RECOMMENDED FRAMEWORK FOR EVALUATING ECOLOGICAL FLOWS IN THE STREAMS AND RIVERS OF NORTH CAROLINA

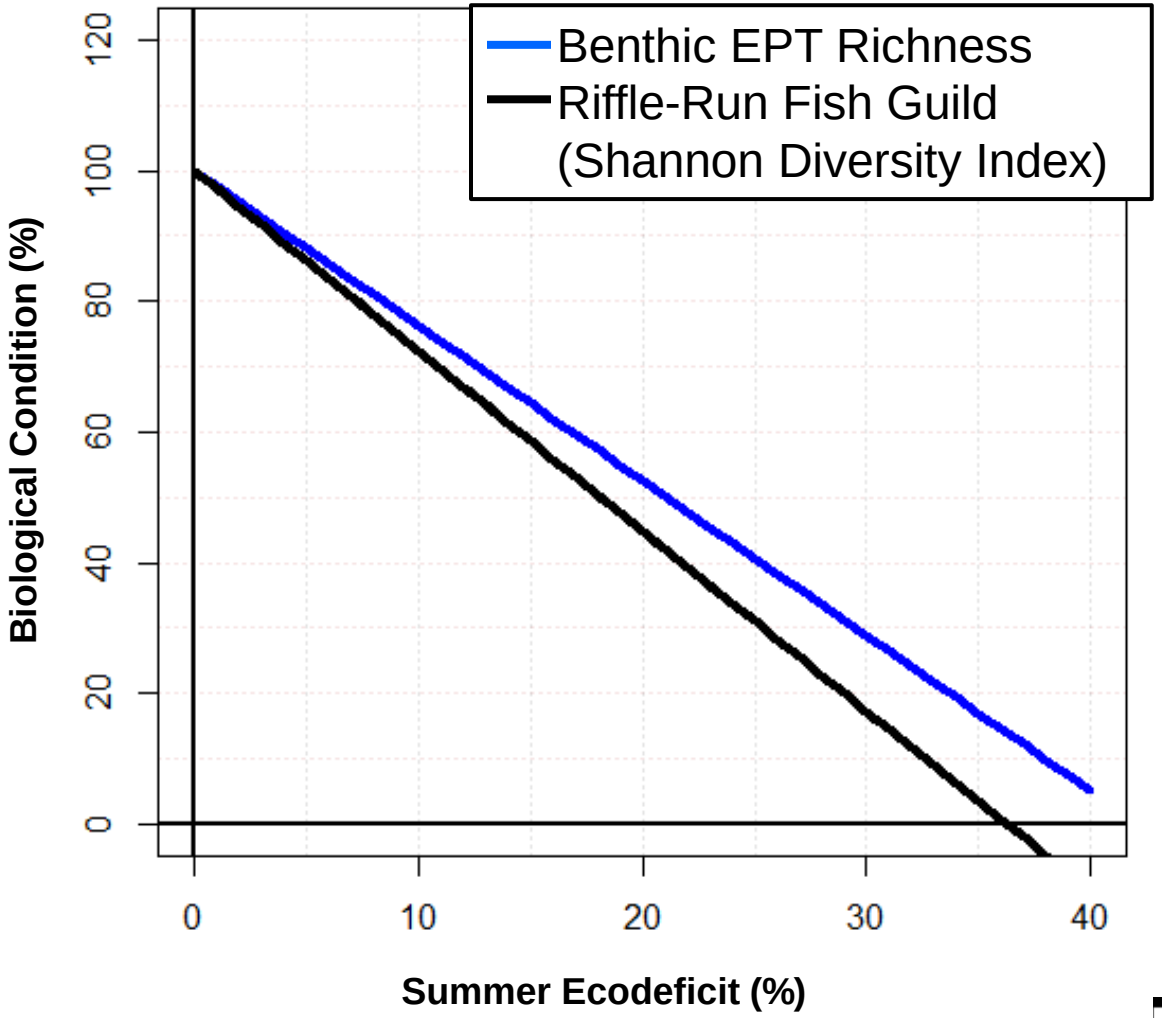
Conducted by: RTI and USGS

Funded by: Environmental Defense Fund, NC DENR, and NC WRC

COMPONENTS

- Flow Alteration – Biological (i.e., flow-biology) response curves for fish and benthos
  - Ecological Flow (EF) Categories and Thresholds
    - Based on “Working Rivers” concept
  - Examples within the Upper Neuse River Basin
- Where do these curves apply?

