 02L .0106.

Enclosures: Enclosure 1 – Receptor Survey Dan River Combined Cycle Station Ash Basin
Enclosure 2 – Generalized Groundwater Flow Direction Figure
Enclosure 3 – Groundwater Monitoring Program Sampling, Analysis, and Reporting Plan

Enclosure 1

Receptor Survey

Dan River Ash Basin System

(NPDES Permit NC0003468)

RECEPTOR SURVEY
DAN RIVER COMBINED CYCLE STATION ASH BASIN
NPDES PERMIT NC0003468

Dan River Combined Cycle Station
900 South Edgewood Road
Eden, North Carolina

Prepared for:
DUKE ENERGY CAROLINAS, LLC
Charlotte, North Carolina

Prepared by:
HDR ENGINEERING, INC. OF THE CAROLINAS
Charlotte, North Carolina

July 31, 2014

REPORT VERIFICATION

PROJECT: **RECEPTOR SURVEY**
DAN RIVER COMBINED CYCLE STATION ASH BASIN
NPDES PERMIT NC0003468

This document has been reviewed for accuracy and quality commensurate with the intended application.

Prepared by: Justin B Schumacher Date: 7/31/2014

Checked by: [signature] Date: 7/31/2014

Approved by: Brooke Ahrens Date: 7/31/2014

Project Manager: Brooke Ahrens, PE

RECEPTOR SURVEY
DAN RIVER COMBINED CYCLE STATION ASH BASIN
NPDES PERMIT NC0003468

TABLE OF CONTENTS

Section **Page No.**

FIGURES

Section 1
Introduction

Duke Energy Carolinas, LLC (Duke Energy) owns and formerly operated the Dan River Steam Station, a coal-fired electric generating station, located near the town of Eden in Rockingham County, North Carolina. The station used the ash basin for disposal of ash generated by the coal combustion process and other water treatment at the coal-fired plant. Duke Energy now operates a natural gas-fired combined cycle electric generating station (DRCCS) at the site (Figure 1).

The discharge from the ash basin is permitted by the North Carolina Department of Environment and Natural Resources (NCDENR) Division of Water Quality (DWQ) under the National Pollution Discharge Elimination System (NPDES) Permit NC0003468.

HDR Engineering, Inc. of the Carolinas (HDR) has completed a receptor survey to identify water supply wells, public water supplies, surface water bodies, and wellhead protection areas (if present) within a 0.5 mile radius of the DRCCS ash basin compliance boundary (Figure 1). The compliance boundary for groundwater quality in relation to the ash basin is defined in accordance with 15A NCAC 02L .0107(a) as being established at either 500 feet from the waste boundary or at the property boundary, whichever is closer to the source.

The survey activities performed and the findings of those activities are presented in Sections 3 and 4, respectively.

Section 2
Background

2.1 Plant and Ash Basin Description

The former Dan River Steam Station was a coal-fired electricity-generating facility located in Rockingham County, North Carolina, near the town of Eden. All three coal-fired units were retired in 2012. The site is located on the north bank of the Dan River.

The ash basin system is located adjacent to the Dan River and consists of a Primary Cell, a Secondary Cell, and associated embankments and outlet works, as shown on Figure 1. The ash basin is impounded by earthen dikes, and an earthen/ash divider dike separates the Primary Cell from the Secondary Cell.

The original ash basin was constructed in 1956 and laterally expanded in 1967. In 1980 the height of the earthen dikes was raised and an intermediate dike was constructed to form the current Primary Cell and Secondary Cell. The ash basin was an integral part of the coal-fired unit's wastewater treatment system. During operation of the coal-fired units, the ash basin received inflows from the ash removal system, station yard drain sump, and stormwater flows. The ash from the coal combustion was sluiced to the ash basin through a pipe, discharging in the southwest corner of the Primary Cell. Flow was discharged from the Primary Cell through a concrete discharge tower into the Secondary Cell. The discharge flow from the Secondary Cell to the Dan River is through a concrete discharge tower.

Since February 2014, the Primary Cell only collects storm water and water pumped from plugged pipes under the basin collecting as a pool approximately 20-feet wide and 10-feet deep adjacent to the discharge tower. On March 1, 2013, the DRCCS wastewater was rerouted from the Primary Cell to Outfall 001 due to the new NPDES permit going into effect. The Secondary Cell continues to operate and receives flows from storm water, re-routed yard sumps, DRCCS drains, and treated domestic sewage. The discharge flow from the Secondary Cell to the Dan River is through a concrete discharge tower and Outfall 002.

2.2 Description of Surrounding Properties

Properties located within a 0.5 mile radius of the DRCSS ash basin compliance boundary are located in and southeast of Eden, Rockingham County, North Carolina. The majority of the land is undeveloped property. Residential properties are located north and northwest of the ash basin compliance boundary within the 0.5 mile radius. One residence is located on the south side of Dan River. Two industrial properties are located northeast of DRCCS; one of these properties has a wastewater treatment plant discharging into the Dan River. Farm land is located southeast of the station. Figure 1 depicts the properties surrounding DRCCS.

Section 3
Receptor Survey Activities

3.1 NCDENR Records Review

HDR reviewed the NCDENR Department of Environmental Health (DEH) Public Water Supply Section's (PWSS) Public Water Supply Water Sources Geographic Information System (GIS) point data set (pwsws.shp) obtained from the NC OneMap GeoSpatial Portal (http://data.nconemap.com/geoportal/catalog/main/home.page) to identify public water supply sources within a 0.5 mile radius of the DRCCS ash basin compliance boundary.

On July 8, 2014, HDR reviewed the NCDENR Division of Water Resources (DWR) Source Water Assessment Program (SWAP) online database for public water supply sources to identify any wells located within a 0.5 mile radius of the ash basin compliance boundary, to confirm the location of wells included in the Public Water Supply Water Sources GIS point data set, and to identify any wellhead protection areas located within a 0.5 mile radius of the compliance boundary. The NCDENR SWAP database provides detailed assessments of all public drinking water intakes and wellhead protection areas in North Carolina. The website address is: (http://swap.ncwater.org/website/swap/viewer.htm).

On July 10, 2014, Mr. Justin Schumacher with HDR contacted Mr. Sean McGuire, GIS Specialist with the NCDENR PWSS, by telephone. Mr. McGuire stated that as of July 10, 2014, the data contained in the Public Water Supply Water Sources GIS point data set obtained from the NC OneMap GeoSpatial Portal was current through November 18, 2009. The most current GIS data set of public water supply locations available from North Carolina state agencies was available by request since the report update is in process. The GIS point data for the public water supply wells includes, but is not limited to information such as public water supply (PWS) system identification numbers, ownership information, PWS source type, well depth, and well yield.

Mr. McGuire indicated the Public Water Supply Water Sources GIS point data set and the SWAP online database is scheduled to be updated and released to the public in July 2014. As of

the date of this report, the Public Water Supply Water Sources GIS point data set and the SWAP online database was not updated. HDR recommends review of the new data set and online database once they are made available.

3.2 Rockingham County Records Review

HDR contacted the Rockingham County Environmental Health Department to inquire about the location and details (if available) for registered water supply wells located in Rockingham County within a 0.5 mile radius of the ash basin compliance boundary. On July 8, 2014, Mr. Justin Schumacher with HDR met with Ms. Angel Wyatt with the Rockingham County Environmental Health Department.

3.3 Public Water Supplier Records Review

HDR contacted the City of Eden, to inquire about municipal water supply to properties located in their service area within a 0.5 mile radius of the ash basin compliance boundary. On July 7, 2014, Mr. Justin Schumacher spoke with Mr. Terry Shelton, Director of Environmental Services regarding the extent of the city water service.

HDR contacted the Dan River Water Inc., a private water utility company, to inquire about municipal water supply to properties located in their service area of Rockingham County south of the Dan River and within a 0.5 mile radius of the ash basin compliance boundary. On July 8, 2014, Mr. Schumacher with HDR spoke with Ms. Linda Carter.

3.4 HDR Field Survey

HDR personnel performed a field reconnaissance on July 9, 2014, to attempt to identify water supply wells and surface waters located within a 0.5 mile radius of the ash basin compliance boundary. A windshield survey was conducted from public roadways to identify water meters, fire hydrants, valves, and any potential well heads/well houses. Prior to conducting the field reconnaissance, HDR personnel reviewed orthophotography obtained from NC OneMap GeoSpatial portal (dated 2010) to identify any potential well heads/well houses and surface waters within a 0.5 mile radius of the ash basin compliance boundary.

In addition, HDR personnel contacted Duke Energy site personnel to identify water supply wells potentially located on Duke Energy property. During a site visit on June 18, 2014, HDR personnel observed the property to the east of DRCCS from the southeastern Duke Energy property boundary.

3.5 USGS Hydrography Review

HDR reviewed the United States Geological Survey (USGS) National Hydrography Dataset (NHD) obtained from the USGS National Map Viewer (http://viewer.nationalmap.gov/viewer/) to identify any surface waters within a 0.5 mile radius of the ash basin compliance boundary. Hydrography data obtained from the USGS NHD is included on Figure 1.

Section 4
Findings

Details of the findings from the local and state records review and field survey activities are provided in Sections 4.1 through 4.4. A general summary of the receptor survey findings is provided in Section 4.5.

4.1 NCDENR Records

No public water supply wells were identified in the Public Water Supply Water Sources GIS point data set (obtained from NC OneMap GeoSpatial Portal) or on the NCDENR SWAP online database within a 0.5 mile radius of the ash basin compliance boundary.

No wellhead protection areas were identified on the NCDENR SWAP online database within a 0.5 mile radius of the ash basin compliance boundary.

4.2 Rockingham County Records

The Rockingham County Environmental Health Department has no records of private or public water supply wells located within a 0.5 mile radius of the ash basin compliance boundary. Ms. Wyatt retrieved record files for the property owners south of the Dan River and within the 0.5 mile radius of the ash basin compliance boundary but did not find record of water supply well information. Ms. Wyatt informed Mr. Schumacher that Rockingham County's records for wells only date back to 2000 for private and/or public water supply wells.

4.3 Public Water Supplier Records

Mr. Shelton confirmed that the City of Eden provides municipal water service to the DRCCS site and properties located to the north of the Dan River in Rockingham County within the 0.5 mile radius of the ash basin compliance boundary.

Ms. Carter of Dan River Water Inc. confirmed that water service was provided along Town Creek Road south of the Dan River in Rockingham County.

4.4 HDR Field Survey

HDR field personnel identified two private water supply wells located outside of Duke Energy's property within a 0.5 mile radius of the ash basin compliance boundary during the field reconnaissance and the June 8th site visit. The wells are included on Figure 1 as "field identified" private water supply wells.

Duke Energy personnel familiar with DRCCS reported that no water supply wells are present on Duke Energy's property. A service water pond for cooling water is located adjacent to the river. All drinking water is supplied by the City of Eden.

Indicative of municipal water supply, water meters, fire hydrants, and valve markings were identified at properties with structures located in Rockingham County within a 0.5 mile radius of the ash basin compliance boundary and north of the Dan River.

From the public roadway, HDR personnel did not identify indications of municipal water supply for the properties located in Rockingham County within a 0.5 mile radius of the ash basin compliance boundary and south of Dan River. One well is located beside a house along Town Creek Road and one well is located on the property to the east of the DRCCS property boundary near the Dan River. No record of the private water supply wells identified was on file with the Rockingham County Environmental Health Department. The approximate location of the private water supply wells are shown on Figure 1. No other wells were identified within a 0.5 mile radius of the ash basin compliance boundary.

Several surface water bodies were identified and/or confirmed during HDR's field reconnaissance. The surface water bodies located within a 0.5 mile radius of the ash basin compliance boundary generally flow toward the Dan River.

4.5 Summary of Receptor Survey Findings

A summary of the receptor survey findings is provided below. The identified water supply wells and surface water bodies are shown on Figure 1.

- Two private water supply wells were identified within a 0.5 mile radius of the ash basin compliance boundary.
- No public water supply wells were identified within a 0.5 mile radius of the ash basin compliance boundary.
- Several tributaries of the Dan River were identified within a 0.5 mile radius of the ash basin.
- No wellhead protection areas were identified within a 0.5 miles radius of the ash basin compliance boundary.

FIGURES

NOTES:
1. PARCEL DATA FOR THE SITE WAS OBTAINED FROM DUKE ENERGY REAL ESTATE AND IS APPROXIMATE.
2. ASH BASIN WASTE BOUNDARY AND ASH STORAGE AREA BOUNDARIES ARE APPROXIMATE.
3. ORTHOPHOTOGRAPHY WAS OBTAINED FROM NC ONEMAP GIS WEB SITE (DATED 2010).
4. THE COMPLIANCE BOUNDARY IS ESTABLISHED ACCORDING TO THE DEFINITION FOUND IN 15A NCAC 02L .0107 (a).
5. PRIVATE WATER SUPPLY WELLS WERE IDENTIFIED DURING HDR'S FIELD RECONNAISSANCE ON JULY 10, 2014, AND SITE VISIT ON JUNE 18, 2014.
6. HYDROGRAPHY WAS OBTAINED FROM THE USGS NATIONAL MAP VIEWER AND DOWNLOAD PLATFORM ON JULY 8, 2014 (http://nationalmap.gov/viewer.html)

SCALE (FEET)
600′ 0 600′ 1,200′
1" = 1,200′

License Number: F-0116
440 South Church Street Charlotte, NC 28202

RECEPTOR SURVEY MAP
DUKE ENERGY CAROLINAS, LLC
DAN RIVER COMBINED CYCLE STATION ASH BASIN
NPDES PERMIT #NC0003468
ROCKINGHAM COUNTY, NORTH CAROLINA

DATE
JULY 31, 2014

FIGURE
1

Enclosure 2

Generalized Groundwater Flow Direction Figure

Dan River Ash Basin System

(NPDES Permit NC0003468)

July 31, 2014

Mr. Sean DeNeale
Duke Energy Carolinas, LLC
Mail Code EC13Z
P.O. Box 1006
Charlotte, NC 28201-1006

Via Email: sean.deneale@duke-energy.com

Subject: Generalized Groundwater Flow Directions Figure
Duke Energy Carolinas, LLC
Dan River Combined Cycle Station Ash Basin

Dear Mr. DeNeale:

HDR is pleased to provide the attached figure presenting generalized groundwater flow directions for the shallow water table aquifer adjacent to the ash basin at the Duke Energy Carolinas, LLC (Duke Energy) Dan River Combined Cycle Station.

This letter provides the background on the development of this information.

1.0 Background

Duke Energy owns and formerly operated the Dan River Steam Station, a coal-fired electric generating station, located in Rockingham County. The coal-fired plant was retired in 2012. The station used an ash basin for disposal of ash generated by the coal combustion process and other water treatment at the coal-fired plant. Duke Energy now operates a natural gas-fired combined-cycle electric generating station at the site.

In 2011, Duke Energy provided Altamont Environmental, Inc. (Altamont) information on the groundwater monitoring wells installed at the ash basin and information on the water levels in the ash basin. Altamont utilized this information along with consideration of adjacent bodies of water and site topography to develop generalized groundwater direction flow arrows for the areas adjacent to the ash basins. This information was presented in the report titled *Generalized Groundwater Flow Direction Maps for Ash Basins, Duke Energy Carolinas, LLC, Fossil Stations, December 12, 2011*. The report contained figures with similar generalized groundwater flow arrows for all seven of the Duke Energy Carolinas fossil station ash basins. The report was prepared by Altamont staff and was sealed by William M. Miller, PE. The information from that report is used with the permission of Duke Energy.

As stated in Section 3.0 of the report:

> *The purpose of the Generalized Ash Basin Groundwater Flow Direction Maps, Figures 1 through 7, is to provide Duke with an interpretation of the generalized groundwater flow directions in the areas surrounding the ash basins. The maps were developed utilizing existing data that were readily available and with data collected as part of on-going monitoring at the ash basins. No additional field investigation was conducted as part of the development of the maps.*
>
> *The maps are not intended to provide absolute groundwater flow direction data at a specific location. Rather, they are an interpretation of the generalized groundwater flow direction for the shallow water table based on readily available data.*
>
> *As described in the following sections (Section 4.0, Section 5.0, and Section 6.0), there may be hydrogeologic conditions present at the ash basins that cause groundwater flow conditions to differ from the generalized groundwater flow directions shown on Figures 1 through 7.*

The generalized groundwater flow directions were determined based on a consideration of the information described above, most notably that the sites are located in the Piedmont physiographic province (Piedmont). In addition, the generalizations of typical Piedmont hydrogeology found in *A Master Conceptual Model for Hydrogeological Site Characterization in the Piedmont and Mountain Region of North Carolina* (LeGrand 2004) apply to these sites.

As stated in Section 5.0 of the report, the possible effects of pumping from adjacent water supply wells were not considered in the development of the generalized groundwater flow direction arrows.

The groundwater elevations used in development of the generalized groundwater direction flow arrows were from the compliance groundwater monitoring wells (compliance wells) wells monitored in association with the National Pollution Discharge Elimination System (NPDES) permits and from groundwater monitoring wells voluntarily (voluntary wells) installed by Duke Energy. No groundwater elevation data readings were performed on the voluntary wells after January 2012. The compliance wells were installed in 2010 and 2011.

Section 7.0 of the Altamont report discusses the development of the generalized groundwater flow direction arrows and the relative level of confidence in the interpretation of the generalized flow direction. The text below was copied from that report:

> *Groundwater flow direction arrows are used to depict the interpreted direction of generalized groundwater flow. Three different colors of arrows were used to indicate the relative level of confidence in the interpretation of the generalized groundwater flow direction.*

The relative level of confidence in the interpretation of flow direction was determined by:

- *The distance from groundwater monitoring wells or surface water elevation data*
- *The number of groundwater data elevation points utilized*
- *Consideration of the surface topography*

Descriptions of the relative confidence levels indicated by groundwater flow direction arrow colors are as follows:

- *Black arrows represent high confidence in the groundwater flow direction interpretation. The black arrows were used in areas in which there were several known groundwater or surface water elevation data points and the surface topography supported the interpretation of groundwater flow characteristic of typical Piedmont groundwater flow.*
- *Gray arrows represent moderate confidence in the groundwater flow direction interpretation. The gray arrows were used in areas where at least one groundwater or surface water elevation point was known or in areas where there was strong surface topographic data to support the groundwater flow direction interpretation.*
- *White arrows represent estimated groundwater flow direction interpretation. The white arrows were used in areas where there was little or no groundwater or surface water elevation data and there was not conclusive surface topographic data to support a gray arrow.*

2.0 Scope of HDR Review and Results

Since limited groundwater elevation data readings were performed on the voluntary wells after January 2012, HDR reviewed the historic groundwater level data available from the compliance groundwater monitoring wells in conjunction with the current approximate ash basin pond elevation data.

HDR found the generalized groundwater flow direction arrows presented in the Altamont report to generally represent the probable direction of groundwater flow for the shallow water table aquifer. As stated in the Altamont report, the generalized groundwater flow direction arrows present an

interpretation of flow direction based on data from the shallow water table aquifer and do not consider the possible effects of pumping from adjacent water supply wells.

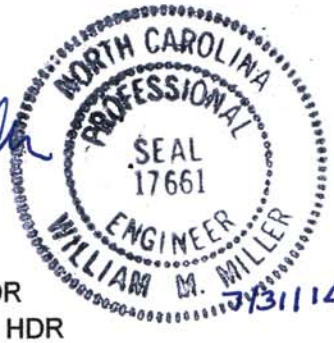
After the pipe break at the Primary Cell of the Dan River ash basin in early 2014, the elevation of the water in the Primary Cell has decreased from the elevation used in the Altamont report (536 feet). Duke Energy reports that no free water is currently contained in the Primary Cell. Based on the topography of the site and the proximity of the adjacent Dan River to the ash basin, it is unlikely that there would be a significant change in the direction of the groundwater flow as represented by the generalized groundwater flow direction arrows developed by Altamont due to the decrease in water level in the Primary Cell.

The generalized groundwater flow directions for the area adjacent to the Dan River ash basin are found on the attached figure *Dan River Combined Cycle Station Ash Basin Figure DRCCS-1.*

HDR appreciates the opportunity to provide continued support to Duke Energy. Should you have any questions regarding this submittal or need further information, please do not hesitate to contact me.

Respectfully submitted,

HDR Engineering, Inc. of the Carolinas

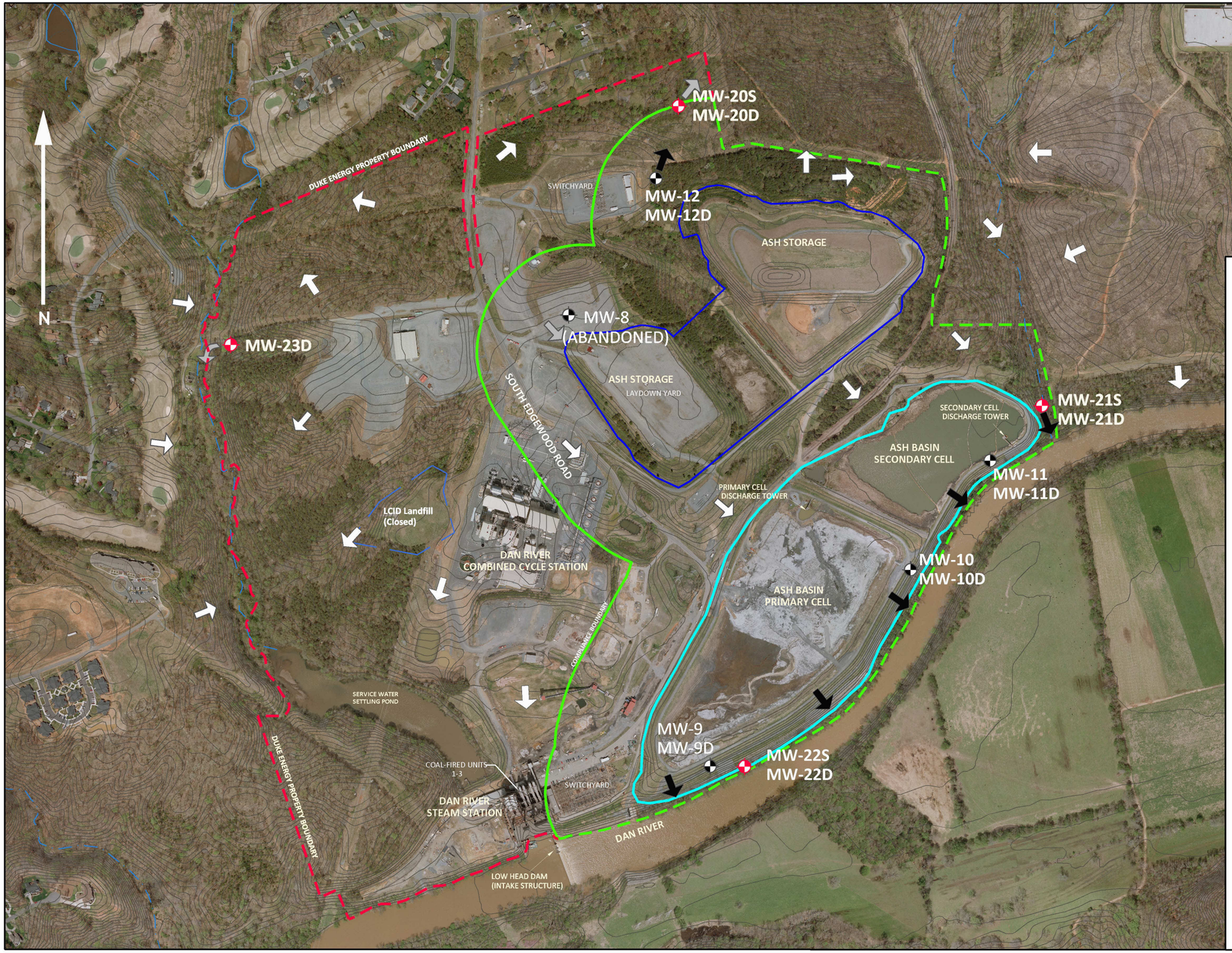


William M. Miller, P.E.
Senior Engineer

cc: Ty Ziegler, HDR
Scott Spinner, HDR

Attachments:

Dan River Combined Cycle Station Ash Basin Figure DRCCS-1



GROUNDWATER FLOW DIRECTION ARROW LEGEND:

GENERALIZED GROUNDWATER FLOW DIRECTION (HIGH CONFIDENCE)
- Supported by several groundwater elevation data points and strong topographic data

GENERALIZED GROUNDWATER FLOW DIRECTION (MODERATE CONFIDENCE)
- Supported by at least one groundwater elevation data point and/or strong topographic data

GENERALIZED GROUNDWATER FLOW DIRECTION (ESTIMATED)
- Groundwater flow direction estimated due to lack of groundwater data and/or strong topographic data

NOTES FOR GENERALIZED GROUNDWATER FLOW DIRECTION ARROWS:

1. GENERALIZED GROUNDWATER FLOW DIRECTION ARROWS PRESENT PROBABLE GENERALIZED GROUNDWATER FLOW DIRECTION FOR THE SHALLOW WATER TABLE AQUIFER BASED ON MONITORING WELL WATER LEVELS, TOPOGRAPHIC AND HYDROLOGIC FEATURES SHOWN ON THIS FIGURE. THESE GENERALIZED GROUNDWATER FLOW DIRECTION ARROWS WERE DEVELOPED IN THE REPORT TITLED "GENERALIZED GROUNDWATER FLOW DIRECTION MAPS FOR ASH BASINS, DUKE ENERGY CAROLINAS, LLC, FOSSIL STATIONS, DECEMBER 12, 2011", WILLIAM M. MILLER, P.E. ALTAMONT ENVIRONMENTAL, ASHEVILLE, NC, PROJECT NUMBER 2370.07.
2. AS NOTED IN THIS REPORT, THESE GENERALIZED GROUNDWATER FLOW DIRECTION ARROWS DO NOT CONSIDER THE EFFECTS OF PUMPING FROM POTENTIAL WATER SUPPLY WELLS. INFORMATION FROM THIS REPORT USED WITH PERMISSION OF DUKE ENERGY CAROLINAS, LLC.
3. SEE HDR LETTER REPORT WILLIAM M. MILLER (HDR) TO KIM HUTCHINSON (DUKE ENERGY), DATED JULY 31, 2014.

