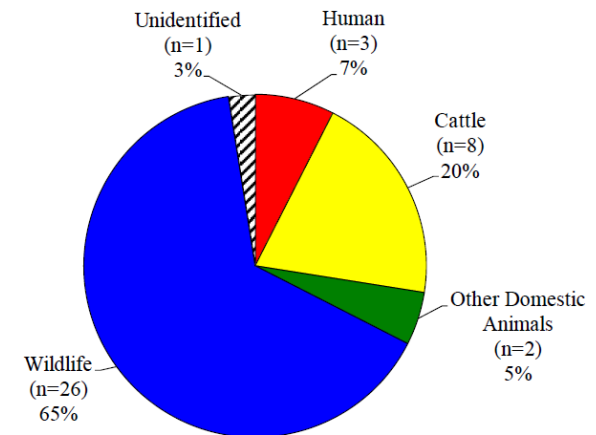
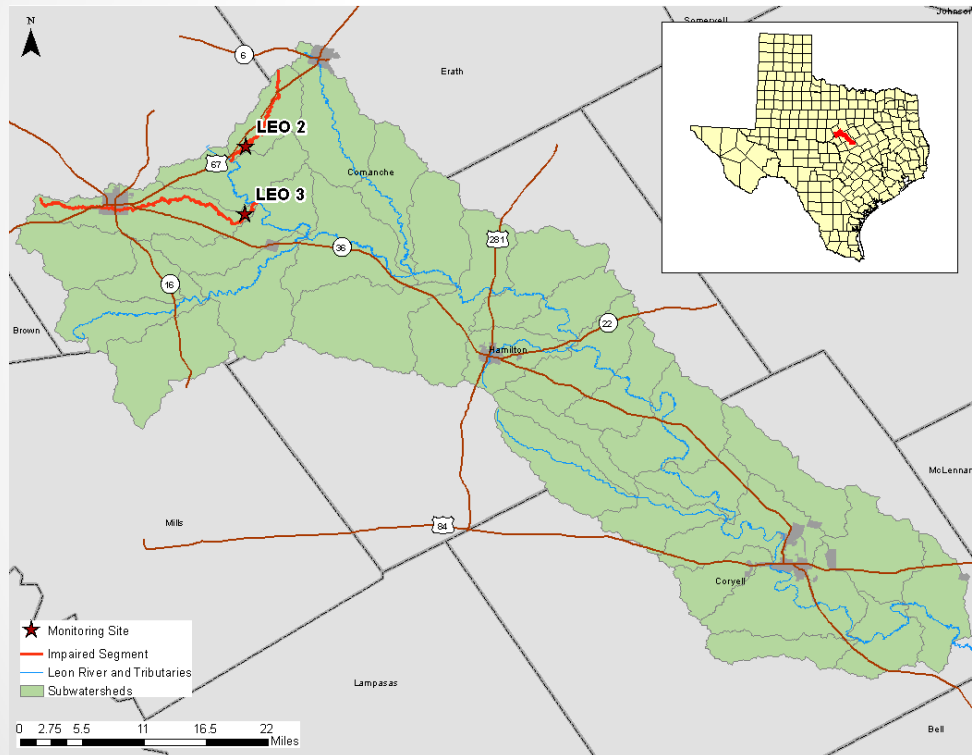


# Application of QMRA and BST to Assess the Associated Human Health Risks from Multiple Fecal Sources During Recreation in the Leon River Watershed

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# Leon River Watershed



- LEO 2:
  - Walnut Creek
  - 163 cfu/ 100 mL *E. coli*

What is the human health risk for a GI illness when you have a mixture of fecal sources in a waterbody?

