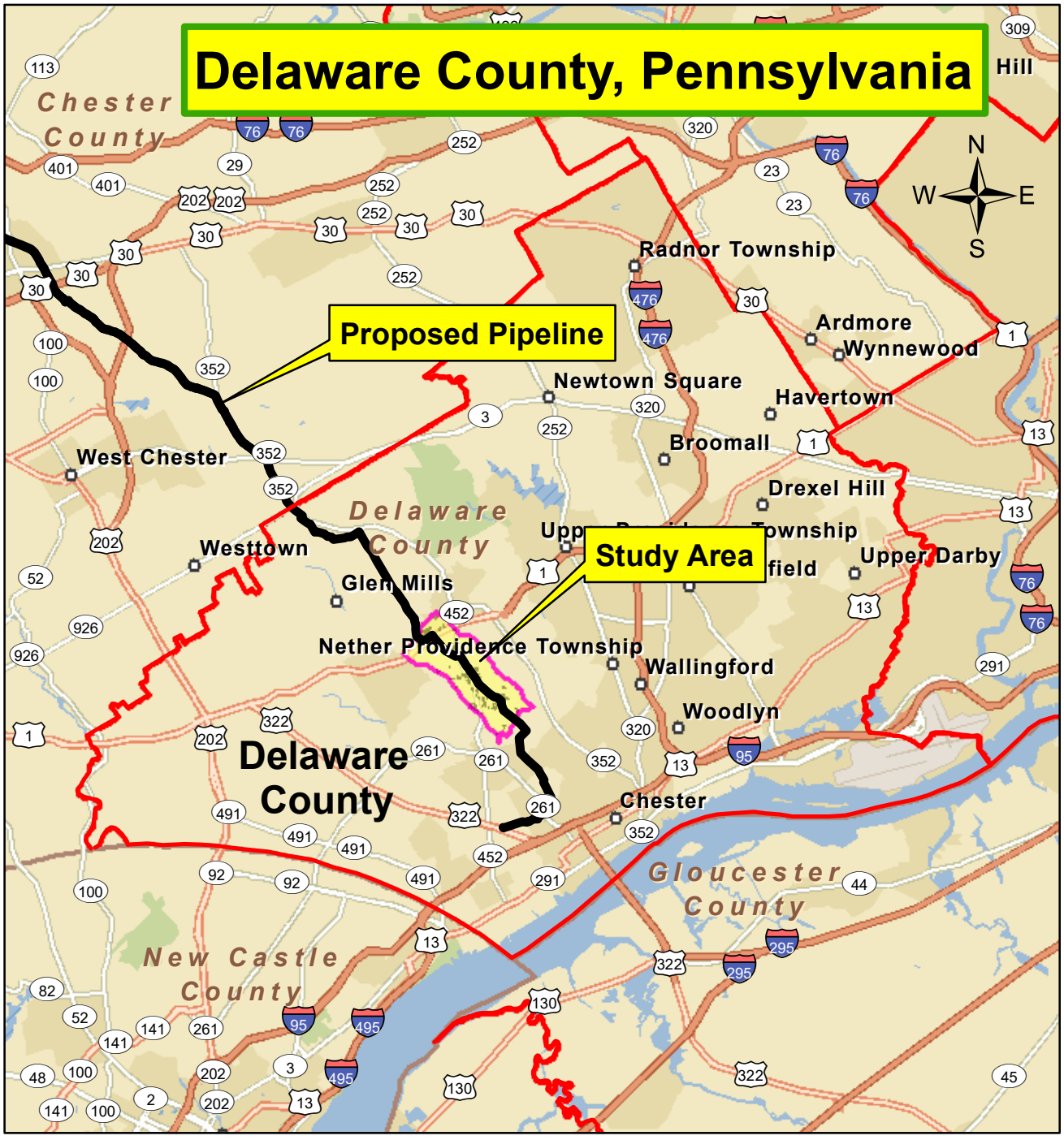
Gas Arrival Time Assessment of the Sunoco Mariner East II Natural Gas Liquids Pipeline Proposal as Affects a Delaware County, PA Community. (15 minute travel time examined)

Sept. 12, 2016 Presentation

Initial assessment work was completed to characterize worst case gas arrival times using a portion of Delaware County, PA as an example. The scenario analyzed examines community area outward from a failed or ruptured pipeline. This assessment includes factors to be considered relative to public health and safety.