LEGEND:

- DUKE ENERGY PROPERTY BOUNDARY
- ASH BASIN COMPLIANCE BOUNDARY
- ASH BASIN COMPLIANCE BOUNDARY COINCIDENT WITH DUKE ENERGY PROPERTY BOUNDARY
- ASH BASIN WASTE BOUNDARY
- ASH STORAGE AREA BOUNDARY
- ASH BASIN COMPLIANCE GROUNDWATER MONITORING WELL
- ASH BASIN VOLUNTARY GROUNDWATER MONITORING WELL
- LANDFILL - LAND CLEARING & INERT DEBRIS
- STREAM
- TOPOGRAPHIC CONTOUR (4 FOOT)

NOTES:
1. PARCEL DATA FOR THE SITE WAS OBTAINED FROM DUKE ENERGY REAL ESTATE AND IS APPROXIMATE.
2. ASH BASIN WASTE BOUNDARY AND ASH STORAGE AREA BOUNDARIES ARE APPROXIMATE.
3. AS-BUILT MONITORING WELL LOCATIONS PROVIDED BY DUKE ENERGY.
4. SHALLOW MONITORING WELLS (S) - WELL SCREEN INSTALLED ACROSS THE SURFICIAL WATER TABLE.
5. DEEP MONITORING WELLS (D) - WELL SCREEN INSTALLED IN THE TRANSITION ZONE BETWEEN COMPETENT BEDROCK AND THE REGOLITH.
6. ORTHOPHOTOGRAPHY WAS PROVIDED BY DUKE ENERGY (DATED 2014).
7. TOPOGRAPHIC CONTOURS WERE OBTAINED FROM NCDOT WEB SITE (DATED 2010) AND ARE APPROXIMATE.
8. THE ASH BASIN COMPLIANCE BOUNDARY IS ESTABLISHED ACCORDING TO THE DEFINITION FOUND IN 15A NCAC 02L .0107 (a).

SCALE (FEET)
300' 0 300' 600'
1" = 600'

North Carolina Engineering Firm Number: F-0116
440 South Church Street Charlotte, NC 28202

GENERALIZED GROUNDWATER FLOW DIRECTIONS
DUKE ENERGY CAROLINAS, LLC
DAN RIVER COMBINED CYCLE STATION ASH BASIN
NPDES PERMIT #NC0003468
ROCKINGHAM COUNTY, NORTH CAROLINA

DATE
JULY 31, 2014

FIGURE
DRCCS-1

Enclosure 3

Groundwater Monitoring Program Sampling, Analysis, and Reporting Plan

Dan River Ash Basin System

(NPDES Permit NC0003468)

Dan River Combined Cycle Station Ash Basin

Groundwater Monitoring Program Sampling, Analysis, and Reporting Plan

NPDES Permit NC0003468

July 31, 2014

Report Verification

PROJECT: **GROUNDWATER MONITORING PROGRAM**
DAN RIVER COMBINED CYCLE STATION
ASH BASIN
NPDES PERMIT NC0003468

TITLE: **GROUNDWATER MONITORING**
SAMPLING, ANALYSIS, AND REPORTING PLAN

This document has been reviewed for accuracy and quality commensurate with the intended application.

Prepared by: _____ Date: 7/31/2014

Checked by: _____ Date: 7/31/2014

Approved by: _____ Date: 7/31/2014

Project Manager: Brooke Ahrens, PE

Professional Geologist Seal:

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440 South Church St., Suite 1000
Charlotte, NC 28202
North Carolina Geology License Number C-503

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Section 1 - Introduction

This Groundwater Monitoring Program Sampling, Analysis, and Reporting Plan (Plan) is developed to support the Duke Energy Carolinas, LLC (Duke Energy) requirement for groundwater monitoring around the Dan River Combined Cycle Station (DRCCS) ash basin operated under National Pollution Discharge Elimination System (NPDES) Permit NC0003468.

This Plan describes the groundwater monitoring network, methodologies of field sampling, record-keeping protocols, laboratory analytical methods, data quality objectives, data validation, and reporting that will be used for the DRCCS ash basin groundwater monitoring program.

Section 2 - Site Description

2.1 Plant Description

The Dan River Steam Station was a coal-fired electricity-generating facility located in Rockingham County, North Carolina, near the town of Eden. The three-unit coal-fired station is located on the north bank of the Dan River and began commercial operation in 1949. The coal-fired units were retired from service in 2012. Duke Energy currently operates a natural-gas fired combined cycle plant (DRCCS) located at the site just northwest of the ash basin system (Figure 1).

2.2 Ash Basin Description

The ash basin system is located adjacent to the Dan River and consists of a Primary Cell, a Secondary Cell, and associated embankments and outlet works as shown on Figure 1. The ash basin is impounded by earthen dikes, and an earthen/ash divider dike separates the Primary Cell from the Secondary Cell. The Primary Cell has an approximately 10-foot deep pool of water adjacent to the discharge tower, and stormwater falling within the cell's drainage area is the only contributing flow to the Primary Cell. The Secondary Cell has a water surface elevation of approximately 524 feet and a surface area of approximately 12.2 acres. The approximate elevation of the Dan River adjacent to the MW-22S/D monitoring well pair is 482 feet.

The original ash basin was constructed in 1956 and laterally expanded in 1967. In 1980, the height of the earthen dikes was raised, and an intermediate dike was constructed to form the current Primary Cell and Secondary Cell. The ash basin was an integral part of the coal-fired unit's wastewater treatment system. During operation of the coal-fired units, the ash basin received inflows from the following sources:

- Ash removal system
- Station yard drain sump
- Stormwater flows

During operation of the coal-fired units, the ash from the coal combustion was sluiced to the ash basin through a pipe, discharging in the southwest corner of the Primary Cell. Flow was discharged from the Primary Cell through a concrete discharge tower into the Secondary Cell.

On March 1, 2013, the combined cycle plant wastewater was rerouted from the Primary Cell to Outfall 001 due to the new NPDES permit going into effect. Since February 2014, the Primary Cell only collects rainwater and water pumped from plugged pipes under the basin collecting as a pool approximately 20-feet wide and 10-feet deep adjacent to the discharge tower. The Secondary Cell continues to operate and receives flows from storm water, re-routed yard sumps, DRCCS drains, and treated domestic sewage. The discharge flow from the Secondary Cell to the Dan River is through a concrete discharge tower and Outfall 002.

Section 3 - Site Geology and Hydrogeology

3.1 Geologic/Soil Framework

The DRCCS and the ash basin are located within the Dan River Triassic Basin in the Piedmont physiographic province (Piedmont) (North Carolina Geological Survey 1985). Based on the location of the site on the geologic map of the Charlotte 1º x 2º Quadrangle, North and South Carolina (Goldsmith et al. 1988), the underlying bedrock at the site mainly consists of conglomerate, sandstone, and mudstones with intrusive diabase dikes and sills.

The soils that overlie the bedrock in the area have generally formed from the in-place weathering of the parent bedrock. The fractured bedrock is overlain by a mantle of unconsolidated material known as regolith. The regolith, where present, includes the soil zone; a zone of weathered, decomposed bedrock known as saprolite; and alluvium. Saprolite, the product of chemical and mechanical weathering of the underlying bedrock, is typically composed of silt and coarser granular material up to boulder size and may reflect the texture of the rock from which it was formed. The weathering products of felsic rocks may be sandy textured and rich in quartz content while mafic rocks form a more clayey saprolite (LeGrand 2004).

Based on a review of the monitoring well installation logs provided by Duke Energy, the soils comprising the saprolite layer on site were characterized as ranging from silty clay to silty gravel. Bedrock encountered on site consists of mudstone, fine-grained sandstone, and shale (MACTEC and AMEC).

3.2 Hydrogeologic Framework

The groundwater system in the Piedmont Province in most cases is comprised of two interconnected layers or mediums: 1) residuum/saprolite and weathered rock (regolith) overlying, and 2) fractured crystalline bedrock (Heath 1980; Harned and Daniel 1992). Within the regolith layer, a thoroughly weathered and structureless material termed residuum occurs near the ground surface with the degree of weathering decreasing with depth. The residuum grades into a coarser-grained material that retains the structure of the parent bedrock and is termed saprolite. Beneath the saprolite, partially weathered bedrock occurs with depth until sound bedrock is encountered. This mantle of residual soil, saprolite, and weathered rock is a hydrogeologic unit that covers and crosses various types of rock (LeGrand 1988). It provides an intergranular medium through which the recharge and discharge of water from the underlying fractured rock occurs. The bedrock layer consists of fractured, nonporous crystalline bedrock. The fractures control both the hydraulic conductivity and storage capacity of the rock mass.

A transition zone at the base of the regolith has been interpreted to be present in many areas of the Piedmont. The zone consists of partially weathered/fractured bedrock and lesser amounts of saprolite that grades into bedrock and has been described as “being the most permeable part of the system, even slightly more permeable than the soil zone” (Harned and Daniel 1992). The zone thins and thickens within short distances and its boundaries may be difficult to distinguish.

It has been suggested that the zone may serve as a conduit of rapid flow and transmission of contaminated water (Harned and Daniel 1992).

Piedmont topography is characterized by gently rounded sloped hills and valleys. Recharge typically occurs on upland areas and slopes while groundwater discharge is concentrated in surface water bodies and lowland areas. LeGrand's (1988, 2004) conceptual model of the groundwater setting in the Piedmont incorporates the above two medium systems into an entity that is useful for the description of groundwater conditions. That entity is the surface drainage basin that contains a perennial stream or river (LeGrand 1988). Each basin is similar to adjacent basins and the conditions are generally repetitive from basin to basin. Within a basin, movement of groundwater is generally restricted to the area extending from the drainage divides to a perennial stream or river (Slope-Aquifer System; LeGrand 1988, 2004). Rarely does groundwater move beneath a perennial stream or river to another more distant stream (LeGrand 2004).

Therefore, in most cases in the Piedmont, the groundwater system is a two-medium system (LeGrand 1988) restricted to the local drainage basin. The groundwater occurs in a system composed of two interconnected layers: residuum/saprolite and weathered rock overlying fractured crystalline rock separated by the transition zone. Typically, the residuum/saprolite is partly saturated and the water table fluctuates within it. Water movement is generally through the fractured bedrock. The near-surface fractured crystalline rocks can form extensive aquifers. The character of such aquifers results from the combined effects of the rock type, fracture system, topography, and weathering. Topography exerts an influence on both weathering and the opening of fractures while the weathering of the crystalline rock modifies both transmissive and storage characteristics. The aquifer system in the Piedmont typically exists in an unconfined or semi-confined condition in the bedrock zone. Under natural conditions, the general direction of groundwater flow can be approximated from the surface topography. Groundwater moves both vertically down through the regolith and parallel to the bedrock surface to areas where groundwater discharges as seepage into streams, lakes, or other surface water bodies.

The DRCCS is located adjacent to and north of the Dan River which flows from southwest to northeast along the ash basin dike (Figure 2). Two unnamed tributaries of the Dan River are located along the eastern and western sides of the site property. A surface water divide is located generally along South Edgewood Road, with surface water on the east side of South Edgewood Road draining towards the unnamed tributary located on the east side of the property and surface water on the west side of Edgewood Road draining towards the unnamed tributary located to the west of the property. Based on the slope aquifer system, groundwater on the east side of South Edgewood Road is expected to flow toward the unnamed tributary and the Dan River.

Section 4 - Monitoring Program

4.1 Regulatory Requirements for Groundwater Monitoring

The NPDES program regulates wastewater discharges to surface waters to ensure that surface water quality standards are maintained. DRCCS operates under NPDES Permit No. NC0003468 which authorizes discharge of cooling water (Outfall 001) and ash basin discharge (Outfall 002) to the Dan River in accordance with effluent limitations, monitoring requirements, and other conditions set forth in the permit. The NPDES permitting program requires that permits be renewed every 5 years.

The DRCCS NPDES permit requires groundwater monitoring to be conducted. Permit Condition A(11), Attachment XX, Version 1.1, dated June 15, 2011, to the NPDES permit lists the groundwater monitoring wells to be sampled, the parameters to be analyzed, and the requirements for sampling frequency and reporting the results. Attachment XX also provides requirements for well location and well construction. A copy of Attachment XX is included as Appendix B.

The compliance boundary for groundwater quality at the DRCCS ash basin site is defined in accordance with 15A NCAC 02L .0107(a) as being established at either 500 feet from the waste boundary or at the property boundary, whichever is closer to the source.

Sampling at the compliance groundwater wells commenced in January 2011. Analytical results have been submitted to the Department of Water Resources (DWR) before the last day of the month following the date of sampling for all compliance monitoring wells. In the future, analytical results will be submitted to the DWR within 60 days of the date of sampling for all compliance monitoring wells.

4.2 Description of Groundwater Monitoring System

The groundwater monitoring system for the DRCCS ash basin system consists of the following monitoring wells: MW-20S, MW-20D, MW-21S, MW-21D, MW-22S, MW-22D, and MW-23D. The locations for the monitoring wells were selected in consultation with the North Carolina Department of Environment and Natural Resources (NCDENR) Department of Water Resources (DWR) Aquifer Protection Section. The locations of the compliance monitoring wells, the approximate ash basin boundary, and the compliance boundary are shown on Figure 2. Well construction data is provided in Table 1. A summary of the monitoring well location data is included in Appendix C. Based on the slope-aquifer system conceptual model, groundwater at the site is expected to flow from the northern portions of the site south to the ash basin and on to the Dan River. As described below, the wells provide monitoring data on the groundwater adjacent to the ash basin.

Monitoring wells MW-20S and MW-21S were installed to monitor the surficial aquifer. These wells were installed by rotary drilling methods using hollow stem augers with the well screen installed above auger refusal to monitor the shallow aquifer within the saprolite layer. These wells were installed with screen lengths of 15 feet and 5 feet, respectively. The wells were

installed with the screen interval for MW-20S from 4 feet to 19 feet below ground surface (bgs) with a total depth from top of well casing (TOC) of 22.11 feet, and the screen interval for MW-21S from 3.5 feet to 8.5 feet bgs with a total depth from TOC of 11.56 feet.

Monitoring wells MW-20D and MW-21D were installed to monitor the transition zone of the surficial aquifer. These monitoring wells were installed by rotary drilling methods using hollow stem augers and by rock coring techniques (HQ diameter barrel) with the well screen installed in the uppermost region of the fractured rock transition zone. These wells were installed with 5-foot-long screens. The wells were installed with the screen interval for MW-20D from 36.5 feet to 41.5 feet bgs with a total depth from TOC of 44.20 feet, and the screen interval for MW-21D from 13.6 feet to 18.6 feet bgs with a total depth from TOC of 21.40 feet.[1]

Monitoring wells MW-22S and MW-22D are located at the toe of the earthen dike impounding the Primary Cell where large-diameter stone prevented installation by the drilling techniques used for wells MW-20S, MW-20D, MW-21S, and MW-21D. Wells MW-22S and MW-22D were installed by using an air-powered ODEX drilling system. Well MW-22S was installed to monitor the surficial aquifer with a 10-foot-long screen from 12.35 feet to 22.35 feet bgs with a total depth from TOC of 24.86 feet. MW-22D was installed to monitor the transition zone and was installed with a 5-foot-long screen from 31.95 to 36.95 feet bgs with a total depth from TOC of 39.41 feet.[2]

Monitoring well MW-23D is located approximately 1,400 feet west of the compliance boundary and was installed by Duke Energy to represent background water quality at the site. MW-23D was installed by rotary drilling methods using hollow stem augers and by rock coring techniques (HQ diameter barrel) with the well screen installed in the uppermost region of the fractured rock transition zone. This well was installed with a 10-foot-long screen from 6.7 to 16.7 feet bgs with a total depth from TOC of 20.11 feet.

Monitoring wells MW-20S and MW-20D are located north of the ash storage area. Monitoring wells MW-21S and MW-21D are located east of the Secondary Cell. Monitoring wells MW-22S and MW-22D are located south of the Primary Cell.

The monitoring wells at DRCCS are equipped with dedicated bladder-type pumps.

Groundwater monitoring wells MW-8, MW-9, MW-9D, MW-10, MW-10D, MW-11, and MW-11D were installed by Duke Energy prior to the installation of the compliance monitoring wells as part of a voluntary monitoring system. No samples are currently being collected from these wells under the compliance monitoring program.

4.3 Monitoring Frequency

The monitoring wells will be sampled three times per year in January, May, and September.

[1] Ash Basin Monitoring Well Installation Report, Dan River Steam Station, MACTEC Project No. 6228-10-5284, January 31, 2011
[2] Ash Basin Monitoring Well Installation Report, Dan River Steam Station, AMEC Project No. 6228-10-5284, January 3, 2012

4.4 Sample Parameters and Methods

The monitoring program consists of sampling and analysis for parameters and constituents identified in Attachment XX of the NPDES permit (Appendix B).

The parameters and constituents and the analytical methods are presented in Table 2.

The analytical results for the detection monitoring program will be compared to the 2L Standards or the site-specific background concentrations for the parameter or constituent.

4.5 Data Quality Objectives

The overall Quality Assurance (QA) objective is to ensure that reliable data of known and acceptable quality are provided. All measurements will be documented to yield results that are representative of the groundwater quality. Data will be calculated and reported in units as required by the NCDENR.

The analytical QA objectives for precision, accuracy, and completeness have been established by the laboratory(s) in accordance with the Environmental Protection Agency (EPA) or other accepted agencies for each measurement variable where possible. The objectives are outlined in the Duke Energy Analytical Laboratory Procedures Manual and are available upon request.

Appropriate methods have been selected to meet applicable standards for groundwater quality. Instances may occur, however, in which the condition of the sample will not allow detection of the desired limits for various parameters either because of matrix interference or high analyte concentrations requiring sample dilution. The laboratory(s) will provide sufficient documentation with each data package to notify reviewers about any analytical problems with the data, if needed.

Section 5 - Sampling Procedures

5.1 Sampling Equipment

Development, purging, and sampling equipment shall be selected to ensure that materials are compatible with the sample parameters and comply with state and federal regulatory requirements for sampling. Positive-gas-displacement fluorocarbon resin bladder pumps are installed in each monitoring well as dedicated purging and sampling systems.

5.1.1 Equipment Cleaning Procedures

Dedicated sampling equipment has been installed in each monitoring well. In the event non-dedicated equipment is used between monitoring wells, equipment will be cleaned before use and between wells in accordance with standard EPA-approved cleaning procedures for field equipment. This standard is outlined in the Standard Operating Procedures and Quality Assurance Manual, Engineering Support Branch, EPA Region IV, February 1, 1991.

5.2 Groundwater Sampling

5.2.1 Development of Monitoring Wells

All seven monitoring wells addressed in this sampling plan have been developed.

If new monitoring wells are installed, they will be developed prior to initial sampling. Development removes silt that has settled into the bottom of the well following installation and removes fine silt and clay particles from the well screen and sand pack surrounding the screen. Well development is necessary to eliminate potential clogging and enhance well performance. Development involves removing an estimated ten or more well volumes from the well using a positive-gas-displacement fluorocarbon resin bladder pump with up-and-down agitation to loosen particles from the well screen. After development of a well, a true well depth is recorded referencing the top of well casing (TOC).

5.2.2 Groundwater Level and Total Depth Measurements

Water level measurements shall be collected and recorded to determine the groundwater elevations and groundwater flow direction and to calculate the volume of standing water in the well. All monitoring wells have been surveyed to determine the elevation of the TOC. All depth and water level measurements shall be referencing the TOC and recorded to the nearest one - hundredth of a foot.

Water level measurements shall be made with an electronic measuring device consisting of a spool of dual-conductor wire and sensor. When the sensor comes in contact with water, the circuit is closed and a meter light and/or buzzer are attached to the spool to signal the contact. The sensor is lowered further until it rests on the bottom of the well to determine the total depth of the well referencing the TOC. The depth and water level measurements shall be used to verify that the well has not filled with silt and to calculate the volume of water in the well.

The volume of well water (in gallons) is calculated using the following equation:

$$V = h * \pi * r^2 * (7.48052 \text{ gal/ft}^3)$$

Where:

V = volume of water in the well screen and casing (gallons)

h = height of standing water (feet) = total well depth - water level

r = radius of well casing (feet)

For example, a 2-inch-diameter casing will have a volume of 0.1631 gallons per foot.

In dedicated sampling systems, an accurate well depth is determined as indicated above after development of the well and prior to installation of the dedicated bladder pump. The well depth will be re-measured any time the dedicated sampling system is removed for repair or replacement. The well depth, water level measurement, and calculated well volume are recorded on the Groundwater Monitoring Data Sheet (Figure 4).

5.2.3 Well Purging and Sampling

The selection of purging technique is dependent on the hydrogeologic properties of the aquifer and hydraulic characteristics of each well. Hydraulic conductivity, water column, well volume, screen length, and other information are evaluated to select the purging technique to acquire groundwater representative of the aquifer conditions. The Groundwater Monitoring Data Sheet (Figure 4) is used to record purging methods and measurements.

A multi-parameter water quality monitoring instrument is used to measure field stabilization or indicator parameters for determining representative groundwater during purging. These instruments measure pH, specific conductance, temperature, dissolved oxygen (DO), and oxidation-reduction potential (ORP). Instrument calibration must be performed and documented before and after each sampling event. The pH subsystem will be calibrated with two pH standards (pH 7.0 and 4.0) bracketing the expected groundwater pH. The specific conductance subsystem will be calibrated using two standards bracketing the expected groundwater conductivity. Calibration results will be recorded on a Field Sampling Calibration Form (Figure 5).

Various well purging techniques are described below. The purging method utilized at any particular well will be selected after considering the characteristics of the well and the purging method(s) used during previous sampling events.

CONVENTIONAL PURGING

This technique entails removing one equivalent well volume and measuring the indicator parameters (temperature, pH, and specific conductance). When the parameters have stabilized to within ±0.2 pH units and ±10 percent for temperature and conductivity over three to five well volumes, representative groundwater has been achieved for sampling. It is acceptable to begin sampling after five complete well volumes have been removed, even when indicator parameters have not stabilized. Groundwater is pumped into a graduated container to measure the volume

of water purged. Under normal rates of recovery, samples should be collected immediately after purging in accordance with EPA guidelines.

For low-yield wells incapable of yielding three to five well volumes in a reasonable amount of time (e.g., 2 hours or less), groundwater is purged to the elevation of the pump intake while measuring indicator parameters. Typically, low-yield wells are evacuated to dryness one time and sampled when sufficient water level recovery occurs. Turbidity is not a required stabilization parameter, but turbidity levels of 10 nephelometric turbidity units (NTU) or less should be targeted.

LOW-FLOW PURGING

Low-flow purging and sampling are appropriate when the recharge rate of the well approximates or equals the discharge rate of the pump with minimal drawdown of the water column (≤1 foot).

During low-flow purging and sampling, groundwater is pumped into a flow-through chamber at flow rates that minimize or stabilize water level drawdown within the well. Indicator parameters are measured over time (usually at 5-minute intervals). When parameters have stabilized within ±0.2 pH units and ±10 percent for temperature, conductivity, and DO; and ±10 millivolts (mV) for ORP over three consecutive readings; representative groundwater has been achieved for sampling. Turbidity is not a required stabilization parameter, but turbidity levels of 10 NTU or less should be targeted.

MODIFIED LOW-FLOW PURGING

This technique is considered a viable option particularly in the Piedmont region due to the likely presence of fine-grained soils where water level drawdown cannot be stabilized while pumping. When the well recharge rate is less than the pump discharge rate, excessive drawdown (>1 foot) of the water column occurs and mixes with stagnant water located above the screened interval. One equivalent well volume is removed initially before measuring indicator parameters. Frequently, removal of the initial well volume reduces the hydraulic head and allows for matching of the recharge rate with the pumping rate providing stabilization of drawdown. Indicator parameters should be measured at 5-minute intervals using a flow-through chamber attached to a multi-parameter water quality instrument. When parameters have stabilized to within ±0.2 pH units and ±10 percent for temperature, conductivity, and DO; and ±10 mV for ORP over three consecutive readings; representative groundwater has been achieved for sampling. Turbidity is not a required stabilization parameter, but turbidity levels of 10 NTU or less should be targeted.

