PA-AWWA 64th Annual Conference

AMERICAN WATER WORKS ASSOCIATION
PENNSYLVANIA SECTION

SUSTAINABLE UTILITY INFRASTRUCTURE PLANNING AND REPLACEMENT IN KARST AREAS

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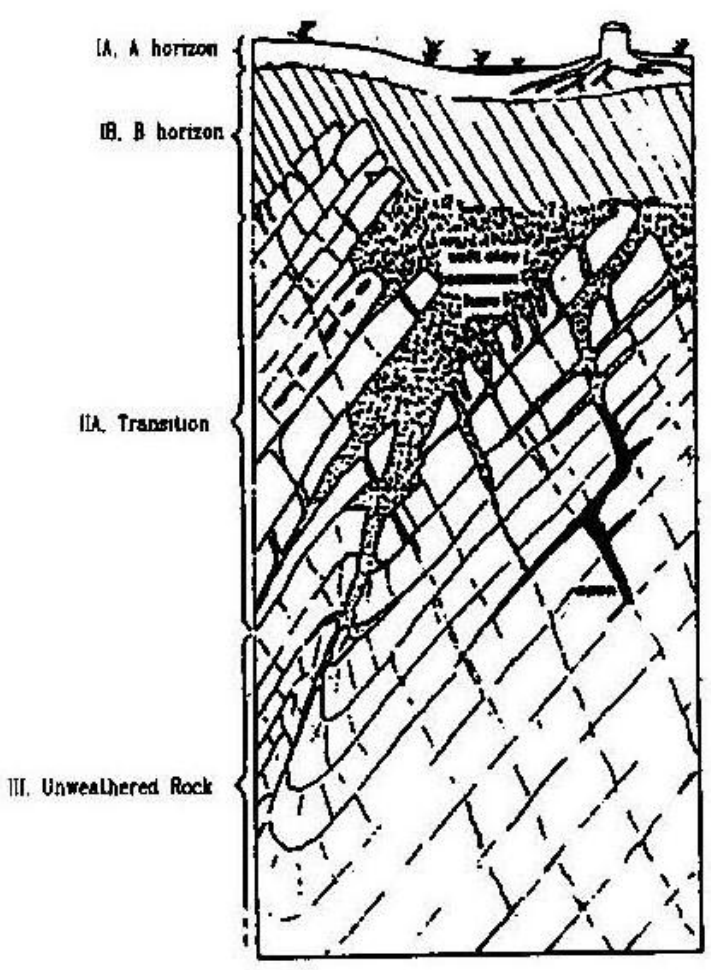
MAY 3-4, 2012 – LANCASTER MARRIOTT

