Load Duration Curve Results

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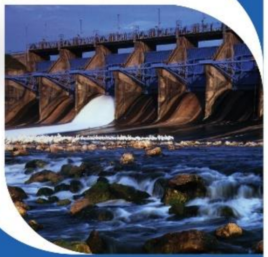
Trinity River Authority

January 11, 2018



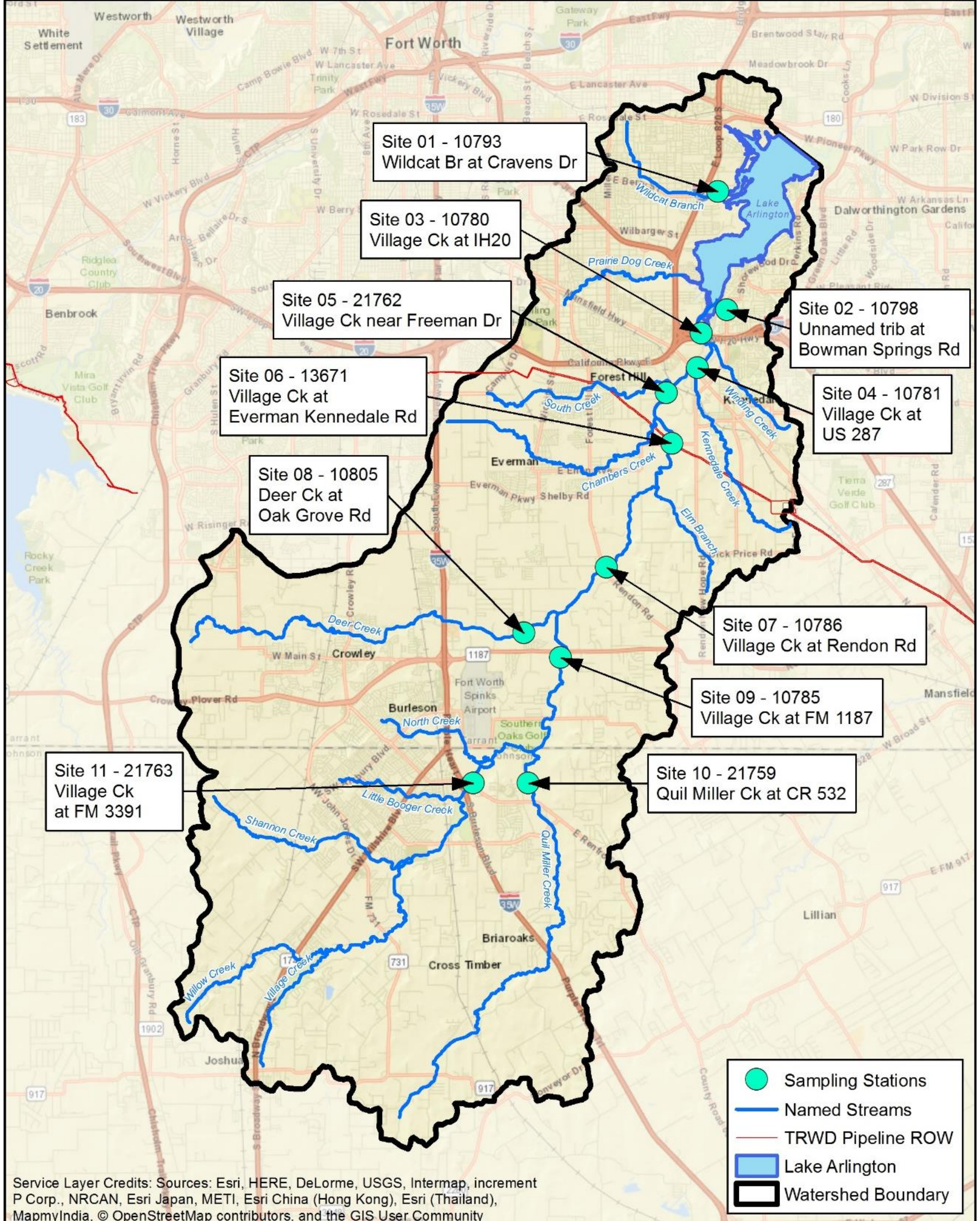
Village Creek Lake Arlington WATERSHED PROTECTION

Trinity River Authority of Texas

Enriching the Trinity basin as a resource for Texans

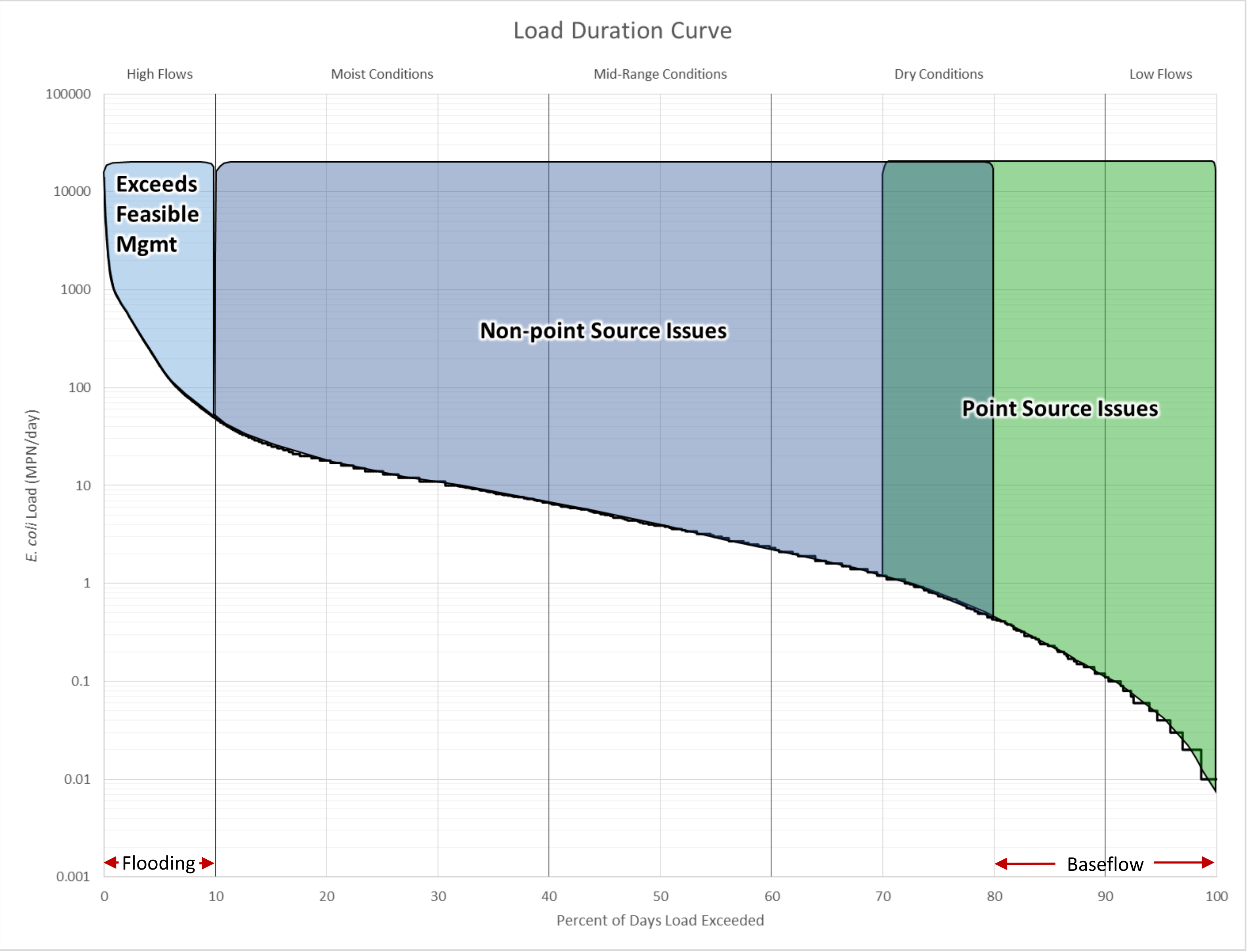
Load Duration Curve (LDC) Analysis

- Water quality data collected from June 2016 – May 2017 used to formulate LDCs
- LDCs calculated at each station for five parameters of interest
- Comparing data within a station
  - How do points compare to the max allowable load?
  - Problems at high flow or low flow?
- Comparing different stations
  - Worth our time to focus on subwatersheds that correspond to specific stations?
  - Substantial increases between two stations?



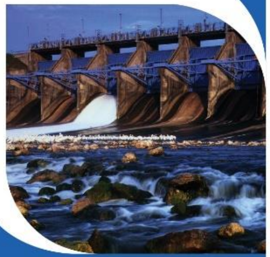
Site 01 - 10793
Wildcat Br at Cravens Dr
Site 02 - 10798
Unnamed trib at Bowman Springs Rd
Site 03 - 10780
Village Ck at IH20
Site 04 - 10781
Village Ck at US 287
Site 05 - 21762
Village Ck near Freeman Dr
Site 06 - 13671
Village Ck at Everman Kennedale Rd
Site 07 - 10786
Village Ck at Rendon Rd
Site 08 - 10805
Deer Ck at Oak Grove Rd
Site 09 - 10785
Village Ck at FM 1187
Site 10 - 21759
Quil Miller Ck at CR 532
Site 11 - 21763
Village Ck at FM 3391
Sampling Stations
Named Streams
TRWD Pipeline ROW
Lake Arlington
Watershed Boundary
Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

What does an LDC graph tell me?

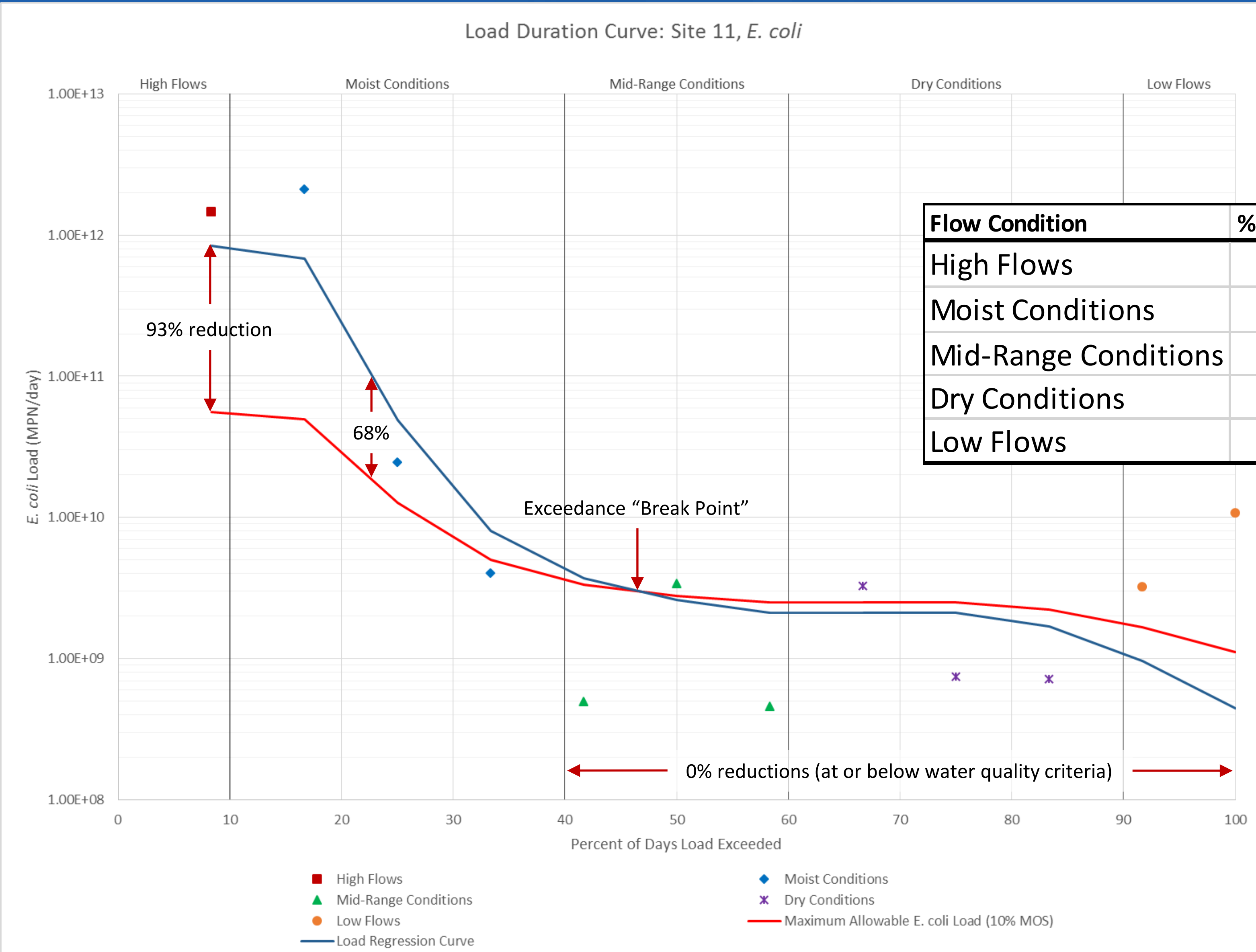


Regions of likely pollutant sources along load duration curve (log scale Y-axis, normal scale X-axis).

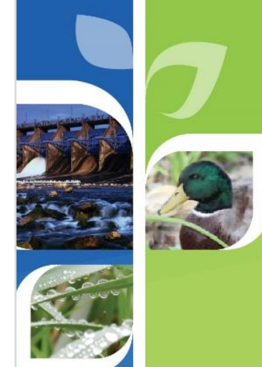
Bacteria - *E. coli*



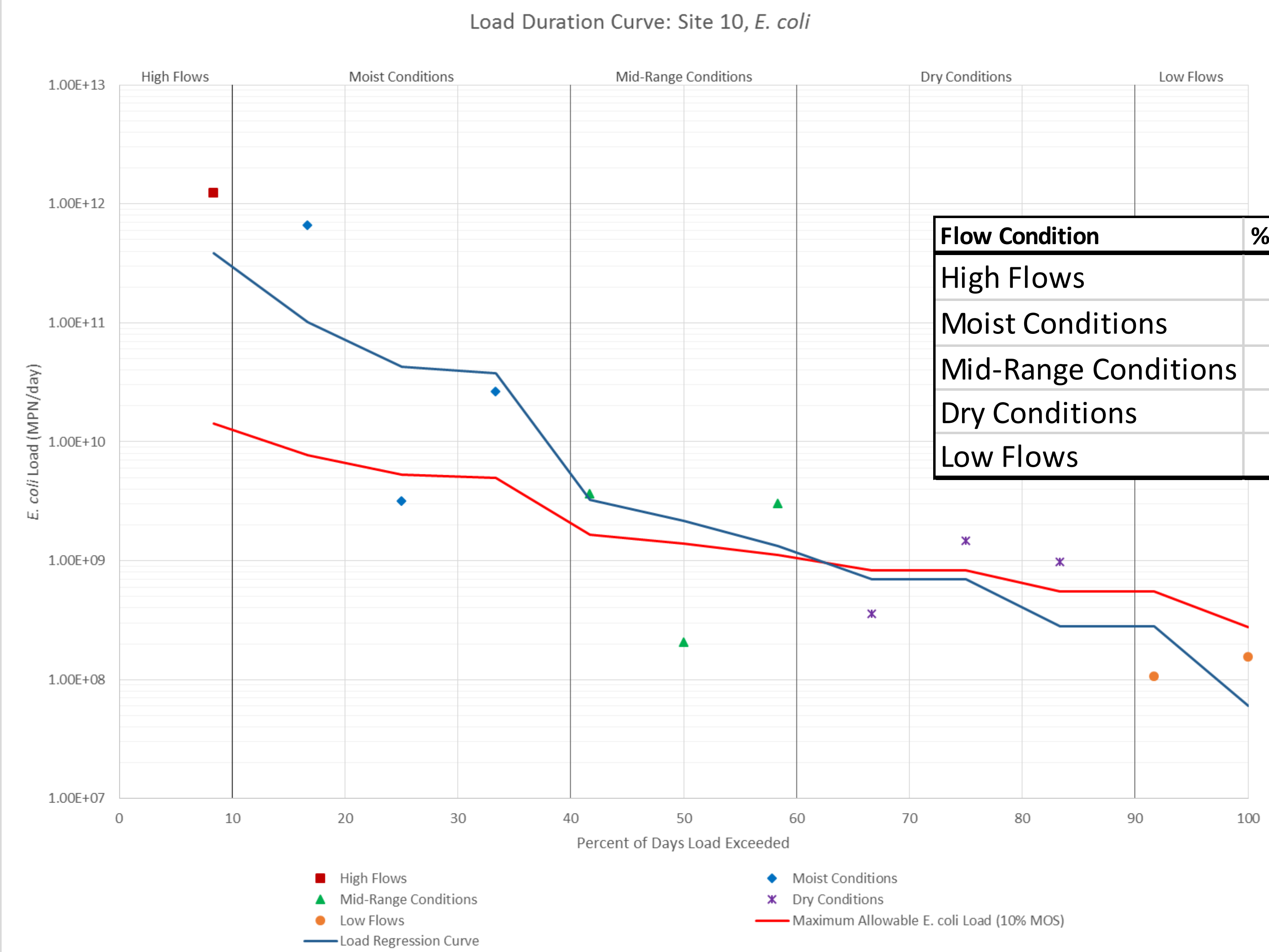
VC11 – VC at Renfro Rd (FM 3391)



Flow Condition	% Exceedance	% Reduction
High Flows	0-10%	93
Moist Conditions	10-40%	68
Mid-Range Conditions	40-60%	0
Dry Conditions	60-90%	0
Low Flows	90-100%	0

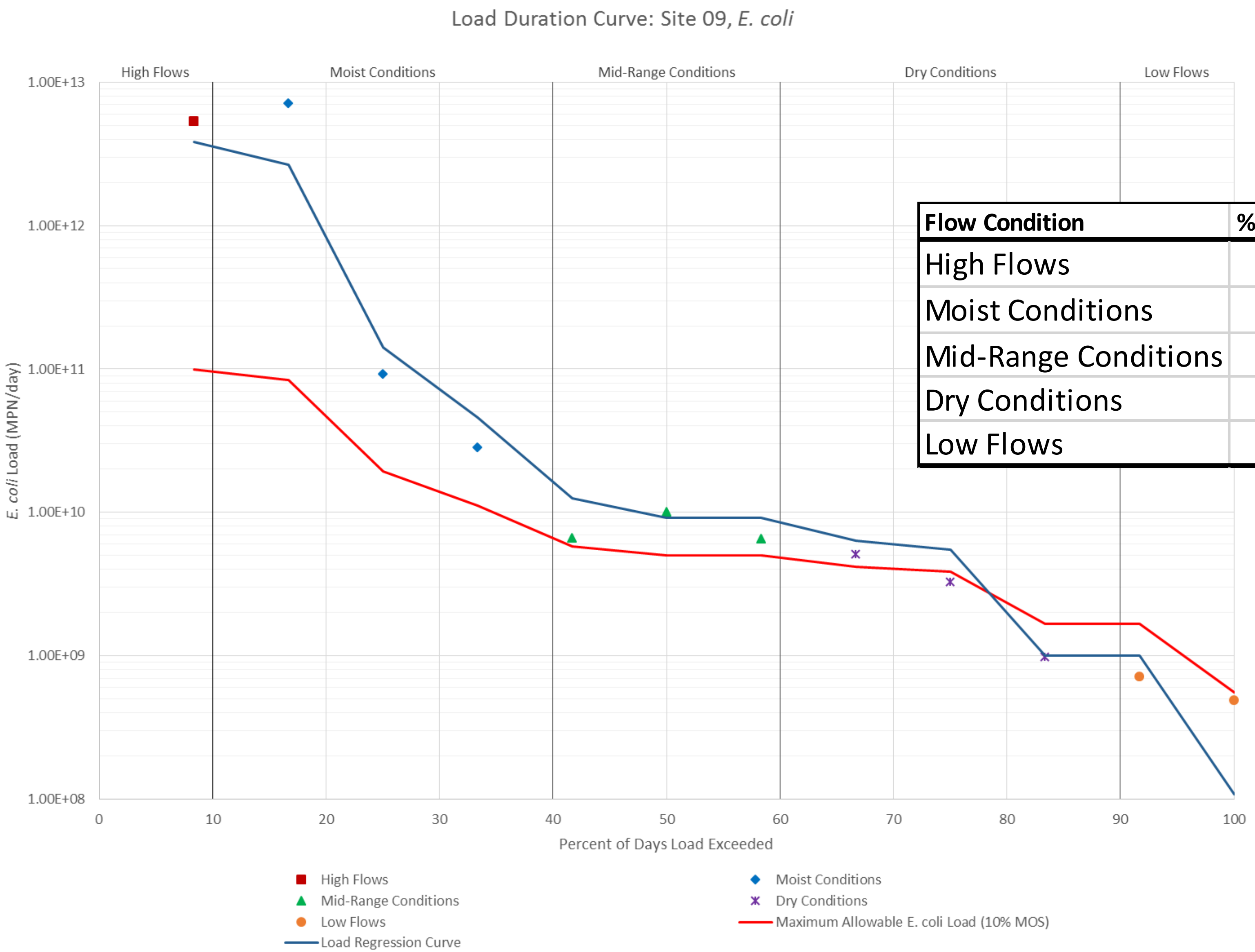


VC10 – Quil Miller at CR 532



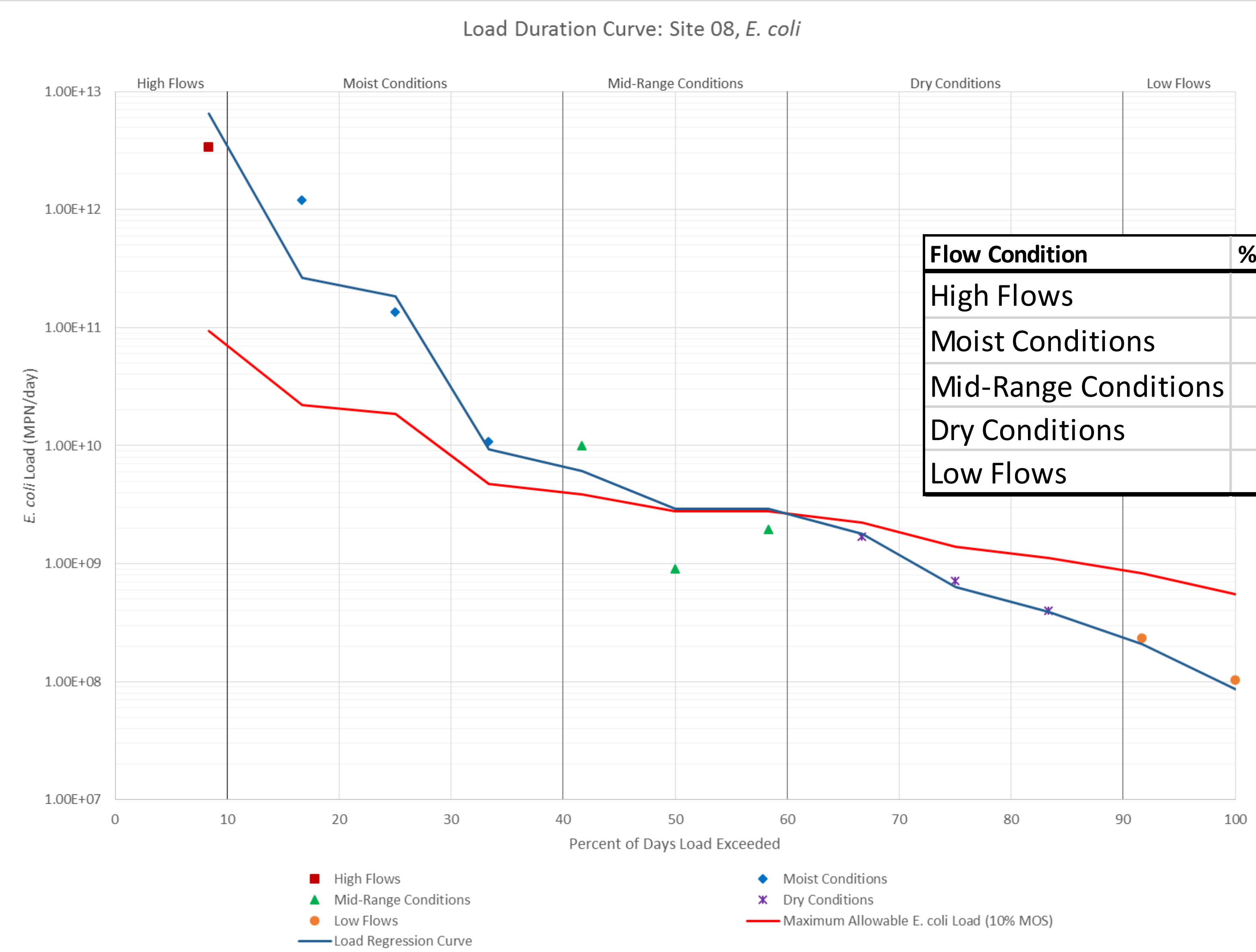
Flow Condition	% Exceedance	% Reduction
High Flows	0-10%	96
Moist Conditions	10-40%	89
Mid-Range Conditions	40-60%	34
Dry Conditions	60-90%	0
Low Flows	90-100%	0