VERY LOW-YIELD WELL PURGING

This technique provides the best option for monitoring wells that historically purge to dryness and do not sufficiently recharge to provide adequate volume for sample collection. Wells that yield less than 100 milliliters per minute (mL/min) frequently incur significant drawdown during well purging. Therefore, if the well yield is less than 100 mL/min, the volume of the pumping system (i.e., the pump bladder, tubing, and flow-through chamber) shall be calculated and two pumping system volumes shall be removed. Indicator parameters will be measured and recorded initially, and then sample collection will begin.

5.3 Sample Collection

Groundwater samples are collected after representative groundwater has been determined by purging and stabilizing the indicator parameters.

Sampling personnel wear clean, disposable, non-powdered nitrile gloves at each location. Samples are collected in the order of the volatilization sensitivity of the parameters:

- Metals, metalloids, and selenium
- Sulfate, nitrate, and chloride
- Total dissolved solids

After collection, samples will be preserved and stored according to parameter-specific methods and delivered to the laboratory under proper Chain-of-Custody (COC) procedures. All pertinent notations, water-level measurements, removed well volumes, and indicator parameters shall be documented on the Groundwater Monitoring Data Sheet (Figure 4).

5.4 Sample Containers, Volume, Preservation, and Holding Time

All sample containers supplied by the laboratory for the collection of groundwater samples shall be new and pre-cleaned as approved by EPA procedures appropriate for the parameters of interest. Table 3 summarizes the sample containers, sample volume, preservation procedures, and holding times required for each type of sample and parameter. Sample containers will be kept closed until used. All sample containers will be provided by Duke Energy or vendor laboratories.

5.5 Sample Tracking

The COC procedures allow for tracing the possession and handling of individual samples from the time of field collection through laboratory analysis and report preparation. Samples shall be pre-logged prior to sample collection. This process assigns a unique tracking number for each sample and generates corresponding labels. An example of the COC Record is provided as Figure 6.

5.6 Sample Labeling

Sample containers shall be pre-labeled and organized prior to field activities as part of the pre-sampling staging process. As samples are collected, the sampling personnel shall write the following information directly on the label: sampling date and time, and initials of sample collector. This information is also recorded on the Groundwater Monitoring Data Sheet (Figure 4) and the COC Record (Figure 6).

5.7 Field Documentation

Field documentation from each sampling event is recorded on the Groundwater Monitoring Data Sheets (Figure 4), the Field Sampling Calibration Form (Figure 5), and the COC Record (Figure 6). Additionally, a Groundwater Sampling Site Checklist (Figure 7) is completed indicating information about the monitoring well such as proper identification (ID) tag and condition of

protective casing and pad. Field notations shall be made during the course of the field work to document the following information:

- Identification of well
- Well depth
- Static water level depth and measurement technique
- Presence of immiscible layers and detection method
- Well yield – high or low
- Purge volume or pumping rate
- Sample identification numbers
- Well evacuation procedure/equipment
- Sample withdrawal procedure/equipment
- Date and time of collection
- Types of sample containers used
- Identification of replicates or blind samples
- Preservative(s) used
- Parameters requested for analysis
- Field analysis data and methods
- Sample distribution and transporter
- Field observations during sampling event
- Name of sample collector(s)
- Climatic conditions including estimate of air temperature

The Groundwater Monitoring Data Sheets (Figure 4), the Field Sampling Calibration Form (Figure 5), and the COC Record and Analysis Request Form (Figure 6) will be filed by project and date. Recorded entries will be made on electronic forms or on paper forms with indelible ink. Errors on paper documents will be corrected by drawing a line through the error, initialing and dating the correction, and starting a new entry on the next line (if necessary).

5.8 Chain-of-Custody Record

The COC Record (Figure 6) accompanies the sample(s), traces sample possession from time of collection to delivery to the laboratory(s), and clearly identifies which sample containers have been designated for each requested analysis. The record includes the following types of information:

- Sample identification number
- Signature of collector
- Date and time of collection
- Sample type (e.g., groundwater, immiscible layer)
- Identification of well
- Number of containers
- Parameters requested for analysis
- Preservative(s) used
- Signature of persons involved in the chain of possession
- Inclusive dates of possession

5.9 Sample Custody, Shipment, and Laboratory Receipt

For the purpose of these procedures, a sample is considered in custody if it is:

- In actual possession of the responsible person
- In view, after being in physical possession
- Locked or sealed in a manner so that no one can tamper with it after having been in physical custody or in a secured area restricted to authorized personnel

All samples shall be maintained in the custody of the sampling crew during the sampling event. At the end of each sampling day and prior to the transfer of the samples off site, entries shall be completed on the COC form for all samples. Upon transfer of custody, the COC form is signed by a sampling crew member including the date and time. If outside vendor laboratories are utilized, samples shall be delivered to these facilities by Duke Energy personnel or courier.

All COC forms received by the laboratory(s) shall be signed and dated by the respective supervising scientist(s) or their designee (at the Duke Energy lab) or the laboratory sample custodian (at vendor labs) immediately following receipt by the laboratory.

The analysts at the laboratory(s) maintain a sample tracking record that will follow each sample through all stages of laboratory processing. The sample tracking records show the date of

sample extraction or preparation and analysis. These records are used to determine compliance with holding time limits during lab audits and data validation.

Custody procedures followed by Duke Energy laboratory personnel are described in detail in the Duke Energy Laboratory Services Procedures Manual.

Section 6 - Analytical Methods

The main analytical laboratory used in this program is the Duke Energy Laboratory Services Laboratory: N.C. Drinking Water (NC37804) and Wastewater (#248) Certifications. The organizational structure and staff qualifications of the laboratory are discussed in its generic Quality Assurance Program (QAP). The QAP and the Analytical Laboratory Procedures Manual are available for review upon request.

Vendor laboratories that meet EPA and North Carolina certification requirements may be used for analyses with approval by Duke Energy.

The analytical methods used for the samples analyzed for this Groundwater Monitoring Program are listed in Table 2. Specific conductance, field pH, and temperature are measured in the field according to the Duke Energy Groundwater Monitoring and Sample Collection Procedure or the instrument manufacturer instructions.

Section 7 - Internal Quality Control Checks

Internal laboratory quality control (QC) checks used by the laboratories are described in each laboratory's generic QAP and procedures manual. Using the internal laboratory QC checks, the laboratories demonstrate the ability to produce acceptable results using the methods specified.

Internal quality control checks for sampling procedures and laboratory analyses will be conducted with each sampling event. These checks will consist of the preparation and submittal of field blanks, trip (travel) blanks, and/or field replicates for analysis of all parameters at frequencies described in the laboratory(s) procedures manuals.

The field QC blanks and replicates that may be included as internal QC checks are described below. The specific type and number of blanks used may vary depending on the sampling event and will be determined by the Duke Energy field sampling personnel:

- Field Blanks: A field blank consists of a sample container filled in the field with organic-free, deionized, or distilled water prepared and preserved in the same manner as the samples. The field blank is transported to the laboratory with the samples and analyzed along with the field samples for the constituents of interest to check for contamination imparted to the samples by the sample container, preservative, or other exogenous sources. Field blanks are typically utilized for each sampling event. The field blanks are typically analyzed for major anions, cations, and metals.

- Trip Blanks: A trip (travel) blank is a sample container filled with organic-free water in the laboratory that travels unopened with the sample bottles. Trip blanks are typically utilized when sampling for volatile organic compounds. The trip blank is returned to the laboratory with the field samples and analyzed along with the field samples for parameters of interest.

- Equipment Blanks: If non-dedicated equipment is used between wells, it is recommended that equipment blanks be collected. The field equipment is cleaned following documented cleaning protocols. An aliquot of the final control rinse water is passed over the cleaned equipment directly into a sample container and submitted for analyses.

- Field Replicates: A field replicate is a duplicate sample prepared at the sampling locations from equal portions of all sample aliquots combined to make the sample. Both the field replicate and the sample are collected at the same time, in the same container type, preserved in the same way, and analyzed by the same laboratory as a measure of sampling and analytical precision.

Section 8 - Validation of Field Data Package

The field data package includes all of the field records and measurements developed by the sampling team personnel. The field data package validation will be performed by Duke Energy personnel. The procedure for validation consists of the following:

- A review of field data contained on the Groundwater Monitoring Data Sheets for completeness.
- Verification that equipment blanks, field blanks, and trip blanks were properly prepared, identified, and analyzed.
- A check of the Field Sampling Calibration Form for equipment calibration and instrument conditions.
- A review of the COC Record for proper completion, signatures of field personnel and the laboratory sample custodian, dates and times, and for verification that the correct analyses were specified.

Section 9 - Validation of Laboratory Data

The laboratory will perform a validation review of the submitted samples and analytical results to ensure that the laboratory QA/QC requirements are acceptable.

Section 10 - Report Submittal

A report of the monitoring results for monitoring wells MW-20S, MW-20D, MW-21S, MW-21D, MW-22S, MW-22D, and MW-23D will be submitted to the NCDENR DWQ within 60 days of the date of sampling. The monitoring results will be submitted on NCDENR Form GW-59CCR.

The DWR will be notified in the event that vendor lab analyses have not been completed within this time frame. All Groundwater Monitoring Data Sheets, Field Calibration Forms, COC Records, Laboratory QA data, and Data Validation Checklists shall be kept on file by Duke Energy and are available upon request.

Section 11 - References

AMEC. 2012. Ash Basin Monitoring Well Installation Report, Dan River Steam Station, AMEC Project No. 6228-10-5284, January 3, 2012.

Goldsmith, R., Milton, D.J., and Horton, J.W, Jr. 1988. Geologic map of the Charlotte 1o x 2o quadrangle, North Carolina and South Carolina: United States Geological Survey, Miscellaneous Investigations Series, Map I-1251-E, scale 1:250,000.

Harned, D.A. and Daniel, C.C., III. 1992. The Transition Zone Between Bedrock and Regolith: Conduit for Contamination? p. 336-348, in Daniel, C. C., III, White, R. K., and Stone, P. A., eds., Groundwater in the Piedmont: Proceedings of a Conference on Ground Water in the Piedmont of the Eastern United States, October 16-18, 1989, Clemson University, 693p.

Heath, R.C. 1980. Basic elements of ground-water hydrology with references to conditions in North Carolina: U. S. Geological Survey Water-Resources Open-File Report 80-44, 86p.

Heath, Ralph. C. 1994. Ground-Water Recharge in North Carolina: Prepared for the Groundwater Section, Division of Environmental Management, North Carolina Department of Environment, Health, and Natural Resources 45, 52p.

LaGrand, H.E. 1988. Region 21, Piedmont and Blue Ridge, p.201-208, in Black, W., Rosenhein, J.S., and Seaber, P.R., eds., Hydrogeology: Geological Society of America, The Geology of North America, v. O-2, Boulder, Colorado, 524p.

LeGrand, Harry, Sr. 2004. A Master Conceptual Model for Hydrogeological Site Characterization in the Piedmont and Mountain Region of North Carolina, North Carolina Department of Environment and Natural Resources.

MACTEC. 2011. Ash Basin Monitoring Well Installation Report, Dan River Steam Station, MACTEC Project No. 6288-10-5284, January 31, 2011.

North Carolina Geological Survey. 1985. Geologic map of North Carolina: Raleigh, North Carolina Geological Survey, scale 1:500,000.

Figures

NOTE:
SOURCE: USGS TOPO; 2011, USGS NATIONAL MAP AERIAL IMAGERY; 2010 NORTH CAROLINA STATEWIDE ORTHOIMAGERY, NC GEOSPATIAL & TECHNOLOGY MANAGEMENT OFFICE

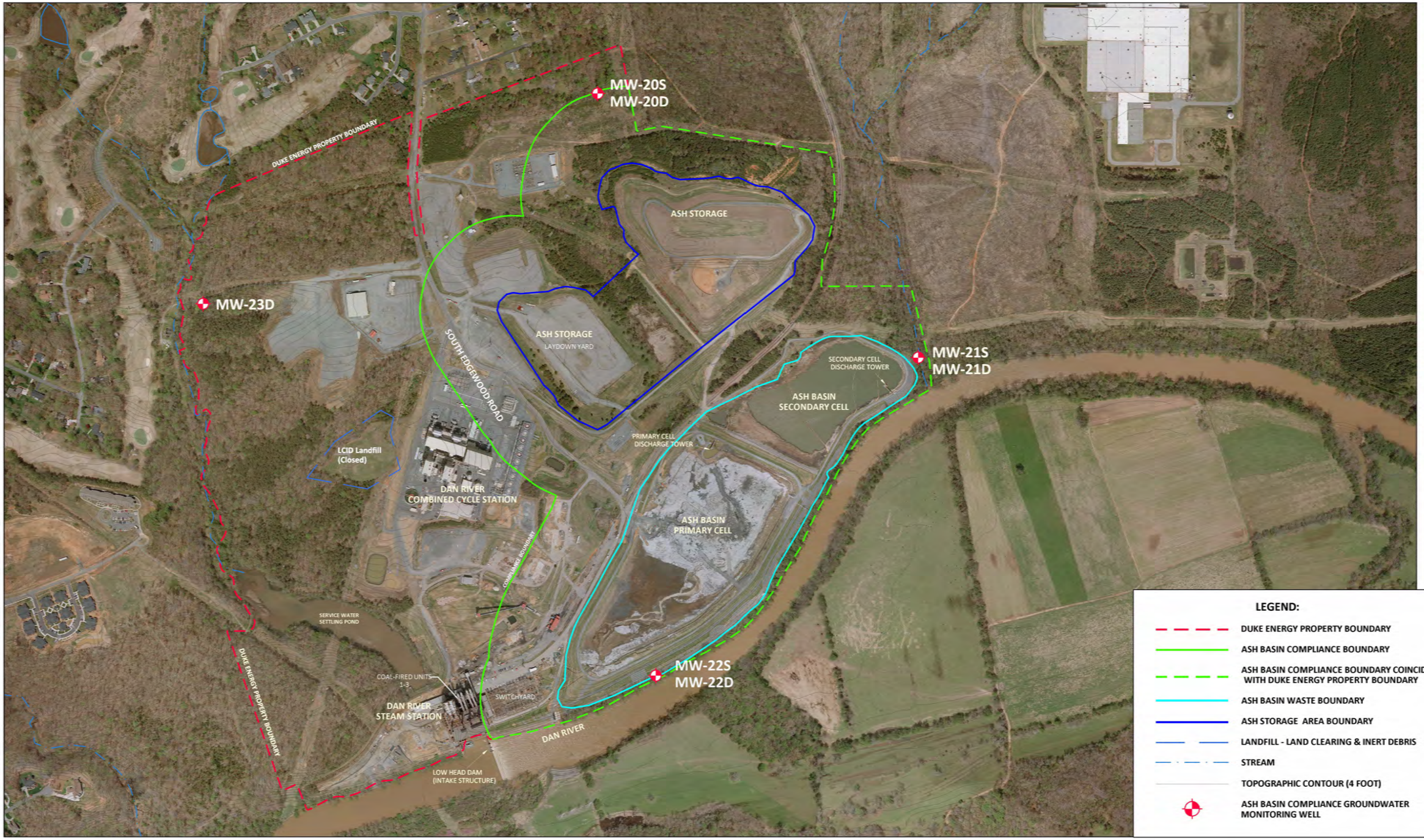
SCALE (FEET)
800 0 800 1,600

License Number: F-0116
440 South Church Street Charlotte, NC 28202

SITE LOCATION MAP
DAN RIVER COMBINED CYCLE STATION ASH BASIN
DUKE ENERGY CAROLINAS, LLC
ROCKINGHAM COUNTY, NORTH CAROLINA

DATE
JULY 31, 2014

FIGURE
1



NOTES:
1. PARCEL DATA FOR THE SITE WAS OBTAINED FROM DUKE ENERGY REAL ESTATE AND IS APPROXIMATE.
2. ASH BASIN WASTE BOUNDARY AND ASH STORAGE AREA BOUNDARIES ARE APPROXIMATE.
3. AS-BUILT MONITORING WELL LOCATIONS PROVIDED BY DUKE ENERGY.
4. SHALLOW MONITORING WELLS (S) - WELL SCREEN INSTALLED ACROSS THE SURFICIAL WATER TABLE.
5. DEEP MONITORING WELLS (D) - WELL SCREEN INSTALLED IN THE TRANSITION ZONE BETWEEN COMPETENT BEDROCK AND THE REGOLITH.
6. ORTHOPHOTOGRAPHY WAS PROVIDED BY DUKE ENERGY (DATED 2014).
7. TOPOGRAPHIC CONTOURS WERE OBTAINED FROM NCDOT WEB SITE (DATED 2010) AND ARE APPROXIMATE.
8. THE ASH BASIN COMPLIANCE BOUNDARY IS ESTABLISHED ACCORDING TO THE DEFINITION FOUND IN 15A NCAC 02L .0107 (a).

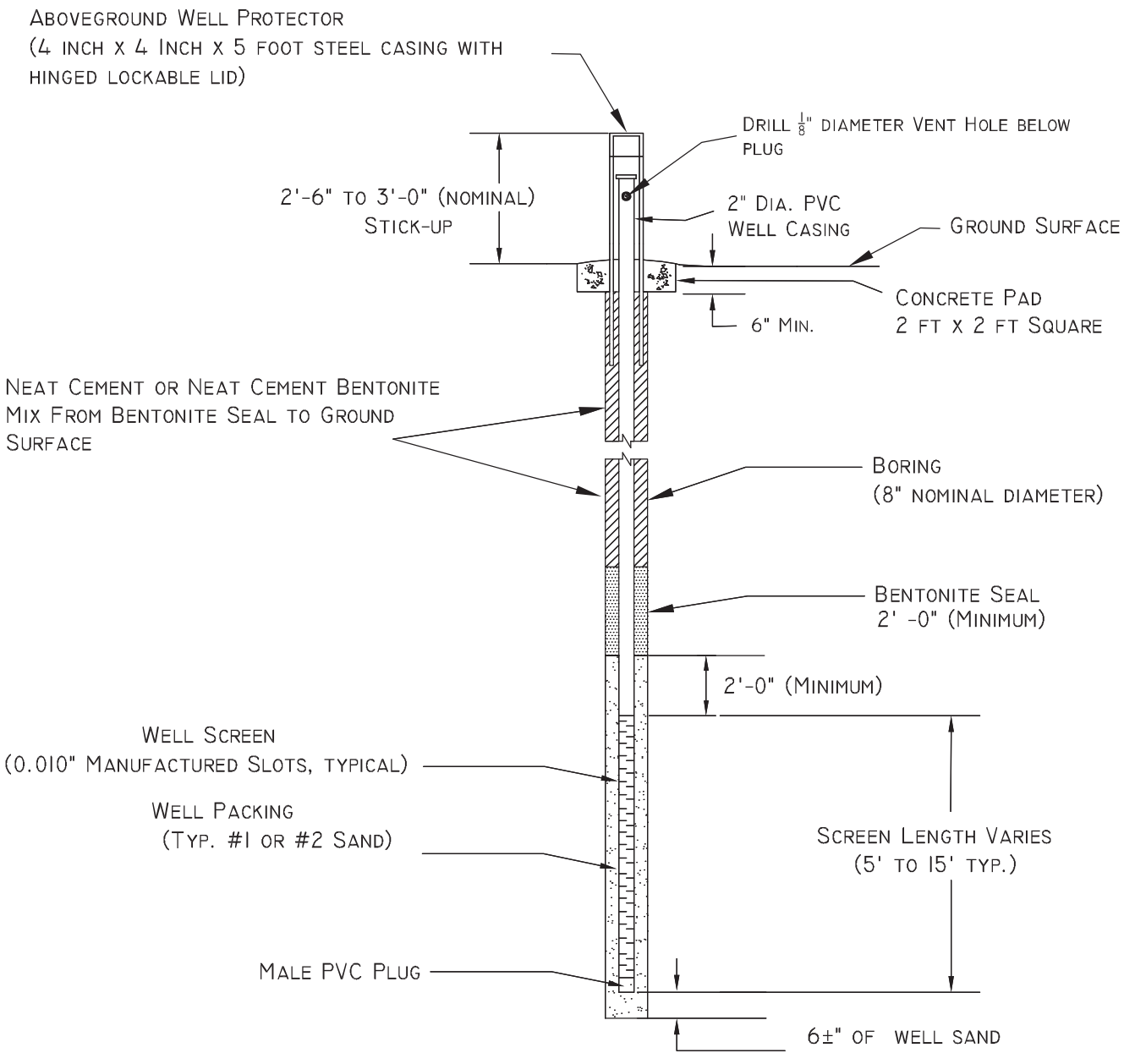
SCALE (FEET)
300′ 0 300′ 600′
1" = 600′

HDR
License Number: F-0116
440 South Church Street Charlotte, NC 28202

COMPLIANCE MONITORING WELLS
DUKE ENERGY CAROLINAS, LLC
DAN RIVER COMBINED CYCLE STATION ASH BASIN
NPDES PERMIT #NC0003468
ROCKINGHAM COUNTY, NORTH CAROLINA

DATE
JULY 31, 2014

FIGURE
2



Typical Well Construction Details
(no scale)

INFORMATION PROVIDED BY DUKE ENERGY CAROLINAS, LLC

License Number: F-0116
440 South Church Street Charlotte, NC 28202

TYPICAL MONITORING WELL CONSTRUCTION DETAILS

DATE
JULY 31, 2014

FIGURE
3

DUKE ENERGY

GROUNDWATER MONITORING DATA SHEET FOR CONVENTIONAL SAMPLING

PROCEDURE NO	3175.1

SITE NAME	Dan River Combined Cycle Station	PERMIT #	NC0003468	SITE ID	N/A
PROJECT NAME	Ash Basin Groundwater Monitoring	FIELD CREW			
SAMPLING DATE(s)	☐ ☐ ☐ ☐	WELL/LOCATION NAME			

MONITORING WELL INFORMATION

WELL DIAMETER (in)		TOC ELEV (ft msl)		MIDDLE OF WETTED SCREEN (ft toc)			
WELL DEPTH (ft TOC)		GS ELEV (ft msl)		PUMP INTAKE DEPTH (ft TOC)			
SCREEN LENGTH (ft)		ELEV REF		SCREEN INTERVAL (ft TOC)		TO	

EQUIPMENT INFORMATION

LEVEL METER SERIAL#		SAMPLING EQUIPMENT			PURGE METHOD		
		TUBING DIAMETER (in)					
PUMP CONTROLLER SETTINGS							
PRESSURE	(psi)	RECHARGE	(sec)	DISCHARGE	(sec)		

SAMPLING INFORMATION

INITIAL DEPTH TO WATER (ft TOC)		WATER COLUMN (ft)		*Well Volume = water column X conversion factor*	
WATER ELEVATION (ft msl)		WELL VOLUME (gal)		(Conversion factor dependent on well diameter and selected well volume units)	
DETECTED ODOR	None	CONVERSION FACTOR	0.1631		
APPEARANCE	Normal				

PURGE VOLUME (gal)	WATER LEVEL AFTER PURGE * (ft)	COMPLETE EVACUATION (YES/NO)	☑ TEMP (deg C)	☑ SPECIFIC COND. (umho/cm)	☑ pH (SU)	☑ TURBIDITY (NTU)	☐ ORP (mV -NEH)	☐ DISSOLVED OXYGEN (mg/L)	☐ (gal) WELL VOL (recalculates on current water level)

TOTAL PURGE VOLUME	* Optional measurement to recalculate well volume when purging results in substantial drawdown of water column	SAMPLE COLLECTED BY	DATE	@ TIME	CHLORINE (mg/l)
0.00					NA

QC By:	

WELL CONDITION

PROTECTIVE CASING		
WELL PAD		
WELL CASING		
WELL TAG		

ADDITIONAL WELL CONDITION NOTES

SAMPLING NOTES

FIGURE 4: EXAMPLE GROUNDWATER MONITORING DATA SHEET

FIELD SAMPLING CALIBRATION FORM

STUDY: Dan River Combined Cycle Station Ash Basin Groundwater Monitoring

DATE (s): | **SURFACE UNIT READER:**

COLLECTORS: | **SURFACE UNIT SERIAL #:**

ANALYZER MODEL#: | **ANALYZER SERIAL #:**

OTHER EQUIPMENT: | **WEATHER CONDITIONS:**

PROCEDURE #: HYDROLAB 3210.3 **VALIDATED BY:**

Calibration Date / Time		DATE:			TIME:		DATE:			TIME:	
		BP (mmHg)					BP (mmHg)				
Parameter	**Calibation Standard**	**Instrument Value**		**Standard Value**	**Calibration Results**		**Instrument Value**		**Standard Value**	**Calibration Results**	
SPEC. COND. (uS/cm)	SS	0.0	—/—►	0.0	Instrument Zeroed		0.0	—/—►	0.0	Zero Pass	
	SS		—►	350				—/—►	350		
	SS		—/—►	150				—/—►	150		
pH (units)	B (7.00)		—►	7.00				—/—►			
	B (4.00)		—►	4.00				—/—►			
	B (10.00)		—/—►	10.00				—/—►			
			Buffer Temp.	25.00				Buffer Temp.			
Mid-Day Ck	B (7.00)		—►								
Time:			Buffer Temp.								
☑ ORP (mV)	SS (7.00)		—►	285				—/—►	285		
	SS (4.00)	N/A	—/—►	462			N/A	—/—►	462		
			ORP Temp.	25.00				ORP Temp.	25.00		
☐ DO (mg/L)	W										
	W										
	AW		—►					—/—►			
☐ TURB (ntu)	SS		—/—►					—/—►			
Temp Cert Device #											
TEMP (deg C)	NIST	N/A	—/—►	N/A	Adjustment Not Available		N/A	—/—►	N/A	Adjustment Not Available	
AMMONIUM (mg/L)	SS	N/A	—/—►	N/A			N/A	—/—►	N/A		
	SS	N/A	—/—►	N/A			N/A	—/—►	N/A		

INSTRUMENT MAINTENANCE	DATE / TIME

Conductance Subsystem

- ☐ Cleaned Electrodes
- ☐ Tested - OK
- ☐ See Notes

pH Subsystem

- ☐ Cleaned Electrodes
- ☐ Replaced ref Electrode KCL
- ☐ Replaced Ref. Electrode Tip
- ☐ Tested - OK ☐ See Notes

Dissolved Oxygen Subsystem

- ☐ Replaced Teflon Membrane
- ☐ Replaced DO electrolyte
- ☐ Cleaned Electrode
- ☐ See Notes

Ammonium Subsystem

- ☐ Cleaned Electrode Tip
- ☐ Installed New Electrode
- ☐ Removed Electrode / Installed Plug
- ☐ Tested - OK ☐ See Notes

Oxidation Reduction Subsystem

- ☐ Cleaned Electrode
- ☐ Tested - OK ☐ See Notes

Turbidity Subsystem

- ☐ Cleaned Electrode & Wiper
- ☐ Tested - OK ☐ See Notes

Temperature Subsystem

- ☐ Cleaned Electrode
- ☐ Tested - OK ☐ See Notes

Depth Subsystem

- ☐ Reset / Calibrated
- ☐ Tested - OK ☐ See Notes

KEY: B = Buffer; SS = Standard solution; W = Winkler; AW = Average Winkler; —► = Adjusted To; —/—► = Not Adjusted To; N/A = Not Applicable

NOTES:

FIGURE 5: EXAMPLE FIELD SAMPLING CALIBRATION FORM

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST FORM

Duke Energy

For Detailed Instructions, see:
http://dewww/essenv/coc/

Duke Energy Analytical Lab Services
Mail Code MGO3A2 (Building 7405)
13339 Hagers Ferry Rd
Huntersville, N. C. 28078
(704) 875-5245
Fax: (704) 875-5038

Analytical Laboratory Use Only

LIMS # | Samples Originating From NC √ SC

Logged By | Date & Time | SAMPLE PROGRAM: Groundwater √ NPDES Drinking Water UST RCRA Waste

Vendor | Cooler Temp (C)

PO # | [15]Preserv.:1=HCL 2=H_2SO_4 3=HNO_3 4=Ice 5=None

MR #

Customer to complete all appropriate NON-SHADED areas.

