STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
ENERGY FACILITY SITING BOARD

IN RE: APPLICATION OF
INVENERGY THERMAL DEVELOPMENT LLC'S
PROPOSAL FOR CLEAR RIVER ENERGY CENTER

DOCKET SB-2015-06

PRE-FILED DIRECT TESTIMONY
OF
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Introduction

Q. Please state your name and occupation, and provide your office address.

A. My name is Scott Comings, and I am the Associate State Director of The Nature Conservancy in Rhode Island. My office address is 159 Waterman Street, Providence, RI, 02906.

Q. Please describe The Nature Conservancy.

A. The Nature Conservancy's (The Conservancy) mission is to "conserve the lands and waters on which all life depends." Our vision is a world where the diversity of life thrives, and people act to conserve nature for its own sake and its ability to fulfill our needs and enrich our lives. The Conservancy pursues non-confrontational, pragmatic solutions to conservation challenges working with partners including indigenous communities, businesses, governments, multilateral institutions, and other non-profits.

The Conservancy's work focuses on the global priorities of Lands, Water, Climate, Oceans, and Cities. Founded in Arlington, Virginia, in 1951, The Nature Conservancy now impacts conservation in 69 countries, including all 50 states of the United States. The Conservancy has over one million members, and has protected more than 119,000,000 acres (48,000,000 ha) of land and thousands of miles of rivers worldwide. The Nature Conservancy also operates more than 100 marine conservation projects globally. The organization's assets total $6.71 billion as of 2015. The Nature Conservancy is the largest environmental nonprofit by assets and by revenue in the Americas.

The Nature Conservancy rates as one of the most trusted national organizations in Harris Interactive polls every year since 2005. Forbes magazine rated The Nature Conservancy's fundraising efficiency at 88 percent in its 2005 survey of the largest U.S. charities. The Conservancy received a three-star rating from Charity Navigator in 2016 (three-star in 2015). The American Institute of Philanthropy gives the Conservancy an A- rating and includes it on its list of "Top-Rated Charities." Finally, the

Conservancy is an accredited organization by the Land Trust Alliance, meeting national standards for protecting important natural places and working lands.

The Nature Conservancy is led by President and CEO Mark Tercek, a former managing director at Goldman Sachs. He is the author of the Washington Post and Publisher's Weekly bestselling book Nature's Fortune: How Business and Society Thrive by Investing in Nature. The Nature Conservancy's Chief Scientist is Australian Hugh Possingham, who was named to this position in 2016. The organization's Board of Directors draws from all segments of the community. The current board chairman is Craig McCaw, the Chairman & CEO of Eagle River Inc. Other current members include former U.S. Senator Bill Frist, chairman of the Alibaba Group Jack Ma, and Chairman and Co-founder of The Bridgespan Group Thomas Tierney. There are currently over 4,000 employees working for the Conservancy worldwide.

The Nature Conservancy in Rhode Island began its work in Rhode Island in 1965 supporting Audubon Society of Rhode Island's acquisition of the Davis Memorial Refuge in North Kingstown and accepted our first land donation in 1968. After working on land conservation in Rhode Island from the Boston office for 21 years, The Conservancy opened its Rhode Island Office in 1989. By 1999, the Chapter had grown from 3 staff members to 23 becoming one of the largest conservation organizations in the state focused on conserving and managing land and freshwater in Rhode Island.

As of 2016, the chapter has 28 full time employees and over 3,000 members. The Conservancy has worked to conserve over 35,000 acres in Rhode Island. The Conservancy owns and manages almost 10,000 acres making it the largest non-governmental landowner in the state. The Conservancy priorities now include conserving lands and freshwater, restoring ocean and coasts, and a recently-launched Providence Metro Program focused on nature-based solutions to climate change, storm water runoff, and other environmental impacts.

The RI Chapter Timeline is included as Attachment A to this testimony.

Q. Please summarize your qualifications.

A. I have a BA in Biology with a focus in ornithology. I worked as a field ornithologist for Brown University, University of California, Davis, Smithsonian Migratory Bird Center, and Louisiana State University. In 1997, I started working for The Nature Conservancy and since then have held many positions including Education Coordinator, Block Island Director, Director of Stewardship, and Director of Land and Freshwater Conservation. I currently hold the position of Associate State Director. As part of my role at The Nature Conservancy I have worked with and facilitated hundreds of scientific research projects in the state, participated in multiple statewide habitat assessments and overseen stewardship of all of the Conservancy's Rhode Island lands since 2009.

My CV is included as Attachment B to this testimony.

Q. Please summarize your specific experience and familiarity with the Northwest Corner of Rhode Island and Burrillville area.

A. The Nature Conservancy has recognized the ecological significance and conservation value of this area for decades. In 1997, I reviewed the document The Nature Conservancy drafted called the "Northwest Corner Conservation Plan" which highlighted the area's ecological value, documented threats to its ecological integrity, and prioritized conservation strategies. In the plan, this area is noted for its "large patches of relatively unfragmented forest" and is described as follows: "…in the statewide and regional contexts, the Northwest Corner is an ecologically distinct, biologically significant region in Rhode Island, worthy of conservation concern. Protection of the forested ecosystem of the Northwest Corner is a vital component of The Conservancy's efforts to protect the diversity of species and ecosystems found in Rhode Island and New England as a whole." Forest fragmentation, the breaking of large, contiguous, forested areas into smaller pieces of forest, typically by roads, agriculture, utility corridors, subdivisions, or other human development, was identified as the major source of stress to this ecosystem.

The Northwest Corner Conservation Plan is included as Attachment C to this testimony.

In 2001, I was one of many who assisted with The Nature Conservancy's completion of a regional assessment of this area called The Lower New England/Northern Piedmont Ecoregional Plan. This plan evaluated the relative ecological value of places or "sites" within an ecoregion that includes portions of 12 states and the District of Columbia, from Southern Maine to Northern Virginia. Two of these priority sites, Croff Farm Brook, and Cedar Swamp Pond, are located within the forest block that contains the proposed construction site. These locations were identified as important contributors to the biodiversity of the entire region and identified as priorities for conservation. These priorities as well as others identified by The Lower New England/Northern Piedmont Conservation Plan and the North Atlantic Coast Conservation Plan formed the basis of the conservation priority map or 'portfolio' that The Nature Conservancy has used as a guiding document when prioritizing conservation action throughout the state.

In 2012, I led The Nature Conservancy in Rhode Island's process to update its portfolio map to better incorporate a 'whole system' approach to conservation. This approach emphasizes the value of larger landscapes of connected sites over isolated islands of natural preserves. With the goal of connectivity in mind the Nature Conservancy's portfolio map was redrawn and the value of the natural block of land containing the proposed development and the Croff Farm Brook and Cedar Swamp Pond sites was again highlighted.

In addition to state-wide ecosystem assessment work, since 2009 I have been working on land acquisition in mainland Rhode Island (leading the program since 2011) and overseeing stewardship on all Conservancy lands in the state; both of these efforts include the Northwest Corner and Burrillville. In 2012 on behalf of The Nature Conservancy, I assisted the Rhode Island Department of Environmental Management (RIDEM) with the conservation of 188 acres (former Boy Scouts property) in the described natural corridor in western Burrillville. This conservation project served as a continuation of our

commitment to conservation in this area. Other notable acquisitions are in 2003 The Conservancy assisted RIDEM with the conservation of 200 acres and in 2008, The Conservancy assisted RIDEM and the Burrillville Land Trust with the conservation of 86 acres. Over the last seven years on behalf of The Nature Conservancy, I have been very active in the larger landscape that the Northwest Corner is contained within called the "Borderlands Landscape" specifically around our Tillinghast Pond Management Area in West Greenwich and Coventry.

