December 10, 2018

Mr. John Arehart III
Apex Clean Energy, Inc.
310 4th Street NE, Suite 200
Charlottesville, VA 22902

Re: Groundwater Hydrogeological and Geotechnical Desktop Document Review Summary Report for the Proposed Republic Wind Project Located in Seneca & Sandusky Counties; ACX002.300.0011.

Dear Mr. Arehart:

Hull & Associates, Inc. (Hull) is pleased to provide Apex Clean Energy, Inc (Client) with this Desktop Document Review of readily available geologic, hydrogeologic, and geotechnical information that was reviewed for the proposed Republic Wind Project located in Seneca and Sandusky Counties, Ohio. The Client is pursuing the development of a 200-megawatt wind-powered electric generation facility that includes construction of associated infrastructure such as operation and maintenance buildings, access roads, electrical collection lines, substation(s), construction staging areas, and meteorological towers.

For this summary report, the following definitions have been used when describing the project pursuant to the Ohio Power Siting Board's (OPSB's) current Ohio Administrative Code (OAC) rules (Chapter 4906-1-01):

- **Project Area:** "all land within a contiguous geographic boundary that contains the facility, associated setbacks, and properties under lease or agreement that contain any components of the facility" (OAC 4906-1-01(GG)). Additionally, pursuant to OAC 4906-4-08(C)(2), each of the turbine Sites will have an established setback to the nearest habitable residential structure located on adjacent properties at the time of the certification application.

- **Facility:** "the proposed major utility facility and all associated facilities" (OAC 4901-1-01(W)).

- The **Project Boundary:** was established by the Client.

- The **Study Area:** is defined by Hull to better describe the region outside of the Project Boundary that was included during database searches of available public information.

PROJECT APPROACH

The Desktop Document Review was completed to gather the applicable geologic, hydrogeological, and geotechnical information specified in the OPSB's current OAC rules (Chapter 4906-4) concerning certificate applications for electric generation facilities. The information was gathered by completing a literature search of existing and readily available documents related to the hydrogeological and geotechnical conditions of the Study Area. This information was then reviewed to develop a generalized understanding of the suitability of conditions within the Study Area for the proposed construction within the Project Boundary. The information summarized below was obtained from available on-line databases and/or documents maintained or produced by the following federal, state and local agencies:

1. Federal Emergency Management Administration (FEMA);
2. Ohio Department of Agriculture (ODA);
3. Ohio Department of Natural Resources (ODNR);
4. Ohio Environmental Protection Agency (Ohio EPA);

5. Ohio Department of Transportation District 2 (ODOT);
6. Ohio State University, Agricultural Extension Office;
7. Seneca and Sandusky County Engineers;
8. United States Department of Agriculture (USDA) Soil Conservation Service Soil Survey of Seneca & Sandusky Counties; and
9. United States Geological Survey (USGS).

No environmental studies or structural evaluations were performed as part of this scope of work, and therefore no recommendations relative to environmental or structural issues are included in this report.

FACILITY LOCATION

As shown on Figure 1 and as previously stated, the Facility is located in Seneca and Sandusky Counties. The currently proposed Project Boundary is shown on Figure 1and subsequent figures discussed below.

INFORMATION REVIEW AND ANALYSIS

The following provides a summary of the information reviewed and its applicability to the proposed project.

Geology and Seismology

The Project Boundary lies entirely within the Bellevue-Castalia Karst Plains and the Maumee Lake Plains Region of the Huron-Erie Lake Plains Section of the Central Lowland Physiographic Province (Figure 2). The majority of the Project Boundary lies within the Bellevue-Castalia Karst Plains, which is characterized as a hummocky plain of rock knobs and numerous sinkholes, large solution features, springs and caves; thinly mantled by drift. The region straddles both the Eastern Lake Plain (northern portion of the Project Boundary) and Till Plain (southern portion of the Project Boundary). Surface elevations range from 570 feet to 825 feet above mean sea level (msl).

The remaining northwestern portion of the Project Boundary is composed of the Maumee Lake Plains Region and is characterized as a flat-lying Ice-Age lake basin containing beach ridges, bars, dunes, deltas, and clay flats. The Region formerly contained the Black Swamp, which was a regional wetland extending southwest from present-day western Lake Erie through northwest Ohio into extreme northeastern Indiana. The Black Swamp consisted of extensive swamps and marshes, with some higher dry ground interspersed. Low physiographic relief (less than 5 feet) is generally present in the region, which has been slightly dissected by modern streams. Surface elevations in the Maumee Lake Plains Region range from approximately 570 to 800 feet above msl (Ohio Division of Geological Survey, 1998).

The surface topography within the Project Boundary is the result of ice-deposited ground moraine, which was planed by waves in glacial lakes following deposition, resulting in a relatively flat surficial topography. Small areas of lake-deposited (i.e. lacustrine) sand, silt, or clay are present on the surface in the extreme northeastern portion of the Project Boundary. These lacustrine deposits are generally laminated and were formed in the calm waters of glacial lakes (Pavey *et. al.*, 1999). Lacustrine deposits are a heterogeneous mixture of all sizes of soil particles inclusive of clay, silt, sand, and gravel. Lacustrine deposits may also contain streaks, seams, layers or lenses of sand and gravel, which may or may not be water-bearing. The deposits have a greater thickness to bedrock (up to 147 feet) on the western portion of the Project Boundary, than they do on the eastern portion (less than 10 feet). The area was passed over by both Pre-Illinoian and Wisconsinan glaciers.

The uppermost bedrock unit, located in the central eastern portion of the Project Boundary is the Devonian Columbus Limestone. The unit consists predominantly of limestone and dolomite; gray to brown, with massive bedding. The upper two thirds of the formation are a fossiliferous gray limestone, and the lower third is a brown dolomite which is subject to karst formations. Thickness ranges from 0 to 105 feet (Slucher *et. al.* 2006). The Delaware Limestone is deposited beneath the Columbus Limestone and is located on the eastern portion of the Project Boundary. The Delaware Limestone is gray to brown in color and has thin to massive bedding. The limestone has argillaceous partings, nodules, and layers. It is carbonaceous and has a petroliferous odor. The formation can be as thick as 45 feet. The remaining eastern portion of the Project Boundary is composed of Devonian units: Olentangy Shale, Prout Limestone and Plum Brook Shale. The western half of the Project Boundary is composed of the Silurian Salina Group and Tymochtee and Greenfield formations. These formations are composed of dolomite that can have laminated to massive bedding, with occasional shale, anhydrite, and gypsum brecciated zones. The bedrock topographic surface is shown on Figure 3. Reviewing ODNR water well logs, bedrock has been documented as being encountered during the installation of several domestic water wells in the western portion of the Project Boundary at depths ranging between 30 and 60 feet bgs. The eastern portion of the Project Boundary, bedrock was encountered at depths ranging between (4) four and 30 feet bgs. Based on the inferred bedrock topography within the Project Boundary, the depth to bedrock appears to vary between approximate depths of four (4) and 60 feet. Depending on the depth set of the underground electrical collection lines, bedrock may be encountered during installation on the eastern portion of the Project Boundary.