FLOW – BIOLOGY CURVES



ECOLOGICAL FLOW (EF) CATEGORIES AND THRESHOLDS

- EF Category = Current biological condition that determines EF Threshold
- EF Threshold = Change in biological condition (caused by flow alteration) that triggers a “red flag”

EF Category (current biological condition of stream/river (%))	EF Threshold (% change in biological condition before “red flag”)
100 – 80	5
80 – 60	10
60 – 35	15
<35	Other or minimum flows standard

- “Working Rivers” approach

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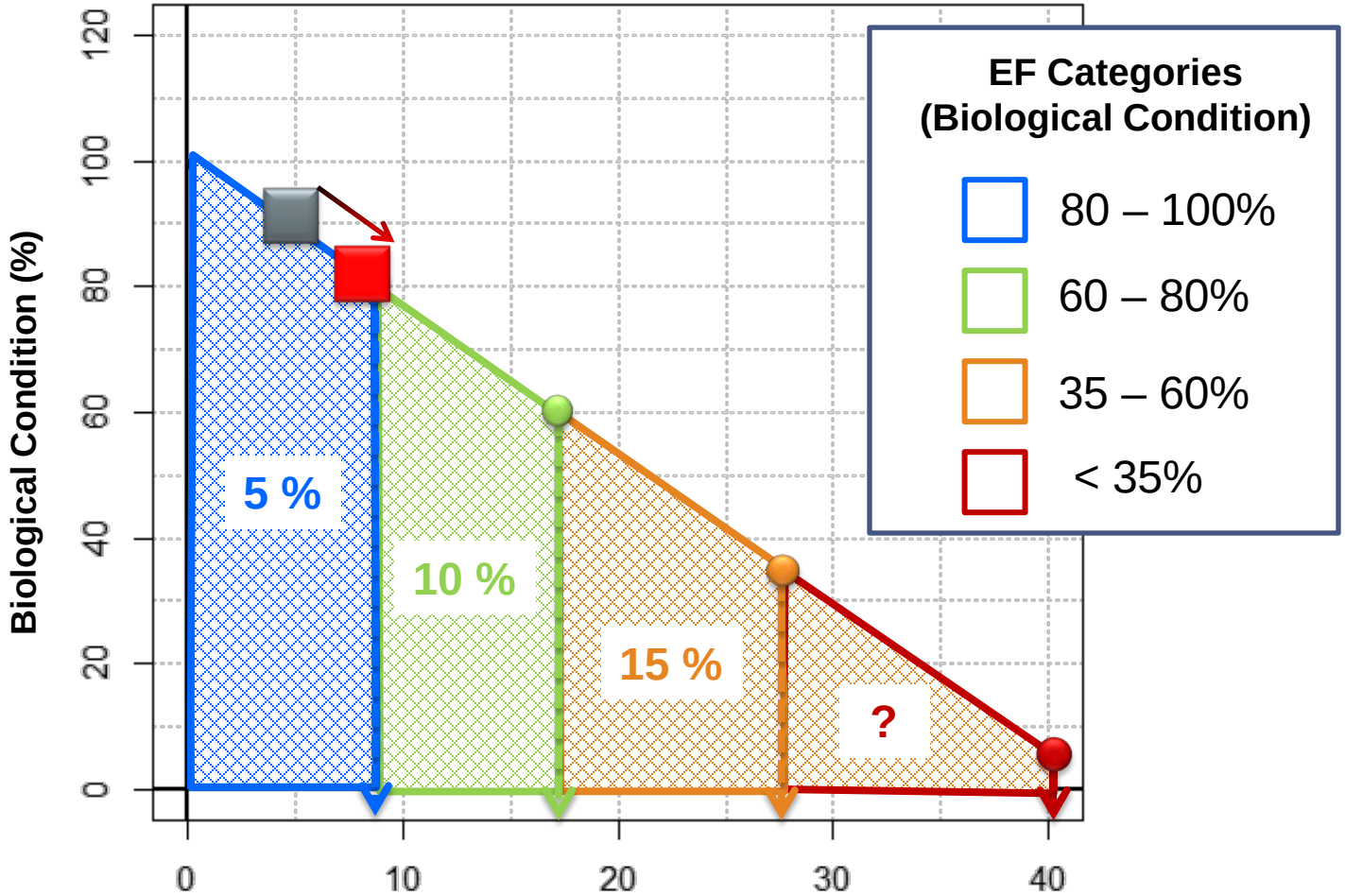
BENTHIC EPT RICHNESS IN RESPONSE TO SUMMER ECODEFICIT - EF CATEGORIES AND THRESHOLDS