VC09 – VC at FM 1187



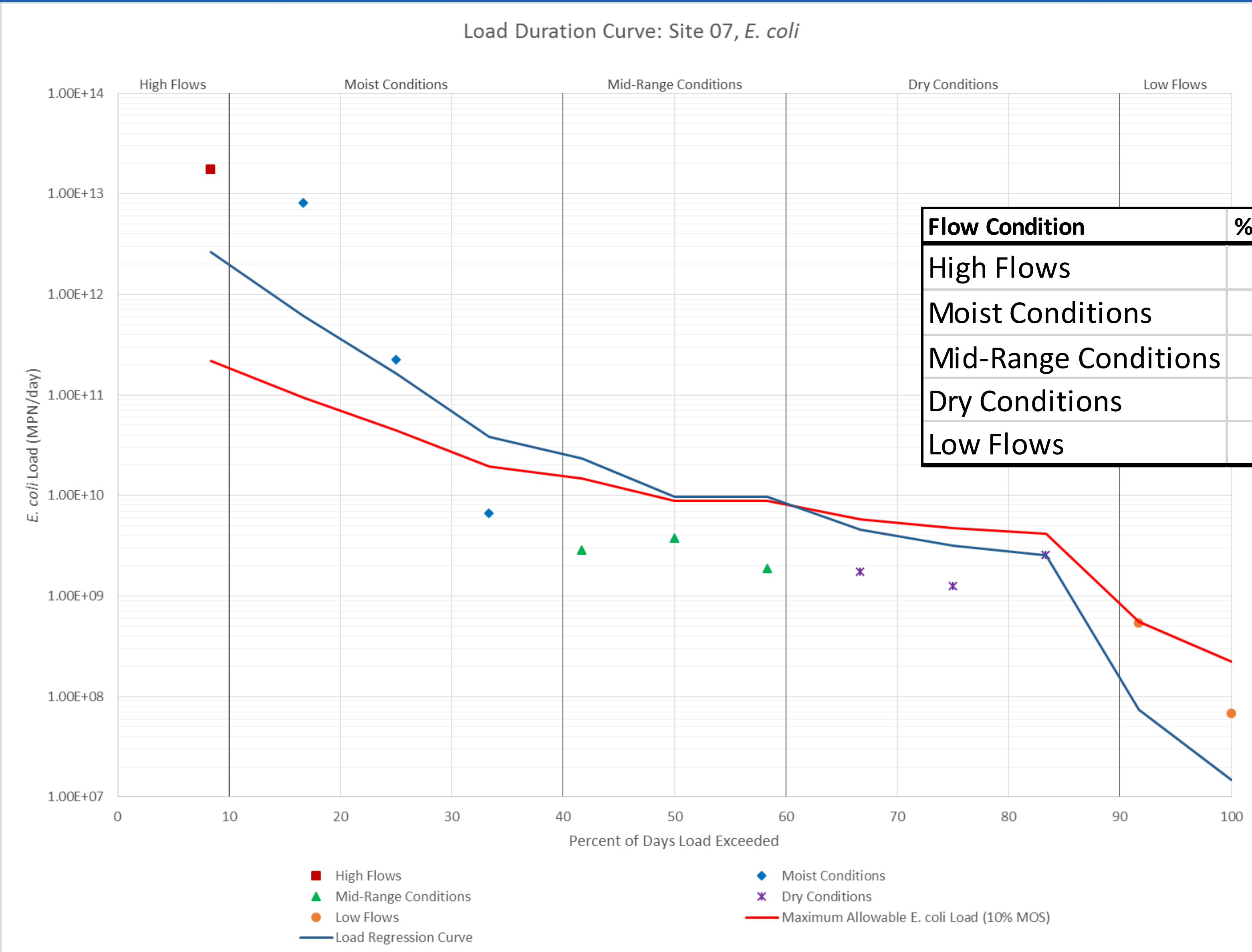
Flow Condition	% Exceedance	% Reduction
High Flows	0-10%	97
Moist Conditions	10-40%	86
Mid-Range Conditions	40-60%	48
Dry Conditions	60-90%	0
Low Flows	90-100%	0

VC08 – Deer Creek at Oak Grove Rd



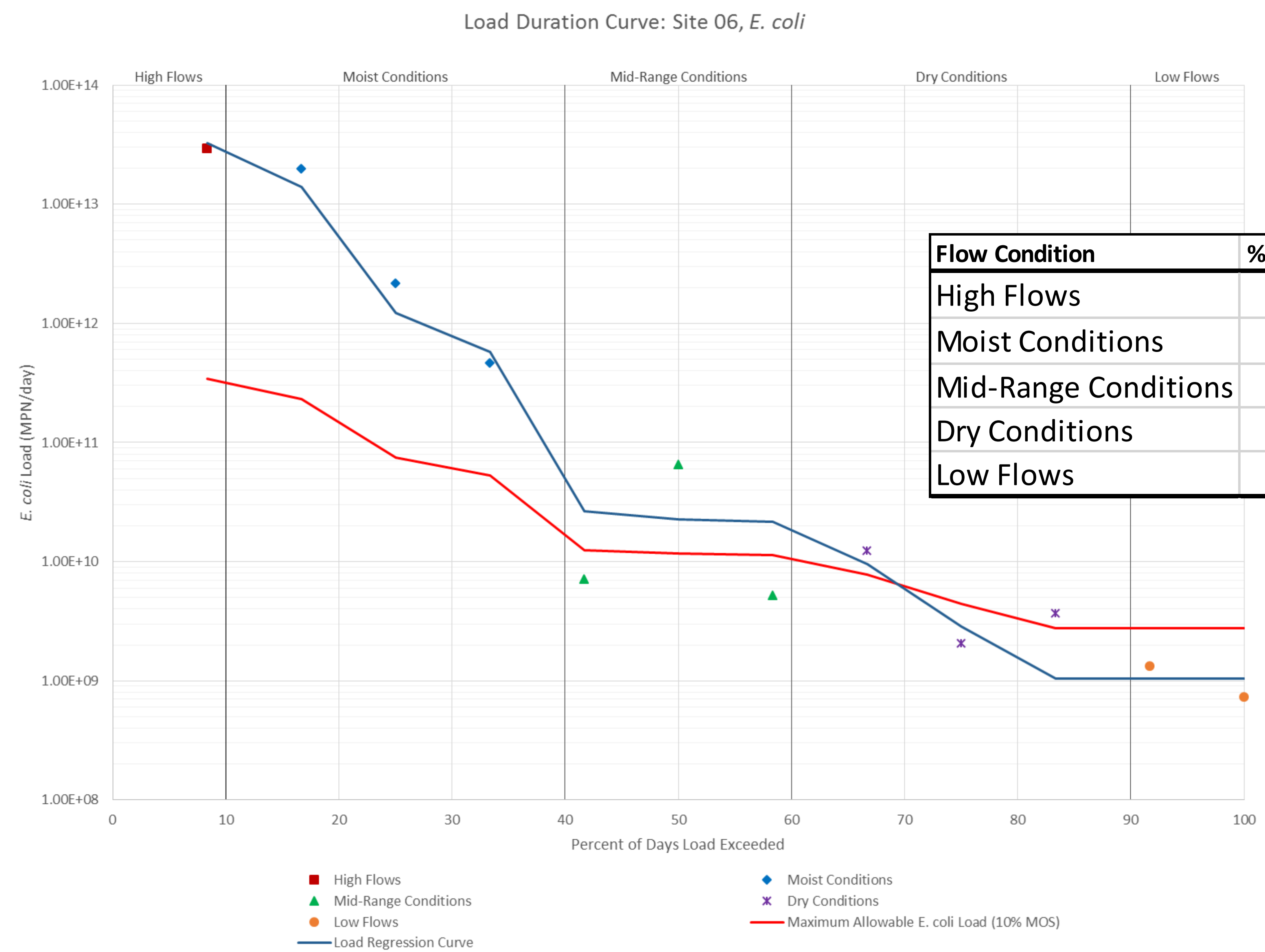
Flow Condition	% Exceedance	% Reduction
High Flows	0-10%	99
Moist Conditions	10-40%	77
Mid-Range Conditions	40-60%	15
Dry Conditions	60-90%	0
Low Flows	90-100%	0

VC07 – VC at Rendon Rd

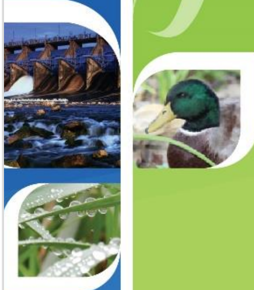


Flow Condition	% Exceedance	% Reduction
High Flows	0-10%	92
Moist Conditions	10-40%	69
Mid-Range Conditions	40-60%	18
Dry Conditions	60-90%	0
Low Flows	90-100%	0

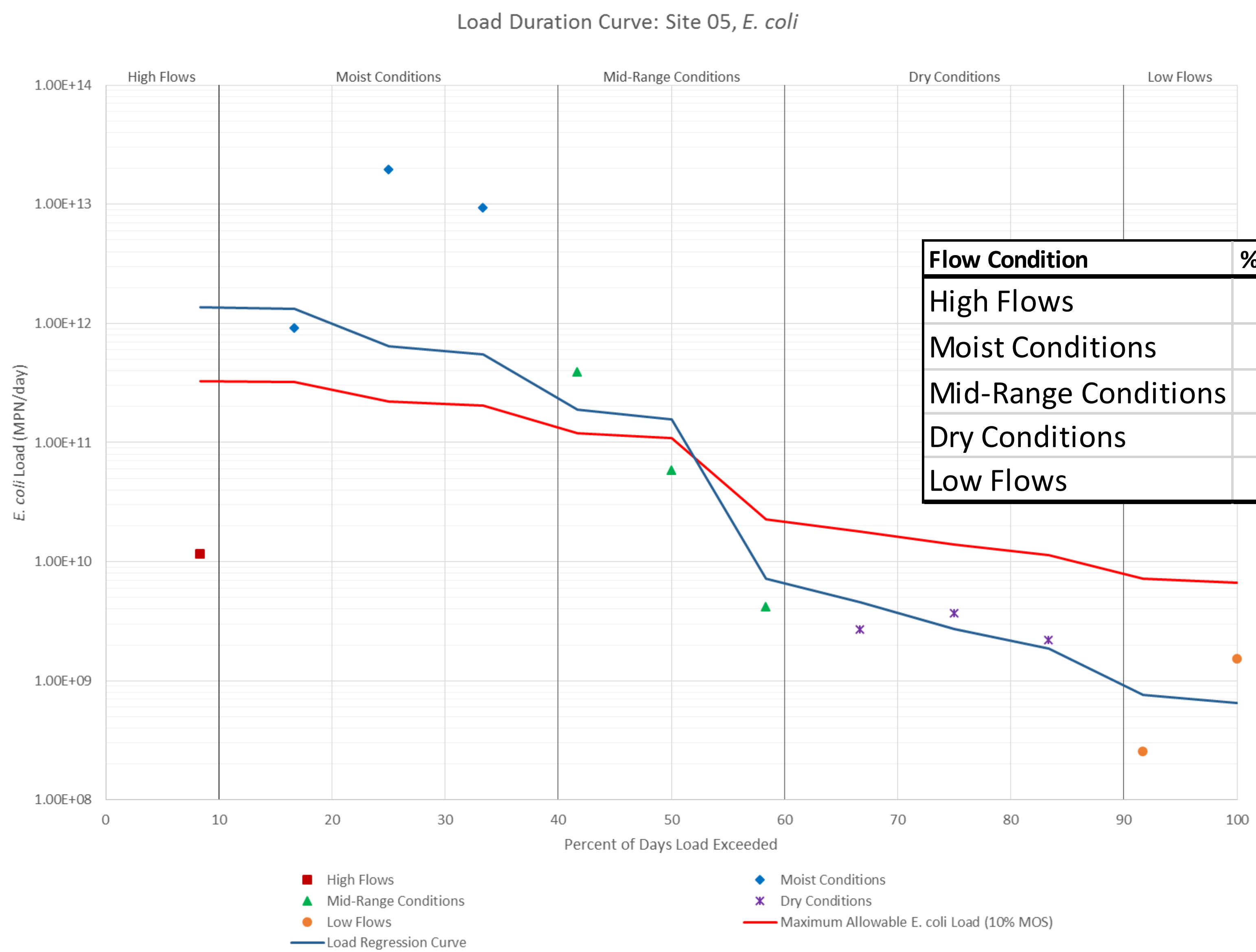
VC06 – VC at Everman-Kennedale Rd



Flow Condition	% Exceedance	% Reduction
High Flows	0-10%	99
Moist Conditions	10-40%	94
Mid-Range Conditions	40-60%	50
Dry Conditions	60-90%	0
Low Flows	90-100%	0

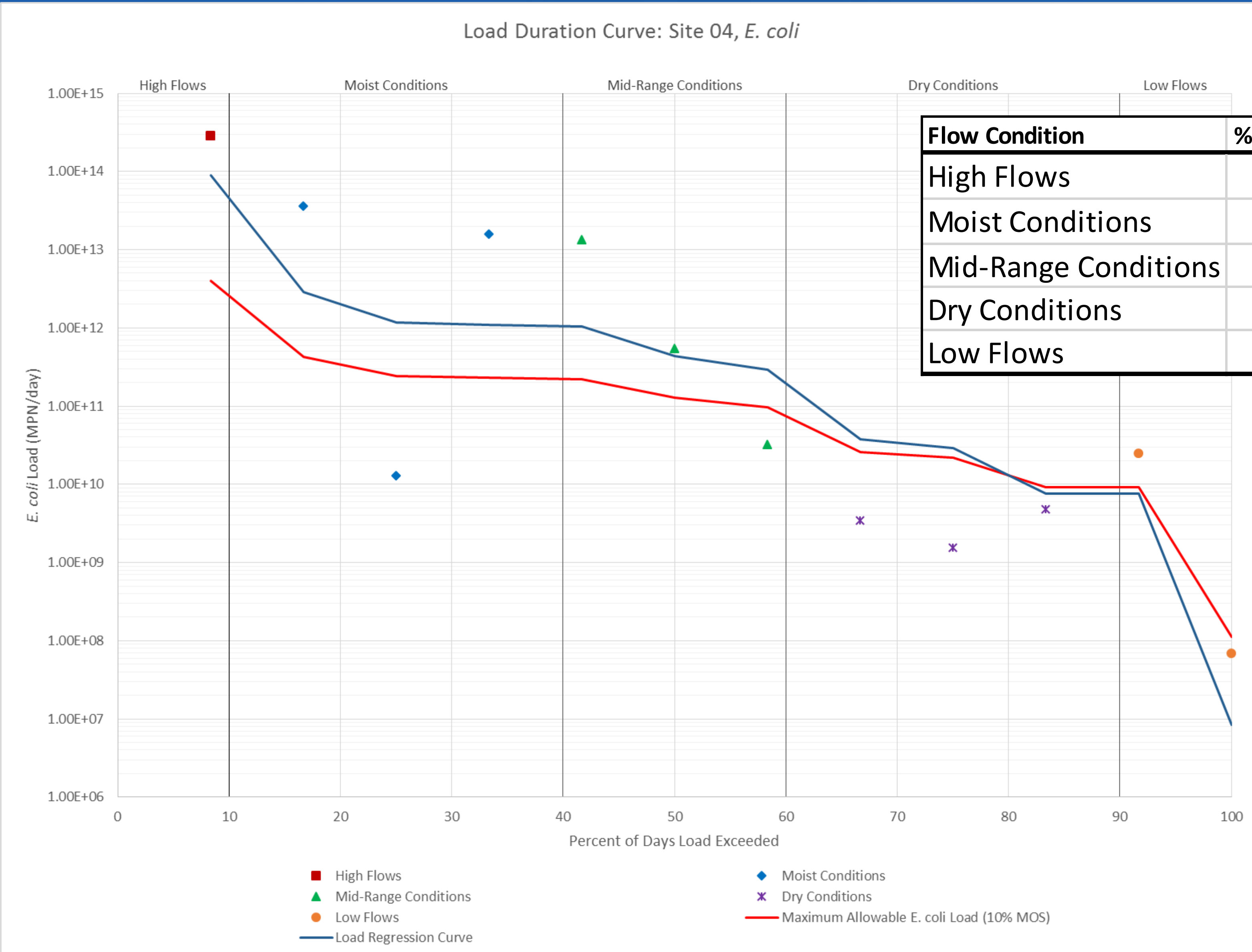


VC05 – VC near Enon Rd



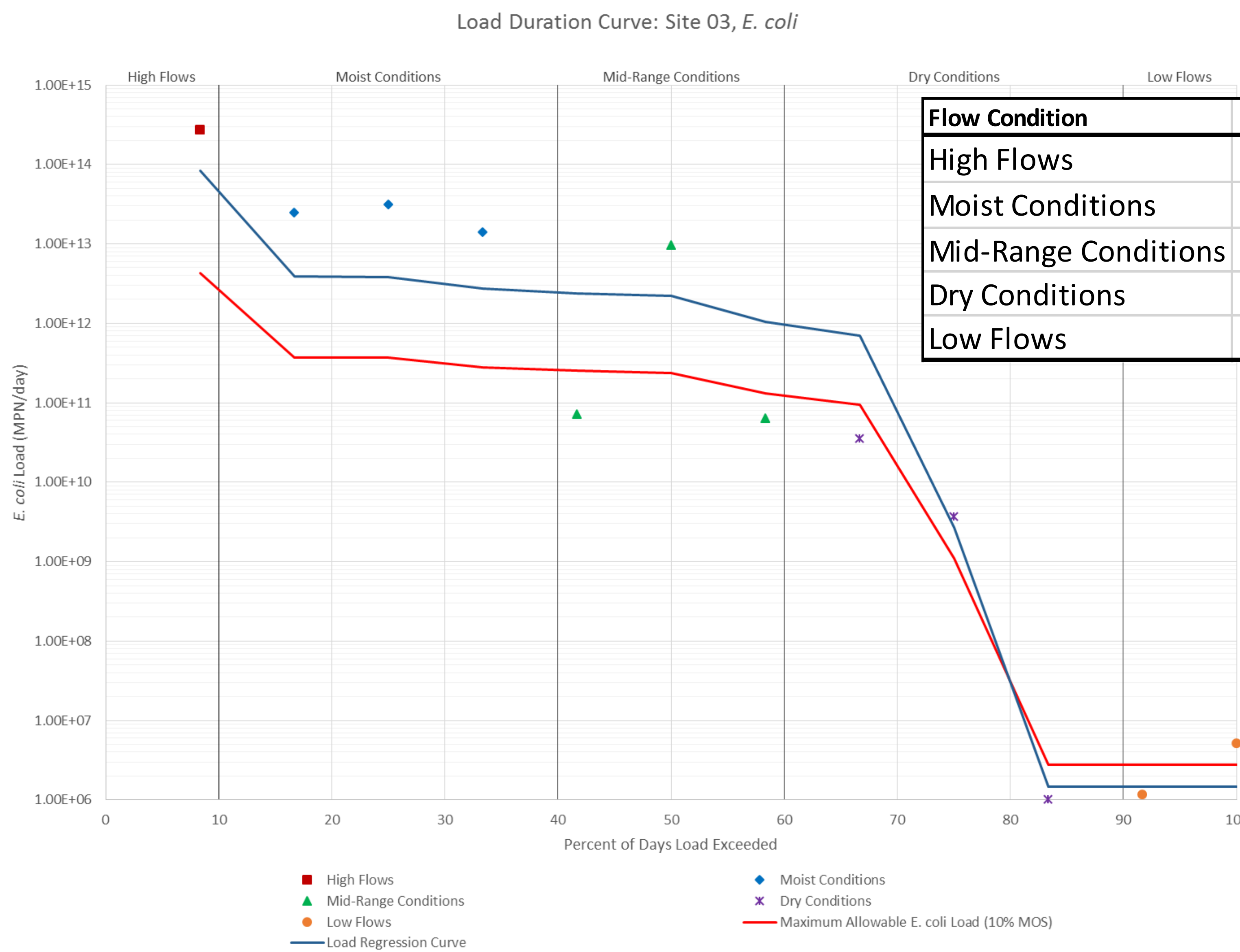
Flow Condition	% Exceedance	% Reduction
High Flows	0-10%	76
Moist Conditions	10-40%	68
Mid-Range Conditions	40-60%	0
Dry Conditions	60-90%	0
Low Flows	90-100%	0

VC04 – VC at US-287 BUS

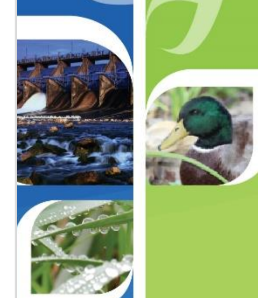


Flow Condition	% Exceedance	% Reduction
High Flows	0-10%	96
Moist Conditions	10-40%	81
Mid-Range Conditions	40-60%	72
Dry Conditions	60-90%	12
Low Flows	90-100%	0

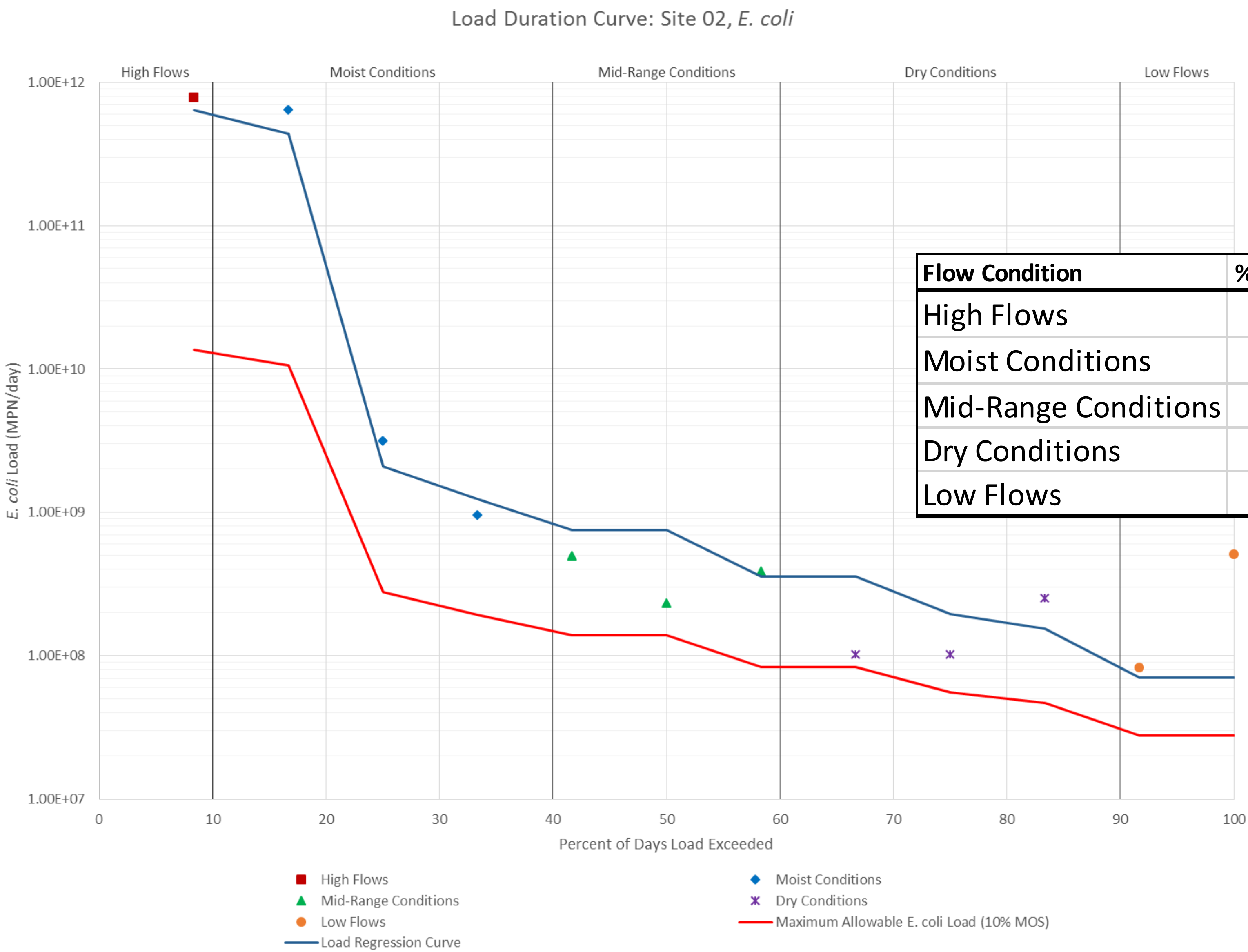
VC03 – VC at I-20



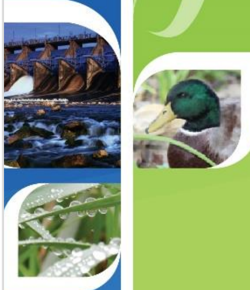
Flow Condition	% Exceedance	% Reduction
High Flows	0-10%	95
Moist Conditions	10-40%	90
Mid-Range Conditions	40-60%	89
Dry Conditions	60-90%	18
Low Flows	90-100%	0



