

CONFIDENTIAL: ATTORNEY CLIENT & WORK PRODUCT PRIVILEGES
DEFENDANTS' DAMAGES TO PENNSYLVANIA

This requested Memorandum of January 30, 2017 supplements Plaintiffs' Complaint & Memorandum of Law & Fact, for consideration by Hon. Josh Shapiro, and documents:

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1. Role and Status of the Attorneys General in this Case. In addition to requesting that Plaintiffs prepare the Memorandum of Law & Fact, the DC Attorney General requested on December 21, 2016, that a meeting be scheduled with Defendants to resolve these legal violations.

2. Resilience Damages are Systemic, Extraordinary, Greatly Understated & May Get Out of Control. The American Security Project Blog below, prepared at the request of the Defense Department, documents the very real *positive feedback loops* understating and accelerating dangerous climate change and resilience damages, that are not taken into account in the IPCC assessments or US Climate Assessment Report. Considering the S&P Credit Rating Downgrade slide below, with development led by U.S. Senate staff, unless comprehensive national resilience financing is established very soon, a downgrade or major litigation over damages can trigger financial contagion. This presents a substantial and unreasonable risk to Pennsylvania.

These major damage categories herein are expected to increase and expand to new categories given that (1) atmospheric CO2 concentrations have risen above 400 parts per million (ppm), (2) are continuing to rapidly rise, (3) 350 ppm and below are recognized as the safe level by the leading scientists, (4) higher than 350 ppm is the dangerous level (*Green Bond Business Case* 2014), and (5) IPCC and US Climate Assessment Report did not incorporate in their assessments, the *positive feedback loops* / accelerators identified

above at the request of the Defense Department. Further, Pennsylvania resilience damage assessment shows that there is so much latent power of existing CO2 in the atmosphere that the damages calculated herein are not dependent on future CO2 reductions (*Economic Impacts of Projected Climate Change in Pennsylvania: Report to the Department of Environmental Protection, 2009 at 2*).

American Security Project Blog Article
Wanted Alive: Private Sector Solutions to the Climate Bubble / Crash
Protecting the Global Economy & National Security

Developed at recommendation of Pentagon Climate Officers Briefing (Aug.12, 2014), & decided not to be published by DoD Comptroller's Office due to potential trigger financial contagion since there is no climate solution in place

Connecting the dots on recent public announcements raises likely near term unacceptable national and economic security risks:

Pending Climate Bubble, Crash, Contagion (economic panic) warning by Former Republican Treasury Secretary Hank Paulson (using Wall Street *Green Bond Business Case* released at NYSE & updated by leading economists 2013)

Planned Climate Credit Downgrades by Standard & Poor's credit rating agency (May 15, 2014)

Lack of Insurance for climate change damages (*Green Bond Business, Fireman's Fund Allianz July 1014, National Association of Insurance Commissioner Survey, Aug. 2014*)

Accelerating Systemic Climate Damages in all economic sectors (*Green Bond Business Case*)

Rising Seas' Systemic Damages including Miami Beach sunny day flooding (July 2014 NYTimes & Guardian) with no solution due to porous limestone bedrock that can permanently undermine the City's credit rating. Miami and all other South Florida coastal cities have similar risks.

Lack of Needed Market Confidence in Solutions Stopping the Bubble by reducing 18 gigatons of carbon pollution in the near term costing \$2 trillion and preventing *unmanageable* dangerous climate change (*Green Bond Business Case*)

The Climate Bubble is Permanent unlike all prior bubbles going back to the 11th Century where there was economic recovery (See *This Time is Different* 2011)

Military Sea Level Base Ongoing Relocations Hampered by lack of appropriations adverse! affecting military readiness since Congress doesn't recognize climate change (GAO July 2014)

JPMorgan Calling *Unmanageable* Dangerous Climate Change a High Probability Near

Term Black Swan Statistical Event (*Green Bond Business Case*)

Accelerating Dangerous Climate Change Positive Feedback Loops including -

- methane permafrost and ocean hydrates releases
- ocean limit exceedance of CO2 absorption
- Greenland glacial melt moulins & tsunamis
- West Antarctic Ice Sheet collapse
- greater warming from loss of albedo reflective capacity from decreased sea and glacial ice
- rising sea and land surface temperatures intensifying climate and weather events
- unknown positive feedback loops due to paramount climate system complexity

"Climate Change ... May Act as an Accelerant of Instability or Conflict. ... Managing the National Security Effects of Climate Change Will Require DoD to Work Collaboratively, Through a Whole-of-Government Approach, with Both Traditional Allies and New Partners. ... Climate change, energy security, and economic stability are inextricably linked" (Defense Department Quadrennial Reviews Mar. 4, 2014 & 2010).

These preceding factors raise serious unacceptable near term domestic national and economic security risks from planned US climate credit downgrades required by law to warn investors due to accelerating systemic climate damages. Without a climate solution in place, downgrades can trigger contagion.

Fortunately, institutional investors with over \$70 trillion in assets under management are starting to deploy funds that can stop the Bubble (*Green Bond Business Case*).

Are there private sector announcements that can be made on solutions to the Bubble / Crash to boost market confidence as the necessary antidote to contagion?

Accordingly, Pennsylvania buildings, homes, infrastructure, public health and economy must be made resilient to deal with these growing, unprecedented damages that are extraordinarily expensive and present an unreasonable risk.

Solving Climate Credit Rating Downgrades

Challenge: Near Term Climate Bubble / Crash Can Be Triggered by

- Pending climate credit downgrades, and / or
- Imminent litigation over collapse of coastal property values from faster rising seas.

Accelerating Forces

- Lack of insurance for climate damages / resilience
- Several trillion dollars must be spent on near term solutions.
- JPMorgan predicts unmanageable dangerous climate change is a near term high probability *Black Swan* statistical event.
- Time is of the essence: triggers can happen now.

Solution:

Rating Agencies Use Consensus Criteria Entities Can Achieve to Avoid Downgrades BEFORE They are Issued.

Accelerating Forces

- S&P criteria use can serve as underwriting for new insurance products, brand improvement, 30 yr. profitable business models.
- Government action not required.
- Capital markets have more than enough investor funds to pay for solution including through green + resilient bonds.
- Green bond growth is explosive.
- Rating agencies acknowledge higher ratings for energy efficiency.
- Improves public health & environment.
- Rebuilds / protects built environment.
- Creates estimated \$800B in new wages / 400,000 new jobs.
- Consensus criteria rating agencies helped initiate are available & similar to existing bond criteria.



Data From Capital Markets Partnership (CMP) Green Bond / Sustainable Investment Business Case & RELI Consensus Underwriting Standards Supported by U.S. Conference of Mayors (2008), Peer-reviewed & Released at NYSE (2009), Updated by Leading Economists (2013), & Used by Former Republican Treasury Secretary Hank Paulson Announcing Climate Bubble (NYTimes, WSJ 2014). Slide Developed With US Senate Staff and CMP as a Result of US Senate Staff Briefing on Climate Credit Rating Downgrades (Feb. 6, 2015).

3. Out of the Pennsylvania's Partial Damages of \$5.3 Trillion, Calculated Recoverable Treble Damages for this Case Total \$64 Million to the Commonwealth, and fall within the following categories due to Defendants' unlawful acts:

- Preventing the Commonwealth's ability to ameliorate well-documented, accelerating resilience damages including S&P and Moody's planned climate credit rating downgrades, by using the National Consensus Resilience Standard (RELI) approved by OMB and Homeland Security for critically needed resilience financing to reduce damages, and prevent financial contagion and national security threats identified by the Defense Department (*Standards and Finance to Support Community Resilience* 2016). These calculated damages herein are: sea level rise, increased Lyme disease costs, resilience grants and expenditures, more intense storms, hurricanes, precipitation and floods, ski, snowmobile & dairy industries decline, and hickory total destruction, the Commonwealth's most economically valuable wood products industry.
- Diminished value of the Commonwealth's long-term achievement of Forest Stewardship Council (FSC) Certification of the State's Forests protecting the forest environment, caused by the undemocratic, unilateral, automatic, change to Commonwealth requirements adding

the competing *greenwash* SFI industry certification without required due process notice and opportunity to be heard by the Commonwealth and its constituents; this was unlawful. SFI is documented to facilitate cheap illegal logging and destruction of the forest causing strict criminal liability in violation of the Lacey Act and National Consensus Lacey Act Due Care Standard / Legal Opinion.

- c. Diminishing indoor air quality and the resulting health and productivity of building occupants, and building economic value caused by unilateral, undemocratic, automatic weakening for Commonwealth buildings, of the successful healthy product / hazard approach, and thus specifying more toxic products in Commonwealth buildings.

3.1 The Costs of Resilience Inaction are Substantial & Lasting. Resilience Must Address Correlative Risk.

"The costs of inaction are persistent and lasting. Benefits from climate change may be brief and fleeting - for example, climate does not stop changing once a farm benefited from temporarily improved growing conditions. In contrast, costs of inaction are likely to stay and to increase." (Severe Climate Change Costs Forecast For Pennsylvania, North Carolina, Tennessee, North Dakota, And Other U.S. States, U. of Md. 2008).

Moreover, to be effective, resilience must take a regional approach and reduce correlative risk, whereby one risk factor can shutdown an entire region, e.g., wastewater treatment plant shutdown from flooding means hospitals can't operate (RELI National Consensus Resilience Standard 2014 application to Corpus Christi). Insurers will not come back into the resilience market without a mechanism countering correlative risk.

The \$5.3 trillion in Commonwealth partial existing, systemic resilience damages are in eight categories calculated below in §§3.3 – 3.15, and aggregated in the Damage Table on page 21. These damages are well-documented by the Commonwealth, its municipalities, constituents, federal government, leading researchers, and national environmental organizations.

3.2 Lack of Insurance / Reinsurance Exacerbates Damages. The impact of Commonwealth resilience damages is far greater since insurers and reinsurers pulled out of the resilience market, determining that climate change is an uninsurable risk (*Green Bond Business Case* 2014). Instead, reinsurers are marketing catastrophe bonds which on a project-by-project basis, are a form of reinsurance that spread out reinsurance risk and costs to investors and away from reinsurers.

3.3 Substantial Pennsylvania Climate Impacts & Damages. The following are some of the key Commonwealth resilience damages in addition to floods and storms, however, many other exist that are not included herein, since additional research is required to quantify damages.

