



October 10, 2014

Mr. Sean DeNeale
Duke Energy Carolinas, LLC
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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
Allen Steam 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) Allen Steam Station (Allen).

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

1.0 Background

Duke Energy owns and operates Allen, a coal-fired electric generating station, located in Gaston County, North Carolina. Allen uses an ash basin for disposal of ash generated by the coal combustion process and other water treatment at the coal-fired plant.

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* (2011 Altamont report). 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 2011 Altamont 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 2011 Altamont 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 Pollutant Discharge Elimination System (NPDES) permits - and from groundwater monitoring wells voluntarily installed by Duke Energy (voluntary wells). With the exception of shallow voluntary wells AB-5, AB-6A, and AB-6R, no groundwater elevation data readings were performed on the voluntary wells after March 2011. The compliance wells were installed in November and December 2010.

Section 7.0 of the 2011 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 the installation of the compliance wells during November and December 2010 as described in Section 1.0, 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 2011 Altamont report to generally represent the probable direction of groundwater flow for the shallow water table aquifer. As stated in the 2011 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.

The ash basin pond elevation at Allen is essentially unchanged from the ash basin pond elevation utilized in the 2011 Altamont report. Based on the topography of the site, the ash basin pond elevation, and the water levels measured in the compliance wells, 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.

The generalized groundwater flow directions for the area adjacent to the Allen ash basin are found on the attached *Allen Steam Station Ash Basin Figure Allen-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