Information obtained from ODNR Division of Geological Survey indicates that the majority of the eastern portion of the Project Boundary lies within a probable karst area. Twenty-one (21) of the 49 proposed turbine locations are positioned in the probable karst area. Probable karst areas and known karsts are presented in Figure 4. The Ohio Geological Survey completed mapping and field verifications of karst features and depths of karst depressions for the Bellevue Quadrangle and portions of the Clyde and Castalia Quadrangles (2013) and the Fireside Quadrangle and portions of the Flat Rock and Clyde Quadrangles (2014). These in-depth studies produced detailed karst maps of 2-km^2 tiles of the quadrangles and cover the eastern portion of the Project Boundary. The Ohio Geological Survey indicates that the majority of the Karst features are formed by dissolution of the Columbus Limestone and portions of the Salina undifferentiated formations (Aden, 2013 and Aden, 2014). The studies are presented in Appendix A.

Geologic structural and seismic information was assessed for the Study Area. Structural features and earthquake epicenters within Ohio are shown on Figure 5. A review of the information showed that no epicenters lie within the Project Boundary. However, the Tiffin Fault extends to approximately ¼ mile from the western Project Boundary. The Seneca Anomaly covers the majority of the western portion of the Project Boundary, seven (7) of the 49 turbines are located within the Seneca Anomaly boundary. Other faults and fault systems in the vicinity of the Project Boundary include the Outlet Fault, part of the Bowling Green Fault System, situated approximately 21 miles west-southwest at its closest proximity to the Project Boundary.

Recorded seismic information shows that four earthquakes have originated in Seneca County; two occurred in 1936, one in 1967, and the most recent in 2010. The earthquakes' magnitudes were recorded as 3.1, 2.5, 3.7 and 2.4 m_{bLg}, respectively. Two earthquakes occurred in Sandusky County in 1975 and 2010 and produced a magnitude of 3.3 and 2.6 m_{bLg}, respectively. The closest seismic event to the Project Boundary was the 1936, 3.1-magnitude earthquake in Seneca County, Ohio, with an epicenter located approximately 3 miles west of the Project Boundary.

Hydrology and Hydrogeology

Surface water flow within the Project Boundary is generally to the northwest. The entire Project Boundary is located within the Lake Erie Drainage Basin. Surface water bodies present within the Project Boundary include several small streams, ditches, ponds, and above ground reservoirs. The streams generally flow from the southeast to the northwest. The majority of the surface water inside the Project Boundary flows into Emerson Creek and Royer Ditch, located in the central northern portion of the Project Boundary. These water bodies connect to Beaver Creek, before connecting to Green Creek which discharges into Lake Erie. Several small un-named tributaries in the southwestern portion of the Project Boundary, connect to the Sandusky River, which parallels the western Project Boundary, before discharging into Lake Erie.

Figure 6 contains the location of 100-year floodplains in the Project Boundary, and was prepared using information obtained from the ODNR and FEMA. Several 100-year floodplains are located within the

Project Boundary, mostly surrounding portions of Royer Ditch and Emerson Creek, as well as several unnamed tributaries in the southern portion of the Project Boundary and portions of Raccoon Creek on the northern portion of the Project Boundary. None of the Turbines appear to be located in the 100-year floodplains. However, several underground electrical collection lines pass through streams and 100-year flood plains, proper steps should be taken during the installation of these lines when crossing streams and flood plains, in accordance with Nationwide and State Regulations.

The principal groundwater source within the Project Boundary is a carbonate limestone bedrock aquifer. Groundwater yields of up to 500 gallons per minute (gpm) have reportedly been measured at depths less than 300 feet. Agricultural and domestic supplies of about 10 to 15 gpm can reportedly be developed at depths of less than 125 feet. The presence of hydrogen sulfide is common in these wells (Schmidt, 1982).

The Tiffin Thin Upland Aquifer overlies the bedrock aquifer on the eastern portion of the Project Boundary and yields less than 5 gpm. The Tiffin Ground Moraine Aquifer composes the majority of the western portion of the Project Boundary, small areas occupied by the Lake Maumee Beach Ridge, Green Creek Buried Valley and Lake Maumee Lacustrine Aquifers as shown on Figure 6. These aquifers yield less than 5 gpm, except the Lake Maumee Lacustrine Aquifer may yield between 5 and 25 gpm.

The Project Boundary lies within a rural area. Property owners within the Project Boundary utilize private wells to supply potable water. Water well locations are shown on Figure 7, which was compiled from well location information provided by ODNR, Ohio EPA, and the Seneca & Sandusky County Health Department. Hull has not reviewed specific information such as depth, boring logs, or construction associated with any of the wells depicted on the figure, nor has there been an attempt to verify whether these private wells were completed within the carbonate aquifer, unconsolidated aquifers, or some other aquifer.

The presence of Source Water Protection Areas (SWPAs) for public water systems within the Project Boundary was evaluated. SWPAs are areas defined and approved by the Ohio EPA for the purpose of protecting drinking water resources. Numerous SWPAs have been established in Seneca and Sandusky Counties, a ground water protection area is located on the northeastern portion of the Project Boundary (Capital Aluminum and Glass SWPA, Figure 7), protecting the groundwater associated with the karst formations of the Columbus Limestone. Twenty-one (21) turbines are located inside the Capital Aluminum and Glass SWPA. Due to the high groundwater flow rates (3,500-8,600 ft./day) and a relatively high vulnerability (shallow depth to bedrock, sinkholes and rapid flow of groundwater), the Ohio EPA delineated the entire region contributing water via the karst system as a SWPA. The Capital Aluminum and Glass SWPA is a non-transient, non-community public water system located near Bellevue. The system operates one well and pumps approximately 2,600 gallons per day from the carbonate bedrock aquifer.