THE PROBLEM – KARST GEOLOGY



THE PROBLEM – KARST SOILS

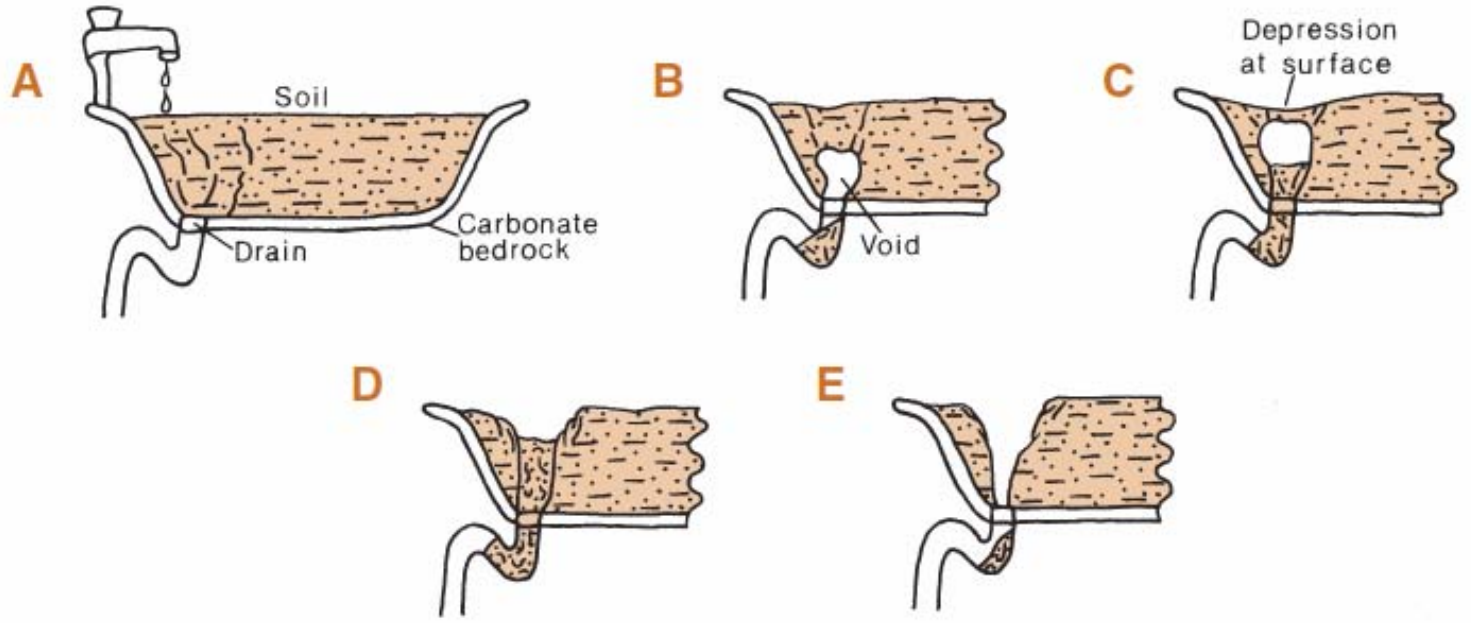
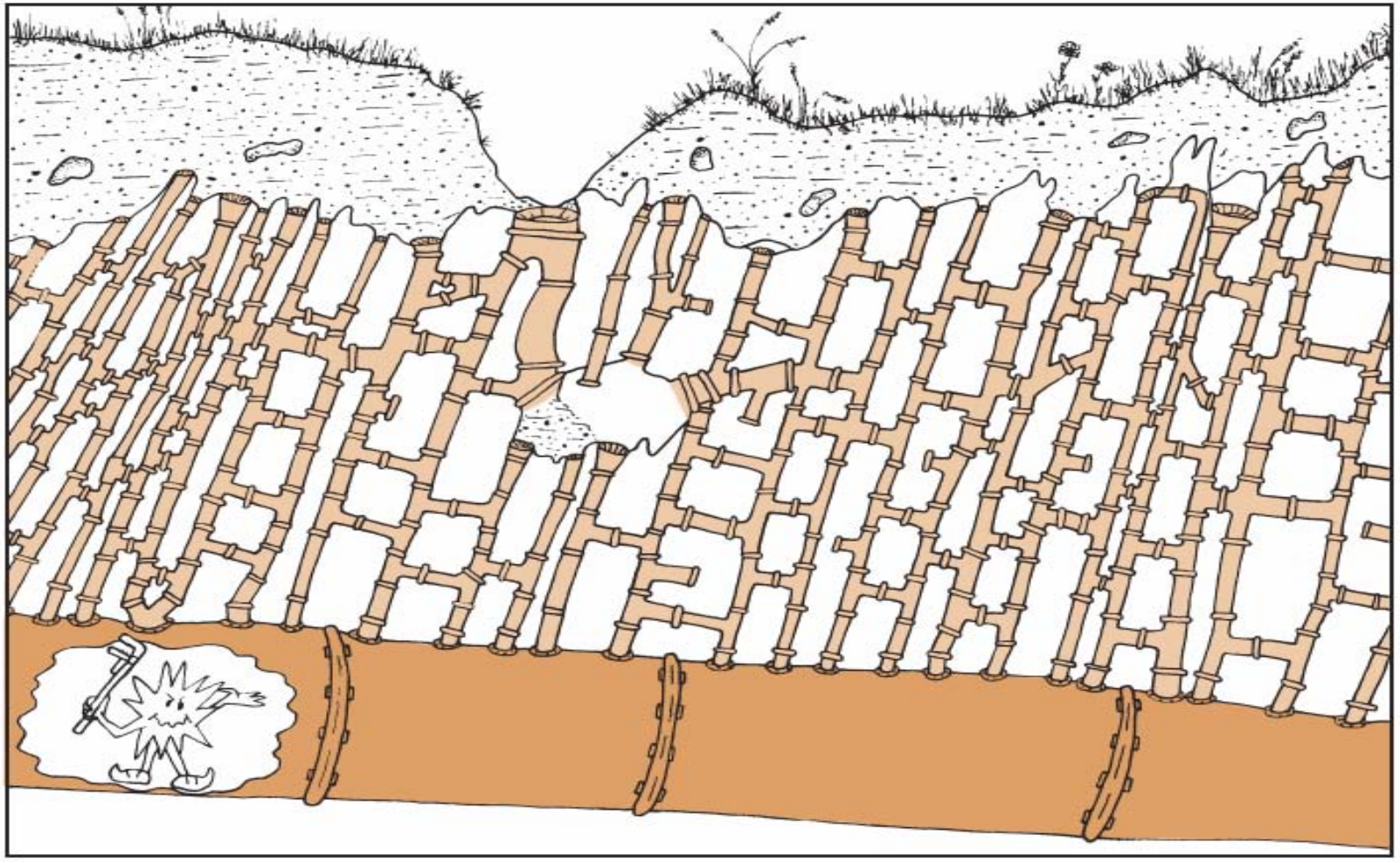
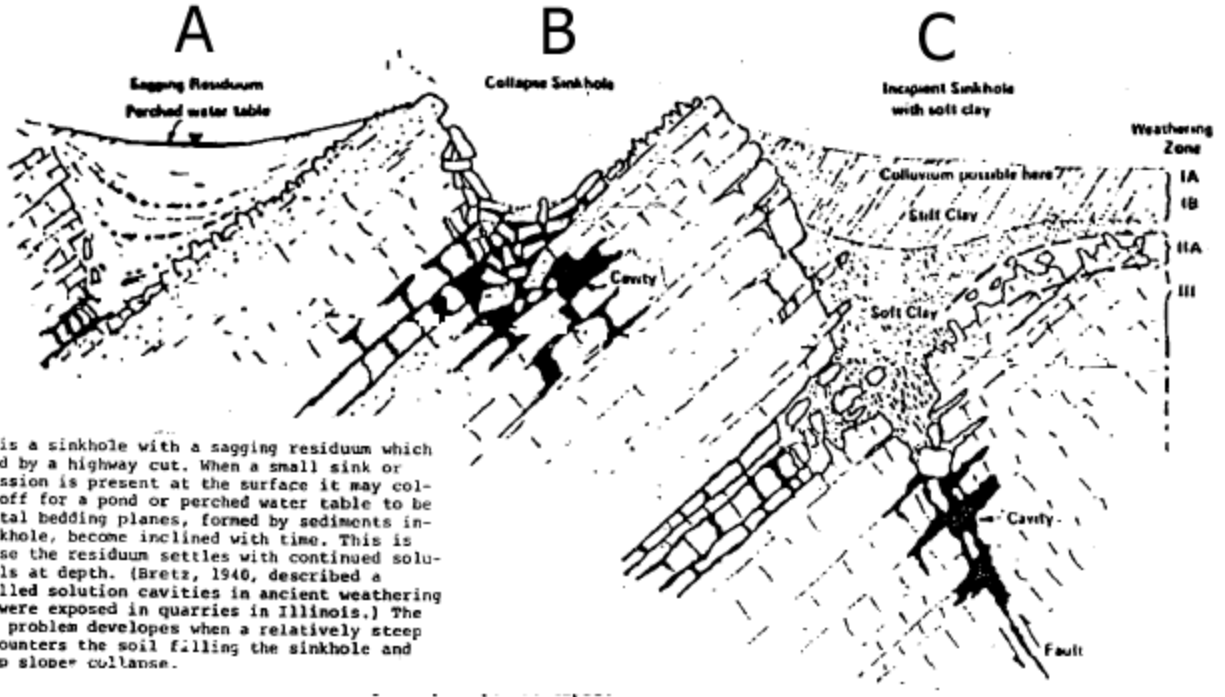