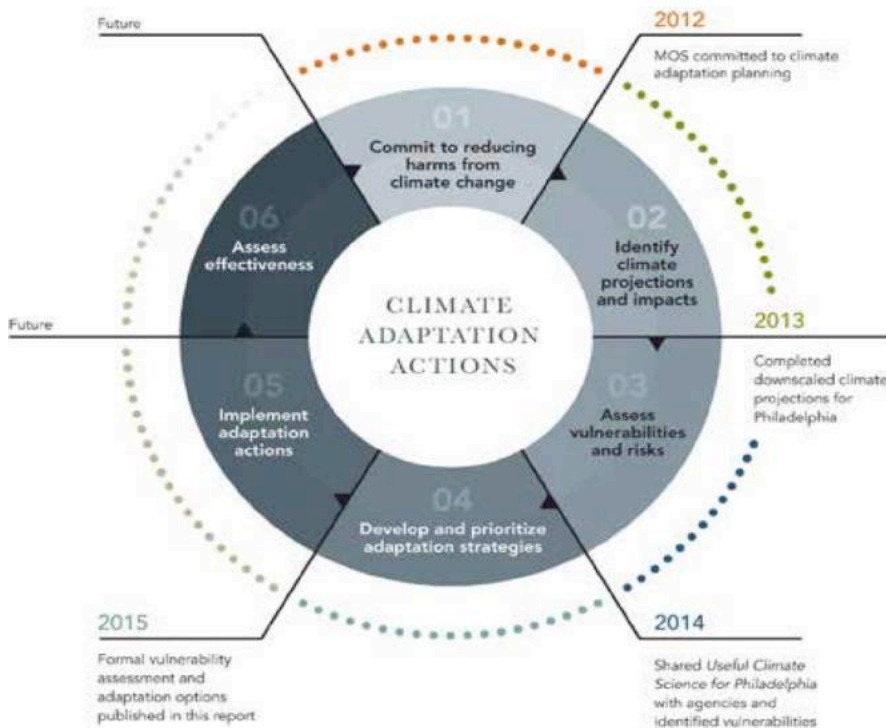
"Pennsylvania - Observed Climate Change Impacts

- *In 2011, Pennsylvania broke 45 heat records, 57 rainfall records, and 49 snowfall records.*
- *There are now 20 days every year over 90° F in major cities like Philadelphia and Harrisburg. Nearly one million Pennsylvanians live where summertime temperature records were set in 2010.*
- *Rising temperatures have contributed to the spread of dangerous vector-borne diseases in the state: over 51,000 reports of Lyme disease were observed from 1990-2008^{vii} and 405 cases of West Nile virus from 1999-2010, where there were none prior." (WHAT DOES CLIMATE CHANGE MEAN FOR PENNSYLVANIA? Climate Reality Project 2014 at 1).*



Images (clockwise, from top left) of the Schuylkill River in its current state, an actual photo during Hurricane Irene, a simulation of four feet of sea level rise (*Growing Stronger: Toward a Climate Ready Philadelphia*, Report by the Mayor’s Office of Sustainability and ICF International, Nov. 2015, at 6).

PROCESS AND TIMELINE FOR DEVELOPING AND IMPLEMENTING CLIMATE ADAPTATION ACTIONS FOR PHILADELPHIA



3.4 Pennsylvania Resilience Damage Assessment and Calculation. [The US Climate Assessment Report](#) (2014) documents the primary substantive recognizable existing climate damages to the Commonwealth:

1. **71% more intense precipitation**
2. **6% higher peak floods**
3. **2'-6' accelerating rising seas**

“Assessing the Risks and Vulnerabilities [to the Commonwealth]

- Higher temperatures during summer months;
- Wetter winters – more intense winter storms;
- More extreme heat events;
- More high impact storms resulting in more flooding and greater floods;
- Drier summers resulting in drought; and
- Sea level rise – salt water intrusion in the Delaware River.

[\(Pennsylvania Climate Adaptation Planning Report, Penn. Dept. of Envir. Protect. 2014 at 10\)](#)

“Climate change has already begun to manifest itself in the Commonwealth in the form of higher temperatures, an increase in annual precipitation, significantly higher numbers of large storm events, changes in peak stream flows, decreased snow cover, and the movement of some species to the north and to higher elevations. In addition to these direct impacts, climate change is a threat-multiplier, magnifying the impacts of other environmental stressors such as invasive species, habitat fragmentation, and deer overpopulation.” [\(DCNR and Climate Change: Planning for the Future, Penn. Dept. of Conser. & Nat. Resour. 2015 at 3\).](#)

“Climate Central finds that three of the top 50 U.S. cities seeing the biggest [heavy precipitation] increases since 1950 are in Pennsylvania. Philadelphia is third on the list with a 360% increase, Harrisburg is seventh, with a 283% increase, and Lancaster is 14th, with a 112% increase.” [\(Id. at 4\).](#)

“Risks and Vulnerabilities

“Since temperature and precipitation are fundamental determinants for the composition and function of ecosystems, we can expect to see widespread impacts to natural resources. Warming, precipitation changes, and other alterations associated with climate change also magnify the effects of other environmental stressors, such as invasive species and pathogens, deer over-browsing, and habitat fragmentation, to mention a few.

Current problems, such as the decline in sugar maple and ash, as well as limited forest regeneration, will worsen as the climate continues to change. This coupled with a projected decline in northern hardwoods, especially black cherry, may result in mill closings and job losses and the depression of economic development in some areas. Similarly, increased stress and decline of street trees in urban settings may increase safety hazards, alter the character of towns and neighborhoods, and affect real estate values and a community’s sense of place.” [\(Id. at 5\).](#)

“Between the 2009 ... and the beginning of the City of Philadelphia’s climate adaptation planning process in 2012, extreme weather events increasingly convinced cities that—as the entities responsible for emergency services, stormwater management, and street plowing—municipal governments are the first responders to the results of climate change. ... [T]he Mayor’s Office of Sustainability (MOS) along with the Climate Adaptation Working Group (CAWG), a group of 10 agencies and departments committed to guiding the city’s work to prepare for climate change.” [\(Growing Stronger: Toward a Climate Ready Philadelphia, Report by the Mayor’s Office of Sustainability and ICF International, Nov. 2015, at 6\).](#)

“The forecast for Philadelphia’s future climate can be summed up as “warmer and wetter,” but much of that warmth and moisture will be concentrated in the form of heat waves and heavy precipitation events (rain or snow)—posing challenges to infrastructure, city services, businesses, and residents.” [\(Id. at 9\).](#)

“Since 2010, Philadelphia has experienced:

- THE SNOWIEST WINTER ON RECORD.
- THE TWO WARMEST SUMMERS ON RECORD.
- THE WETTEST DAY ON RECORD.
- THE TWO WETTEST YEARS ON RECORD.
- TWO HURRICANES.

- A DERECHO (Id. at 11)

“Philadelphia is also projected to experience a greater frequency of heavy and extremely heavy precipitation events, with the largest increase occurring in precipitation that falls during winter months. Heavy precipitation and flooding can be caused by a variety of weather systems, including tropical storms and hurricanes, thunderstorms, and frontal activity. When these heavy precipitation events fall as rain, they often exceed the capacity of the city’s storm sewer infrastructure; when they fall as snow, they require many city resources to manage. Some of these projections are already becoming a reality, as Philadelphia has experienced an increase in the intensity and frequency of storm events over the last decade, which has on occasion resulted in significant flooding.

Rising seas ... affect water levels in the Delaware and Schuylkill Rivers bordering Philadelphia. Higher sea levels will increase the depth and extent of flooding in and around the city from storm surges, such as those occurring during hurricanes and other tropical storms. Low-lying areas already experience localized flooding during heavy storm events, and both municipal infrastructure and private development exist along the two rivers.” (Id. at 12).

“The vulnerability assessment conducted for this report considered these three factors to evaluate the vulnerability of city departments and city-owned assets to key impacts of climate change. The assessment evaluated exposure of all 2,698 city-owned facilities to flooding, and identified the locations of populations potentially vulnerable to extreme heat (including older adults, young children, low-income populations, and those without nearby access to cooling centers). The assessment also evaluated the flooding vulnerabilities of evacuation routes, vulnerable populations, stormwater outfalls, and assets rated as “critical” by the Philadelphia Office of Emergency Management (OEM). Critical assets include those with high safety, cultural, economic, and environmental value.” (Id. at 13).

“Rising sea levels are expected to increase the frequency and severity of flooding in Philadelphia. Coastal storms combined with higher sea levels will cause more extensive flooding than the same storms would cause today, although tides, saturation of the ground, ground temperature, and other factors can vary the degree of flooding experienced from two storms with the same amount of rainfall.

Flooding presents many risks to Philadelphia, including public health and safety hazards, interruptions in key services, and damage to buildings and infrastructure.

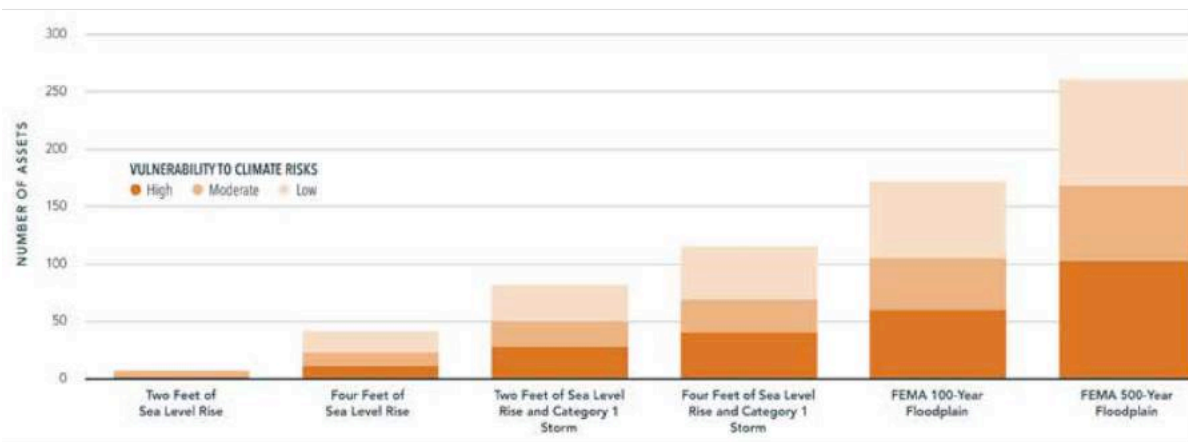
“Flooding...is the most frequent and costly of all hazards in Pennsylvania.”

Floods can disrupt transportation, hampering emergency services and evacuation efforts. Because fuel pumps and sump pumps require electricity to operate, a power failure during a flood could limit the availability of fuel for generators and vehicles, and allow water levels to rise in buildings and other facilities.

To understand which of the city’s assets will be most vulnerable to flooding as the climate changes, the project team analyzed a wide range of scenarios across three different sources of flooding: sea level rise, storm surge (i.e., a rise in water level generated by a storm, over and above normal tides), and riverine flooding, which occurs when heavy rainfall causes water in rivers or creeks to overtop their banks. (Id. at 14).

“Extreme floods are one of the most costly and damaging climate-related threats to our infrastructure. According to the National Climatic Data Center, Pennsylvania experienced more than 156 storms from 2000 to 2010 that had more than \$1 million in property damage each. Total property damage over that same time period is estimated at \$1.5 billion. (DCNR and Climate Change: Planning for the Future, Penn. Dept. of Conser. & Nat. Resour. 2015 at 9).

NUMBER OF VULNERABLE CITY-OWNED ASSETS UNDER SIX SCENARIOS, BY VULNERABILITY LEVEL



The high, moderate, and low portions of the bars indicate the number of assets that would have high, moderate, and low vulnerability under each scenario. Source: Master Facilities Database

Extreme Weather Events

Pittsburgh confronts a variety of challenges from extreme weather. Much of the city is adjacent to rivers and their floodplains, and local weather patterns can produce a range of extreme precipitation events. Such events have caused major disasters in the city's history, but climate change could make extreme weather events in Pittsburgh either more frequent, more intense, or both.

