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BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

Application of Transource Pennsylvania, LLC for approval of the Siting and Construction of the 230 kV Transmission Line Associated with the Independence Energy Connection - East and West Projects in portions of York and Franklin Counties, Pennsylvania.	:	A-2017-2640195 A-2017-2640200
Petition of Transource Pennsylvania, LLC for a finding that a building to shelter control equipment at the Rice Substation in Franklin County, Pennsylvania is reasonably necessary for the convenience or welfare of the public.	:	P-2018-3001878
Petition of Transource Pennsylvania, LLC for a finding That a building to shelter control equipment at the Furnace Run Substation in York County, Pennsylvania is reasonably necessary for the convenience or welfare of the public.	:	P-2018-3001883
Application of Transource Pennsylvania, LLC for approval to acquire a certain portion of the lands of various landowners in York and Franklin Counties, Pennsylvania for the siting and construction of the 230 kV Transmission Line associated with the Independence Energy Connection – East and West Projects as necessary or proper for the service, accommodation, convenience or safety of the public.	:	A-2018-3001881, et al.

DIRECT TESTIMONY OF
IRA D. SASOWSKY

WITNESS STATEMENT ON BEHALF OF
STOP TRANSOURCE FRANKLIN COUNTY

Q. Please state your name and address.

A. My name is Ira D. Sasowsky. My address is 379 Bittersweet Rd.; Akron, OH 44333

Q. What is your occupation?

A. I am a university professor, teaching and conducting research in the field of geosciences. I also provide occasional outside consulting through Sasowsky Earth Science Consultants, Ltd. My testimony here is provided under that role.

Q. What is your educational background?

A. I received the Bachelor of Science (B.S.) degree in geology from the University of Delaware. I received the Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) degrees in geology from The Pennsylvania State University. The focus of my graduate degrees, thesis and dissertation, was karst geology. Since then my education has continued with participation at many professional conferences, and through independent study.

Q. Are you involved with any professional organizations?

A. Yes, with many. The ones I am active with are

Geological Society of America

Pennsylvania Council of Professional Geologists

Association of Environmental & Engineering Geologists (AEG)

National Ground Water Association

American Association of Petroleum Geologists

Cave Conservancy of the Virginias

National Speleological Society

Karst Waters Institute

British Cave Research Association

Sigma Xi, The Scientific Research Society

Northern Ohio Geological Society

Q. Has your professional work been recognized by these or other organizations?

A. I have received several awards or other recognition for my work related to the geosciences over the years. In the Geological Society of America, I have been elected a Fellow, and also received the GSA Hydrogeology Division Distinguished Service Award. In the National Speleological Society, I received: The Science Award, Ralph Stone Research Award, Certificate of Merit, and election as a Fellow. From the British Cave Research Association, I received the Jeff Jefferson Research Award. I was the Edwards Aquifer (Texas) Distinguished Lecturer, and have also presented invited lectures at many U.S. universities, as well as overseas.

Q. What qualifications do you have regarding evaluating the proposed project?

A. Beyond my formal education, which was mentioned above, I have been studying geology, hydrology, and geochemistry, especially of karst areas, for over 35 years. This has included both academic research projects, and applied problems such as determining the causes of collapse sinkholes, evaluating water inflows to limestone quarries, superfund and RCRA facility studies, and so forth. My academic research has been supported by the National Science Foundation, Ohio

EPA, and U.S. Department of Agriculture. Clients I have worked with have included private landowners, mineral extraction companies, petroleum exploration companies, manufacturers, and law firms. On the academic side I have directed 30 Master of Science thesis projects, and served as a reader on 38 projects. I have taught hundreds of college students on the topics of hydrogeology and karst, have led field trips and organized professional conferences on the topics of karst, have published 45+ papers/book chapters and 100+ abstracts on these and other related themes. I have edited 11 books/proceedings on the subject, including being the lead editor on the most recent Proceedings of The Sinkhole Conference (2018). My work has involved field observations of karst in 30+ of the United States and Puerto Rico, numerous Caribbean nations, Mexico, several countries in Europe, and Brazil. I was the Earth Sciences Editor for 15 years for the *Journal of Cave and Karst Studies*, the premier journal on this topic in North America, and an Associate Editor for the journal *Ground Water* for 5 years.

I have extensive direct experience with karst in Pennsylvania, including the Great Valley (Cumberland Valley) Region (where the proposed project is located). Within the state my work has included many field trips involving observation of surface and subsurface karst forms (including 40+ non-developed caves), design and oversight of groundwater monitoring systems in carbonate rocks, and groundwater sampling. This has encompassed observation of numerous karst features in the field in the adjacent Cumberland County, and an investigation of

groundwater contamination in the shallow karst aquifer underlying Letterkenny Army Depot within Franklin County.

Q. Have you ever been qualified as an expert witness?

A. Yes, several times. In the past few years I testified to the Pennsylvania Environmental Hearing Board (Judge Labuskes), Docket No. 2011-136-L, and in a Pennsylvania Utilities Commission Administrative Law Hearing (Judge Barnes), PUC Docket No. C-2018-3001451, and P-2018-30011453. I have also recently served as a Technical Advisor to the U.S. District Court, Western District of Pennsylvania, for Judge Nora Barry Fischer. In that case, the matter before the court is highly technical, regarding geology, hydrology, and geochemistry. The Judge sought my involvement as an impartial third party who could educate the Court and bring clarity to interpretation of the testimony of various experts who had been called.

Q. Are you a licensed Professional Geologist?

A. Yes, I am a licensed Professional Geologist in Pennsylvania, license number PG-000417G, and also in Tennessee (PG-5504).

Q. What is the purpose of your testimony?

A. I have been asked to provide expertise and advice regarding potential impacts that Transource's proposed project might have on the Franklin County area, especially due to the karst landscape.

Q. Please describe the nature of the geology and hydrology in the area of the proposed project.

A. The dominant characteristic of this area is that it is a karst terrain. It is useful to first give a general explanation of what this term "karst" means, as it is probably unfamiliar unless someone has lived in such regions. After that I will speak specifically about the region.

Most parts of the earth consist of some loose uppermost material, termed regolith (what lay people would call "soil"), which lays over a more cohesive, or solid bedrock. Karst is the name given to areas that have "greater than normal bedrock solubility" and that commonly have such features as sinkholes, caves, and dominant underground drainage. A perspective of this is shown in FIGURE A. Sinkholes (FIGURES B, C) are closed topographic depressions in the land surface, of various sizes. By the term "closed depression", we mean that a bowl-shaped or similar low spot is present, sloping upwards on all sides from a central low point. Sometimes sinkholes may be water filled. Caves (FIGURE D) are natural underground openings, large enough for humans to enter, and generally going back in to total darkness. They may actively have water flowing through them, or they may be mostly dry (abandoned). These landforms and landscapes form because of the bedrock that underlies them, and the interaction of that bedrock with surface and groundwaters. Simply put, if the underlying bedrock is of the types called limestone or dolomite (both of which are made of chemicals called carbonates), then the weak natural acids present in water allow the dissolution of the bedrock over time. This creates relatively large openings in the rock, which permits fast water movement, as well as the movement of regolith.