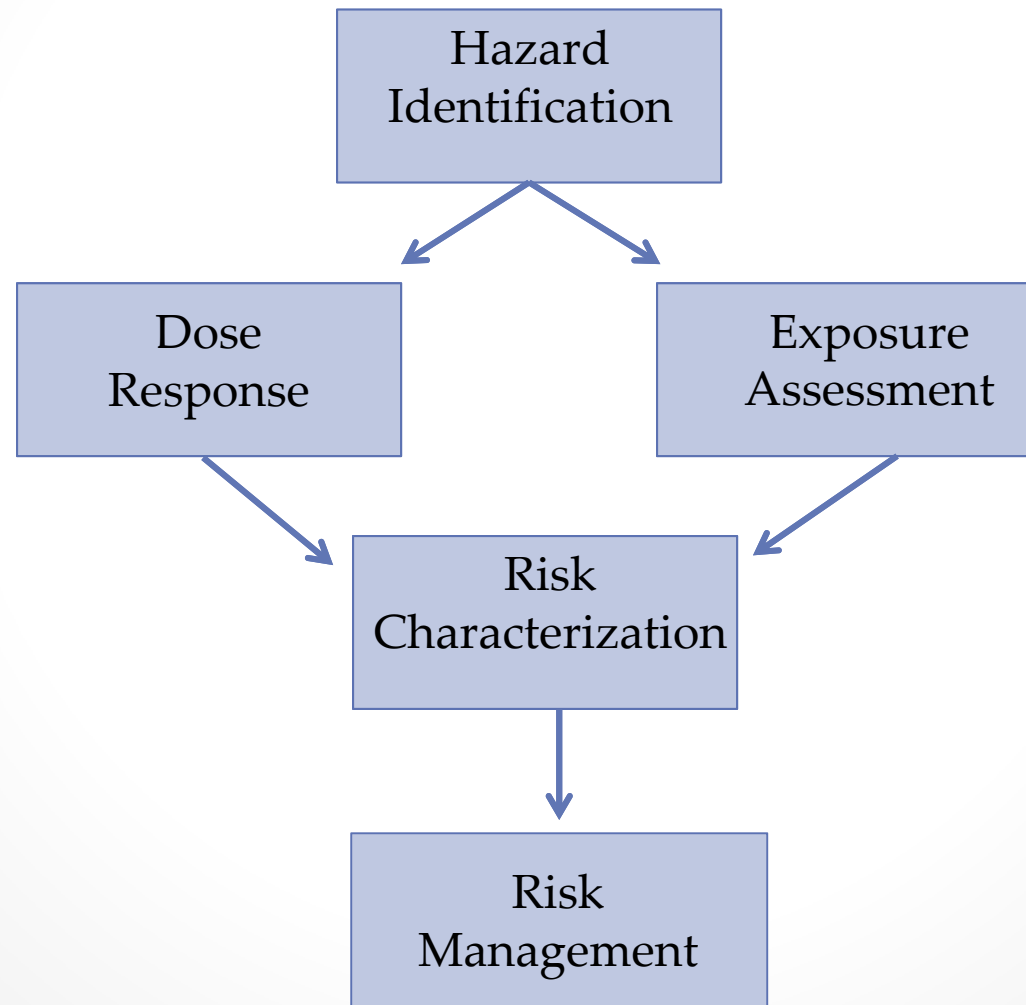
# Water Quality and Human Health

- 2012: GI illness redefined from HCGI to NGI
  - Acceptable NGI risk level: 0.036
  - Redefined to include viral illnesses
- Prior research has found different levels of risk depending on the fecal source
  - Human v. non-human sources



U.S. EPA, 2012. Recreational Water Quality Criteria. Office of Water, Washington D.C., 820-F-12-058.