Figure 9. The bathtub model. A. Water infiltrates through the soil. B. As soil enters the drain, a void is left behind. C. Over time, the soil moves into the void and the void "migrates" toward the surface. D. Support is removed and collapse occurs. E. If enough water is supplied, an open connection to the drain results.

THE PROBLEM - KARST BEDROCK



THE PROBLEM – KARST WEATHERING

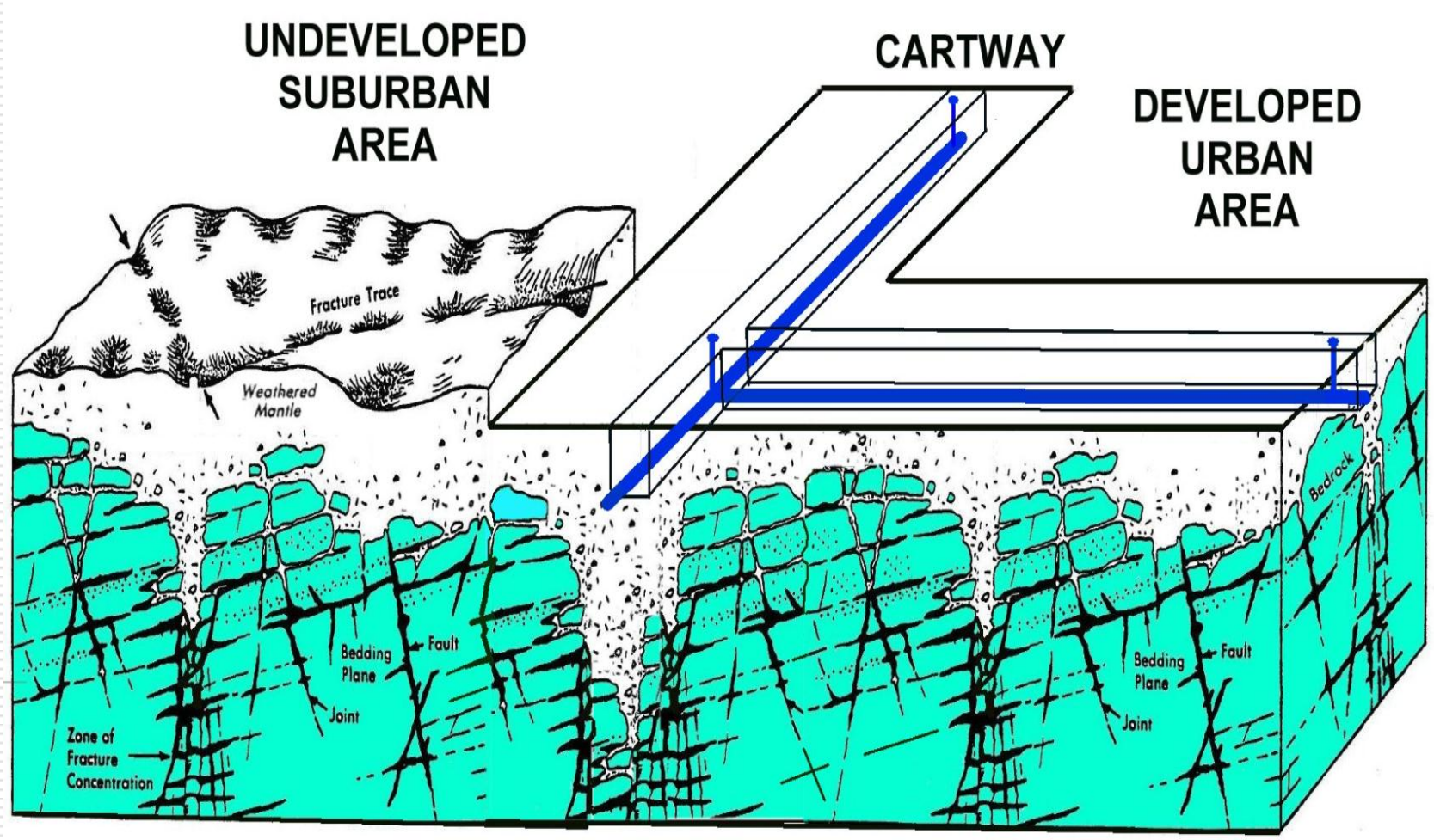


Feature A is a sinkhole with a sagging residuum which has been exposed by a highway cut. When a small sink or undrained depression is present at the surface it may collect enough runoff for a pond or perched water table to be formed. Horizontal bedding planes, formed by sediments infilling the sinkhole, become inclined with time. This is primarily because the residuum settles with continued solution of materials at depth. (Bretz, 1940, described a variety of infilled solution cavities in ancient weathering profiles which were exposed in quarries in Illinois.) The slope stability problem developes when a relatively steep bedrock cut encounters the soil filling the sinkhole and the overly steep slopes collapse.