Q. You mentioned the Borderlands Landscape – what is that?

A. The Borderlands Landscape refers to the relatively undeveloped region in the vicinity of the border shared by Rhode Island and Connecticut. It begins in the south around Rhode Island's Arcadia Management Area and the adjacent Pachaug State Forest in Connecticut. It then runs north and includes the Northwest Corner described earlier. Conservation in this area has been a priority for the state and towns for many years, with a large part of the state's Arcadia Management Area dating back to 1954. This area has been a priority for The Conservancy since we started working in Rhode Island.

Q. How long has The Nature Conservancy been working on the Borderlands Landscape?

A. The Nature Conservancy has recognized the importance of the Borderlands since it began work in Rhode Island in 1968. The Conservancy purchased the Butler tract of the Ell Pond Preserve in 1972 and continued to actively work in and acquire land here until 2002 when The Conservancy started a formal Borderlands Landscape Project. This project's purpose was the focused conservation and management of this ecologically important landscape.

Q. How long have you been involved in the Borderlands Landscape?

A. I have been involved with stewardship and land acquisition in the Borderlands Landscape since 2009.

Q. Are you working with any partners on the Borderlands Landscape?

A. Yes, we work with many partners in the landscape, including: The Audubon Society of Rhode Island, The West Greenwich Land Trust, The Burrillville Land Trust, The Town of West Greenwich, Rhode Island Department of Environmental Management, The Hopkinton Land Trust, The Foster Land Trust, and The Town of Coventry.

Q. What is the current status of the Borderlands Landscape?

A. The Borderlands is an ecologically valuable forest ecosystem that is one of the best examples of its type between Boston and Washington DC. It contains tens of thousands of acres of relatively unfragmented forest and The Nature Conservancy is working with partners to try preserve its current state.

Q. On whose behalf are you testifying in this case?

A. I am testifying on behalf of the Conservation Law Foundation (CLF). My testimony also reflects the position of The Nature Conservancy.

Q. Has The Nature Conservancy formally taken a position with respect to the Invenergy proposal?

A. Yes.

Q. What is The Nature Conservancy's position?

A. The Nature Conservancy opposes the development of the Invenergy power plant proposed for Burrillville because it will make it more difficult for Rhode Island to achieve its newly enacted greenhouse gas reduction targets; it has not been proven necessary to meet energy needs; and it will pose unacceptable environmental risks to habitats and plant and animal species.

The Nature Conservancy's position statement is included as Attachment D to this testimony.

Q. In your experience, is it common for The Nature Conservancy to take a position on a proposed development project in Rhode Island?

A. No, it is very rare.

Q. To the best of your knowledge, why has The Nature Conservancy taken a position in this case?

A. The Nature Conservancy is taking a position in this case because we find it important to prevent the negative impacts that we believe this development will have on the ecological health, resilience, connectivity, and biodiversity of this regionally significant landscape.

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to address the effects of Invenergy's proposed power plant on the environment, specifically with respect to habitat, connectivity, resilience, and biodiversity.

Q. Why are you addressing habitat and biodiversity but not climate or energy reliability?

A. Other expert witnesses are speaking to climate and energy reliability. My expertise is in Rhode Island biota and ecological communities and thus I can only address the habitat and biodiversity impacts of this proposed development.

Q. What documents do you rely upon in your analysis, and for your findings and observations?

A. I rely upon the following documents:

1. The Nature Conservancy, Northwest Corner Conservation Plan (October 1997);

2. The Nature Conservancy, Lower New England – Northern Piedmont Ecoregional Conservation Plan (January 2001), available as Link 1;

3. The Nature Conservancy, Maintaining a Landscape that Facilitates Range Shifts for Terrestrial Species (June 30, 2016), included as Attachment F;

4. The Nature Conservancy, Resilient and Connected Landscapes for Terrestrial Conservation (2016), available as Link 2;

5. The Nature Conservancy, Resilient Sites for Terrestrial Conservation in Eastern North America (2016), available as Link 3;

6. The Nature Conservancy in Rhode Island's Terrestrial Conservation Portfolio Map, included as Attachment G;

7. The Nature Conservancy, Modeling Landscape Permeability (January 24, 2012), available as Attachment H;

8. Mark G. Anderson and Charles E. Ferree (2010), Conserving the Stage: Climate Change and the Geophysical Underpinnings of Species Diversity. PLoS ONE 5(7):e11554. Available as Attachment I.

Summary Observations

Q. Please summarize your findings and observations.

A. In my opinion, the location of the proposed development will have unacceptable negative ecological impacts. The location of this proposed development lies in a regionally significant, relatively unfragmented forested landscape. Furthermore, the development lies directly in a corridor that has been identified as a natural flow concentration area, meaning that this area is a 'pinch point' or 'bottleneck' for species movement across the landscape. Development of the type proposed brings a number of negative ecological impacts. The creation of impervious surfaces, noise, light pollution, wetland destruction, deforestation, and other effects, can act as barriers to species movement and disrupt these natural ecosystems.

Q. How is your testimony structured?

A. First, I explain the science underlying my understanding of how the proposed Invenergy plant will affect habitat and biodiversity. I introduce the concept of habitat connectivity and explain how connectivity is essential to wildlife conservation in the face of rampant habitat loss and climate change. I also discuss why science indicates that focusing on habitat is more important than focusing on species-level effects when considering wildlife conservation. I conclude this section of my testimony by explaining some methods for assessing habitat connectivity.

Next, I examine the Invenergy plant's proposed location. I place the site in context, looking at the high level of development along the coast from Washington, D.C. all the way to Boston, and highlighting how western Rhode Island is one of the few remaining pockets of unfragmented habitat in

the northeast coastal United States. Then I zoom in on Burrillville and show how the site of the proposed Invenergy plant would break up this presently unfragmented habitat, eliminating an important wildlife corridor and undermining decades of coordinated conservation efforts. Finally, I conclude that by causing the negative impacts briefly sketched above and set forth in detail below, the proposed power plant would pose unacceptable harm to the environment.

The Science of Habitat and Biodiversity

Q. What is habitat connectivity?

A. Habitat connectivity is the degree to which the landscape facilitates animal movement and other ecological flows. Wildlife need to move. Mobility is the key to survival for many wildlife species. For most of the 20th century conservation focused on the conservation of 'islands' (distinct areas) of important habitat. To ensure resilient habitats that can change and allow the flow of species between these 'islands' we must consider connectivity – how these important habitats are distributed and connected on the landscape. To map connectivity we evaluate the landscape in terms of permeability. The permeability of a landscape is a function of spatial arrangement: the types and expanse of barriers to animal movement, the connectedness of natural cover, and the arrangement of land uses. Taking this into account, connectivity is the degree to which a landscape encompassing a variety of natural, semi-natural, and developed land cover types will sustain ecological processes and be conducive to the movement of many types of organisms as well as facilitate the rearrangement of existing communities in response to change.

Q. Why does habitat connectivity matter?

A. Habitat connectivity is an important component of resilient natural systems. Connectivity is critical for species movement as they disperse from their birth sites to breeding sites. It is also critical for movement or dispersal between breeding sites, allowing the flow of genetic material through

populations. Connected landscapes are more resilient to disturbance by allowing recolonization after disturbance events.

Q. In its advisory opinion to the Energy Facility Siting Board in this docket, RIDEM wrote that "[f]ish and wildlife rely on habitat connectivity to find scarce resources, preserve gene flow, and locate alternatives to lost habitat."[1] Do you agree?

A. Yes.

Q. In your opinion, what does it mean that fish and wildlife rely on habitat connectivity to find scarce resources?

A. Animals rely on connected landscapes in part due to the seasonal variability in available resources such as shelter, food, and water. Animals need to move from one place to another to sustainably use these resources.