Scott A. Spinner, P.G.
Environmental Geologist

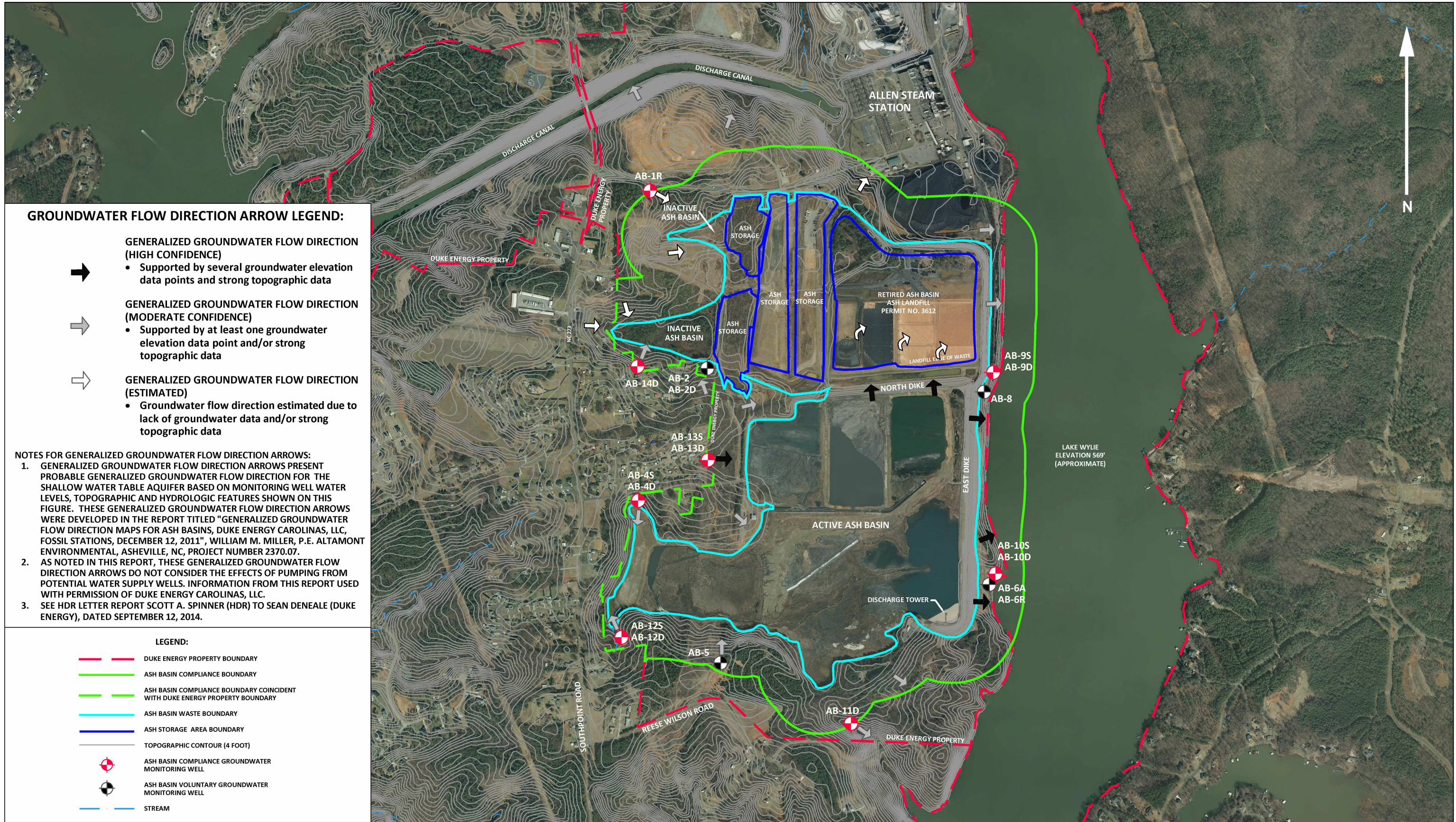


cc: Ty Ziegler, HDR
William M. Miller, HDR




Attachments:

Allen Steam Station Ash Basin

Figure Allen-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

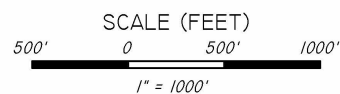
- NOTES FOR GENERALIZED GROUNDWATER FLOW DIRECTION ARROWS:**
1. GENERALIZED GROUNDWATER FLOW DIRECTION ARROWS PRESENT PROBABLE GENERALIZED GROUNDWATER FLOW DIRECTION FOR THE SHALLOW WATER TABLE AQUIFER BASED ON MONITORING WELL WATER LEVELS, TOPOGRAPHIC AND HYDROLOGIC FEATURES SHOWN ON THIS FIGURE. THESE 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 SCOTT A. SPINNER (HDR) TO SEAN DENEALE (DUKE ENERGY), DATED SEPTEMBER 12, 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
-  TOPOGRAPHIC CONTOUR (4 FOOT)
-  ASH BASIN COMPLIANCE GROUNDWATER MONITORING WELL
-  ASH BASIN VOLUNTARY GROUNDWATER MONITORING WELL
-  STREAM

GENERAL NOTES:

1. PARCEL DATA FOR THE SITE WAS OBTAINED FROM DUKE ENERGY REAL ESTATE AND IS APPROXIMATE.
2. ASH BASIN WASTE BOUNDARY, ASH LANDFILL LIMIT OF WASTE, AND STRUCTURAL FILL BOUNDARY 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. TOPOGRAPHY DATA FOR THE SITE WAS OBTAINED FROM NC DOT GEOGRAPHIC INFORMATION SYSTEM (GIS) WEB SITE.
7. ORTHOPHOTOGRAPHY WAS OBTAINED FROM NC ONEMAP GIS WEB SITE (DATED 2010).
8. THE ASH BASIN COMPLIANCE BOUNDARY IS ESTABLISHED ACCORDING TO THE DEFINITION FOUND IN 15A NCAC 02L .0107 (a).



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

GENERALIZED GROUNDWATER FLOW DIRECTIONS
DUKE ENERGY CAROLINAS, LLC
ALLEN STEAM STATION
NPDES PERMIT #NC0004979
GASTON COUNTY, NORTH CAROLINA

DATE
OCT. 10, 2014

FIGURE
ALLEN-1