Many areas of Pennsylvania are underlain by rocks of this type (FIGURE E). These areas are profoundly different from areas that are underlain by less soluble bedrock, such as sandstone and shale, where openings in the rocks are tiny, water moves very slowly, and regolith is stable. Another characteristic of these areas is that the surface of the bedrock, which typically is covered by loose material called regolith (~soil), can be extremely irregular (FIGURE F). All of these characteristics result in great complexity and unpredictability in the movement and storage of water, as well as with construction, as I will address a subsequent question.

To continue answering the question, I'd like to address the specifics of the Franklin County region karst now. The area lies in a Physiographic region known as the Great Valley (or Cumberland Valley). This is an area of deformed sedimentary rocks that outcrop as a broad sinuous band in eastern Pennsylvania (FIGURE E), and continue in to adjacent states. The limestones here are of Cambrian and Ordovician Age. This is one of the most well-developed karst areas in the state, with prolific distribution of sinkholes (see Figure 7a of Siting Study), 130 known caves in the County (Opatka-Metzgar and Metzgar, 2013), and a lack of defined surface drainage (see Figure 8a of Siting Study). Maps of the caves show them to have both horizontal and vertical reach, with some extensive development controlled by rock jointing. Water is present in many cases, and the famous Cleversburg Sink in Cumberland County just to the northeast is well

known for rapid flooding, illustrating the intimate connection between surface and groundwater in karst.

Q. What are your concerns with the proposed project?

A. The karst nature of this area presents significant challenges to safe development of infrastructure and indeed for any land use changes. Based upon the Application, and ancillary documents, including discovery responses, that I have examined, it does not seem that Transource has suitable processes in place to make this safe development likely. The concerns fall in to two categories: Hazards to the project, and hazards to the surrounding environment (including residents). Specifically, these include

- Collapse/stability hazards
- Hazards to groundwater/wells
- Hazards to surface water
- Hazards to natural resources
- Hazards to ecosystems/organisms

All of these relate to the relatively large openings that can be present in the bedrock, and the way in which water and regolith can move in those openings. It is critical also to recognize that problems may arise not only during construction, but can also develop over years during operation of the system as the modified landscape adjusts to changes that have been made.

In order to reduce problems both during and after construction of the transmission line, and indeed even for selection of its route, a more robust analysis of the karst of the area, along with laying out of plans for karst specific site procedures and investigations would be needed. At present, from the documents I have had access to, the overall treatment of the karst issue seems cursory, being presented as a single figure with an accompanying line of text in the Siting Study of the Application (pages 33-34). The figure simply displays known surface karst features (sinkholes) from the Pennsylvania karst database. Use is not made of a) Detailed previous published studies (e.g. maps and other materials available in Root 1968 & 1971), b) site specific techniques/investigations (e.g. geophysical techniques, or evaluation of proprietary data such as the Pennsylvania Cave Database), or c) previous experience (e.g. from construction of I-81, railroads, etc.). In the absence of such review and approaches, it is difficult to have certainty about the safe construction and operation of the proposed project, the selection of the route that minimizes environmental impact, and any alternative routes.

Q. Can you please explain further your concerns with ground stability/collapses?

A. One of the ways in which sinkholes form is by ground collapse, the rapid downward motion of rock and/or regolith. This is a dangerous situation in terms of both human health and infrastructure, and can occur in poorly predictable locations within karst terrains. The collapses are commonly related to human

activities such as construction or drainage changes. Anything on the overlying land surface can be damaged, or even destroyed when these collapses occur (FIGURES G & H). Property concerns include residences, businesses, roads, rail-lines, pipelines (water, gas, etc.), telephone and electric lines. In Carroll County, Maryland, to the southeast, a driver was killed in 1994 as the result of a collapse sinkhole that opened in a road one evening.

Changes in drainage by human activities are common as both causes and triggers for the formation of collapses. This has to do with the processes that lead to collapses (FIGURE I). In order to make a collapse, there has to be a void in the subsurface for the overlying materials to fall in to. When surface or subsurface drainage is changed by humans, water may be routed in to areas that previously did not have this flow. Increased water gradients (basically increased pressures) can also play a role by increasing water velocity and flow quantity. When this happens, regolith present near the surface, or even filling in bedrock voids at depth, can be moved. This process, which may be called "piping" or "ravelling" may go on for years before a stability threshold is reached, and collapse occurs. The effects of changes in drainage by human activities are sometimes seen at great distance from the location of the initial drainage change, and due to the complex nature of the subsurface karst (FIGURE F) it is very challenging to predict where problems will develop.

The proposed project will result in changes to the surface of the land both in terms of topography and land cover. It will also involve changes to the subsurface through tower foundations for the infrastructure, whether monopoles or lattice towers are used, and possibly other activities. This means that there will certainly be changes to drainage both during and after construction. These changes may involves decreasing water flow in to the ground at some points, and increasing it at others. In order to minimize the possibility of collapses, a robust evaluation of existing drainage conditions, along with design for site specific drainage issues would be of paramount importance. It is not clear from existing documents if and how these concerns would be addressed. In order to protect public health and infrastructure, it would be important that these things be considered, and that steps be taken to minimize impacts. Basic questions that should be answered for activities within the Right-Of-Way include: Where does water currently drain, how much is there, and how will this change with proposed changes in land cover/land configuration? Follow-up questions include: Where might regolith movement be exacerbated, where might collapses be anticipated, how might such problems be minimized.

Q. Can you please explain further your concerns with groundwater and wells?

A. Yes, these concerns fall in to two categories: quantity and quality. Before going in to detail on this, it is important to review the movement and occurrence of groundwater, and particularly that in karst regions. In all regions, karst or otherwise, water that falls on the land surface may either run off directly to

receiving surface water bodies or it may percolate downward to become part of the groundwater system. The downward percolation process that feeds groundwater is termed "recharge". This water eventually comes back to the surface, sometimes quite far away, as springs or seeps. It can also be tapped via wells. So, precipitation is the original source of groundwater and well water. In non-karst regions the downward movement of this precipitation water is usually quite slow, as the water must make its way through the regolith and then through tiny pores and fractures in the bedrock. In karst areas, because of sinkholes at the surface and large openings that may be present below, water can move in to and through the ground very quickly. This means that the natural filtration present in non-karst areas may not occur, and water quality may be easily degraded (FIGURE J).

Since groundwater originates from the land surface, any changes to the karst land surface have the high potential to change water quality and quantity in groundwater. For example, in Figure J we see that the water being drawn from the well is at least partially sourced from water entering the sinkhole. If water quality at the surface was degraded, for example by application of herbicides, there would likely be degradation of water quality at the well. Likewise, if drainage near the sinkhole was changed, decreasing recharge, the well might run dry.

For these reasons, it is sound practice before making changes to a karst land surface to undertake an inventory of wells and springs in an area, to delineate their catchments (which may be considered springhead and wellhead protection areas), and to take steps to minimize any potential negative impacts. Such work may entail mapping of the features, topographic determination of likely flow routes and amounts, dye tracing, measurement of background water chemistry, and so forth. In this rural region no doubt there are numerous residents who use well, and possibly spring, waters for a variety of purposes. In order to protect these resources, a detailed understanding of the local hydrology is required. It is not clear from existing documents if the issues of groundwater quality and quantity would be addressed. Transource's Supplemental Response to Data Request No. 26, dated October 4, 2018 states that "The Company does not have any documents that refer or relate to the location of any wells that are hydrologically connected to the proposed right of way." In order to protect public health, as well as the viability of residential and agricultural activities, it would be important that these things be considered, and that steps be taken to minimize impacts.