Tonight we will examine data and factors that should be considered in assessing potential risks to family, friends, the community, and the environment. Questions quickly arise. For example, do the benefits of transmitting highly flammable liquids and fuel in close proximity to families outweigh potential risks? Was the planned pipeline location selected to avoid densely populated areas, thereby reducing health and safety risks? Are potential dangers warranted? It should be recognized tonight that these questions will be addressed from a worst case scenario perspective.

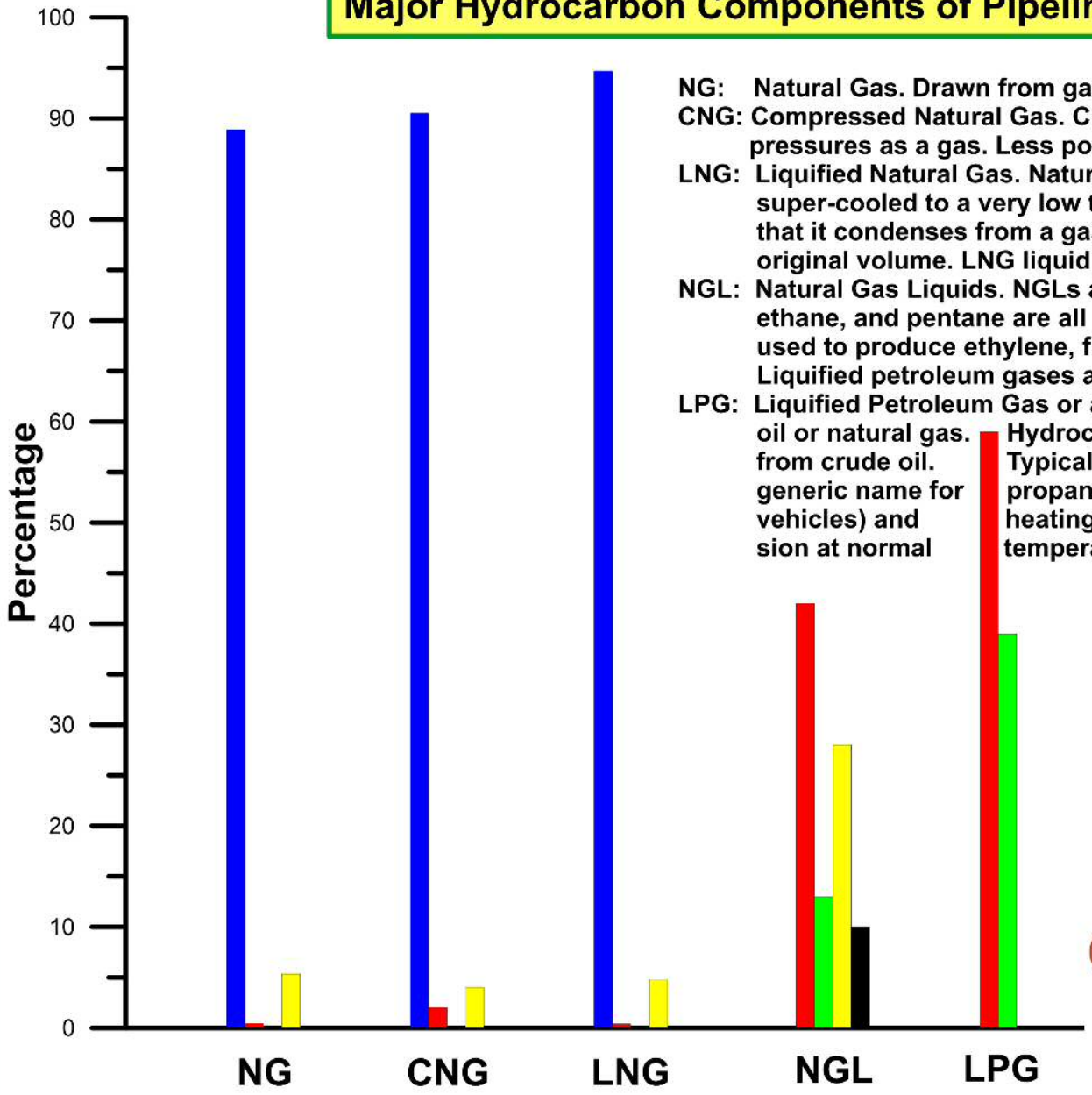
Paul A. Rubin
HydroQuest
414 E. Kerley
Corners Road
Tivoli, New York 12583
845-657-8111
hydroquest@yahoo.com



Much of the Mariner East Pipeline corridor routes through highly populated areas of homes, town houses and assorted businesses.

