

# TMDL CALCULATIONS

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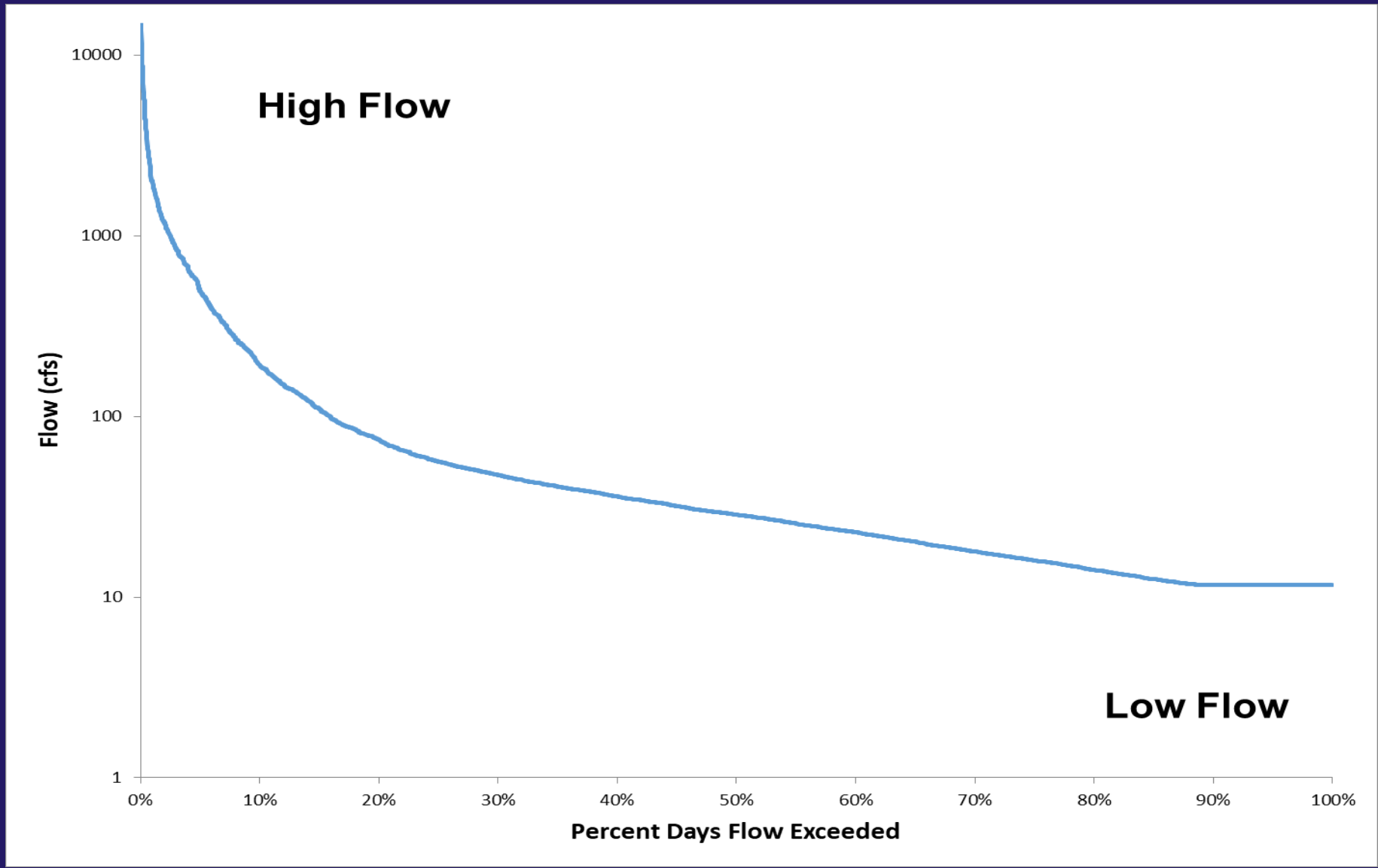
# Flow Duration Curve and Load Duration Curve Development

# Streamflow Record

- Determine period of record
- Develop streamflow record using available data (gauge, DAR, modeling, or combination)

# Flow Duration Curve

- Rank daily streamflow data highest to lowest
- Calculate percent exceedance values for each ranked streamflow value. (Divide rank by number of days of record +1)
- Plot ranked streamflow data (y-axis) and percent exceedance (x-axis).