Q. In your opinion, what does it mean that fish and wildlife rely on habitat connectivity to preserve gene flow?

A. It is important for populations and sub-populations to exchange members to maintain a diverse genetic stock. Isolated populations are at risk of inbreeding leading to low genetic diversity which in turn may make them susceptible to disease as well as a less adaptable population.

Q. In your opinion, what does it mean that fish and wildlife rely on habitat connectivity to locate alternatives to lost habitat?

A. Having pathways for wildlife to find new opportunities to mitigate disturbance and climate change is crucial to long term sustainability. For example, if changes in water temperature, a natural disaster, or human development significantly alters the habitat of a particular species, connectivity allows that species to migrate to a new area that provides acceptable living conditions for that species

[1] Advisory Opinion at 10, *available at* http://www.ripuc.ri.gov/efsb/efsb/SB2015_06_ADV_DEM.pdf.

to thrive. On the converse, fragmentation could mean that species are unable to adapt to the changes in habitat.

Q. Does climate change affect the importance of habitat connectivity?

A. Yes.

Q. How does climate change affect the importance of habitat connectivity?

A. The natural world constantly rearranges, but climate change is expected to accelerate these natural dynamics, shifting seasonal temperature and precipitation patterns and altering disturbance cycles of fire, wind, drought, and flood. Rapid periods of climate change tens of thousands of years ago, when the landscape comprised continuous natural cover, saw shifts in species distributions but few extinctions. Not surprisingly, the need to maintain connectivity has emerged as a point of agreement among scientists. Maintaining a permeable landscape, when done in conjunction with protecting and restoring sufficient areas of high quality habitat, should facilitate the expected range shifts and community reorganization.

Pervasive landscape fragmentation disrupts ecological processes and impedes the ability of many species to respond, move, or adapt to changes. The concern is that broad-scale degradation will result from the impaired ability of nature to adjust to rapid change, creating a world dominated by depleted environments and weedy generalist species. Fragmentation then, in combination with habitat loss, poses one of the greatest challenges to conserving biodiversity in a changing climate.

In August 2016, the New England Governors and Eastern Canadian Premiers acknowledged this essential role of connectivity when they adopted Resolution 40-3, Resolution on Ecological Connectivity, Adaptation to Climate Change, and Biodiversity Conservation. While noting that global climate change is a prominent threat to the vital forest ecosystems of New England and the eastern Canadian provinces, the resolution recognizes “the importance of ecological connectivity for the adaptability and resilience of our region’s ecosystems, biodiversity, and human communities in the face of climate change.” The

resolution instructs agencies within their jurisdiction "to identify priority connectivity zones that connect and expand existing protected areas" and advises them to "support land protection and planning efforts that maintain and improve connectivity."

Resolution 40-3 is included as Attachment E to this testimony.

Q. You mentioned range shifts – what are those?

A. A species range is the full geographic area where a species can be found. As temperature and precipitation patterns change, the location and distribution of the conditions that a species finds favorable will likely also change. This will result in a species occupying a different geography. This change in geography is a range shift. Increases in temperature are having the effect of shifting ranges up-slopes and northward to relatively cooler areas.

Q. Are there any other effects of climate change that impact the importance of habitat connectivity?

A. There are likely many unknown impacts from climate change. A network of connected habitats offering a variety of landscape characteristics provides options for animals and provides them the best opportunity to find suitable habitat in the face of those unknowns. Large intact tracts of land with a variety of microclimates similarly provide opportunities and means to access them.

Q. When assessing the possible ecological effects of a project like the proposed Invenergy plant, does it make more sense to assess effects on habitat, or species-level effects?

A. Effects on habitat.

Q. Please explain.

A. Rather than trying to protect biodiversity one-species at a time, the key is to protect the ultimate drivers of biodiversity. The world has always experienced some measure of climate change and species ranges are not fixed. Accordingly, we should seek to maintain the landscape features that ultimately control species richness rather trying to preserve a specific suite of species in a given location

that is really just a snapshot in time of a naturally changing landscape. By focusing our conservation efforts on the preservation of a connected network of natural lands with a variety of habitat types we provide the opportunity for a diverse assemblage of species to exist under both current and future climates.

Q. How do you assess habitat connectivity?

A. The Nature Conservancy assesses habitat connectivity using a "regional flow patterns" dataset developed by The Conservancy. The regional flow patterns dataset was designed to identify potential larger-scale directional movements and pinpoint the areas where these movements are likely to become concentrated, diffused, or rerouted, due to the structure of the landscape. Conservancy GIS Specialists used the software tool Circuitscape (program designers: McRae and Shah; release date: 2009; program link: http://www.circuitscape.org/) based on electric circuit theory, to model these larger flow patterns for the region. The underlying data for this analysis was land-cover and road data converted to a resistance grid by assigning weights to the cell types based on their similarity to cells of natural cover. However, instead of quantifying local neighborhoods, the Circuitscape program calculates a surface of effective resistance to current moving across the whole landscape. The output of the program, an effective resistance surface, shows the behavior of directional flows. Analogous to electric current or flowing water, the physical landscape structure creates areas of high and low concentrations similar to the diffuse flow, braided channels, and concentrated channels one associates with a river system. Three basic patterns can be seen in the output, as the current flow will: 1) avoid areas of low permeability where there would be significant obstacles for wildlife to travel, 2) diffuse in highly intact/highly permeable areas where animals can move freely, or 3) concentrate in key linkages where flow accumulates or is channeled through a pinch point. Concentration areas are recognized by their high current density, and the program's ability to highlight concentration areas and pinch-points made it particularly useful for identifying the linkage areas that may be important to maintaining a base level of

permeability across the whole region. The result is a map overlaid with colored cells, where each colored cell indicates the 'permeability' or flow possible across that portion of the map.

Q. Can any other kinds of maps or images provide information about connectivity?

A. There are many ways to map intact, or locally connected lands. Many rely on satellite data such as those that map forest cover, water and developed impervious surfaces such as roads and buildings. Satellite images taken at night provide a useful tool for mapping human activity. These maps indicate areas of light pollution, and they can also act as a good indicator of habitat connectivity.

Q. How does a map showing areas of light pollution provide information about habitat connectivity?

A. Nighttime lights are a consistent and easy to visualize way of mapping human developments that act as barriers to ecological flow. Areas with brighter lights tend to be cities or otherwise dense human development. Darker areas tend to be natural areas with less habitat fragmentation and other negative ecological impacts associated with human development.

Q. Does nighttime light have any broader importance when it comes to assessing habitat and biodiversity?

A. Yes. Though human development can harm the integrity of ecological systems in a number of ways, light pollution itself can have negative impacts. These nighttime lights maps are a direct measure of this light pollution, at least on a regional landscape scale.

Q. In its advisory opinion to the Energy Facility Siting Board in this docket, RIDEM wrote that "[t]he effects of artificial lighting on animals include[] attracting and killing night-flying insects as well as repelling animals that are sensitive to light."[2] Do you agree?

A. Yes.

Q. Please explain.

[2] Advisory Opinion at 15.

A. As RIDEM mentioned nighttime flying insects are particularly vulnerable and are often attracted to these light sources, and animals that have evolved to take advantage of the cover of darkness will avoid them.

Q. The Department of Environmental Management also mentioned possible "disruption of circadian rhythms" from light pollution.[3] Do you agree that light pollution can cause "disruption of circadian rhythms?

A. Yes.

Q. Please explain.

A. While some animals avoid areas of light pollution for many it changes their daily cycle causing unnatural longer periods of mating, foraging and other diurnal activities. The extension of these diurnal activities causes the ecological system to become out of balance.

Q. You mentioned maps showing "flow" above. What information can be conveyed by a map showing "flow?"

A. Animals' movement across the landscape can be hindered or redirected based on barriers or even perceived barriers. By mapping the distribution and pattern of these barriers across the landscape we can model the most likely "path of least resistance" that animals will take as they move across the landscape. There are many methods of mapping general landscape permeability; these show contiguous natural areas that allow movement within a location. More recently applications such as Circuitscape are being used to identify the larger scale patterns of movement on the landscape. The use of these tools allows planners to identify places with a high concentration of flow, indicating a bottleneck or pinch point of flow.