Additionally, there are two Inland Surface Water Protection Areas located in the central (City of Clyde) and northwestern (City of Fremont) portion of the Site, as presented in Figure 7. The Clyde City Inland Surface Water Protection Area encompasses Beaver Creek, which serves as the surface water source for the City of Clyde. Beaver Creek is approximately 3.6 miles long and has a drainage area of 49.8 square miles, it flows into Green Creek before discharging into the Sandusky River. The protection area covers approximately 44.3 square miles, twenty-four (24) of the turbines are located within the Surface Water Protection Area.

The City of Fremont Inland Surface Water Protection Area encompasses the Sandusky River, which serves as the surface water source for the City of Fremont. The Sandusky River is approximately 130.2 miles long and has a drainage area of 1,420 square miles. The Sandusky River flows into Sandusky Bay, Lake Erie. The water system intake is located approximately 18.02 miles from the mouth of the Sandusky Bay. The protection area covers approximately 1,256 square miles, thirteen (13) turbines are located within the Surface Water Protection Area.

Environmental regulatory programs within the Ohio EPA, as well as other regulatory agencies such as the Ohio Bureau of Underground Storage Regulations (BUSTR), have adopted regulations that restrict specific activities within SWPAs. These activities include concentrated animal feeding operations, wastewater treatment land application systems, industrial, municipal and residual waste landfills, leaking underground storage tanks (LUSTs) and voluntary action program (VAP) cleanups. The restrictions typically apply to SWPAs relying on groundwater as their drinking water source. Hull has reviewed the range of programs which have adopted rules related to the presence of SWPAs and have concluded that construction of the proposed wind turbine facility will not constitute an activity that would be restricted within either a surface water or groundwater SWPA.

Well Survey

Hull mailed a brief survey to the property owners within the Project Area that were under contract with the Client at the time the hydrogeology review commenced in April 2016 and in October 2018. A list of names and addresses for the property owners was provided to Hull by the Client. The survey included multiple questions regarding the number, depth, installation date and construction of the wells. Additional information was requested regarding the aquifer type, depth to water and yield of each well. The survey also requested information regarding any problems experienced by the property owners with their wells.

The survey was mailed to 139 separate property owners in the Project Area. At the time this Desktop Document Review was completed, Hull had received 79 responses to the survey. Copies of the well surveys are attached in Appendix B. It should be noted that Hull has not matched the addresses of the property owners that responded to the survey to well or turbine locations shown on the figures.

Of the 79 survey respondents, 19 respondents had no wells on their property. Sixty respondents had at least one well on their property. Of these 60 respondents, 41 reported that they had one well, while 15 respondents noted two wells, 2 reported three wells, 1 reported four wells, and 1 reported five wells. The wells provided potable water for the residents as well as water for livestock and agricultural uses. Five respondents indicated that they were connected to a municipal water supply.

Approximately half of the respondents who indicated that they had a well on their property were able to provide information regarding the well diameter, total depth, producing formation, depth to water, and well yield. Drilled well diameters were generally three to 10 inches, several dug wells were reported being 4 to 5 feet in diameter. Reported well depths ranged between 18 and 160 feet. Thirty respondents indicated that their well was completed in an unspecified bedrock, while four respondents indicated their well was set in a limestone bedrock. Twenty-two respondents were unaware of what formation their well was set in and seven respondents indicated their well was set in sand & gravel formations. Respondents that provided information as to the depth to water in their wells indicated that water depths varied between 8 and 100 feet. Well yields were reported to vary between 4 and 50 gpm.

Respondents were asked on the survey whether they had ever experienced problems with their wells related to the water table being lowered or poor yield. One respondent indicated they re-drilled their well in 1967 because of a lowering water table, 3 respondents indicated wells were re-drilled because of turbid water, and 1 indicated poor water quality.

Soil Survey

The USDA Soil Conservation Service Soil Survey of Seneca and Sandusky County was reviewed (USDA, 1977). Soil surveys furnish surface soil maps and provide general descriptions and potentials of the soil to support specific uses, and can be used to compare the suitability of large areas for general land uses. The majority of the surface soils of the Project Boundary are comprised of the Blount Silt Loam (BoA & BoB) covering approximately 51.07 % of the Project Boundary. The Glynwood silt and clay loams (GwA, GwB, GxB2 & GxC2) cover approximately 14.79 %, and the Pandora silt loam (Pa) covers approximately 5.19 % of the project boundary. The remainder of the Project Boundary is covered by various clay, silt, and sand loams as presented in the soils map, Figure 8.

The soil survey information suggests the Blount silt loams have a 0 to 6 % slope and are somewhat poorly drained soils. The permeability of the soil is slow to moderately slow, the available water capacity is moderate and the seasonal high water table is 12 to 36 inches bgs. The Glynwood silt and clay loams have a 0 to 12 % slope and moderately well drained soils. The permeability of the soil is slow, the available water capacity is moderate and the seasonal high water table is 24 to 42 inches bgs. The Pandora silt loam has a 0 to 2 % slope and are very poorly drained soils. The permeability of the soil is slow, the water capacity is moderate and the seasonal high water table is near the surface during times of extended precipitation. The soil surveys indicate that these soils do not frequently flood, however the Pandora clay frequently ponds surface water runoff.

Underground and Surface Mines

Information obtained from the ODNR, Division of Geological Survey and phone discussions with ODOT District 2 and the Seneca and Sandusky County Engineer's Offices indicated that there is no information available that suggests that underground mines are located within the Project Boundary. Soil survey information provided by the USDA indicates that there is one surface mine quarry located in the northeastern portion of the Project Boundary. The Hanson Midwest Aggregates, LLC limestone quarry is located south of turbine 41. Additionally, the Heitsche North Shore Limestone Quarry is located just outside of the northeast project boundary, east of proposed turbine 44 and 45. Figure 9 illustrates that no known abandoned mines shafts or probable abandoned mines are located within the Project Boundary.