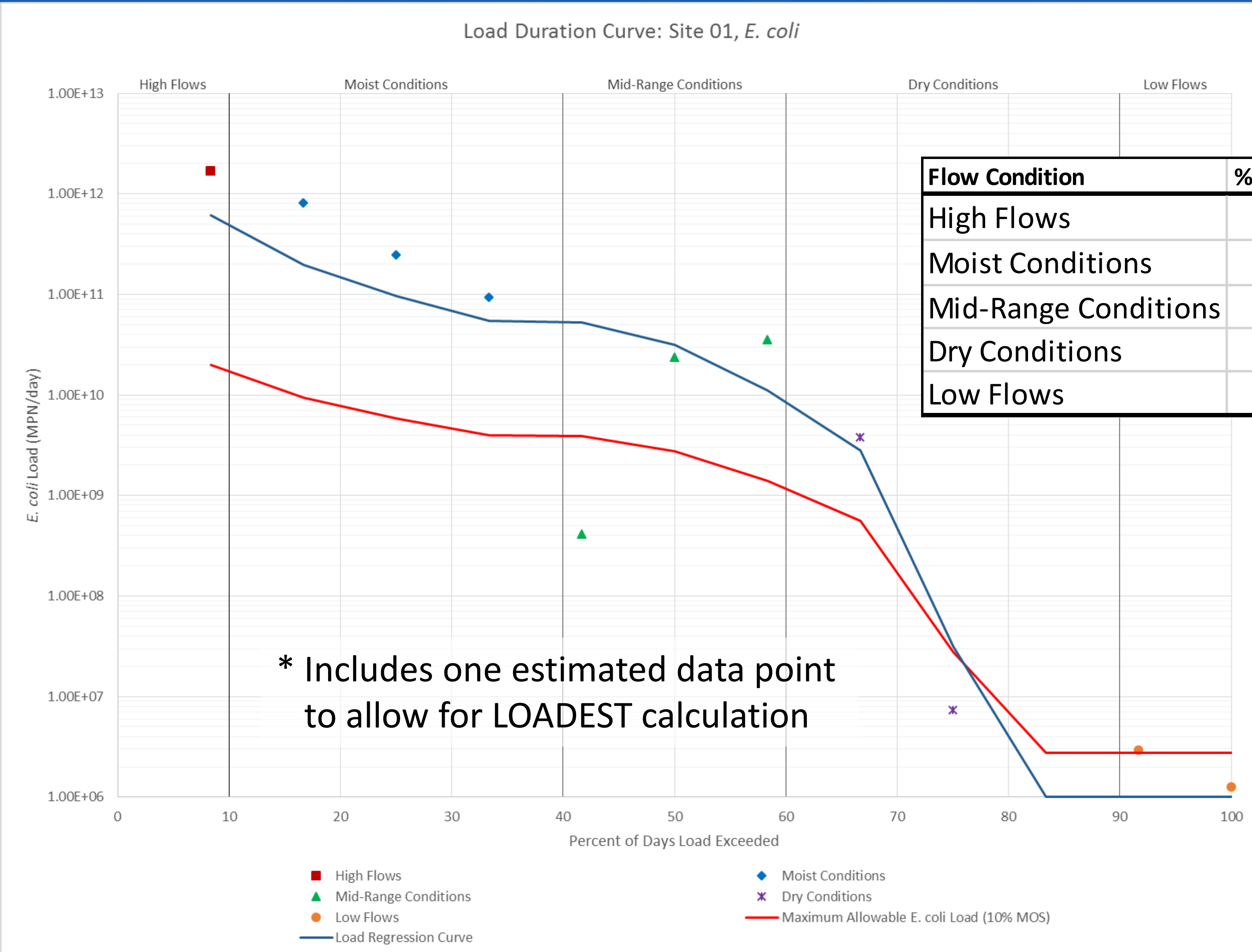
VC02 – Tributary at Bowman Springs



Flow Condition	% Exceedance	% Reduction
High Flows	0-10%	98
Moist Conditions	10-40%	90
Mid-Range Conditions	40-60%	80
Dry Conditions	60-90%	73
Low Flows	90-100%	61

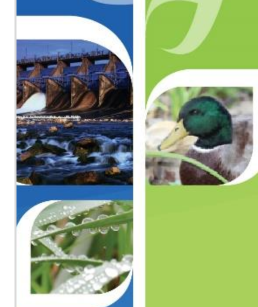


VC01 – Wildcat Branch at Cravens*

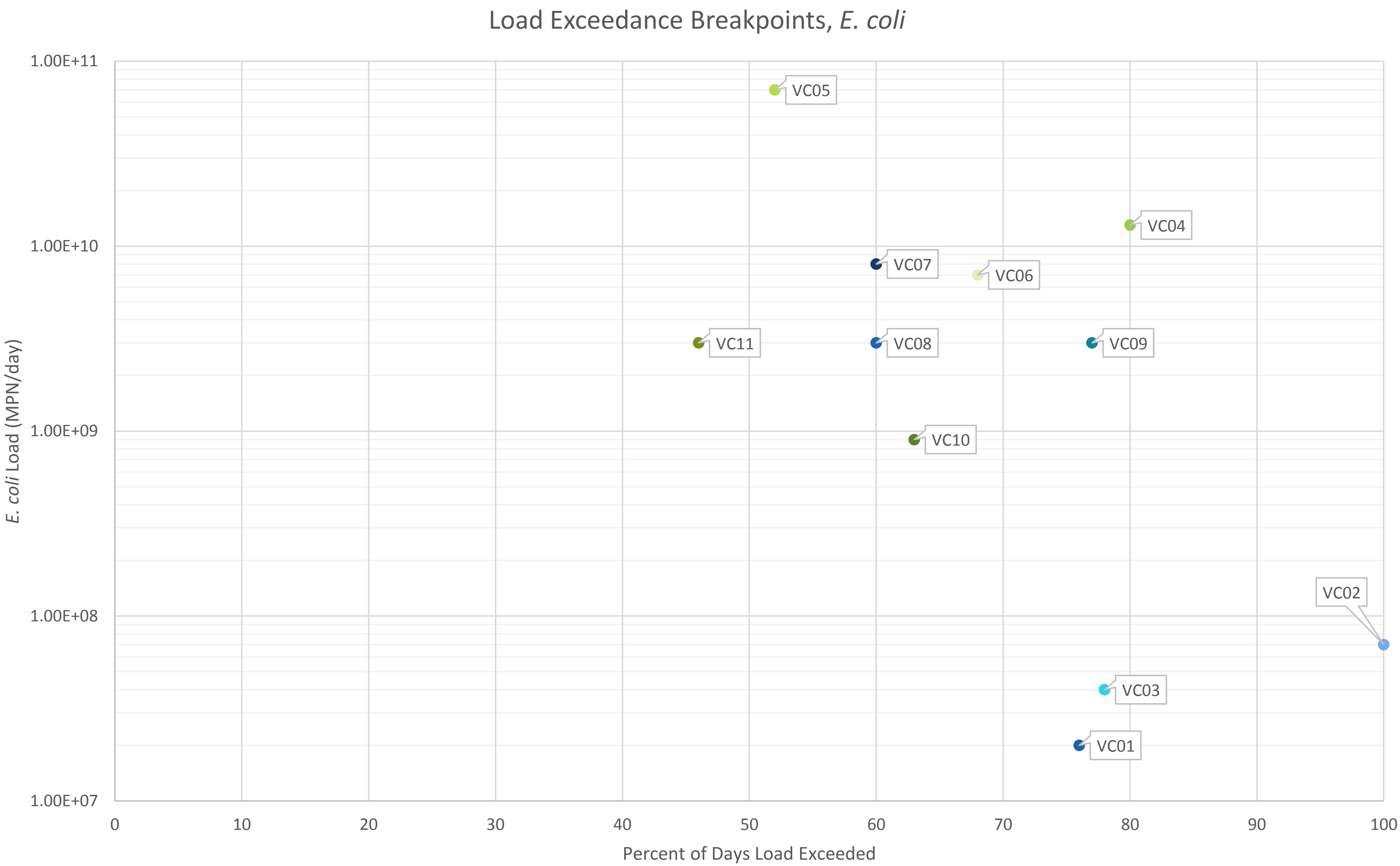


Flow Condition	% Exceedance	% Reduction
High Flows	0-10%	97
Moist Conditions	10-40%	94
Mid-Range Conditions	40-60%	90
Dry Conditions	60-90%	0
Low Flows	90-100%	0

* Includes one estimated data point to allow for LOADEST calculation



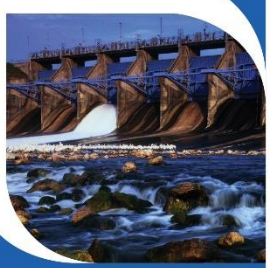
Load Exceedance Breakpoints for *E. coli*



Conclusions (so far)

- Non-point sources (stormwater inflows) dominant in upper reaches, VC06 – VC11
- Dilution from TRWD outfall a factor at VC05 – short-term *E. coli* decrease
- Confounding variable at VC01, VC03, and possibly VC04:
  - lake influence, or “backwater conditions”
- Very likely influence from point sources at VC02

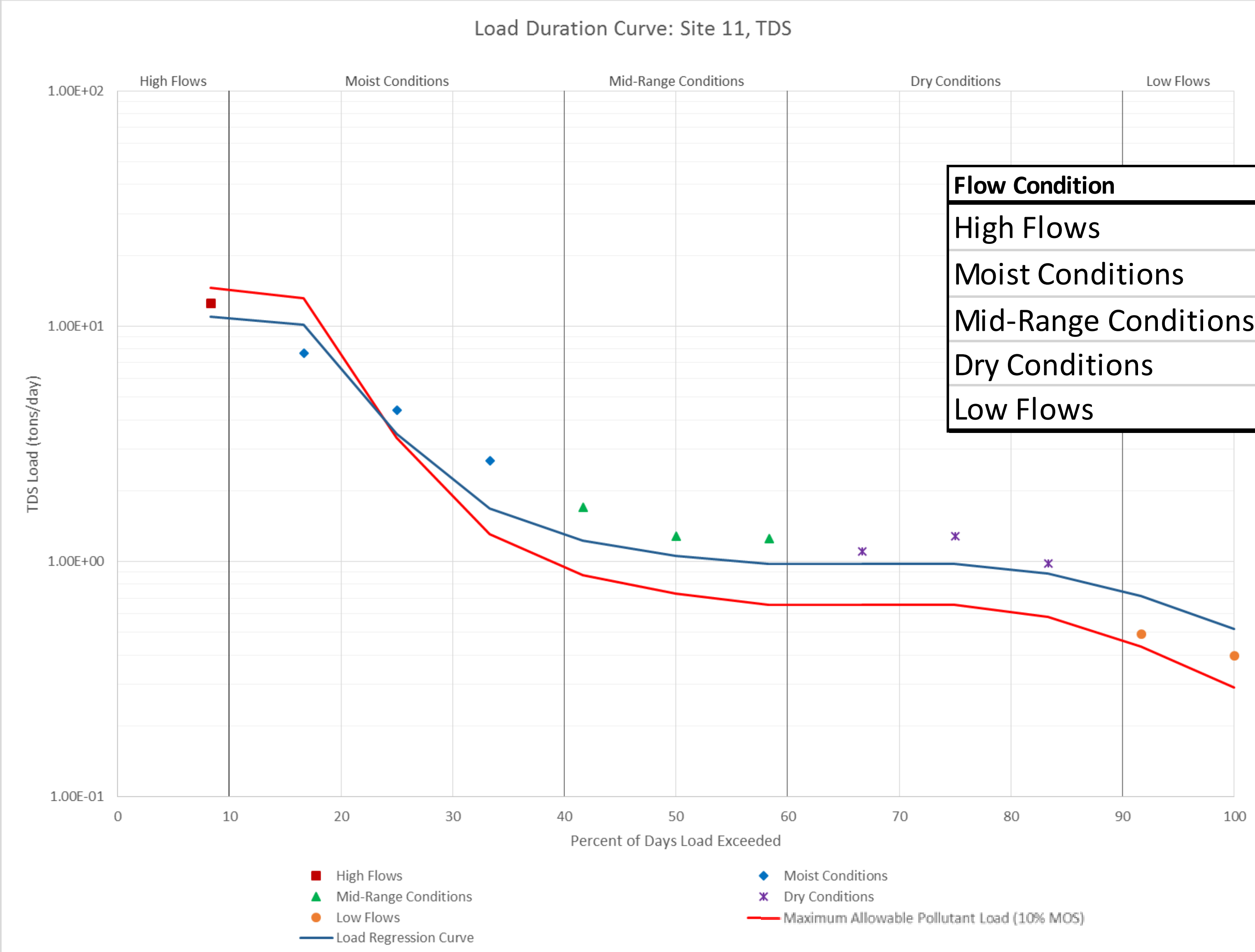
Total Dissolved Solids (TDS)



TDS in Water Quality

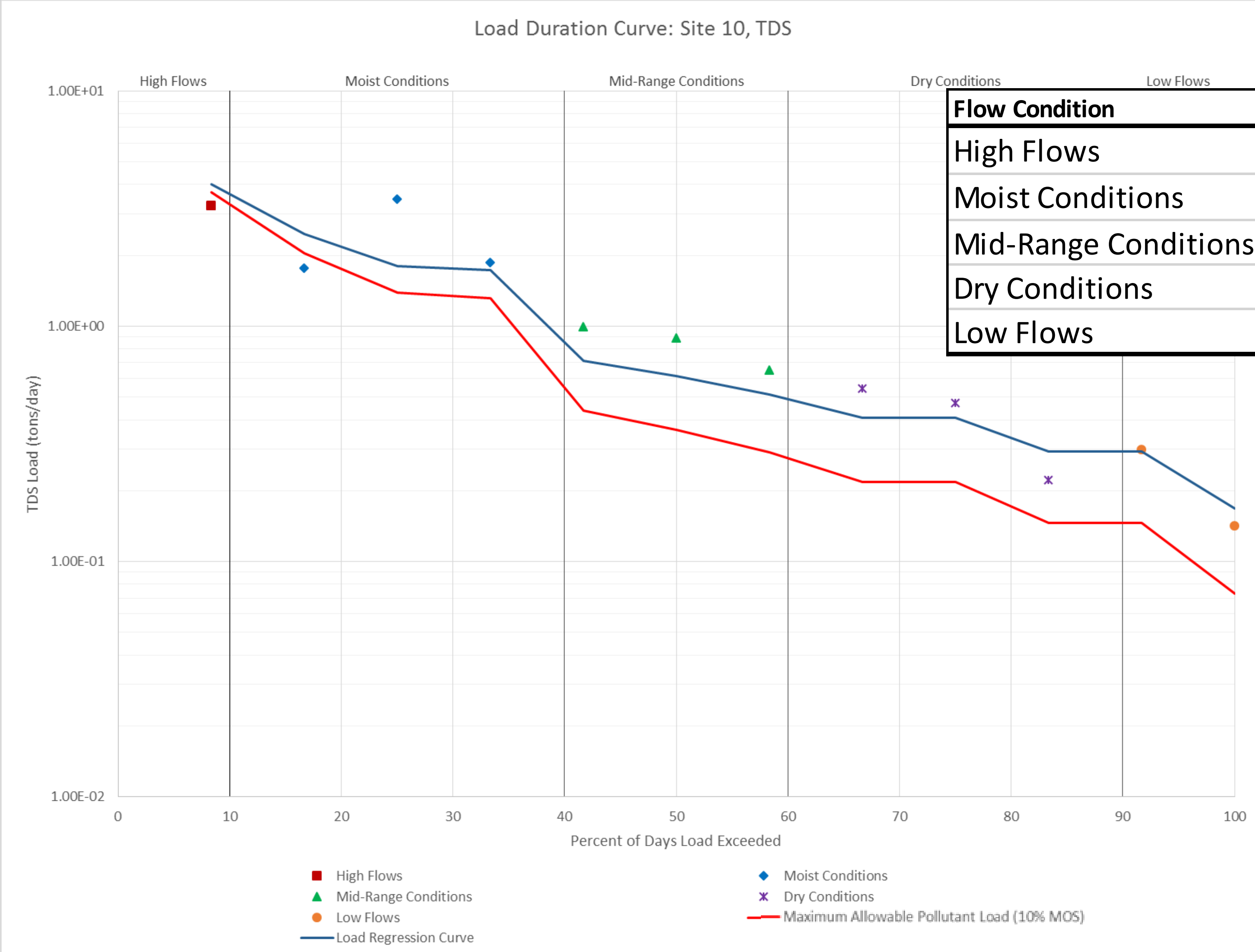
- TCEQ water quality criterion: 300 mg/L
- What do TDS levels tell us?
  - Rough indicator of potential problems with other dissolved salts (nitrates, sodium, sulfates, copper, cadmium, fluoride)
    - Corrosivity (chlorides – think Flint, Michigan)
- High TDS in finished drinking water:
  - Taste/odor issues (carbonates, chlorides)
  - Always asking yourself, “Why am I still thirsty?”
  - Long term – kidney stones, stiff joints, hardened arteries
- Common sources: everything!

VC11 – VC at Renfro Rd (FM 3391)



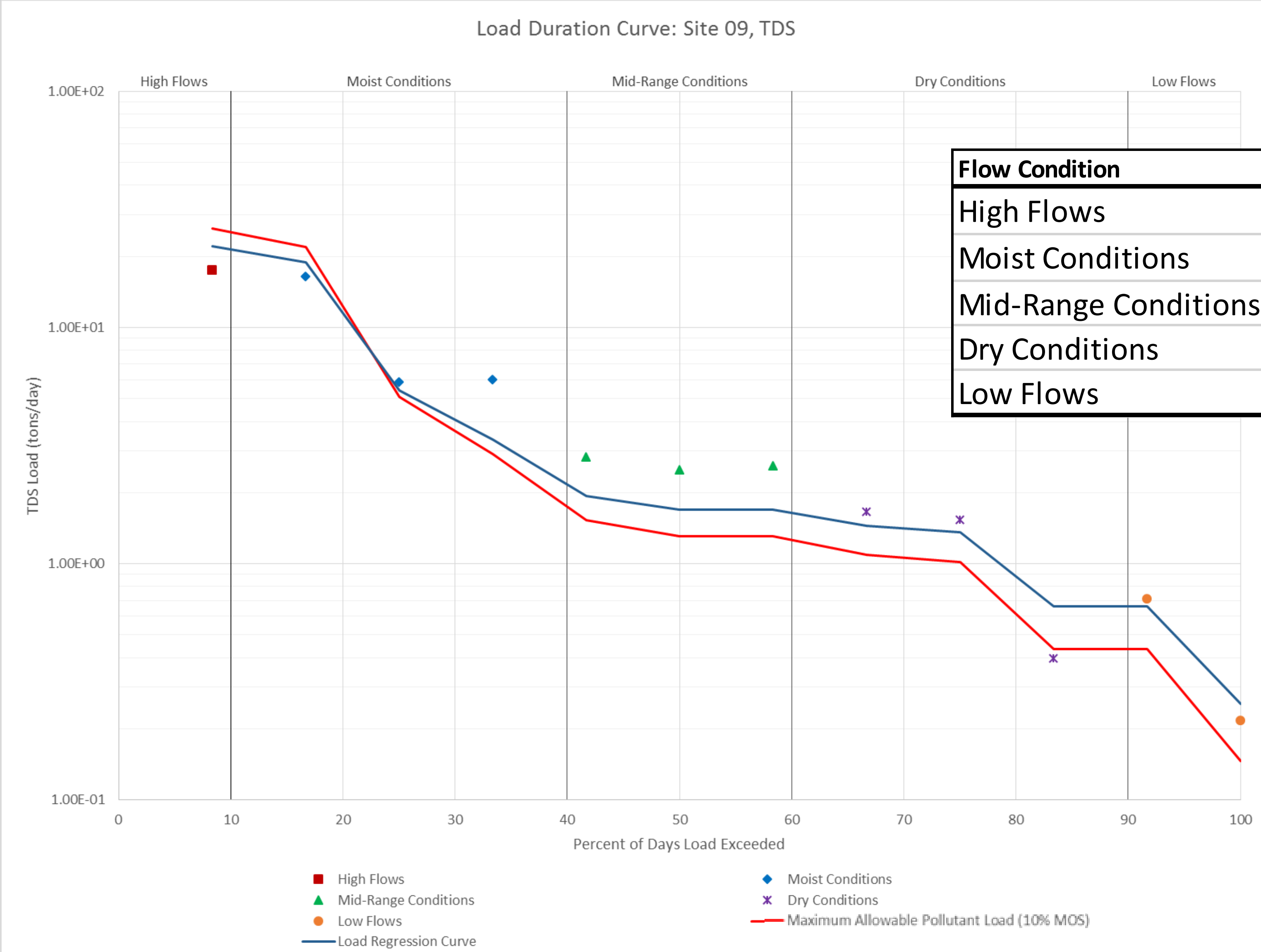
Flow Condition	% Exceedance	% Reduction
High Flows	0-10%	0
Moist Conditions	10-40%	0
Mid-Range Conditions	40-60%	31
Dry Conditions	60-90%	33
Low Flows	90-100%	41

VC10 – Quil Miller at CR 532

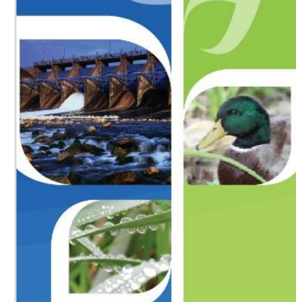


Flow Condition	% Exceedance	% Reduction
High Flows	0-10%	7
Moist Conditions	10-40%	21
Mid-Range Conditions	40-60%	41
Dry Conditions	60-90%	48
Low Flows	90-100%	53

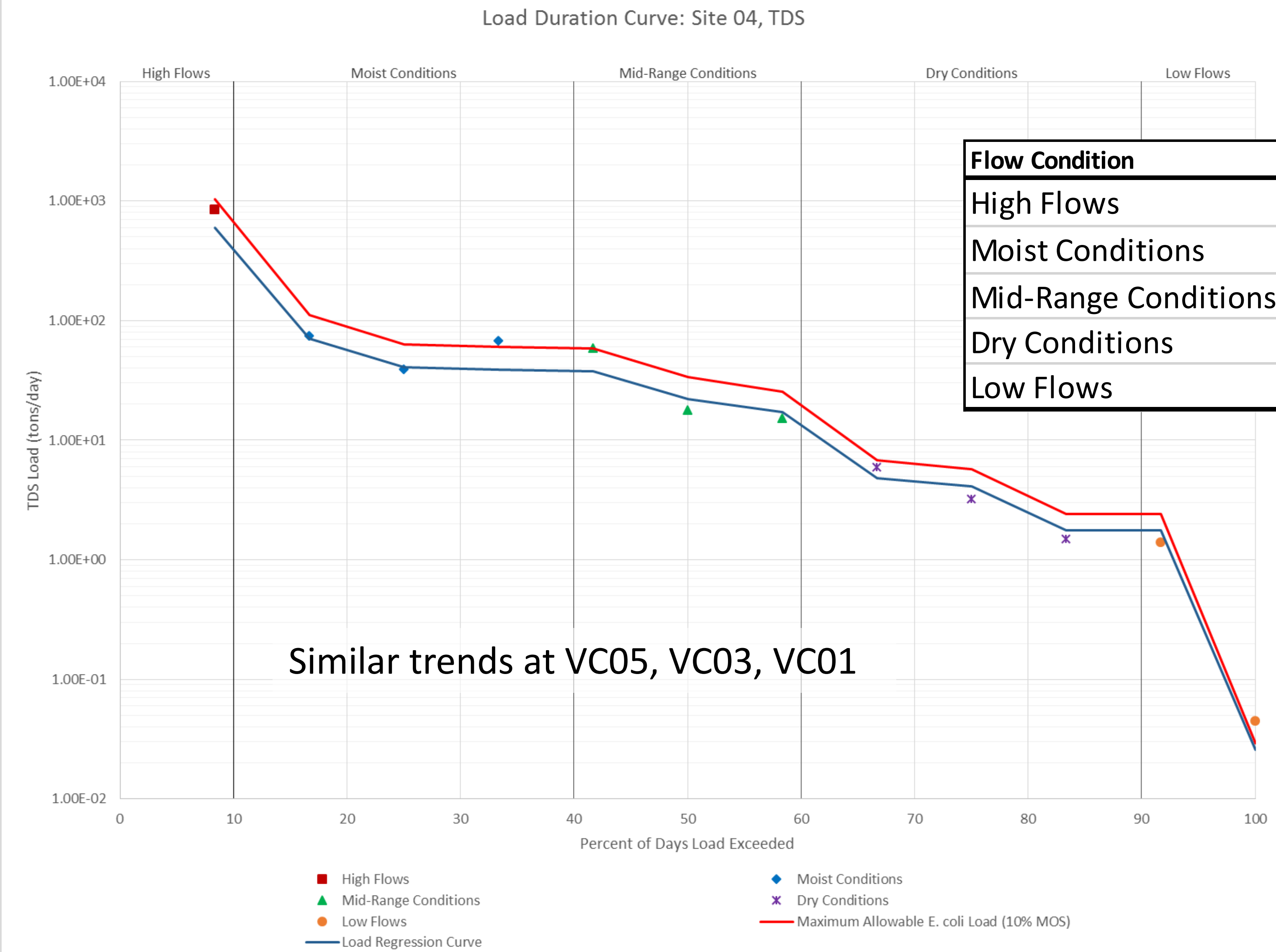
VC09 – VC at FM 1187



Flow Condition	% Exceedance	% Reduction
High Flows	0-10%	0
Moist Conditions	10-40%	1
Mid-Range Conditions	40-60%	22
Dry Conditions	60-90%	28
Low Flows	90-100%	38