Q. What does "flow" mean in the context of one of these maps?

[3] Advisory Opinion at 15.

A. Flow in the context of these maps represents the movement of animals across the landscape. It also means the movement of habitats including plant species as they shift about the landscape in response to changes and stresses such as those that result from climate change.

Q. Are there any peer-reviewed scientific studies that support the use of connectivity flow maps for determining habitat connectivity?

A. Yes:

1. McRae, B. H., Dickson, B. G., Keitt, T. H. and Shah, V. B. (2008), Using circuit theory to model connectivity in ecology, evolution and conservation. Ecology, 89: 2712–2724. Available as Attachment J.
2. Theobald, D. M., Reed, S. E., Fields, K. and Soulé, M. (2012), Connecting natural landscapes using a landscape permeability model to prioritize conservation activities in the United States. Conservation Letters, 5: 123–133. Available as Attachment K.
3. McRae, Brad H., and Paul Beier (2007), Circuit theory predicts gene flow in plant and animal populations. Proceedings of the National Academy of Sciences, 104.50: 19885-19890. Available as Attachment L.

Q. Can a map of protected lands provide information about habitat connectivity?

A. Land cover maps based on existing conditions capture the current state of the landscape but development will likely continue to alter and change that landscape. Protected land data maps those places that have some type of conservation ownership or easement that prevents the development of these properties. We can have a high degree of confidence that these places will remain natural into the future.

Q. Are there any peer-reviewed scientific studies that support the use of protected-lands maps for highlighting opportunities for persistent habitat connectivity?

A. Yes: Theobald, David M (2003), Targeting conservation action through assessment of protection and exurban threats. Conservation Biology, 17.6: 1624-1637. Available as Attachment M.

Q. So by reviewing nighttime aerial photos, connectivity flow maps, and maps of protected lands, can you identify whether land is important for habitat connectivity?

A. Yes.

Q. And, again, what is the broader importance of habitat connectivity?

A. Connectivity allows the movement of species for dispersal and resource utilization as well as providing the opportunities for shifting habitat composition in the face of climate change. Disrupting connectivity can lead to broad environmental harm from habitat fragmentation, disrupting ecological processes and impeding the ability of species to respond, move, or adapt to climate change.

Q. So by reviewing nighttime aerial photos, connectivity flow maps, and maps of protected lands, can you offer an opinion as to whether developing certain land will cause unacceptable environmental harm?

A. Yes.

Q. Can you offer an opinion as to whether the proposed Invenergy plant will cause unacceptable environmental harm?

A. Yes.

Effects of the Proposed Invenergy Plant on Habitat

Q. What is your opinion regarding the environmental consequences of the proposed Invenergy plant?

A. In my opinion, the impacts of this plant will be significantly negative and cause unacceptable harm to the ecological integrity of the area. These effects include habitat fragmentation in a currently relatively connected landscape. The direct impacts include but are not limited to deforestation, light pollution, noise pollution, and runoff.

Q. How have you arrived at that opinion?

A. Review of conservation plans for the state and region and maps of the ecological context of the site.

Q. Do you have any figures that support your opinion?

A. Yes, I will present seven figures that support my opinion.

Q. What is the first figure that supports your opinion?

A. Figure 1, below, is a map showing visible, artificial, light at night acquired from NASA.

Figure 1

Q. How was Figure 1 prepared?

A. The Nature Conservancy's GIS Analyst acquired the image from NASA Earth Observatory. This image of North and South America at night is a composite assembled from data acquired by the Suomi NPP satellite in April and October 2012. The new data was mapped over existing Blue Marble imagery of Earth to provide a realistic view of the planet.

The nighttime view was made possible by the new satellite's "day-night band" of the Visible Infrared Imaging Radiometer Suite (VIIRS). VIIRS detects light in a range of wavelengths from green to near-infrared and uses filtering techniques to observe dim signals such as city lights, gas flares, auroras, wildfires, and reflected moonlight. In this case, auroras, fires, and other stray light have been removed to emphasize the city lights.

Q. What does Figure 1 show?

A. Figure 1 shows artificial lighting in the coastal southern New England and Mid Atlantic. Artificial lighting is widely acknowledged as an easily observable and therefore very useful proxy for human activity. Social scientists and demographers have used night lights to model the spatial distribution of economic activity, of constructed surfaces, and of populations. Planners and environmental groups have used maps of lights to select sites for astronomical observatories and to monitor human development around parks and wildlife refuges. Electric power companies, emergency managers, and news media turn to night lights to observe blackouts.

Q. What do the dark areas on Figure 1 show?

A. The dark areas on Figure 1 show places that have a low density of artificial light. These areas tend to also have a low density of human development and associated habitat degradation and fragmentation.

Q. And what do the light areas on Figure 1 show?

A. The light areas on Figure 1 show places that have a high density of artificial light. These places tend to also have a high density of human development and associated habitat degradation and fragmentation.

Q. What is the significance of Figure 1?

A. This map illustrates the high degree of development present along the coastal Mid Atlantic and Southern New England region. The Borderlands Landscape situated along the Rhode Island and

Connecticut border is one of the few dark areas in this region. This means the Borderlands Landscape is one of the few areas in the region with a high degree of habitat connectivity.

Q. What is the second figure that supports your opinion?

A. Figure 2 is the same Earth at Night imagery, but the dark areas are highlighted in green to emphasize the low light pollution areas that are less densely populated and developed.