[19]Page 1 of 1
DISTRIBUTION
ORIGINAL to LAB,
COPY to CLIENT

Customer must Complete

1)Project Name		2)Phone No:
3)Client		4)Fax No:
5)Business Unit: 20036	6)Process:	7)Resp. To:
8)Project ID:	9)Activity ID:	10)Mail Code:

LAB USE ONLY [11]Lab ID	[12]Chem Desktop No.	[13]Sample Description or ID	[14]Collection Information Date	Time	Signature	[17]Comp.	[18]Grab	[16]Analyses Required	[20]Total # of Containers
									6

Customer to complete appropriate columns to right

Customer to sign & date below

21)Relinquished By	Date/Time	Accepted By	Date/Time
Relinquished By	Date/Time	Accepted By	Date/Time
Relinquished By	Date/Time	Accepted By	Date/Time
23)Seal/Locked By	Date/Time	Sealed/Lock Opened By	Date/Time
24)Comments			

Customer, important please indicate desired turnaround

[22]Requested Turnaround

14 Days √

*7 Days

* 48 Hr

*Other
* Add. Cost Will Apply

FIGURE 6 - CHAIN-OF-CUSTODY RECORD AND ANALYSIS REQUEST FORM

NORTH CAROLINA GROUNDWATER SAMPLING SITE CHECKLIST

LOCATION / SITE Dan River Combined Cycle Station / Ash Basin Groundwater Monitoring PERMIT # NC0003468 **SAMPLE DATE**
SITE CONTACT **FIELD CREW**
WEATHER
PAGE 1 OF 1

		MW-20S	MW-20D	MW-21S	MW-21D	MW-22S	MW-22D	MW-23D								
ACCESS TO WELLS																
Access cleared into well																
Access cleared around well																
Tall grass or weeds - needs mowing																
Road washing out / muddy / needs grading																
Fallen tree blocking access																
WELL SECURITY																
Well found locked																
Well found unlocked																
WELL LOCK CONDITION																
Lock in good condition																
Lock rusted, difficult to open / needs replacing																
Replaced damaged lock																
WELL CASINGS																
Casing in good condition																
Damaged casing / still functional																
Damaged casing / repair required																
CONCRETE PADS																
Pad in good condition																
Minor cracks																
Major cracks / broken / repair required																
Undermined / washing out																
Fire ants around concrete pad																
WELL PROTECTIVE CASINGS																
Casing in good condition																
Damaged casing / still functional																
Damaged casing / repair required																
Broken hinge on protective lid																
Wasp nest inside protective casing																
Ants inside protective casing																
WELL CAPS																
Well cap in good conditon																
Damaged / needs replacement																
Replaced damaged well cap																
FLUSH MOUNT WELLS																
Vault in good condition																
Water inside vault																
Vault bolt holes broken or stripped																
Bolts stripped																
Vault lid cracked or broken																
WELL ID TAGS																
Well tag in good condition																
Well tag missing																
Well tag damaged / illegible																
Lacks required information - Driller Reg #																
Lacks required information - Completion date																
Lacks required information - Total well depth																
Lacks required information - Depth to screen																
Lacks required information - Non potable tag																

NOTE:

FIGURE 7: GROUNDWATER SAMPLING SITE CHECKLIST

Tables

Table 1
Monitoring Well Information
Dan River Combined Cycle Station Ash Basin

	MW-20S	MW-20D	MW-21S	MW-21D	MW-22S	MW-22D	MW-23D
North (ft)	1,000,690.53	1,000,692.39	998,981.03	998,974.10	996,917.37	996,920.04	999,329.97
East (ft)	1,788,917.72	1,788,922.72	1,790,997.03	1,790,995.70	1,789,291.54	1,789,298.66	1,786,365.57
Top of PVC Casing Elevation (ft)	562.28	562.23	498.80	498.90	504.52	505.19	528.22
Well Diameter	2"	2"	2"	2"	2"	2"	2"
Well Stick-up (ft)	2.57	2.81	2.77	2.67	2.47	2.97	3.24
Type of Casing	PVC	PVC	PVC	PVC	PVC	PVC	PVC
Total Depth below TOC (ft)	22.11	44.20	11.56	21.40	24.86	39.41	20.11
Screen Length (ft)	15	5	5	5	10	5	10
Screen Interval (ft below TOC)	7.11 - 22.11	39.20 - 44.20	6.56 - 11.56	16.40 - 21.40	14.86 - 24.86	34.41 - 39.41	10.11 - 20.11

Notes:

1. ft indicates feet.
2. TOC indicates top of casing.
3. As-built well coordinates (NAD 83) and top of PVC casing elevations (NAVD 88) provided by Duke Energy.
4. Well diameter, type of casing, and screen lengths were obtained from Well Construction Records provided by Duke Energy.
5. Well total depth below TOC and well stick-up measurements provided by Duke Energy.

Table 2
Sample Parameters and Analytical Methods
Dan River Combined Cycle Station Ash Basin

PARAMETER	UNITS	ANALYTICAL METHOD
In Situ Parameters		
Field pH	pH Units	Hydrolab
Conductivity	µmhos/cm	Hydrolab
Temperature	°C	Hydrolab
Water Level	ft	Water Level Meter
Laboratory Analyses		
Antimony	µg/L	TRM / EPA 200.8
Arsenic	µg/L	TRM / EPA 200.8
Barium	µg/L	TRM / EPA 200.7
Boron	µg/L	TRM / EPA 200.7
Cadmium	µg/L	TRM / EPA 200.8
Chloride	µg/L	EPA 300.0
Chromium (total)	µg/L	TRM / EPA 200.7
Copper	µg/L	TRM / EPA 200.7
Iron	µg/L	TRM / EPA 200.7
Lead	µg/L	TRM / EPA 200.8
Manganese	µg/L	TRM / EPA 200.7
Mercury	µg/L	EPA 245.1
Nickel	µg/L	TRM / EPA 200.7
Nitrate (as Nitrogen)	µg/L	EPA 300.0
Selenium	µg/L	TRM / EPA 200.8
Sulfate	µg/L	EPA 300.0
Thallium	µg/L	TRM / EPA 200.8
Total Dissolved Solids	µg/L	SM 2450C
Zinc	µg/L	TRM / EPA 200.7

Notes:

1. µmhos/cm indicates micro-mhos per centimeter.
2. ft indicates feet.
3. µg/L indicates micrograms per liter.
4. TRM indicates total recoverable metals.
5. EPA indicates Environmental Protection Agency.
6. SM indicates Standard Method.

Table 3
Sample Containers, Preservatives, and Holding Times
Dan River Combined Cycle Station Ash Basin

PARAMETER	CONTAINERS	PRESERVATIVES	HOLDING TIMES
In Situ Parameters			
Field pH	In Situ	None	Analyze Immediately
Conductivity	In Situ	None	Analyze Immediately
Temperature	In Situ	None	Analyze Immediately
Laboratory Analyses			
Antimony	500 ml HDPE	pH<2 HNO_3	6 months
Arsenic	500 ml HDPE	pH<2 HNO_3	6 months
Barium	500 ml HDPE	pH<2 HNO_3	6 months
Boron	500 ml HDPE	pH<2 HNO_3	6 months
Cadmium	500 ml HDPE	pH<2 HNO_3	6 months
Chloride	500 ml HDPE	Cool 4° C	28 days
Chromium (total)	500 ml HDPE	pH<2 HNO_3	6 months
Copper	500 ml HDPE	pH<2 HNO_3	6 months
Iron	500 ml HDPE	pH<2 HNO_3	6 months
Lead	500 ml HDPE	pH<2 HNO_3	6 months
Manganese	500 ml HDPE	pH<2 HNO_3	6 months
Mercury	500 ml HDPE	pH<2 HNO_3	6 months
Nickel	500 ml HDPE	pH<2 HNO_3	6 months
Nitrate (as Nitrogen)	500 ml HDPE	Cool 4° C	28 days
Selenium	500 ml HDPE	pH<2 HNO_3	6 months
Sulfate	500 ml HDPE	Cool 4° C	28 days
Thallium	500 ml HDPE	pH<2 HNO_3	6 months
Total Dissolved Solids	500 ml HDPE	Cool 4° C	28 days
Zinc	500 ml HDPE	pH<2 HNO_3	6 months

Notes:

1. ml indicates milliliter.
2. HNO_3 indicates nitric acid.
3. HDPE indicates high density polyethylene.

A

Appendix A - Boring Logs and Monitoring Well Construction Records

MACTEC

engineering and constructing a better tomorrow

January 31, 2011

Mr. Thomas Wiest, Project Manager
Duke Energy Corporation
3195 Pine Hall Road
Belews Creek, North Carolina 27009

Subject: **Ash Basin Monitoring Well Installation Report**
Dan River Steam Station
900 South Edgewood Road
Eden, Rockingham County, North Carolina
MACTEC Project No.: 6288-10-5284

Dear Mr. Wiest:

MACTEC is pleased to provide this report on behalf of our client, AE Drilling, LLC. The purpose of this report is to present the results of monitoring well installation and evaluation activities conducted in November and December 2010 at the above-referenced site (Figure 1). The well installation and testing was conducted in general accordance with the requirements outlined in the Ash Basin Groundwater Monitoring Well Installation Project Work Summary (Work Summary) provided by Duke Energy (Duke). The following Figure, Tables and Appendices have been included:

Figure 1:	Monitoring Well Locations
Table 1:	Summary of Well Construction Details
Table 2:	Summary of Slug Test Results
Appendix A:	Rock Core Photographs
Appendix B:	Soil and Rock Boring Logs
Appendix C:	NCDENR Monitoring Well Construction Records
Appendix D:	Monitoring Well Development Records
Appendix E:	Photographs of Completed Well Pairs
Appendix F:	Slug Test Data

Two Type II groundwater monitoring well pairs and one Type II single groundwater monitoring well (a total of 5 wells) were installed between November 23, 2010 and December 21, 2010 at the locations shown on Figure 1. The well locations were pre-determined by Duke and marked in the field with wooden stakes and survey flagging. Each well pair consisted of one shallow well (using the identifier "S") set into overburden soils and one deep well (using the identifier "D) set into

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2801 Yorkmont Road, Suite 100 • Charlotte, NC 28208 • Phone: 704.357.8600 • Fax: 704.357.8638

www.mactec.com

bedrock. Please note that a shallow well was not installed at location MW-23 because bedrock was encountered prior to groundwater, indicating a local absence of a surficial aquifer in this location. Standard Penetration Testing (SPT) and split-spoon sampling was performed at five-foot intervals from the surface to bedrock during installation of the deep well at each well pair. Soils observed in the split-spoon samples were logged in the field in accordance with the Unified Soil Classification System (ASTM D2487/D2488). Upon auger refusal, each deep boring was extended a minimum of 10 feet into competent bedrock using HQ-sized rock core techniques.

Rock core samples were logged in the field in accordance with the Field Guide for Rock Core Logging and Fracture Analysis established by Midwest Geosciences. As specified in the Work Summary, split-spoon sampling and rock coring were not performed during installation of the shallow wells. Photographs of rock cores obtained during installation of the three deep wells are included as Appendix A.

Shallow wells were installed using 4.25-inch ID hollow stem augers; deep wells were installed using 4.25-inch ID hollow stem augers to refusal, then HQ-sized rock core approximately 10 feet into competent bedrock. Total depths for shallow wells ranged from 8.8 feet below ground surface (bgs) in MW-21S to 19 feet bgs in MW-20S. Total depths for bedrock wells ranged from 17 feet bgs in MW-23D to 41.5 feet bgs in MW-20D. Shallow wells were constructed with 5 to 15 feet of 0.010-slot 2-inch diameter PVC well screen and riser with well screens set so that most of screen is below the static water table at the time of installation. Deep wells were constructed with 5-foot well screens (except well MW-23D, in which a 10-foot screen was installed) set across low-RQD bedrock core intervals to facilitate maximum water flow through each well. Filter sand was placed in the annular space between the augers and the casing from the total depth of the boring to at least one foot above the screen. A bentonite seal was placed on top of the filter pack and the well was grouted to the surface. Please note that shallow well depths were typically adjusted after installation, but prior to placement of bentonite, to account for rise in hydraulic head observed at each location. In these instances, additional filter sand was placed between the bottom of the borehole and the bottom of the well. Each well was completed with a stand-up well cover that extends approximately 30 inches above-grade and set into a 2-foot by 2-foot concrete pad. Monitoring well ID tags were secured to the outside of the stand-up covers and well numbers were etched into the wet concrete pad. Soil boring logs and well construction records for the five monitoring wells installed during this work have been included as Appendix B and C, respectively.

Subsequent to installation, each well was developed using a submersible or bladder pump to remove fine-grained material. In general, each well was purged until the development water appeared visually clear, at which time, water quality parameters (temperature, pH, conductivity and turbidity) were recorded in 5-gallon increments until turbidity readings were less than or equal to 50 NTUs. Purge water generated during well development ranged from 10 gallons to 200 gallons and was discharged to the ground surface adjacent to each well. Monitoring well development records are included as Appendix D. Photographs of the completed monitoring well pairs are included as Appendix E.

Rising head slug tests were performed on each well on December 27 and 28, 2010. Prior to the tests an In-situ Level Troll pressure transducer and 4-foot long stainless steel slug were placed into the well. The water level in the well was recorded as a "Background" test until the well recharged to within 90% of the original measurement. Subsequent to normalization, the rising head test was started, the slug was removed and the change in head versus time was measured using a Rugged-reader data logger. Slug test data was analyzed using Aqtesolv software to estimate hydraulic conductivity in each well. A summary of slug test data is presented in Table 2. Copies of raw data generated during completion of the rising head slug tests are included in Appendix F. Electronic slug test data is included on the attached compact disc.

Please contact the undersigned at (704) 357-8600, if you have questions or comments concerning this project.

Sincerely,

MACTEC ENGINEERING AND CONSULTING, INC.

Jacqueline Williams

Mark P. Filardi, P.G.
Senior Geologist

Robert C. Foster, L.G.
Principal

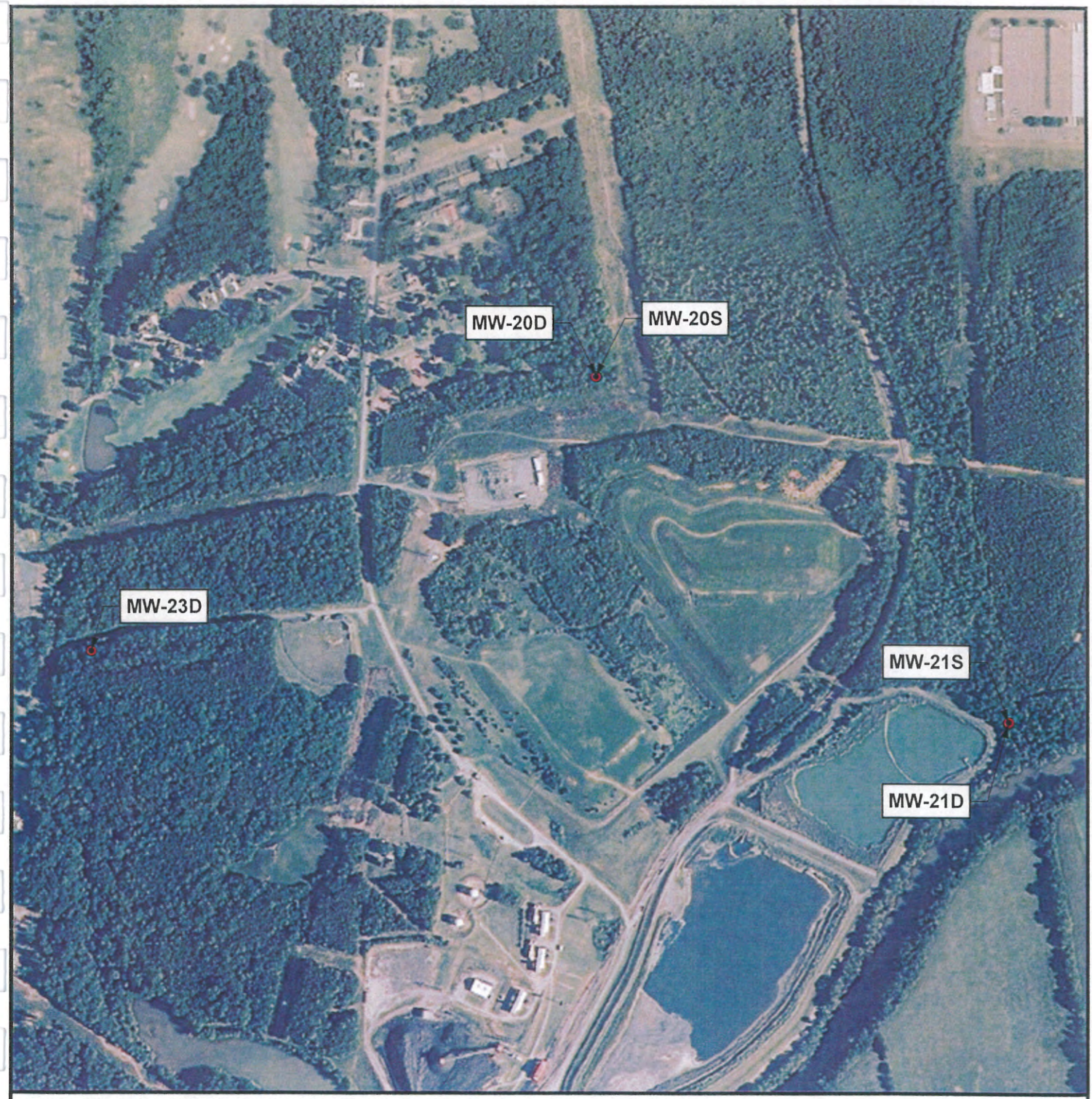
NORTH CAROLINA LICENSED SEAL 1351 GEOLOGIST ROBERT C. FOSTER III

Enclosures

For Mark P. Filardi
With Permission

cc: William M. Miller, PE, PLS, Altamont Environmental
Mark Lassiter, PG, AE Drilling, LLC

FIGURE



Source: USDA-FSA-APFO NAIP MrSID Mosaic for Rockingham County, North Carolina, dated 2009.

Monitoring Well Location

N

0 500 1,000 2,000 3,000 4,000 Feet

MACTEC

MONITORING WELL LOCATIONS
DUKE ENERGY
DAN RIVER STEAM STATION
ROCKINGHAM COUNTY, NORTH CAROLINA

PREPARED BY	DATE	CHECKED BY	DATE	JOB NUMBER	FIGURE
SJM	2/7//2011	RCF	2-4-11	6228-10-5284	1

TABLES

Table 1
Summary of Well Construction Details
Dan River Steam Station, Eden, North Carolina

Well Number	Coordinates		Drilling Method	Construction Details				Measured Details			
	Latitude	Longitude		Well Diameter (I.D. in.)	Borehole Depth (ft bgs)	Well Depth (ft bgs)	Screen Interval (ft bgs)	Top of Casing Elevation (NAVD 88)	Well Depth (ft below TOC)	Depth to Water (ft below TOC)	Height of Water Column (ft)
MW-20S	36.4972458	-79.71803198	HSA	2	20	19	4 - 19	562.28	22.31	4.72	17.59
MW-20D	36.49725101	-79.71801502	HSA/Rock Core	2	45	41.5	36.5 - 41.5	562.23	44.42	3.72	40.70
MW-21S	36.49259198	-79.71091746	HSA	2	11.8	8.8	3.5 - 8.5	498.80	11.76	5.21	6.55
MW-21D	36.49257293	-79.71092181	HSA/Rock Core	2	18.8	18.8	13.6 - 18.6	498.90	21.61	1.51	20.10
MW-23D	36.4934582	-79.72667936	HSA/Rock Core	2	22	17.0	6.7 - 16.7	528.22	20.20	12.09	8.11

ft bgs = feet below ground surface
HSA = Hollow-stem Auger

Prepared by Date: MDF 1-31-11
Checked by Date: RCF 1-31-11

Table 2
Summary of Slug Test Data
Dan River Steam Station, Eden, North Carolina

WELL ID	Test Date	Aquifer Model	Rising Head Test		Borehole Depth (ft bgs)	Well Depth (ft bgs)	Screen Interval (ft bgs)	Well Diameter (I.D. in.)
			Solution Method	K-value (cm/sec)				
MW-20S	12/28/2010	unconfined	Bouwer-Rice	2.40 E-04	20	19	4 - 19	2
MW-20D	12/28/2010	confined	Bouwer-Rice	1.51 E-03	45	41.5	36.5 - 41.5	2
MW-21S	12/27/2010	unconfined	Bouwer-Rice	2.22 E-03	11.8	8.8	3.5 - 8.5	2
MW-21D	12/27/2010	confined	Bouwer-Rice	7.37 E-05	18.8	18.8	13.6 - 18.6	2
MW-23D	12/27/2010	confined	Bouwer-Rice	4.69 E-05	22	17	6.7 - 16.7	2

Note: In calculating the hydraulic conductivity values, an unconfined aquifer model was assigned to wells screened (S-series) within the surficial aquifer. A confined aquifer model was presumed for wells screened (D-series) in the bedrock aquifer. The saturated thicknesses (Appendix F) were derived from lithologic data from well borings including likely water-bering zones.

Prepared By Date: chb 2-15-11
Checked By Date: RLF 2-16-11

APPENDICES

APPENDIX A

ROCK CORE PHOTOGRAPHS

Photograph 1: Well MW-20D (core run 1).

Photograph 2: Well MW-20D (core run 2).

Photograph 3: Well MW-20D (core run 3).

Photograph 4: Well MW-20D (core run 4).

Photograph 5: Well MW-21D (core run 1).

Photograph 6: Well MW-21D (core run 2).

Photograph 7: Well MW-23D (core run 1).

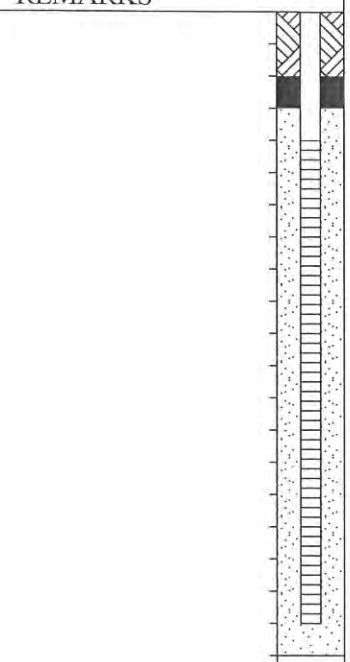
Photograph 8: Well MW-23D (core run 2).