Example:

- Current Ecodeficit = 6%
- Current Biological Condition = 85.8%
- EF Category:
  - 80-100%
- EF Threshold:
  - 5% change in biological condition
  - 8.1% Ecodeficit (2.1% additional Ecodeficit)



EF Category: 0 -------- 8.4% -----16.8% -------27.4% ----------40%

Summer Ecodeficit (%)

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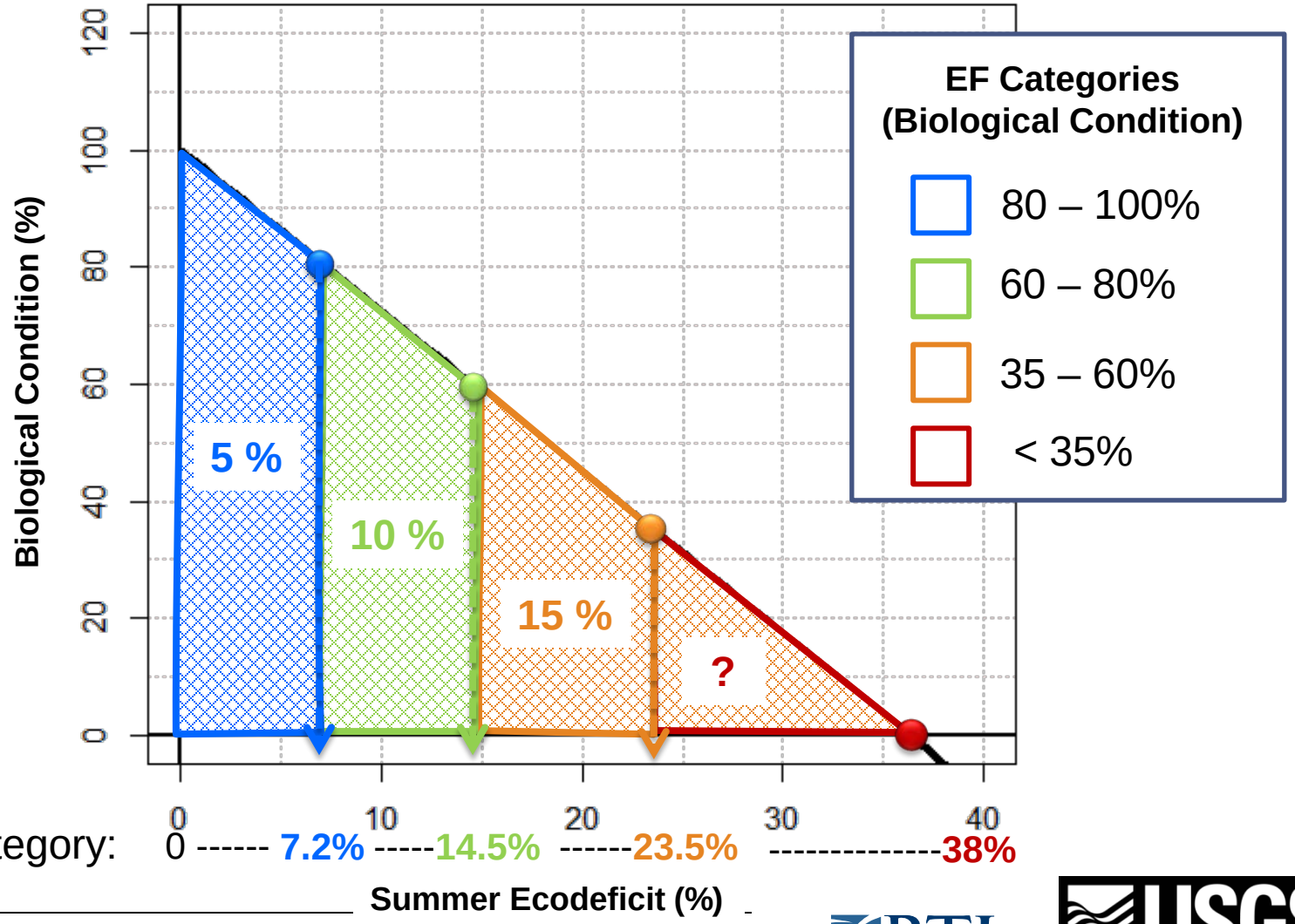
RIFFLE-RUN FISH GUILD SHANNON DIVERSITY IN RESPONSE TO SUMMER ECODEFICIT - EF CATEGORIES AND THRESHOLDS