Feature B, the collapse sinkhole, seldom causes a stability problem. Although the collapsed rock may be weaker than the surrounding rock, the nature of the material is apparent when the excavation begins. However, the collapsed debris may become mixed with clayey residual soil and a larger slope failure could develop.

Feature C is an incipient sinkhole in which the lower portion is filled with soft clay. This feature is likely to lead to a more serious slope failure than the others because the low strength of the soft clay may not be determined until the slide develops.

THE PROBLEM – URBAN LAND



THE PROBLEM – AGING UTILITIES

THE PROBLEM – AGING PAVEMENTS

- **Migration of surface water from deteriorating pavements, sidewalks, and curbs into residual soils can result in slow subsurface erosion of soil into the underlying bedrock resulting in subsidence and utility line main breaks.**

THE PROBLEM – UTILITY MAIN BREAKS

Allentown water main break
(Donna Fisher/The Morning Call / December 30, 2011)

Officials gather as the sinkhole at 10th and Gordon Streets undergoes excavation. Old trolley tracks are evident at right.

MAJOR PROPERTY DAMAGE

Allentown water main break
(Donna Fisher/The Morning Call / December 29, 2011)

A new sign marks the home at 401 N. 10th Street as unfit for habitation in the wake of a water main break in the street's 300 block Thursday morning.

Allentown water main break
(Donna Fisher/The Morning Call / December 30, 2011)

Homes in the 300 block of N. 10th Street are affected by the sinkhole at 10th and Gordon Streets in Allentown.

DECLINING PROPERTY VALUES

WORST CASE – LOSS OF LIFE

- **Failure of underground utilities in sinkhole prone karst areas can result in major property damage and even loss of life.**


BLAST KILLS FIVE; NEIGHBORHOOD IN RUINS

Tragedy heightens fear of city's aging gas lines.

Demolition of homes damaged in the Allentown gas explosion late Wednesday night begins on Friday morning. (Donna Fisher/The Morning Call / February 11, 2011)

SUSTAINABLE INFRASTRUCTURE

Sustainable Infrastructure Engineering

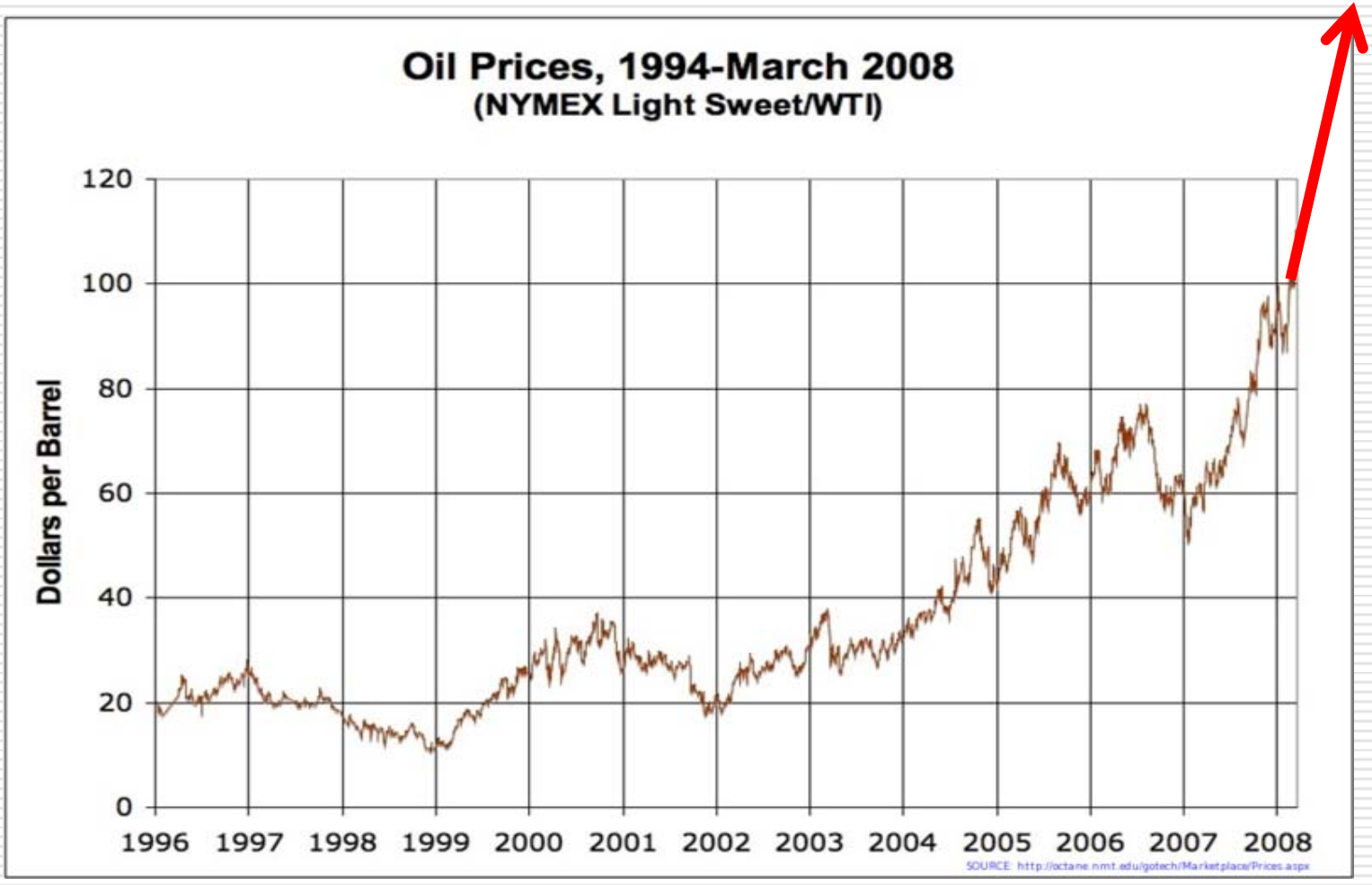
"The design of new infrastructure, and the re-design, rehabilitation, re-use or optimization of existing infrastructure, which is consistent with the principles of urban sustainability and global sustainable development"