Middletown Coalition for Community Safety

Major Hydrocarbon Components of Pipeline Gases & Fluids



NG: Natural Gas. Drawn from gas wells, mostly methane. Lighter than air.

CNG: Compressed Natural Gas. Compressed from NG and stored at high pressures as a gas. Less portable than LNG. Lighter than air.

LNG: Liquified Natural Gas. Natural gas (mostly methane) that has been super-cooled to a very low temperature (e.g., -120° C to -170° C) so that it condenses from a gas into a liquid. Volume is 1/600th of its original volume. LNG liquid and vapor initially heavier than air.

NGL: Natural Gas Liquids. NGLs are hydrocarbons. Propane, butane, ethane, and pentane are all NGLs. The high ethane component is used to produce ethylene, from which plastics are produced. Liquified petroleum gases are all heavier than air.

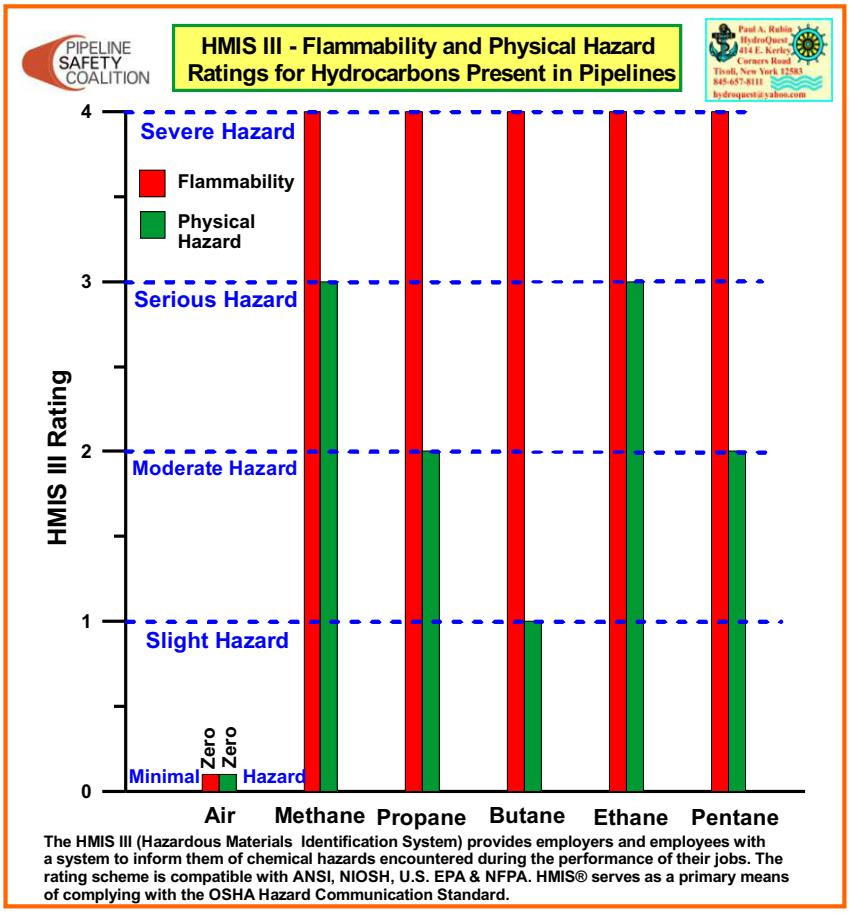
LPG: Liquified Petroleum Gas or autogas. Synthesized by refining crude oil or natural gas. Hydrocarbons removed (condensed) as a liquid from crude oil. Typically has a high % of propane. LPG is a generic name for propane and butane gas used in fuel (e.g., for vehicles) and heating. Gas is liquefied by moderate compression at normal temperatures. Heavier than air.