Q. Can you please explain further your concerns with surface waters?

A. As with groundwater, surface water originates from precipitation. Streams can be fed from surface runoff, but streams that flow the year round (perennial streams) are fed by springs and other seepage along their beds. This component is called "baseflow". Consequently, the health of surface streams in terms of quantity of

flow and overall water quality is dependent upon the same factors as mentioned in answer to the preceding question about groundwater. Within karst areas, as mentioned earlier, there may be a limited number of surface streams because most of the water "sinks" underground in to caves through sinkholes. Indeed, it can be seen that the karst areas of Franklin County show a remarkable lack of perennial streams (FIGURE K). Consequently, the protection of these few streams, especially in their headwaters, is paramount. The spring-fed nature of High Quality streams in karst, for example Cold Spring Run and Falling Spring, is noted in the Siting Study. But, Transource gives no indication of approaches that would be used to maintain quality and quantity of water flow. In order to do this, study of the water sources, both groundwater fed and otherwise, would need to be accomplished. Without an understanding of the hydrology of the streams, identification of the source areas that feed given stream reaches, and the implementation of protection of those areas in terms of water quantity and quality, impacts from changes to land use and construction will be hard to judge and avoid. Due to the incomplete nature of the information provided, I reserve the right to supplement my testimony, or to recommend additional subject matters experts to address water quality impacts.

Q. Can you please explain further your concerns with hazards to natural resources?

A. In the Siting Study, Mineral and Subsurface Resources are briefly considered on page 63, but the major aesthetic and recreational resources of the caves

themselves are not addressed. Caves frequently contain delicate and beautiful crystalline mineral deposits (speleothems, FIGURE L). These form over millennia, and when damaged, are not replaceable on human timeframes. The value of these natural resources is recognized in the Pennsylvania Cave Protection Law of 1989. Activities associates with construction of the transmission line, as well as ongoing drainage and other changes during operation, have the potential to impact these features. A robust evaluation of known caves, as well as site specific studies to identify unknown caves, would be needed in order to protect the resource. This might involve liaison with local cave exploration organizations, and geophysical studies such as microgravity.

Q. Can you please explain further your concerns with hazards to ecosystems/organisms?

A. Much as described above for the mineral deposits, caves are also significant for their role in providing habitat for a variety of rare and sensitive organisms. The most well-known cave dwellers are bats, but they are many less-well known animals that use caves by preference or by obligation. The low energy environment of the cave, lacking light, leads to small populations - in fact there is one organism known from a single Pennsylvania Cave that is not known from anywhere else in the world. Although some of these organisms have been documented, and may be listed in Federal or private databases, others may as yet be undocumented. Along with a survey of caves and other karst features, the expertise of a karst biologist to evaluate and document cave biota would be critical to minimize impacts to these ecosystems/organisms. Threats can come in

changes to water flow (quantity greater, quantity lesser, frequency of flows), as well as quality (temperature, chemistry). Transource has indicated it may conduct bat surveys, among other surveys, and will provide information when surveys are completed, per Supplemental Response to Stop Transource Franklin County Data Request No. 5.

Q. What sources have you relied upon and/or reviewed?

A.

AECOM, 2017, Siting Study, Independence Energy Connection (West): Rice-Ringgold 230 kV, Transmission Line Project: 109 p. + appendices [This document is Attachment 3 in document Transource PA 2017].

Direct Testimony of Wade Gobrecht, Assistant Director on Behalf of York County Planning Commission, September 25, 2018, 38 p.

Direct Testimony of Scott J. Rubin, on Behalf of The Office of Consumer Advocate, September 25, 2018, 112 p.

Direct Testimony of Joseph Dague, on Behalf of Stop Transource Franklin County, September 27, 2018, 9 p.

Flippo, H. N. J., 1974, Springs of Pennsylvania, Water Resources Bulletin 10, Pennsylvania Department of. Environmental Resources, 46 p.

Kochanov, W.E., 1989, Sinkholes and karst related features of Franklin County [20 maps]: Open-file report (Pennsylvania. Bureau of Topographic and Geologic Survey), 89-03. Available at http://www.docs.dcnr.pa.gov/cs/groups/public/documents/document/dcnr_017314.zip

Kochanov, W. E., 1999, Sinkholes in Pennsylvania: Educational Series 11, Pennsylvania Geological Survey, 4th ser., 33 p.

Opatka-Metzgar, K., and Metzgar, T. J., 2013, The Caves of Pennsylvania: A guidebook to the 2013 NSS Convention, Shippensburg, Pennsylvania, National Speleological Society, p. 328.

Pennsylvania DCNR, 2018, Karst Features in Pennsylvania (digital dataset): https://data-dcnr.opendata.arcgis.com/datasets/a8cc961fb81641f4b9c52b828fc33b85_8

Potter, N., Jr., 1999, Physiography: Southeast of Blue Mountain, *in* Shultz, C. H., ed., The Geology of Pennsylvania: Special Publication 1, Pennsylvania Geological Survey and Pittsburgh Geological Society, p. 345-351.

Root, S. I., 1968, Geology and mineral resources of southeastern Franklin County, Pennsylvania, Atlas 119cd, Pennsylvania Geological Survey, 4th ser., 118 p.:

Root, S. I., 1971, Geology and mineral resources of northeastern Franklin County, Pennsylvania, Atlas 119ab, Pennsylvania, Bureau of Topographic and Geologic Survey, 126 p.:

Transource PA, LLC, 2017, Attachments in support of the Certification Application (December 2017), 406 p..
Transource PA, LLC, 2018, Statements 1-6 (Direct Testimony of Peggy I Simmons, Kamran Ali, Paul F. McGlynn, Barry A. Baker, Kent M. Herzog, Thomas Schaffer: 109 p.
Transource Supplemental Responses to STFC-01D-05, STFC-01D-26 & STFC-01-16: 11 p.
White, W. B., 1976, Geology and biology or Pennsylvania caves, General Geology Report 66: Harrisburg, Pennsylvania Geological Survey, p. 103.
White, W. B., 1988, Geomorphology and hydrology of karst terrains, Oxford, Oxford University Press, 464 p.:
Wilshusen, J. P., and Kochanov, W. E., 1999, Environmental and Engineering Applications: Land subsidence - karst terrane, *in* Shultz, C. H., ed., The Geology of Pennsylvania: Special Publication 1, Pennsylvania Geological Survey and Pittsburgh Geological Society, p. 715-723.

Q. Does this complete your direct testimony?

A. Yes, it does. I offer these opinions to a reasonable degree of scientific certainty. As more information becomes available from Transource about the proposed route of the transmission lines, field data collected, it may be necessary to supplement my testimony. I reserve the right to supplement my testimony at any time during the course of this proceeding, including after receiving the results of environmental investigations that Transource is ordered to provide once complete and which have not yet been made available, and further, to supplement my testimony.