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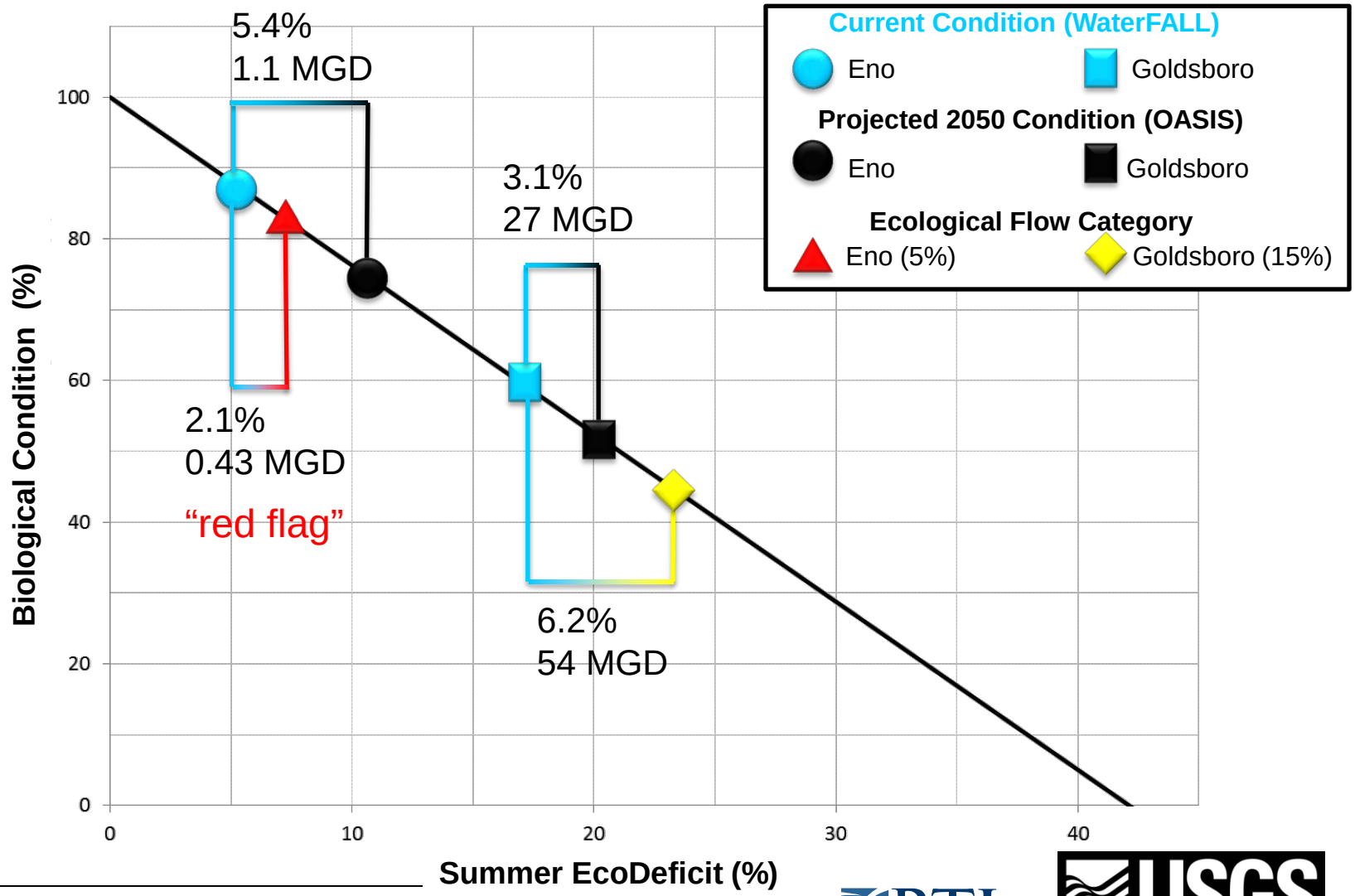
APPLICATION EXAMPLES – UPPER NEUSE BASIN