# Quantitative Microbial Risk Assessment



# Reference Pathogens

- Each source represented by a reference pathogen
  - Health output: GI illness
  - Pathogens selected represent majority of non-foodborne GI illnesses
  - No dose-response model for *E. coli*

Sources	Reference Pathogen
Human	Norovirus
Cattle/Domestic Animals	<i>Campylobacter</i>
Wildlife	<i>Cryptosporidium</i>

# Dose Ingested

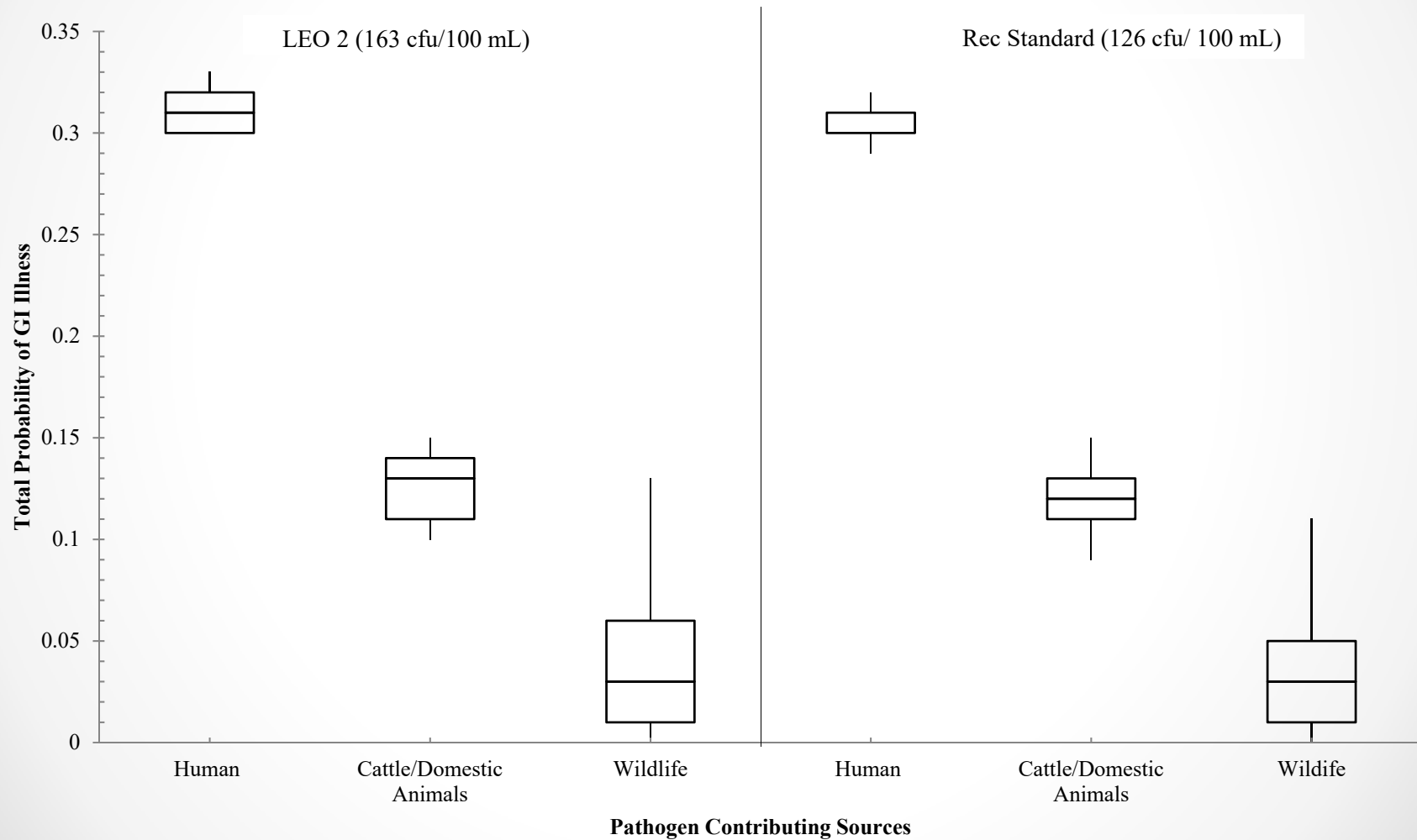
- Variables in the Dose Formula
  - Volume of water ingested
  - Density of *E.coli* and reference pathogen in waste (for each source)
  - Infectious prevalence and potential of each reference pathogen
  - *E. coli* data