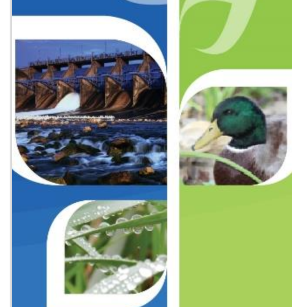


VC04 – VC at US-287 BUS

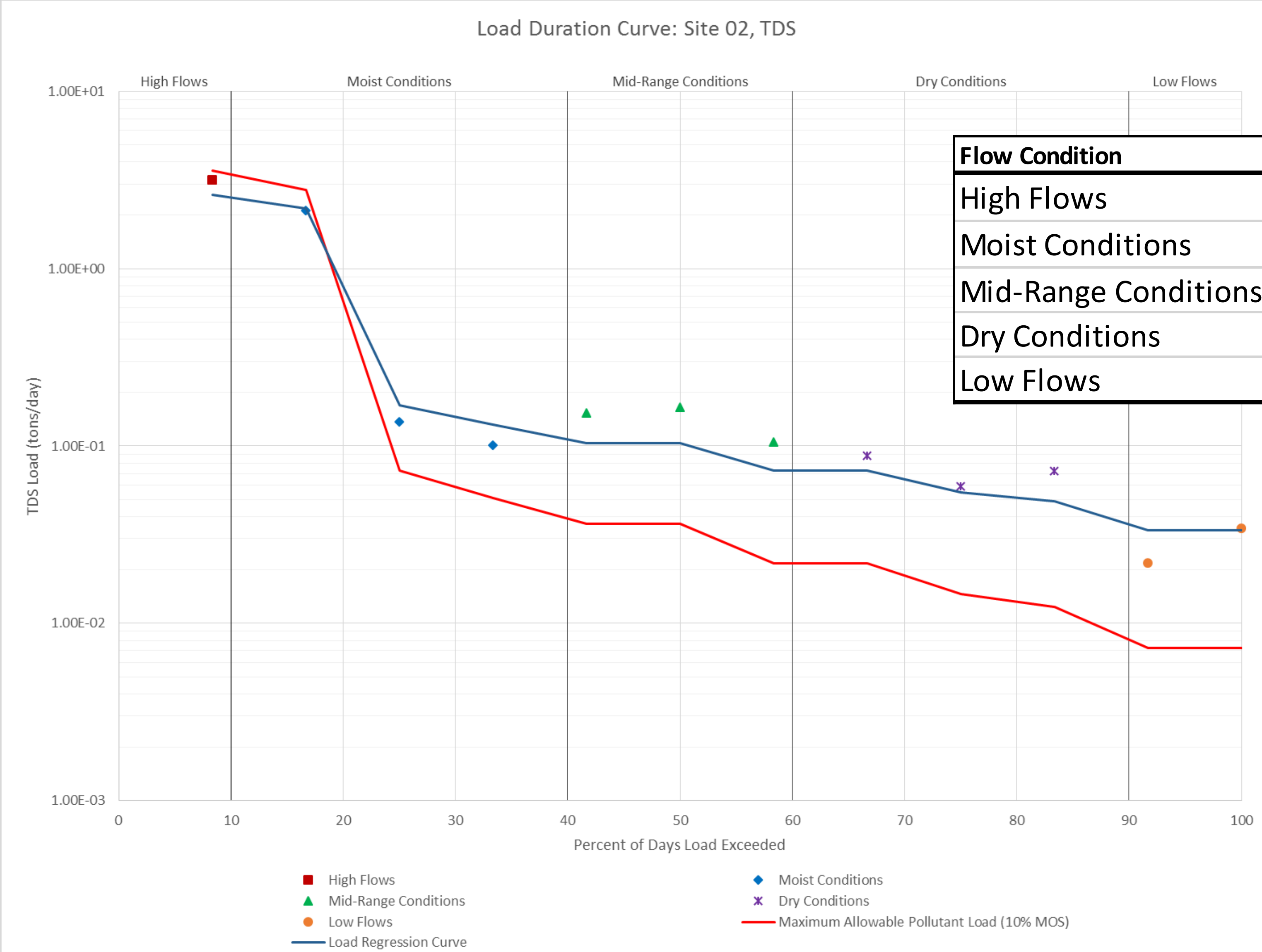


Flow Condition	% Exceedance	% Reduction
High Flows	0-10%	0
Moist Conditions	10-40%	0
Mid-Range Conditions	40-60%	0
Dry Conditions	60-90%	0
Low Flows	90-100%	0

Similar trends at VC05, VC03, VC01



VC02 – Tributary at Bowman Springs

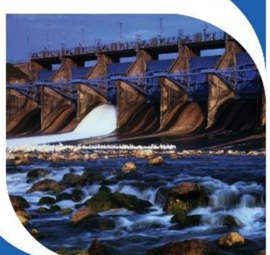


Flow Condition	% Exceedance	% Reduction
High Flows	0-10%	0
Moist Conditions	10-40%	31
Mid-Range Conditions	40-60%	67
Dry Conditions	60-90%	73
Low Flows	90-100%	78

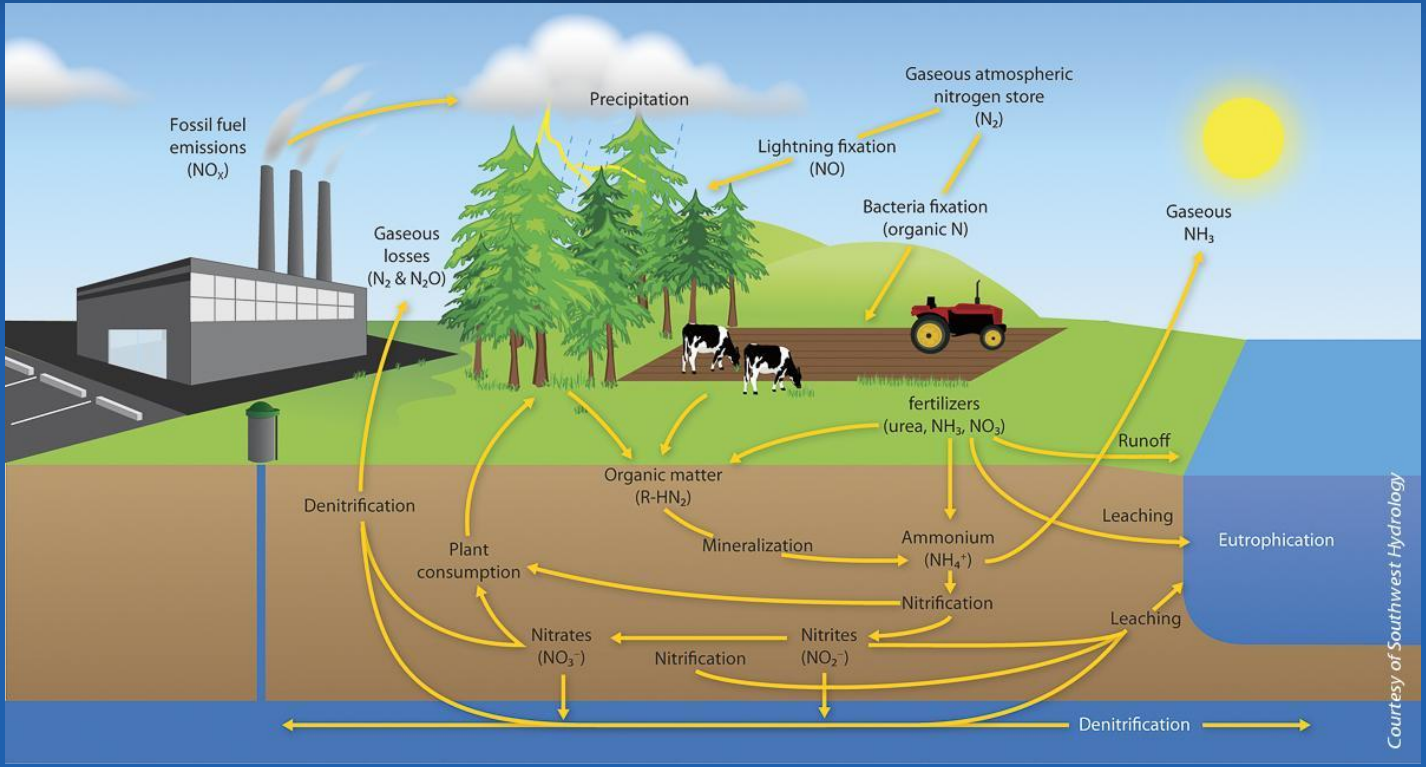
Conclusions (so far)

- Almost anything can be a TDS source
- Management measures tough to pin down
- So how is this useful?
  - TDS LDCs best used as additional guidance when analyzing other pollutants
  - “Do TDS trends behave differently than expected?”
- Example: VC02
  - Load regression curve drifts further away from max allowable load curve as conditions get dryer
  - Another indicator for a point source issue

Nitrate (NO_3)



Nitrate in Water Quality



- TCEQ nutrient screening level in streams: 1.95 mg/L
- Common source – lawn/crop fertilizers
- Health issues in finished drinking water
  - “Blue Baby Syndrome” (methemoglobinemia)
- Environmental - lakes
  - Algal bloom/bust → oxygen depletion → fish kills

Fish Kills & Algal Blooms

factors contributing to fish kills

Low dissolved oxygen
due to oxygen consumption associated with algal blooms, chemical demands, or poor mixing.

Algal toxins
toxins produced by some species, under certain conditions

Contaminants
eg. hydrogen sulfide, carbon dioxide, ammonia, methane and other contaminants (e.g. metals)

Physical irritants
suspended sediment, algal cells and bacteria interfere with fish gills

factors contributing to algal blooms

Nutrients
food for algae; sources can be natural or include rural and urban inputs

Water temperature
higher temperatures promote growth and thus proliferation of algae

Reduced flushing
Nutrients more commonly accumulate in poorly flushed or mixed areas

COMMON LOCATIONS OF BLOOMS & FISH KILLS

- In depositional areas (poorly flushed), e.g. lower catchments and near barriers
- In conjunction with salt wedge (due to low oxygen condition at bottom)
- In urbanised or rural catchments

COMMON TIMES FOR BLOOMS & FISH KILLS

- Spikes in nutrients (food for algae) and other contaminants often occur following rainfall (typically first flows of season). Flow stirs up sediment and washes contaminants in from the catchment
- Summer is a common period as higher temperatures increase growth rate of phytoplankton and bacteria

BARRIERS TO FLOW

- Barriers to flow create areas where organic material and nutrients accumulate (deposition areas)
- Barriers can also restrict the ability of biota to avoid poor water quality
- *Low Oxygen* conditions often occur in deposition areas

LOW OXYGEN

- Low oxygen conditions typically occur in deeper or stratified areas, or around *Barriers to Flow* (poorly mixed). Salinity stratification is a common cause of reduced mixing in estuarine environments.
- Low oxygen condition results in favourable conditions for breakdown of organic material by bacteria, which can reduce oxygen (due to respiration) and release bound contaminants.

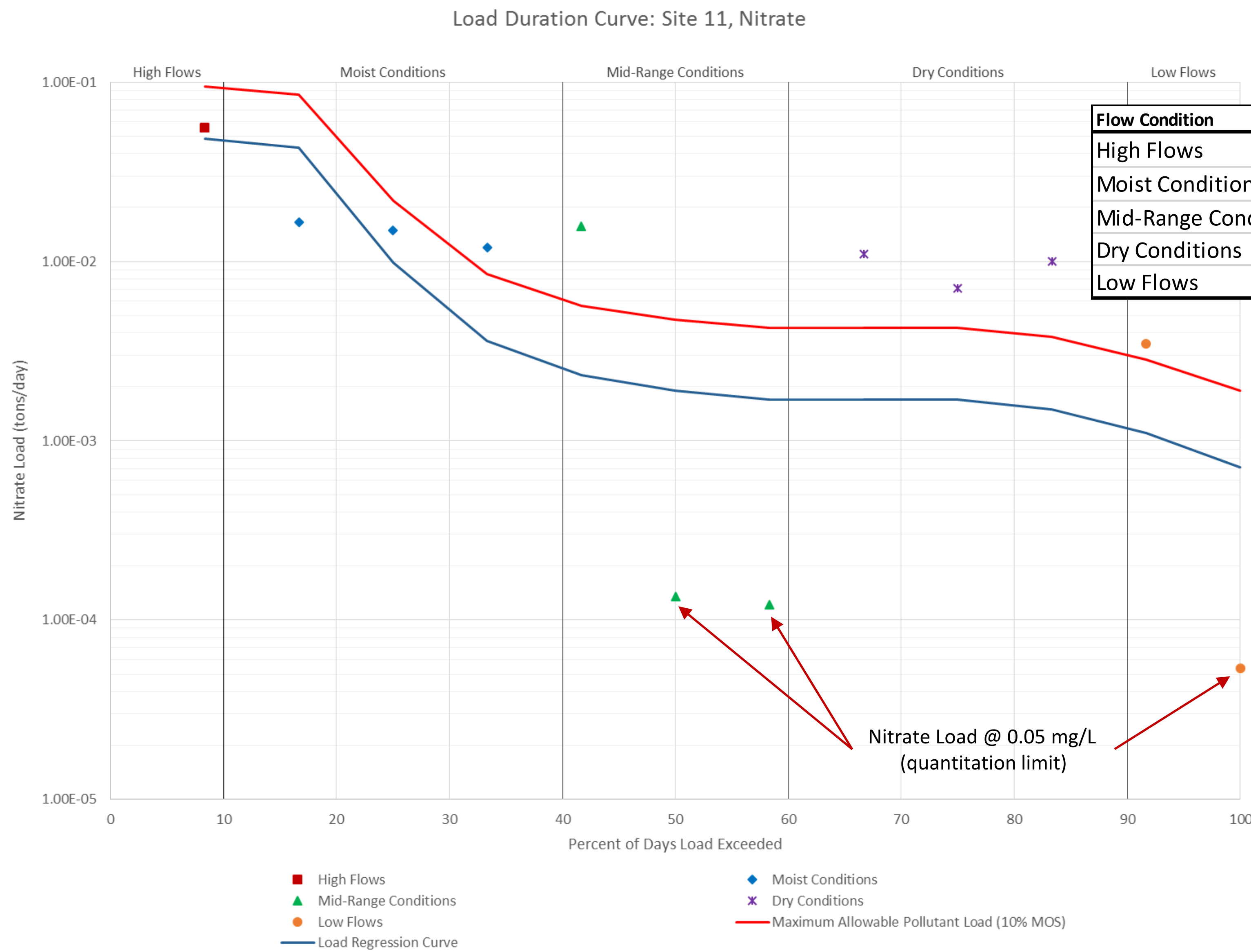
MICRO & MACRO ALGAE BLOOMS

- Algal growth requires nutrients and light. Higher temperatures can promote growth.
- Environmental effects from blooms include low oxygen (due to algae respiring at night), excess oxygen (due to algae photosynthesising during day), and the possibility of toxins produced by some species, which can affect biota.
- Social effects include odour and aesthetics
- Excessive growth of aquatic macrophytes can also occur; having similar causes but minor negative environmental effects.

DECAY OF ORGANIC MATERIAL

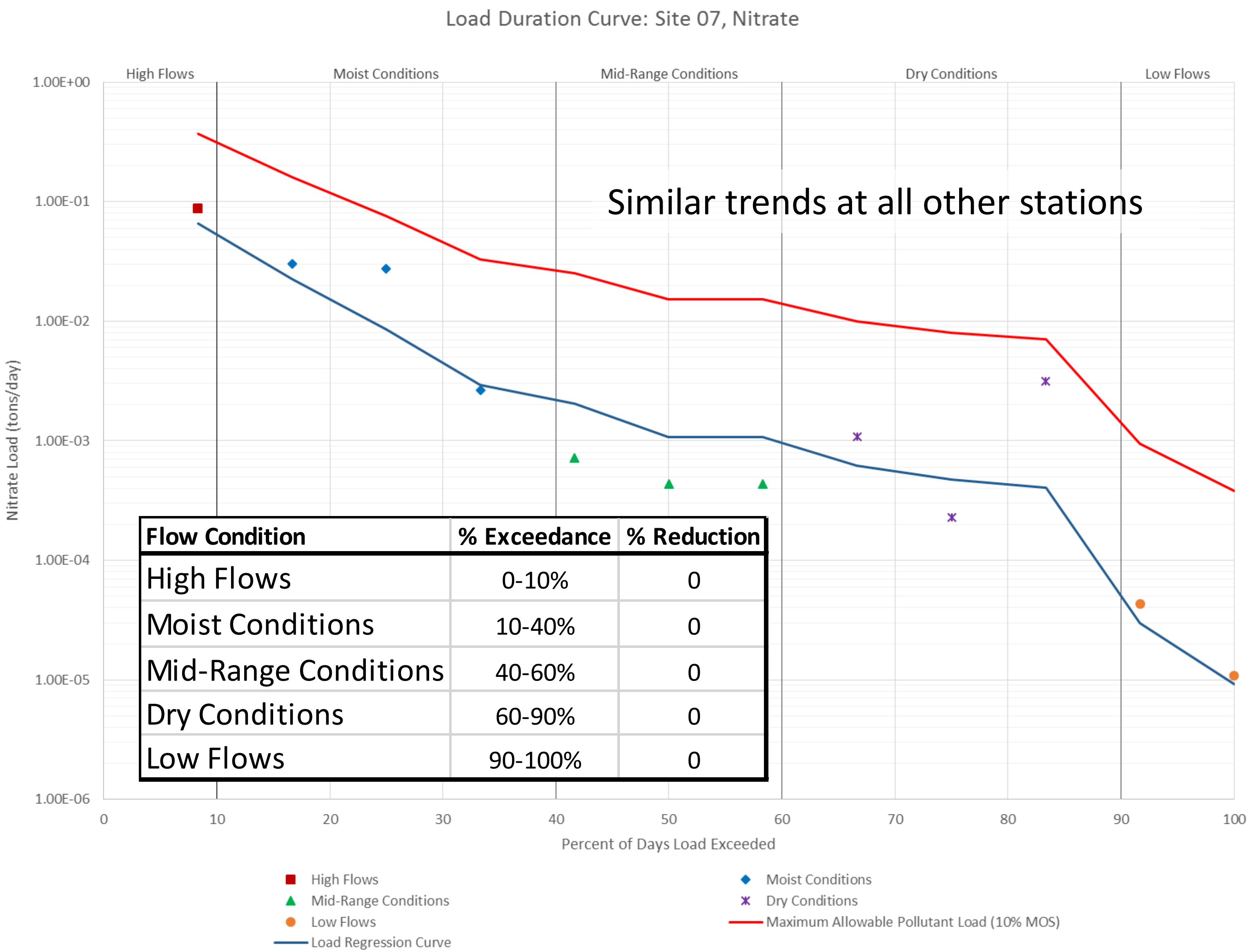
- Effects from decay of organic material include low oxygen (due to growth of bacteria)
- Sources of organic material include vegetation, eroded soils and animal wastes from the catchment (natural, rural and urban sources) and large inputs following crash of *Micro & Macro Algal Blooms*

VC11 – VC at Renfro Rd (FM 3391)



Flow Condition	% Exceedence	% Reduction
High Flows	0-10%	0
Moist Conditions	10-40%	0
Mid-Range Conditions	40-60%	0
Dry Conditions	60-90%	0
Low Flows	90-100%	0

VC07 – VC at Rendon Rd



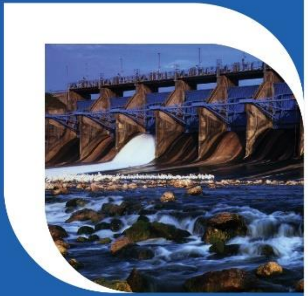
Similar trends at all other stations

Flow Condition	% Exceedance	% Reduction
High Flows	0-10%	0
Moist Conditions	10-40%	0
Mid-Range Conditions	40-60%	0
Dry Conditions	60-90%	0
Low Flows	90-100%	0

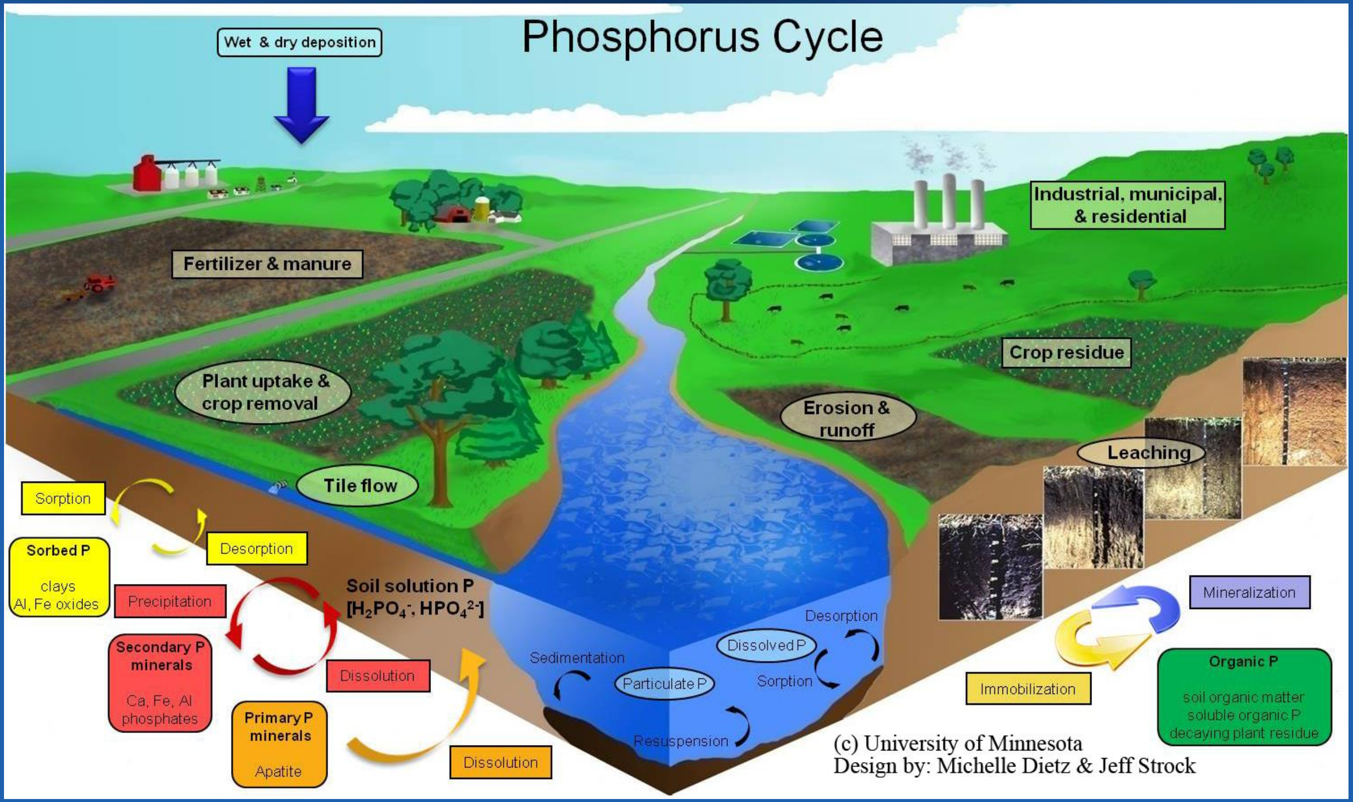
Conclusions (so far)

- Nitrate issues not an immediate concern in the tributaries themselves
  - High single-sample measurements at VC11 offset by several at or below 0.05 mg/L quantitation limit
- Does not mean tributaries shouldn't be considered as a source
  - Lake screening level (0.37 mg/L) lower than stream level (1.95 mg/L)
  - Must account for residence time, use by organisms in lake, and storage in sediments

Total Phosphorus (TP)

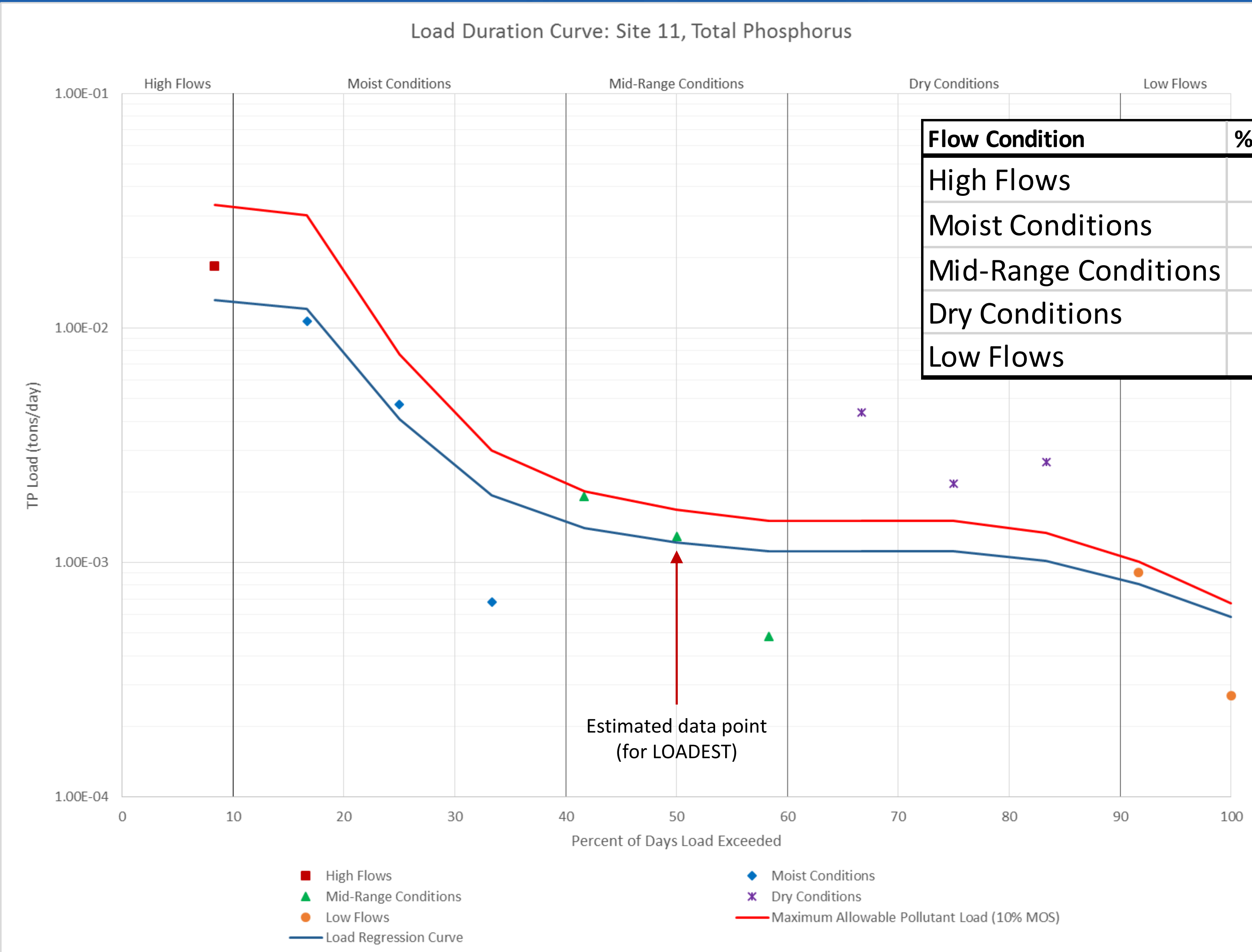


Phosphorus in Water Quality



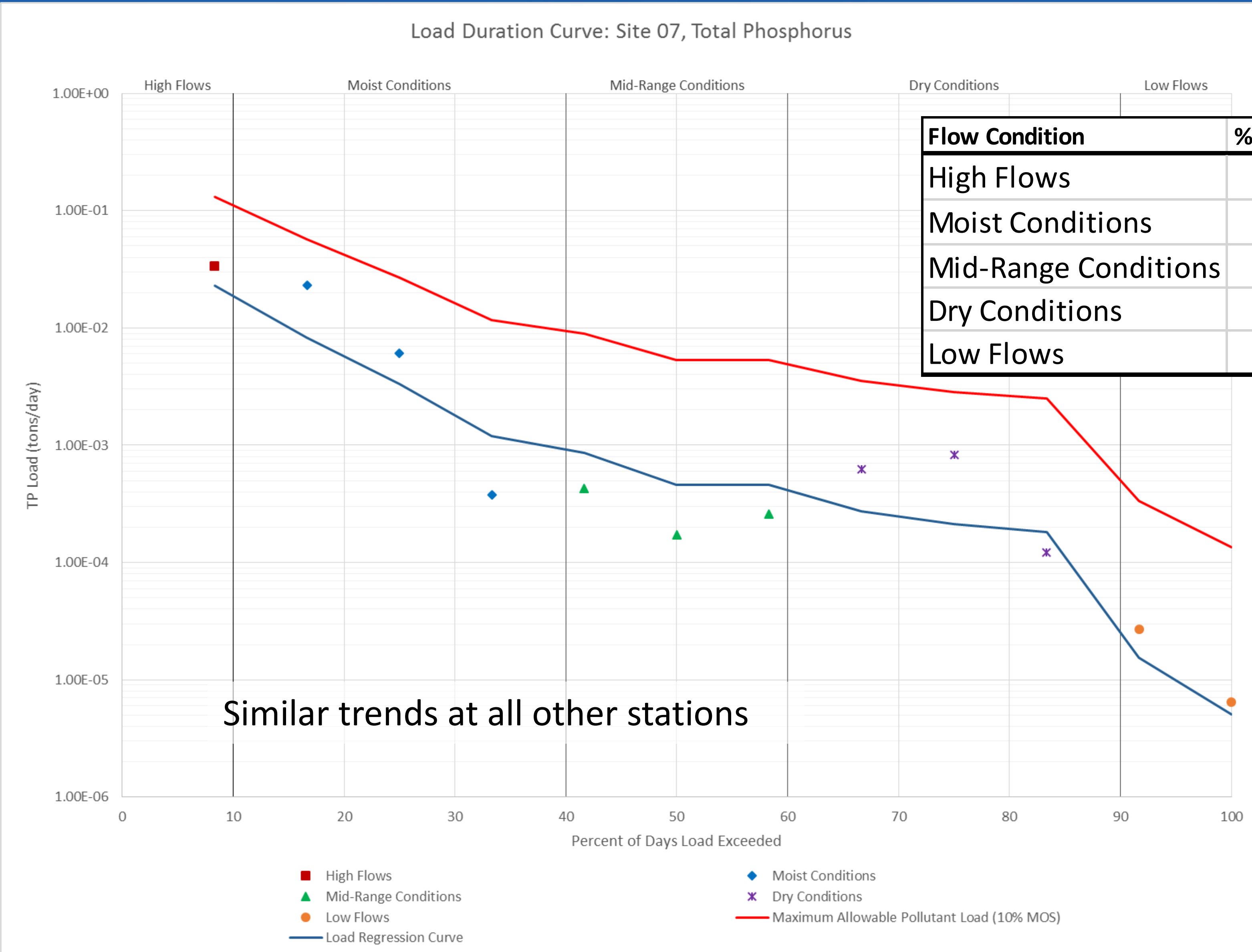
- TCEQ nutrient screening value in streams: 0.69 mg/L
- Common source – lawn/crop fertilizers
- Health issues of excessive phosphate
  - Rare, but can be linked to kidney failure and osteoporosis
  - Imbalances usually from prolonged medicine use, not water consumption
- Environmental – lakes (same as nitrates)
  - Algal bloom/bust → oxygen depletion → fish kills