FIGURES

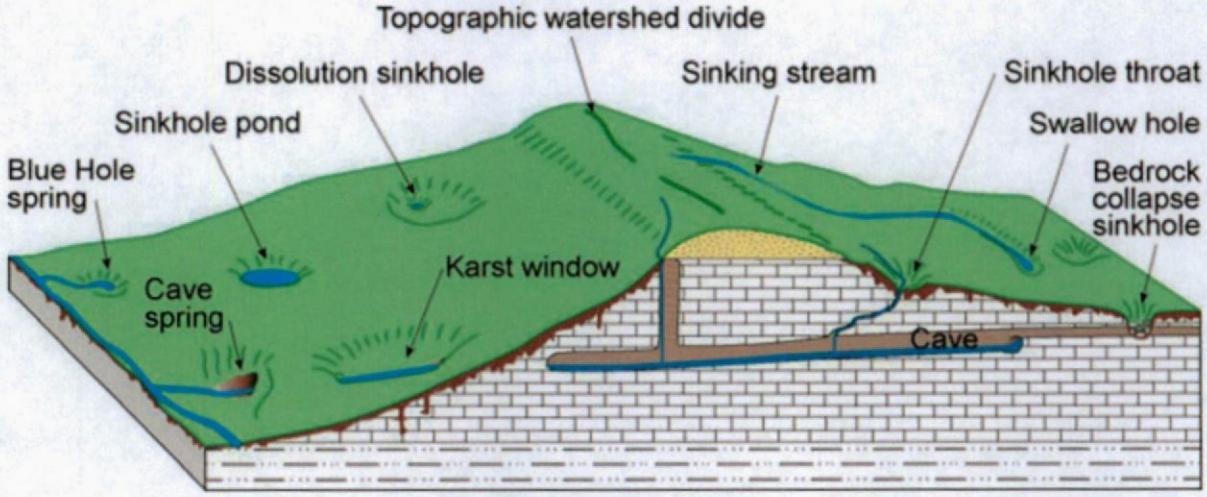

Figure A Block diagram showing typical karst features (source: http://www.uky.edu/KGS/karst/)

Figure B Typical small collapse sinkhole (from Kochanov 1999)

Figure C Grouping of larger sinkholes (from Kochanov 1999)

Figure D A typical cave passage.

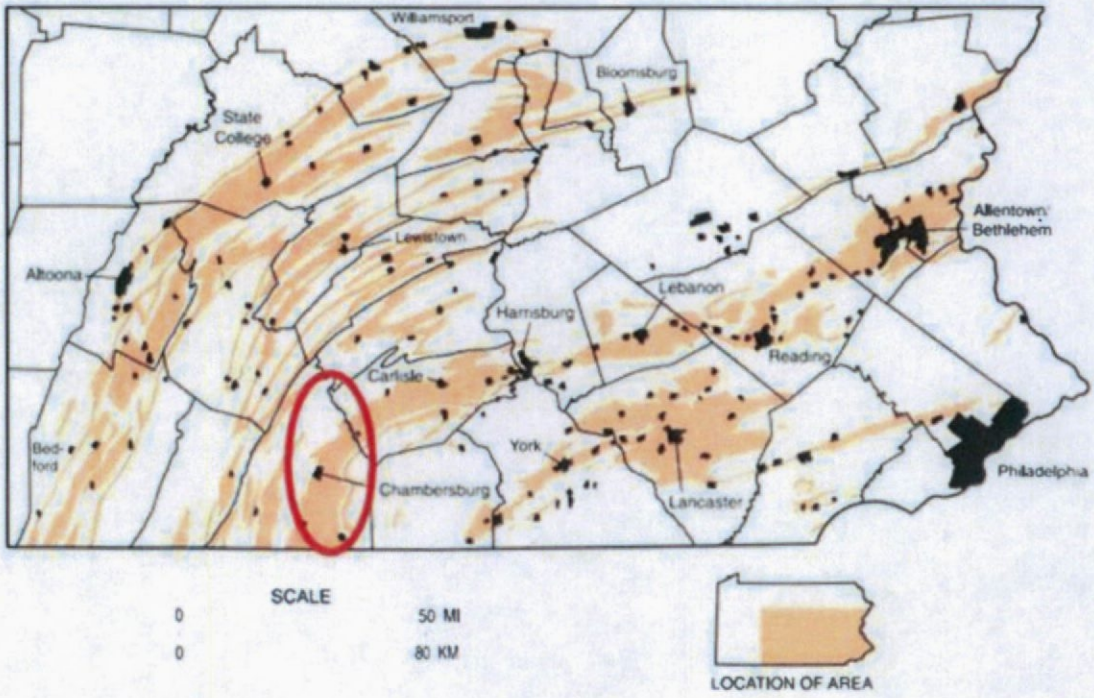

Figure E Carbonate bedrock distribution (color) and major population centers in central and eastern Pennsylvania (from Kochanov, 1999). Project area approximately shown by red ellipse.

Figure F Photograph showing highly irregular bedrock surface that is typical under soil in karst areas (from Kochanov, 1999). Note person for scale.

Figure G Photograph showing loss of street due to collapse sinkhole formation (from Kochanov, 1999).

Figure H Photograph showing driveaway destroyed and house threatened by collapse sinkhole formation (from Kochanov, 1999).

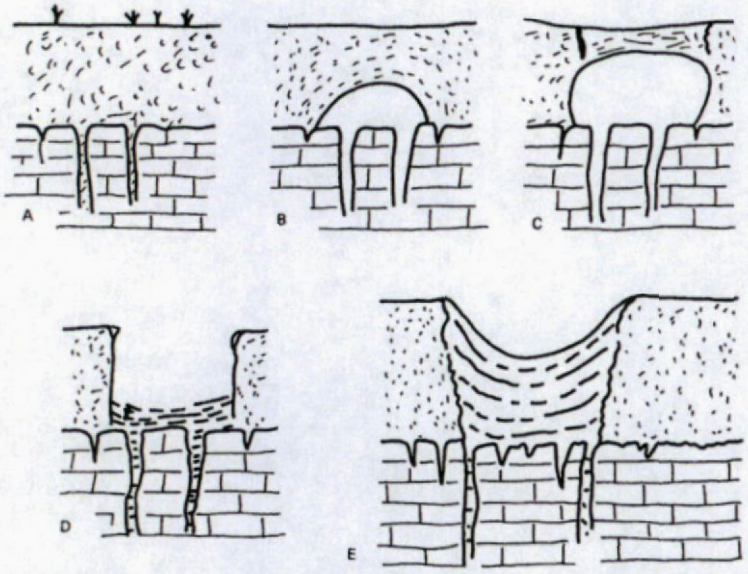

Figure I Diagram showing sequential process of collapse sinkhole formation (from White, 1988). In stages A and B, regolith is removed via downward movement. At stage C the overlying arch of regolith is barely able to support its own weight, and in stage D collapse occurs.