# Risk Scenarios

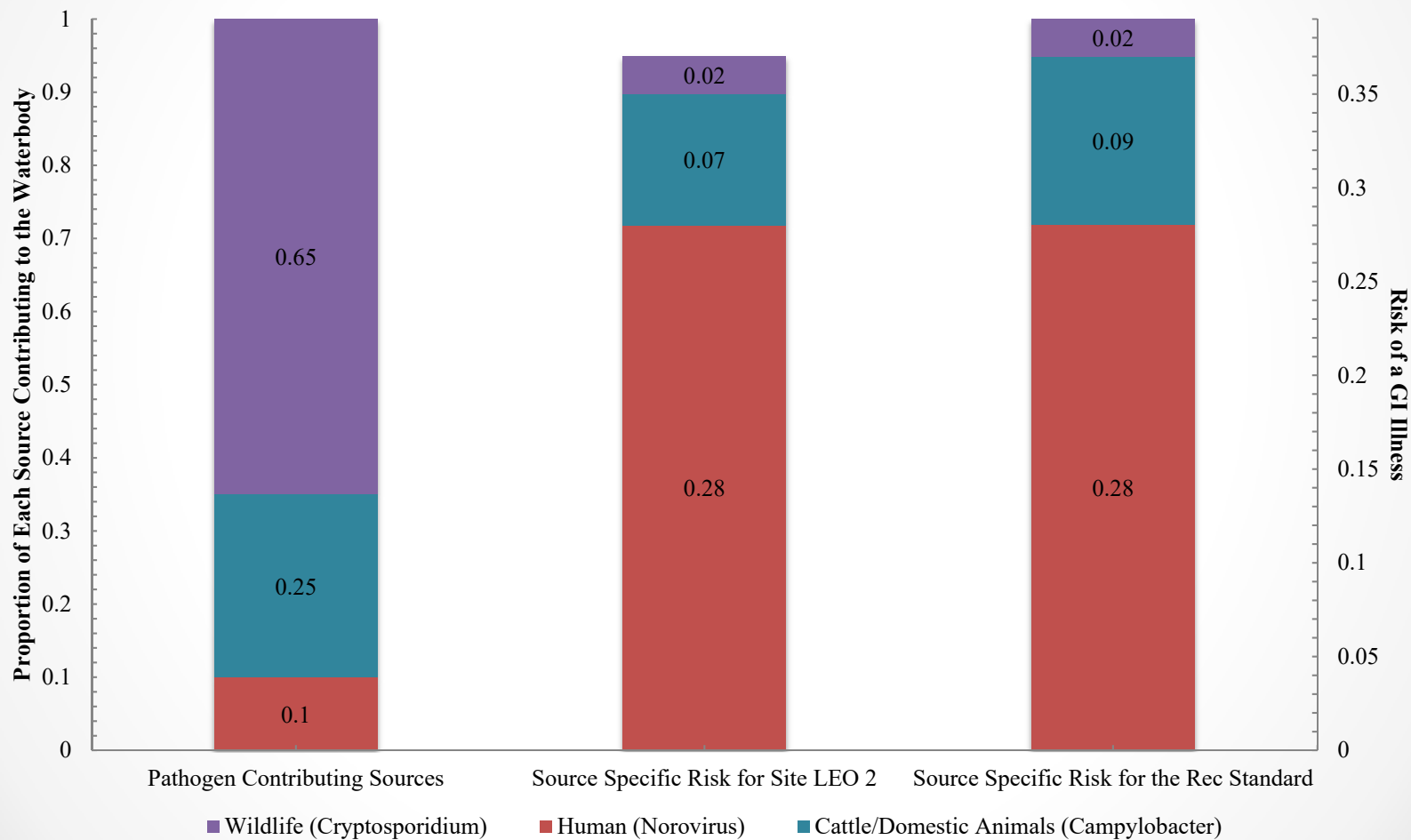
Simulations	Descriptions
Scenario 1	Each source contributes to 100% (each source contribution tested independently)
Scenario 2	Each source contributes according to BST results <ul style="list-style-type: none"><li>• 10% human (including unidentified)</li><li>• 25% cattle/domestic animals</li><li>• 65% wildlife</li></ul>
Scenario 2 Modified	Each source contributes according to modified BST results (separating cattle and domestic animals) <ul style="list-style-type: none"><li>• 7% human</li><li>• 20% cattle</li><li>• 73% wildlife/domestic animals (including unidentified)</li></ul>
Scenario 3	Each source contributes equally to the bacteria load (33.3%)