"Precipitation and Flooding

Pittsburgh's neighborhoods are at risk from flash floods and riverine flooding. This is due to prevalence of impervious surfaces, hills, issues with stormwater management capacity, and changes in precipitation patterns. Areas in the City of Pittsburgh experienced 11 significant flash flooding events between 2007 and 2013, including the 2011 Washington Boulevard floods that took the lives of 4 people. River flooding is also a continued threat due to the location of the city at the convergence of three rivers. These risks have been managed since the U.S. Army Corps of Engineers began building flood control infrastructure along the major rivers following the 1936 flood, but an upstream flood coupled with the failure of aging locks and dams could nevertheless lead to a major flood event in the heart of the city. As of 2001, Downtown Pittsburgh had experienced at least 4 "100-year" floods over the past century alone." ([Resilient Pittsburgh, City of Pittsburgh 2016 at 30](#)).

"Winter storms

Large winter storms are relatively common in Pennsylvania, and are expected to happen more frequently. Major winter storms occur an average of 5 times per year in Pennsylvania, and since 2003 Pittsburgh has experienced three major snowstorms which led to emergency declarations. In the coming decades, the Northeastern United States is projected to experience a greater number of major winter storms, with an average precipitation increase of 5 to 20 percent.

Extreme temperatures

Extreme hot and cold temperatures are expected to have a greater impact on the city in the future. Long and extended cold spells are common during winters in Pittsburgh, with the longest stretch of sub-zero temperatures being 52 hours in January 1994, when temperatures reached -22° F.¹ On the flipside, the climate is warming and temperature fluctuations are increasing. Pittsburgh also experiences urban heat island effect, where cities with more thermal mass tend to be 1 to 3 degrees warmer than surrounding more rural areas. Pittsburgh is expected to see 15 to 30 extreme heat days per year, an increase from the 9 to 13 experienced between 2000 and 2009. Pittsburgh's aging population and housing infrastructure, including outdated heating and cooling systems, place residents at increased risk of negative health effects stemming from extreme temperatures. ([Resilient Pittsburgh, City of Pittsburgh 2016 at 31](#)).

"Infrastructure Failure

Due to the age and condition of much of the City of Pittsburgh's infrastructure ..., and with the potential strain placed on infrastructure with extreme weather, the possibility of infrastructure failure is a growing concern. Because of the city's dynamic topography of hills, valleys, and waterways, for instance, any failure to a key road, tunnel, or bridge could immobilize residents, potentially isolating thousands of individuals until access is restored.

- **Energy grid failure:** The city relies on a large-scale, interconnected electricity distribution system. Temporary power outages are common in the city, and are likely to increase as the energy grid is strained during extreme weather events. During the polar vortex of 2014, a regional transmission operator lost 22 percent of its capacity; demand was close to exceeding supply.
- **Bridge failure:** Allegheny County maintains 557 bridges, nine of which are major river crossings; the City of Pittsburgh owns 186 bridges; and the two major railroad companies in the region also own and maintain bridges. As of 2011, 30 percent of the bridges in Pittsburgh were considered structurally deficient.
- **Lock and dam failure:** Pittsburgh and the surrounding river system contain 23 locks and dams used to regulate water flow, transportation, and water supply to the city. Many of the locks and dams were constructed during the mid-20th century and have had few, if any repairs made since. In fact, only 5 of the 23 locks or dams have had any repairs made, most occurring before the 1990s. A lock and dam failure could mean that the City loses the ability to draw and treat potable water, a key power plant could not receive fuel by barge, and hazardous materials could spill into the rivers.

"Landslides and Subsidence

Landslides and subsidence incidents regularly affect parts of the city, and may only get worse. The city and region have a long history of coal extraction and undermining, putting many areas at risk for subsidence and sink holes, in addition to the landslide risk of Pittsburgh's fragile hillsides. These risks are exacerbated by extreme weather risks such as extreme rainfall. In fact, 900 structures within the city limits are considered to be in areas "Very Hazardous to Landslides". In recent years, landslides have occurred in the neighborhoods of Oakland, Greenfield and Perry North. Wet weather caused a landslide on Mount Washington in 2014 which covered 100 yards of rail lines, halting train traffic for 2 days." ([Resilient Pittsburgh, City of Pittsburgh 2016 at 32](#)).

3.5 Sea Level Rise Protection Costs of \$1.8 Billion. The Commonwealth has 57 miles of tidal shoreline affected by sea level rise, primarily on the Delaware which is urbanized (*Assessing the Tidal Delaware*, Del. Val. Reg. Plan. Commis. 2012 at 4). There is about another 60 miles on the Schuylkill River and minor tributaries, thus totaling 117 linear miles. Both sides of the Schuylkill and minor tributaries need protection, thus the grand total of shoreline needing protection is about 177 miles. Pennsylvania's tidal shoreline population is about 1 million (*id.*).

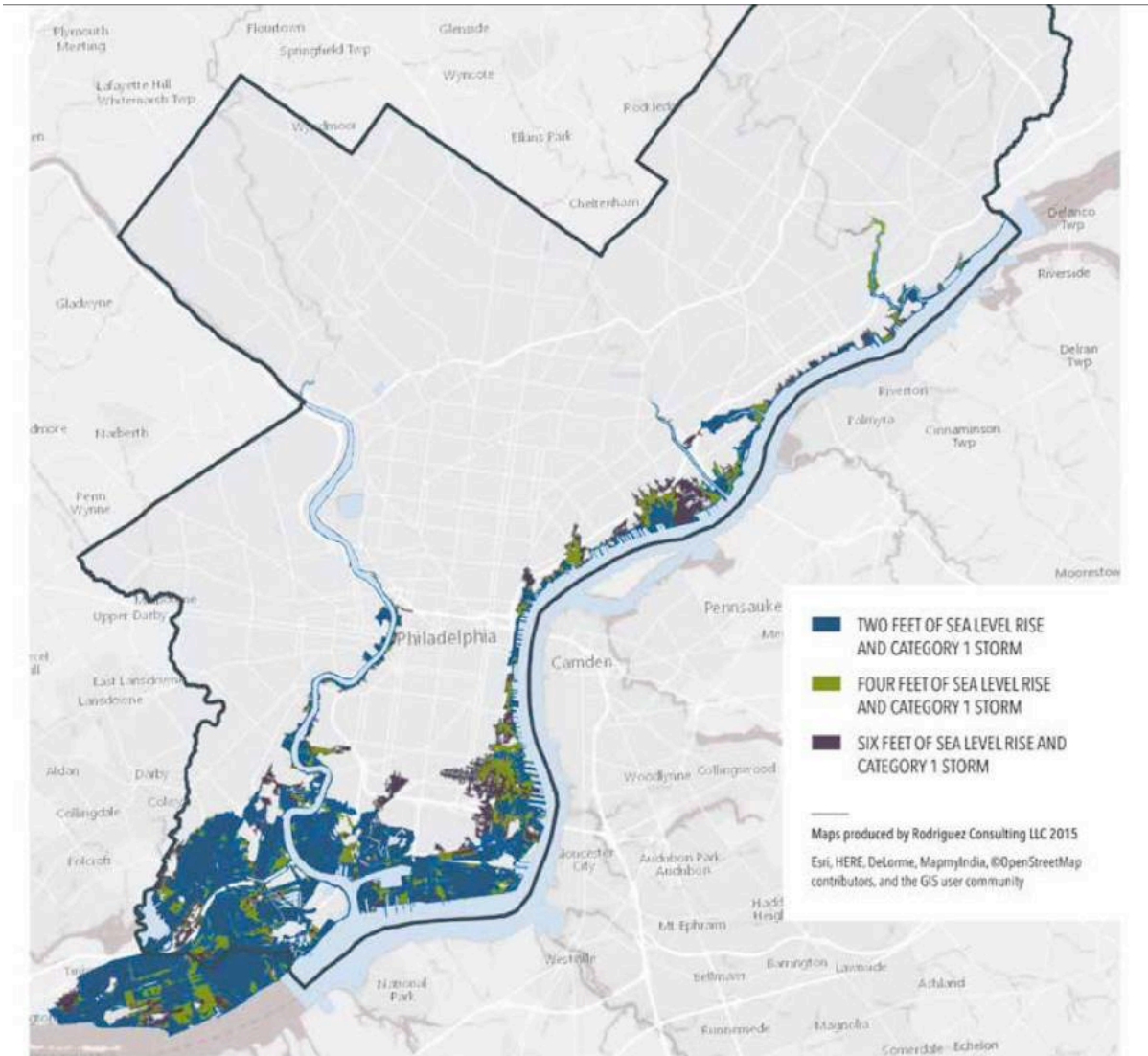
Sea Walls or Comparable Remedies. The 177 miles of shoreline need to be protected by sea walls or natural systems or a combination thereof. Seawalls cost about \$.06 million to \$44 million per linear mile (*Sea Walls*, Climate TechWikki / UN Environment Program 2010). This totals from \$10.6 million to \$1.8 billion. The \$1.8 billion figure is used since such a massive and complex construction undertaking has never been done before in the US and the uncertainties and resultant cost increases will occur. Also, maintenance costs are expensive and are not included in this estimate.

3.6 New Financing Mechanisms Are Needed for Bond Debt Service Paid by the Public Because the Cost is Too High. There was a consensus by the multitude of resilience and financial experts at the Oct. 2015 Ballard Spahr Philadelphia Infrastructure Conference, that even with the numerous financial advantages of green + resilient bonds, the public will not be able to afford the debt service due to the unprecedented costs, and thus additional financing mechanisms are needed now. The Ballard Spahr Conference Green Bond Session, mapped for participants with *Surging Seas* (see the following similar map), near term inundation from accelerating rising seas of Philadelphia's tidal areas along the Delaware River:

- Philadelphia Airport
- City's primary wastewater treatment plant
- City's waterfront
- By salt water of the City's drinking water intake requiring relocation upstream

Rising seas' damages have been calculated for Miami Beach by engineering feasibility studies as presented by Plaintiffs at the White House Resilience Conference (Sept. 2016) and at the capital markets' meeting at S&P Headquarters (Jun. 30, 2015). S&P confirmed to the US Conference of Mayors, its planned climate credit rating downgrades required by law to warn investors of accelerating systemic damages that are well documented by the investor and insurance communities, government, S&P (*Green Bond Business Case* 2014) and Moody's (2016). Near term engineering costs total an estimated \$1 trillion for Miami Beach alone, with comparable costs for the other urbanized areas of South Florida.

More intense precipitation and higher peak flows resulted in substantial floods in Pittsburgh trapping motorists in their cars drowning of a number of residents (Sept. 26, 2015 meeting with Mayor Bill Peduto, Chief Resilience Officer Grant Ervin, and Sustainable Pittsburgh).



Growing Stronger: Toward a Climate Ready Philadelphia, Report by the Mayor’s Office of Sustainability and ICF International, Nov. 2015, at 17.

“Increased Disaster Costs

Climate change is increasing the intensity of extreme storms, and just one severe hurricane could cause more than \$2 billion in damages citywide, a cost equivalent to roughly one-half of the city’s entire yearly operating budget. Philadelphia will also see more frequent extreme storms with higher winds and more flooding, due in part to sea level rise combined with heavy rains.”