Photograph 9: Well MW-23D (core run 3).

APPENDIX B

SOIL AND ROCK BORING LOGS

DEPTH (ft)	SOIL CLASSIFICATION SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES: IDENT	SAMPLES: TYPE	SAMPLES: N-COUNT (1st 6" / 2nd 6" / 3rd 6")	REMARKS
0	Reddish brown (7.5 YR 5/8) silty clay (CL)						
5	Light brown (10 YR 7/3) fine sandy silt (ML)						
10							
15	Gray (Gley 1 6/N) silty fine sand (SM)						
20	Boring terminated at 20 feet below land surface						
25							
30							
35							
40							
45							



SOIL DAN RIVER GINT.GPJ 2/1/11

DRILLER: Dan Bergman/AE Drilling
EQUIPMENT: CME 750 ATV
METHOD: 4.25" (ID) HSA
HOLE DIA.: 8" HSA
REMARKS:

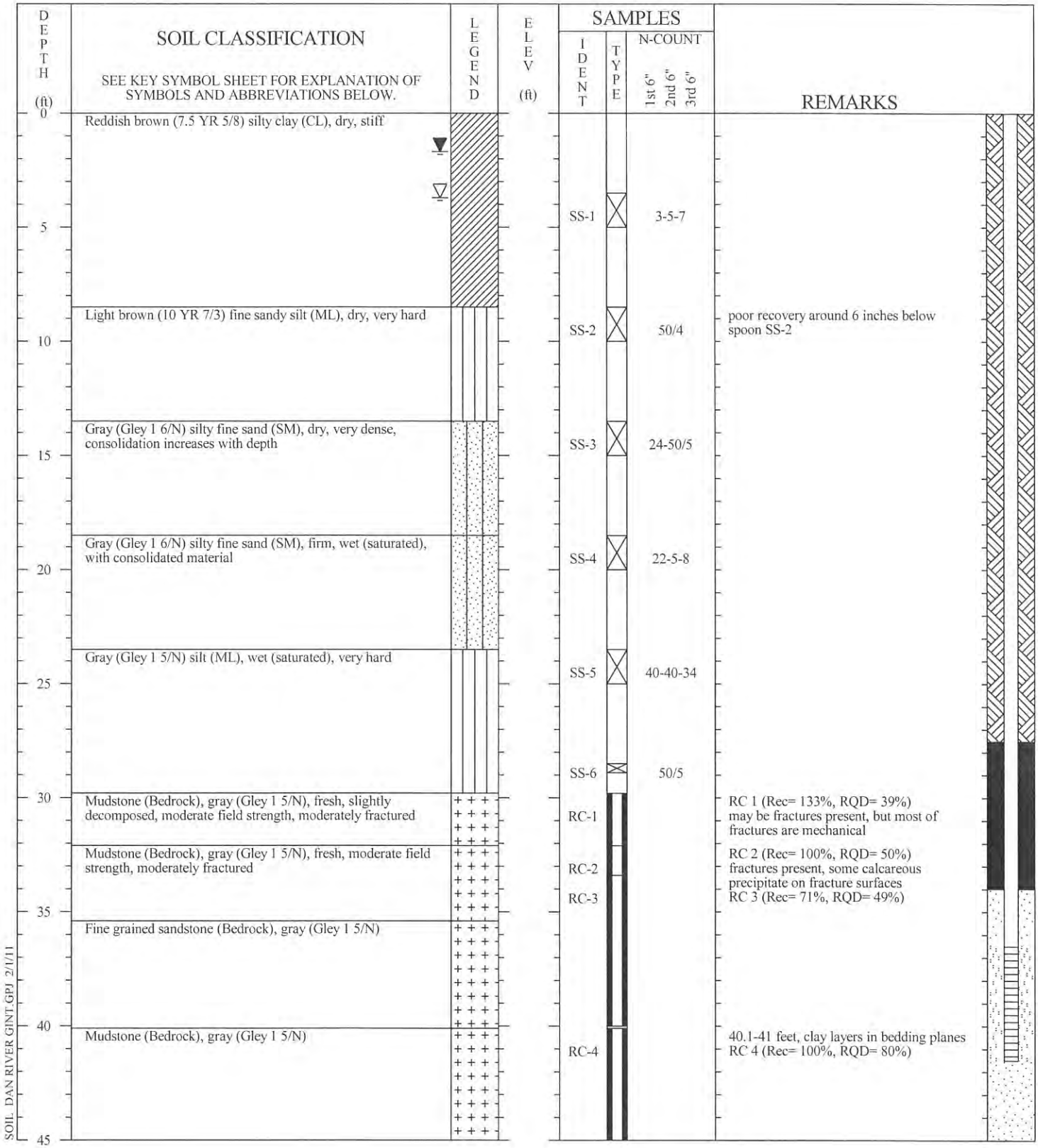
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

PROJECT: Dan River Steam Station
WELL ID: MW-20S

November 23, 2010
PROJ. NO.: 6228-10-5284.05 **PAGE** 1 **OF** 1

MACTEC



SOIL_DAN RIVER GINT.GPJ 2/1/11

DRILLER: Dan Bergman/AE Drilling
EQUIPMENT: CME 750 ATV
METHOD: 4.25" (ID) HSA, HQ Rock Core
HOLE DIA.: 8" HSA, HQ Rock Core
REMARKS:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

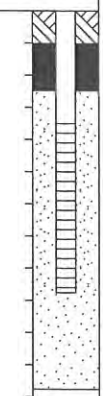
SOIL TEST BORING RECORD

PROJECT: Dan River Steam Station
WELL ID: MW-20D

November 19, 2010
PROJ. NO.: 6228-10-5284.05 **PAGE 1 OF 1**

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	SAMPLES N-COUNT 1st 6" 2nd 6" 3rd 6"	REMARKS
0	Reddish brown (7.5 YR 4/6) plastic clay (CH)						
5							
10							
	Boring terminated at 11.8 feet below ground surface						
15							
20							
25							
30							
35							
40							
45							



SOIL_DAN RIVER GINT.GPJ 2/1/11

DRILLER: Dan Bergman/AE Drilling
EQUIPMENT: CME 750 ATV
METHOD: 4.25" (ID) HSA
HOLE DIA.: 8" HSA
REMARKS:

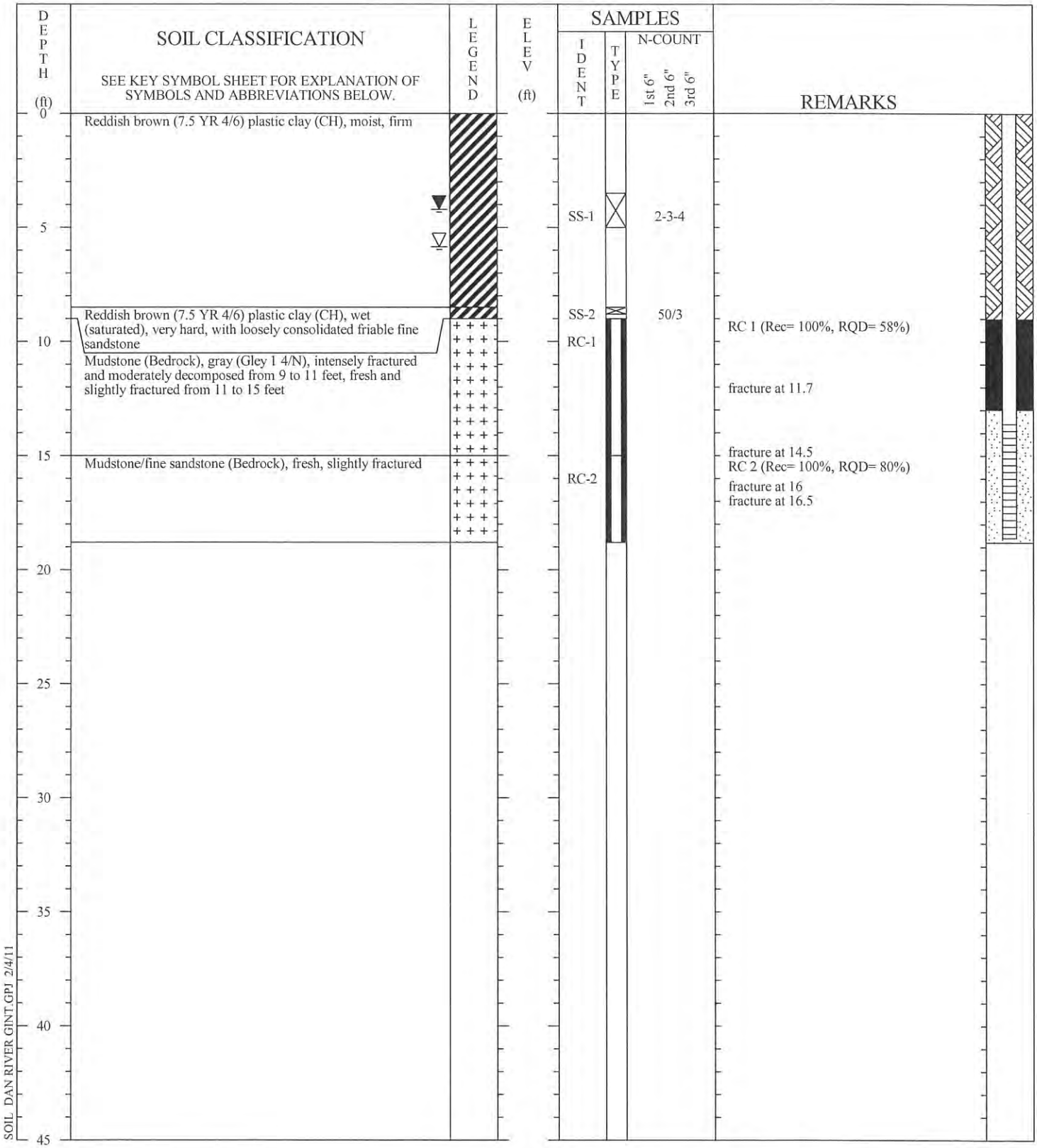
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

PROJECT: Dan River Steam Station
WELL ID: MW-21S

November 24, 2010
PROJ. NO.: 6228-10-5284.05 **PAGE** 1 **OF** 1

MACTEC



SOIL_DAN RIVER GINT.GPJ 2/4/11

DRILLER: Dan Bergman/AE Drilling
EQUIPMENT: CME 750 ATV
METHOD: 4.25" (ID) HSA, HQ Rock Core
HOLE DIA.: 8" HSA, HQ Rock Core
REMARKS:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

PROJECT: Dan River Steam Station
WELL ID: MW-21D

November 23, 2010
PROJ. NO.: 6228-10-5284.05 **PAGE** 1 **OF** 1

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	SAMPLES N-COUNT 1st 6" 2nd 6" 3rd 6"	REMARKS
0	Dark gray (5 YR 4/1) with little yellowish red (5 YR 5/6), weathered shale/residuum sampled as lean silt (ML), moist, very stiff, some relict rock structure (thinly bedded), little friable angle grain sized shale fragments, trace roots			SS-1		3-6-12	petroleum-like odor
5							
	Dark gray (5 YR 4/1) silty gravel (GM), very dense, moist, angular grain sized shale fragments, moderately indurated, some relict rock structure			SS-2		50/0.3	RC 1 (Rec= 56%, RQD= 12%)
	Shale/mudstone (Bedrock), black (Gley 1 2.5/N), strong, aphanitic, thinly bedded, fresh, competent, moderately fractured			RC-1			
10							two 45 degree joints at 11 feet one 45 degree joint, very narrow, partially healed, iron stained vertical closed/healed joint from 12 to 12.5 feet
				RC-2			RC 2 (Rec= 60%, RQD= 48%) some healed dessication cracks in Run 2 two 45 degree joints at 15.5 feet
15							10 degree joint at 17 feet 28 degree joint with iron staining at 17.8 feet
				RC-3			RC 3 (Rec= 60%, RQD= 40%)
20							two 45 degree bedding plane fractures at 21.5 to 22
25							
30							
35							
40							
45							

SOIL DAN RIVER GINT.GPJ 2/1/11

DRILLER: William Burnette/AE Drilling
EQUIPMENT: CME 750 ATV
METHOD: 4.25" (ID) HSA, HQ Rock Core
HOLE DIA.: 8" HSA, HQ Rock Core
REMARKS:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

PROJECT: Dan River Steam Station
WELL ID: MW-23D

December 21, 2010
PROJ. NO.: 6228-10-5284.05 **PAGE 1 OF 1**

MACTEC

APPENDIX C

NCDENR MONITORING WELL CONSTRUCTION RECORDS

NON RESIDENTIAL WELL CONSTRUCTION RECORD

North Carolina Department of Environment and Natural Resources- Division of Water Quality

WELL CONTRACTOR CERTIFICATION # 3485-A

1. WELL CONTRACTOR: JOHN GORMAN
Well Contractor (Individual) Name

A E DRILLING SERVICES, LLC
Well Contractor Company Name

Two United Way
Street Address

Greenville SC 29607
City or Town State Zip Code

(864) 288-1986
Area code Phone number

2. WELL INFORMATION:

WELL CONSTRUCTION PERMIT#

OTHER ASSOCIATED PERMIT#(if applicable)

SITE WELL ID #(if applicable) MW-205

3. WELL USE (Check One Box) Monitoring ☒ Municipal/Public ☐
Industrial/Commercial ☐ Agricultural ☐ Recovery ☐ Injection ☐
Irrigation ☐ Other ☐ (list use)

DATE DRILLED 11-22-10

4. WELL LOCATION:

900 S. Edgewood Drive
(Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)

CITY: Eden COUNTY Rockingham

TOPOGRAPHIC / LAND SETTING: (check appropriate box)
☐ Slope ☐ Valley ☒ Flat ☐ Ridge ☐ Other

LATITUDE 36.497246

LONGITUDE -79.718032

Latitude/longitude source: ☐ GPS ☐ Topographic map
(location of well must be shown on a USGS topo map and attached to this form if not using GPS)

6. FACILITY (Name of the business where the well is located.)

Duke Energy – Dan River Steam Station (if applicable)
900 S. Edgewood Rd
Eden, NC 27288

City or Town State Zip Code

Mike Cook
Contact Name

Mailing Address

City or Town State Zip Code

(336) 445-0325
Area code Phone number

6. WELL DETAILS:

a. TOTAL DEPTH: 19.0

b. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☒

c. WATER LEVEL Below Top of Casing: 4.72 FT. +
(Use "+" if Above Top of Casing)

d. TOP OF CASING IS 2.57 FT. Above Land Surface*
*Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.

e. YIELD (gpm): N/M METHOD OF TEST

f. DISINFECTION: Type N/A Amount

g. WATER ZONES (depth):
Top Bottom Top Bottom
Top Bottom Top Bottom
Top Bottom Top Bottom

7. CASING:	Depth		Diameter	Thickness/ Weight	Material
Top +3.0	Bottom 4.0	Ft.	2"	SCH 40	PVC
Top	Bottom	Ft.			
Top	Bottom	Ft.			

8. GROUT:	Depth		Material	Method
Top 0.0	Bottom 2.0	Ft.	PORTLAND	TREMIE
Top 2.0	Bottom 3.0	Ft.	BENT.	
Top	Bottom	Ft.		

9. SCREEN:	Depth		Diameter	Slot Size	Material
Top 4.0	Bottom 19.0	Ft.	2 In.	.01 In.	PVC
Top	Bottom	Ft.	In.	In.	
Top	Bottom	Ft.	In.	In.	

10. SAND/GRAVEL PACK:

	Depth		Size	Material
Top 3.0	Bottom 19.0	Ft.	#1	SAND
Top	Bottom	Ft.		
Top	Bottom	Ft.		

11. DRILLING LOG

Top	Bottom	Formation Description
0	20	sandy silt & silty sand

12. REMARKS:

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

SIGNATURE OF CERTIFIED WELL CONTRACTOR 11-28-10 DATE

JOHN GORMAN
PRINTED NAME OF PERSON CONSTRUCTING THE WELL

Submit the original to the Division of Water Quality within 30 days. Attn: Information Mgt., 1617 Mail Service Center – Raleigh, NC 27699-1617 Phone No. (919) 807-6300

Form GW-1b
Rev. 11/08

NON RESIDENTIAL WELL CONSTRUCTION RECORD

North Carolina Department of Environment and Natural Resources- Division of Water Quality

WELL CONTRACTOR CERTIFICATION # 3485-A

1. WELL CONTRACTOR: JOHN GORMAN
Well Contractor (Individual) Name
A E DRILLING SERVICES, LLC
Well Contractor Company Name
Two United Way
Street Address
Greenville SC 29607
City or Town State Zip Code
(864) 288-1986
Area code Phone number

2. WELL INFORMATION:
WELL CONSTRUCTION PERMIT#
OTHER ASSOCIATED PERMIT#(if applicable)
SITE WELL ID #(if applicable) MW-20D

3. WELL USE (Check One Box) Monitoring ☒ Municipal/Public ☐
Industrial/Commercial ☐ Agricultural ☐ Recovery ☐ Injection ☐
Irrigation ☐ Other ☐ (list use)
DATE DRILLED 11-22-10

4. WELL LOCATION:
900 South Edgewood Drive
(Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)
CITY: Eden COUNTY Rockingham
TOPOGRAPHIC / LAND SETTING: (check appropriate box)
☐ Slope ☐ Valley ☒ Flat ☐ Ridge ☐ Other
LATITUDE 36.497251
LONGITUDE -79.718015
Latitude/longitude source: ☐ GPS ☐ Topographic map
(location of well must be shown on a USGS topo map andattached to this form if not using GPS)

5. FACILITY (Name of the business where the well is located.)
Duke Energy - Dan River Steam Station
Facility Name Facility ID# (if applicable)
900 S. Edgewood Rd
Street Address
Eden NC 27288
City or Town State Zip Code
Mike Cook
Contact Name
Mailing Address
City or Town State Zip Code
(336) 445-0325
Area code Phone number

6. WELL DETAILS:
a. TOTAL DEPTH: 41.5
b. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☒
c. WATER LEVEL Below Top of Casing: 3.72 FT. +
(Use "+" if Above Top of Casing)

d. TOP OF CASING IS 2.81 FT. Above Land Surface*
*Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.
e. YIELD (gpm): N/M METHOD OF TEST
f. DISINFECTION: Type N/A Amount
g. WATER ZONES (depth):
Top Bottom Top Bottom
Top Bottom Top Bottom
Top Bottom Top Bottom

7. CASING:

Depth		Diameter	Thickness/ Weight	Material
Top +3.0 Bottom 36.5	Ft.	2"	SCH40	PVC
Top Bottom	Ft.			
Top Bottom	Ft.			

8. GROUT:

Depth		Material	Method
Top 0.0 Bottom 27.5	Ft.	Portland	Tremie
Top 27.5 Bottom 34	Ft.	Bent.	
Top Bottom	Ft.		

9. SCREEN:

Depth		Diameter	Slot Size	Material
Top 36.5 Bottom 41.5	Ft.	2 In.	.01 In.	PVC
Top Bottom	Ft.	In.	In.	
Top Bottom	Ft.	In.	In.	

10. SAND/GRAVEL PACK:

Depth		Size	Material
Top 34.0 Bottom 45.0	Ft.	#1	SAND
Top Bottom	Ft.		
Top Bottom	Ft.		

11. DRILLING LOG

Top	Bottom	Formation Description
0	30	silt and sand
30	45	mudstone (bedrock)

12. REMARKS:

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

SIGNATURE OF CERTIFIED WELL CONTRACTOR 11-28-10 DATE

JOHN GORMAN
PRINTED NAME OF PERSON CONSTRUCTING THE WELL

Submit the original to the Division of Water Quality within 30 days. Attn: Information Mgt., 1617 Mail Service Center – Raleigh, NC 27699-1617 Phone No. (919) 807-6300

Form GW-1b
Rev. 11/08

NON RESIDENTIAL WELL CONSTRUCTION RECORD

North Carolina Department of Environment and Natural Resources- Division of Water Quality

WELL CONTRACTOR CERTIFICATION # 3485A

1. WELL CONTRACTOR:
JOHN GORMAN
Well Contractor (Individual) Name
A E DRILLING SERVICES, LLC
Well Contractor Company Name
Two United Way
Street Address
Greenville SC 29607
City or Town State Zip Code
(864) 288-1986
Area code Phone number

2. WELL INFORMATION:
WELL CONSTRUCTION PERMIT#
OTHER ASSOCIATED PERMIT#(if applicable)
SITE WELL ID #(if applicable) MW-21D

3. WELL USE (Check One Box) Monitoring ☒ Municipal/Public ☐
Industrial/Commercial ☐ Agricultural ☐ Recovery ☐ Injection ☐
Irrigation ☐ Other ☐ (list use)
DATE DRILLED 11-23-10

4. WELL LOCATION:
900 S. Edgewood
(Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)
CITY: Eden COUNTY Rockingham
TOPOGRAPHIC / LAND SETTING: (check appropriate box)
☒ Slope ☐ Valley ☐ Flat ☐ Ridge ☐ Other
LATITUDE 36.492573
LONGITUDE -79.710922
Latitude/longitude source: ☐ GPS ☐ Topographic map
(location of well must be shown on a USGS topo map andattached to this form if not using GPS)

5. FACILITY (Name of the business where the well is located.)
Duke Energy - Dan Rivee Steam Station
Facility Name Facility ID# (if applicable)
900 S. Edgewood Rd
Street Address
Eden NC 27288
City or Town State Zip Code
Mike Cook
Contact Name
Mailing Address
City or Town State Zip Code
(336) 445-0885
Area code Phone number

6. WELL DETAILS:
a. TOTAL DEPTH: 18.6
b. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☒
c. WATER LEVEL Below Top of Casing: 1.51' FT. +
(Use "+" if Above Top of Casing)

d. TOP OF CASING IS 2.67' FT. Above Land Surface*
*Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.
e. YIELD (gpm): N/M METHOD OF TEST
f. DISINFECTION: Type N/A Amount
g. WATER ZONES (depth):
Top Bottom Top Bottom
Top Bottom Top Bottom
Top Bottom Top Bottom

7. CASING:	Depth		Diameter	Thickness/ Weight	Material
Top 13.0	Bottom 13.4	Ft.	2"	SCH40	PVC
Top	Bottom	Ft.			
Top	Bottom	Ft.			

8. GROUT:	Depth		Material	Method
Top 0.0	Bottom 9.0	Ft.	Portland	tremie
Top 9	Bottom 13	Ft.	Bent.	
Top	Bottom	Ft.		

9. SCREEN:	Depth		Diameter	Slot Size	Material
Top 13.4	Bottom 18.4	Ft.	2 in.	.01 in.	PVC
Top	Bottom	Ft.	in.	in.	
Top	Bottom	Ft.	in.	in.	

10. SAND/GRAVEL PACK:	Depth		Size	Material
Top 12.5	Bottom 18.6	Ft.	#1	SAND
Top	Bottom	Ft.		
Top	Bottom	Ft.		

11. DRILLING LOG

Top	Bottom	Formation Description
0	9	Plastic clay
9	19	mudstone

12. REMARKS:

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

SIGNATURE OF CERTIFIED WELL CONTRACTOR — DATE: 11-28-10

JOHN GORMAN
PRINTED NAME OF PERSON CONSTRUCTING THE WELL

Submit the original to the Division of Water Quality within 30 days. Attn: Information Mgt., 1617 Mail Service Center – Raleigh, NC 27699-1617 Phone No. (919) 807-6300

Form GW-1b
Rev. 11/08

NON RESIDENTIAL WELL CONSTRUCTION RECORD

North Carolina Department of Environment and Natural Resources- Division of Water Quality

WELL CONTRACTOR CERTIFICATION # 3485-A

1. WELL CONTRACTOR: JOHN GORMAN
Well Contractor (Individual) Name
A E DRILLING SERVICES, LLC
Well Contractor Company Name
Two United Way
Street Address
Greenville SC 29607
City or Town State Zip Code
(864) 288-1986
Area code Phone number

2. WELL INFORMATION:
WELL CONSTRUCTION PERMIT#
OTHER ASSOCIATED PERMIT#(if applicable)
SITE WELL ID #(if applicable) MW-215

3. WELL USE (Check One Box) Monitoring ☒ Municipal/Public ☐
Industrial/Commercial ☐ Agricultural ☐ Recovery ☐ Injection ☐
Irrigation ☐ Other ☐ (list use)
DATE DRILLED 11-23-10

4. WELL LOCATION:
900 S. Ed
(Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)
CITY: Eden COUNTY Rockingham
TOPOGRAPHIC / LAND SETTING: (check appropriate box)
☒ Slope ☐ Valley ☐ Flat ☐ Ridge ☐ Other
LATITUDE 36.492592
LONGITUDE -79.710917
Latitude/longitude source: ☐ GPS ☐ Topographic map
(location of well must be shown on a USGS topo map andattached to this form if not using GPS)

5. FACILITY (Name of the business where the well is located.)
Duke Energy - Dan River Steam Station
Facility Name Facility ID# (if applicable)
900 S. Edgewood Rd
Street Address
Eden NC 27288
City or Town State Zip Code
Mike Cook
Contact Name
Mailing Address
City or Town State Zip Code
(336) 445-0325
Area code Phone number

6. WELL DETAILS:
a. TOTAL DEPTH: 8.8
b. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☒
c. WATER LEVEL Below Top of Casing: 5.21 FT. +
(Use "+" if Above Top of Casing)

d. TOP OF CASING IS 2.77 FT. Above Land Surface*
*Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.
e. YIELD (gpm): N/M METHOD OF TEST
f. DISINFECTION: Type N/A Amount
g. WATER ZONES (depth):
Top Bottom Top Bottom
Top Bottom Top Bottom
Top Bottom Top Bottom

7. CASING:

Depth	Diameter	Thickness/ Weight	Material
Top 3.0 Bottom 3.5	Ft. 2"	SCH40	PVC
Top Bottom	Ft.		
Top Bottom	Ft.		