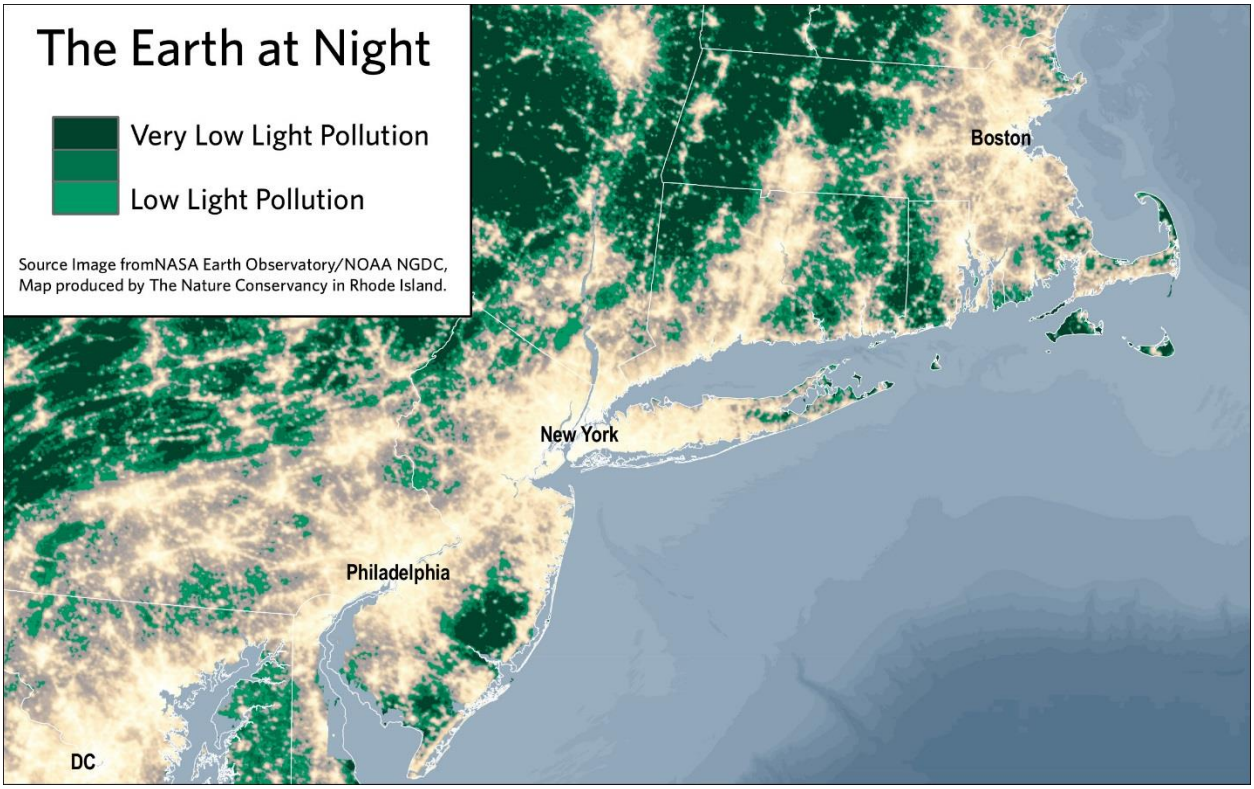

Figure 2

Q. How was Figure 2 prepared?

A. The Nature Conservancy's GIS Analyst converted the color imagery from Nasa Earth Observatory into a single band (grayscale) image with intensity values between 3 and 255. Values between 3 and 12 were coded with a dark green color indicating very low light pollution, values between 12 and 24 were colored with a medium green value indicating median low light pollution, and values between 34 and 50 were colored light green indicating moderately low light pollution.

Q. What does Figure 2 show?

A. Figure 2 shows the same information as figure 1 but with a highlight on the dark areas to help locate the darkest, least developed areas of the landscape.

Q. Both your earlier testimony and Figure 2 refer to "light pollution." What is "light pollution?"

A. Light pollution is commonly defined as excessive and inappropriate artificial light. Light pollution in this case refers to the intensity of artificial light as seen from space at night. It is referred to as pollution since it carries many negative consequences for wildlife as well as decreased visibility of the night sky.

Q. What is the significance of Figure 2?

A. As with Figure 1, this map illustrates the high degree of development present along the coastal Mid Atlantic and Southern New England region. The Borderlands Landscape situated along the Rhode Island and Connecticut border is one of the few dark areas in this region. This is made more evident by coding the dark areas with green. Habitats in the coastal zone have different character and species composition than those located further inland. This figure makes it evident how rare unfragmented landscapes like those of the Borderlands are in the coastal zone.

Q. What is the next figure that supports your opinion?

A. Figure 3 is a map of connectivity. It shows areas of diffuse and concentrated flow.

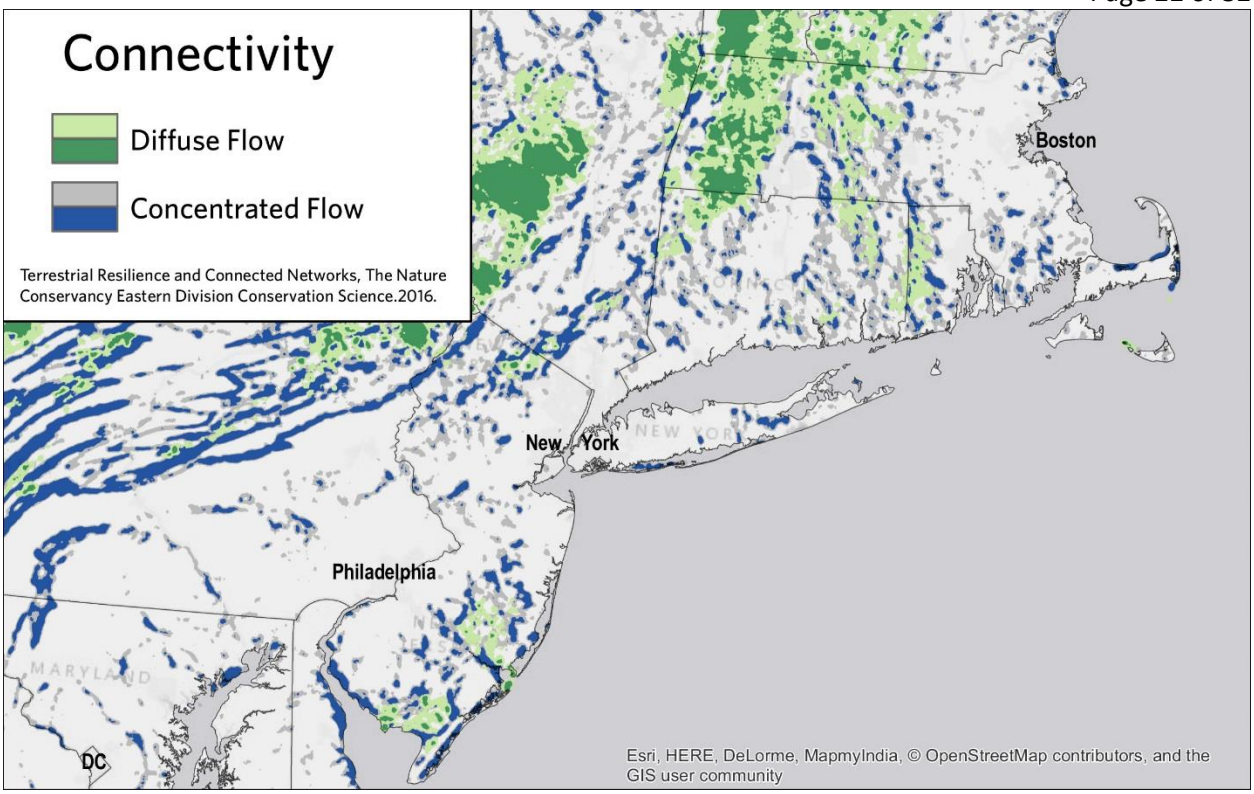

Figure 3

Q. How was Figure 3 prepared?

A. Figure 3 was adapted from The Nature Conservancy's 2016 report *Resilient and Connected Landscapes for Terrestrial Conservation*, included as Link 2. This method was first used by The Nature Conservancy as part of its 2012 report *Resilient Sites for Terrestrial Conservation in the Northeast and Mid-Atlantic Region*, the 2016 update of this report, *Resilient Sites for Terrestrial Conservation in North America*, which is included as Link 3. To create a wall-to-wall surface of landscape permeability, we used the software Circuitscape, described above. Circuitscape's circuit modeling is conceptually aligned with the concept of landscape permeability because it recognizes that movement through a landscape is affected by a variety of impediments, and it quantifies the degree and the directional outcomes of the compounding effects. One output is a "flow" map that shows the behavior of directional flows and highlights concentration areas and pinch-points. This is what Figure 3 is. The results of flow mapping using Circuitscape can highlight locally and regionally significant places where species range shifts may

be impeded or concentrated by anthropogenic or ecological resistance, and that may warrant conservation.

Q. What does Figure 3 show?

A. Figure 3 shows areas of the region that allow the flow of animals and by the inverse, those areas that are barriers to animal movement.

Q. Figure 3 refers to "Connectivity." Is this the same "connectivity" that you discussed earlier in your testimony?

A. Yes.

Q. Figure 3 refers to "diffuse flow." What is "diffuse flow?"

A. Areas that are extremely intact and consequently facilitate high levels of dispersed flow that spreads out to follow many different and alternative pathways. Animals can travel freely through areas of diffuse flow.

Q. Figure 3 refers to "concentrated flow." What is "concentrated flow?"

A. Areas where large quantities of flow are concentrated through a narrow area. Because of their importance in allowing animals to flow across a larger network these pinch points are important candidates for land conservation because they provide unique pathways.