# Each Source Contributing 100% of the Bacteria Load

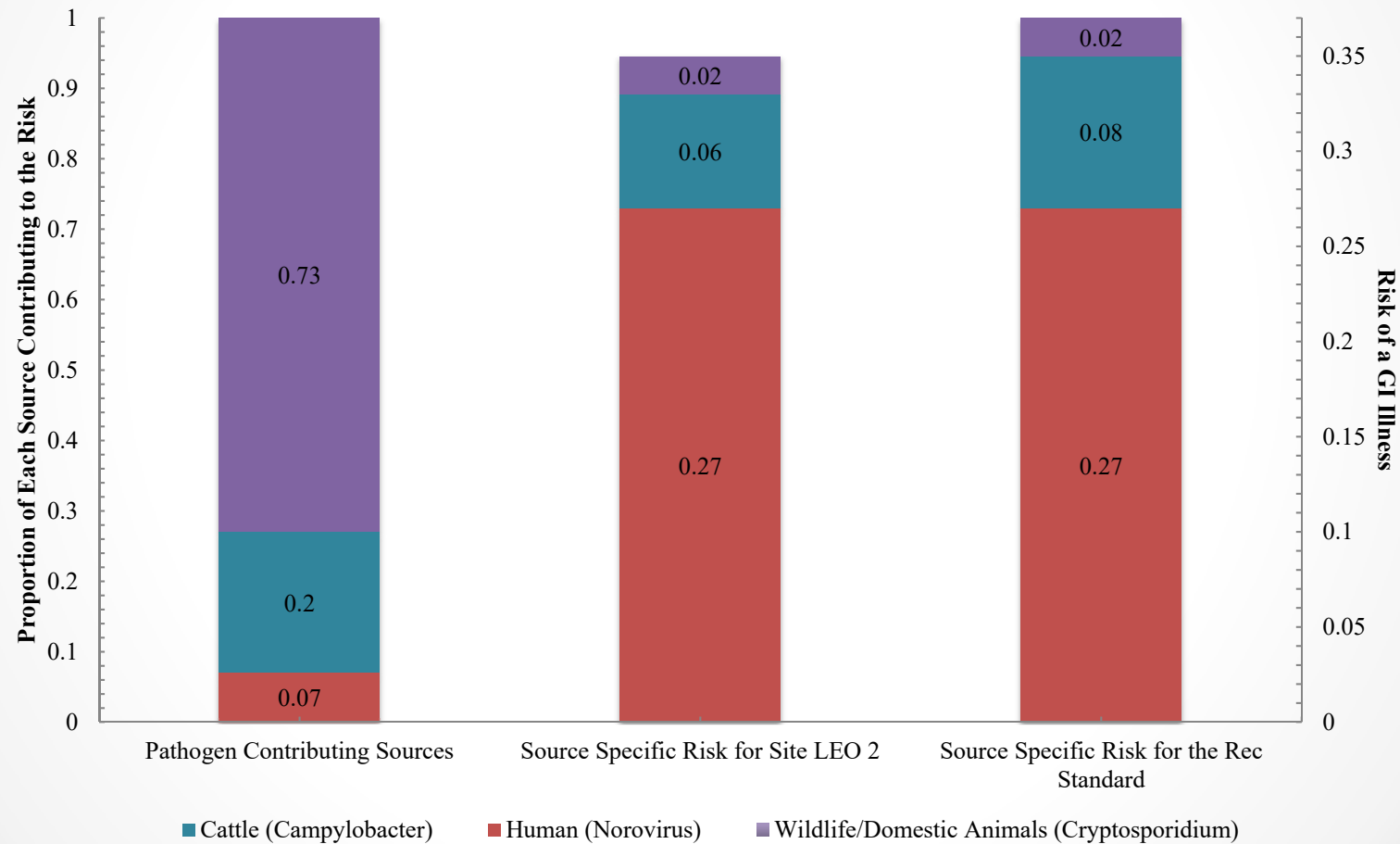