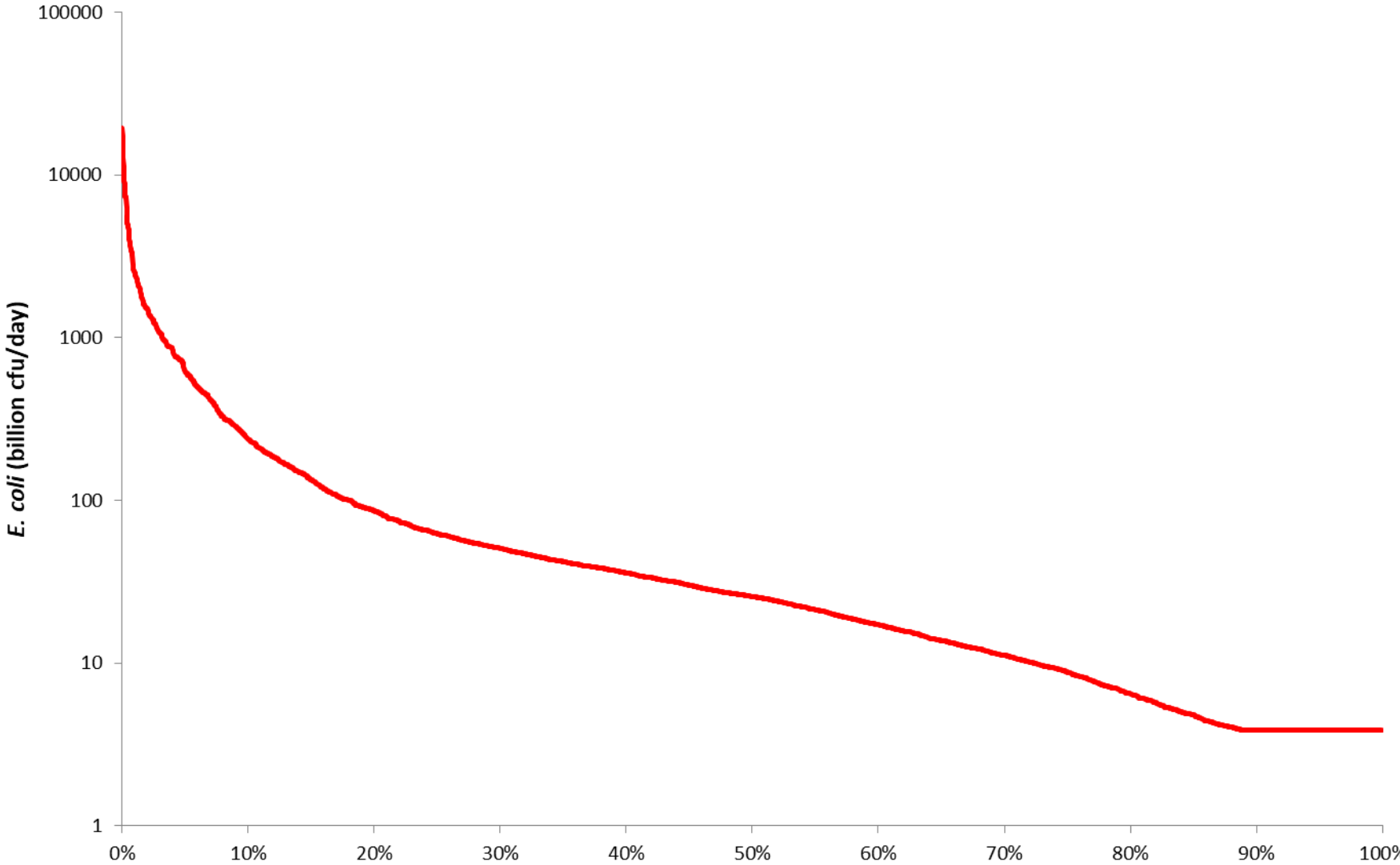


# Flow Duration Curve

# Load Duration Curve

- Convert the FDC to a LDC by:
  - Multiplying streamflow values (cfs) by the relevant numeric criterion (126 CFU/100 mL) and then by a conversion factor ( $2.44658 \times 10^7$ ).
- Plot the calculated allowable loadings (cfu/day)