- Locations:
  - Eno River State Park stream segment
  - Goldsboro river segment
- Scenarios (flow metrics and associated biological condition):
  - Current Condition = WaterFALL PNV – 2006
  - Projected 2050 Condition = OASIS current – 2050
  - EF Category and Threshold = determined by flow-biology curve
- Flow metrics and Million Gallons per DAY (MGD)

BENTHIC EPT RICHNESS IN RESPONSE TO SUMMER ECODEFICIT - EXAMPLE



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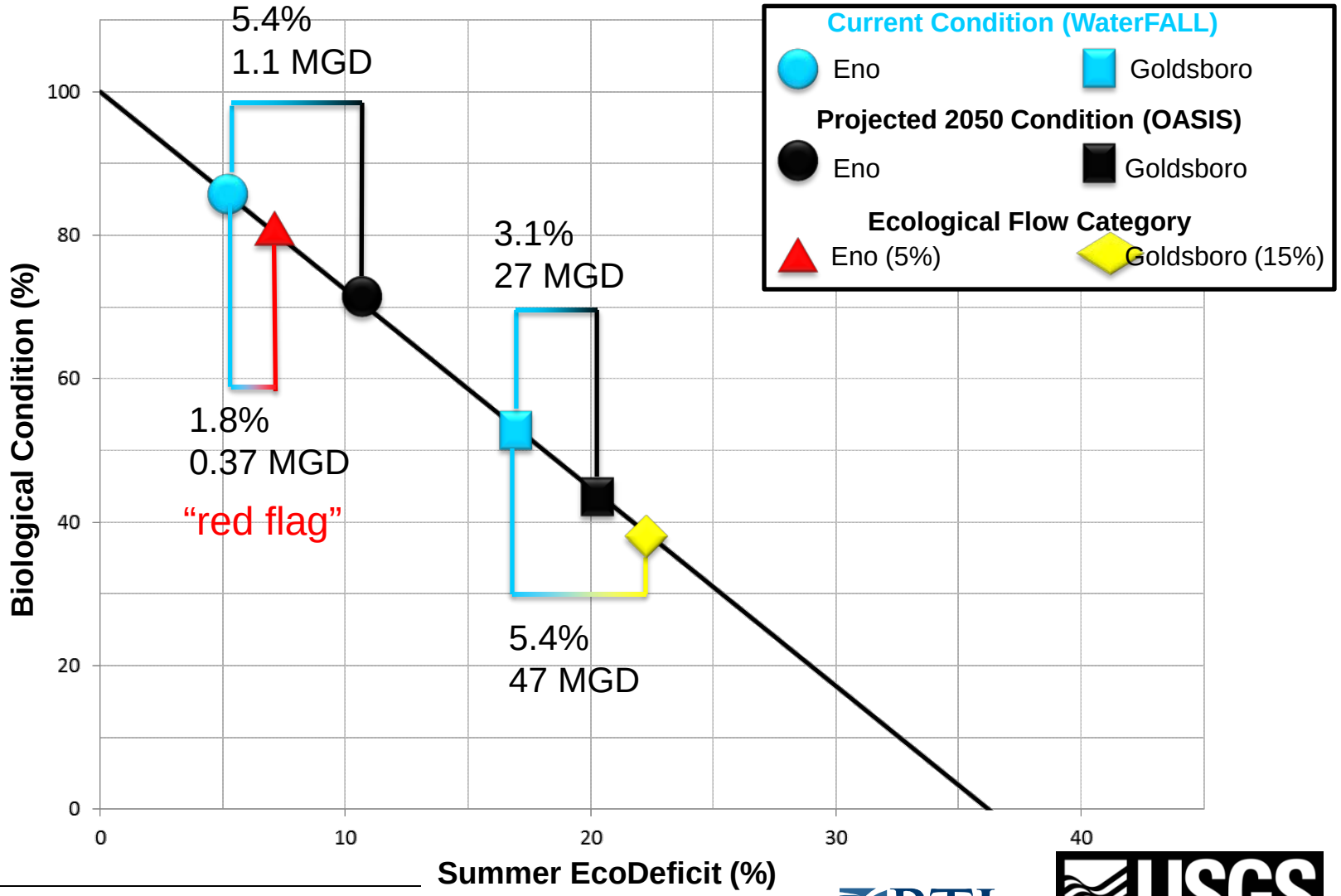
RIFFLE-RUN FISH GUILD SHANNON DIVERSITY IN RESPONSE TO SUMMER ECODEFICIT - EXAMPLE