Increased Operating Costs

In addition to increasing disaster costs, higher heat and more precipitation will increase the everyday cost of doing business for Philadelphia government, businesses, and residents. A small subset of illustrative examples is outlined below. These examples suggest that a comprehensive tally of increased operating costs from climate change across all sectors would total a significant economic impact in the city. Much of these costs will be borne by city departments in combination with state and federal government; others will fall directly on the private sector.

Yearly costs of climate change to the City of Philadelphia will include a variety of increases ranging from energy and maintenance costs to the increasing costs of continuing to provide services. As examples of these costs [to City government only], the city expects climate change to:

- *Increase annual electricity costs by up to \$1 million due to increased demand for air conditioning.*

- Create an additional \$2 to \$4 million in roadway maintenance costs from rutting (permanent pavement indentations from traffic) caused by precipitation, rutting caused by freeze- thaw cycles, and cracking during periods of high temperatures.
- Double or nearly triple the annual cost, currently around \$20,000, of running the Heatline, a helpline service the city runs during heat emergencies to advise callers about how to avoid heat stress and refer those in need of help to emergency services.

Citywide, Philadelphia will face a variety of increased costs due to climate change. For example, higher levels of ozone resulting from climate change will increase the incidence and costs associated with a variety of diseases, including asthma, cardiovascular disease, COPD, and other respiratory diseases. Citywide, the higher costs for medical treatment and lost productivity associated with these diseases will approach \$20 million by 2050. Regional transit will be affected as well: SEPTA has estimated that without additional resilience investments beyond those implemented to date, its increased operational costs and damages from climate change could rise by almost \$2 million per year.” (*Growing Stronger: Toward a Climate Ready Philadelphia*, Report by the Mayor’s Office of Sustainability and ICF International, Nov. 2015, at 19).

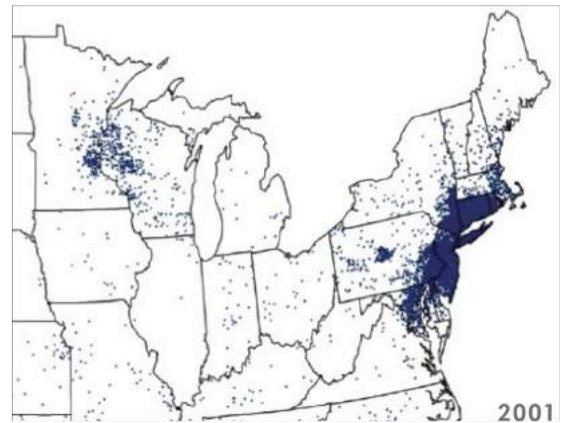
3.7 Partial Damages of \$366 Million to Pennsylvania Healthcare. There are a plethora of additional damages that need to be prevented by resilience that have yet to be monetized, e.g., heat impacts.

“Heat Impacts in Philadelphia

Extreme heat is likely to increase risks to the health of vulnerable populations in the city. As noted above, heat events and hot days are projected to increase substantially in Philadelphia.

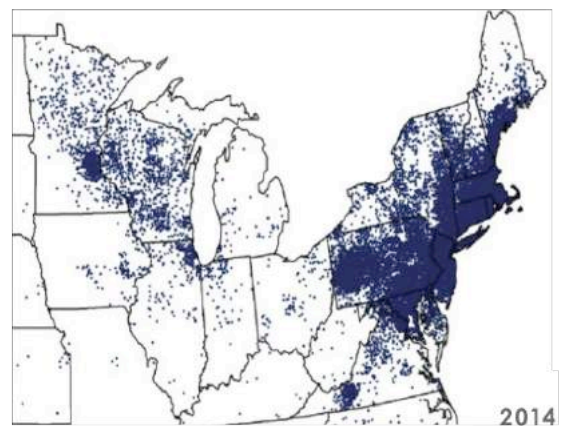
Extreme heat is responsible for more deaths in Pennsylvania than all other natural disasters combined,8 killing an average of 50 people per year between 1997 and 2004.9 A 10-day heat wave that hit Philadelphia in July 1993 resulted in 118 deaths. *Growing Stronger: Toward a Climate Ready Philadelphia*, Report by the Mayor’s Office of Sustainability and ICF International, Nov. 2015, at 6).

Climate Ready Boston, City of Boston 2016



Existing \$366 Million Added Cost of Lyme Disease From Warming. Pennsylvania incidence of Lyme was the greatest of any State with 51,276 confirmed cases from 2005 to 2015 (*Reported cases of Lyme disease by state or locality, 2005-2015*, Centers for Disease Control (CDC), Lyme Disease Home, Statistics. “Lyme disease has been a nationally notifiable condition in the United States since 1991”).

“The number of cases of Lyme disease in the United States has nearly doubled since 1991, and according to the Center for Disease Control is now the most commonly reported vector-borne disease in the United States. In Pennsylvania the number of reported cases of Lyme disease increased by 25% in 2014. The black-legged tick, which is the vector for Lyme disease, is now found in every county in Pennsylvania, and according to researchers at the Cary Institute of Ecosystem Studies, climate change is increasing not only the range of the black-legged tick, but also the time of the year during which the tick feeds. (*DCNR and Climate Change: Planning for the Future*, Penn. Dept. of Conser. & Nat. Resour. 2015 at 8).



CHANGES IN LYME DISEASE CASE REPORT DISTRIBUTION

Maps show the reported cases of Lyme disease in 2001 in 2014 for the areas of the country where lyme disease is most common (the Northeast and Upper Midwest). Both the distribution and the numbers of cases have increased. (Figure source: adapted from CDC 2015)

Lyme is undiagnosed by 20-40% and underreporting of confirmed case is 90% since:

1. CDC states that doctors fail to report the confirmed case which is similar to other disease reporting.

"Each year, approximately 30,000 cases of Lyme disease are reported to CDC by state health departments and the District of Columbia. However, this number does not reflect every case of Lyme disease that is diagnosed in the United States every year. Surveillance systems provide vital information but they do not capture every illness. Because only a fraction of illnesses are reported, researchers need to estimate the total burden of illness to set public health goals, allocate resources, and measure the economic impact of disease. CDC uses the best data available and makes reasonable adjustments—based on related data, previous study results, and common assumptions—to account for missing pieces of information." (How Many People Get Lyme Disease? Lyme Disease Home, Statistics. CDC)

2. Disease symptoms are similar to other well-known diseases making diagnosis difficult.

(See Lyme Overlap With Other Diseases, Columbia University Medical Center Lyme and Tick-Borne Disease Research Center: "Are there any diseases that can be misdiagnosed as Lyme disease? Lots of diseases could be misdiagnosed as Lyme disease. This of course makes sense when you know that Lyme disease itself may manifest as a multisystemic disorder that can mimic other diseases. This means that just as the Lyme disease might be "missed" in some cases, some individuals may be misdiagnosed as having Lyme disease when in fact they have another disease").

3. It usually takes from 3 - 30 days after being bitten by a tick to develop the initial symptoms of Lyme disease (id.) and thus the delay in symptoms can cause a lack of association of the tick bite with the resulting disease.

4. Also making diagnosis difficult is the fact that only about 60-80% of Lyme disease cases have the bulls-eye skin rash known as erythema migrans -- latin for migrating redness. "According to the Centers for Disease Control (2008), erythema migrans occurs in 60-80% of Confirmed cases" (What percent of cases of reasonably proven Lyme disease present without erythema migrans? Columbia University Medical Center Lyme and Tick-Borne Disease Research Center).

5. Further and *"[c]ontrary to popular opinion, only about 10% to 15% of erythema migrans rashes are true bull's-eyes," Shapiro told Infectious Disease News. "About two-thirds are uniformly red or they have enhanced central erythema, but they don't necessarily have that clear area around it; some do, but it's relatively uncommon." (Lyme disease underreported, incidence still on the rise, Infectious Disease News, Jan. 2014. Eugene Shapiro, MD, is professor of pediatrics and epidemiology at the Yale School of Public Health).*

"Blood tests for Lyme disease have "very good sensitivity," according to the CDC, meaning they're quite good at detecting antibodies produced by the body in response to the infection. But like most medical tests, they have their limitations. Because the two tests look for antibodies, they can give false negative results during the first few weeks after exposure to the bacterium -- a window of time during which the body is still mounting its response to the infection. That's why the tests should be performed four to six weeks after a tick bite." (Myths About Lyme Disease, Kate Moisse, ABC News Aug. 21, 2013).

The blood tests are reported to be abysmal for chronic Lyme with up to 40% false negatives (communication from Sarah Fletcher, MD who specializes in the treatment of Lyme disease and chronic illness using functional medicine principles (Jan. 29, 2017).

* * *

"The CDC clinical criteria for Lyme Disease which exist for the purpose of monitoring the rate of Lyme disease nationally are quite narrowly defined in order to ensure a high degree of specificity in the diagnosis. These criteria are mainly useful for the early stages and rheumatological presentations of Lyme Disease, such as when a patient appears with an erythema migrans rash, arthritis, a Bell's palsy, or early central neurologic Lyme disease (meningitis or encephalitis). The CDC criteria are not very helpful for helping the clinician to detect late stage neurologic Lyme Disease. For example, the most common manifestation of late neurologic Lyme Disease is cognitive dysfunction (often referred to as "encephalopathy"). A patient who presents with new onset encephalopathy and a positive blood test for Lyme Disease would not be considered by the CDC to be a case of Lyme disease. Although the CDC recognizes that Lyme encephalopathy exists, encephalopathy is not part of the "surveillance case definition". Hence, physicians who rely on the narrow surveillance case criteria of the CDC for clinical diagnosis will fail to diagnose some patients who in fact do have Lyme disease; in these cases, the patient's treatment will either not occur or be delayed. Such delay in treatment may result in an acute treatable illness becoming a chronic less responsive one." (THE LYME DISEASE CONTROVERSY, Columbia University Medical Center Lyme and Tick-Borne Disease Research Center)

Given the preceding data that the 51,276 cases of Lyme in the Commonwealth is low due to 20% - 40% of cases are undiagnosed, and only 10% of the confirmed cases are reported, a

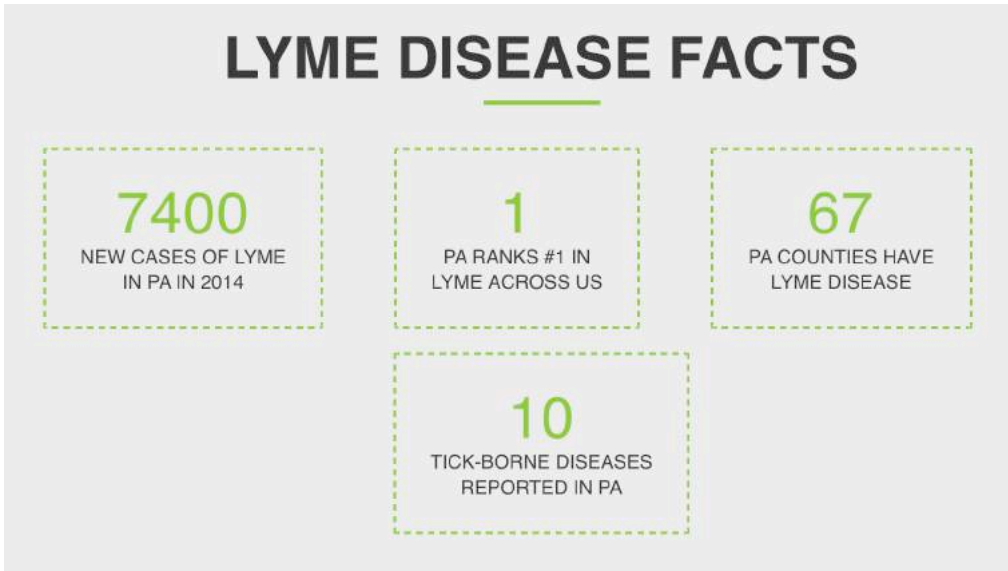
conservative estimate is that there are actually 50% more cases. Thus the real number of cases is 51,276 plus 50% more or 76,949 cases.