VC11 – VC at Renfro Rd (FM 3391)



Flow Condition	% Exceedence	% Reduction
High Flows	0-10%	0
Moist Conditions	10-40%	0
Mid-Range Conditions	40-60%	0
Dry Conditions	60-90%	0
Low Flows	90-100%	0

VC07 – VC at Rendon Rd



Flow Condition	% Exceedance	% Reduction
High Flows	0-10%	0
Moist Conditions	10-40%	0
Mid-Range Conditions	40-60%	0
Dry Conditions	60-90%	0
Low Flows	90-100%	0

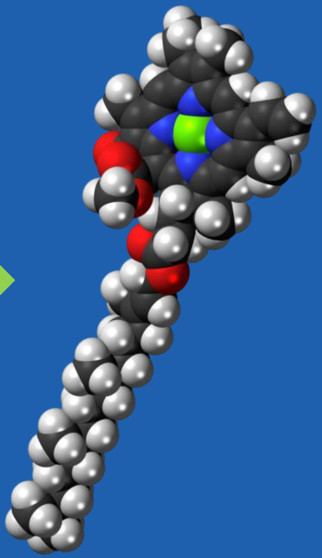
Similar trends at all other stations

Same song, 2nd verse…

- Phosphorus issues not an immediate concern in the tributaries themselves
  - Exception: VC11's high single-sample measurements for "Dry Conditions"
- Does not mean tributaries shouldn't be considered as a source
  - Lake screening level (0.20 mg/L) lower than stream level (0.69 mg/L)
  - Must account for residence time, use by organisms in lake, and storage in sediments

Chlorophyll-a

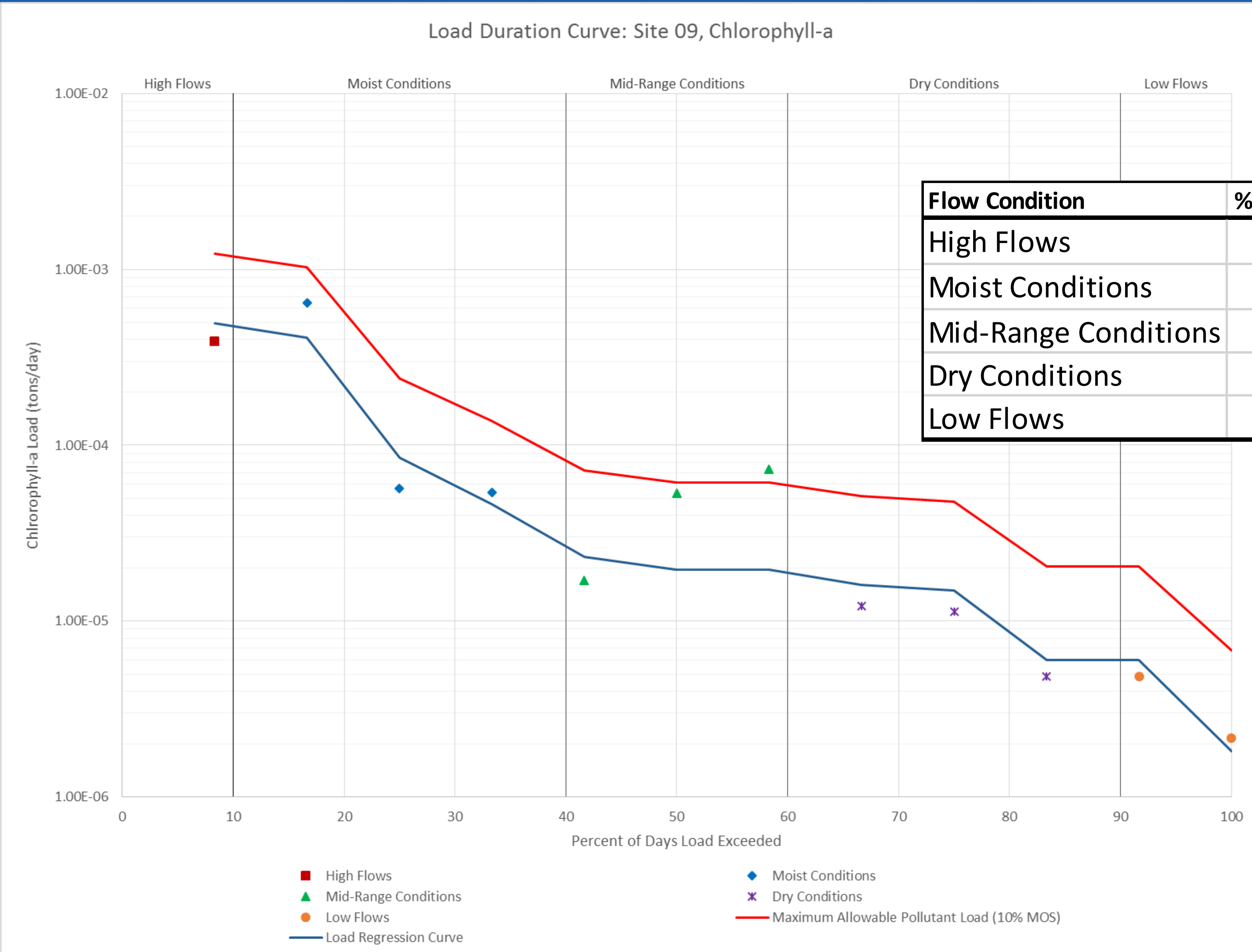
Chlorophyll-a in Water Quality



https://en.wikipedia.org/wiki/Chlorophyll_a

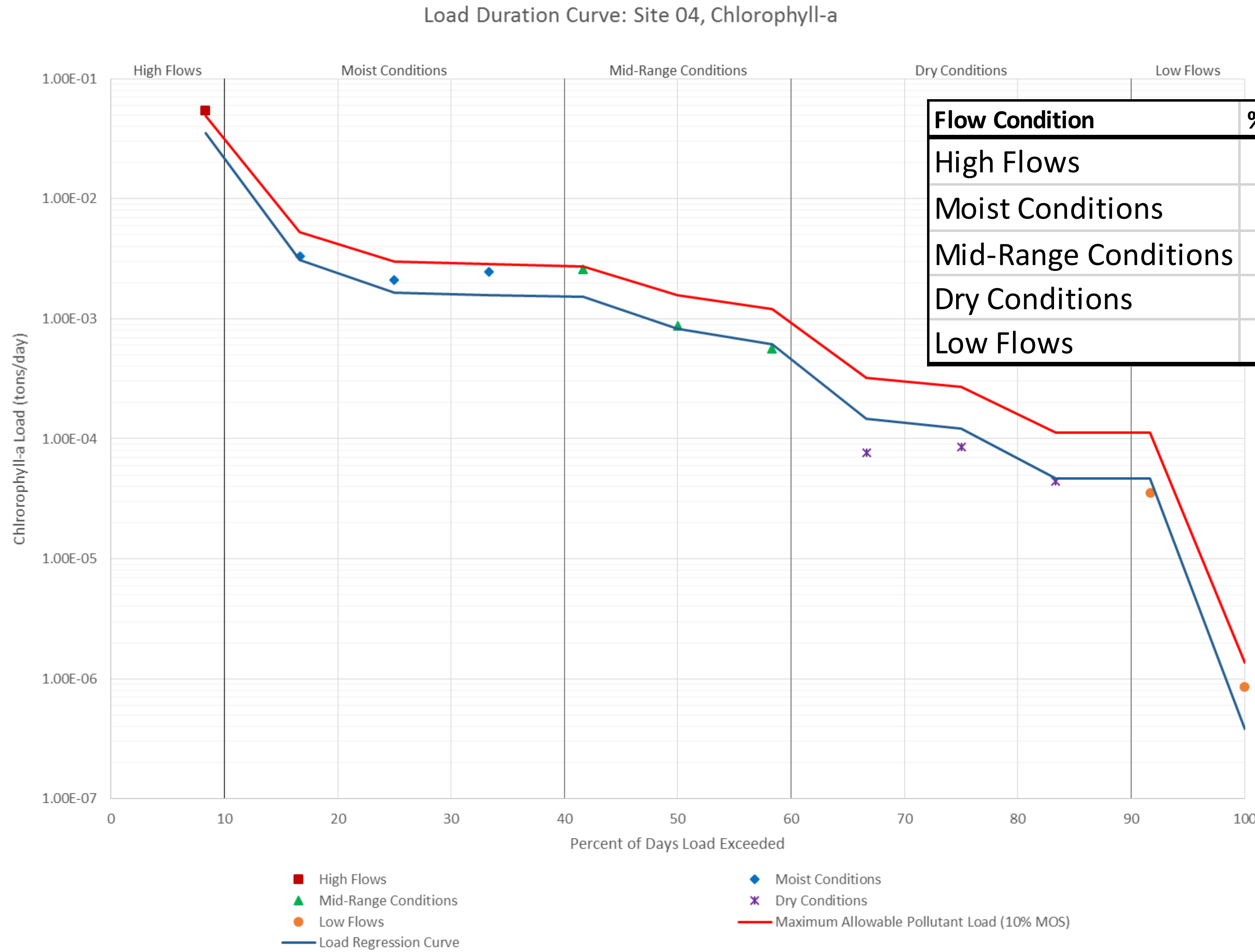
- TCEQ nutrient screening value in streams: 14.1 µg/L
- Photosynthetic molecule in most algae and plants that gives green color
- Used as surrogate for algal growth in water
- Another way to track potential algal blooms
  - Cause: high nutrient inputs to lakes/streams
  - Response: high chlorophyll-a production

VC09 – VC at FM 1187



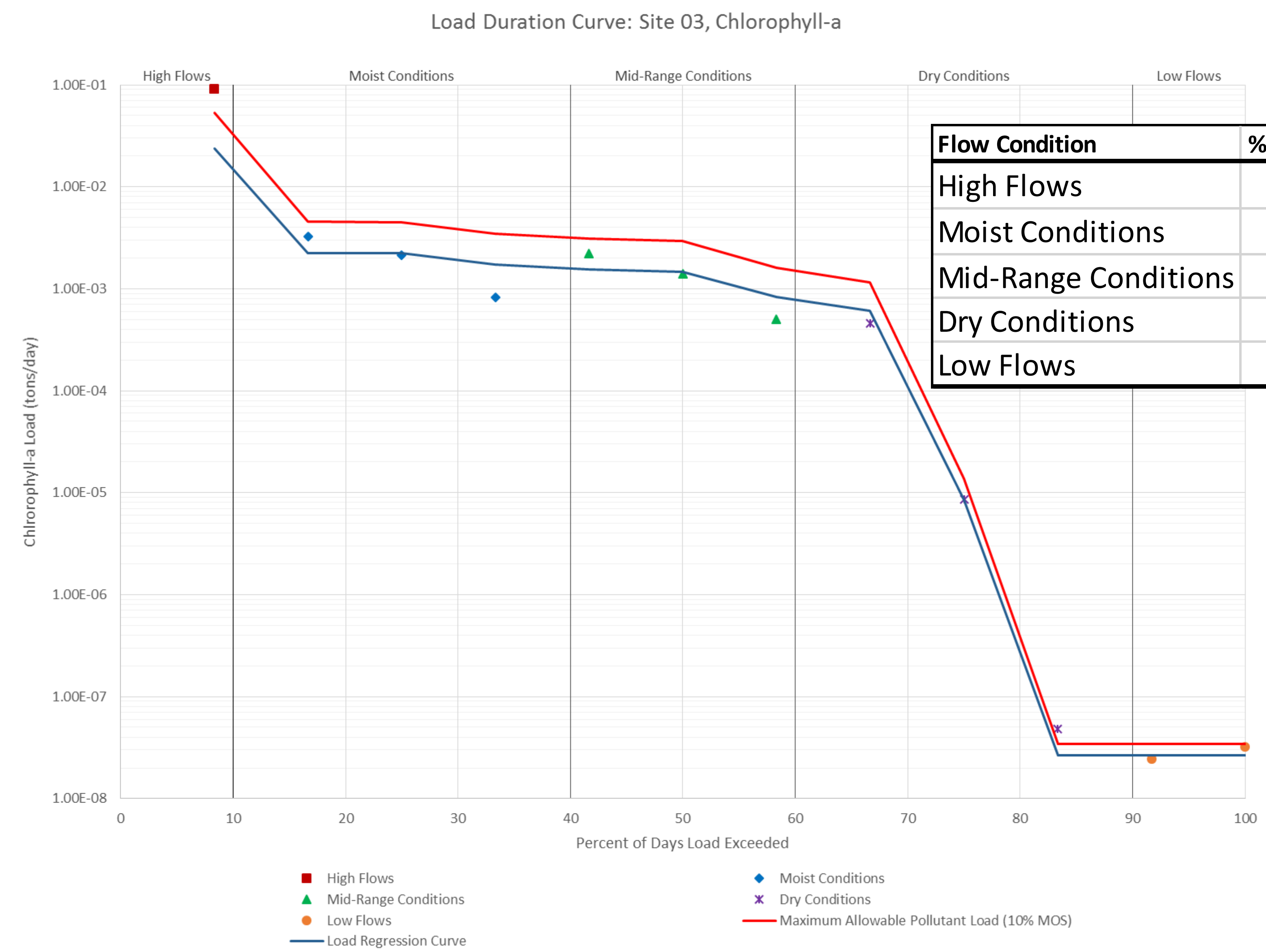
Flow Condition	% Exceedance	% Reduction
High Flows	0-10%	0
Moist Conditions	10-40%	0
Mid-Range Conditions	40-60%	0
Dry Conditions	60-90%	0
Low Flows	90-100%	0

VC04 – VC at US-287 BUS



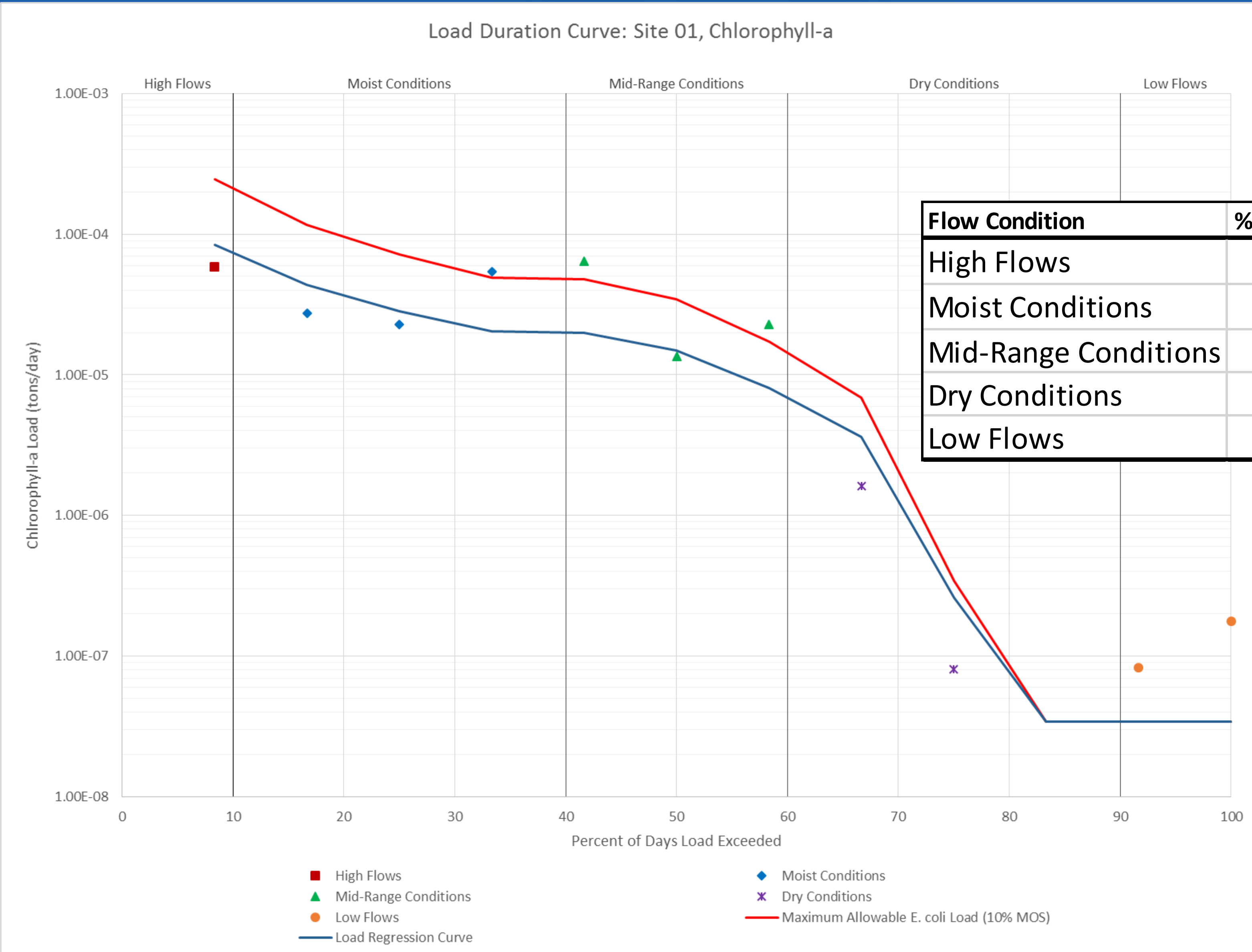
Flow Condition	% Exceedance	% Reduction
High Flows	0-10%	0
Moist Conditions	10-40%	0
Mid-Range Conditions	40-60%	0
Dry Conditions	60-90%	0
Low Flows	90-100%	0

VC03 – VC at I-20

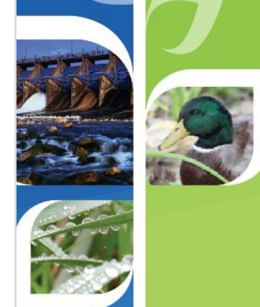


Flow Condition	% Exceedance	% Reduction
High Flows	0-10%	0
Moist Conditions	10-40%	0
Mid-Range Conditions	40-60%	0
Dry Conditions	60-90%	0
Low Flows	90-100%	0

VC01 – Wildcat Branch at Cravens*



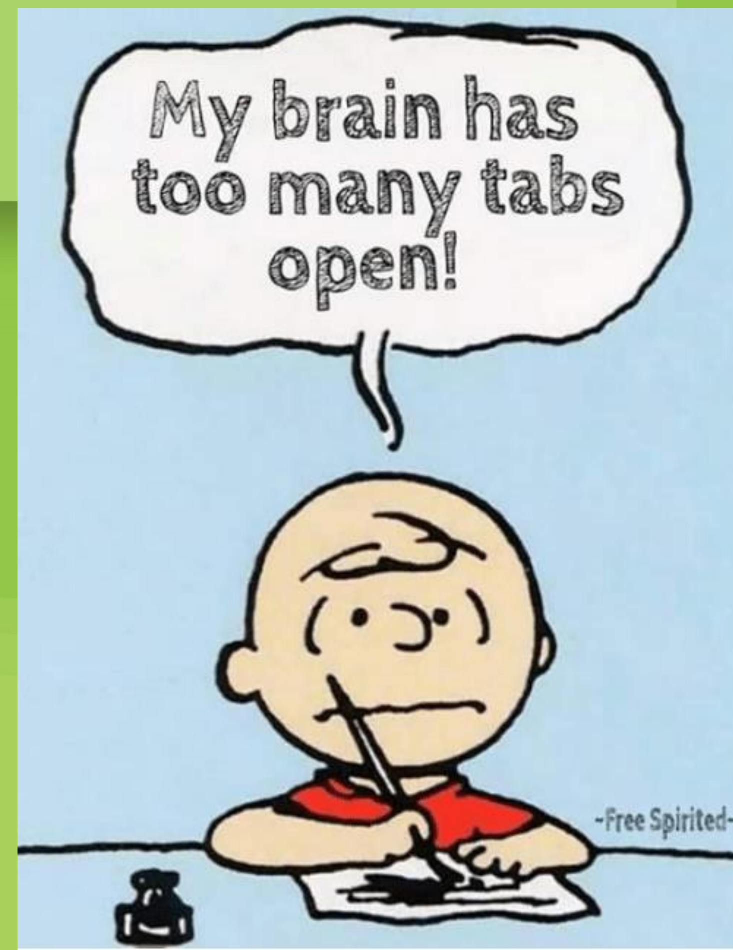
Flow Condition	% Exceedence	% Reduction
High Flows	0-10%	0
Moist Conditions	10-40%	0
Mid-Range Conditions	40-60%	0
Dry Conditions	60-90%	0
Low Flows	90-100%	1



What, this again? Oh wait…

- Chlorophyll-a loading not an immediate concern for the tributaries
- For tributaries:
  - Can *technically* deliver chlorophyll-a to lake but…
  - Bigger concern goes back to the nutrients being delivered and *potential* for growth
  - Lake screening level (26.7 µg/L) higher than stream level (14.1 µg/L)
  - What happens when we move from a flowing system to a lake?