8. GROUT:

Depth	Material	Method
Top 0.0 Bottom 1.0	Ft. PORTLAND	TREMIE
Top 1 Bottom 2.5	Ft. Bent	
Top Bottom	Ft.	

9. SCREEN:

Depth	Diameter	Slot Size	Material
Top 3.5 Bottom 8.5	Ft. 2 In.	.01 In.	PVC
Top Bottom	Ft. In.	In.	
Top Bottom	Ft. In.	In.	

10. SAND/GRAVEL PACK:

Depth	Size	Material
Top 2.5 Bottom 11.8	Ft. #1	SAND
Top Bottom	Ft.	
Top Bottom	Ft.	

11. DRILLING LOG

Top	Bottom	Formation Description
0	11.8	Plastic clay

12. REMARKS:

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

SIGNATURE OF CERTIFIED WELL CONTRACTOR 11-28-10 DATE

JOHN GORMAN
PRINTED NAME OF PERSON CONSTRUCTING THE WELL

Submit the original to the Division of Water Quality within 30 days. Attn: Information Mgt., 1617 Mail Service Center – Raleigh, NC 27699-1617 Phone No. (919) 807-6300

Form GW-1b
Rev. 11/08

NON RESIDENTIAL WELL CONSTRUCTION RECORD

North Carolina Department of Environment and Natural Resources- Division of Water Quality

WELL CONTRACTOR CERTIFICATION # 3485A

1. WELL CONTRACTOR: JOHN GORMAN
Well Contractor (Individual) Name
A E DRILLING SERVICES, LLC
Well Contractor Company Name
Two United Way
Street Address
Greenville SC 29607
City or Town State Zip Code
(864) 288-1986
Area code Phone number

2. WELL INFORMATION:
WELL CONSTRUCTION PERMIT#
OTHER ASSOCIATED PERMIT#(if applicable)
SITE WELL ID #(if applicable) MW-23D

3. WELL USE (Check One Box) Monitoring ☒ Municipal/Public ☐
Industrial/Commercial ☐ Agricultural ☐ Recovery ☐ Injection ☐
Irrigation ☐ Other ☐ (list use)
DATE DRILLED 11-21-10

4. WELL LOCATION: Dan River Steam Station
900 Edgewood
(Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)
CITY: Eden COUNTY Rockingham
TOPOGRAPHIC / LAND SETTING: (check appropriate box)
☒ Slope ☐ Valley ☐ Flat ☐ Ridge ☐ Other
LATITUDE 36.493458
LONGITUDE -79.726679
Latitude/longitude source: ☐ GPS ☐ Topographic map
(location of well must be shown on a USGS topo map and attached to this form if not using GPS)

5. FACILITY (Name of the business where the well is located.)
Duke Energy – Dan River Steam Station (if applicable)
900 S. Edgewood Rd
Eden, NC 27288
City or Town State Zip Code
Mike Cook
Contact Name
Mailing Address
City or Town State Zip Code
(336) 445-0325
Area code Phone number

6. WELL DETAILS:
a. TOTAL DEPTH: 17.0'
b. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☒
c. WATER LEVEL Below Top of Casing: 12.09 FT. +
(Use "+" if Above Top of Casing)

d. TOP OF CASING IS 3.24 FT. Above Land Surface*
*Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.
e. YIELD (gpm): N/M METHOD OF TEST
f. DISINFECTION: Type N/A Amount
g. WATER ZONES (depth):
Top Bottom Top Bottom
Top Bottom Top Bottom
Top Bottom Top Bottom

7. CASING:	Depth		Diameter	Thickness/ Weight	Material
Top 13.5	Bottom 6.7	Ft.	2"	SCH 40	PVC
Top	Bottom	Ft.			
Top	Bottom	Ft.			

8. GROUT:	Depth		Material	Method
Top 0.0	Bottom 2.8	Ft.	PORTLAND	TREMIE
Top	Bottom	Ft.		
Top	Bottom	Ft.		

9. SCREEN:	Depth		Diameter	Slot Size	Material
Top 6.7	Bottom 16.7	Ft.	2 in.	.01 in.	PVC
Top	Bottom	Ft.	in.	in.	
Top	Bottom	Ft.	in.	in.	

10. SAND/GRAVEL PACK:	Depth		Size	Material
Top 4.8	Bottom 17.0'	Ft.	#2	SAND
Top	Bottom	Ft.		
Top	Bottom	Ft.		

11. DRILLING LOG

Top	Bottom	Formation Description
0	8	silt, weathered bedrock
8	22	shale bedrock

12. REMARKS:

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

SIGNATURE OF CERTIFIED WELL CONTRACTOR — DATE 11-21-10

PRINTED NAME OF PERSON CONSTRUCTING THE WELL

Submit the original to the Division of Water Quality within 30 days. Attn: Information Mgt., 1617 Mail Service Center – Raleigh, NC 27699-1617 Phone No. (919) 807-6300

Form GW-1b
Rev. 11/08

APPENDIX D

MONITORING WELL DEVELOPMENT RECORDS

MACTEC

MONITORING WELL DEVELOPMENT DATA

Project Name: DAN River Date: 11-23-10

Project Number: 6228-10-5284.05 Personnel: JCG

Well Number: MW-205

Date of Installation: 11-22-10

Installation Method: 4.25" H.S.A.

Well Depth: 19.0 feet bgs

Screen Length: 15.0' feet

Static Water Level: 5.42 feet bgs

1 Well Volume: 0.86 gallons

5 Well Volumes: 4.3 gallons

Depth to Sediment Before Development: 19.0 feet bgs

Depth to Sediment After Development: 19.0 feet bgs

Development Technique: Submersible Pump

Development Equipment: HARiba and whale

PARAMETER	BEFORE	DURING		AFTER
pH	6.74	6.33	6.30	6.32
Temperature (°C)	15.3	16.0	16.0	15.9
Specific Conductance (mS/cm)	.263	.277	.294	.298
Turb.	264	170	58	48

Quantity of Water Removed: 200 gallons

Character of Water After Development: clear

Additional Comments: None

MACTEC

MONITORING WELL DEVELOPMENT DATA

Project Name: DAN RIVER Date: 11-23-10

Project Number: 6228-10-5284.05 Personnel: JCG

Well Number: MW-20D

Date of Installation: 11-23-10

Installation Method: HSA + HQ

Well Depth: 41.5 feet bgs

Screen Length: 5.0' feet

Static Water Level: 6.71 feet bgs

1 Well Volume: ~~4.5~~ 4.4 gallons

5 Well Volumes: ~~22.5~~ 22.0 gallons

Depth to Sediment Before Development: 41.5 feet bgs

Depth to Sediment After Development: 41.5 feet bgs

Development Technique: Submersible Pump

Development Equipment: HARIBA & WHALE

PARAMETER	5 BEFORE	10 DURING	15 DURING	20 AFTER
pH	7.23	7.73	7.74	7.76
Temperature (°C)	14.3	14.3	14.4	14.4
Specific Conductance (mS/cm)	.360	.351	.350	.350
TURB.	401	31	13	6

Quantity of Water Removed: 88 gallons

Character of Water After Development: CLEAR

Additional Comments: well will not Pump DRY.

MACTEC

MONITORING WELL DEVELOPMENT DATA

Project Name: DAN River Date: 11-23-10

Project Number: 6228-10-5284.05 Personnel: JCG

Well Number: MW-215

Date of Installation: 11-23-10

Installation Method: 4.25" H.S.A.

Well Depth: 8.76 feet bgs

Screen Length: 5.0' feet

Static Water Level: 5.44 feet bgs

1 Well Volume: 0.42 gallons

5 Well Volumes: 2.1 gallons

Depth to Sediment Before Development: 8.76 feet bgs

Depth to Sediment After Development: 8.76 feet bgs

Development Technique: Submersible Pump

Development Equipment: HARiba and whale

PARAMETER	BEFORE	DURING		AFTER
pH	7.41	7.13	7.14	7.19
Temperature (°C)	19.4	19.4	19.3	19.3
Specific Conductance (mS/cm)	.266	.246	.247	.247
Turb.	81	80	74	36

Quantity of Water Removed: 55 gallons

Character of Water After Development: clear

Additional Comments: None

MACTEC

MONITORING WELL DEVELOPMENT DATA

Project Name: DAN River Date: 11-23-10

Project Number: 6228-10-5284.05 Personnel: JCG

Well Number: MW-21D

Date of Installation: 11-23-10

Installation Method: 4.25" HSA & HQ

Well Depth: 18.6 feet bgs

Screen Length: 5.0 feet

Static Water Level: 5.4 feet bgs

1 Well Volume: 1.6 gallons

5 Well Volumes: 8.4 gallons

Depth to Sediment Before Development: 18.6 feet bgs

Depth to Sediment After Development: 18.6 feet bgs

Development Technique: Submersible Pump

Development Equipment: Hose, Rope and Bucket

PARAMETER	BEFORE	DURING		AFTER
pH	7.51	7.35	7.6	7.65
Temperature (°C)	18.0	18.1	17.6	17.6
Specific Conductance (mS/cm)	.854	.790	.871	.865
Turb.	353	214	40	11

Quantity of Water Removed: 40 gallons

Character of Water After Development: clear

Additional Comments: None

MACTEC

MONITORING WELL DEVELOPMENT DATA

Project Name: Dan River Steam Station Date: 12/21/10

Project Number: 6228-10-5284.05 Personnel: Rodney Clark

Well Number: MW-23D

Date of Installation: 12/21/10

Installation Method: 4¼" HSA & HQ core

Well Depth: 17.0' feet bgs

Screen Length: 10' feet

Static Water Level: 7.6' feet bgs

1 Well Volume: 1.6" gallons

5 Well Volumes: 8.0 gallons

Depth to Sediment Before Development: 17.0 feet bgs

Depth to Sediment After Development: 17.0' feet bgs

Development Technique: Submersible Pump

Development Equipment: Waterra pump & ½" poly tubing

PARAMETER	BEFORE	2 vol	DURING	4 vol	AFTER	6 vol
pH	7.76	7.69	7.63		7.61	
Temperature (°C)	9.6°C	9.8°C	11.5°C		9.9°C	
Specific Conductance (mS/cm)	0.344 mS/cm	0.340	0.331		0.329	
turbidity	721 NTU	999	999		785	

Quantity of Water Removed: Appx 10 gallons

Character of Water After Development: dark & cloudy / began to clear

Additional Comments: alternate MW-23D location / well purged dry after appx 1 vol / allowed time to recharge & purged again / developed from 1500 to 1730

APPENDIX E

PHOTOGRAPHS OF COMPLETED WELL PAIRS

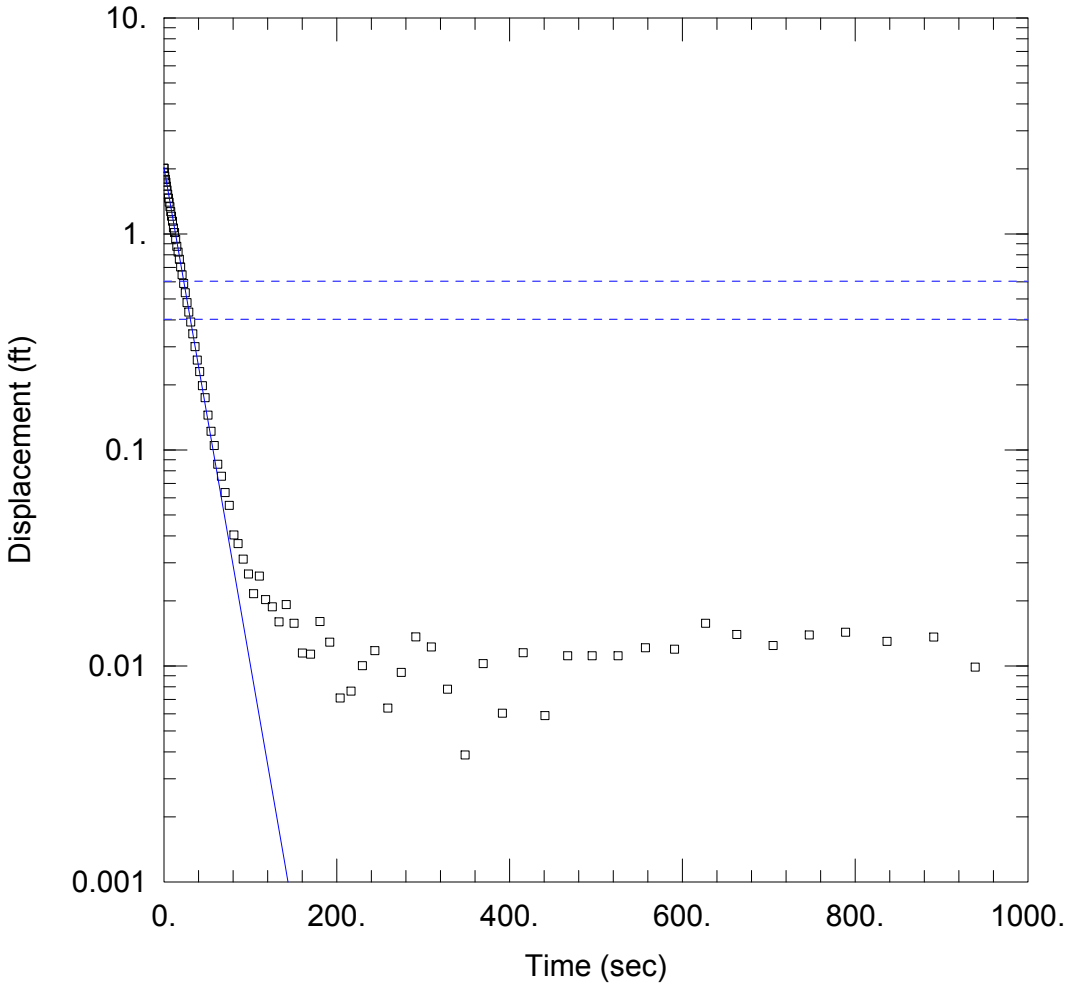
Photograph 1: Wells MW-20S and MW-20D.

Photograph 2: Wells MW-21S and MW-21S.

Photograph 3: Well MW-23D.

APPENDIX F

SLUG TEST DATA



MW-21S RISING HEAD TEST

PROJECT INFORMATION

Company: MACTEC
Client: Duke Energy
Project: 6228-09-4964
Location: Dan River Steam Station
Test Well: MW-21S
Test Date: 12/27/10

AQUIFER DATA

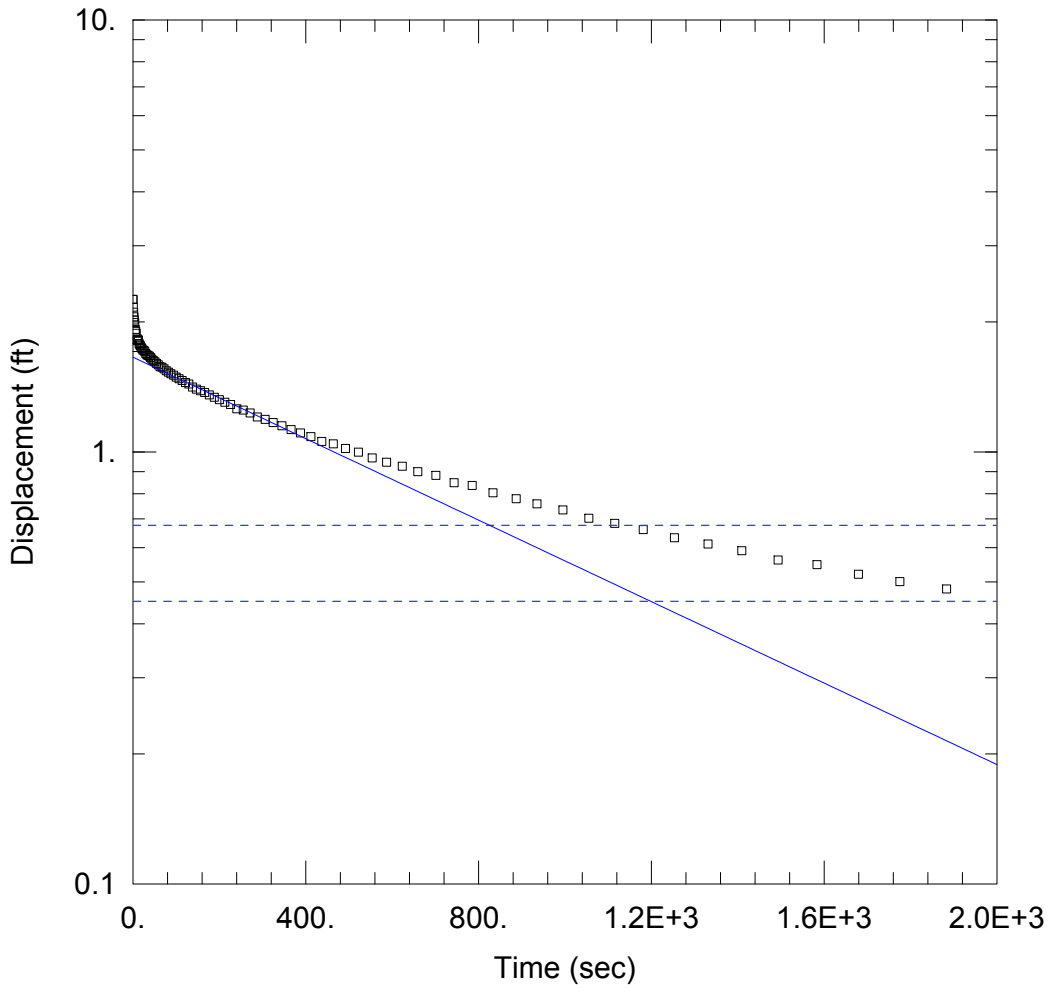
Saturated Thickness: 6.55 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-21S)

Initial Displacement: 2.014 ft
Total Well Penetration Depth: 6.55 ft
Casing Radius: 0.086 ft
Static Water Column Height: 6.55 ft
Screen Length: 5. ft
Well Radius: 0.34 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.002221 cm/sec
y0 = 2.033 ft



MW-21D RISING HEAD TEST

PROJECT INFORMATION

Company: MACTEC
Client: Duke Energy
Project: 6228-10-5284.02
Location: Dan River Steam Station
Test Well: MW-21D
Test Date: 12/27/10

AQUIFER DATA

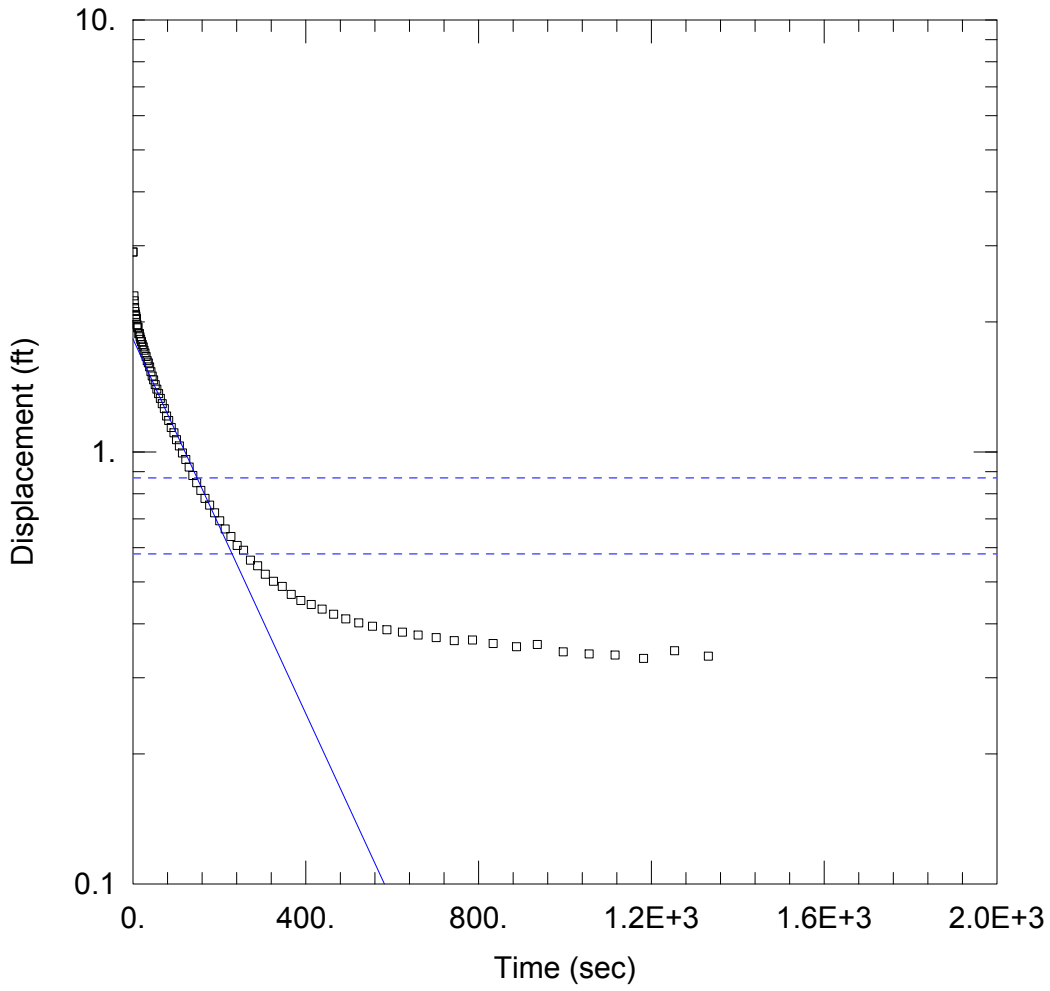
Saturated Thickness: 10. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-21D)

Initial Displacement: 2.255 ft
Total Well Penetration Depth: 20.1 ft
Casing Radius: 0.086 ft
Static Water Column Height: 20.1 ft
Screen Length: 5. ft
Well Radius: 0.16 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 7.365E-5 cm/sec
y0 = 1.657 ft



MW-20S RISING HEAD TEST

PROJECT INFORMATION

Company: MACTEC
Client: Duke Energy
Project: 6228-09-4964
Location: Dan River Steam Station
Test Well: MW-20S
Test Date: 12/28/10

AQUIFER DATA

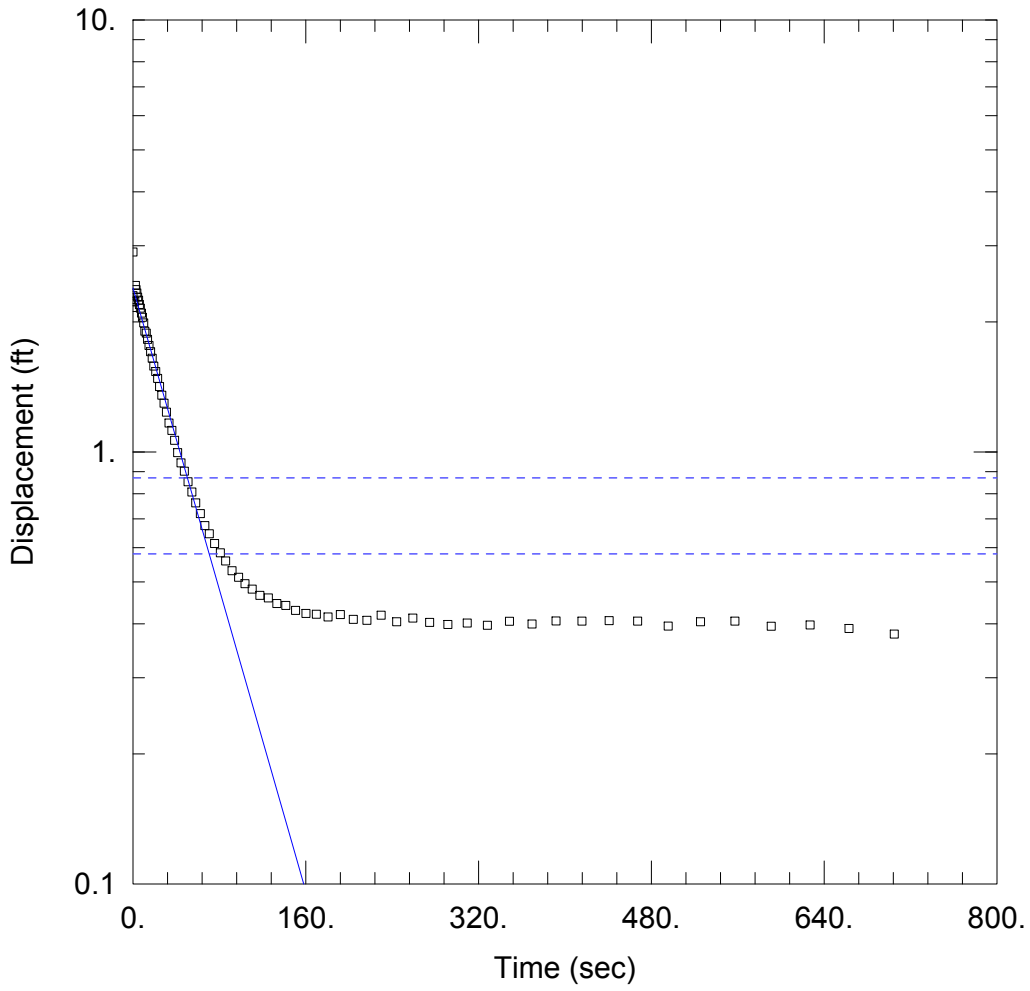
Saturated Thickness: 5.5 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-20S)