# Allowable Load at Geomean Criterion

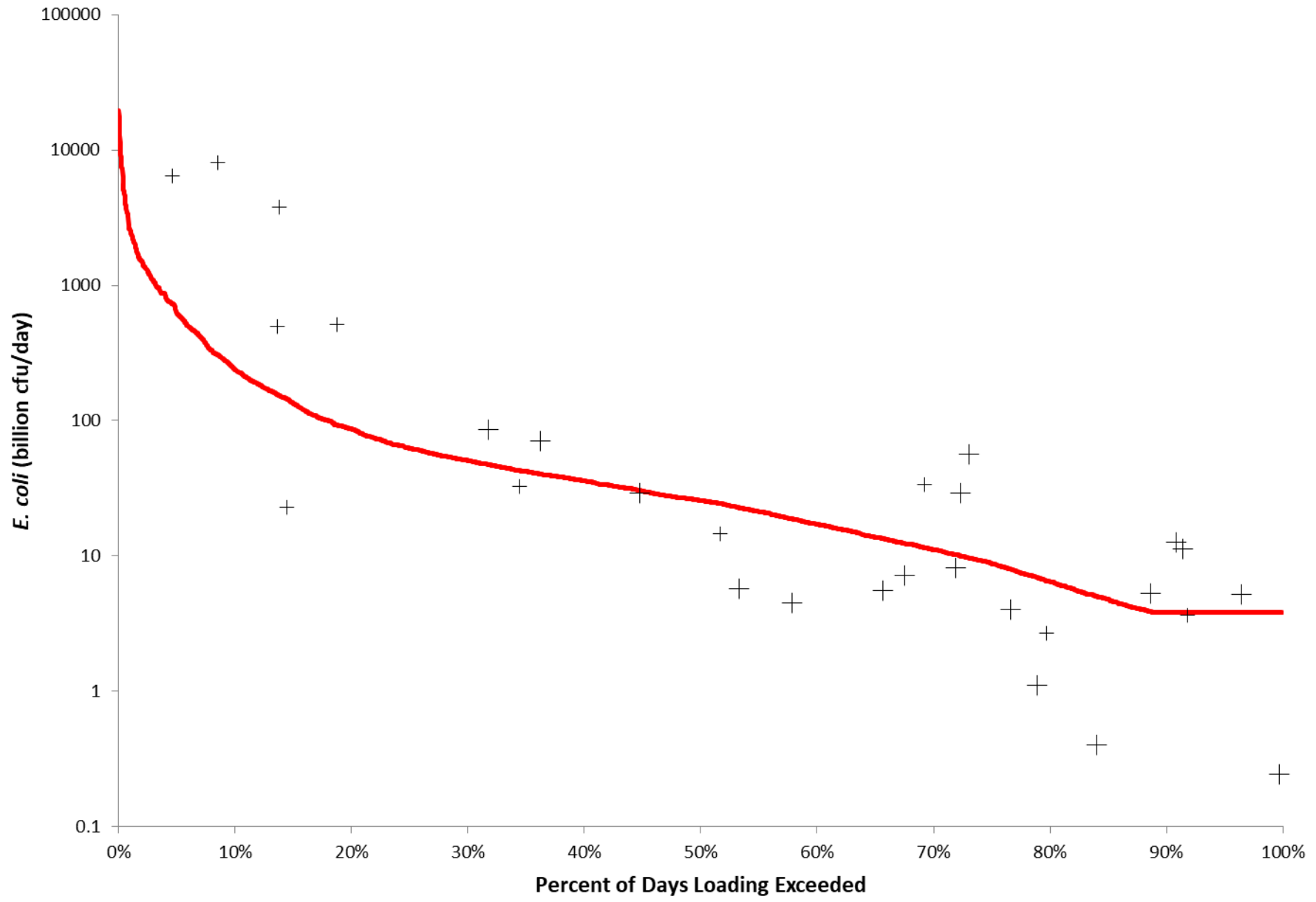


— Allowable Load at Geomean Criterion

# Load Duration Curve

- Convert available bacteria sample data into loadings (cfu/day) by multiplying the bacteria results by the corresponding streamflow and the conversion factor ( $2.44658 \times 10^7$ )