Average per person 2015 costs for Lyme are \$10,343 based on CDC data and include treatment, insurance, and lost productivity, but not pain and suffering. In 2002, the annual cost per person was \$8,712. Average cost from 2004 - 2015 is \$9,528.

Given that the substantial recorded growth of climate impacts including annual average temperature increases since 2000, the growth of Lyme due to climate impacts including warming

creating a more conducive environment for ticks, has been a primary cause of the doubling of confirmed Lyme cases from 2004 – 2015 (*"Climate change is speeding up the spread of Lyme disease," STAT, (July 1, 2016) (with links to Journal of Medical Entomology studies); "Effect of Climate Change on Lyme Disease Risk in North America," Ecohealth. 2005 Mar; 2(1): 38–46; "With Climate Change, Ticks Are Moving On Up, Spreading Lyme Disease And Other Tick-Borne Diseases To New*

Pa Lyme Resource Network 2015



Parts Of The Country," Medical Daily (May 11, 2015) ("it's likely that warming temperatures have and will spread ticks to more parts of the world; we don't have a firm grasp of how and where exactly this will happen."); "Climate change may affect tick life cycles, Lyme disease," Oregon State University News, News and Research Communications (Feb. 17, 2015); "Key Finding 2: Earlier Tick Activity and Northward Range Expansion." Vector & Vector Borne Diseases | Climate & Health Assessment," Climate & Health Assessment, GlobalChange.gov, US Global Change Research Program (2014); "Effects of Climate on Variability in Lyme Disease Incidence in the Northeastern United States," American Journal of Epidemiology (Mar. 15, 2003); "The Rise in Tick-Borne Diseases: Is Climate Change Responsible?" ("Although data support a link between climate change and increased transmission of tick-borne diseases, there are numerous confounding variables," Clinical Correlations, NYU Langone Online Journal of Medicine (June 4, 2014); "In a warmer world, ticks that spread disease are arriving earlier, expanding their ranges," Cary Institute of Ecosystem Studies (Feb. 18, 2015); "Climate change may spread Lyme disease. Balmy seasons have already expanded the territory of the ticks that carry the bacteria," Science News (Mar. 19, 2014); "CLIMATE CHANGE INCREASES IN THE NUMBER AND GEOGRAPHIC RANGE OF DISEASE-CARRYING SECTS AND TICKS," CDC & American Public Health Association (Circa 2014)).

Thus a conservative assumption is that 50% of the 76,949 cases in Pennsylvania were attributable to warming, or 38,457 cases.

Since RELi includes Community Quality of Life - COMPREHENSIVE ADAPTATION + MITIGATION FOR A RESILIENT PRESENT + FUTURE (RELi Action List 2015) which can cover increased disease, this Lyme damage calculation is relevant and appropriate. Total damages equal the number of cases (38,457) times the average cost per person (\$9,528) or \$366.42 million.

3.8 About \$200 Million in Resilience Grants and Bond Expenditures. The Commonwealth and its municipalities conducted numerous resilience reports including those cited herein and capital expenditures for resilience costing about \$200 million.

3.9 More Intense Winter and Summer Storms are Being Experienced Costing an Added \$442 Billion. Cost data show prior storm and hurricane economic and loss of life damages to Pennsylvania:

“A look at damages associated with historical precipitation events could provide a window into the future, if such events increase in frequency. According to the National Climatic Data Center, Pennsylvania has had a moderate history with extreme weather events relative to other states. The state has experienced 13-15 major storms that resulted in over a billion dollars worth of damages since 1980 (National Climatic Data Center 2008).

The most recent weather disaster was the Northeast flooding in June 2006. Storms produced rainfall in excess of 12 inches (see Figure 5) in Eastern Pennsylvania over the course of three days. High rainfall occurred in the Susquehanna River basin, causing flooding and the evacuation of over 200,000 people in the Wilkes-Barre region. The associated flooding reportedly killed 16 individuals and caused over \$100 million in damages. These damages, in turn, led to the diversion of resources from other productive uses in the state economy (National Climatic Data Center 2008a).” (Economic Impacts of Climate Change on Pennsylvania, Univer. Of Md. 2008, at 10).

“Hurricanes can easily track inland and bring heavy rains and tornados to all parts of the state. In September 2004, Hurricanes Jeanne and Ivan caused flood and wind damage. Isabel in 2003 tracked through western Pennsylvania and with it brought heavy rains to the central and eastern parts of the state. Tropical storm Allison wreaked havoc in Philadelphia and Wilkes-Barre, Pennsylvania in June 2001 (National Climatic Data Center 2008). While most of the \$5 billion in damages occurred during landfall in Houston, heavy rains and flooding (some due to storm surge) caused several hundred thousand dollars in damage to Pennsylvania and 7 deaths. The remnants of Allison dumped 3 inches of rainfall overnight in most parts of Eastern Pennsylvania on June 18th; Doylestown, PA received over 10 inches. Likewise, 1999’s Hurricane Floyd also tracked up the eastern coast and caused heavy rains throughout Pennsylvania (Hurricanes and Middle Atlantic States 2008). The \$6 billion storm hit North Carolina hardest, but also 8 deaths in Pennsylvania. Over 400,000 were without electricity at one point, 4000 went homeless, and 2000 homes were damaged (National Climatic Data Center 1999). (Id.)

NASA reports from the MIT recognized expert on the subject Kerry Emanuel, that Atlantic hurricanes are 60% more powerful than in 1970 including from well-documented rising sea surface temperatures *(In a Warming World, the Storms May Be Fewer But Stronger, NASA 2016).*

Using damages from Hurricane Sandy as the most recent Atlantic hurricane to strike land in the Northeast with the epicenter in New Jersey, Sandy costs for New Jersey were \$36.9 billion *(Christie Administration Releases Total Hurricane Sandy Damage Assessment of \$36.9 Billion, Governor’s press release Nov. 28, 2012).* Sixty percent of \$36.9 billion is \$22.1 billion which is the amount attributable to warming. Assuming one summer storm and one comparable winter storm every ten years for 100 years which at minimum is the expected duration due to the latent warming in the atmosphere, total hurricane and storm damages to the Commonwealth are \$442 billion.

3.10 Added Cost of \$3.92 Trillion to Pennsylvania’s Built Environment from Existing & Accelerating 71% More Intense Precipitation & 6% Increased Peak Floods. Increased flooding greatly increases costs and thus It is cost-effective to ensure that these existing and expected increases can be safely accommodated by the built environment.

“The Pennsylvania Emergency Management Agency has recently published estimates of projected losses for flood events for the state and the counties. For the nine most populated counties in the state (accounting for over 50 percent of total population), a ten year flood is expected to inflict \$9.2 billion in damages to buildings – about 20 percent of the cost will be to residential homes and around 50 percent of the cost will be to commercial businesses. A fifty-year flood will cost over \$12 billion to those counties (Pennsylvania Emergency Management Agency 2008).

As climate change progresses unchecked, the floods are likely to become more frequent –more than once every ten years – causing large recurrent damages. For example, a study of economic impacts of severe weather events in the Mid-Atlantic region showed that a 1 percent increase in annual precipitation results in a 2.8 percent increase in annual flood and hurricane economic losses, as measured by historical insurance loss data (Choi and Fisher 2003). If precipitation increases by around 10 percent in the state, a 10-year flood would cost the most-populated counties an additional \$2.5 billion per event.” (Economic Impacts of Climate Change on Pennsylvania, Univer. of Md. 2008, at 9).

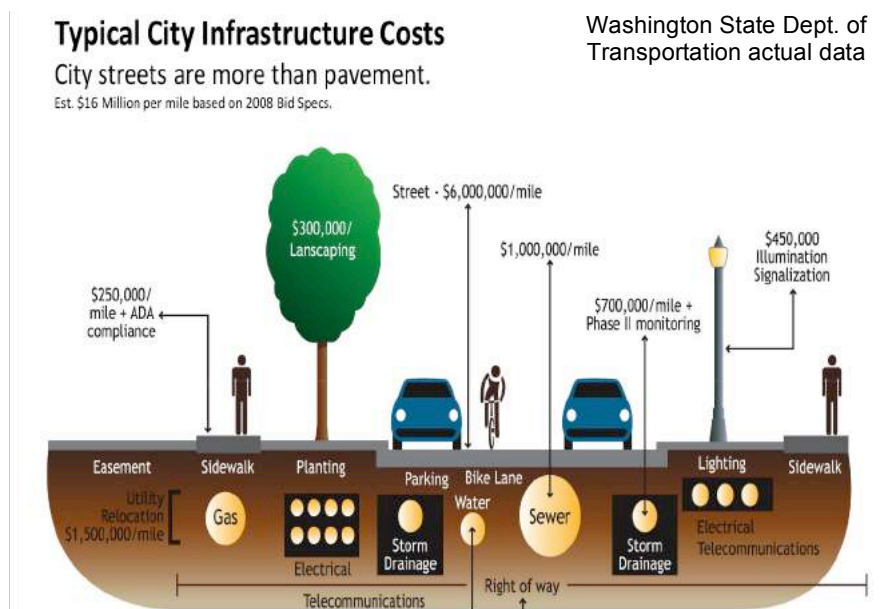
"In June 2006, more than 12 inches of rain fell in northeastern Pennsylvania over three days. Flooding due to the storm caused more than \$100 million in damage. More than 200,000 people in the city of Wilkes-Barre were evacuated, and 16 people died." (PENNSYLVANIA: Assessing the Costs of Climate Change, Nat. Confer. of State Legis. 2008 at 1).

Center City Philadelphia commercial and residential property is assessed by the City at \$12 billion excluding infrastructure (Aggregated Commercial & Residential Assessments, Center City District Development Corporation 2017). Center City District 2015 population is 187,000 (Id.) and Philadelphia 2015 population according to the Census is 1.53 million, or about eight times greater. Thus the value of Philadelphia built environment excluding infrastructure is about \$96 billion. Pennsylvania 2015 Census population was 12.8 million or 12 times greater than Philadelphia's bringing Pennsylvania built environment value excluding infrastructure to about \$1.52 trillion based on this population ratio.