BRAIN BREAK



SELECT Results – *E. coli*

Aaron Hoff
Trinity River Authority
January 11, 2018

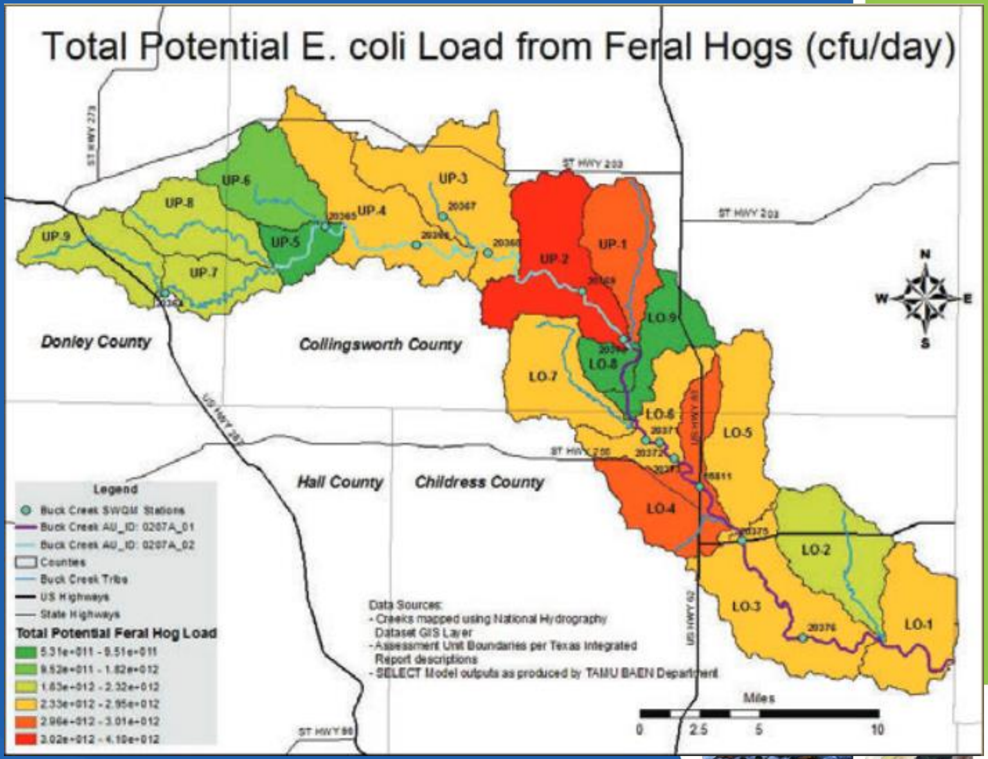
Village Creek Lake Arlington WATERSHED PROTECTION
Trinity River Authority of Texas
Enriching the Trinity basin as a resource for Texans

SELECT Refresher

- Spatially Explicit Load Enrichment Calculation Tool (SELECT)
- Analytical approach for determining potential bacterial loads in specific areas of a watershed
- Spatial data inputs
  - Land use data
  - Population data (human and animal)
- Literature values for fecal production rates
- SELECT does *not* account for any natural or anthropogenic mitigation processes
  - Results in an overestimation of potential sources
  - Provides a “worst-case scenario”

Provides visual output

- Evaluates selected pollutant sources separately
- Determines which “catchments” have the greatest contribution to the overall pollutant load
- Targets areas for potential management practices

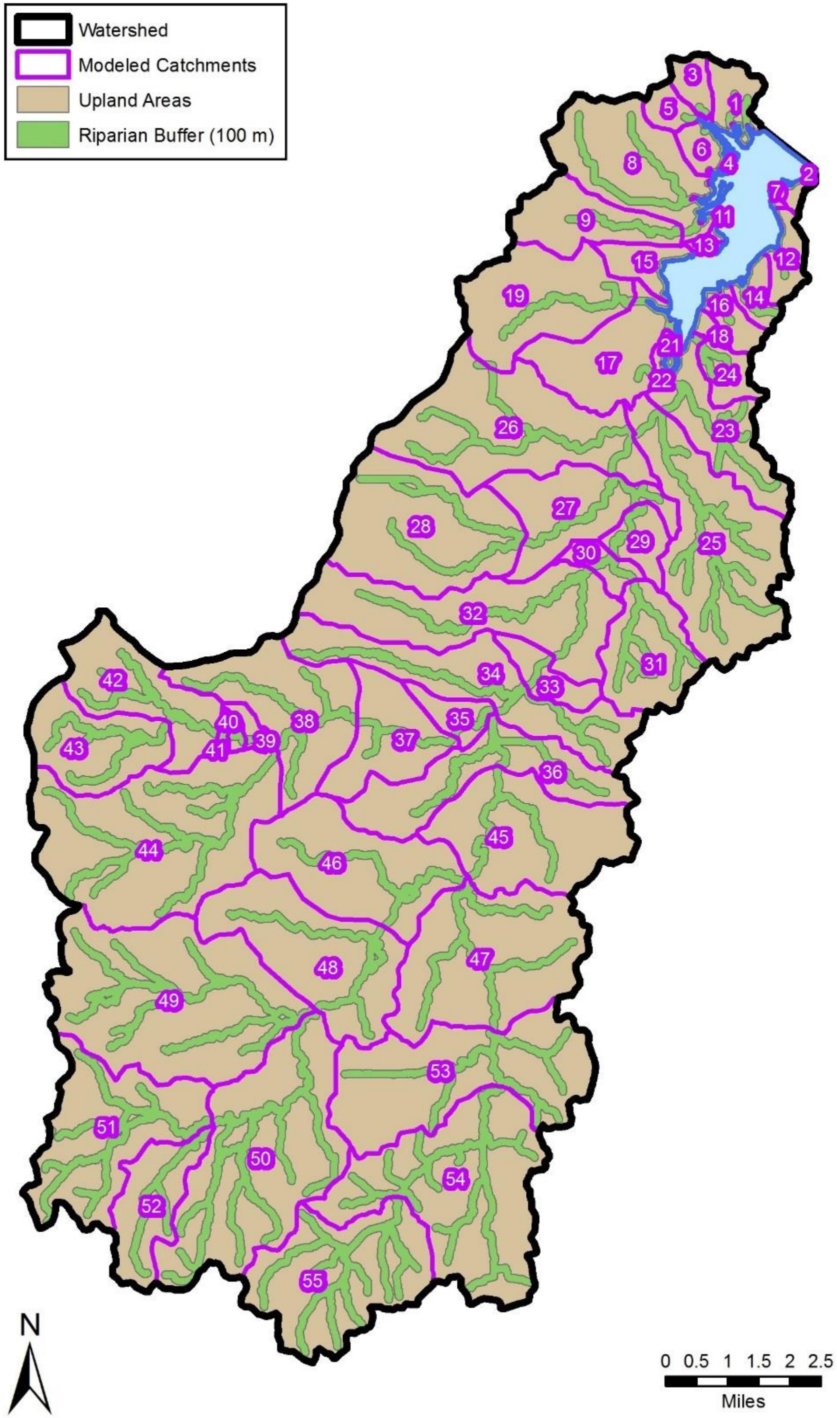


Source: Buck Creek Watershed Protection Plan

“Worst-case scenario” revisited

- Logic follows – sources further from stream will have less influence on load
- Distance from *E. coli* source (the “poop point”) to stream isn’t taken into account automatically
- Artificially account for this to a small degree by using a stream buffer
  - Within buffer zone = more influence
    - 90% reaches stream
  - Outside buffer zone = less influence
    - 50% reaches stream

- Used catchments developed during the Lake Arlington Master Plan (LAMP) effort
  - 55 catchments
  - used for consistency
- National Hydrography Database (NHD) layer used for streams
- Built a 330-ft (~100-m) buffer around NHD streams
- Inside buffer
  - "riparian band"
  - More *E. coli* reaches stream
- Outside buffer
  - "upland areas"
  - Less *E. coli* reaches stream
- Loads "normalized" to subwatershed areas to account for dissimilar subwatershed sizes



Population Density Estimates

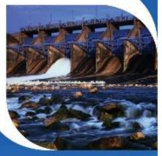
- Used to estimate E. coli load contributions
- Animal estimates strongly tied to land use/land cover type
- 1 of 2 main drivers of the SELECT analysis
- Assists with future resource management

- Preliminary estimates calculated for:
  - Cattle
  - Sheep/goats
  - Equine species
  - Deer
  - Feral hogs
  - Domestic dogs
  - Septic Systems (OSSFs)

Loading Rates

Table 2. Calculation of potential *E. coli* loads from various sources in the watershed.

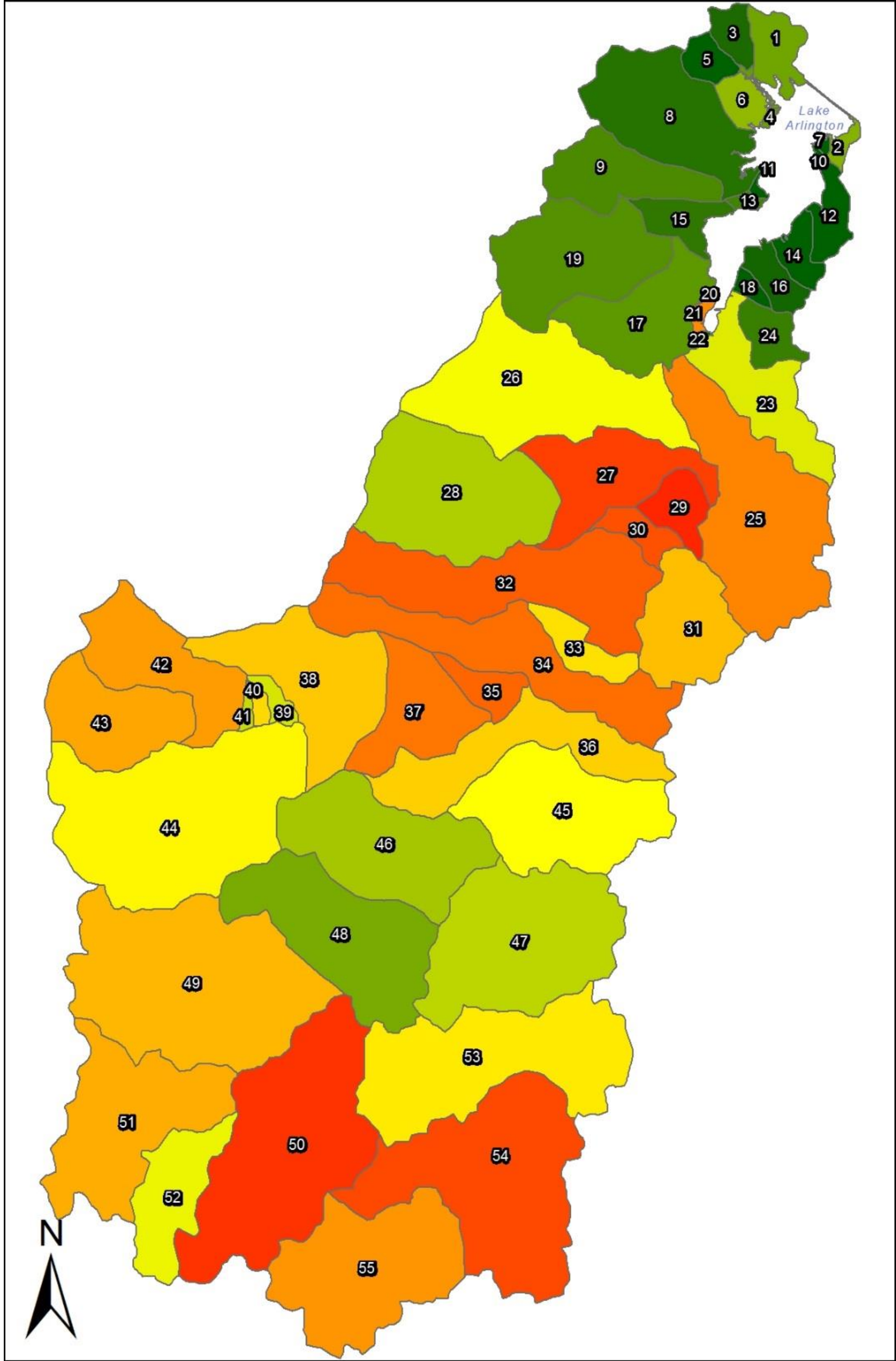
Source	Calculation
Cattle	$EC = \#\,\text{cattle} \cdot 2.7 \cdot 10^{9}\,\text{cfu}\ \text{d}^{-1}\ \text{head}^{-1}$
Horses	$EC = \#\,\text{horses} \cdot 2.1 \cdot 10^{8}\,\text{cfu}\ \text{d}^{-1}\ \text{head}^{-1}$
Sheep and goats	$EC = \#\,\text{sheep} \cdot 9 \cdot 10^{9}\,\text{cfu}\ \text{d}^{-1}\ \text{head}^{-1}$
Deer	$EC = \#\,\text{deer} \cdot 1.75 \cdot 10^{8}\,\text{cfu}\ \text{d}^{-1}\ \text{head}^{-1}$
Feral hogs	$EC = \#\,\text{hogs} \cdot 4.45 \cdot 10^{9}\,\text{cfu}\ \text{d}^{-1}\ \text{head}^{-1}$
Dogs	$EC = \#\,\text{households} \cdot \frac{0.8\ \text{dogs}}{\text{household}} \cdot 2.5 \cdot 10^{9}\,\text{cfu}\ \text{d}^{-1}\ \text{head}^{-1}$
Failing septic systems	$EC = \#\,\text{failing systems} \cdot \frac{5 \cdot 10^{5}\,\text{cfu}}{100\ \text{mL}} \cdot \frac{2.65 \cdot 10^{5}\,\text{mL}}{\text{person/day}} \cdot \frac{\text{Avg}\ \#\,\text{persons}}{\text{household}}$
WWTP	$EC = \text{permitted MGD} \cdot \frac{126\ \text{cfu}}{100\ \text{mL}} \cdot \frac{10^{6}\,\text{gal}}{\text{MGD}} \cdot \frac{3758.2\ \text{mL}}{\text{gal}}$



Cattle

- Stakeholder recommendation
  - Use NASS Data estimate
- NASS Data (2012)
  - 6,488 head in watershed
    - County numbers scaled down to illustrate estimate of cattle only in the watershed
    - limited to grassland and pasture land classes
  - Average watershed density = 5.43 ac per animal
  - Contribution factors:
    - Riparian – 90% reaches stream
    - Upland – 50% reaches stream

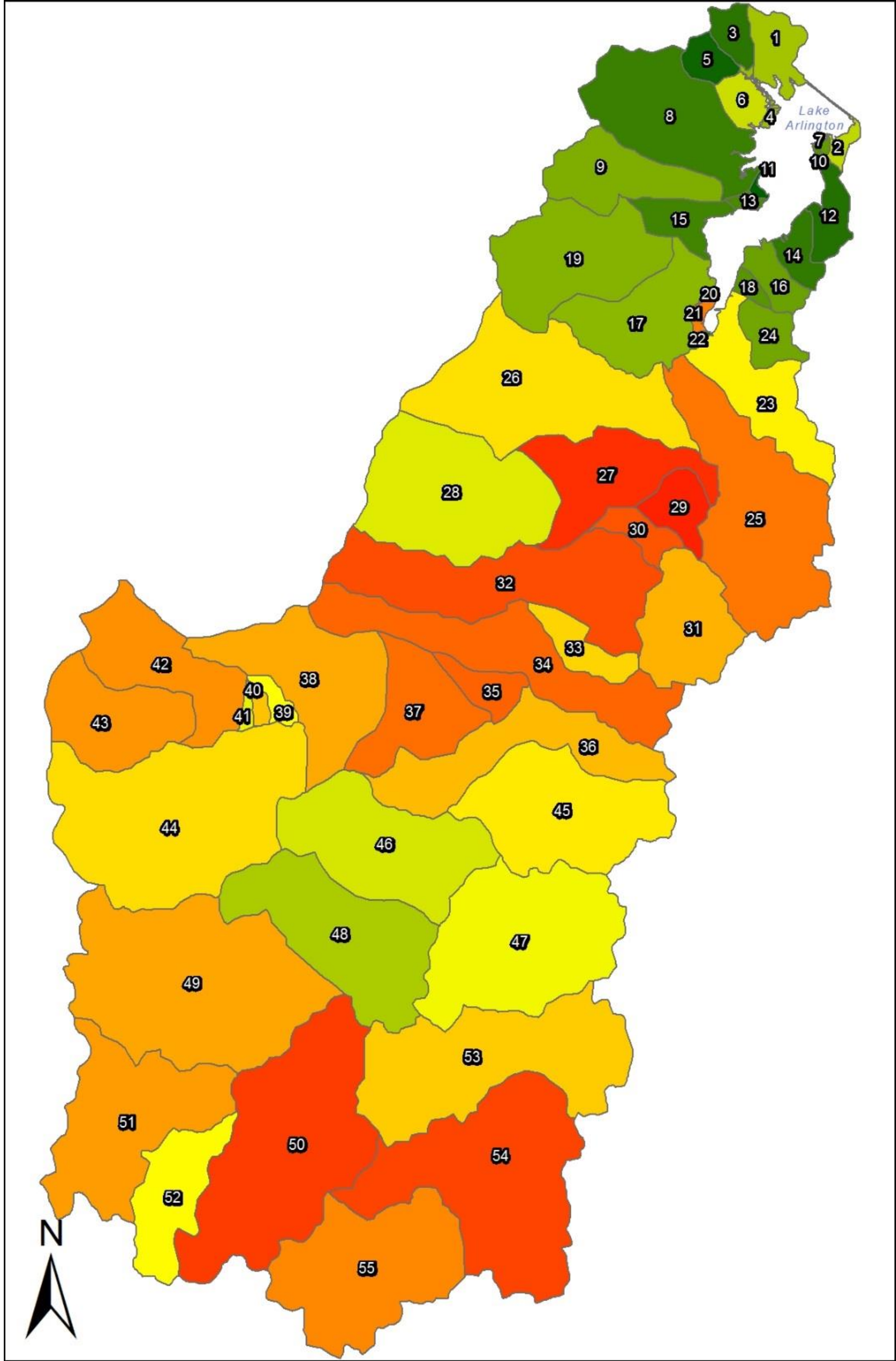
SELECT - Cattle



Equine Species

- Stakeholder recommendation
  - 2500 head in watershed
  - Distribute to 100% of grassland and 90% of pasture land classes
  - Include 5% of low-density development in estimate to account for ‘small acreage’ (non-ag) owners that may not receive NASS
  - Average watershed density = 14.0 ac per animal
  - Contribution factors:
    - Riparian – 90% reaches stream
    - Upland – 50% reaches stream

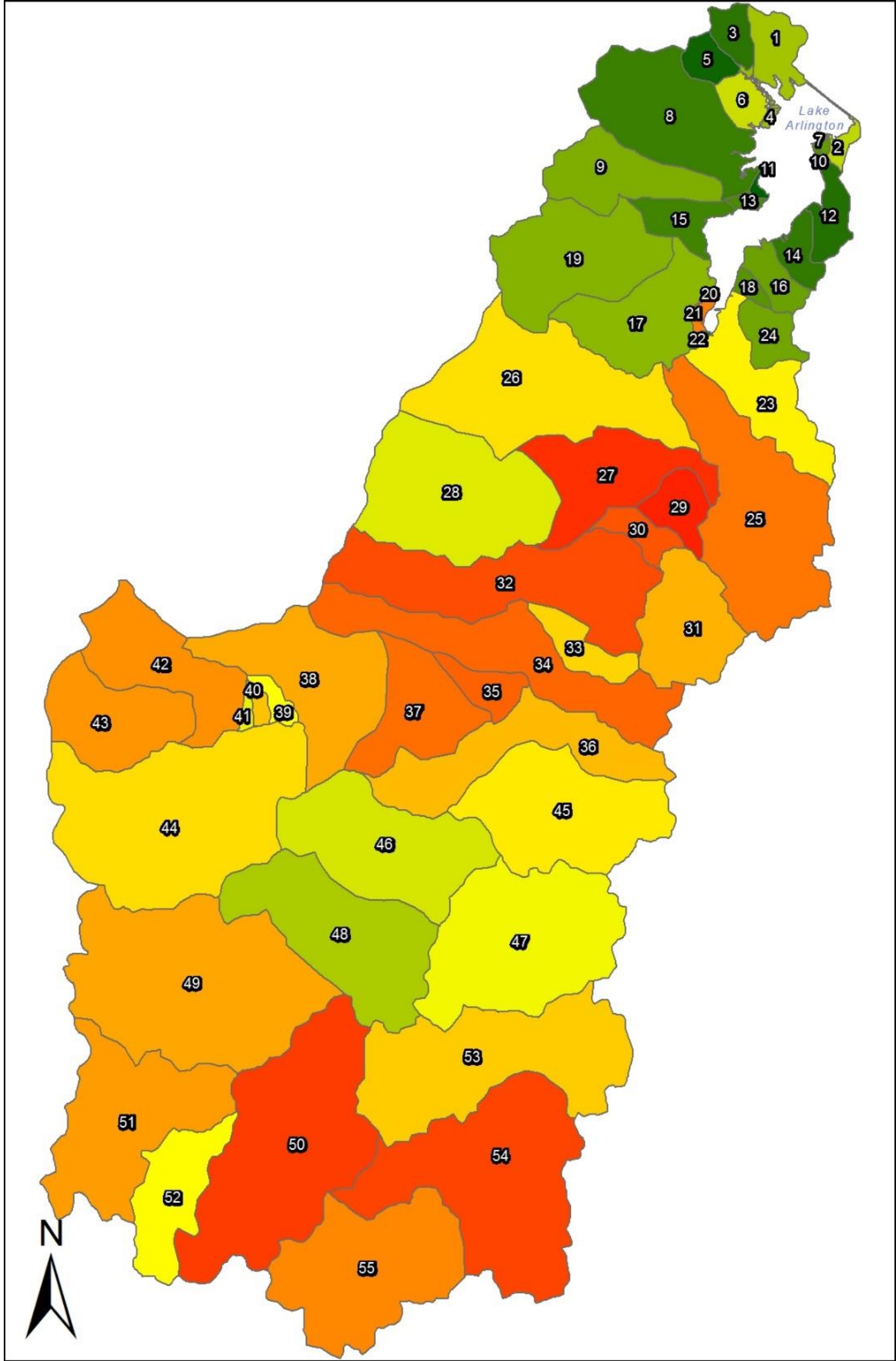
SELECT – Equine Species



Sheep & Goats

- Stakeholder recommendation
  - 2500 head in watershed
  - Distribute to 100% of grassland and 90% of pasture land classes
  - Include 5% of low-density development in estimate to account for ‘small acreage’ (non-ag) owners that may not receive NASS
  - Average watershed density = 14.0 ac per animal
  - Contribution factors:
    - Riparian – 90% reaches stream
    - Upland – 50% reaches stream

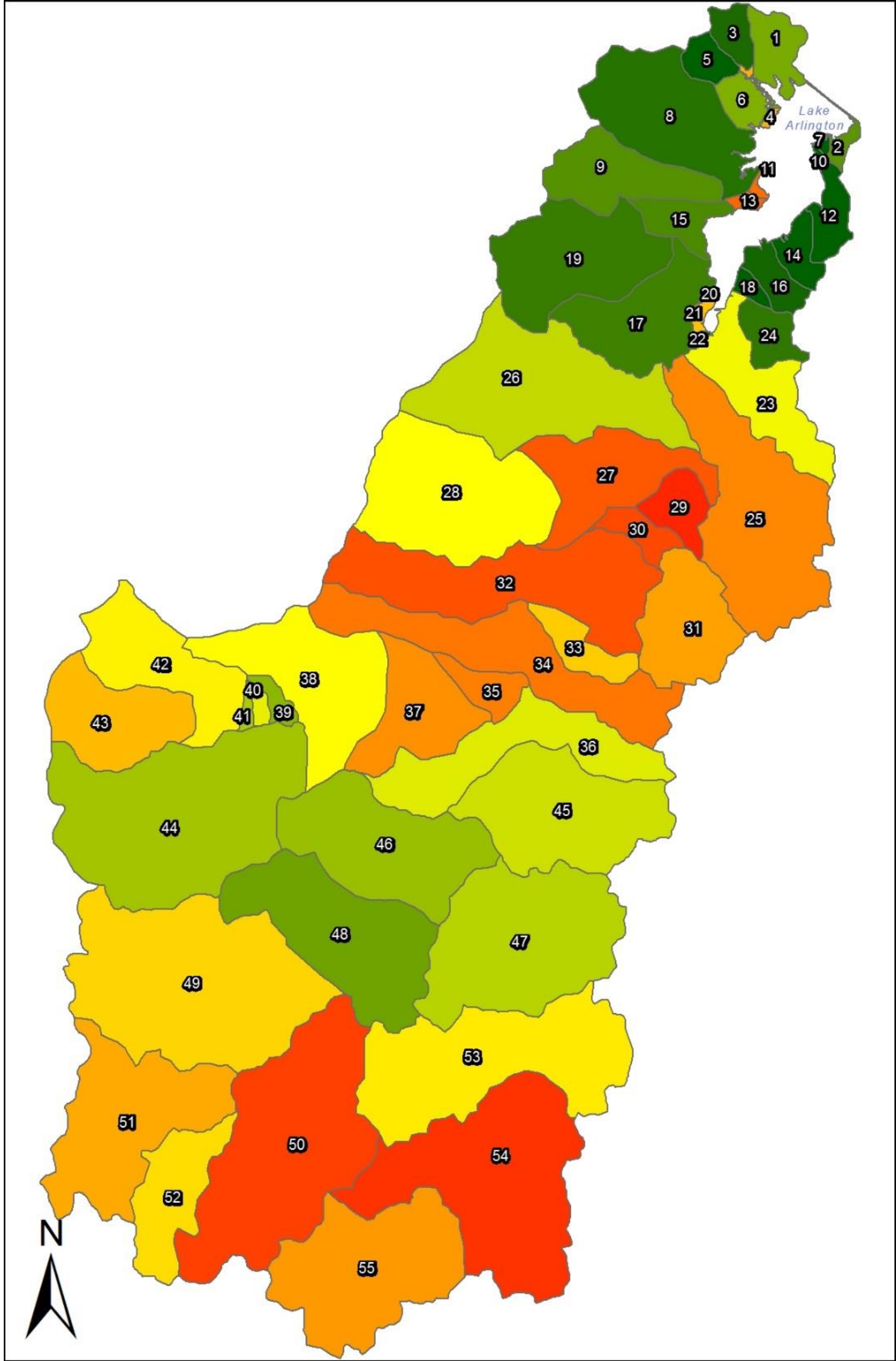
SELECT – Sheep & Goats



Deer

- Stakeholder recommendation
  - Use median density from TPWD
  - 53.7 ac/deer = 1461 deer in watershed
  - Applies to all land use except heavy development and open water
  - Average watershed density = 53.7 ac per animal
  - Contribution factors:
    - Riparian – 90% reaches stream
    - Upland – 50% reaches stream