Q. What do the blue areas on Figure 3 show?

A. Areas of high concentrated flow.

Q. What do the darker gray areas on Figure 3 show?

A. Areas of moderately concentrated flow.

Q. What do the green areas on Figure 3 show?

A. Areas of diffuse flow.

Q. And what do the areas that are not blue, dark gray, or green show?

A. Barriers or areas of restricted flow.

Q. Altogether, what is the significance of Figure 3?

A. This figure shows the patterns of ecological flow. The areas of diffuse and concentrated flow are ecologically valuable and are good targets for conservation. Blue concentration zones can be particularly valuable as conservation priorities due to their irreplaceable nature.

Q. What is the next figure that supports your opinion?

A. Figure 4 is the same connectivity data as Figure 3 but it is zoomed in to the scale of Rhode Island.

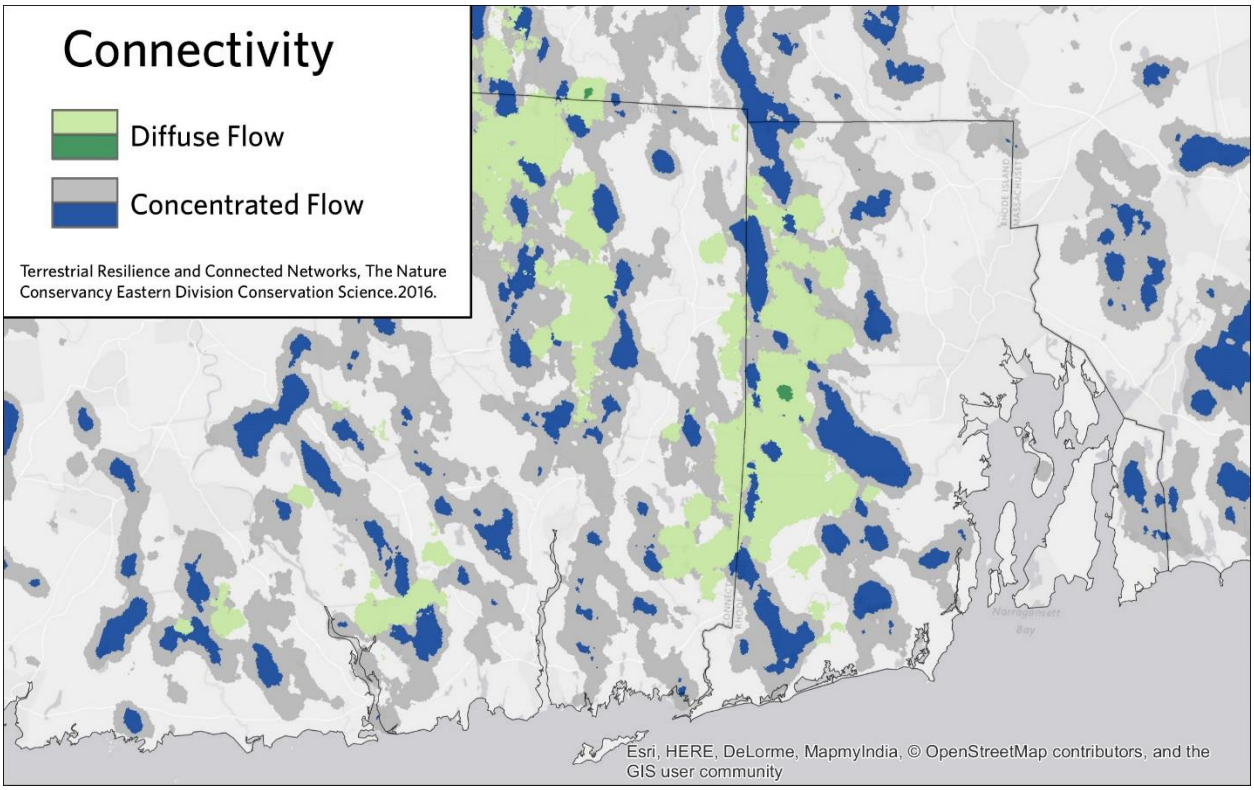

Figure 4

Q. How was Figure 4 prepared?

A. The same as Figure 3 but zoomed in to Rhode Island.

Q. What is the difference, if any, between Figure 3 and Figure 4?

A. The only difference is the extent.

Q. What is the significance of Figure 4?

A. This map shows the regional flow patterns specific to Rhode Island. In particular, this map illustrates the areas of diffuse and concentrated flow in the Borderlands Landscape.

Q. What is the next figure that supports your opinion?

A. Figure 5 is the same as Figure 4 but includes the footprint of the proposed development. An arrow points to this location.

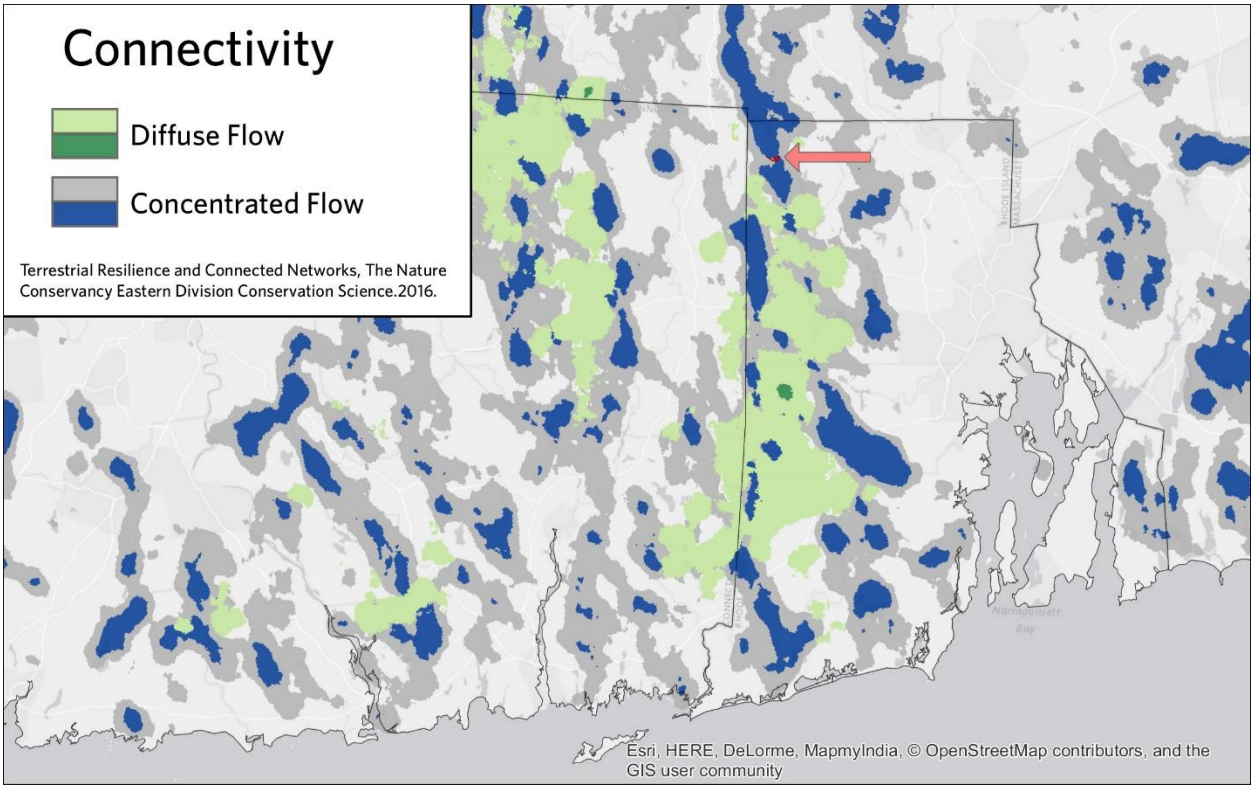

Figure 5

Q. How was Figure 5 prepared?

A. The footprint of the proposed development was digitized based on maps from the Rhode Island Energy Facility Siting Board Application prepared by ESS. This foot print was overlaid on the map from Figure 4.