The Aquaduct of Valens in Istanbul, Turkey - a symbol of sustainable infrastructure perhaps? Built in the 4th century, it supplied water for 1500 years -- without requiring an energy supply.

This definition encompasses:

- infrastructure renewal
- long-term economic analysis of infrastructure, e.g. life-cycle analysis, ecological footprinting
- modeling of land use and transportation for assessment of policies on emissions, energy use and reduced infrastructure costs.
- the protection of existing infrastructure from environmental degradation, e.g. preservation of historical masonry buildings
- material selection for sustainability - quality, durability and energy conservation
- making better use of so-called "waste" water and materials
- the redesign of infrastructure in light of global climate change
- the remediation of environmentally damaged soils and water

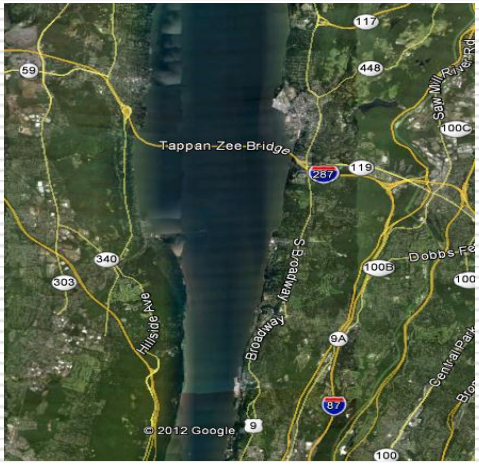
SUSTAINABLE INFRASTRUCTURE



INFRASTRUCTURE RESILIENCE

- **Infrastructure resilience** is the ability to reduce the magnitude and/or duration of disruptive events. It is the ability to *anticipate*, *absorb*, *adapt to*, and/or *rapidly recover* from a potentially disruptive event. It has three key features:
  - **Robustness**: the ability to maintain critical operations and functions in the face of crisis
  - **Resourcefulness**: the ability to prepare for, respond to, and manage a crisis or disruption as it unfolds
  - **Rapid recovery**: the ability to return to and/or reconstitute normal operations as quickly and efficiently as possible after a disruption
- **Protection** and **resilience** represent complementary elements of a comprehensive risk management strategy

SUSTAINABILITY?? & RESILIENCE??



The plan to replace the Tappan Zee Bridge carries a smaller price tag and fewer grand ambitions than previous proposals but cuts through the red tape that has stalled the project for years. The $5.2 billion bridge will add an eighth lane and some safety upgrades but will not immediately bring new mass transit to the Hudson Valley. The focus is firmly on replacing the 56-year-old Tappan Zee Bridge, which carries 120,000 vehicles in seven lanes across the Hudson River each day and is in the second phase of a $296 million deck replacement project.

HOW DO WE SOLVE THE PROBLEM

- **Conduct a Comprehensive Inventory, Condition Assessment, Useful Life Determination,**
- **Evaluate Life Cycle & Replacement Costs**
- **Conduct a Sustainability & Resilience Review that takes into account risk of failure, future energy costs, geologic and environmental hazards, etc.**
- **Identify, Prioritize and Establish Costs for Critical Infrastructure Replacement Projects**

HOW DO WE FIND THE MONEY

- **Establish a Long-Term Funding Source through Infrastructure Replacement Fees deposited into Municipal or Authority Reserve Accounts.**

FAIRWAYS AT BROOKSIDE

2010 OPERATING BUDGET

Exterior Lighting (PPL)-	$11,000	
Curb, Sidewalk, Street, Drainage Maintenance -	$20,000	
Grounds Care (lawns, landscaping, trees) -	$55,000	
Snow Removal -	$16,000	
Trash Collection (twice per week) -	$14,000	
Shared Facility Costs (Entry Drive, pool, etc) -	$ 16,000	
Capital Reserve (streets, utilities, roofs) -	$32,000	
Property & Liability Insurance -	$25,000	
Management, Accounting, Misc -	$25,000	
2010 Total Operating Expenses -		$214,000
2010 Monthly Operating Expenses-		$ 17,833
Approximate Total Monthly Condo Fee ($17,833/91 units)		$ 200/month

FAIRWAYS AT BROOKSIDE

LVASCE REGIONAL REPORT CARD

LV INFRASTRUCTURE REPORT CARD SOUTH WHITEHALL TOWNSHIP LEHIGH COUNTY, PA

- $120 million estimated replacement cost
- $100 per capita per year - 20,000 population
- No dedicated replacement funding source
- No formal condition assessment program
- No prioritization plan