Pennsylvania infrastructure in 14 categories needs to be made resilient from well-documented, existing and accelerating more intense precipitation and floods, and higher winds, and includes (Pennsylvania 2013 Infrastructure Report Card):

1. Sewers including storm and combined and natural systems to reduce flows
2. Wastewater & drinking water treatment plants
3. Roads & highways
4. Bridges
5. Airports
6. Rail, subway & stations
7. Ports
8. Inland waterways
9. Dams & levees
10. Solid waste recycling & disposal facilities
11. Parks
12. Schools
13. Telecommunications & IT including overhead and underground wires
14. Energy, electrical including overhead and underground electrical wires, substations, and generating facilities

According to our research and NYU cited in Bloomberg (IS U.S. INFRASTRUCTURE MORE EXPENSIVE? NYU Marion Institute June 2, 2015), data on average US infrastructure costs are sparse. Consequently, actual data are used herein for the calculations. The Philadelphia City Center map shows 35 streets in a north - south direction (2.5 miles long), and 35 streets in an east - west direction (1.3 miles long). City Center Development



District is a rectangular area between the Delaware and Skuykill Rivers. The total of street miles in City Center is 35 x 2.5 miles (87.5) + 35 x 1.3 miles (45.5), or 133 street miles. Actual data on city infrastructure costs as shown in the preceding Figure are \$16 million per mile excluding rail, subway, treatment facilities, stations and operating facilities as well as airports and schools. Thus this partial infrastructure cost is very conservative and is \$16 million times 133 miles or \$213 billion.

Based on a population ratio above whereby Philadelphia's population is eight times greater than Center City, Philadelphia infrastructure value is eight times \$213 billion or about \$1.7 trillion. Pennsylvania's population is 12 times greater than Philadelphia, thus total Pennsylvania infrastructure value \$1.7 trillion times 12 or about \$20.5 trillion.

Importantly, this value excludes the cost of operation and maintenance (O&M). Using Congressional Budget Office 2000 – 2019 calculations of \$53 billion for US O&M costs for water and wastewater infrastructure and \$30 billion for capital costs, capital costs are 57% of O&M costs, thus O&M costs are 43% greater (*Future Investment in Drinking Water and Wastewater Infrastructure* May 2002). Forty-three percent of \$20.5 trillion value of Pennsylvania infrastructure is \$8.8 trillion, thus total Pennsylvania infrastructure value is about \$29 trillion.

However, Pennsylvania infrastructure in seven categories where the greatest resilience costs occur, is substantially deficient, graded on average a D by the American Society of Civil Engineers (*Pennsylvania 2013 Infrastructure Report Card*):

- Bridges D+
- Stormwater D+
- Wastewater D –
- Drinking Water D
- Roads D –
- Transit D
- Levees C -

This existing deficiency in existing critical infrastructure adds about 30% to infrastructure resilience costs since so much is failing now and resilience upgrades can't be effective without making the existing infrastructure functional. For example, 23% of Pennsylvania's bridges are structurally deficient, the highest in the US and “[u]nfortunately, even with the additional funding fully in place, it is estimated that more than 50 percent of the needs for state bridges and more than 60 percent of the funding needs for local bridges will still not be met in 2019. ... Simply keeping the road system from degrading, let alone improving it, requires more funding than is currently available.” (*Id.*).

An additional 30% to resilient infrastructure costs from existing critical deficiencies raises \$29 trillion of Pennsylvania infrastructure value for purposes of resilience total to about \$37.7 trillion. The value of Pennsylvania built environment excluding infrastructure calculated above is about \$1.5201 trillion. Thus, total Pennsylvania built environment value is about \$39 trillion.

Upgrades to ensure this built environment can withstand existing and accelerating 71% more intense precipitation and 6% higher peak floods, must either resize the built environment, and / or construct natural remedies to reduce the more intense flows. The Cost of this substantial upgrade including for greater known future climate intensity based on its well-documented latency, is estimated at about 10% of the built environment value, or \$3.92 trillion.

3.11 Partial Damages of \$40 Billion to Recreation From Loss of Snow. Pennsylvania comprises about 20% of the Northeast ski industry with millions of skier visits / yr.

"With 3.6 million skier visits in 2009/2010, Pennsylvania rivals the combined total skier visits of Idaho, Montana, and Wyoming. In 2010, Pennsylvania's winter tourism industry supported 12,000 employees, who earned \$395 million in wages. Skiers, snowboarders, and snowmobilers contributed \$690 million in value added to the state's economy.

During lower-snowfall years (e.g., 2001/2002 and 2008/2009), Pennsylvania sees 12 percent fewer skier visits compared to visits during higher-snowfall winters (e.g., 2002/2003 and 2009/2010). Consequently, the net loss in ski resort revenue was an estimated \$67.6 million with 820 fewer jobs." (Climate Impacts on the Winter Tourism Economy in the United States, NRDC & PROTECTOURWINTERS.ORG 2012 at 29)

"In terms of lost revenue, Pennsylvania suffered the worst, in the mid-Atlantic region, missing out on more than \$67 million in potential resort revenue and over 800 fewer jobs, during low-snowfall years, compared to colder, snowy years. (Id. at 17).

"During the 2006–2007 season, 32 ski areas operating in Pennsylvania logged over 2.75 million skier visits, ranking the state sixth nationally in ski visits." (Climate Change in Pennsylvania, Union of Concerned Scientists 2008, at 44). [New York has the most ski resorts in the US with a total of 34 (On the Snow.com)].

State's ski industry vulnerable

Pennsylvania hosted over 2.75 million skier visits during the 2006–2007 season, but this industry is under growing pressure. Warming winters have increased the amount of snowmaking required in much of the Northeast, at considerable cost both to ski resorts and skiers alike. In Pennsylvania, this trend is projected to progress under either emissions scenario, until many resorts experience conditions that are too warm for snowmaking altogether. (Climate Change in Pennsylvania, Union of Concerned Scientists 2008, at 45).

"Perhaps the greatest impact, however, will be on winter recreation. Winter low temperatures are expected to rise further, with much of Pennsylvania having insufficient snow cover by the end of the century to support skiing or snowmobiling and insufficient ice to support ice fishing. Data collected from 1965-2005 indicated that snow-covered January days declined by 1.5 days per decade in the Northeast and one day per decade in February. Snow totals are expected to further decline 20-30% near the New York border and 50-60% in the Laurel Highlands." . (DCNR and Climate Change: Planning for the Future, Penn. Dept. of Conser. & Nat. Resour. 2015 at 11).

At about 20% of the Northeast ski industry, the Commonwealth has a resulting mean regional revenue loss of \$243 million / yr. using University of Maryland data quoted below since Pennsylvania has the greatest ski industry decline from warming in the Mid-Atlantic according to the NRDC report above. Over 100 years for Pennsylvania based on expected continued warming, this is \$24 billion in total damages with DCNR above predicting skiing will be infeasible due to continued warming from latency in 80 years.

"Warmer winter temperatures and reduced snowfall will negatively impact snow-based recreation. Pennsylvania's ski resorts will experience shorter seasons, higher snow making costs, and lower profits as a consequence of climate change. Research also suggests that dispersed winter recreation, such as cross country skiing and snowmobiling, will decline because of less snowfall and fewer extended periods of cold weather." (2015 Climate Change Action Plan Update, Penn. Dept. of Environ. Protect. 2016 at 18).

"In the Northeast, ... [t]he region can expect a decrease of 10-20% in skiing days, resulting in a loss of \$405-810 million per year." (The US Economic Impacts of Climate Change and the Costs of Inaction, University of Maryland, Oct. 2007 at 4).

"Millions of residents and tourists alike head for the woods and hills of Pennsylvania each winter, lured by more than 30 ski areas and 3,000-plus miles of public snowmobile trails. Winter recreation in the Commonwealth, from sledding in the city parks of Pittsburgh to riding horse-drawn sleighs through the frosty woods of the Poconos, traditionally revolves around snow. However, the face of winter in Pennsylvania is expected to change rapidly and profoundly this century as winter temperatures continue to rise." (Climate Change Impacts and Solutions for Pennsylvania, Union of Concerned Scientists 2008 at 9).

“Snowmobiling conditions are projected to diminish markedly, causing the snowmobile industry—which pumps an estimated \$160 million into the Pennsylvania economy each winter—to all but disappear. As temperatures warm and snowmaking becomes increasingly difficult, Pennsylvania is no longer expected to support viable ski operations.” (Id. at 9).

Since RELi includes Community Quality of Life - COMPREHENSIVE ADAPTATION + MITIGATION FOR A RESILIENT PRESENT + FUTURE (RELi Action List 2015).

Lost snowmobile revenue of \$160 million / yr. costed out for 100 years since the effect on snowmobiling is expected to last that long due to the latent effect of warming, is \$16 billion.

Total snowmobile lost revenue of \$16 billion plus total ski lost revenue of \$24 billion is a total of \$40 billion in partial lost winter sport revenue for Pennsylvania.

3.12 Partial Damages of \$28 Billion to Agriculture. Dairy is the top Agricultural Industry in the Commonwealth with a 2002 commodity value of \$1.4 billion

(Climate Change in Pennsylvania, Union of Concerned Scientists, 2008 at 28).

“Although farmers have often proven adaptable to changing weather patterns and market demands, they face greater uncertainty, risk, and expense as the pace and scope of climate change increase.” (Id.).

The 20% decline in milk production from warming according to the US Global Change data below, shows reduced revenue of \$280 million / yr., which taken over 100 years based on expected continued warming from latent CO2 is a total of \$28 billion.

“In parts of Connecticut, Massachusetts, New Jersey, New York, and Pennsylvania, a large decline in milk production, up to 20 percent or greater, is projected. Under the lower emissions scenario, however, reductions in milk production of up to 10 percent remain confined primarily to the southern parts of the region. (Report: Global Climate Change Impacts in the United States, U.S. Global Change Research Program) (Massachusetts Fact Sheet on Climate Change, EarthJustice.

“The predicted higher temperatures due to ... climate change will likely have a negative impact on the dairy industry; prolonged heat stress decreases milk production. One study shows that above a critical temperature threshold of 77° F, dairy cows produce less milk – up to 22 percent less (PNAS 2007). Such an impact on the dairy industry of Pennsylvania would also affect related economic activities, such as manufacturing and sales of dairy products, which annually account for nearly \$16 billion and over 20,000 jobs (Census 2002; 2007 \$s). Decline in dairy production may inflict around \$480 million in direct and indirect economic costs; and the number of direct and indirect jobs affected may reach 5300 (RESI 2008).” (Climate Change in Pennsylvania, Union of Concerned Scientists, 2008 at 22).

3.13 Partial Damages of \$8 Billion to Forestry: Expected Loss of Hickory. Pennsylvania has an extensive and profitable forest resource. Substantial declines in profitable wood species are expected due to warming according to State agency and other reports for black cherry, hemlock, red and sugar maple, American beech, ash, yellow birch:

“Hemlock (the state tree) is projected to lose two-thirds of its current suitable habitat. Under the lower-emissions scenario it could lose less than half.