- Methane (CH4)
- Propane (C3H8)
- Butane (C4H10)
- Ethane (C2H6)
- Pentane (C5H12)

PIPELINE SAFETY COALITION

Paul A. Rubin
HydroQuest
414 E. Kerley Corners Road
Tivoli, New York 12583
845-657-8111
hydroquest@yahoo.com

Note: Component percentages are highly variable, sometimes with seasons. NGLs may be mixed with other products.



Asphyxiation/suffocation risk associated with inhalation of methane, propane, butane, and ethane is RAPID. Liquified Natural Gas, Natural Gas Liquids, and Liquified Petroleum Gas are all heavier than air. They may accumulate in confined spaces, particularly at or below ground level. Accumulation in home basements may lead to asphyxiation, explosions and death. Pipeline failure and hydrocarbon excursions close to homes pose a real risk to public health and safety. Regardless of their chemical compositions (e.g., high % methane OR propane) - Natural Gas, Compressed Natural Gas, Liquified Natural Gas, Natural Gas Liquids and Liquified Petroleum Gas ALL contain high percentages of extremely flammable and explosive chemicals - making accidents along these hydrocarbon transmission pipelines dangerous and life-threatening.

HMIS III - Flammability Ratings (abridged)

0	Minimal Hazard	Materials that will not burn.
1	Slight Hazard	Materials that must be preheated before ignition will occur.
2	Moderate Hazard	Materials that must be moderately heated or exposed to high ambient temperatures before ignition will occur.
3	Serious Hazard	Materials capable of ignition under almost all normal temperature conditions.
4	Severe Hazard	Flammable gases, or very volatile flammable liquids with flash points below 73 F, and boiling points below 100 F. Materials may ignite spontaneously with air.

HMIS III - Physical Hazard Ratings (abridged)

0	Minimal Hazard	Materials that are normally stable, even under fire conditions ... Non-Explosives.
1	Slight Hazard	Materials that are normally stable but can become unstable (self-react) at high temperatures and pressures.
2	Moderate Hazard	Materials that are unstable and may undergo violent chemical changes at normal temperature and pressures with low risk for explosion.
3	Serious Hazard	Materials that may form explosive mixtures with water and are capable of detonation or explosive reaction in the presence of a strong initiating source.
4	Severe Hazard	Materials that are readily capable of explosive water reaction, detonation or explosive decomposition, polymerization, or self-reaction at normal temperature and pressure.

Examples of Gas Excursion Pathways & Failure Mechanisms

As proposed, Mariner East pipelines would be of large diameters and would be placed under high pressures (to ~ 1,500 psi);

Needed safety distances increase when the internal diameter or the operating pressure of pipelines increases. Nevertheless, safety distance is more sensitive with pipe size rather than operating pressure (Sklavounos & Rigas, 2006);

Liquefied, flammable, gas clouds have been documented as having drifted up to 5 miles before exploding in a "wall of fire" some 1 mile wide (Siberia, Russia - June 4, 1989);

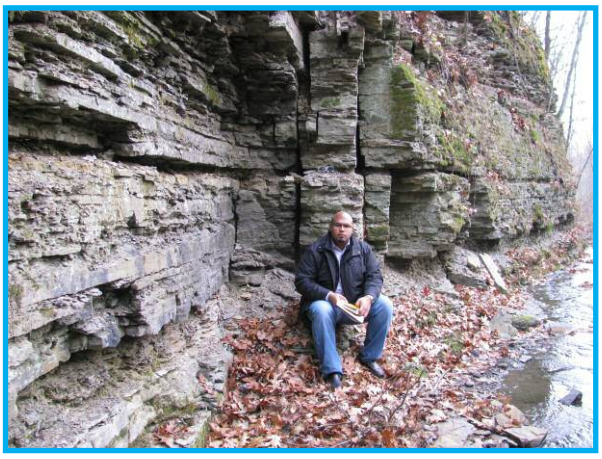
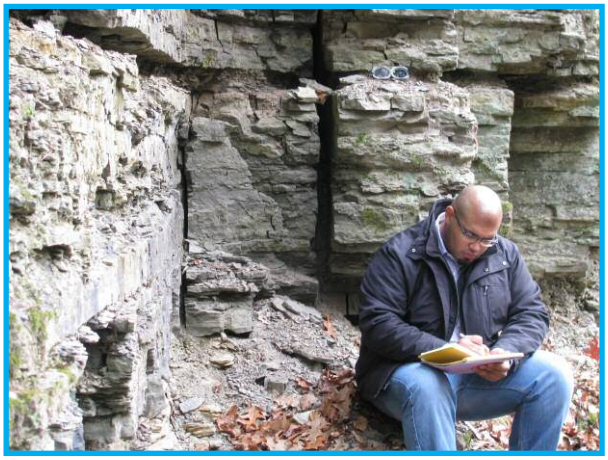
Multiple pipelines with nearly intersecting pathways or placed in close proximity to each other increase health & safety risk.