PROJECT BOUNDARY RECONNAISSANCE

In addition to the desktop study, Hull completed a field reconnaissance on May 16, 2016, and March 13, 2017, at representative points within the Project Boundary to observe geotechnical-related conditions including topography, surface geologic features, and surface water conditions. The areas within proximity of the Project Boundary predominantly consist of agricultural fields. In general, the Project Boundary appears to be adequately drained. Standing water was not observed, although the Project Boundary did not receive any significant rainfall in the days prior to the dates of each field reconnaissance. Construction of gravel access roads will be necessary to access all turbine locations from the Township and County roads. Several of the Township roads are currently dirt roads with grassy vegetation or gravel roads. These roads may need to be improved to provide access to turbine locations. No information was available from ODOT or the County Engineer's office concerning rockfalls or landslides within the Project Boundary. Based on a review of the existing topography of the Project Boundary and the visual observations completed by Hull during the reconnaissance, it is anticipated that the potential for rockfalls and landslides are very low due to the relative flatness of the Project Boundary. In addition, though Hull did not observe any sinkholes or depressions within the Project Boundary, karst features are known to exist within the eastern portion of the Project Boundary. Representative photographs from the site reconnaissance are presented in Appendix C to illustrate the general Project Boundary conditions.

AGENCY INTERVIEWS

Hull contacted ODOT District 2 in order to discuss typical maintenance issues encountered in the area. Bryan Spero, Transportation Manager for Seneca County, ODOT District 2 indicated that the most common geotechnical issue encountered in the Project Boundary are sinkholes resulting from karstic features. These sinkholes are typically encountered within agricultural fields and have not impacted ODOT roads to Mr. Spero's knowledge. Mr. Spero further indicated that a sinkhole developed south of Bloomville, Ohio years ago but no new sinkholes have been reported with the last several years. Mr. Spero indicated that historical use of injection wells by industrial operations within the district may have enhanced or contributed to the development of karst. Finally, Mr. Spero mentioned that an "underground river" associated with the cave system in the area flows between Bloomville and Bellevue, Ohio.

Hull contacted the Sandusky County Engineer's Office regarding their knowledge and experience of previous construction projects, subsurface conditions, and maintenance history in the vicinity the Project Boundary. Mr.

Rich Randolf, Design Engineer, corroborated that sinkholes are the primary geotechnical issue encountered within the area. For many municipalities, sinkholes function as the primary source for drainage. Mr. Randolf's office works almost exclusively with roads, bridges, and right-of-way issues. Mr. Randolf indicated that the only roadway issues encountered have been flooding associated with sinkholes. One incident involved sinkhole-related flooding within the last decade that did not subside for a period of approximately three months.

Hull contacted the Seneca County Engineer's Office on several occasions, but has not received a response to date.

PRELIMINARY CONSTRUCTION CONSIDERATIONS

Based on our experience with earthwork in the region, conventional, shallow foundations typical for turbines of similar size may be able to support the structures. However, this assumption will need to be confirmed by a detailed geotechnical exploration and evaluation for each turbine-site (e.g., each turbine and associated access road locations). If it is determined that shallow foundations are not suitable for structural support, extended foundation systems (such as driven H-piles, micropiles, or auger cast piles) may be necessary to bear in suitable material or on bedrock. Additionally, other suitable foundation types may be utilized according to their compatibility with the geotechnical parameters of the specified turbine site.

The geotechnical engineer, or a designated representative, should examine foundation designs and compatibility with the supporting soils and approve the work prior to placement of foundation components.

Based on the information collected to date, it is anticipated that there will be no construction concerns related to the access roads. However, this assumption will need to be confirmed by a detailed geotechnical exploration and evaluation of each access road location.

Adequate surface water run-off drainage should be established at each turbine site, access road and the substation location to minimize any increase in the moisture content of the subgrade material. Positive drainage of each turbine site and access road location should be created by gently sloping the surface toward existing or proposed drainage swales. Surface water runoff should be properly controlled and drained away from the work area. It should be noted that the subgrade soils are subject to shrinking and swelling with variation in seasonal moisture content and consideration should be given during constructability reviews to determine how best to deal with potential moisture fluctuations.

The contractors should be prepared to deal with any seepage or surface water that may accumulate in excavations. Site dewatering may be required during construction if excavations extend below the water table, or significant precipitation events occur when the foundation excavations are exposed. The contractor should be able to minimize the amount of excavation exposed at one time, especially when precipitation is forecasted. Fluctuations in the groundwater level may occur seasonally and due to variations in rainfall, construction activity, surface runoff, and other factors. Since such variation is anticipated, we recommend that design drawings and specifications accommodate such possibilities and that construction planning be based on the assumption that such variation can occur.

The foundations and excavations are to be designed by the Client's structural designer. The contractor should be solely responsible for constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. All excavations should comply with applicable local, state, and federal safety regulations including the current Occupational Safety and Health Administration (OSHA) Excavation and Trench Safety Standards (29 CFR Part 1926).

As mentioned above, due to the glacial history and presence of karst topography within the Study Area, the depth to bedrock varies considerably throughout. Bedrock is generally shallower within the eastern portion of the Project Boundary (evidenced by the presence of limestone quarries and karst) and deeper within the western portion (evidenced by thick deposits of glacial drift). Consequently, foundation considerations vary depending on the location of each turbine.

Based on a review of the soil survey information and our experience with earthwork in the Study Area, the soils should be suitable for grading, compaction, and drainage when each turbine site is prepared as discussed in this report. Due to the anticipated depth of bedrock, excavation within bedrock may be necessary in the eastern portion of the Site to install foundations. Furthermore, karst areas may include sinkholes, solution cavities, and cave systems. These voids may need to be grouted in order to provide adequate foundation support. These assumptions must be confirmed with geotechnical test borings prior to construction.

Additional considerations relative to site preparation, suitability of fill materials, fill placement, and weather limitations are presented in Appendix D for reference. These considerations are provided as general guidelines and the contractor is responsible for selecting and implementing the most appropriate construction techniques (e.g., construction means, methods, sequences or procedures, and safety precautions or programs) for each site-specific condition(s).

SUMMARY

Based on the information reviewed to date and the field reconnaissance, it does not appear that the local geology and/or hydrogeology will be prohibitive regarding construction of the proposed wind turbines, access roads, and/or substations. Likewise, based on Hull's knowledge of typical wind turbine foundation construction, it does not appear that the construction of the proposed wind turbines will have a significant impact on the local geology and/or hydrogeology of the Project Boundary. Therefore, based on the information presented herein and the associated analysis, construction of the wind turbines, or other project components, are not anticipated to result in any significant negative impact to the property owner's wells.