South Whitehall Township Infrastructure Inventory

Item	Cost (million)
Township Roads	$15
Bridges	3
Signalized Intersections	3
Street Lights	7
Water line	30
Fire Hydrants	3
Water Tanks	5
Water Systems	4
Sanitary sewer	22
Sanitary sewer manholes	2
Storm sewer	18
Storm sewer manholes	2
Storm Water Basins	1
Facilities/Structures	9
Total	$124

REGIONAL REPLACEMENT FEES

Region	County	Population	Per Capita Replacement Fee	Estimated Yearly Reserve Funds	50 year Useful Life	75 year Useful Life	100 year Useful Life
Philadelphia (PA)	Bucks:	625,249	$100	$62,524,900	$3,126,245,000	$4,689,367,500	$6,252,490,000
	Chester:	498,886	$100	$49,888,600	$2,494,430,000	$3,741,645,000	$4,988,860,000
	Delaware:	558,979	$100	$55,897,900	$2,794,895,000	$4,192,342,500	$5,589,790,000
	Montgomery:	799,874	$100	$79,987,400	$3,999,370,000	$5,999,055,000	$7,998,740,000
	Philadelphia:	1,526,006	$100	$152,600,600	$7,630,030,000	$11,445,045,000	$15,260,060,000
				$400,899,400	$20,044,970,000	$30,067,455,000	$40,089,940,000
Pittsburgh Area	Pittsburgh Area Counties:	2,356,285	$100	$235,628,500	$11,781,425,000	$17,672,137,500	$23,562,850,000
				$0	$0	$0	$0
Lehigh Valley	Lehigh-Northampton	790,000	$100	$79,000,000	$3,950,000,000	$5,925,000,000	$7,900,000,000
				$0	$0	$0	$0
Scranton & Wilkes-Barre Area	Lackawanna & Luzerne	549,430	$100	$54,943,000	$2,747,150,000	$4,120,725,000	$5,494,300,000
				$0	$0	$0	$0
Harrisburg-Carlisle Area	Dauphin, Cumberland, Perry	533,983	$100	$53,398,300	$2,669,915,000	$4,004,872,500	$5,339,830,000
				$0	$0	$0	$0
York Area	York & Westmoreland	434,972	$100	$43,497,200	$2,174,860,000	$3,262,290,000	$4,349,720,000
				$0	$0	$0	$0
Reading Area	Berks	335,757	$100	$33,575,700	$1,678,785,000	$2,518,177,500	$3,357,570,000
				$0	$0	$0	$0
Johnstown-Altoona Area		125,527	$100	$12,552,700	$627,635,000	$941,452,500	$1,255,270,000
				$0	$0	$0	$0
				$0	$0	$0	$0
				$0	$0	$0	$0
State of Pennsylvania		12,702,370	$100	$1,270,237,000	$63,511,850,000	$95,267,775,000	$127,023,700,000
				$0	$0	$0	$0
				$0	$0	$0	$0
United States - 1990		248,709,873	$100	$24,870,987,300	$1,243,549,365,000	$1,865,324,047,500	$2,487,098,730,000
United States - 2010		281,421,906	$100	$28,142,190,600	$1,407,109,530,000	$2,110,664,295,000	$2,814,219,060,000

VMT - LOCAL ROAD FUNDING

Region	County	Population	Estimated Vehicle Count (Pop/4)	Vehicle Miles Traveled	$0.01/mile	$0.02/mile	$0.03/mile
Philadelphia (PA)	Bucks:	625,249	156,312	12,000	$18,757,470	$37,514,940	$56,272,410
	Chester:	498,886	124,722	12,000	$14,966,580	$29,933,160	$44,899,740
	Delaware:	558,979	139,745	12,000	$16,769,370	$33,538,740	$50,308,110
	Montgomery:	799,874	199,969	12,000	$23,996,220	$47,992,440	$71,988,660
	Philadelphia:	1,526,006	381,502	12,000	$45,780,180	$91,560,360	$137,340,540
			0	12,000	$0	$0	$0
			0	12,000	$0	$0	$0
			0	12,000	$0	$0	$0
Pittsburgh Area	Pittsburgh Area Counties:	2,356,285	589,071	12,000	$70,688,550	$141,377,100	$212,065,650
			0	12,000	$0	$0	$0
Lehigh Valley	Lehigh-Northampton	790,000	197,500	12,000	$23,700,000	$47,400,000	$71,100,000
			0	12,000	$0	$0	$0
Scranton & Wilkes-Barre Area	Lackawanna & Luzerne	549,430	137,358	12,000	$16,482,900	$32,965,800	$49,448,700
			0	12,000	$0	$0	$0
Harrisburg-Carlisle Area	Dauphin, Cumberland, Perry	533,983	133,496	12,000	$16,019,490	$32,038,980	$48,058,470
			0	12,000	$0	$0	$0
York Area	York & Westmoreland	434,972	108,743	12,000	$13,049,160	$26,098,320	$39,147,480
			0	12,000	$0	$0	$0
Reading Area	Berks	335,757	83,939	12,000	$10,072,710	$20,145,420	$30,218,130
			0	12,000	$0	$0	$0
Johnstown-Altoona Area		125,527	31,382	12,000	$3,765,810	$7,531,620	$11,297,430
			0	12,000	$0	$0	$0
			0	12,000	$0	$0	$0
			0	12,000	$0	$0	$0
State of Pennsylvania		12,702,370	3,175,593	12,000	$381,071,100	$762,142,200	$1,143,213,300
			0	12,000	$0	$0	$0
			0	12,000	$0	$0	$0
United States - 1990		248,709,873	62,177,468	12,000	$7,461,296,190	$14,922,592,380	$22,383,888,570
United States - 2010		281,421,906	70,355,477	12,000	$8,442,657,180	$16,885,314,360	$25,327,971,540