Initial Displacement: 2.903 ft
Total Well Penetration Depth: 17.59 ft
Casing Radius: 0.086 ft
Static Water Column Height: 17.59 ft
Screen Length: 15. ft
Well Radius: 0.34 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.0002402 cm/sec
y0 = 1.824 ft



MW-20D RISING HEAD TEST

PROJECT INFORMATION

Company: MACTEC
Client: Duke Energy
Project: 6228-09-4964
Location: Dan River Steam Station
Test Well: MW-20D
Test Date: 12/28/10

AQUIFER DATA

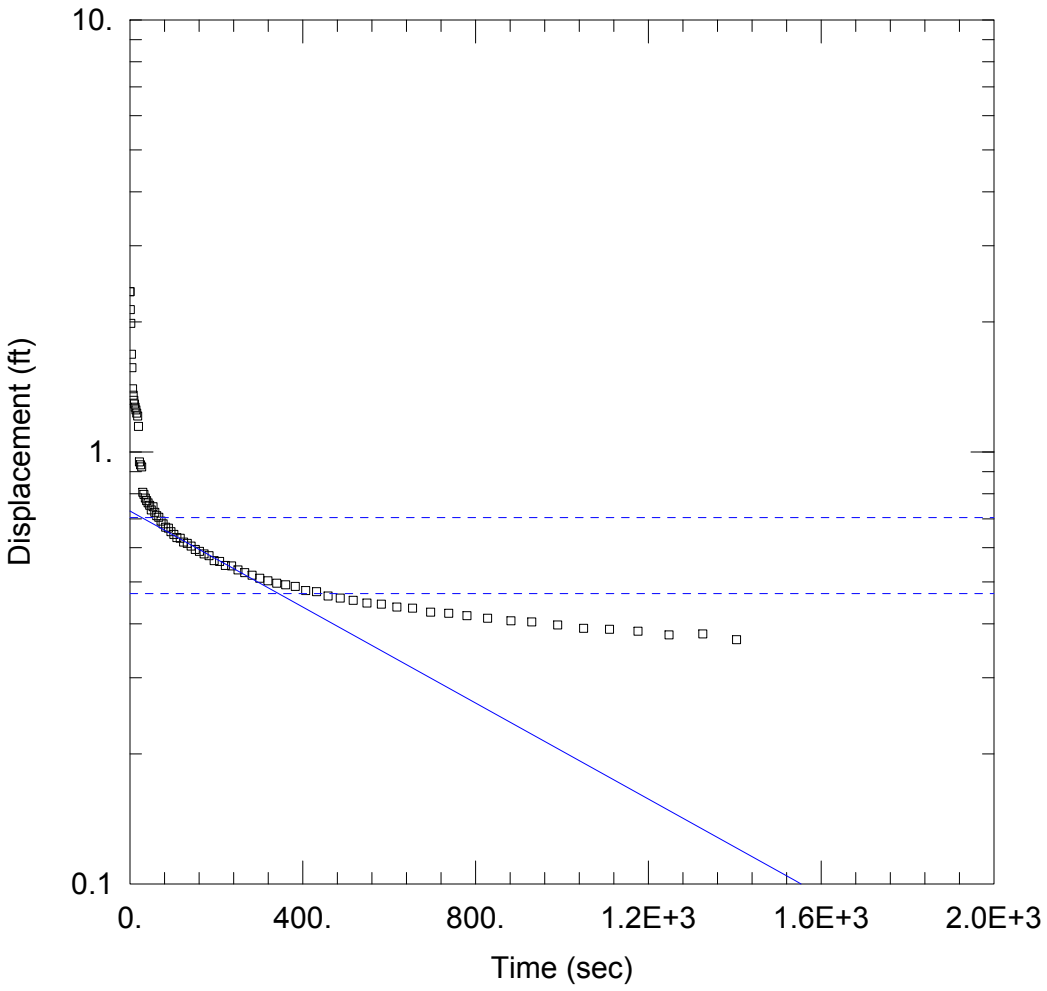
Saturated Thickness: 14.5 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-20D)

Initial Displacement: 2.903 ft
Total Well Penetration Depth: 40.7 ft
Casing Radius: 0.086 ft
Static Water Column Height: 40.7 ft
Screen Length: 5. ft
Well Radius: 0.16 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 0.001513 cm/sec
y0 = 2.395 ft



MW-23D RISING HEAD TEST

PROJECT INFORMATION

Company: MACTEC
Client: Duke Energy
Project: 6228-10-5284.02
Location: Dan River Steam Station
Test Well: MW-23D
Test Date: 12/27/10

AQUIFER DATA

Saturated Thickness: 8.11 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-23D)

Initial Displacement: 2.349 ft
Total Well Penetration Depth: 8.11 ft
Casing Radius: 0.086 ft
Static Water Column Height: 8.11 ft
Screen Length: 8.11 ft
Well Radius: 0.16 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 4.693E-5 cm/sec
y0 = 0.7298 ft

January 3, 2012

Mr. Thomas Wiest, Project Manager
Duke Energy Corporation
3195 Pine Hall Road
Belews Creek, North Carolina 27009

Subject: **Ash Basin Monitoring Well Installation Report**
Dan River Steam Station
900 South Edgewood Road
Eden, Rockingham County, North Carolina
AMEC Project No.: 6288-10-5284

Dear Mr. Wiest:

AMEC E & I, Inc. (AMEC) is pleased to provide this report on behalf of our client, AE Drilling, LLC. The purpose of this report is to present the results of monitoring well installation and evaluation activities conducted in November and December 2011 at the above-referenced site (Figure 1). The well installation and testing was conducted in general accordance with the requirements outlined in the Ash Basin Groundwater Monitoring Well Installation Project Work Summary (Work Summary) provided by Duke Energy (Duke), dated November 11, 2011. The following Figure, Tables and Appendices are included in this report:

Figure 1:	Monitoring Well Locations
Table 1:	Summary of Well Construction Details
Table 2:	Summary of Slug Test Results
Appendix A:	NCDENR Monitoring Well Construction Records
Appendix B:	Monitoring Well Development Records
Appendix C:	Photograph of Completed Well Pair
Appendix D:	Slug Test Data

One pair of groundwater monitoring wells (MW-22S and MW-22D) was installed between November 22 and 23, 2011 at the locations shown on Figure 1. The well locations were pre-determined by Duke and marked in the field with wooden stakes and survey flagging. The well pair consisted of one shallow well (using the identifier "S") set into overburden soils and one deep well (using the identifier "D) set into

Correspondence:
AMEC E&I, Inc.
2801 Yorkmont Road, Suite 100
Charlotte, North Carolina 28208
Tel 704-357-8600
Fax 704-357-8638

www.amec.com

the bedrock. The wells were installed using an air-powered, ODEX drilling system, which involves placement of temporary steel casing. Therefore, no soil or rock samples were collected. A Project Geologist logged soil and rock "cuttings" in the field.

Well MW-22S was installed to monitor the shallow groundwater. MW-22S was installed as a Type II well using two-inch diameter schedule 40 polyvinyl chloride (PVC) screen and casing. MW-22S was installed to a depth of 22.5 feet with a 10-foot screen with manufactured 0.010-inch slots. The well screen was centered in the borehole to provide adequate packing between the well screen and the formation. The annulus surrounding the screen of well MW-22S was backfilled with fine sand (gravel pack #1). The sand pack extended about one foot above the top of the screen. Above the sand pack, the drilling contractor installed a six-foot thick bentonite seal hydrated with potable water. Neat cement grout was placed in the annular space between the PVC casing and the borehole above the bentonite seal and extended to ground surface.

Well MW-22D was installed to monitor the groundwater in the zone where the regolith transitions into bedrock. Well MW-22D was installed as a Type II well using two-inch diameter Schedule 40 PVC screen and casing. Well MW-22D was installed to a depth of 37.2 feet with a five-foot well screen with manufactured 0.010-inch slots. AMEC personnel and the Duke representative collaborated by telephone to attempt to set the well screen in the most conductive hydrogeologic interval of the transition zone with the screen below the static groundwater level. The well screen was centered in the borehole to provide adequate packing between the well screen and the formation. The annulus surrounding the screen of well MW-22S was backfilled with fine sand (gravel pack #2). The sand pack extended about one foot above the top of the screen. Because the well borehole was advanced through about 12 feet of riprap fill, it was necessary to seal the riprap fill interval of the borehole using bentonite. Above the sand pack, the drilling contractor installed a 28.3-foot thick bentonite seal hydrated with water. Neat cement grout was placed in the annular space between the PVC casing and the borehole above the bentonite seal and extended to ground surface.

Each well was completed with a stand-up well cover that extends approximately 30 inches above-grade and set into a 2-foot by 2-foot concrete pad. Monitoring well ID tags were secured to the outside of the stand-up covers and well numbers were etched into the uncured concrete pad. The well construction records for the two monitoring wells installed during this work are included as Appendix A.

Subsequent to installation, each well was developed using a submersible pump to remove fine-grained material. In general, each well was evacuated of water, allowed to recharge and was evacuated repeatedly. Water quality parameters (pH, conductivity, DO and ORP) were recorded at regular intervals. AMEC attempted to measure and record Turbidity readings, but the slow recharge of the wells resulted in a low volume of discharged water and elevated turbidity readings. Purge water generated during well development was discharged to the ground surface adjacent to each well. Monitoring well development records are included as Appendix B. A photograph of the completed monitoring well pair is included as Appendix C.

Rising head slug tests were performed on each well on December 1, 2011. Initially, an In-situ Level Troll pressure transducer and either a 2-foot (MW-22D) or 4-foot (MW-22S) long stainless steel slug were placed into each well. The water level in each well was recorded as a "falling head" test until the water in the well discharged to within 90% of the original measurement. Reporting falling head test data is not recommended for wells MW-22S or MW-22D, because the well screens are not fully submerged which will allow displaced water to flow into well sand pack and result in unrealistic hydraulic conductivity (K) values.

Subsequent to water level stabilization, the rising head test was started by removing the slug and recording the change in head (rising) versus time using a Rugged-reader data logger. Slug test data was analyzed using Aqtesolv software to estimate hydraulic conductivity in each well.

Appendix D includes the slug test data for wells MW-22S and MW-22D. The measured K value calculated from the rising head test in well MW-22S (1.91 E-04 cm/sec) seems appropriate for the type of overburden soils at the site. The measured static water column height (1.5 feet) in well MW-22D limited the volume of available water to be offset by insertion and removal of the slug. As a result, the maximum displacement was measured at 0.257 feet of water during the rising head test. It is AMEC's opinion that the rate of inflow of water into the well measured during the rising head test for this well is probably more representative of the hydraulic conductivity of the sand pack than the surrounding formation material. The measured K value calculated from the rising head test in well MW-22D is 1.71 E-03 cm/sec.

It is our recommendation that the wells be further developed by pumping until turbidity readings of the water removed from the wells are less than or equal to 50 NTUs. Following development, well MW-22D should be purged to complete dryness and a rising head test be performed for an extended period time

(possibly one or two days, as needed) to allow for stabilization of the water level to within 90% of the static fluid level. A summary of slug test data is presented in Table 2. Electronic slug test data is included on the attached compact disc.

Please contact the undersigned at (704) 357-8600, if you have questions or comments concerning this project.

Sincerely,

AMEC E & I, INC.

Jacqueline Williams

Michael D. Flanik, P.G.
Project Geologist

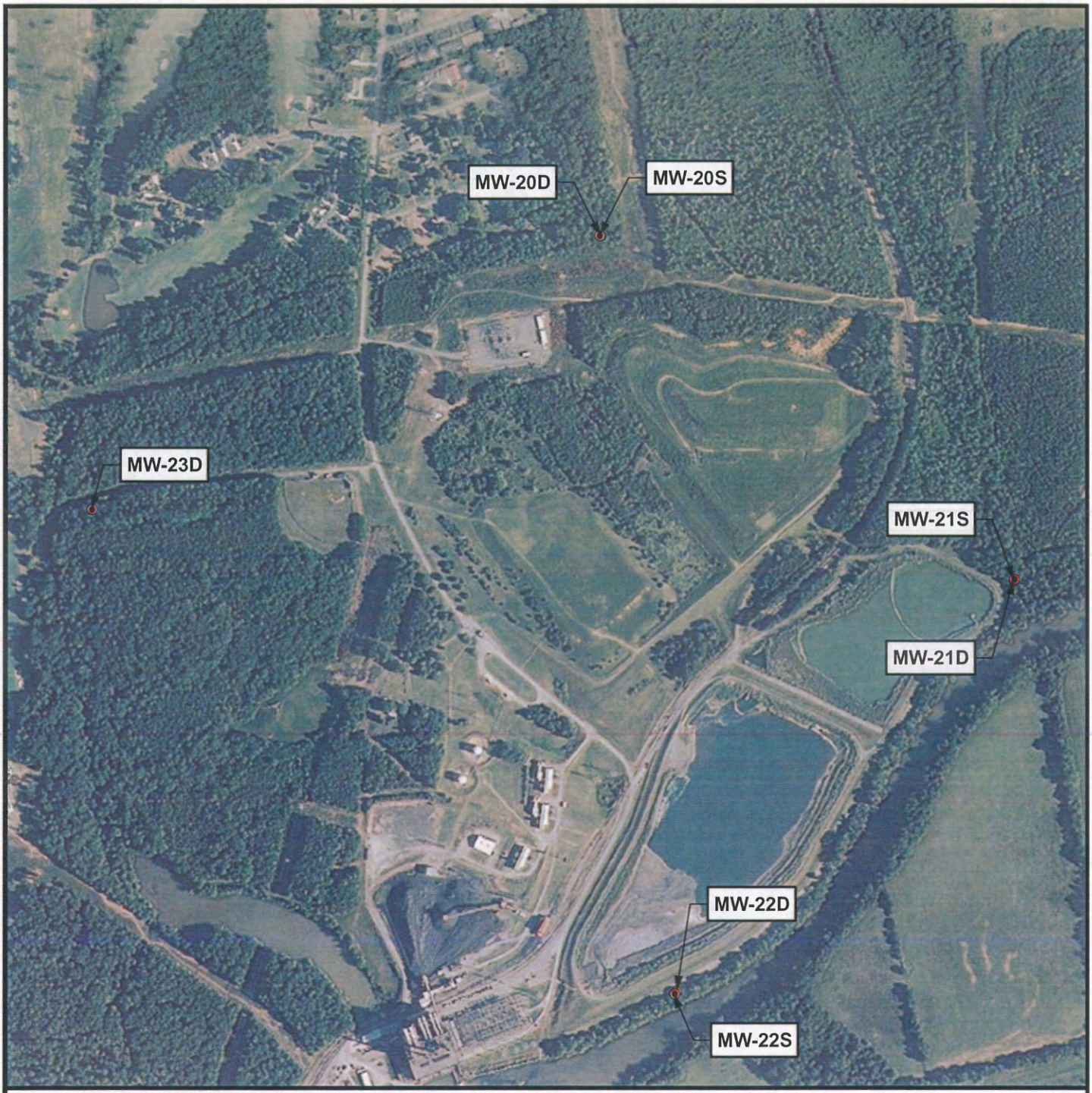
Robert C. Foster, LG
Principal

NORTH CAROLINA LICENSED SEAL 3358 GEOLOGIST ROBERT C. FOSTER

Enclosures For Michael D. Flanik With Permission

cc: William M. Miller, PE, Altamont Environmental
Mark Lassiter, PG, AE Drilling, LLC
Ed Sullivan, Duke Energy
Sherri Knight, NCDENR, WSRO DWQ
George Tolbert, Duke Energy

FIGURE



Source: USDA-FSA-APFO NAIP MrSID Mosaic for Rockingham County, North Carolina, dated 2009.

Monitoring Well Location

N

0 500 1,000 2,000 3,000 4,000 Feet

amec

MONITORING WELL LOCATIONS
DUKE ENERGY
DAN RIVER STEAM STATION
ROCKINGHAM COUNTY, NORTH CAROLINA

PREPARED BY	DATE	CHECKED BY	DATE	JOB NUMBER	FIGURE
SJM	12-14-11	RCF	1-3-12	6228-10-5284	1

TABLES

Table 1
Summary of Well Construction Details
Dan River Steam Station, Eden, North Carolina

Well Number	Coordinates		Drilling Method	Construction Details				Measured Details			
	Latitude	Longitude		Well Diameter (I.D. in.)	Borehole Depth (ft bgs)	Well Depth (ft bgs)	Screen Interval (ft bgs)	Top of Casing Elevation (NAVD 88)	Well Depth (ft below TOC)	Depth to Water (ft below TOC)	Height of Water Column (ft)
MW-22S	36.486891	-79.716668	ODEX	2	23	22.55	12.35 - 22.35	504.52	25.07	19.02	6.05
MW-22D	36.486898	-79.716644	ODEX	2	38	37.15	31.95 - 36.95	505.19	39.65	38.15	1.50

ft bgs = feet below ground surface

Dan River water elevation measured at 481.7 feet NAVD 88 on December 14, 2011 at 3:00 pm.

Prepared by Date: MDF 12-15-11

Checked by Date: RGF 1-3-12

Table 2
Summary of Slug Test Data
Dan River Steam Station, Eden, North Carolina

WELL ID	Test Date	Aquifer Model	Rising Head Test		Borehole Depth (ft bgs)	Well Depth (ft bgs)	Screen Interval (ft bgs)	Well Diameter (I.D. in.)
			Solution Method	K-value (cm/sec)				
MW-22S	12/1/2011	unconfined	Bouwer-Rice	1.91 E-04	23	22.55	12.35 - 22.35	2
MW-22D	12/1/2011	unconfined	Bouwer-Rice	1.71 E-03	38	37.15	31.95 - 36.95	2

Note: In calculating the hydraulic conductivity values, an unconfined aquifer model was assigned to both wells. The saturated thicknesses (Appendix D) were derived from lithologic data from well borings including likely water-bering zones.

Prepared By Date: MDF 12-15-11
Checked By Date: RCF 1-3-12

APPENDICES

APPENDIX A

NCDENR MONITORING WELL CONSTRUCTION RECORDS

NON RESIDENTIAL WELL CONSTRUCTION RECORD

North Carolina Department of Environment and Natural Resources- Division of Water Quality

WELL CONTRACTOR CERTIFICATION # 2209

1. WELL CONTRACTOR:
Randy Phillips
Well Contractor (Individual) Name
A E DRILLING SERVICES, LLC
Well Contractor Company Name
TWO UNITED WAY
Street Address
GREENVILLE SC 29607
City or Town State Zip Code
(864) 288-1986
Area code Phone number

2. WELL INFORMATION:
WELL CONSTRUCTION PERMIT#
OTHER ASSOCIATED PERMIT#(if applicable)
SITE WELL ID #(if applicable) MW-22S

3. WELL USE (Check One Box) Monitoring ☑ Municipal/Public ☐
Industrial/Commercial ☐ Agricultural ☐ Recovery ☐ Injection ☐
Irrigation ☐ Other ☐ (list use)
DATE DRILLED 11-22-11- 11-23-

4. WELL LOCATION:
900 South Edgewood Road
(Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)
CITY: Eden COUNTY Rockingham
TOPOGRAPHIC / LAND SETTING: (check appropriate box)
☐Slope ☐Valley ☐Flat ☐Ridge ☑Other Berm
LATITUDE 36 ° ' " DMS **OR** 36.486891 DD
LONGITUDE 75 ° ' " DMS **OR** -79.716668 DD
Latitude/longitude source: ☐GPS ☐Topographic map
(location of well must be shown on a USGS topo map andattached to this form if not using GPS)

5. FACILITY (Name of the business where the well is located.)
Dan River Steam Station
Facility Name Facility ID# (if applicable)
900 South Edgewood Road
Street Address
Eden NC 27288
City or Town State Zip Code
Duke Energy Company
Contact Name
500 South Church Street
Mailing Address
Charlotte NC 28201
City or Town State Zip Code
(336.0 445-0325
Area code Phone number

6. WELL DETAILS:
a. **TOTAL DEPTH:** 22.5'
b. **DOES WELL REPLACE EXISTING WELL?** YES ☐ NO ☑
c. **WATER LEVEL** Below Top of Casing: 25.07 + FT.
(Use "+" if Above Top of Casing)

d. **TOP OF CASING IS** 2.5 FT. Above Land Surface*
*Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.
e. **YIELD (gpm):** n/m **METHOD OF TEST**
f. **DISINFECTION: Type** n/a **Amount**
g. **WATER ZONES** (depth):
Top Bottom Top Bottom
Top Bottom Top Bottom
Top Bottom Top Bottom

7. CASING:	Depth		Diameter	Thickness/ Weight	Material
Top 0	Bottom 12	Ft.	2"	Sch40	PVC
Top	Bottom	Ft.			
Top	Bottom	Ft.			

8. GROUT:	Depth		Material	Method
Top 4	Bottom 10.7	Ft.	Bentonite/	Tremie
Top 0	Bottom 4	Ft.	Cement	Tremie
Top	Bottom	Ft.		

9. SCREEN:	Depth		Diameter	Slot Size	Material
Top 12	Bottom 22	Ft.	2 in.	.010 in.	PVC
Top	Bottom	Ft.	in.	in.	
Top	Bottom	Ft.	in.	in.	

10. SAND/GRAVEL PACK:

	Depth		Size	Material
Top 10.7	Bottom 22.5	Ft.	#1	Sand
Top	Bottom	Ft.		
Top	Bottom	Ft.		

11. DRILLING LOG (cuttings)

Top	Bottom	Formation Description
0	4	Crushed stone (fill)
4	7	Rip rap (fill)
7	12	Brown silt
12	22	Brown sandy silt

12. REMARKS:

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

SIGNATURE OF CERTIFIED WELL CONTRACTOR 12-14-11 DATE

Randy Phillips
PRINTED NAME OF PERSON CONSTRUCTING THE WELL

Submit within 30 days of completion to: Division of Water Quality - Information Processing, 1617 Mail Service Center, Raleigh, NC 27699-161, Phone : (919) 807-6300

Form GW-1b
Rev. 2/09

NON RESIDENTIAL WELL CONSTRUCTION RECORD

North Carolina Department of Environment and Natural Resources- Division of Water Quality

WELL CONTRACTOR CERTIFICATION # 2209

1. WELL CONTRACTOR:
Randy Phillips
Well Contractor (Individual) Name
A E DRILLING SERVICES, LLC
Well Contractor Company Name
TWO UNITED WAY
Street Address
GREENVILLE SC 29607
City or Town State Zip Code
(864) 288-1986
Area code Phone number

2. WELL INFORMATION:
WELL CONSTRUCTION PERMIT#
OTHER ASSOCIATED PERMIT#(if applicable)
SITE WELL ID #(if applicable) MW-22D

3. WELL USE (Check One Box) Monitoring ☑ Municipal/Public ☐
Industrial/Commercial ☐ Agricultural ☐ Recovery ☐ Injection ☐
Irrigation ☐ Other ☐ (list use)
DATE DRILLED 11-22-11- 11-23-

4. WELL LOCATION:
900 South Edgewood Road
(Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)
CITY: Eden COUNTY Rockingham
TOPOGRAPHIC / LAND SETTING: (check appropriate box)
☐Slope ☐Valley ☐Flat ☐Ridge ☑Other Berm
LATITUDE 36 ° ' " DMS **OR** 36.486898 DD
LONGITUDE 75 ° ' " DMS **OR** -79.716644 DD
Latitude/longitude source: ☐GPS ☐Topographic map
(location of well must be shown on a USGS topo map andattached to this form if not using GPS)

5. FACILITY (Name of the business where the well is located.)
Dan River Steam Station
Facility Name Facility ID# (if applicable)
900 South Edgewood Road
Street Address
Eden NC 27288
City or Town State Zip Code
Duke Energy Company
Contact Name
500 South Church Street
Mailing Address
Charlotte NC 28201
City or Town State Zip Code
(336.0) 445-0325
Area code Phone number

6. WELL DETAILS:
a. **TOTAL DEPTH:** 37.2'
b. **DOES WELL REPLACE EXISTING WELL?** YES ☐ NO ☑
c. **WATER LEVEL** Below Top of Casing: 38.15+ FT.
(Use "+" if Above Top of Casing)

d. **TOP OF CASING IS** 2.97 FT. Above Land Surface*
*Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.
e. **YIELD (gpm):** n/m **METHOD OF TEST**
f. **DISINFECTION: Type** n/a **Amount**
g. **WATER ZONES** (depth):
Top Bottom Top Bottom
Top Bottom Top Bottom
Top Bottom Top Bottom

7. CASING:

Depth	Diameter	Thickness/ Weight	Material
Top 0 Bottom 31.9 Ft.	2"	Sch40	PVC
Top Bottom Ft.			
Top Bottom Ft.			