It is Hull's understanding that there is a minimum setback distance which will be established from each turbine to the nearest residential structure. Although the exact location of each potable use well cannot be determined with the information obtained to date, it is assumed that the potable wells are located in close proximity to each property owners' residence. Therefore, based on the information presented herein and the associated analysis, construction of the wind turbines, or other project components, are not anticipated to result in any significant negative impact to the property owners' wells.

Based on the information reviewed and the field reconnaissance, it appears that the primary geotechnical issue for the Facilities, access roads, and substation location that should be considered during construction is variable subsurface conditions (i.e., depth to bedrock and karst) and the poor drainage of the surface soils within the Project Boundary. As previously discussed, adequate surface water drainage should be established at each Project Area, access road, and substation location to minimize any increase in the moisture content of the subgrade material. Surface water drainage can be managed by implementing techniques such as surface water swales, drainage berms, etc. Furthermore, foundation system design for each turbine location should consider the findings and recommendations of the geotechnical subsurface investigation and laboratory testing.

Site-specific geotechnical information should be obtained by the Client prior to design of the turbine foundations, and prior to preparation of construction specifications and design plans. This may require, but not be limited to, completion of geotechnical explorations to further evaluate the *in-situ* materials at each Facility. A generalized scope of work template for the geotechnical explorations has been provided in Appendix E, which can be used to prepare detailed Requests for Proposals for the individual Facilities.

The conclusions included in this Desktop Document Review are based on general summaries available through the resources previously listed. There may be anomalies in the hydrogeology or geotechnical conditions of a specific Facility that cannot be resolved at the scale of the publicly available data used in this study. As noted previously, site-specific geotechnical information should be obtained prior to final turbine foundation design.

STANDARD OF CARE

Hull has performed its services using that degree of care and skill ordinarily exercised under similar conditions by reputable members of its profession practicing in the same or similar locality at the time of service. No other warranty, expressed or implied, is made or intended by our proposal or by our oral or written reports. The work does not attempt to evaluate past or present compliance with federal, state, or local environmental or land use laws or regulations. Conclusions presented by Hull regarding the area within the Project Boundary are consistent with the Scope of Work, level of effort specified, and investigative techniques employed. Reports, opinions, letters, and other documents do not evaluate the presence or absence of any condition not specifically analyzed and reported. Hull makes no guarantees regarding the completeness or accuracy of any information obtained from public or private files or information provided by subcontractors.

If you have any questions regarding the summary and conclusions presented in this Desktop Document Review Report, please do not hesitate to contact either of the undersigned at your convenience.

Sincerely,

Shawn D. McGee, P.E.
Project Manager
(440) 232-9945

Rob Corzatt
Senior Project Manager
(614) 793-8777

Attachments

REFERENCES

REFERENCES

1. Aden, Douglas J., 2013, Karst of the Bellevue Quadrangle and portions of the Clyde and Castalia Quadrangles, Ohio.

2 Aden, Douglas J., 2014, Karst of the Fireside Quadrangle and portions of the Flat Rock and Clyde Quadrangles, Ohio.

3. Ohio Department of Natural Resources. *Water Well Log and Drilling Report*. Retrieved May 2nd, 2016, from Division of Water Web-site: https://apps.ohiodnr.gov/water/maptechs/wellogs/app/.

4. Ohio Division of Geological Survey, 1998, Physiogrpahic regions of Ohio: Ohio Department of Natural Resources, Division of Geological Survey, page-size map with text, 2p., scale 1:2,100,00.

5. Pavey, R.R., Goldthwait, R.P., Brockman, C.S., Hull, D.N., Swinford, E.M., and Van Horn, R.G., 1999, Quaternary Geology of Ohio, Ohio Department of Natural Resources, Division of Geological Survey, Map No. 2.

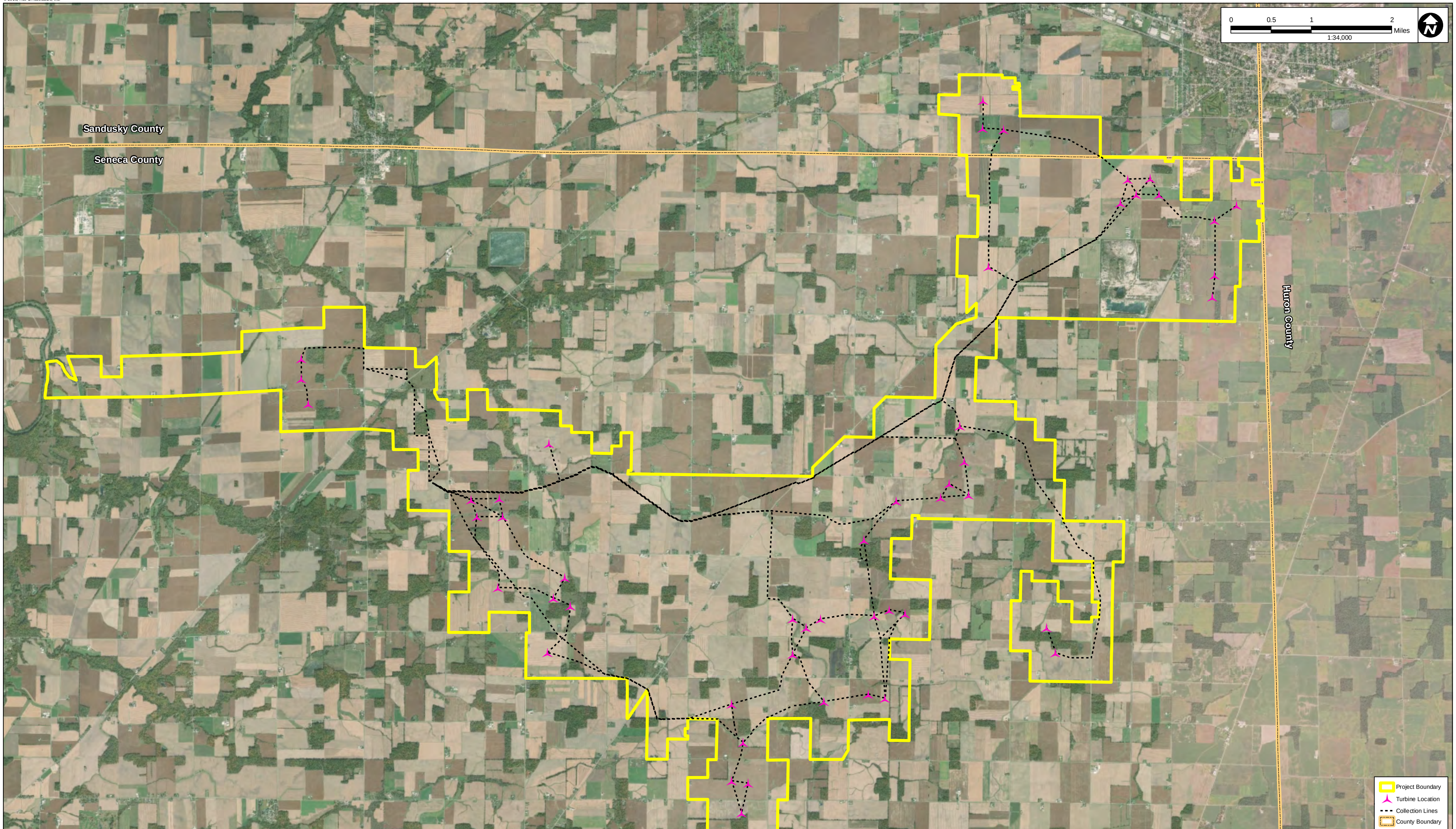
6. Schmidt, James, 1982, Ground-Water Resources of Seneca County, Ohio Department of Natural Resources, Division of Water.