SR & INTERSTATE TOLLING

PA INTERSTATE HIGHWAY & MAJOR SR TOLLING – ESTIMATED REVENUE POSSIBILITIES

ACT 44 – PA TPKE TOLLING - $450 million/yr Plus $300 million for Operations & Maintenance & Repair

PA INTERSTATES: I-70, I-76, I-78, I-79, I-80, I-81, I-83, I-84, I-86, I-90, I-95, I-99, I-276, I-376, I-476; I-380

Replacement Fee – $250 million each/year = $4 billion/yr; $200 billion/50yr; $400 billion/100yr

TRANSPORTATION CORRIDORS

ADDITIONAL FUNDING:

Vehicles Miles Traveled Fee – For State & Local Roads-Bridge Infrastructure Replacement

Registration Fees, Licenses, Parking Fees

Eliminate State Gas tax over time !!!!!

KEY TO THE FUTURE - ESTABLISH MULTI-MODAL INTERSTATE TRANSPORTATION CORRIDORS:

CAR, TRUCK, TRACTOR TRAILER, BUS, & INTERSTATE HIGHWAY CORRIDOR RAIL SYSTEM

LEVERAGE OF RESERVE ACCOUNTS

Infrastructure Reserve Accounts could be used to obtain "zero" interest loans from Regional Federal Reserve Banks similar to the $ 8-Trillion + made available to Wall Street Banks since 2008.

Item	Issuer	Amount of Outlay
Commercial Paper Funding Facility	Federal Reserve	$1.8 trillion
Temporary Liquidity Guarantee Program	FDIC	$1.4 trillion
Term Auction Facility (TAF)	Federal Reserve	$900 billion
Fannie Mae (NYSE: FNM), **Freddie Mac** (NYSE: FRE), and Ginnie Mae	U.S. Treasury / Federal Reserve	$800 billion
Treasury Asset Relief Program (TARP)	U.S. Treasury	$700 billion
Total USD International Currency Swap Lines	Federal Reserve	$688 billion
Money Market Investor Funding Facility	Federal Reserve	$540 billion
Other Loans: Primary Dealer Credit, etc.	Federal Reserve	$288.7 billion
Citigroup (NYSE: C) Guarantee	U.S. Treasury / FDIC	$306 billion
Hope for Homeowners Act of 2008	U.S. Treasury	$304 billion
Term Securities Lending Facility (TSLF)	Federal Reserve	$225 billion
Term Asset-Backed Securities Loan Facility (TALF)	U.S. Treasury	$200 billion
Economic Stimulus Act of 2008	U.S. Treasury	$168 billion
Paid to **JPMorgan Chase** (NYSE: JPM) to Settle Lehman Brothers Debt	Federal Reserve	$138 billion
AIG (NYSE: AIG) Bailout	Federal Reserve	$112.5 billion
Bear Stearns Brokered Sale	Federal Reserve	$26.9 billion
I'm afraid to look ...	**Total:**	**$8,597,100,000,000**

* "Other loans" total from the Fed's statistical release as of Nov. 19, 2008, which includes discount window lending to banks and brokerages, and the Asset-Backed Commercial Paper Money Market Liquidity Facility.

LEVERAGE RESERVE ACCOUNTS

BENEFITS OF FEDERAL RESERVE LOAN GUARANTEES

1. **By Law the Federal Reserve is responsible for monetary policy which is to accomplish manageable inflation, full employment, and steady growth in the economy**

2. **Investment of $8 Trillion in the Replacement of our Infrastructure would Lead to**
   - a) **Increased Employment,**
   - b) **Growth in our Local & Regional Economies,**
   - c) **Increase in Tax and User Fee Revenues,**
   - d) **Replacement of Critical Municipal Infrastructure,**
   - e) **Enhancement of our Quality of Life**
   - f) **Enhancement of Public Safety**

REGIONAL INFRASTRUCTURE PLANNING

Qualification for Reserve Account Loans would come from the Submittal and Approval of Infrastructure Replacement Project Funding Requests by the Regional Municipal Planning (MPO) or Rural Planning Organization (RPO) which have been used for Federal Highway Transportation Infrastructure Funding Planning since 1962.

a. **A Municipal Infrastructure Committee would be established for each MPO and RPO to review and approve infrastructure project requests and loans**