SELECT – Deer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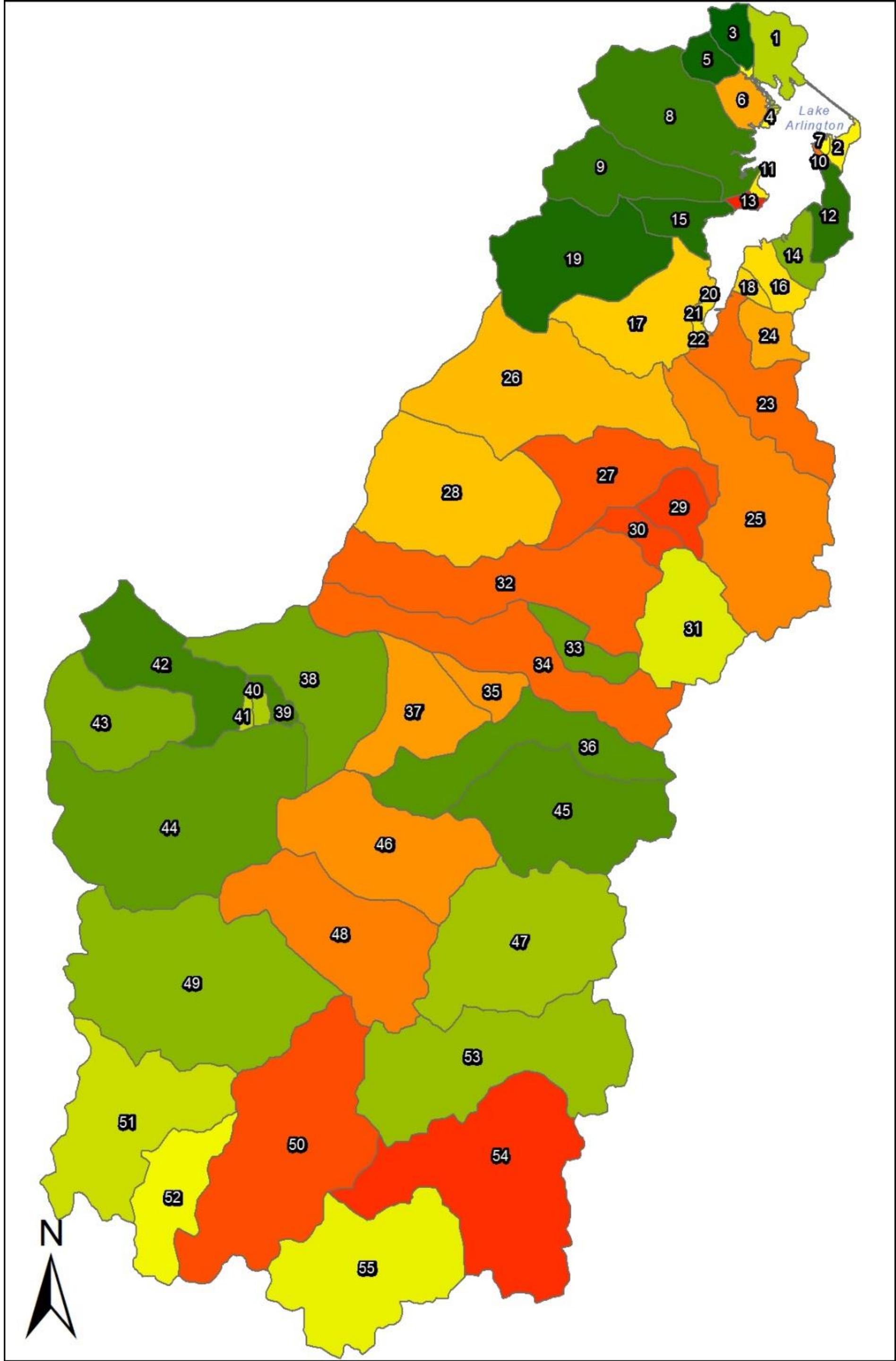
Feral Hogs

- Stakeholder recommendation
  - 1000 head in watershed
  - Distribute to 100% of riparian zones and 100% of upland forested areas
  - Average watershed density = 26.62 ac per animal
  - Contribution factors:
    - Riparian – 90% reaches stream
    - Upland – 50% reaches stream

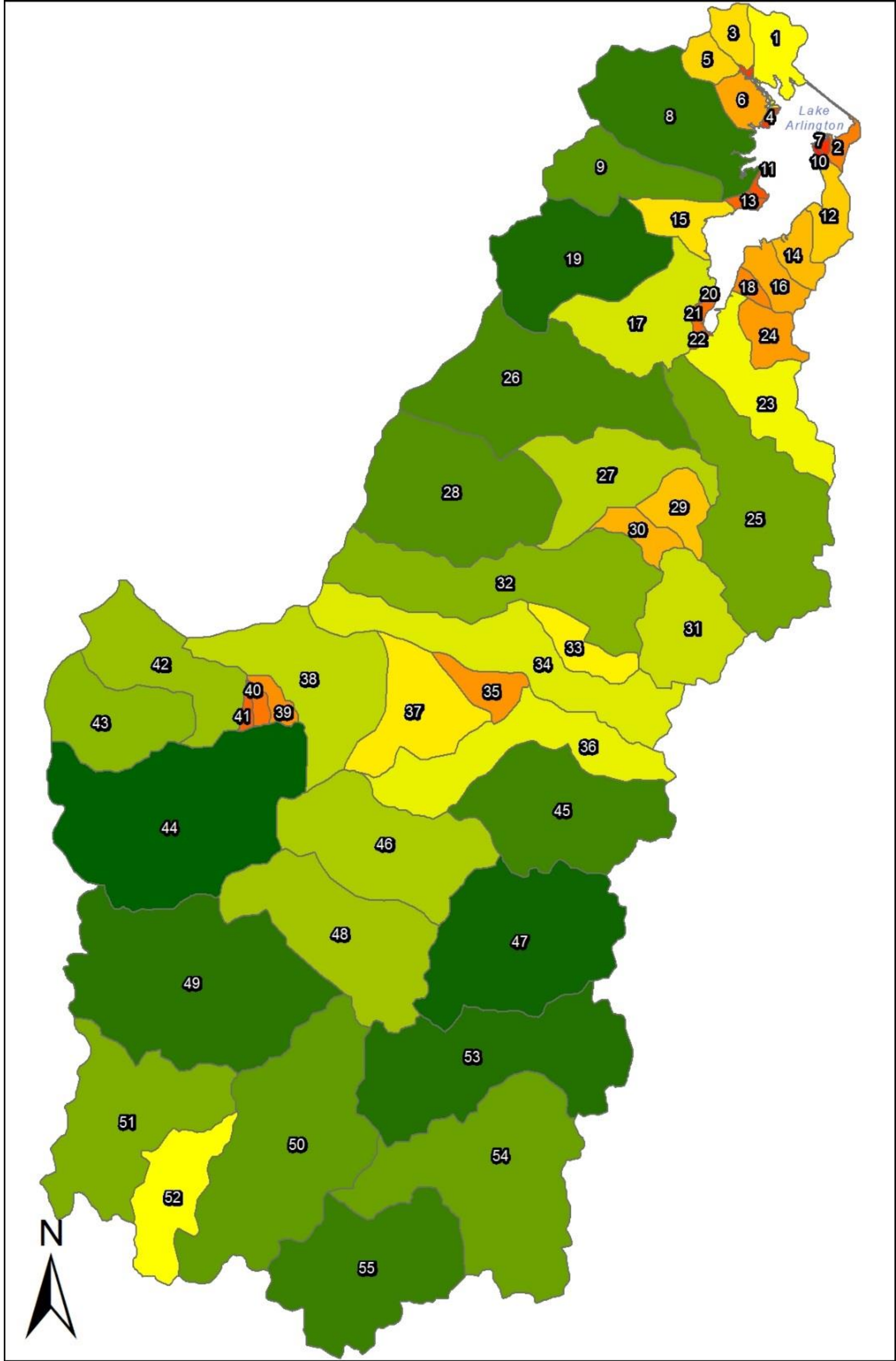
SELECT – Feral Hogs



Dogs and Cats

- Committee Recommendation
  - Use AVMA estimates
  - Households w/dogs – 36.5%
  - Households w/cats – 30.4%
  - In those households, average dogs per household is 1.6
  - Also apply to cats
    - Help account for feral, barn, outdoor cats
  - Contribution factors:
    - Riparian – 90% reaches stream
    - Upland – 50% reaches stream

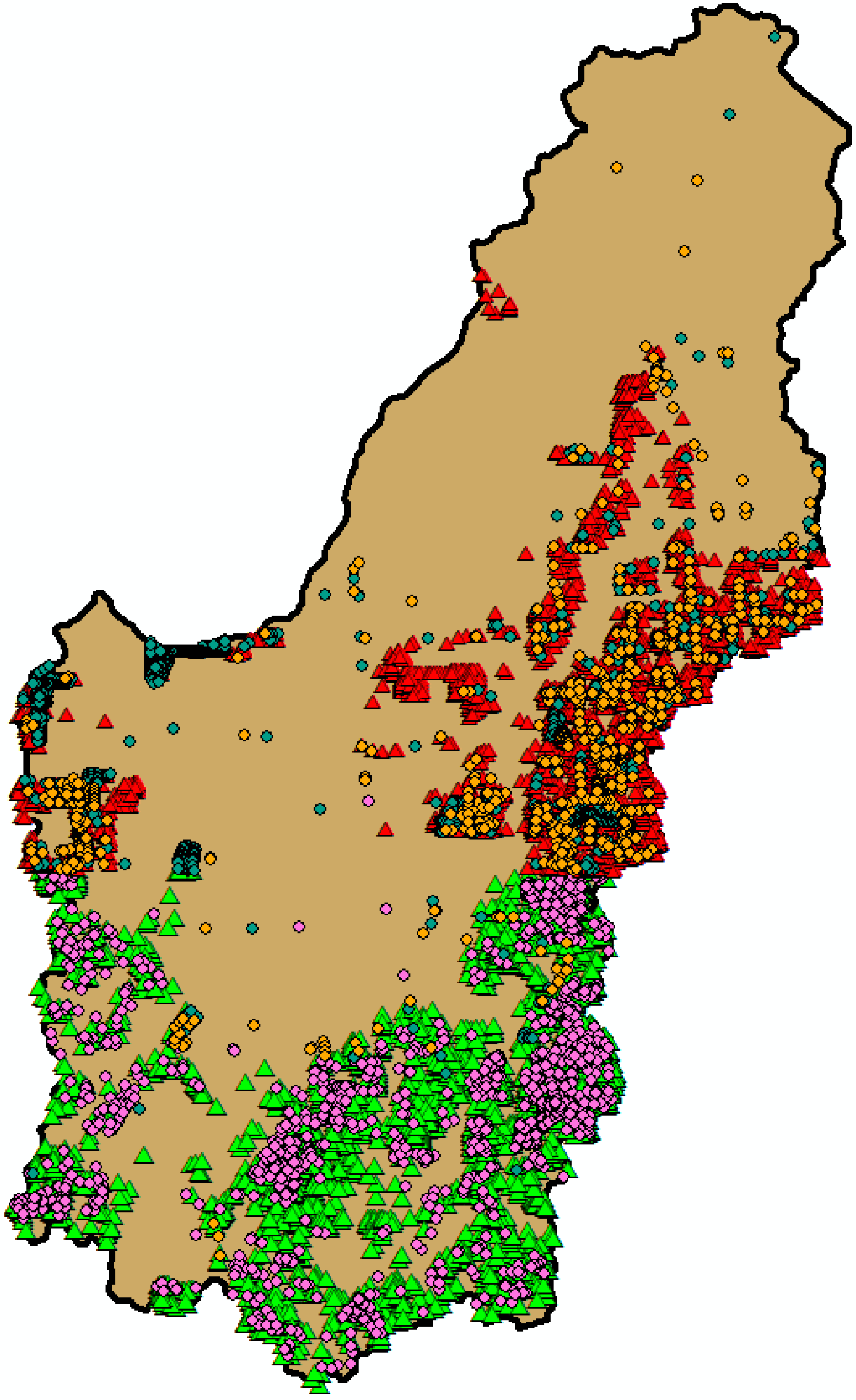
SELECT – Dogs & Cats



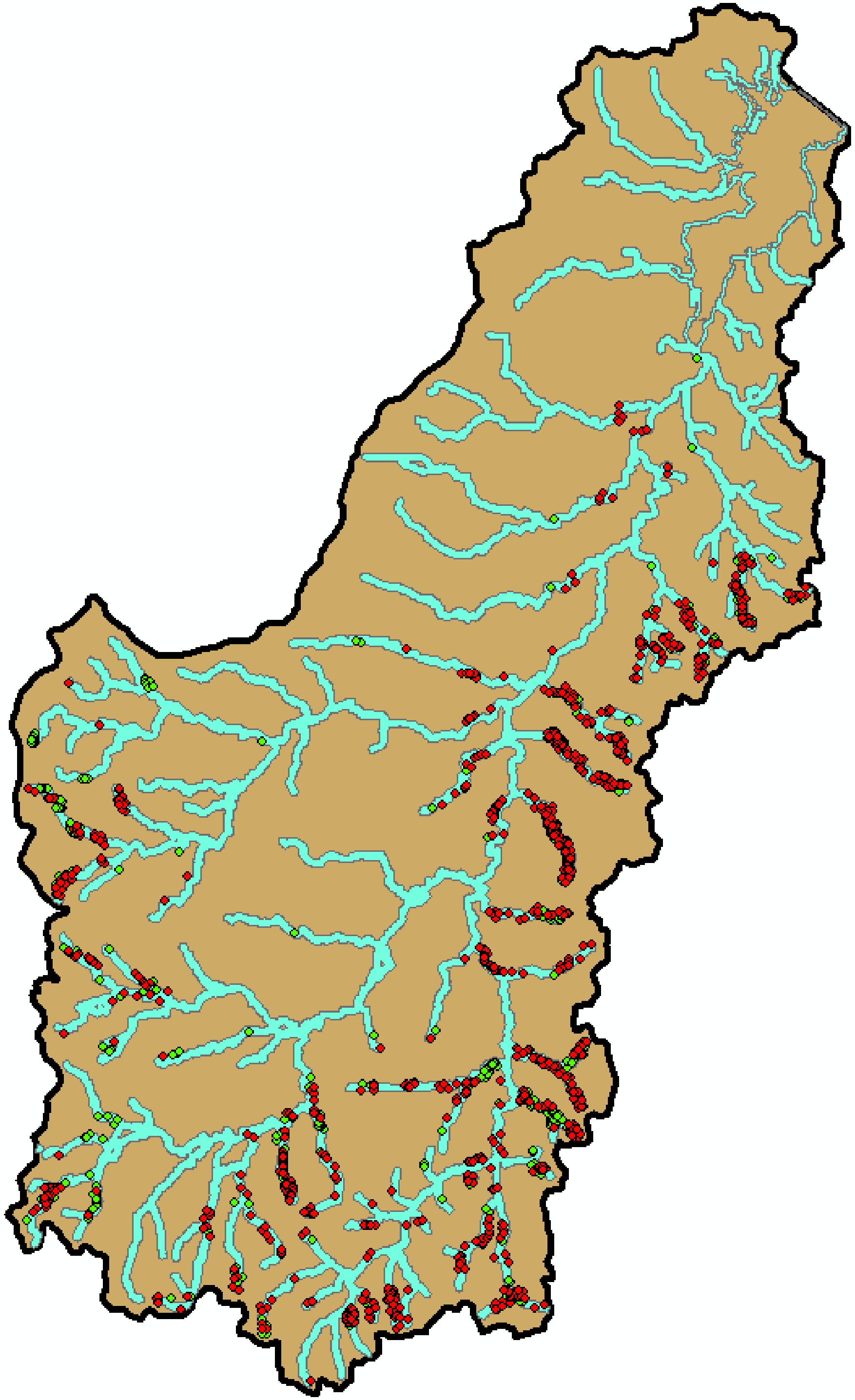
Septic Systems (OSSFs)

- Specific number of OSSFs for each subwatershed based on GIS analysis
- Majority of potential contributions through groundwater
- Permitted OSSFs
  - 12% failure rate
- Unpermitted OSSFs
  - 50% failure rate
- Used only OSSFs in riparian buffer
  - 90% E. coli contribution – in riparian buffer
  - 0% contribution – OSSFs in upland areas

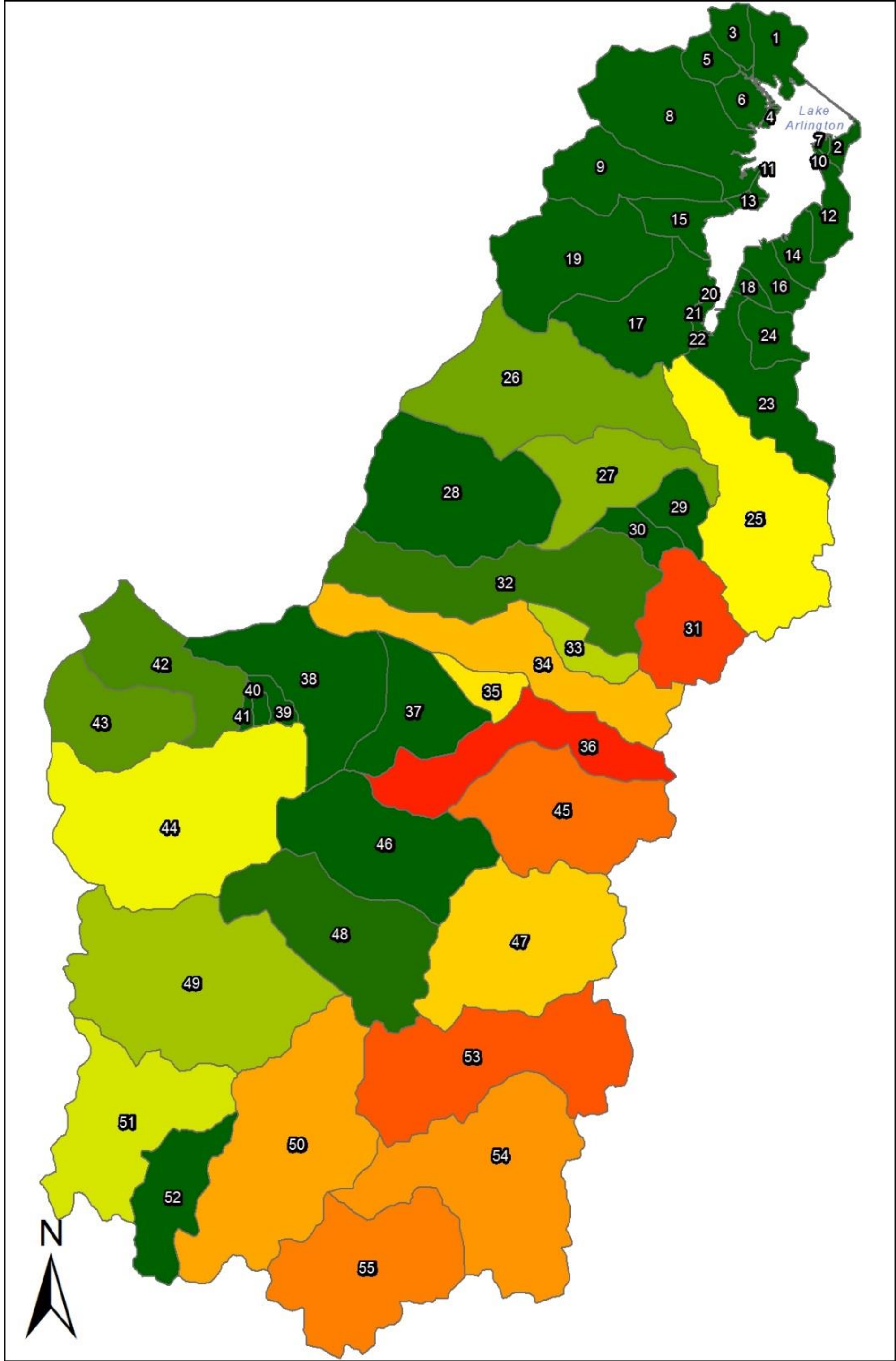
Count – OSSFs (all)



Count – OSSFs
(in riparian zones)



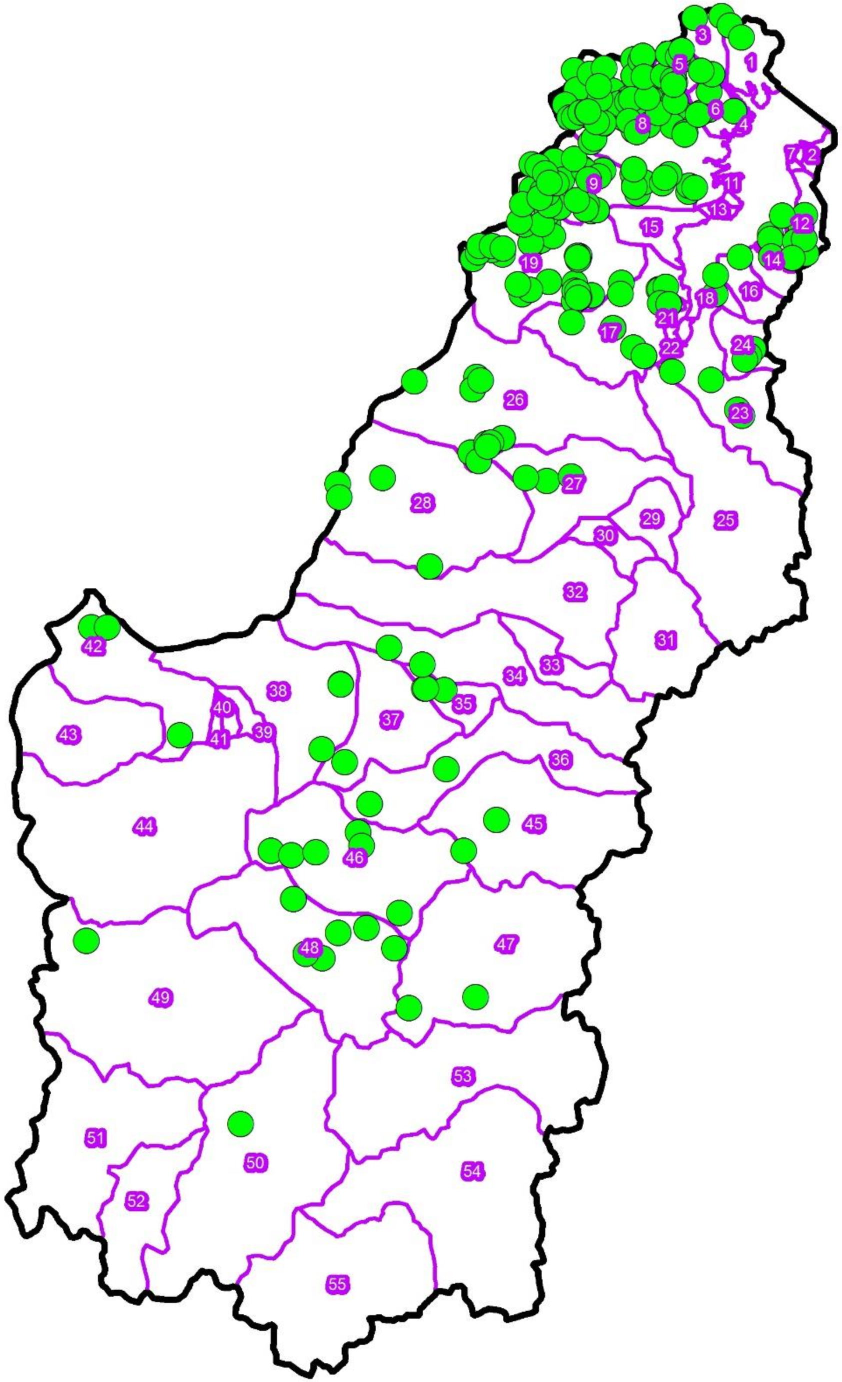
SELECT – OSSFs (in riparian zones)



Sanitary Sewer Overflows (SSOs)

- Used 2011-2016 records for watershed
  - NCTCOG furnished records for Tarrant/Johnson Counties
  - Clipped records to each subwatershed's riparian and upland areas
  - Contribution factors:
    - Riparian – 90% reaches stream
    - Upland – 50% reaches stream