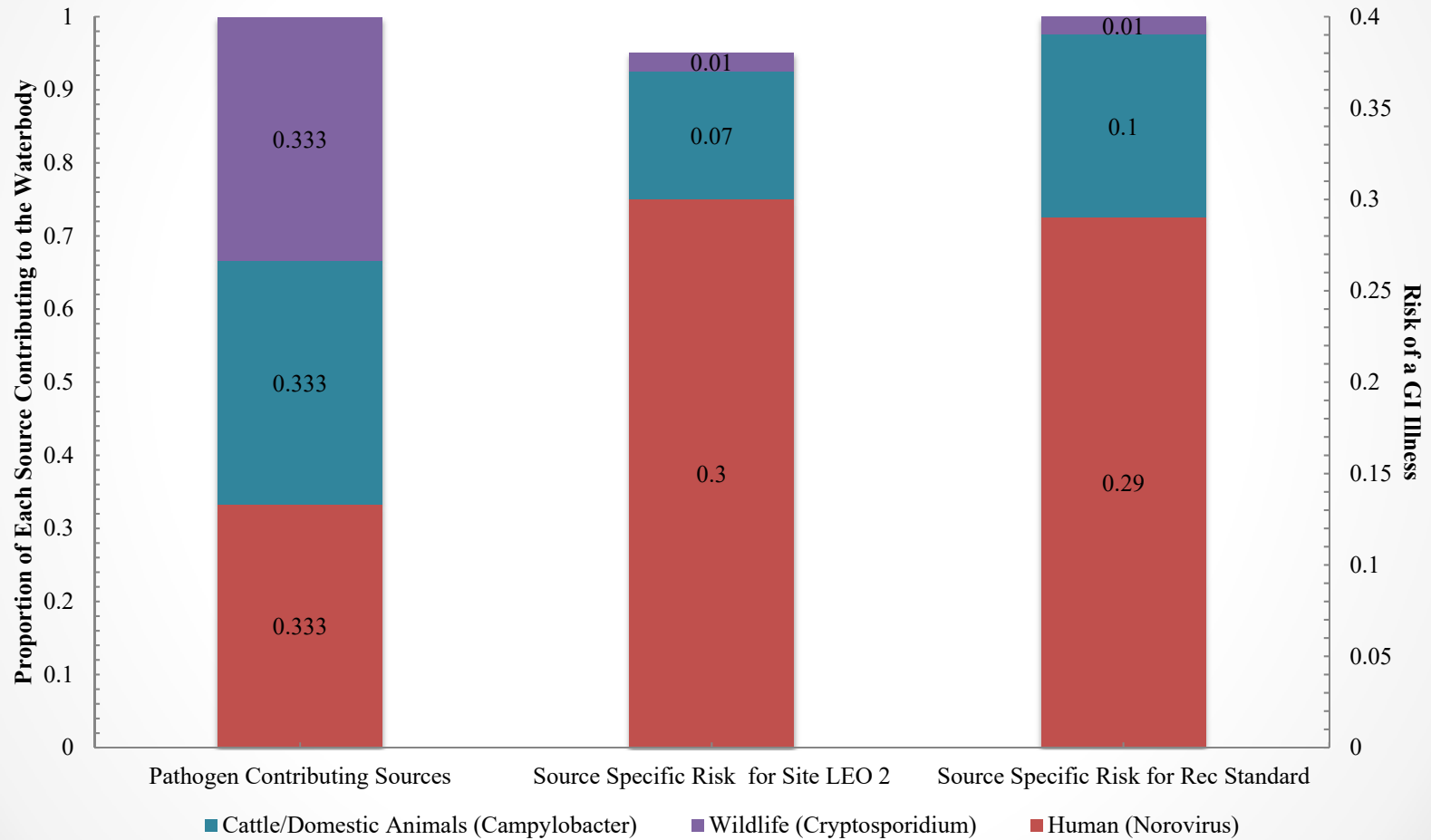
# Risk of GI Illness: BST Percentages



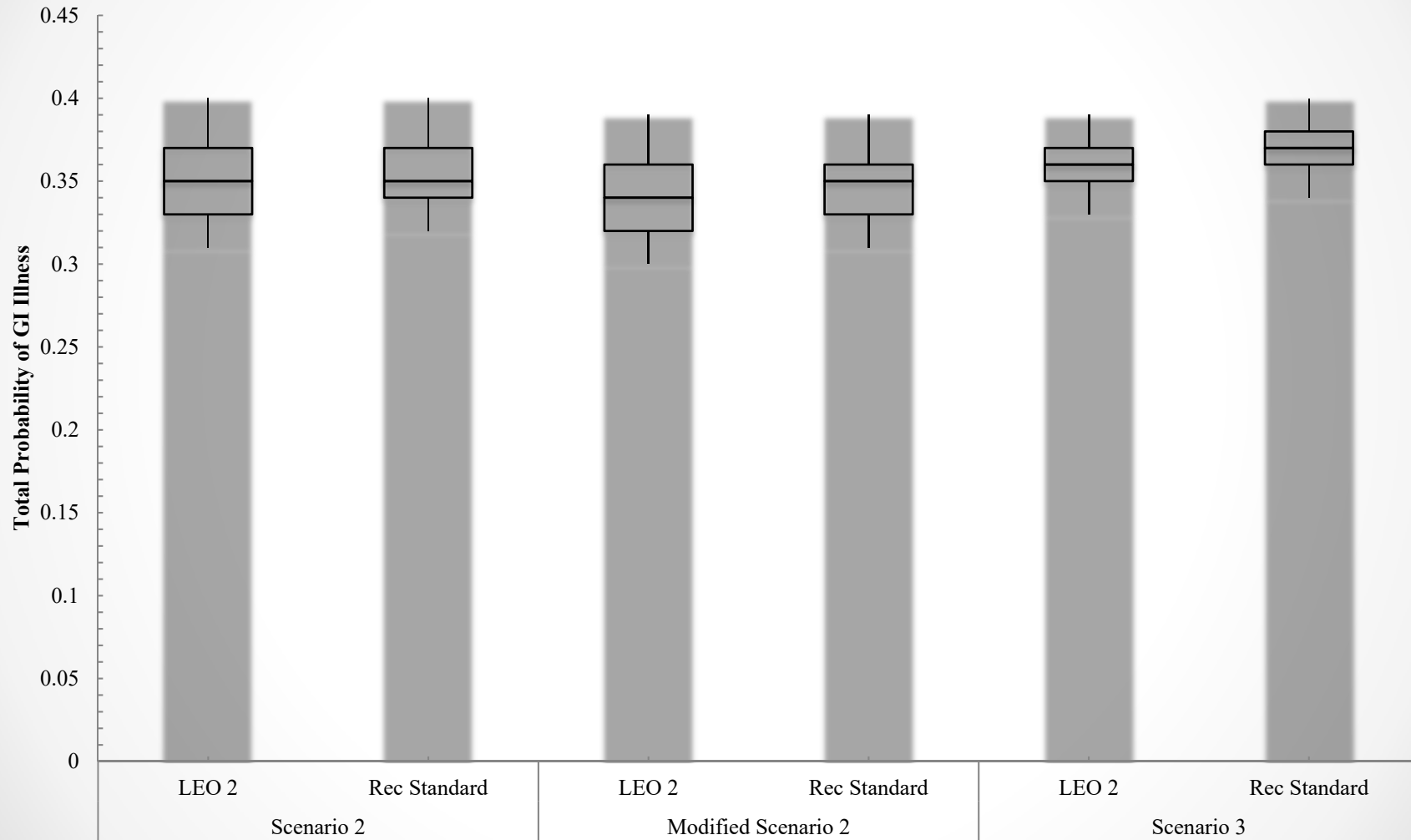
# Risk of GI Illness: Modified BST Percentages (separated cattle from domestic animals)