Causes of documented pipeline failure mechanisms and accidents include (Sklavounos & Rigas, 2006):

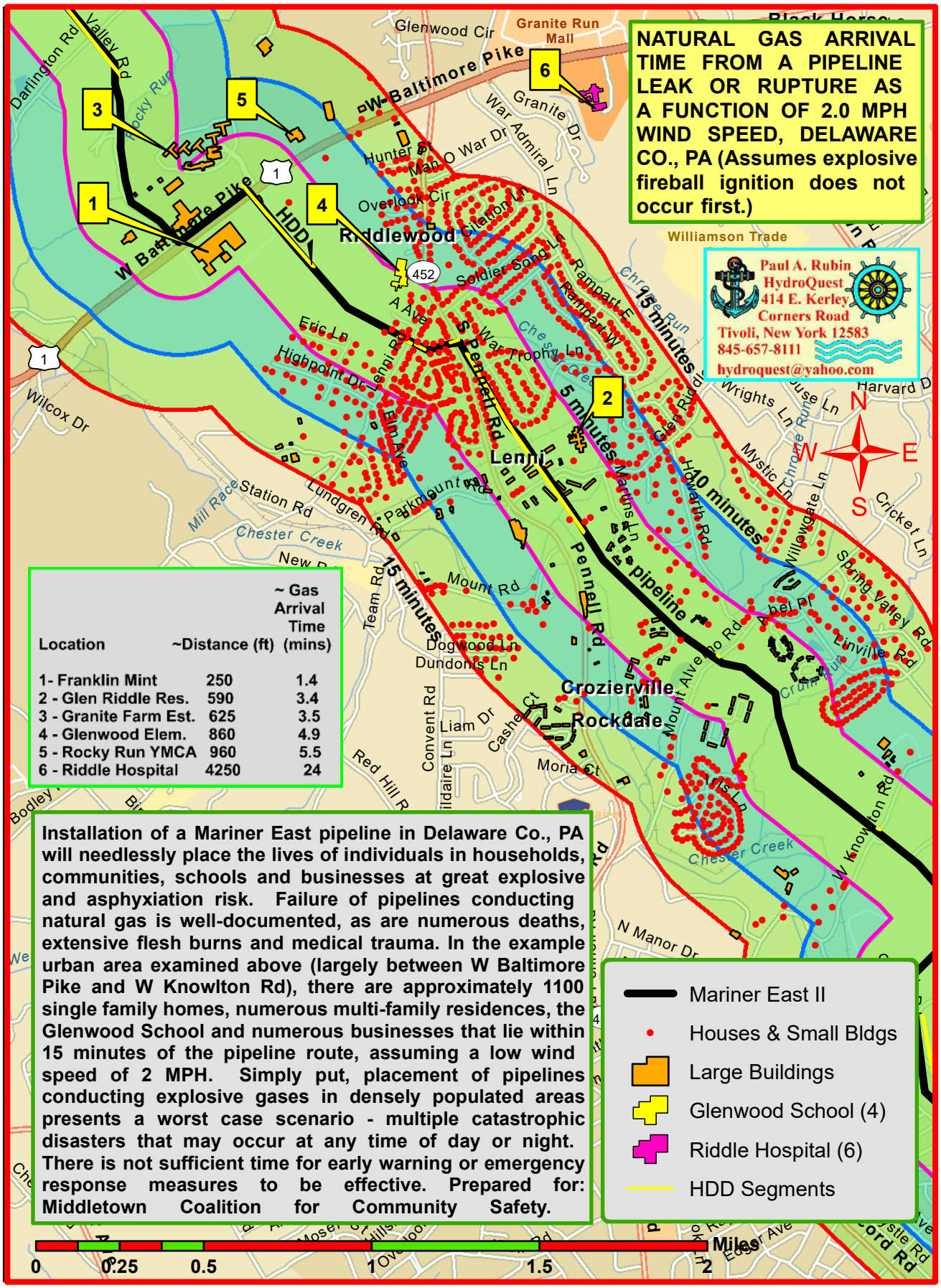
* **External interference or third party activity (e.g., excavator or auger encounters pipeline);**
* **Corrosion;**
* **Construction defect and mechanical or material failure (e.g., cracked & ruptured pipes, pipe joint failure);**
* **Ground movement or generally natural hazards; and**
* **Other or unknown causes.**