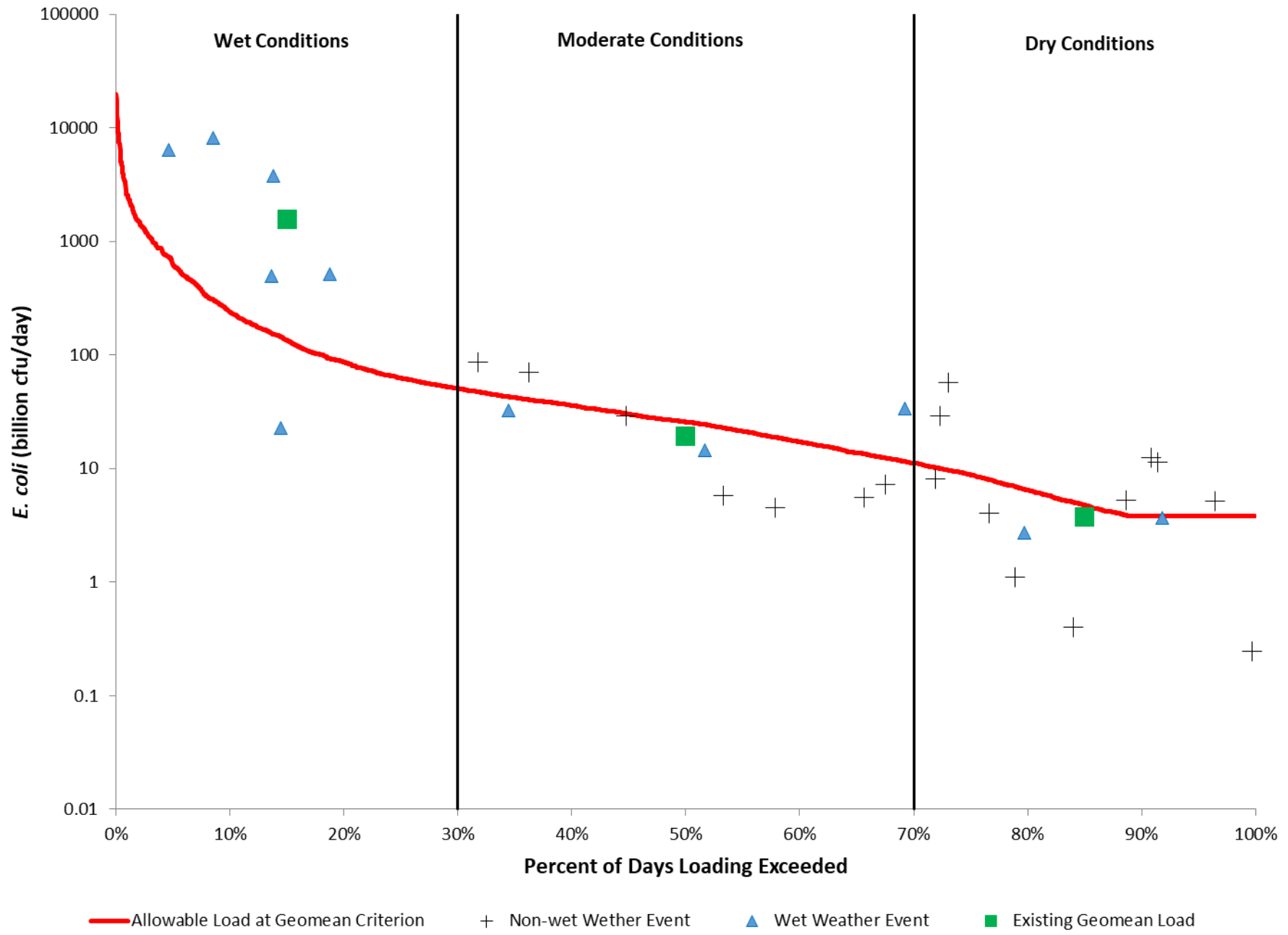




— Allowable Load at Geomean Criterion    + E. coli sampling Event

# Additional Refinements

- Divide the curve into flow regimes
- Calculate existing geomean within each flow regime
- Determine which samples may have been influenced by storm runoff



# TMDL Allocation Process

- Allocates pollutant loads among regulated and non-regulated sources in the watershed
- TMDL is the maximum amount of pollutant loading a water body can receive without violating water quality standards.

# Typical Bacteria TMDL Equation

$$\text{TMDL} = \text{WLA} + \text{LA} + \text{FG} + \text{MOS}$$

- WLA = wasteload allocation, the amount of pollutant allowed by regulated dischargers
- LA = load allocation, the amount of pollutant allowed by unregulated sources
- FG = loadings associated with future growth from potential regulated facilities
- MOS = margin of safety

# Expanded TMDL Allocation equation

$$\mathbf{TMDL = WLA_{WWTF} + WLA_{SW} + LA_{UA} + LA_{TRIB} + FG + MOS}$$

- WLA – Regulated Loading
  - $WLA_{WWTF}$  - Existing wastewater treatment discharges.
  - $WLA_{SW}$  - Construction, industrial and MS4 discharges.
- LA – Unregulated Loading
  - $LA_{UA}$  - Unregulated loading originating within AU.
  - $LA_{TRIB}$  – loadings from tributary water bodies for which TMDLs have been developed
- FG – Future growth from potential permitted facilities.
- MOS - Margin of safety.

# TMDL Calculation

TMDL = criterion \* flow \* conversion factor