7. Slucher, E.R. (principal compiler), Swinford, E.M., Larsen, G.E., and others, with GIS production and cartography by Powers, D.M., 2006, *Bedrock Geologic Map of Ohio*: Ohio Division of Geological Survey Map BG-1, version 6.0, scale 1:500,000.

8. United States Department of Agriculture, Soil Conservation Service, *Soil Survey of Sandusky County,* 1987.

9. United States Department of Agriculture, Soil Conservation Service, *Soil Survey of Seneca County,* 1977.

FIGURES



Notes:
The aerial photo was acquired through the ESRI imagery web service. Aerial photography dated 2015.

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November 2018

Republic Wind

Turbine Map

Seneca and Sandusky Counties, Ohio

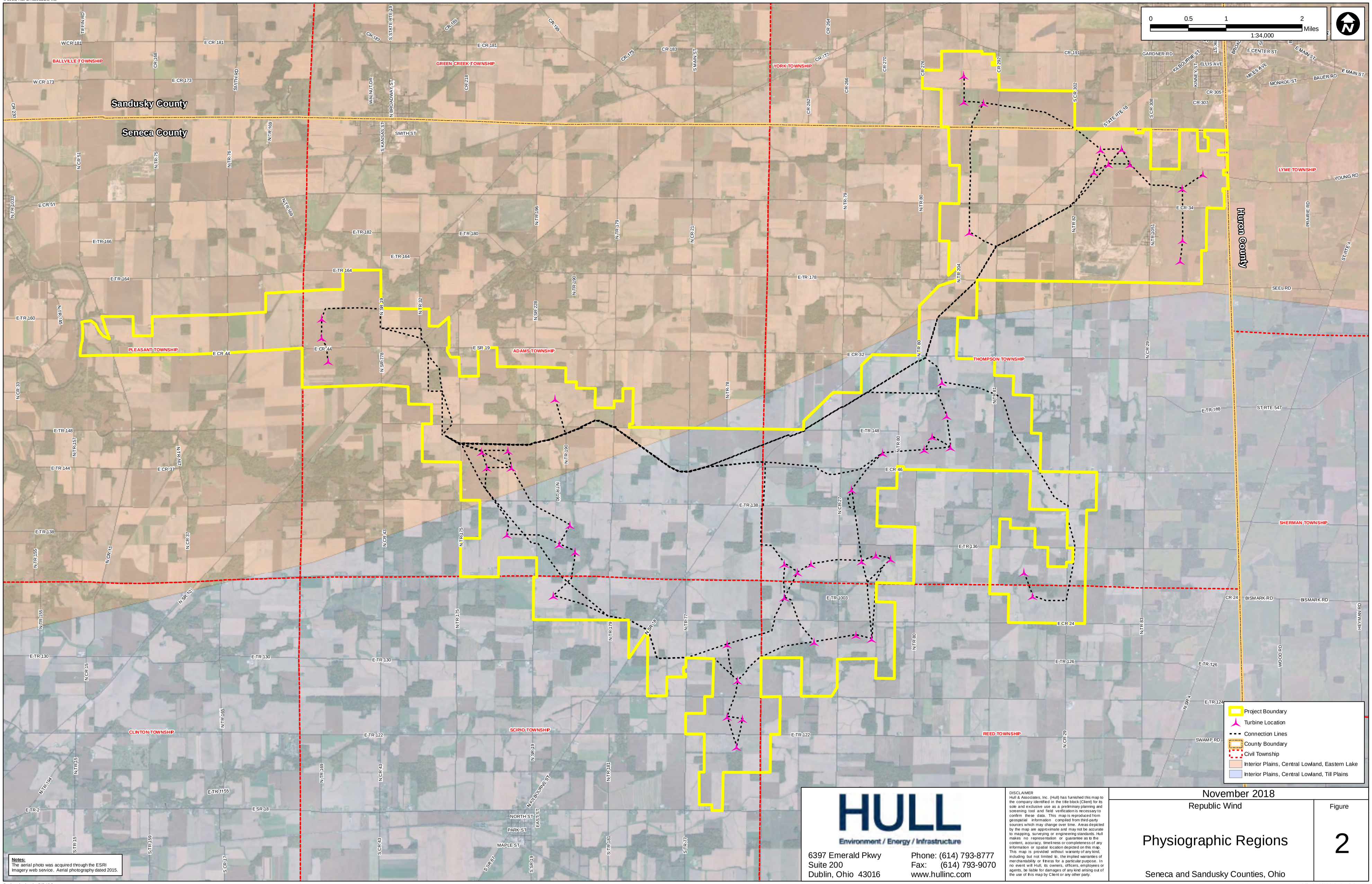
Figure

1

Produced using ArcGIS 10.5

File Name: ACX002_02_Fig01_Turbines.mxd

Edited: 12/3/2018 By: rkalp



Notes:
The aerial photo was acquired through the ESRI imagery web service. Aerial photography dated 2015.