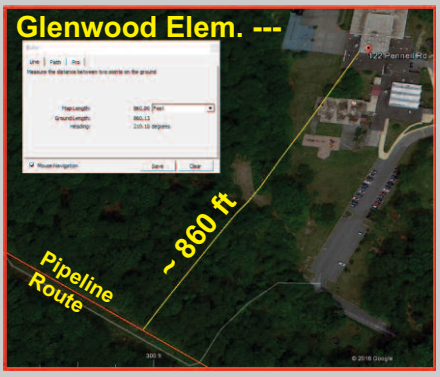


Bedrock joints or fractures present in sedimentary rock layers through which horizontally drilled pipelines are installed provide upward pathways for escaping gas. Additionally, as is the intent of drilling horizontal gas wells, boreholes serve to interconnect numerous joint and fault planes - thus providing increased vectors for escaping gas in the event of pipeline failure due to rupture, failed joints, cracks and corrosion. As depicted, joints are typically near vertical, densely spaced and well interconnected. HydroQuest graphic.


NATURAL GAS ARRIVAL TIME FROM A PIPELINE LEAK OR RUPTURE AS A FUNCTION OF 2.0 MPH WIND SPEED, DELAWARE CO., PA (Assumes explosive fireball ignition does not occur first.)
Paul A. Rubin
HydroQuest
414 E. Kerley Corners Road
Tivoli, New York 12583
845-657-8111
hydroquest@yahoo.com
15 minutes
10 minutes
5 minutes
pipeline
HDD
W Baltimore Pike
Riddlewood
Lenni
Crozierville
Rockdale
Glenwood Cir
Granite Run Mall
Williamson Trade
Harvard D
Wilcox Dr
Darlington Rd
Valley Rd
Rocky Run
Hunter St
War Admiral Ln
Granite Dr
Overlook Cir
Citation Ln
Soldier Song Ln
Rampart E
Rampart W
Eric Ln
Highpoint Dr
Elm Ave
A Ave
S Pennell Rd
War Trophy Ln
Chester Creek
Wrights Ln
Mystic Ln
Willowgate Ln
Cricket Ln
Spring Valley Rd
Linville Rd
Mill Race
Station Rd
Lundgren Rd
Parkmount Rd
Marins Ln
Howarth Rd
Mount Rd
Team Rd
Dogwood Ln
Dundonis Ln
Pennell Rd
Mount Alverno Rd
Abel Pl
Convent Rd
Liam Dr
Cashel Ct
Moria Ct
Iris Ln
Red Hill R
W Knowlton Rd
N Manor Dr
Chester Creek
Bodley
1- Franklin Mint 250 1.4
2 - Glen Riddle Res. 590 3.4
3 - Granite Farm Est. 625 3.5
4 - Glenwood Elem. 860 4.9
5 - Rocky Run YMCA 960 5.5
6 - Riddle Hospital 4250 24
Location
~Distance (ft)
~ Gas Arrival Time (mins)
Installation of a Mariner East pipeline in Delaware Co., PA will needlessly place the lives of individuals in households, communities, schools and businesses at great explosive and asphyxiation risk. Failure of pipelines conducting natural gas is well-documented, as are numerous deaths, extensive flesh burns and medical trauma. In the example urban area examined above (largely between W Baltimore Pike and W Knowlton Rd), there are approximately 1100 single family homes, numerous multi-family residences, the Glenwood School and numerous businesses that lie within 15 minutes of the pipeline route, assuming a low wind speed of 2 MPH. Simply put, placement of pipelines conducting explosive gases in densely populated areas presents a worst case scenario - multiple catastrophic disasters that may occur at any time of day or night. There is not sufficient time for early warning or emergency response measures to be effective. Prepared for: Middletown Coalition for Community Safety.
Mariner East II
Houses & Small Bldgs
Large Buildings
Glenwood School (4)
Riddle Hospital (6)
HDD Segments
N
S
E
W
Miles
0
0.25
0.5
1
1.5
2