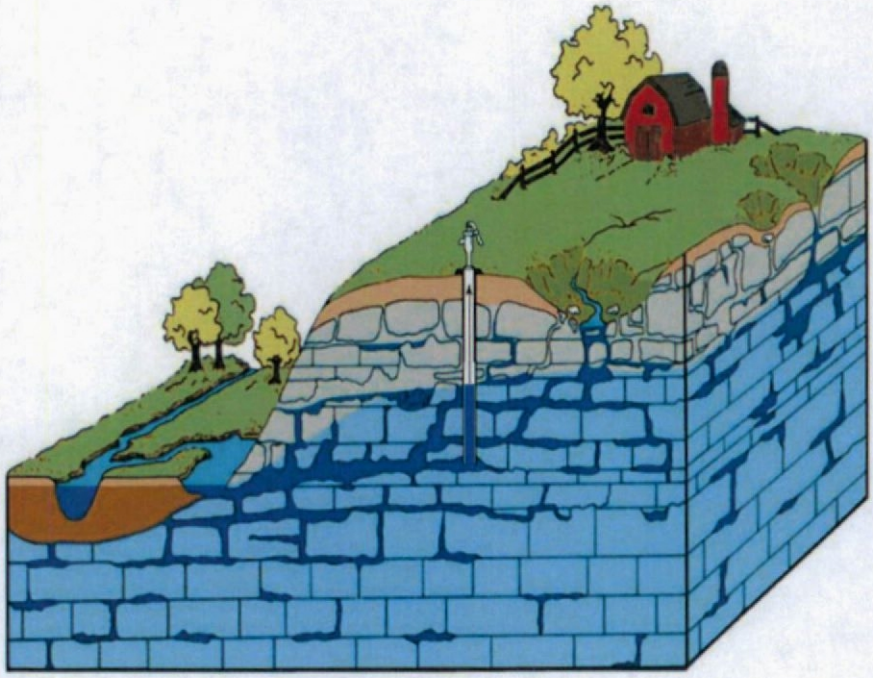

Figure J Diagram showing groundwater occurrence in karst areas and relation of sinkholes, wells, and springs. Source: http://www.iowadnr.gov/Environmental-Protection/Water-Quality/Private-Well-Program/Private-Well-Testing/Contamination-in-Karst.

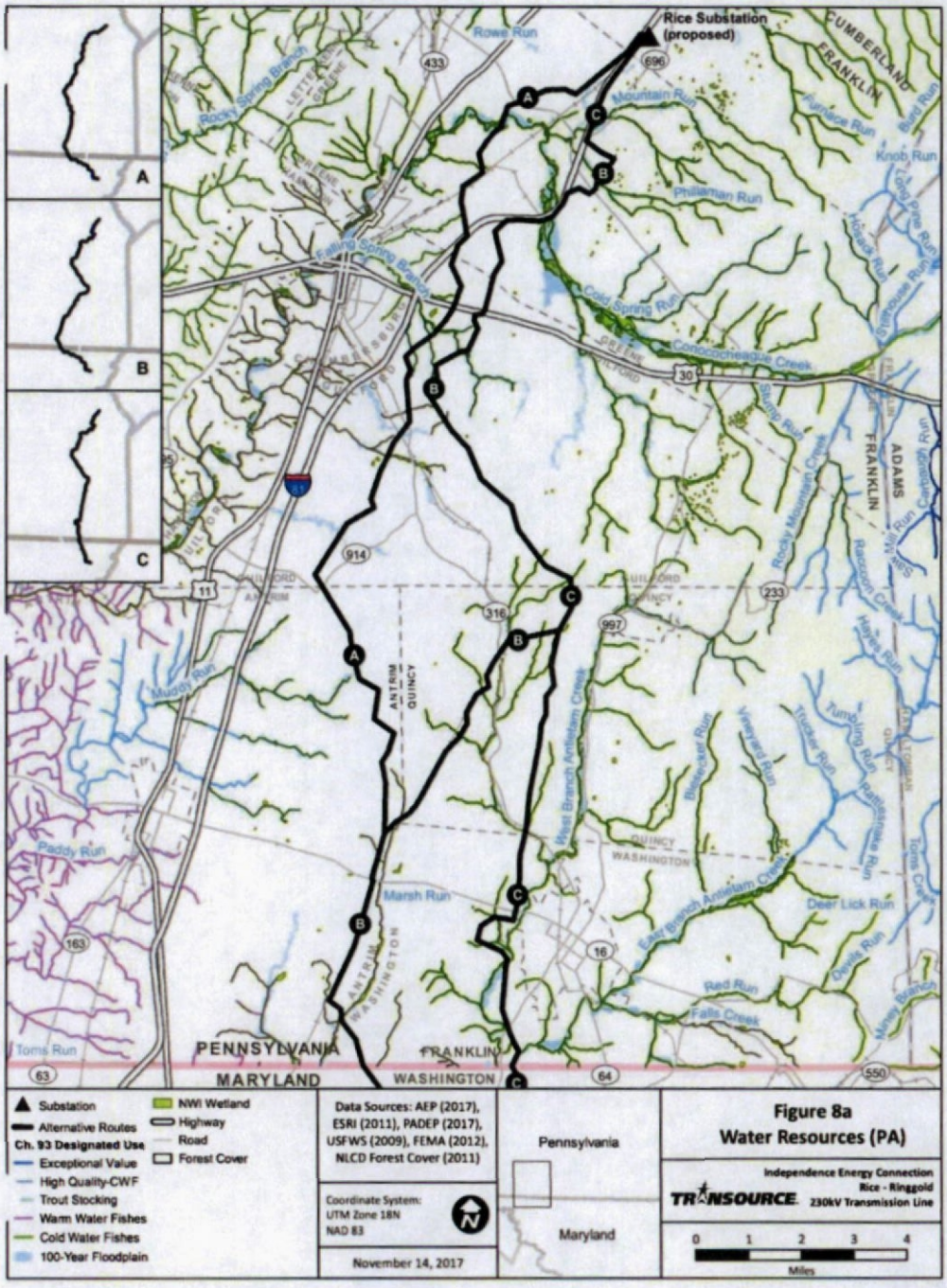

Figure K Map of water resources, showing lack of surface streams in area of proposed construction. (Figure 8a of Siting Study)

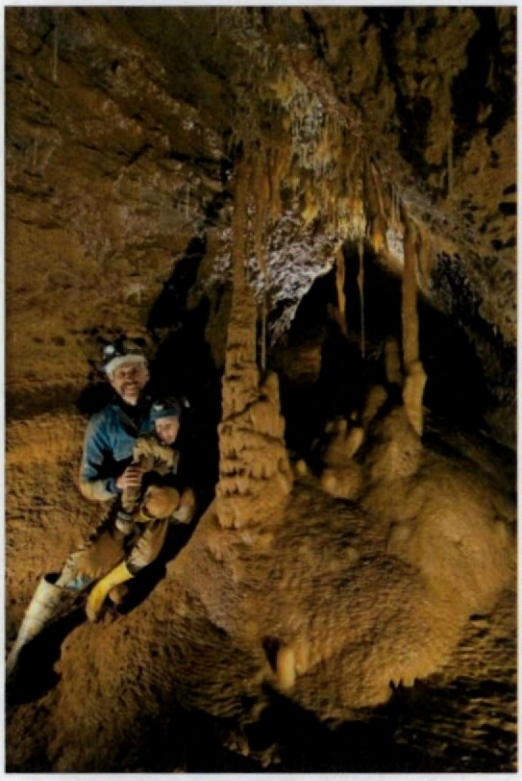

Figure L Photograph showing speleothems from a Pennsylvania Cave. Source: http://lincolncaverns.com/pages/photo_album/the-new-discovery

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VERIFICATION

I, Ira D. Sasowsky, hereby state that the facts above set forth in my Direct Testimony are true and correct and that I expect to be able to testify as to the same at the hearing held in this matter. I understand that the statement herein are made subject to the penalties of 18 Pa. C.S. § 4904 (relating to usworn falsification to authorities).