# Risk of GI illness: Each Source Contributes 33.3%



# Comparison of Risks



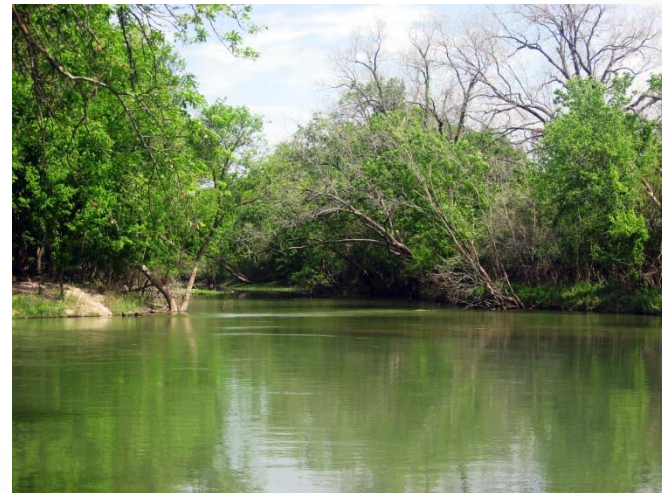
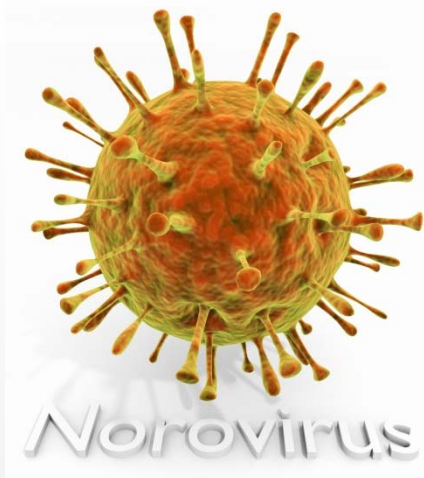
# Assumptions Contributing Uncertainty

- Need research in:
  - Zoonotic pathogens: potential for human infection and prevalence of infection
    - *Campylobacter*
    - *Cryptosporidium* spp.
    - *Other Pathogens to consider: Giardia, Salmonella enterica, E. coli* 0157:H7



# QMRA Results

- Proportion of a source contributing not an indicator of the human health risk
  - Risk was driven by human source
- Calculated human health risk exceeded recreational risk standard
  - Risk primarily driven by norovirus infection and illness



# Implications

- Management efforts toward reducing human source
  - WWTP compliance, septic system maintenance
- Value of using BST and QMRA to quantify the human health risk
  - Developing site-specific standards
- Prioritize sites according to the human health risk
  - Add to the water management “toolbox”

Thank you!