Count – SSOs



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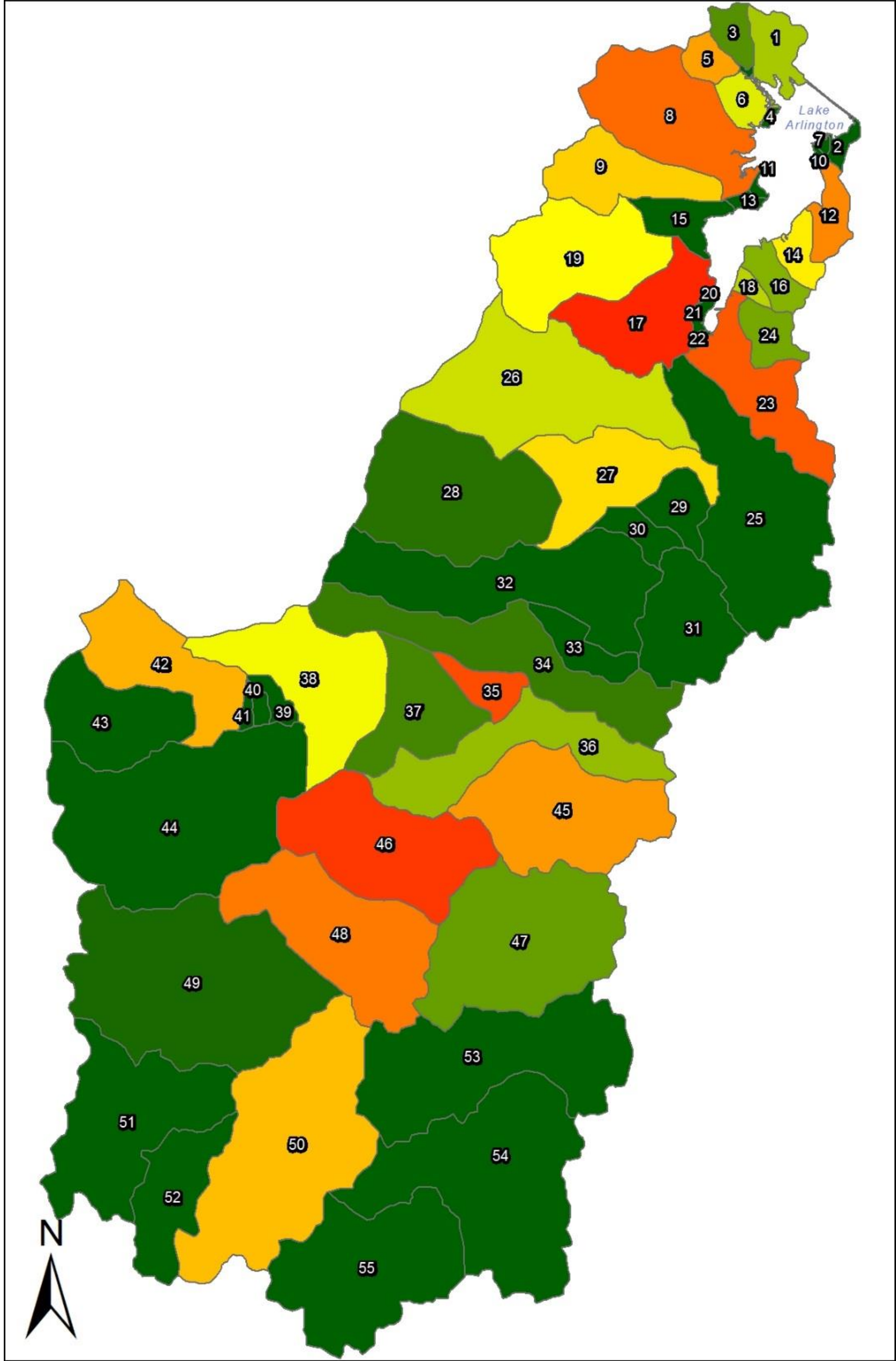
SELECT – SSOs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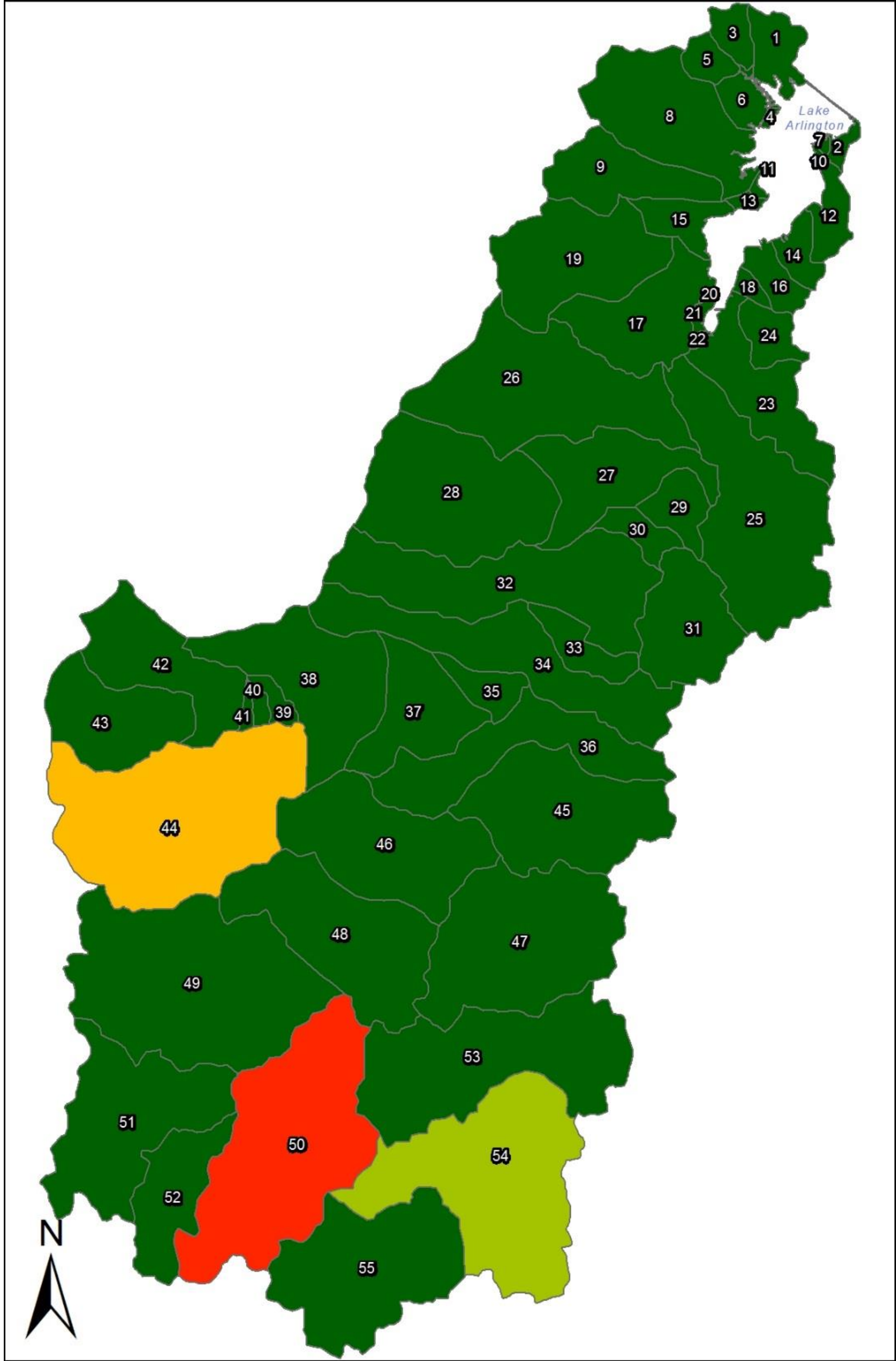
Wastewater Treatment Facilites

- Only three operating in watershed
  - Johnson County SUD
    - Good compliance record
  - Two smaller package plants
    - Mobile home park near Burleson
    - Subdivision near Crowley
  - All three have average discharge of < 8 MPN/100 mL (2014-2016)
    - Used 126 MPN/100 mL as surrogate for loading rate
  - Used each entity's average self-reported flow as discharge (2014-2016)
  - Discharged directly to stream – 100% contribution factor used

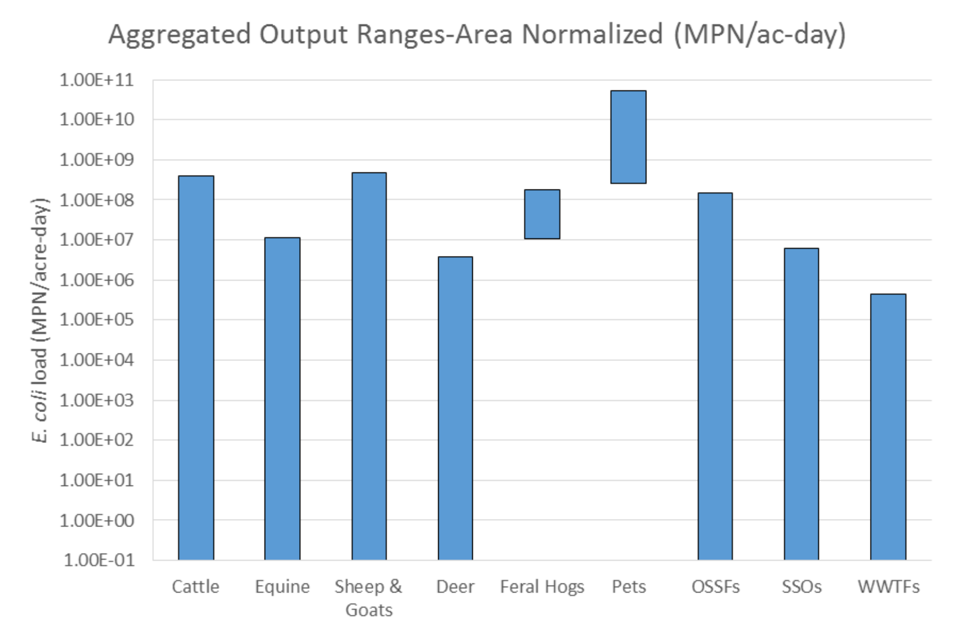
SELECT – WWTFs

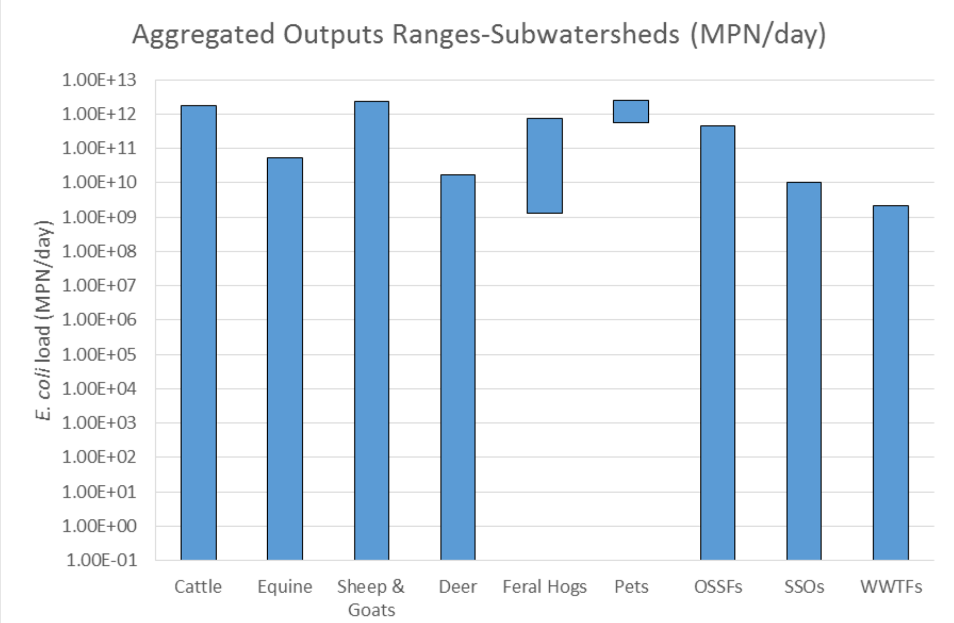


Max/Mins Across All Watersheds - All Sources

Daily Potential *E. coli* Load Ranges - Area Normalized	
Source	**Daily Potential *E. coli* Load (MPN/ac-day)**
Cattle	0 - 3.92E+08
Equine	0 - 1.14E+07
Sheep & Goats	0 - 4.89E+08
Deer	0 - 3.83E+06
Feral Hogs	1.04E+07 - 1.72E+08
Pets	2.54E+08 - 5.14E+10
OSSFs	0 - 1.49E+08
SSOs	0 - 6.03E+06
WWTFs	0 - 4.48E+05

Daily Potential *E. coli* Load Ranges - Subwatersheds	
Source	**Daily Potential *E. coli* Load (MPN/day)**
Cattle	0 - 1.78E+12
Equine	0 - 5.27E+10
Sheep & Goats	0 - 2.26E+12
Deer	0 - 1.64E+10
Feral Hogs	1.26E+09 - 7.64E+11
Pets	5.57E+11 - 1.99E+12
OSSFs	0 - 4.41E+11
SSOs	0 - 1.01E+10
WWTFs	0 - 2.14E+09

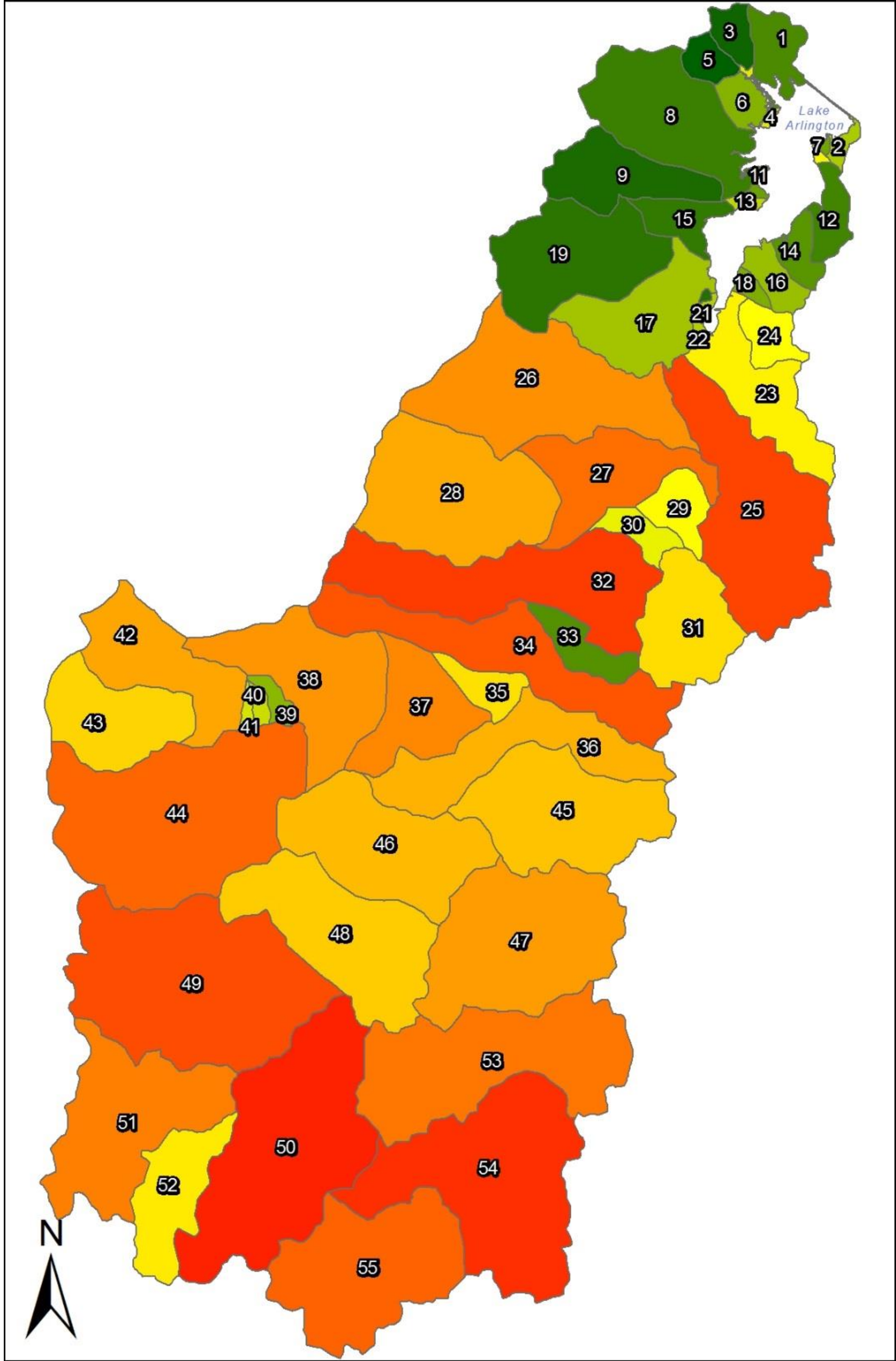




All Sources - Not Normalized

Dark red = <u>subwatersheds</u> w/ largest *E. coli* loads

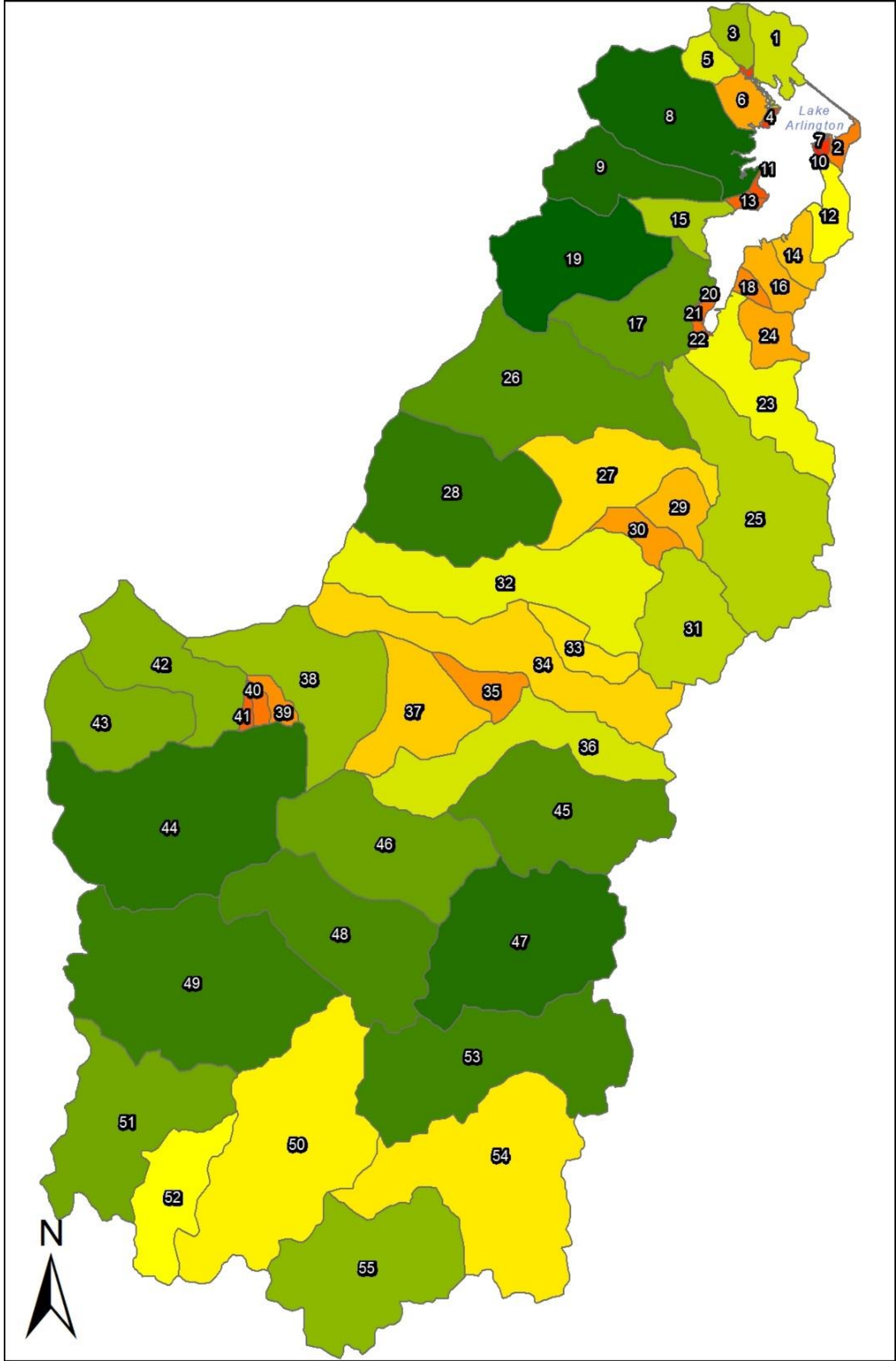
Unit basis = organisms/day



All Sources – Area Normalized

Dark red = largest <u>per-acre</u> *E. coli* loads

Unit basis = organisms/acre-day



Discussion

- Do we need to make adjustments?
  - Weighted contributions for riparian/upland
  - Change any of the loading rates (e.g. WWTFs)
  - Estimated populations (sheep, horses, feral hogs)
- Locations to focus on
- Likely sources based on location
- Strategy based on flow regime
- Appropriate BMPs to recommend
- Committee considers Partnership input, finalizes BMP recommendations

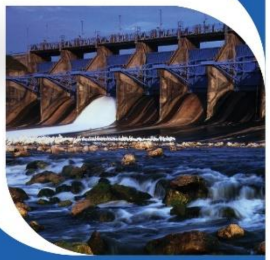
BRAIN BREAK…AGAIN

Preliminary Management Strategy Recommendations

Aaron Hoff

Trinity River Authority

January 11, 2018



Village Creek Lake Arlington WATERSHED PROTECTION

Trinity River Authority of Texas

Enriching the Trinity basin as a resource for Texans

Livestock BMPs

- Includes production farms/ranches for:
  - Cattle (beef and dairy)
  - Sheep/goats
  - Other production animals
- Problems:
  - Direct/indirect *E. coli* loading
  - Overgrazing upland areas
  - Degradation of riparian buffers
- BMPs
  - NRCS Water Quality Management Plans (WQMPs), starting w/those in riparian zones
  - Provide other technical assistance as needed
  - Work with natural resource agencies to develop/enhance educational programs
    - Production agriculture
    - "Hobby farms" and horse ranches

Deer & Other Wildlife BMPs

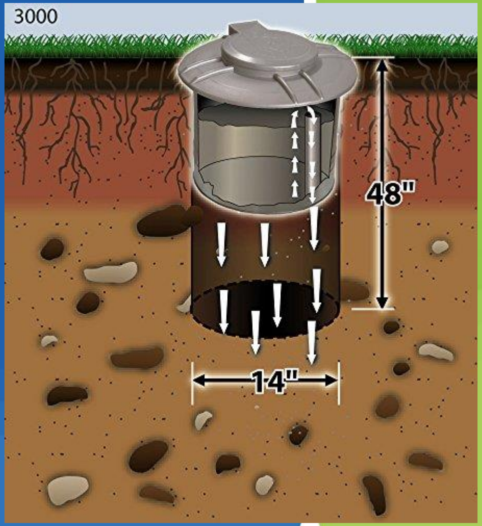
- Problem:
  - Direct/indirect *E. coli* loading in riparian zones
- "How do we manage wild animals?"
- BMP: Develop habitat management plans
  - Landowner partnerships w/TPWD
  - Ex: add supplemental feeding/watering locations outside of riparian zones

Feral Hog BMPs

- Problems
  - Direct/indirect *E. coli* loading in riparian zones
  - Destruction of riparian buffers, crops, pastures
  - Resource competition/predation w/ native species
- BMPs
  - Exclusion from wildlife feeders
  - Work w/ municipalities on “trap share” program for public greenspaces
  - Provide framework to landowners to easily access information to trappers, trap wholesalers, trapping programs, and other info
  - Continue delivery of feral hog educational workshops

Dogs and Cats BMPs

- Problem: Indirect *E. coli* loading from poop in yards, public greenspaces
- BMPs
  - Pet waste stations
    - Ensure good coverage of signage and pet waste stations in public areas
    - Ensure waste stations remain stocked/maintained
  - Public Education
    - Partner w/ NCTCOG on established campaigns
    - Utility bill inserts
    - Specialty programs – e.g., pet waste digesters
  - LID in greenspaces/yards
    - Provide technical assistance (maybe financial too?) for on-site remediation – bioretention, rain gardens, etc.

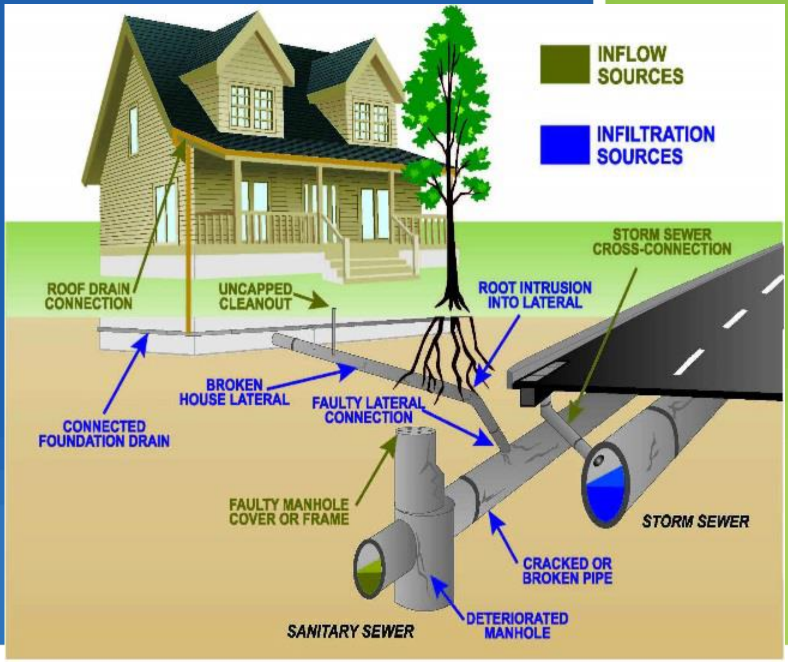


Septic Systems (OSSFs) BMPs

- Problem: direct/indirect loading from failing/non-existent OSSFs
- BMPs
  - Homeowner OSSF education programs
  - Work with municipalities to create/expand "septic to sewer" programs
  - Encourage ordinances that require OSSF to be inspected before property changes hands
  - Incentivize inspections (cheap or free) for existing property owners

Sanitary Sewer Overflows (SSOs)

- Problem: Direct/indirect loading from failing infrastructure/overloaded systems
- BMPs
  - Identify recurring SSOs in watershed
  - Work with municipalities to inventory current methods for SSO response:
    - Preventative maintenance
    - Addressing inflow/infiltration issues
    - Severe rain event prep
  - Public outreach
    - "Cease the Grease"/"Defend Your Drains"
    - "Flushable" Wipes



Nutrients BMPs

- Problem: overuse of fertilizers on lawns, greenspaces, ag fields
- BMPs
  - Many of the same BMPs applied to these areas for *E. coli* management will also result in nutrient reductions
    - WQMPs
    - LID
  - Education for landowners/land managers
    - Where/how to get soil tested
    - Drawbacks of over-fertilizing

Game Plan

- LDCs, SELECT, and management strategies will be developed into final WPP chapters
  - Draft chapters presented to Steering Committee for review and comment (early-mid March)
- Presented to TCEQ for review 4/30/18
- Present Draft WPP for public comment at Partnership meeting on 5/31/18
  - Address public comments
  - Return to TCEQ on 7/2/2018
- Final WPP submitted by 8/30/18

Questions?

http://www.trinityra.org/lakearlingtonvillagecreek

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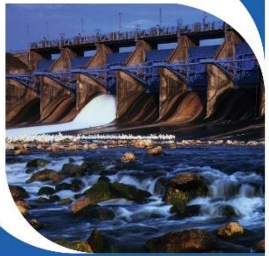
817.493.5581



ARLINGTON
THE AMERICAN DREAM CITY

EPA United States Environmental Protection Agency

Texas Commission on Environmental Quality