Ira D. Sasowsky
379 Bittersweet Road
Akron, OH 44333

Date: October 10, 2018

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STFC Stmt 1-SR
2/21/19 Hrg

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SURREBUTTAL TESTIMONY OF
IRA D. SASOWSKY

WITNESS STATEMENT ON BEHALF OF
STOP TRANSOURCE FRANKLIN COUNTY

Q. What were your initial concerns with the proposed project?

A. These were detailed in my direct testimony but, in brief, it did not seem that Transource had suitable processes in place to make safe development and operation likely. My concerns fell in to two categories: Hazards to the project, and hazards to the surrounding environment (including residents). Specifically, these included

- Collapse/stability hazards
- Hazards to groundwater/wells
- Hazards to surface water
- Hazards to natural resources
- Hazards to ecosystems/organisms

Q. Can you summarize Mr. Yamatani's rebuttal testimony?

A. Mr. Yamatani is a Professional Engineer who has extensive experience with the construction of electrical transmission infrastructure, which includes projects in karst areas. His rebuttal testimony explains, in greater detail than had been previously presented, the approaches that Transource and their collaborators might use to address concerns about karst issues in the project area. He also presents data showing existing transmission lines in karst areas of the eastern US in order to demonstrate that such projects can be successfully completed.

Q. Does Mr. Yamatani's rebuttal make you more comfortable with the likelihood of a good outcome for the project?

A. Both yes, and no. The initial materials presented by Transource about the karst issues in the project were so cursory in nature as to seem only an afterthought. It

is encouraging to subsequently learn something about the successful transmission lines which have been established across other karst areas, and the experience that Mr. Yamatani brings to the endeavor is also promising. Likewise, the engagement of an external expert for a karst study, Dr. Walter Kutschke (currently employed with DiGioia Gray), is a positive step. Dr. Kutschke has a record of experience with karst investigations and a demonstrated knowledge of suitable approaches and issues, concerns that were raised in my testimony. But, there are still many uncertainties about what will actually be done in terms of protecting health and the environment. For this reason, I would say I am encouraged, but not comfortable, regarding the outcome.

Q. What are your ongoing broad concerns?

A. My ongoing broad concerns fall in to three categories. The first of these has to do with the absence of an integrated, holistic approach (plan) for understanding the karst system. By this, I mean that it appears that each individual site will be treated as a special case, a local engineering problem to be solved, rather than looking at the karst hydrological system as a whole. A comprehensive approach would begin with a broad view. This would involve answering such questions as where recharge is occurring in this area, where is the water going, what is the depth of the flow system, what is the nature of the karstification, and so forth. This is the type of information that I would expect would have been gathered before planning any project across a large karst area such as this, but instead only a GIS map showing known sinkholes (surface karst features) was given. A more comprehensive understanding may result from execution of the karst study

proposed, but it is not explicitly clear that this will be the case. It seems more likely that the outcome will be more focused on each specific site.

My second broad concern is somewhat related to the first. The work as proposed seems, on the whole, more reactive than proactive. By this, I mean that the approach being taken seems to envision the karst as a set of geographically discrete problems to avoid. And, if a problem (for example a cave) is found, it would be dealt with by either offsetting the construction or taking engineering action to improve the situation. In many ways this conception is less than ideal. The geologic history of the area, and such factors as the absence of surface drainage, indicate that the whole area is karst. Therefore, it should be expected that every single location will have karst issues, which should be dealt with in a comprehensive way, rather than solely reacting to the specifics of the given location. Failing to consider the karst terrain in more detail before selecting a route and identifying a Right of Way constrains Transource's ability to minimize the impact of the project on the terrain and the hydrology. Efforts should be made before project construction to avoid collapse and stability hazards that can form as a result of man-made construction.

A third broad concern is the absence of specific protocols that would guide actions during the investigation or construction phases. In project documents examined to date, and in the rebuttal, there are no checklists, flowcharts, decisions trees, etc. For example, what specific steps will be undertaken to evaluate the

karst? What manner of site surveys will be conducted? How will active vs. inactive features be differentiated – and can that vary depending upon weather conditions? Is there guidance that will be used from previous workers, either from industry-accepted standards, conference papers, text-books (such as Benson & Yuhr, 2016)? The experience of the team is encouraging, but it would strengthen the undertaking, and the ultimate safety of the project, if the protocols that will be employed are specified, and subject to comment by concerned parties.

Finally, and somewhat related to concern 3 above, there seems to be a lack of commitment to specific actions in the investigation. In his rebuttal, Mr. Yamatani makes use of the word "may" in many cases (for example page 4 line 7, and page 6 line 21). Taken together with the concerns listed in the preceding paragraph, we are left with a lot of uncertainty as to exactly what steps and protections will be undertaken – what commitment is being made. To use an analogy, it is great to know that a car has a seatbelt and that the driver knows how to use it. But it is better to have support and compliance control systems in place (a buzzer for example), and a specific commitment by the driver to use the safety device and laws that require its use. It would go a long way to assuaging concerns about the project if such were the case.

Q. Beyond the broad items, what else raises concern?

A. There are a few things that immediately come to mind in this regard.

The first are water related. Scant attention, other than as a construction impediment, seems to be given to the role and importance of water in the safe conduct of the project. Dr. Kutschke in his 2018 paper rightly emphasizes the significance of water as a concern and as an actor leading to sinkhole development. In Mr. Yamatani's paper, water is not really mentioned, and the emphasis is on controlling construction costs and optimizing schedules. We need to consider water as a resource, as well as a potential hazard or impediment to construction. It seems to me that the best way to accomplish that is to begin by developing an understanding of the local hydrology system(s), and then proceeding from there. That might involve such things as dye tracing, quantitative analysis of flows, or other techniques described in the literature. It is not ideal to simply look at the surface karst features, or localized settings. It is more useful to consider the system as a whole, both across the landscape and at depth first, and then to move to location specific concerns.

Finally, the level of documentation and planning that has been shared, for a project of this size, seems sparse. I would hope that somewhere in the process a detailed written plan, including protocols and QA/QC, would be put forth. This sort of document, if vetted, would serve the double role of assuring that proper steps are taken to protect public and the environment, as well as reassuring the public that their welfare is being attended to.

Q. What sources have you relied upon and/or reviewed?

A. My surrebuttal testimony is mainly a review of the rebuttal testimony presented by Mr. Yamatani (Transource Pennsylvania LLC Statement No. 12-R). I also examined papers which were authored by Dr. Kutschke and Mr. Yamatani, and make reference to a book.