Q. What is the difference between Figure 4 and Figure 5?

A. They are the same except that Figure 5 includes the footprint of the proposed development.

Q. What is the significance of Figure 5?

A. This figure shows that the location of the plant is in a critical location for ecological flow, specifically a concentrated flow area.

Q. What is the next figure that supports your opinion?

A. Figure 6 is a closer look at the development location in the context of the ecological flow.

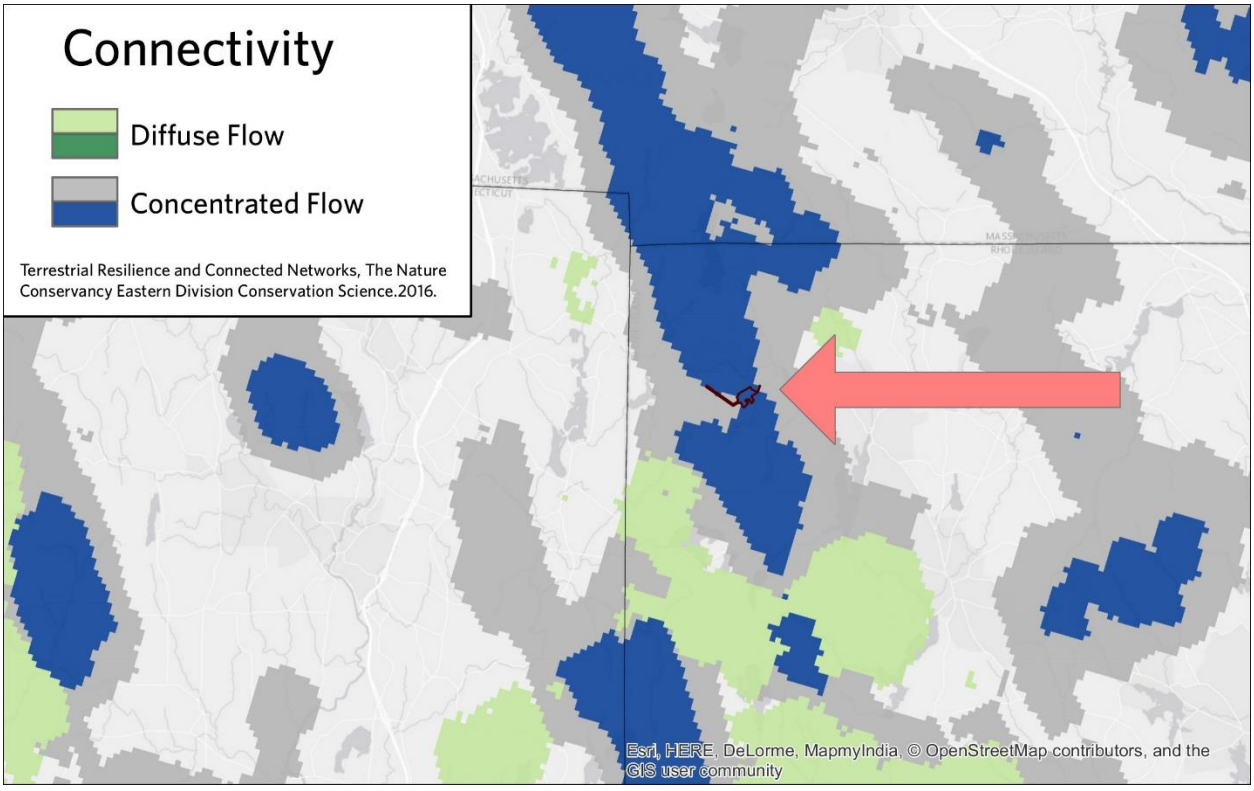

Figure 6

Q. How was Figure 6 prepared?

A. The same as Figure 5 but even more zoomed in.

Q. What is the significance of Figure 6?

A. Figure 6 provides a scale that is close enough to see the footprint of the proposed development and how it overlays the concentrated flow area. It shows even more clearly than Figure 5 that the location of the plant is in a critical location for ecological flow, specifically a concentrated flow area. Indeed, the plant's footprint would cut off the existing bottleneck and result in habitat fragmentation.

Q. What is the next figure that supports your opinion?

A. Figure 7 is an open space map. It shows blocks of natural land greater than 500 acres (in Rhode Island) and areas of existing conservation land.

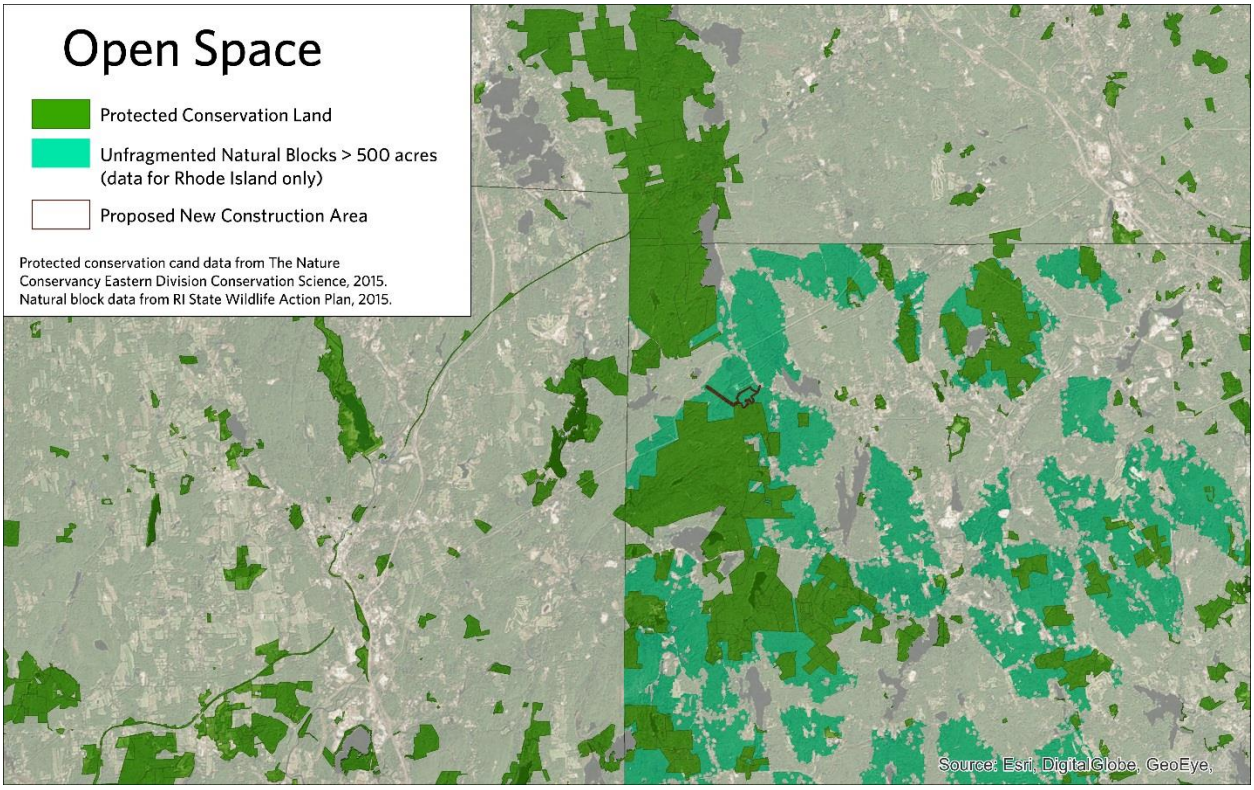

Figure 7

Q. How was Figure 7 prepared?

A. Unfragmented forest blocks of between over 500 acres were mapped in light green. They were created using softwood, deciduous, and mixed forest classes from the RIGIS 2011 land use/land cover data that were not within 30 meters of developed land uses (residential, commercial, etc.) or roads. The darker green areas are existing protected conservation land from The Nature Conservancy's secured areas database.