**Criterion** = 126 cfu/100 mL (*E. coli*)

**Flow** = typically median flow value within highest flow regime

**Conversion Factor** = 283.1685 100 mL/ft<sup>3</sup> \* 86,400 sec/day

# Margin of Safety

May be implicitly or explicitly incorporated into the TMDL

- **Implicit MOS** – uses conservative model assumptions to develop allocations
- **Explicit MOS** – Specifies a portion of the TMDL as the MOS and uses the remainder for allocations



# Example: Explicit MOS of 5%

$$\text{MOS} = 0.05 * \text{TMDL}$$

# $WLA_{WWTF}$

$$WLA_{WWTF} = \text{Target} * \text{Flow} * \text{Conversion Factor}$$

**Target** = 126 cfu/100 mL or often times 63 cfu/100 mL

**Flow** = full permitted flow (MGD)

**CF** = 37,854,000 mL/MGD

# Future Growth

$$FG = WWTF_{FP} * \text{Pop. Increase} * CF * \text{Target}$$

$WWTF_{FP}$  = Full permitted discharge due to pop. increase

**Pop. Increase** = estimated % population increase

**CF** = 37,854,000 mL/MGD

**Target** = 126 cfu/100 mL or often times 63 cfu/100 mL

# Regulated Storm Loads

$$WLA_{SW} = (TMDL - WLA_{WWTF} - FG - MOS) * FDA_{SWP}$$

$FDA_{SWP}$  = fractional proportion of drainage area under jurisdiction of stormwater permits

# Pollutant Load Allocation Calculations

$LA_{Trib}$  &  $LA_{AU}$ :

$LA_{Trib}$  = TMDL of tributary entering the project watershed

The unregulated loading with the AU ( $LA_{AU}$ ) is calculated as:

$$LA_{AU} = TMDL - \sum WLA_{WWTF} - \sum WLA_{SW} - \sum LA_{Trib} - \sum FG - MOS$$

THANK YOU  
Questions?