> Benson, R. C., and Yuhr, L. B., 2016, Site Characterization in Karst and Pseudokarst Terraines: Practical Strategies and Technology for Practicing Engineers, Hydrologists and Geologists, Springer, 440 p.:
>
> Kutschke, W.G., 2018, Case histories: Karst successes and failures in the Eastern United States, in: Sasowsky, I.D., Byle, M.J, and Land, L., (eds.), Proceedings of the 15th Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Impacts of Karst and the 3rd Appalachian Karst Symposium, April 2-6, Shepherdstown, West Virginia: NCKRI Symposium 7. Carlsbad, New Mexico: National Cave and Karst Research Institute, p. 375-382.
>
> Yamatani, K., and Jahangir, A., 2011, Mitigating Risk and Managing Foundation Cost and Schedule on "Mega" Transmission Line Projects: Beginning with the End in Mind, in: Juang, C.H., Phoon, K.K., Puppala, A.J., Green, R.A., and Fenton, G.A. (eds.), GeoRisk 2011: Geotechnical Risk Assessment and Management, ASCE GSP No. 224, p. 1117 – 1124.

Q. Does this complete your surrebuttal testimony?

A. Yes, it does. I offer these opinions to a reasonable degree of scientific certainty. As more information becomes available from Transource about the proposed route of the transmission lines, field data collected, it may be necessary to supplement my testimony. I reserve the right to supplement my testimony at any time during the course of this proceeding, including after receiving the results of environmental investigations and geotechnical recommendations from DiGioia Gray that Transource is ordered to provide once complete and which have not yet been made available, and further, to supplement my testimony.

BEFORE THE PENNSYLVANIA PUBLIC UTILITY COMMISSION

Application of Transource Pennsylvania, LLC for approval of the Siting and Construction of the 230 kV Transmission Line Associated with the Independence Energy Connection - East and West Projects in portions of York and Franklin Counties, Pennsylvania.	: : : : : : :	A-2017-2640195 A-2017-2640200
Petition of Transource Pennsylvania, LLC for a finding that a building to shelter control equipment at the Rice Substation in Franklin County, Pennsylvania is reasonably necessary for the convenience or welfare of the public.	: : : : : : :	P-2018-3001878
Petition of Transource Pennsylvania, LLC for a finding That a building to shelter control equipment at the Furnace Run Substation in York County, Pennsylvania is reasonably necessary for the convenience or welfare of the public.	: : : : : :	P-2018-3001883
Application of Transource Pennsylvania, LLC for approval to acquire a certain portion of the lands of various landowners in York and Franklin Counties, Pennsylvania for the siting and construction of the 230 kV Transmission Line associated with the Independence Energy Connection – East and West Projects as necessary or proper for the service, accommodation, convenience or safety of the public.	: : : : : : : :	A-2018-3001881, et al.

VERIFICATION

I, Ira D. Sasowsky, hereby state that the facts above set forth in my Surrebuttal Testimony are true and correct and that I expect to be able to testify as to the same at the hearing held in this matter. I understand that the statement herein are made subject to the penalties of 18 Pa. C.S. § 4904 (relating to usworn falsification to authorities).

Ira D. Sasowsky
379 Bittersweet Road
Akron, OH 44333

Date: January 30, 2019

STFC Stmt 2
2/21/19
Hrg Dr

BEFORE THE

PENNSYLVANIA PUBLIC UTILITY COMMISSION

Application of Transource Pennsylvania, LLC for approval of the Siting and Construction of the 230 kV Transmission Line Associated with the Independence Energy Connection - East and West Projects in portions of York and Franklin Counties, Pennsylvania.	A-2017-2640195 A-2017-2640200

STOP TRANSOURCE FRANKLIN COUNTY
WITNESS TESTIMONY OF JOSEPH DAGUE

TOPICS ADDRESSED: **Mineralogy and Local Significance of Falling Spring**

Q. Please state your name and address.

A. My name is Joseph A. Dague, Jr., and I reside at 1296 Falling Spring Road, Chambersburg, PA 17202-9009.

Q. What is your occupation?

A. Although I reached full retirement age in 2009, I currently serve as curator of the Frank D. Masters Mineral Gallery at Elizabethtown College, Elizabethtown, PA. I have also continued my business as a specialized mineral collection appraiser, and dealer in earth science specimens for museums, schools and private collectors, which I began in 1988.

Q. What is your educational background?

A. I attended two years of college at the Pennsylvania State University.

Q Are you a member of any professional organizations?

A. I am a member of PA Chapter Friends of Mineralogy and the Nittany Mineralogy Society.

Q. What qualifications do you have?

A. In the past, I served as President of the Clearfield County Historical Society and Vice President of the Clearfield Heritage Foundation. I have published feature articles on Pennsylvania history in *Pennsylvania Magazine, Pennsylvania Outdoors, PA Game News, Farm and Home Journal* and the Progressive Publishing Company's newspaper, *The Progress.*

I assisted two Ph.D. geologists and a Ph.D. paleontologist with the Penn State Mineral Museum in the discovery and recovery of the fragmentary skeleton of an American mastodon entombed in a swamp near Satillo, Huntingdon Co., PA. At the request of the late Dr. Jim Hatch, anthropologist and director of the Penn State Anthropology Museum, I located the prehistoric Carbaugh Hollow Quarry site on South Mountain, Franklin Co., PA and collected lithic artifacts for his research. Since 2016, I have been helping a professional archaeologist from Maryland and a retired geochemist from the PA Geological Survey locate and survey those prehistoric quarry sites on South Mountain in an effort to discover the geochemical "signatures" of the key rock type, metarhyolite, and assess the long distance trade of this material throughout the Middle Atlantic.

I have also served as editorial consultant for *MATRIX-A Journal of the History of Mineral Collecting*, and published several articles on mineralogy in national and regional publications, including co-authoring a professional paper in 2016 for the PA Field Conference of Geologists. I have participated as an invited speaker at the Penn State Mineral Symposium, The PA Chapter, Friends of Mineralogy Symposium, and other geological events.

Based on my participation in these and other research projects, as well as my 50 plus years of field collecting, identifying and cataloging mineral, fossils and artifacts--principally from Pennsylvania, I am familiar with the local geoglogy and archeology of South Mountain and Cumberland Valley.

Further, I have lived in my home at Falling Spring for 22 years, and also quite familiar with the cultural and natural history of the site near Transource's proposed Falling Spring Crossing, which is a few feet from my house.

Q. What is the purpose of your testimony?

A. I will set forth the particularly local history of the Falling Spring area, as a source of archeologic resources due to the unique mineralogy and geologic positions. Second , I describe the more recent 19th century local history that is threatened by the installation of a proposed transmission line through greenfield properties in Franklin County in the Falling Spring area and beyond.

Q. Please describe the local information you have about the Falling Spring mineralogy and geology.

A. The Transylvanian Fault underlies the Falling Spring Branch Creek and has torn open twice in geologic history. Six miles east of Aqua (the original name for our community on Falling Spring), this east-west tear fault lopped off the northern 30 miles of South Mountain and shoved it three miles west. The fault zone extends along the 40 degree N Latitude across southern Pennsylvania. Here, at the proposed transmission line-crossing site, the severely fault-broken and weathered limestone rocks (known as karst) have provided passageways for both the streambed and underground drainage.