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Physiographic Regions

Seneca and Sandusky Counties, Ohio

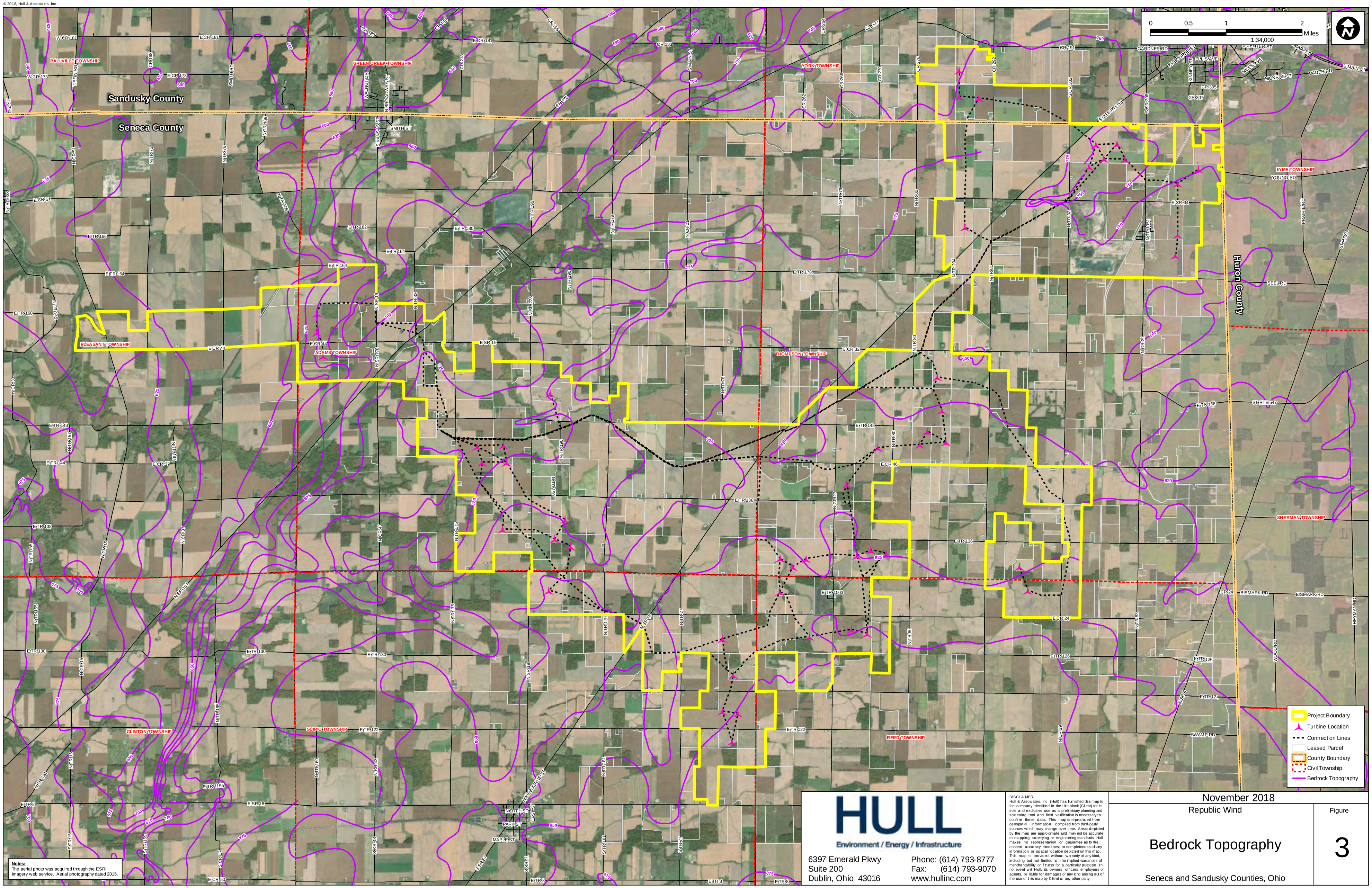
Figure

2

Produced using ArcGIS 10.5

File Name: ACX002_02_Fig02_Physiographic.mxd

Edited: 12/3/2018 By: rkaip



Notes:
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Bedrock Topography

Seneca and Sandusky Counties, Ohio

Figure

3

File Name: ACX002_02_Fig03_Bedrock.mxd

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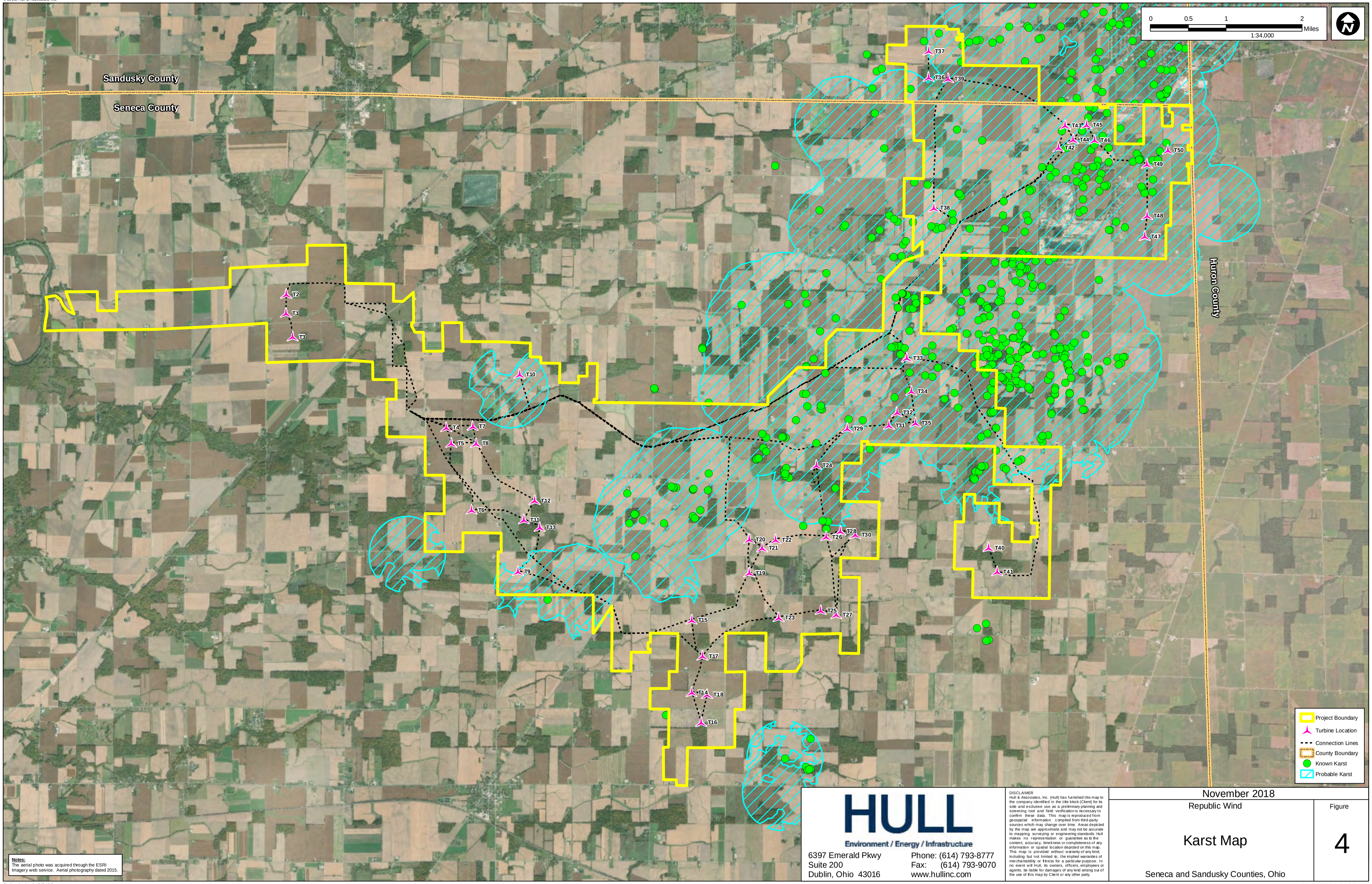