8. GROUT:

Depth	Material	Method
Top 3' Bottom 31.3 Ft.	Bentonite/	Tremie
Top 0' Bottom 3' Ft.	Cement	Tremie
Top Bottom Ft.		

9. SCREEN:

Depth	Diameter	Slot Size	Material
Top 31.9 Bottom 36.9 Ft.	2 in.	.010 in.	PVC
Top Bottom Ft.	in.	in.	
Top Bottom Ft.	in.	in.	

10. SAND/GRAVEL PACK:

Depth	Size	Material
Top 31.3 Bottom 37.5 Ft.	#2	Sand
Top Bottom Ft.		
Top Bottom Ft.		

11. DRILLING LOG (cuttings)

Top / Bottom	Formation Description
0 / 5	Crushed stone (fill)
5 / 8	Brown clayey silt (fill) w/riprap
8 / 12	Shale/Silt stone (fill) w/riprap
12 / 15	Brown sandy silt with roots
15 / 20	Brown sandy silt with roots
20 / 22	no cuttings
22 / 37.5	Grayish brown sandstone
/	
/	
/	
/	

12. REMARKS:

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN GIVEN TO THE WELL OWNER.

SIGNATURE OF CERTIFIED WELL CONTRACTOR 12-14-11 DATE

Randy Phillips
PRINTED NAME OF PERSON CONSTRUCTING THE WELL

Submit within 30 days of completion to: Division of Water Quality - Information Processing, 1617 Mail Service Center, Raleigh, NC 27699-161, Phone : (919) 807-6300

Form GW-1b
Rev. 2/09

APPENDIX B

MONITORING WELL DEVELOPMENT RECORDS

AMEC E&I, INC.

MONITORING WELL DEVELOPMENT FIELD DATA WORKSHEET

AMEC PROJECT NUMBER 6228-10-5784.05 MONITORING WELL NUMBER MW-22S

SITE NAME San Rivo DATE 11/28/11 WEATHER CONDITIONS Mostly cloudy, mid-60's

FIELD PERSONNEL Mike Flank

TOTAL WELL DEPTH (TWD) 22.55 FT. (measured / well tag / drillers log – **circle one**) stick up

SCREENED INTERVAL 22.35 - 12.35 MEASURING POINT FOR DEPTH GS

DEPTH TO GROUNDWATER (DGW) 20.19 - (2.5') = 17.69' bgs

LENGTH OF WATER COLUMN (LWC) = TWD – DGW = 4.86

CASING DIAMETER 2 IN.

ONE STANDING WELL VOLUME = .792 gal.

(NOTE ½" = 0.0102G/FT: ¾" = 0.023 G/FT: 1"= 0.041G/FT: 2" = 0.163 G/FT: 4" = 0.653 G/FT: 6" = 1.46 G/FT)

THREE STANDING WELL VOLUMES = 2.37 FIVE STANDING WELL VOLUMES = 3.96

METHOD OF WELL EVACUATION: BAILER / PUMP / OTHER: TYPE whale

TOTAL VOLUME OF WATER REMOVED: NM GAL.

WELL TYPE: FLUSH MOUNT / ABOVE GRADE

LOCKING CAP YES X NO

PROTECTIVE POST/ABUTMENT YES NO X

NONPOTABLE LABEL YES X NO X NF

ID PLATE YES X NO

WELL INTEGRITY SATISFACTORY YES X NO

WELL YIELD LOW X MODERATE HIGH

COMMENTS

Clarity

DK Brn

Time	Volume	Turbidity (NTU)	pH	Cond	DO	ORP	Notes
1505	0	—	6.56	0.512	2.19	4	WL = 22' BTOC
Pump		Clogged	Drill				Surges
1535	NM	—	6.47	.469	2.53	-3	
Pump	Runs	for 5 seconds	NM				cuts off
1530	NM	—	6.59	.495	4.63	-17	
1535	NM	—	6.66	.472	5.04	-12	
1617	NM	—	6.72	.471	10.54	-24	
1626	NM	825	6.81	.481	9.76	-23	
1715	NM	—	6.58	.484	3.69	-12	
Well	Runs	Dry					

Tan - Lt brown

Tan

well was Turned On and Off to Remove as much sediment & to develop as well as possible

(—) = Too turbid for reading or Instrument clogged

NM = Not measured

AMEC E&I, INC.

MONITORING WELL DEVELOPMENT FIELD DATA WORKSHEET

AMEC PROJECT NUMBER 6228-10-5284.05 MONITORING WELL NUMBER MW-22D

SITE NAME Da River DATE 11/28/11 WEATHER CONDITIONS mostly cloudy, mid 60's

FIELD PERSONNEL Mike Flanik

TOTAL WELL DEPTH (TWD) 37.15 BGS FT. (measured / well tag / drillers log – **circle one**)

SCREENED INTERVAL 36.95 - 31.95 MEASURING POINT FOR DEPTH GS

DEPTH TO GROUNDWATER (DGW) 17.19

LENGTH OF WATER COLUMN (LWC) = TWD – DGW = 19.96

CASING DIAMETER 2 IN.

ONE STANDING WELL VOLUME = 3.25 gal.

(NOTE ½" = 0.0102G/FT: ¾" = 0.023 G/FT: 1"= 0.041G/FT: 2" = 0.163 G/FT: 4" = 0.653 G/FT: 6" = 1.46 G/FT)

THREE STANDING WELL VOLUMES = 9.75 FIVE STANDING WELL VOLUMES = 16.25

METHOD OF WELL EVACUATION: BAILER / PUMP / OTHER: TYPE whale

TOTAL VOLUME OF WATER REMOVED: NM GAL.

WELL TYPE: FLUSH MOUNT / ABOVE GRADE COMMENTS

LOCKING CAP YES X NO

PROTECTIVE POST/ABUTMENT YES NO X

NONPOTABLE LABEL YES X NO X MF

ID PLATE YES X NO

WELL INTEGRITY SATISFACTORY YES X NO

WELL YIELD LOW X MODERATE HIGH

Time	Volume	Turbidity (NTU)	pH	Notes cond	DO	ORP
1355	0	—	6.85	.666	6.14	82
1400	—	194	6.82	.499	7.6	72
1403	Dry					
1415	→					
1430	Pump removed					
1600						
1630						
well dry & doesn't Recover enough to pump						

GS = 2.5' below TOC

WL = 37.79' BTOC

WL = 37.55 "

WL = 38.45 BTOC

WL = 38.43 BTOC

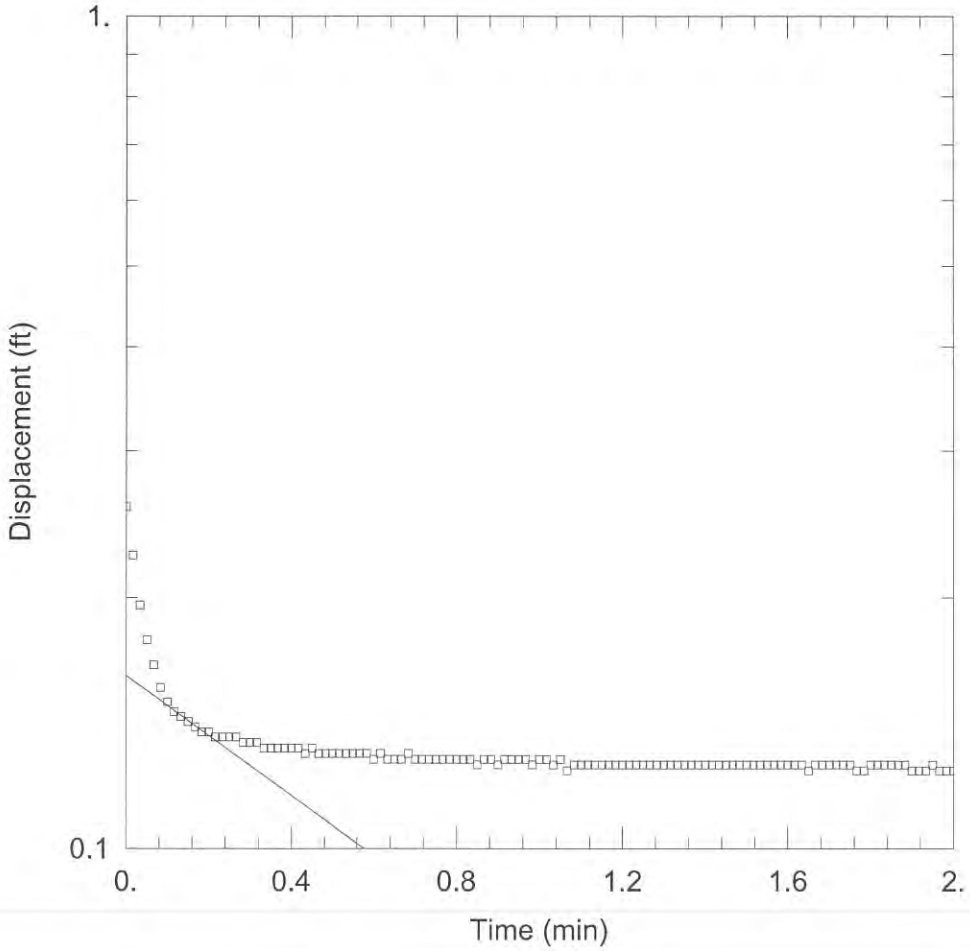
WL = 38.37 BTOC

APPENDIX C

PHOTOGRAPH OF COMPLETED WELL PAIR

Photograph 1: Wells MW-22S and MW-22D.

APPENDIX D
SLUG TEST DATA



MW-22D RISING HEAD TEST

PROJECT INFORMATION

Company: AMEC E&I
Client: Duke Energy
Project: 6234-11-5499
Location: Dan River
Test Well: MW-22D
Test Date: 12/1/11

AQUIFER DATA

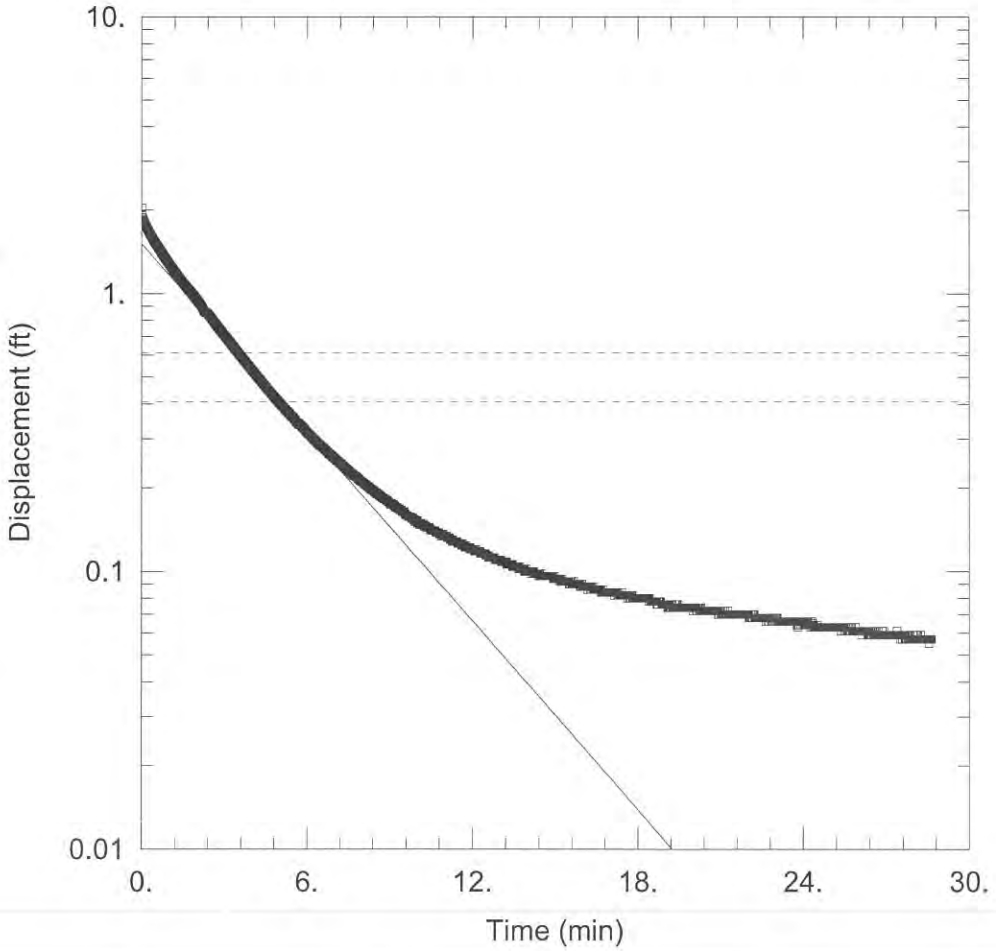
Saturated Thickness: 1.5 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-22D)

Initial Displacement: 0.257 ft
Total Well Penetration Depth: 5. ft
Casing Radius: 0.086 ft
Static Water Column Height: 1.5 ft
Screen Length: 5. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.001715 cm/sec
y0 = 0.1613 ft



MW-22S RISING HEAD TEST

PROJECT INFORMATION

Company: AMEC E&I
Client: Duke Energy
Project: 6234-11-5499
Location: Dan River
Test Well: MW-22S
Test Date: 12/1/11

AQUIFER DATA

Saturated Thickness: 6.05 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-22S)

Initial Displacement: 2.041 ft
Total Well Penetration Depth: 10. ft
Casing Radius: 0.086 ft
Static Water Column Height: 6.05 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.000191 cm/sec
y0 = 1.511 ft

B

Appendix B - Permit Condition A(11) Attachment XX, Version 1.1, June 15, 2011

A. (6) GROUNDWATER MONITORING WELL CONSTRUCTION AND SAMPLING

1. The permittee shall conduct groundwater monitoring as may be required to determine the compliance of this NPDES permitted facility with the current groundwater Standards found under 15A NCAC 2L .0200
2. WELL CONSTRUCTION. Within 120 days of permit issuance, monitoring wells, as proposed on Attachment XX, shall be installed to monitor groundwater quality.
   a. Monitoring wells shall be constructed in accordance with 15A NCAC 02C .0108 (Standards of Construction for Wells Other than Water Supply) and any other jurisdictional laws and regulations pertaining to well construction. The general locations for all monitoring wells are indicated on Attachment XX.
   b. Within 30 days of completion of well construction, a completed Well Construction Record (Form GW-1) must be submitted for each monitoring well to Division of Water Quality, Aquifer Protection Section, 1636 Mail Service Center, Raleigh, NC 27699-1636.
   c. The Winston-Salem Regional Office, telephone number (336) 771-5000, shall approve the location of new monitoring wells prior to installation. The regional office shall be notified at least 48 hours prior to the construction of any monitoring well and such notification to the Aquifer Protection Section's regional supervisor shall be made from 8:00 a.m. until 5:00 p.m. on Monday through Friday, excluding State Holidays.
   d. Within 60 days of completion of the monitoring wells, the Permittee shall submit two original copies of a site map with a scale no greater than 1-inch equals 500 feet. At a minimum, the map shall include the following information:
      i. The location and identity of each monitoring well.
      ii. The location of major components of the waste disposal system.
      iii. The location of property boundaries within 500 feet of the disposal areas.
      iv. The latitude and longitude of the established horizontal control monument.
      v. The elevation of the top of the well casing (i.e., measuring point) relative to a common datum.
      vi. The depth of water below the measuring point at the time the measuring point is established.
      vii. The location of compliance and review boundaries.
      viii. The date the map is prepared and/or revised.
      ix. Topographic contours in no more than ten (10) foot intervals
   e. The above information should be overlaid on the most recent aerial photograph taken of the site. Control monuments shall be installed in such a manner and made of such materials that the monument will not be destroyed due to activities taking place on the property. The map and any supporting documentation shall be sent to the Division of Water Quality, Aquifer Protection Section, 1636 Mail Service Center, Raleigh, NC 27699-1636.
   f. The well(s) must be constructed by a North Carolina Certified Well Contractor, the property owner, or the property lessee according to General Statutes 87-98.4. If the construction is not performed by a certified well contractor, the property owner or lessee, provided they are a natural person, must physically perform the actual well construction activities.

g. The monitoring wells shall be regularly maintained. Such maintenance shall include ensuring that the well caps are rust-free and locked at all times, the outer casing is upright and undamaged, and the well does not serve as a conduit for contamination.

3. GROUNDWATER SAMPLING AND COMPLIANCE. Monitoring wells shall be sampled after construction and thereafter at the frequencies and for the parameters as specified in Attachment XX. All maps, well construction forms, well abandonment forms and monitoring data shall refer to the permit number and the well nomenclature as provided on Attachment XX.

a. Per 15A NCAC 02H .0800, a Division certified laboratory shall conduct all laboratory analyses for the required effluent, groundwater or surface water parameters.

b. The measurement of water levels shall be made prior to purging the wells. The depth to water in each well shall be measured from the surveyed point on the top of the casing. The measurement of pH shall be made after purging and prior to sampling for the remaining parameters.

c. The measuring points (top of well casing) of all monitoring wells shall be surveyed to provide the relative elevation of the measuring point for each monitoring well. The measuring points (top of casing) of all monitoring wells shall be surveyed relative to a common datum.

d. For monitoring wells that are not located at the Compliance Boundary, the Compliance Monitoring Form (GW-59CCR) is not required. However, predictive calculations or modeling shall be submitted to the Regional Office annually (i.e. 12 months after permit issuance) demonstrating groundwater quality standards at the Compliance Boundary.

e. Two copies of the monitoring well sampling shall be submitted on a Compliance Monitoring Form (GW-59CCR), and received no later than the last working day of the month following the sampling month. Copies of the laboratory analyses shall be kept on site, and made available upon request. The Compliance Monitoring Form (GW-59CCR) shall include this permit number and the appropriate well identification number. All information shall be submitted to the following address:

Division of Water Quality
Information Processing Unit
1617 Mail Service Center
Raleigh, North Carolina 27699-1617

f. For groundwater samples that exceed the ground water quality standards in 15A NCAC 02L .0202, the Regional Office shall be contacted within 30 days after submission of the groundwater monitoring report; an evaluation may be required to determine the impact of the waste disposal activities. Failure to do so may subject the permittee to a Notice of Violation, fines, and/or penalties.

4. COMPLIANCE BOUNDARY. The compliance boundary for the disposal system shall be specified in accordance with 15A NCAC 02L .0107(a). This disposal system was individually permitted prior to December 30, 1983; therefore, the compliance boundary is established at either 500 feet from the effluent disposal area, or at the property boundary, whichever is closest to the effluent disposal area. An exceedance of groundwater standards at or beyond the compliance boundary is subject to remediation action according to 15A NCAC 02L .0106(c) as well as enforcement actions in accordance with North Carolina General Statute 143-215.6A through 143-215.6C.

ATTACHMENT XX – GROUNDWATER MONITORING PLAN

Permit Number: NC0003468 **Version 1.1**

WELL NOMENCLATURE	PARAMETER DESCRIPTION				FREQUENCY
Monitoring Wells: MW-20S, MW-20D, MW-21S, MW-21D, MW-22S, MW-22D, MW-23D	**Antimony**	**Chromium**	**Nickel**	**Thallium**	January, May, September
	Arsenic	**Copper**	**Nitrate**	**Water Level**	
	Barium	**Iron**	**pH**	**Zinc**	
	Boron	**Lead**	**Selenium**		
	Cadmium	**Manganese**	**Sulfate**		
	Chloride	**Mercury**	**TDS**		

Note 1: For locations of monitoring wells, see attached map.

Note 2: Monitoring revisions may be considered, as applicable, if there are no significant detections prior to permit renewal.

Dan River Steam Station
Ash Basin Compliance Groundwater Monitoring Well Construction Data
As-Built Data

Well ID	Coordinates		TOC Elevation	Screen Interval	Top of Rock
	Northing (feet)	Easting (feet)	(feet)	(feet bgs)	(feet bgs)
MW-30S	1,000,690.53	1,788,517.72	562.08	4-19	—
MW-30D	1,000,692.39	1,788,522.72	562.73	36.5-41.5	36.5
MW-31S	998,581.01	1,790,997.53	498.60	33-43	—
MW-31D	998,574.18	1,790,985.70	498.90	13.6-18.6	9.0
MW-32D	999,229.97	1,788,385.57	528.22	6.7-16.7	8.0

NOTES:
1. COORDINATES SHOWN ARE BASED ON THE NORTH CAROLINA STATE PLANE COORDINATE SYSTEM.
2. HORIZONTAL DATUM OF NC 1983 NAD 1983 (NSRS 2007).
3. ELEVATIONS SHOWN ARE REFERENCED TO THE NAVD 88 VERTICAL DATUM.
4. COORDINATES AND ELEVATIONS SHOWN ARE BY U.S. SURVEY FOOT.
5. MONITORING WELL LOCATIONS ARE OBTAINED FROM DUKE ENERGY PER AS-BUILT SURVEY MAP TITLED DUKE-439866 MONITORING WELLS.
6. SCREEN INTERVAL AND TOP OF ROCK INFORMATION FROM MACTEC PROJECT NO. 6238-12-2266.
7. TOC = TOP OF CASING.
8. BGS = BELOW GROUND SURFACE.

NOTES:
1. PARCEL DATA FOR THE SITE WAS OBTAINED FROM DUKE ENERGY AND ROCKINGHAM COUNTY GIS. (APPROXIMATE).
2. WASTE BOUNDARY IS APPROXIMATE.
3. AS-BUILT MONITORING WELL LOCATIONS PROVIDED BY DUKE ENERGY.
4. (D) SHALLOW MONITORING WELLS - WELL SCREEN INSTALLED ACROSS THE SAPROLITE/ALLUVIAL AQUIFER UNITS.
5. (S) DEEP MONITORING WELLS - WELL SCREEN INSTALLED IN THE TRANSITIONAL ZONE BETWEEN COMPETENT BEDROCK AND THE OVERLYING SAPROLITE/ALLUVIAL AQUIFER UNITS.
6. TOPOGRAPHY DATA FOR THE SITE WAS OBTAINED FROM NC 2007 CORRAFIRC INFORMATION SYSTEM (CRIS) WEB SITE.
7. ORTHOPHOTOGRAPHY WAS OBTAINED FROM NC ONEMAP GIS WEB SITE (DATED 2009).
8. THE COMPLIANCE BOUNDARY IS ESTABLISHED ACCORDING TO THE DEFINITION FOUND IN 15A NCAC 02L .0107 (a).

SHEET NO. 1 OF 2

ASH BASIN COMPLIANCE GROUNDWATER MONITORING WELLS

DUKE ENERGY DAN RIVER STEAM STATION
ROCKINGHAM COUNTY, NORTH CAROLINA

Duke Energy

REV	DATE	DESCRIPTION	BY	CHK	APP
0	5-22-26	SUBMITTED TO NC DENR	MV	MHM	JDL

ALTAMONT ENVIRONMENTAL, INC
ENGINEERING & HYDROGEOLOGY
231 HAYWOOD STREET ASHEVILLE, NC 28801
TEL 828.281.3350 FAX 828.281.3351
www.altamontenvironmental.com
NC ENGINEERING FIRM #C-2781

DRAWN BY: MARTA VANDUSSEN
PROJECT MANAGER: BILL MILLER
CLIENT: DUKE ENERGY

SCALE (FEET): 0 150 300
1" = 150'

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL

C

Appendix C - Monitoring Well Locations

003018-378566 Dan River Steam Station Monitoring Well Locations					
Description	**Northing**	**Easting**	**Elevation**	**Description**	**Elevation**
TOP OF PVC MW-20D	1000692.39	1788922.72	562.23	MAG NAIL SET MW-20D	559.42
TOP OF PVC MW-20S	1000690.53	1788917.72	562.28	MAG NAIL SET MW-20S	559.71
TOP OF PVC MW-21D	998974.10	1790995.70	498.90	MAG NAIL SET MW-21D	496.23
TOP OF PVC MW-21S	998981.03	1790997.03	498.80	MAG NAIL SET MW-21S	496.03
TOP OF PVC MW-22D	996920.04	1789298.66	505.19	MAG NAIL SET MW-22D	502.22
TOP OF PVC MW-22S	996917.37	1789291.54	504.52	MAG NAIL SET MW-22S	502.05
TOP OF PVC MW-23D	999329.97	1786365.57	528.22	MAG NAIL SET MW-23D	524.98
Note1: Coordinates shown are based on the North Carolina State Plane Coordinate System					
Note2: Horizontal Datum of NC Grid NAD 1983 (NSRS 2007)					
Note3: Elevations shown are referenced to the NAVD 88 vertical datum					
Note4: Coordinates and elevations shown are in U.S. Survey Foot					
Note5: Coordinates and elevations shown only for as-built wells as requested by NCDENR					
Note6: Mag nails set in concrete base of each well for future elevation checks					