Area Locations Within 15-Minute Toxic Gas Arrival Time
Delaware County, Pennsylvania



Glenwood Elementary School Classrooms Are About 860 Feet From The Pipeline

Rocky Run YMCA

Sleighton Park

Example Pipeline Accidents

Incident 1: On May 12, 1975, an 8-inch pipeline, which was closed in under pressure ...ruptured near Devers, Texas. Natural Gas Liquids at 1,425 psi pressure erupted from a fracture near the top of the pipe. The liquids vaporized mixed with air, and formed a cloud which drifted to the southwest over U.S. Highway 90. An automobile entered the vapor cloud and ignited the ethane-propane vapors. The resulting explosion and fire killed the four persons in the automobile, melted telephone and electric power lines, warped railroad tracks, burned and scorched adjacent woodlands, and interrupted rail and highway traffic.

Resulting Safety Recommendation P-76-039: Initiate necesssary equipment changes to provide data necessary for the safe operation of the pipeline continuously to the dispatch centers. Overall Status: Closed - Acceptable Action.

Incident 2: On August 4, 1978, propane that had vaporized and spread widely from a ruptured 8-inch liquefied petroleum gas pipeline (i.e., propane & butane) owned ... was ignited by an unknown source in a rural area near Donnellson, Iowa. The intense fire killed two persons and critically burned three others as they fled their homes. One of the critically burned persons later died. A farmhouse and six buildings were destroyed and two adjacent homes were damaged.

Safety Recommendation P-78-066: Update the list of individuals who should be contacted to close specific valves in the event of an emergency and institute a procedure to assure that the list is updated at least annually. Overall Status: Closed - Acceptable Action.