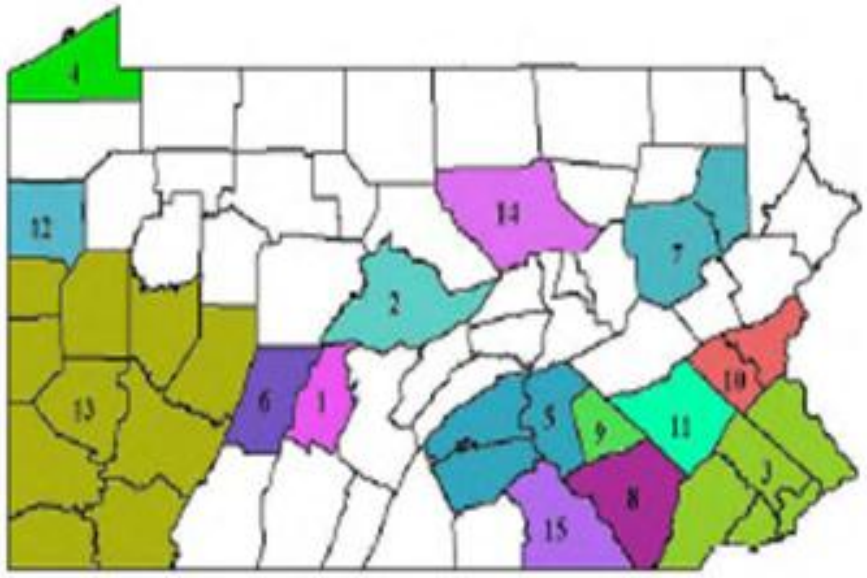
b. **A Sustainability & Resilience Review would be required for approval of each Infrastructure Replacement Project by Regional MPO or RPO Planning Organizations**

PENNSYLVANIA MPO & RPO'S

MPOs are required to develop and maintain a Long Range Transportation Plan of at least 20 years and a Transportation Improvement Program that covers four years. MPOs are supported by Federal and State Planning Funds.

MPOs in Pennsylvania are (See Map 1)

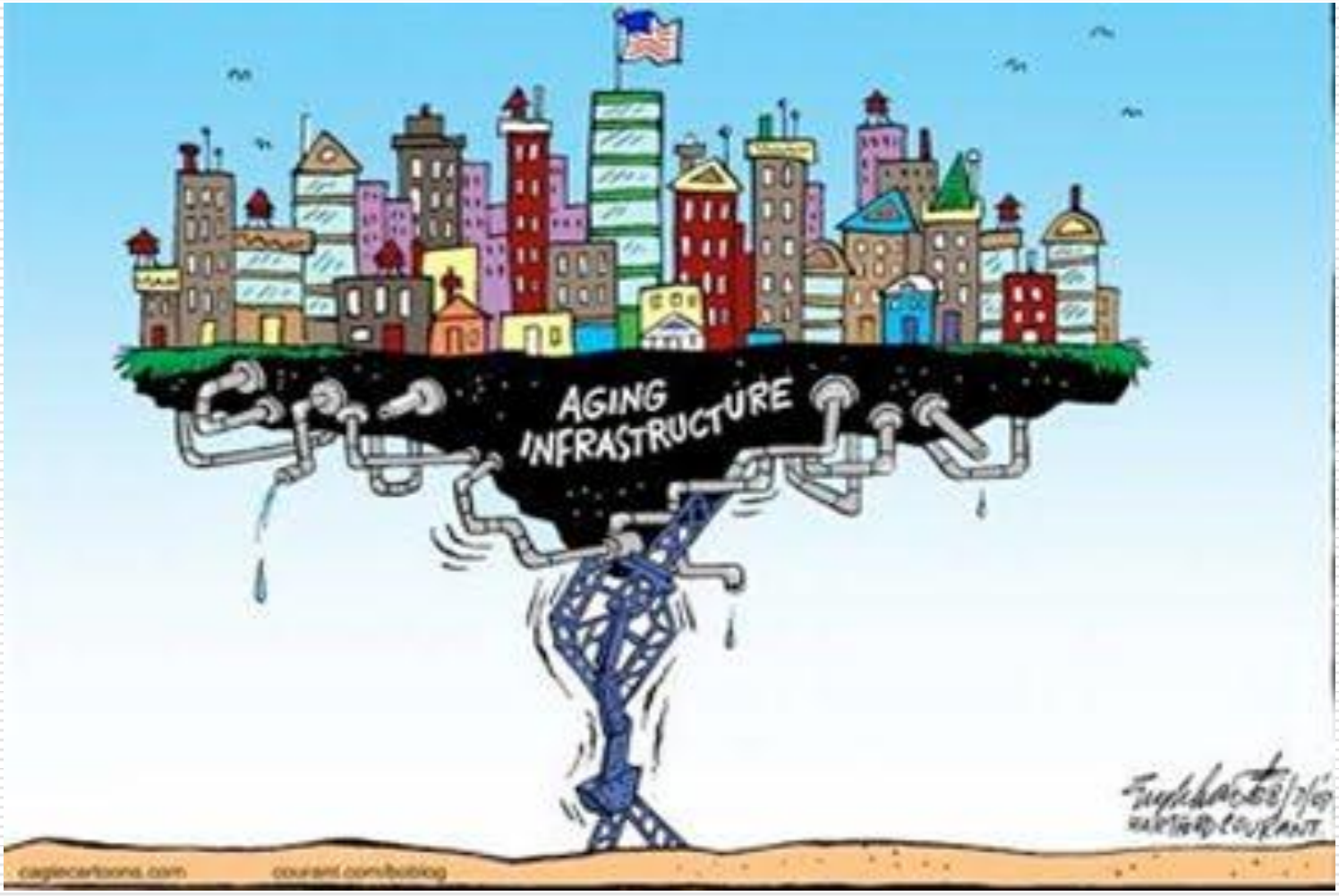
1. Altoona
2. Centre Region
3. Delaware Valley
4. Erie
5. Harrisburg
6. Johnstown
7. Lackawanna/Luzerne
8. Lancaster
9. Lebanon
10. Lehigh Valley
11. Reading
12. Shenango Valley
13. Southwestern Pennsylvania
14. Williamsport
15. York



PA RPO's
Rural Planning
Organizations

REGIONAL SOLUTIONS NEEDED!!

REGIONAL SOLUTIONS NEEDED!!



THANK YOU – ANY QUESTIONS

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