• *Suitable habitat for the black cherry tree is expected to disappear from the state altogether. Possibly the most economically important tree species at risk, black cherry, currently supports a thriving timber and veneer industry.*

• *Suitable habitat for signature species such as sugar maple and American beech—both of which provide brilliant fall foliage—is projected to decrease.*

• *As many as half of the 120 bird species examined in Pennsylvania could see at least 25-percent reductions in their suitable habitat because of changes in climate and vegetation.” (Climate Change Impacts and Solutions for Pennsylvania, Union of Concerned Scientists 2008 at 8).*

“Current problems, such as the decline in sugar maple and ash, as well as limited forest regeneration, will worsen as the climate continues to change. This coupled with a projected decline in northern hardwoods, especially black cherry, may result in mill closings and job losses and the depression of economic development in some areas.” (DCNR and Climate Change: Planning for the Future, Penn. Dept. of Conser. & Nat. Resour. 2015 at 5).

“US Forest Service projections suggest limited habitat will remain for many important northern hardwood species in Pennsylvania by the end of the century, including black cherry, sugar maple, yellow birch and others;” (Id. at 6).

“The economic impact will be especially significant for our forest resources. In 2012, the state’s wood industry had roughly \$11.5 billion in sales, an over- all total economic impact estimated at \$19 billion, and employed approximately 58,000 people. Black cherry, red/soft maple, sugar/hard maple, and mixed hardwoods, which are all predicted to decline due to climate-related stress, collectively account for more than 40% of the total volume of timber harvested in the Commonwealth. These declines could potentially mean significant monetary losses for the department, private landowners, and those employed in the wood products industry. (Id. at 11).

“Pennsylvania produces more than 1 billion board feet of hardwood lumber each year, about 10 percent of the nation’s total hardwood output. Roughly 1.2 million acres of the state’s 16.1 million acres of timberland is black cherry, yielding some 127 million board feet of black cherry annually. The value of black cherry shipments to sawmills in 2006 came to more than \$200 million. Logging provided an estimated 750 jobs in the state in 2004, with black cherry logging accounting for almost 130 of them. In addition, nearly 700 of the 4,000 sawmill jobs in the state can be attributed to black cherry processing. Pennsylvania forests are home to 43 percent of the black cherry growing stock on U.S. timberlands. Thus the health of companies throughout North America that use black cherry wood, such as cabinet and furniture manufacturers, is linked to the fate of the state’s hardwood forests. This small but important sector of the timber industry is particularly vulnerable to climate change.” (Climate Change in Pennsylvania, Union of Concerned Scientists 2008, at 31-32).

“Declines in black cherry habitat would greatly exacerbate stresses on forest-based industries such as timber harvesting, processing, and manufacturing that are key to the economy of the northwestern part of the state. Communities that have traditionally relied on black cherry—e.g., for employment and tax revenue—are staking their economic health on an increasingly vulnerable resource.” (Id. at 39).

Since RELi includes Community Quality of Life - COMPREHENSIVE ADAPTATION + MITIGATION FOR A RESILIENT PRESENT + FUTURE (RELi Action List 2015)

The data are available for black cherry losses, the most profitable wood in the Commonwealth with partial annual revenue of \$200 million documented above, with the US Forest Service and Union of Concerned Scientists predicting black cherry will be gone from the Commonwealth from warming in about 80 years. This decline and elimination of black cherry industry will likely accelerate due to continued increased warming and its latent effect. Assuming a \$200 million annual revenue loss for 40 yrs. over the next 100 years of continued warming, this results in a conservative loss of \$8 billion for black cherry alone.

Partial Damages to State Forests. The Commonwealth’s FSC Certified Forest has been devalued by LEED’s 2016 unlawful, competing SFI Wood Standard that encourages illegal logging. Forestry is an important resource, economy, and mitigator of adverse climate impacts following the Commonwealth’s “Penn’s Woods” namesake. The State owned forests achieved the leadership FSC Certification documenting well-managed forests and protecting the forest environment and recognized by the Leadership Standards Campaign developed by leading environmental groups including the National Wildlife Campaign.

“Forests play an important role in mitigating the impacts of climate change. Healthy, productive forests store and sequester carbon. Sustainable timber harvesting can not only improve the health of the forests and encourage the growth of young, vigorous trees; it can also result in durable wood products, which continue to store carbon for long periods of time.

Pennsylvania has a 2.2-million-acre state forest system which is an important reservoir for both storing carbon and sequestering it from the atmosphere. In 2015, state forests are expected to sequester 4.7 million tons of carbon and store, above ground, 143 million tons. Pennsylvania’s 11.5 million acres of privately owned forestland also provide carbon storage and sequestration, although rates vary depending on how well they are managed and developed. Forests also help to combat the effects of climate change by providing key ecosystem services, such as improving rising stream

temperatures, reducing runoff during heavy rain events, and taking up excess nutrients to keep water clean.” (2015 Climate Change Action Plan Update, Penn. Dept. of Environ. Protect. 2016 at 9-10).

After FSC development and incorporation into LEED, SFI was developed by the wood industry as a status quo certification not protecting the forest environment. For this reason, Plaintiffs’ National Consensus Sustainable Product Standard (SMaRT) approved for LEED Credit in 2006, requires FSC as a prerequisite and was unanimously approved not to include SFI. Weyerhaeuser objected but was voted as nonpersuasive because SFI does not protect against climate change. Weyerhaeuser appealed but dropped the appeal during mandatory dispute resolution, and its objection was dismissed with prejudice.

Subsequently, some 20,000 of Defendants’ Members voted and prevented SFI from LEED incorporation for the same reasons.

Pennsylvania State Forests are FSC Certified and comprise 2.2 million acres (Pa. DCNR State Forests; State Forest District Index 2016). The value of this forest is \$1800 / acre or \$3.96 billion in the year 2008 (Tree Value & Deciding When to Harvest Timber, Forest Finance Report # 8, Penn State Extension 2008).

The Commonwealth’s FSC Forests are devaluated by the LEED SFI Wood credit, through market confusion and the fact that SFI Certification is much easier and cheaper than FSC because it is primarily a status quo certification as documented by Perkins+Will in its seminal evaluation of FSC v. SFI (Perkins+Will *Criteria for the Identification of Leadership Standards for Sustainable Forestry* 2010) recognized in the 2011 *Leadership Standards Campaign Public Criteria* document. In contrast, FSC requires a number of prerequisites ensuring that wood harvesting protects the forest. The Leadership Standards Campaign Criteria were developed by National Wildlife Federation, Sierra Club, Perkins+Will and Eaton Corporation.

Assuming a conservative one thousandth of a percent in Commonwealth FSC forest devaluation based on the well documented and recognized substantial and durable monopoly power of LEED, and the extensive industry PR Campaign announcing SFI approval, \$396,000 in damages to the Commonwealth’s FSC Certified Forest were accrued totaling \$1.188 million in treble damages.

Since RELi includes Community Quality of Life - COMPREHENSIVE ADAPTATION + MITIGATION FOR A RESILIENT PRESENT + FUTURE (RELi Action List 2015)

3.14 Weakening of Healthy Products / Hazard Assessment: Damage Assessment and Calculation. Additional damages were caused by Defendants and incurred by the Commonwealth for LEED’s unlawful 2014 amendment weakening hazard assessment of building products causing toxic product specification increasing indoor air pollution. The National Consensus Green Building Underwriting Standard measures green building increased cash flow including for improved indoor air quality which in turn increases lease-up and tenant retention.

There are at least 1000 certified LEED buildings in Pennsylvania, at least one half are private commercial buildings where cash flow is the measure of profitability (Regional Green Building Stats, Green Building Alliance 2016; Memo to City of Philadelphia Law Department, Sept. 29, 2016 citing Green Building Information Gateway 2016 and listing private sector LEED buildings in the City, and City Green Building Ordinance 9704 for City buildings). For

these buildings certified with credits eliminating product hazard assessment, indoor air quality is impaired and cash flow and productivity are diminished.

For both public and private buildings, diminished indoor air quality decreases occupant productivity and health.

The National Consensus Productivity Underwriting Standard documents that average green building productivity gains are from 5% - 15% with over 20 case studies showing annual productivity savings of \$178 per employee and 57% green building return on investment (ROI).

Assuming LEED building product specification weakening hazard assessment was awarded as a credit in a number of LEED buildings in Pennsylvania, damages can be verified by Defendants in discovery by identifying buildings where the toxic product specification credit was awarded.

3.15 Aggregated \$5.3 Trillion Damages Caused by Defendants for this Case.

Calculated partial resilience costs for the preceding damages to Pennsylvania are \$5.3 trillion in the Table below. However, the Commonwealth has been prevented from utilizing the democratic National Consensus Resilience Standard (RELi), due to market confusion from Defendants' LEED resilience standard pirated from Plaintiffs and unilaterally and undemocratically issued as its own, in violation of Constitutionally required due process. This stopped Plaintiffs from launching much needed National Education that was prepared to provide the Standard to users including governments and the market.

This confusion and substantial similarity of the LEED Standard to RELi was documented in 2015 - 2016 articles in *GreenBiz*, *Environmental Building News*, and publications and workshops of the American Institute of Architects. In contrast to RELi, the pirated LEED resilience standard is not democratic, and was not developed in an American National Standards Institute (ANSI) Accredited Process, and thus violated due process. It also cannot be commercialized due to this risk of getting struck down by antitrust.

Longstanding ANSI and Federal Government policy state that there should be one National Standard to prevent market confusion and allow commercialization of the technology that benefits the economy. Further, as a democratic consensus standard, RELi reduces risk and uncertainty, and is protected from antitrust attacks that have plagued Defendants.

The market confusion precluding national education prevented the Commonwealth, its municipalities, and constituents from using RELi for resilience financing and risk and damage reduction. Given that Pennsylvania's partial damages calculated above, and aggregated in the Table below, are \$5.3 trillion, a highly conservative damage calculation of four ten thousandth of a percent (0.000004) is used constituting \$21.2 million dollars in damages to the Commonwealth from this case.

Damage assumptions for the following Table of partial damages include the facts that:

1. Calculations are based on well-documented *existing* damages including from the US Climate Assessment Report.
2. Warming will continue for many years and thus damages will keep rising no matter what carbon pollution reductions are made due to well-documented latent effect of carbon pollutants in atmosphere.

3. Damages are very likely to be worse because IPCC and US Climate Assessment Report did not include well recognized *positive feedback loops* / accelerators.
4. Damages are more expensive due the lack of insurance / reinsurance.

It is highly reasonable to expect that Pennsylvania's application of RELi as the National Consensus Standard reducing risk and uncertainty and the basis of higher rated resilience bonds, could have easily reduced its \$5.3 trillion in damages by \$21.2 million, but was unlawfully prevented from doing so by Defendants. Using treble damages provided by the Sherman Act, the Commonwealth's resilience damages caused by Defendants are \$63.6 million based on the damage table below, plus \$1.188 million for State forest devaluation, with a grand total of \$64.788 million.