Q. What is the significance of Figure 7?

A. This map highlights some of the most valuable opportunities for conservation. Specifically, the figure shows an opportunity for conserving a block of natural land that connects two existing large

blocks of conserved land. The figure shows that the proposed development is located right in this opportunity area.

Q. You have said that Figures 1 through 7 support your opinion. Can you explain how these figures support your opinion, please?

A. These figures taken together first highlight the regional ecological significance of the Borderlands Landscape. They show how this natural area has ecological value due in large part to its connectivity. The figures show how the proposed development creates a barrier at a critical bottleneck in that connectivity, causing unacceptable ecological harm.

Q. Are you aware that there is already a natural gas compressor station adjacent to the site of the proposed Invenergy plant?

A. Yes.

Q. What did you find when you looked at the compressor station?

A. Existing fragmentation and light pollution.

Q. What is the significance of that finding?

A. While there is existing fragmentation and light pollution the area still has an important connectivity function. Should this proposed development take place, I believe it would dramatically increase fragmentation and light pollution causing a barrier in this critical bottleneck. Specifically, it appears that both the footprint and the magnitude of light pollution from the compressor station are much smaller than the corresponding footprint and magnitude of light pollution from the proposed power plant – the compressor station's impact on habitat connectivity is likely significantly less than Invenergy's proposed power plant's impact would be.

Q: Have you reviewed section 6.6.2.2 of Invenergy's Rhode Island Energy Facility Siting Board Application for the Clear River Energy Center (the Application) – the section titled "Impacts to Wildlife and Ecology?"

A. Yes.

Q: Do you agree with that section's assessment of the project's likely impacts?

A. Yes.

Q: Is there anything missing from this assessment?

A. Yes.

Q: Please explain.

A. In my opinion, the assessment is accurate with regard to the local impacts but it lacks a regional context. Not all locations provide the same ecological service. Location on the landscape relative to other natural areas is important information when factoring impact.

Q. And what, in your opinion, should have been included in the assessment regarding the regional context of the proposed plant?

A. The assessment should include a regional perspective of the significance of the habitat that considers the unfragmented nature of the surrounding landscape. The location of the site relative the surrounding landscape, particularly with regard to connectivity with natural and conserved lands should also be included.

Q. Invenergy says in the August 2016 wetlands addendum to its application that construction of the proposed plant could cause "substantial loss of habitat, fragment large habitat blocks, and create barriers to animal movement, particularly where no such barriers currently exist."[4] Do you agree?

A. Yes.

Q. What is the significance of these environmental impacts?

A. Resilient and healthy ecological systems need to be connected. The siting of the proposed development is in a particularly important location for ecological flow both within the state and region.

[4] Wetlands Addendum at 15, *available at* http://www.ripuc.ri.gov/efsb/efsb/SB2015_06_Invenergy_Wetlands.pdf.

Q. Invenergy also says in its wetlands addendum that "[c]learing and construction associated with the Project will result in the loss of habitat currently used by a variety of bird, mammal, reptile, and amphibian species, including the portion of the site in which the state-threatened black-throated warbler had been observed displaying breeding behavior during the spring and summer of 2015."[5] What is the significance of these environmental impacts?

A. While The Nature Conservancy is focused on habitat conservation, species such as the black-throated blue warbler are interior forest species indicative of a lack of disturbance. This type of habitat and its associated species would be impacted very negatively by the proposed development.

Q. In its Advisory Opinion to the Energy Facility Siting Board, RIDEM wrote that it "cannot, with such little site-specific information, make conjectures on the full suite of species that would be impact by the project and the exact nature and extent of those impacts" but that "[i]t can, however, reasonably assume that the further fragmentation of one of the largest remaining intact forests in the state will negatively impact area fish and wildlife." Do you agree?

A. Yes.

Q. What is the significance of these environmental impacts?

A. Unfragmented forests such as those found in the Borderlands Landscape are rare in this coastal region. Fragmentation of critical high concentration flow areas will have severe impacts on the ability of the ecological system to function and adapt.

Q. Taking into account your analysis, Invenergy's statements, and RIDEM's statements, would you please summarize your opinion with respect to the impacts of the proposed Invenergy plant on habitat?

[5] Wetlands Addendum at 16.

A. The Nature Conservancy has opposed the development of this power plant because it would undermine the state's ability to achieve its greenhouse gas reduction goals, has not been proven necessary, and would result in unacceptable local environmental impacts.

My expertise is in this last area of assessing the environmental impacts in the Borderlands Landscape.

In my opinion, siting the proposed Invenergy power plant in this critical connecting corridor within this regionally significant forest landscape would undermine decades of coordinated conservation strategies and result in unacceptable harm to the environment.

The creation of impervious surfaces, noise, light pollution, wetland destruction, deforestation and other effects of the proposed power plant would break up this currently unfragmented habitat and eliminate an irreplaceable wildlife corridor.

In the context of our changing climate, the proposed power plant would cut off the unique connectivity of habitat that is essential to allow ecological systems to function and adapt.

Because the Energy Facility Siting Board is only allowed to grant a license in the circumstance that an applicant has shown that "the proposed facility will not cause unacceptable harm to the environment," I urge the Board to reject Invenergy's permit for the Clear River Energy Center.

Q. In your expert opinion, are these impacts acceptable?

A. No.

Q. Does that conclude your testimony?

A. Yes.

<u>Attachments to Testimony</u>

A. The Nature Conservancy, RI Chapter Timeline
B. CV of Scott Comings
C. The Nature Conservancy, Northwest Corner Conservation Plan (October 1997)
D. Position Statement of The Nature Conservancy Opposing Proposed Invenergy Plant
E. New England Governors and Eastern Canadian Premiers, Resolution 40-3

F. The Nature Conservancy, Maintaining a Landscape that Facilitates Range Shifts for Terrestrial Species (June 30, 2016)
G. The Nature Conservancy in Rhode Island's Terrestrial Conservation Portfolio Map
H. The Nature Conservancy, Modeling Landscape Permeability (January 24, 2012)
I. Mark G. Anderson and Charles E. Ferree (2010), Conserving the Stage: Climate Change and the Geophysical Underpinnings of Species Diversity. PLoS ONE 5(7):e11554
J. McRae, B. H., Dickson, B. G., Keitt, T. H. and Shah, V. B. (2008), Using circuit theory to model connectivity in ecology, evolution and conservation. Ecology, 89: 2712–2724
K. Theobald, D. M., Reed, S. E., Fields, K. and Soulé, M. (2012), Connecting natural landscapes using a landscape permeability model to prioritize conservation activities in the United States. Conservation Letters, 5: 123–133
L. McRae, Brad H., and Paul Beier (2007), Circuit theory predicts gene flow in plant and animal populations. Proceedings of the National Academy of Sciences, 104.50: 19885-19890
M. Theobald, David M (2003), Targeting conservation action through assessment of protection and exurban threats. Conservation Biology, 17.6: 1624-1637

Documents Available as Links

1. The Nature Conservancy, Lower New England – Northern Piedmont Ecoregional Conservation Plan (January 2001)
https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/Documents/ED_terrestrial_ERAs_LNE_fullreport.pdf

2. The Nature Conservancy, Resilient and Connected Landscapes for Terrestrial Conservation (2016)
http://easterndivision.s3.amazonaws.com/Resilient_and_Connected_Landscapes_For_Terrestial_Conservation.pdf

3. The Nature Conservancy, Resilient Sites for Terrestrial Conservation in Eastern North America (2016)
http://easterndivision.s3.amazonaws.com/Resilient_Sites_for_Terrestrial_Conservation.pdf