Notes:
The aerial photo was acquired through the ESRI Imagery web service. Aerial photography dated 2015.

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Karst Map

Seneca and Sandusky Counties, Ohio

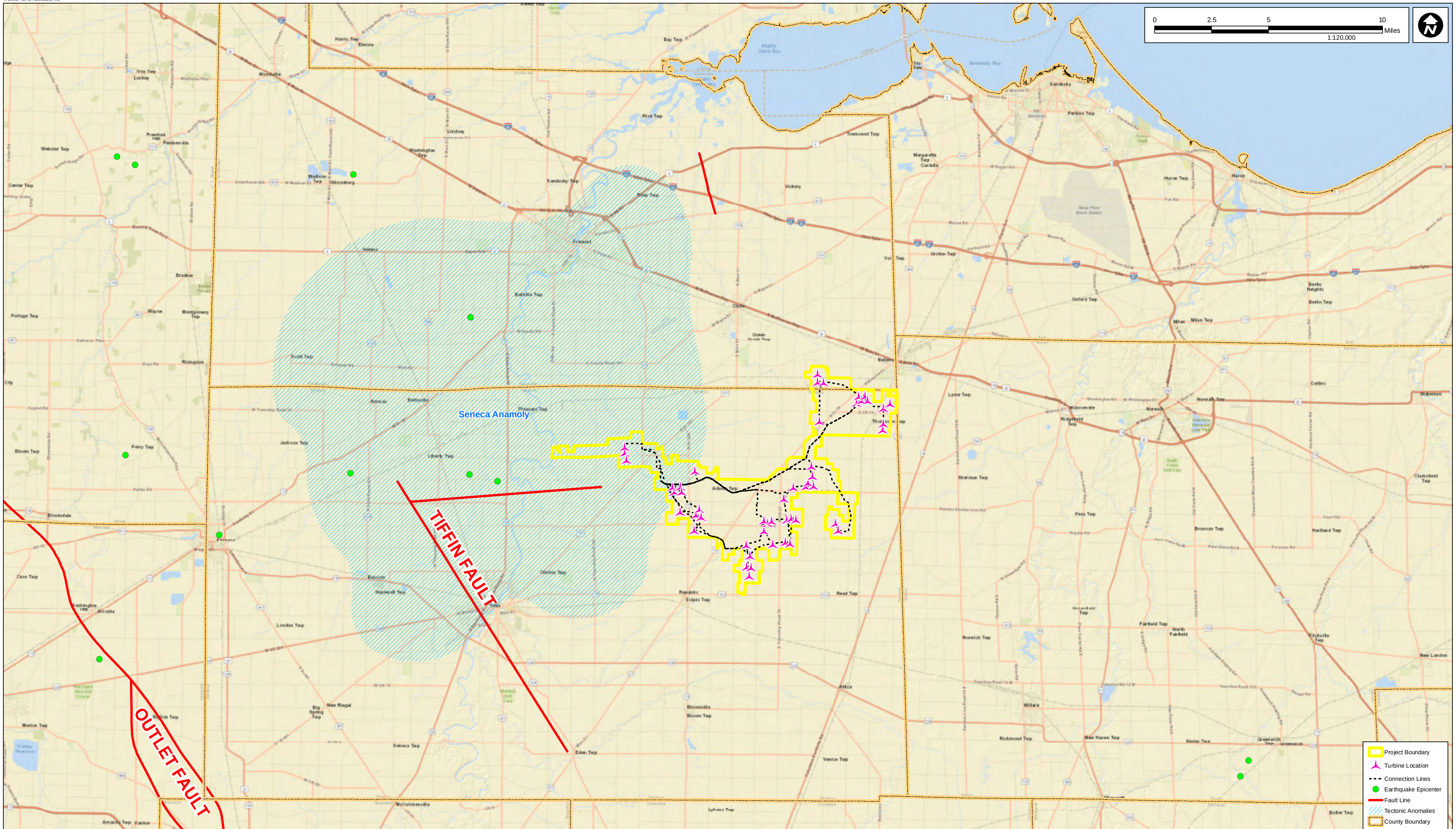
Figure

4

Produced using ArcGIS 10.5

File Name: ACX002_02_Fig04_Karst.mxd

Edited: 12/3/2018 By: rkalp



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Geophysical Map

Seneca and Sandusky Counties, Ohio

Figure

5

File Name: ACX002_02_Fig05_Geophysical.mxd

Edited: 12/3/2018 By: rkaip

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