The Problem: Rain-related Disease Risk

- Waterborne Disease
- Climate Change
- Failing Infrastructure

Stormwater
Policy Solutions: Rain-related Disease Risk

- Disinfect Public Wells
- Statewide Stormwater Standards
- Incentivize Private Sewer Repair

Reduce Health Risk
I. Climate Change
Energizing storms & loading the dice

Adapted from Trenberth 1999
Downscaled models by WICCI

Significant increase in intense storm frequency by 2055

WICCI 2011
25% increase in intense storm frequency

Historical

Expected by 2055

WICCI 2011
Historical

10-40% increase in storm intensity

Expected by 2055

WICCI 2011
More storms for warmer Wisconsin

Historical

Expected by 2055
Historically, Wisconsin is wetter in some areas and drier in others. Drier areas may face added stormwater burden.
Historically we’ve already been getting warmer and wetter

Data from 1950 to 2006:

- Nighttime lows temps up ~1-4°F
- Average annual daytime highs up ~0.5-1°F
- Southern precipitation increased by ~2-4”
- Northern precipitation decreased by ~1-2”

Rainfall over S. Wis. 10-15%

Kucharik et al. 2010
The past is no longer an adequate guide

1950 ≠ 2006

Shifting trends mean our pipes were not designed or constructed to convey actual or expected flows
• 90 million gallons of sewage overflows at 61 communities
• 700 drinking water wells contaminated
• $34 million in damage claims paid

Slide courtesy of David Liebl, WICCI
Reedsburg 2008
Baraboo River Flooding
II. Waterborne Disease
Waterborne Disease in U.S.

- More than half of U.S. waterborne disease outbreaks followed heavy storms
- Contaminated water is responsible for between 6% and 40% of diarrhea-related illness
- Remember *Crypto*?
  - 403,000 sick
  - 69 dead
  - $96 million costs to society
  - $406 million in public investment as cure

Curriero et al. 2001; Gaffield et al. 2003; Corso et al. 2003
Acute Diarrhea (AGI)

• **10%** of U.S. hospital admissions
• **300** U.S. kids’ deaths per year
• **$1 billion** in annual costs to U.S. society

• Biggest concern is for kids age 5 and under
  – Less immunity
  – Smaller body size
  – More complications

Elliot 2007
Relationship between rain & diarrhea

• **11%** increase in AGI ER visits for kids four days after rainfall (2002-2007 Children’s Hospital)
• Associated with rain, not overflows
• Probably underestimates disease incidence
• These kids were primarily served by surface waters, but highlights role of rain in transporting pathogens
• Pathway/s not identified in this study

Drayna et al. 2010
Kids seem to be getting more sick from well water than surface water

- Another Children’s Hospital study
- Top 3 illness risk factors in order of odds ratios:
  - Ill contacts in the home (2.52)
  - Well water (1.38)
  - Primarily bottled water (1.27)

Gorelick et al. 2011
Viruses in Wisconsin groundwater

• Diarrhea linked with septic tank proximity in central Wisconsin (Marshfield)
  – Risk for viral diarrhea increased 8% per additional holding tank per section

• Viruses in pre-treated drinking water from groundwater, with sources both from river and elsewhere (La Crosse)

• Tap water from 14 of 14 non-disinfecting communities tested positive for viruses

Borchardt et al. 2003; Borchardt et al. 2004; Borchardt et al. 2012
2011 Wis. Act 19 leaves some 60 communities vulnerable by not requiring municipal well disinfection.

~65,000 people (1.1% of Wis. pop) and about 4,000 kids under age 5

U.S. Census Bureau

Seeley in Wisconsin State Journal, 2012
Viruses in deep Madison groundwater

Data from six wells from 2007 to 2009

How are they getting there?

Bradbury et al. 2013
Leaky sanitary sewer pipes implicated, transported by recharge from heavy rains

Bradbury et al. 2013
III. Failing Infrastructure
Leaky pipes

• **13,000,000,000** feet of pipe under America
  That’s 10x distance between Earth and Moon

• Old sewer pipes leak, pathogens get out, especially when hydrology is conducive, i.e. when stormwater changes the game

• Old water mains break (1 per 10 miles per year), allowing viruses to seep into municipal distribution systems

American Water Works Association 2012; Folkman 2012
Then there are leaky laterals...
Wisconsin’s estimated 20-yr needs

- $2.5 billion for treatment upgrades
- $3.5 billion for distribution upgrades

Wisconsin budget priorities

- $94 million in low-interest loans for drinking water infrastructure (short of projected 20-yr need by a lot)
- State highways get $3.6 billion over 2 years

U.S. EPA 2007
Wis 2013 Act 20
Systemic Vulnerability

• Even with best treatment, if the distribution system is vulnerable, then we remain at risk
• Proximity of water and sanitary pipes: WI: 8ft; other states, 10ft; in reality there is likely communication when groundwater tables rise under heavy recharge
• Remember those 14 non-disinfected communities? The distribution system was implicated as the entry point for viruses from sewage.

Lambertini et al. 2012
IV. Policy Recommendations

First, acknowledge the scope of the problem

1. Disinfect public water supplies
2. Research local sewer and water vulnerabilities
3. Invest in underground infrastructure
4. Establish statewide stormwater standards that account for climate change expectations
5. Offer incentives to replace sewer laterals
Where’s Our Water?
Out of sight, but not out of mind

Where’s My Water’s lovable alligator, Swampy, knows a thing or two about failing pipes