3.16 Partial Pennsylvania Resilience Damages

where data are available from just 8 out of hundreds of categories

Damages	Basis of Calculation	Cost to the Commonwealth
State Agency & City Resilience Report Costs, Expenditures	Estimated total costs expended	\$200 million
Sea Walls or Comparable Barriers to Rising Seas in Populated Areas	\$44 million per linear mile & 177 miles of populated shoreline	\$1.8 billion
Hurricane & Winter Storm Damages	One winter and one summer storm every ten years for 100 years intensified 60% from warming	\$442 billion
Infrastructure & Built Environment Costs for <i>Existing</i> ~ 6% Higher Peak Floods & 71% More Intense Precipitation	Pa. built environment is valued at \$39 trillion based on Commonwealth data. Extensive upgrades to deal with accelerating, more intense precipitation and higher peak floods over time will cost about 10% of this value.	\$3.92 trillion
50% Increased Lyme Disease From Warming	Average cost of treatment is \$9,528 and number of cases is 38,457	\$366 million
Total Ski & Snowmobile Industry Revenue Losses from Warming	\$403 million in losses over 100 yrs. from a mean 30% reduction in annual revenue	\$40 billion
Total Black Cherry Revenue Loss From Warming	\$200 million / yr. loss over 40 yrs. with documentation of all production stopping in about 80 yrs. due to warming	\$8 billion
Total Dairy Production Revenue Loss from Warming	Documented 22% annual decline from warming of \$280 million, taken over 100 years based on expected continued warming	\$28 billion
Total		\$5.3 trillion

4. Municipal and Constituent Support. Scott Schwarz, General Counsel, Philadelphia Water Department participated in the Ballard Spahr Infrastructure Conference, and is familiar with the increased damages described above to the City from rising seas, including the need for additional funding to reduce the large debt service amount that will have to be paid by citizens of Philadelphia.

Accordingly, it is anticipated that Scott and the City would be supportive of a damage recovery award to create a much needed Commonwealth Resilience Bond Fund. Philadelphia Deputy City Solicitor Dennis Yuen is taking the lead for the City in this Case since Philadelphia adopted LEED by ordinance for City Buildings, and the City has hundreds of LEED commercial buildings that have been adversely impacted by Defendants.

Penn Future, a Statewide Pennsylvania environmental group, is supportive of new sources for resilience financing, is a strong supporter of the FSC Wood Standard, and has been briefed on the Commonwealth's resilience financing needs. Penn Future CEO Larry Schweiger is former National Wildlife Federation (NWF) CEO and NWF and Larry personally supported and helped develop the Capital Markets Partnership's *Green Bond Business Case* documenting the resilience finance need, and that FSC Wood is an important standard ensuring well managed forests. SFI Wood is not a recognized Standard of the Business Case since it was specifically disapproved as *greenwash* in the 2006 national consensus vote of the Sustainable Product Standard SMaRT, and in contrast to FSC, is not a leadership standard recognized by the Leadership Standards Campaign.

5. Recommended Remedy to the Commonwealth: *leverage any damage award to establish a Statewide \$500 Million Resilience Bond Fund that could be established with the Pennsylvania State Employees' Retirement System (PSERS).*

A top Commonwealth priority is securing resilience financing sources to pay for the near term trillions of dollars required for accelerating systemic resilience damages to protect public health, welfare, and environment (*Building Community Resilience in Pennsylvania*, NOAA <https://coast.noaa.gov/digitalcoast/stories/chester.html>, *Climate Change Resiliency*, Delaware Valley Regional Planning Commission <http://www.dvrpc.org/Resiliency>).

Resilience bonds are a subset of green bonds -- a vibrant, rapidly growing market with \$93 billion of issuance in just four years since investors with over \$70 trillion in assets want to buy (*Green Bond Business Case*). This substantial and pent-up investor demand has also caused green bonds to sell out, providing cheaper capital, more proceeds, highly competitive pricing (*Id.*), and an increased 20 basis points in bond yields (*The Cost of Being Green*, Barclays Sept. 18, 2015).

Accordingly, it would be very attractive for PSERS to use a damage award to create a \$500 million bond fund where PSERS would buy Commonwealth Green + Resilient Bonds achieving a RELi National Consensus Resilience Standard legally binding certification reducing risk and uncertainty and measuring increased economic value qualifying for higher credit ratings like achieved by RELi for Green Home Bonds. Further, the *Green Bond Business Case* documents that such Commonwealth green bond investments are more profitable, less risky, and preferred by investors.

The RELi legally binding certification:

- Transparently documents the attributes of the project funded by the bonds that increase tangible economic value
- Ensures that correlative risk is prevented, i.e., there is no one risk factor that can shut down an entire region, e.g., hospitals can't stay open if the wastewater treatment plant is shut down from flooding
- Can be the basis of preventing S&P credit rating downgrades and achieving higher ratings for municipalities
- Can be the basis of insurance discounts thus bringing back insurance coverage for resilience which was dropped by insurers and reinsurers as an uninsurable risk
- Reduces risk and uncertainty including antitrust liability

In addition to recovery of damages, Defendants' unilateral substantive amendments without required due process including voting, need to be rescinded and then lawfully voted on.

6. Recommended AG Role in Accelerating Settlement. It appears the best and fastest way to achieve a satisfactory settlement is to facilitate a meeting with Defendants and the Pennsylvania Attorney General since interests and damages are aligned, and the AG could issue a pre-litigation subpoena and meeting demand for Defendants' secret settlement agreements with the chemical / oil and wood industries that caused unlawful greenwashing / weakening of Pennsylvania building requirements.

Substantial Adverse Impacts to the Commonwealth. For the 1000 or so LEED green buildings in Pennsylvania, including those adopted by statute such as Philadelphia Green Building Ordinance 9704, the changes to LEED automatically change Philadelphia Ordinance requirements and private sector LEED building requirements in the Commonwealth with no required due process. This includes Penn State requirements that all new and renovated facilities be LEED certified. There are 13 Penn State LEED certified buildings with another eight planned or under construction as of February 2013 (Sustainability.psu.edu). Defendants report the substantial economic impact of LEED in Pennsylvania thus demonstrating the significant adverse impact of the *greenwash* / weakening of LEED requirements:

"Currently, Pennsylvania has 999 LEED-certified commercial projects, equivalent to more than 115 million square feet. In addition, between 2015 and 2018, green building in the state of Pennsylvania is expected to support nearly 345,000 green construction jobs and more than \$19 billion in labor earnings, according to USGBC's [2015 Green Building Economic Impact Study](#)" USGBC Press release Aug. 8, 2016.

The Commonwealth finances construction of LEED State Buildings, with allowable reimbursement for LEED construction (*School Construction Reimbursement Criteria*, 24 P.S. §7-733), including for example:

- The Governor's Residence
- The existing Pennsylvania Department of Environmental Resources (DNR) Headquarters Rachel Carson Building in Harrisburg
- Twelve other DNR LEED buildings (Exploring the PA DCNR's LEED Certified Buildings <http://maps.dcnr.pa.gov/StoryMaps/leed>)
- New construction as announced by Governor Tom Wolf --

"Bucks County

Council Rock School District will receive two grants for the construction of two high performance buildings within the district. The first grant for \$2 million is for the construction of a new USGBC LEED Gold middle school located in Newtown, Bucks County. The new 176,000-square-foot school will include geothermal heating and cooling, energy-

efficient lighting, automated energy control systems, low-flow water-saving fixtures, occupancy-based temperature and lighting, a 110 kW solar PV array, and an improved thermal envelope. The project is anticipated to reduce energy consumption by an estimated 3,429,021 kBtu annually. In addition, new low-flow water fixtures will save the district 30 percent of the annual water usage at the building. The total project cost is estimated at \$55,820,000.

Council Rock School District also received a \$2 million grant for the renovation and construction of a USGBC LEED Gold middle school in Northampton Township, Bucks County. The 136,000-square-foot renovation will also feature the addition of 44,000 square feet. The project will also include geothermal heating and cooling, energy-efficient lighting, automated energy control systems, low-flow water-saving fixtures, occupancy-based temperature and lighting, a 110kW solar PV array, and an improved thermal envelope. The project is anticipated to reduce energy consumption by an estimated 3,462,236 kBtu annually. In addition, new low-flow water fixtures will save the district 30 percent of the annual water usage at the building. The total project cost is estimated at \$50,675,001.

Lancaster County

Manheim Central School District will receive a \$2 million grant for the construction of a new USGBC Gold elementary school in Penn Township, Lancaster County. The new 120,000-square-foot school will include a ground-source geothermal HVAC system, energy efficient lighting, a building orientation that takes advantage of natural daylight opportunities, and a modern thermal envelope. The project is anticipated to reduce energy consumption by 1,664,010 kBtu annually. In addition, new low-flow water fixtures will save the district 30 percent of the annual water usage at the building. The total project cost is estimated at \$30,048,000.”

(Governor’s Office Press Release: *Commonwealth Financing Authority Announces New Alternative, Clean Energy Investments to Improve Environment, Invest in Future*, Mar. 10, 2015)

There is Substantial Leverage for Settlement Since Defendants’ Do Not Want Their Intentional Violations to Become Public. It’s highly likely Defendants’ top management abhors having these agreements go public even though they are required to be in the public domain, because it is very possible they could be fired for incompetence for intentionally violating the public’s due process rights and antitrust, and *selling out* to industry.

Defendants knew the extensively quoted content in Plaintiff’s Draft Complaint from the secret settlement agreements and associated industry appeals, that documents these legal violations. Plaintiffs provided Defendants the Draft Complaint with this content in May 2016. Plaintiffs also discussed this material fact with Defendants’ CEO and General Counsel in September 2016, and Defendants did not deny that the secret agreements exist. Knowing this and with industry support, Defendants then made substantive amendments to LEED that were far worse due process violations that caused the secret agreements, with NO due process including no required notice, opportunity to be heard, or voting as documented in the Memorandum of Law & Fact.

The public and Defendants’ important constituents do not know that these agreements in essence place industry in control of Commonwealth building health and welfare requirements, causing them to be weakened, which is completely contrary to why Pennsylvania, its cities, and constituents adopted LEED.

A subpoena for the secret agreements and meeting demand could provide maximum leverage for settlement.

The Pennsylvania Attorney General Plenary Subpoena Powers include under The Administrative Code, the power “to investigate any violations, or alleged violations, of the laws of the Commonwealth” (*Com. Ex Rel. Margiotti v. Orsini*, 368 Pa. 259 S.Ct. 1951). The Attorney General has the authority to subpoena testimony and the production of evidence and to apply to the court for a finding of contempt for any failure to comply with a subpoena. See, e.g., 35 P.S. § 7131.503; 10 P.S. §162.16.

The Pennsylvania Attorney General’s authority to hire outside counsel on a contingent fee basis was upheld by the Pennsylvania courts. The court analyzed §103 of the Commonwealth Attorneys Act, which provides that no party to an action, other than the state agency being

represented, may challenge the authority of the agency's legal representation. Citing earlier decisions, the court stated:

"in addressing the authority of Commonwealth attorneys, [the legislature] intended that no party but the affected agency should be heard to complain about so fundamental an executive matter as the identity of the lawyers representing Commonwealth entities."

The court therefore dismissed the petitioners' claims for lack of standing (*GGNSC v. Kane*, 2016 Pa. Commw. LEXIS 44 (Pa. Commw. Ct. Nov. 18, 2015)).

7. Conclusion. The facts and law show that Pennsylvania incurred substantial damages from Defendants' knowing legal violations that can be recovered to help the Commonwealth financially address its unprecedented \$5.3 trillion in partial resilience costs, as well as protect its extensive State Forests valued at \$3.96 billion.

Commonwealth recoverable treble damages are \$64 million as calculated herein.