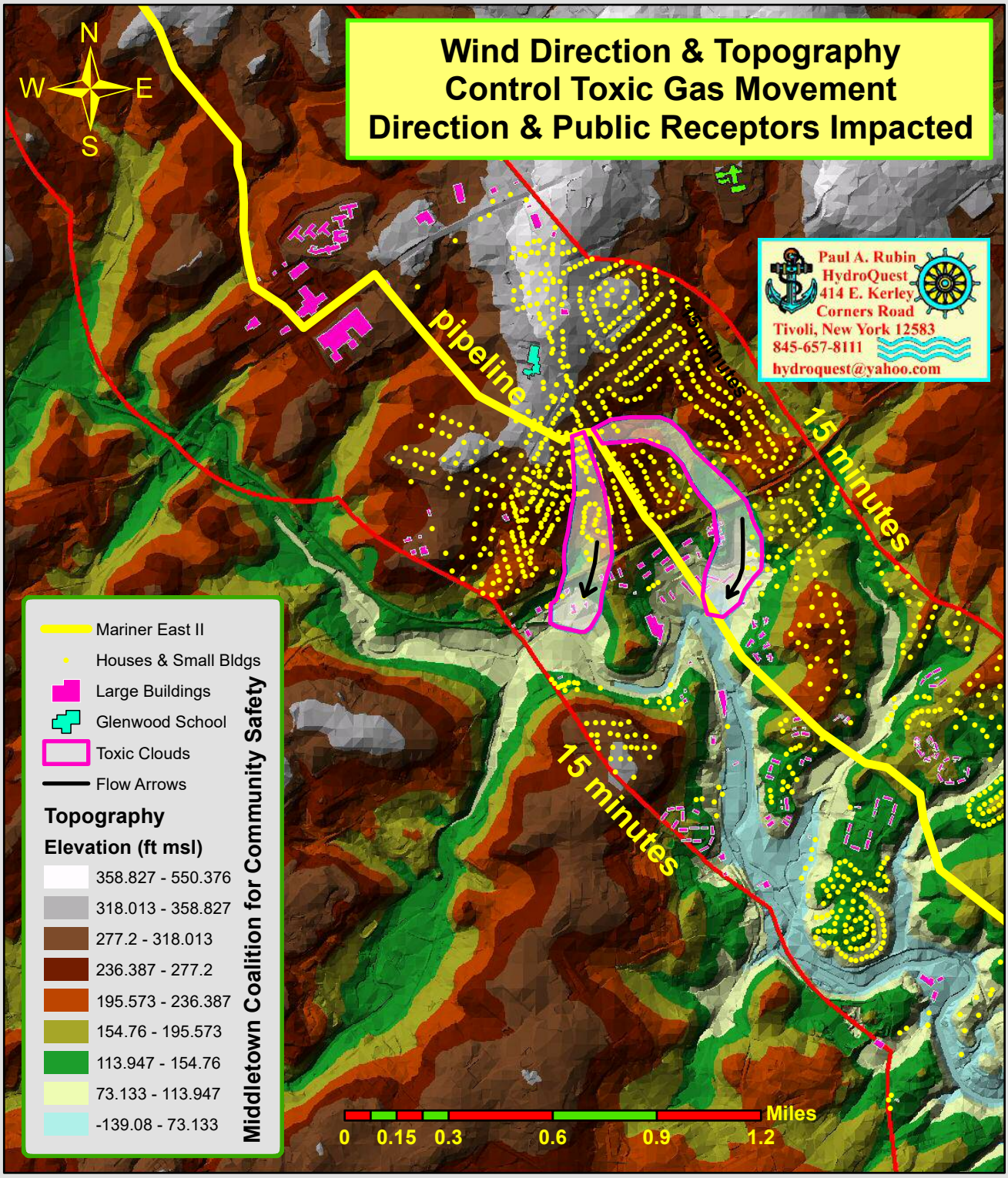
To view more current pipeline accident reports see:

https://en.wikipedia.org/wiki/List_of_pipeline_accidents_in_the_United_States_in_the_21st_century
https://en.wikipedia.org/wiki/List_of_pipeline_accidents
http://www.ntsb.gov/investigations/AccidentReports/Pages/pipeline.aspx
http://mayorscouncilpipelinesafety.com/

Recent Pipeline Accidents

Incident 1: Drawn from the PHMSA CAO: On January 26, 2015, an Enterprise Products pipeline that originates in Pennsylvania structurally failed near Follansbee, West Virginia, resulting in the release of over one million gallons of liquid ethane into a wooded area. The explosion and resulting fire burned approximately five acres of woodlands. The fire in the surrounding area wasn't extinguished until 24 hours later. A house 2,000 feet away suffered thermal damage. This pipeline was brand new, having been put into service just about one year prior to the failure. And the failure was both predictable and predicted: in May 2010, PHMSA issued Advisory Bulletin 2010-0078 on Girth Weld Quality Issues Due to Improper Transitioning, Misalignment, and Welding Practices of Large Diameter Line Pipe. The very issues identified in this Advisory Bulletin were factors in the structural failure of this pipeline.

Incident 2: On Friday April 29, 2016, A large Texas Eastern transmission line — 30 inches in diameter — burst open around 8:15 a.m. in Salem Township, shooting flames into the sky that could be seen for miles. Residents reported hearing a deafening gush of air. The explosion blew a 12 foot deep, 1500 square foot hole and scorched 40 acres. A 24.5 foot section of 30-inch diameter pipe landed 100 feet away. A 26 year old man was hospitalized with third degree burns over 75 percent of his body. "The preliminary investigation has identified evidence of corrosion along two of the circumferential welds: one at the point of failure and another excavated after PHMSA's response to the Failure Site. The pattern of corrosion indicates a possible flaw in the coating material applied to girth weld joints following construction welding procedures in the field at that time."



Excursions of explosive and toxic ethane, propane & butane from ruptured or failed pipelines rapidly travel down wind, filling low-lying areas. Ignition by any kind of spark is well-documented in fatality & burn accident reports. Inhalation of these gases results in death by asphyxia. Here, two heavier-than-air gas clouds move through a community in minutes following failure of a high pressure pipeline.