Erection of utility towers in the ground on the fault zone is a problem. The amount of drilling and blasting that may be necessary to anchor these towers to the subsurface pinnacles and depressions has the potential to destroy the water system of the Falling Spring Branch Creek, and the connected springs and wells that serve as a water source to some residents of the community.

Q. Please describe the local springs in the area near the proposed route.

A. As evidence of the karst topography of this area, four of nearly a score of natural springs that feed into Falling Spring Branch Creek rise within 500 feet of where the proposed transmission line will cross the creek. One rises underneath my home and provides my water supply, and there's another one on the adjacent Guilford Township Water Authority property on the west side of my residence. The other two springs are along Garmen Drive, just northeast of the intersection with Falling Spring Road.

Q. Please describe the history of the prehistoric settlements in this area and what type *of artifacts can be found*

A. Very large outcrops of a rock commonly called rhyolite occur on South Mountain. A large prehistoric rhyolite quarry site is located along Carbaugh Run near Caledonia State Park, about nine miles east of Falling Spring Branch Creek at Aqua. Subjected to intense heat and pressure by volcanic activity metamorphosed this rock into its present form of metarhyolite. This rock proved to be suitable for the manufacture of stone tools. So much so, that it became the dominant lithic material for prehistoric peoples throughout the Middle Atlantic and Northeast regions. The presence of this metarhyolite was an important factor determining settlement in the South Mountain area.

The most extensive use of metarhyolite from South Mountain occurred during the Late Archaic Period, ca 3,000 to 1,000 BCE. During this time, a variety of small base camps and procurement/processing sites expanded to saddles and flats near springs and streams close to South Mountain.

The borough of Chambersburg unearthed two such encampment sites on either side of Falling Spring Branch Creek in 2001, while installing a water transmission main along Edwards Avenue, Guilford Township. Those sitesare adjacent the proposed Transource route and less than one-half mile from the crossing site at Falling Spring Branch Creek. The Harrisburg engineering firm of Gannett Fleming conducted a required two-phase archeological investigation of those sites.

Over the 22 years I have lived here on Falling Spring Branch Creek, I, and other collectors, have found hundreds of prehistoric stone and shell artifacts on the surface of the property where I reside and all along the creek embankment of the Skelly Farm. Many of the specimens I have collected have been examined by archeologists and estimated to span over a millennia from the Late Archaic Period into the Early Woodland Period.

Q. What recommendations do you have with respect to archeological surveys that should be performed?

A. Based on my experience observing abundant archeological artifacts within 500 feet on either side of the proposed route in the Falling Spring arrea, Transource should conduct field archeological surveys every 50 feet along the proposed route to record what is found in the pits. In addition a transverse survey with g round penetrating radar should be made across the route along the Skelly Farm creek embankment and on the embankment on the opposite side of the creek.

Q. What can you tell us about the history of your home, and the historic importance of the hill 14 near Falling Spring Elementary School, which is now part of the Falling Spring Cross Country Course?

A. My home, which sits within a few hundred feet of the proposed power line, dates back to 1855. An earlier log settlement house preceded it. Throughout most of its history, members of the Anabaptist faith lived here, and in 1911 built a stone lined pool here for their congregation's baptism ceremonies. The spring located in the old milk house, which is now attached to main house, feeds that pool.

The hill and woods stretching along Falling Spring Road from my home to the Falling Spring Elementary School includes part of the Chambersburg School District's scholastic sports Cross Country Course, as well as a public green-space recreation trail for hikers and runners. At one time nearly all farms along Falling Spring kept tracts of woodland, this is the last of those preserves. Originally this height of land was known as "Stoner's Hill." Between South Mountain to east and the ridges to the west, it is the highest spot in the Cumberland Valley around Chambersburg. Before the Battle of Gettysburg, the hill was occupied by a detail of Confederate soldiers as a signal or "wigwag" station. The soldiers in charge were reported well-mannered men and took turns coming down to the same house I now where I now live for food. They sat at the table with the family and before leaving politely offered to pay for their meals--in Confederate currency.

Jacob H. Stoner, local educator and historian born in 1861-- in the same house that I reside-- wrote in his 1942 article, *Up and Down the Falling Spring*, "Years ago the Falling Spring Road was known far and wide as a delightful drive and many were the families from Chambersburg and elswhere who drove out that way in their one or two-horse carriages, or low slung phaetons, to view the beautiful scenery and while away a few evening hours. The drive to the head of the Falling Spring and return was one of those things to do seventy or eighty years ago."

Q. What sources have you relied on?

A. Custer, Jay F. (1996), *Prehistoric Cultures of Eastern Pennsylvania*, Commonwealth of Pennsylvania, Pennsylvania Historical and Museum Commission, Harrisburg.

Fauth, John L. (1968), *Geology of Caledonia Park Quadrangle Area, South Mountain, Pennsylvania*, Atlas 129a, Commonwealth of Pennsylvania, Topographic and Geologic Survey.

Shirk, William R. (1980), *A Guide to the Geology of South Central Pennsylvania*, Department of Geography -- Earth Science, Shippensburg State College, Shippensburg, Pennsylvania 17257.

Stoner, Jacob H. Stoner (1947), *Historical Papers, Franklin County and the Cumberland Valley*

Pennsylvania, The Craft Press, Inc., Chambersburg, Pa.

Stose, George W. (1932), *Geology and Mineral Resources of Adams County Pennsylvania*, Bulletin C1, Commonwealth of Pennsylvania, Topographic and Geologic Survey.

Van Diver, Bradford B. (1990), *Roadside Geology of Pennsylvania*, Mountain Press Publishing Company, Missoula.

(1980), *Geologic Map of Pennsylvania*, Commonwealth of Pennsylvania, Topographic and Geologic Survey.

Q. Does this complete your testimony?

A. Yes, it does. As more information becomes available from Transource about the proposed route of the transmission line, field data collected, any archeological surveys conducted, it may be necessary to supplement my testimony. I reserve the right to supplement my testimony at any time during the course of this proceeding.

BEFORE THE PENNSYLVANIA PUBLIC UTILITY COMMISSION

Application of Transource Pennsylvania, LLC	:	
Filed Pursuant to 52 Pa. Code Chapter 57,	:	Docket No. A-2017-2640195
Subchapter G, for Approval of the Siting and	:	Docket No. A-2017-2640200
Construction of the 230 kV Transmission Line	:	
Associated with the Independence Energy	:	
Connection-East and West Projects in Portions of	:	
York and Franklin Counties, Pennsylvania	:	

VERIFICATION

I, Joseph Dague, hereby state that the facts above set forth in my Direct Testimony Witness Statement are true and correct and that I expect to be able to testify as to the same at the a hearing held in this matter. I understand that the statement herein are made subject to the penalties of 18 Pa. C.S. § 4904 (relating to usworn falsification to authorities).

Joseph A. Dague, Jr.

Joseph Dague
1296 Falling Spring Road
Chambersburg, PA ~~17272~~ 17202

Date: September 27, 2018