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ENO RIVER AND GOLDSBORO EXAMPLES – SUMMARY OF FLOW METRICS: BENTHIC EPT RICHNESS

Eno River

Metric	Number of Days	Current EcoDeficit		Projected 2050 EcoDeficit - [Oasis]		Benthic Biologic Condition (%)	
		%	MGD	%	MGD	Current	2050
Winter	121	2.5%	2.0	4.2%	3.4	93.7	83.0
Spring	91	3.7%	1.6	2.8%	1.4	90.9	83.9
Summer	92	5.3%	0.9	5.4%	1.1	87.4	74.7
Fall	61	3.5%	1.1	3.0%	0.5	92.1	85.4
30 Day Min Flow	30	1.7%	0.0	13.1%	1.0	97.7	79.5

Goldsboro

Metric	Number of Days	Current EcoDeficit		Projected 2050 EcoDeficit - [Oasis]		Benthic Biologic Condition (%)	
		%	MGD	%	MGD	Current	2050
Winter	121	12.8%	278	2.5%	57	67.6	61.1
Spring	91	12.5%	142	2.5%	32	69.2	63.1
Summer	92	17.1%	175	3.1%	27	59.4	52.0
Fall	61	21.1%	220	4.1%	23	52.5	43.3
30 Day Min Flow	30	NA	NA	NA	NA	NA	NA

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ENO RIVER AND GOLDSBORO EXAMPLES – SUMMARY OF FLOW METRICS: RIFFLE-RUN GUILD

Eno River

Metric	Number of Days	Current EcoDeficit		Projected 2050 EcoDeficit - [Oasis]		Fish Biologic Condition (%)	
		%	MGD	%	MGD	Current	2050
Winter	121	2.5%	2.0	4.2%	3.4	96.6	91.0
Spring	91	3.7%	1.6	2.8%	1.4	93.9	89.2
Summer	92	5.3%	0.9	5.4%	1.1	85.4	70.6
Fall	61	3.5%	1.1	3.0%	0.5	92.7	86.4
30 Day Min Flow	30	1.7%	0.0	13.1%	1.0	97.3	76.3

Goldsboro

Metric	Number of Days	Current EcoDeficit		Projected 2050 EcoDeficit - [Oasis]		Fish Biologic Condition (%)	
		%	MGD	%	MGD	Current	2050
Winter	121	12.8%	278	2.5%	57	82.7	79.3
Spring	91	12.5%	142	2.5%	32	79.3	75.3
Summer	92	17.1%	175	3.1%	27	52.8	44.1
Fall	61	21.1%	220	4.1%	23	55.9	47.4
30 Day Min Flow	30	NA	NA	NA	NA	NA	NA

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COMPONENTS

- Flow alteration – Biological (i.e., flow-biology) response curves for fish and benthos
  - Ecological Flow (EF) Thresholds
  - Examples within the Upper Neuse River Basin
- Where do these curves apply?

WHERE DO THE FLOW-BIOLOGY RELATIONSHIPS APPLY?

River Class	Drainage Area (sq miles)	# Fish Sites	% Fish Sites	# Benthic Sites	% Benthic Sites	# of Biological Monitoring Sites	% Biological Monitoring Sites
Headwater	< 39	701	81.7	1,124	65.3	1,825	70.7
Creek & small rivers	>= 39 < 200	154	17.9	409	23.7	563	21.8
Medium rivers	>= 200 < 1,000	3	0.4	130	7.6	133	5.2
Mainstem rivers	>= 1,000 < 3,861	0	0.0	42	2.4	42	1.6
Large rivers	>= 3,861	0	0.0	17	1.0	17	0.7
	Totals	**858**	**100**	**1,722**	**100**	**2,580**	**100**

River Class	Drainage Area (sq miles)	Count	% NC catchments
Headwater	< 39	59,803	86.7
Creek & small rivers	>= 39 < 200	5,377	7.8
Medium rivers	>= 200 < 1,000	2,210	3.2
Mainstem rivers	>= 1,000 < 3,861	1,106	1.6
Large rivers	>= 3,861	509	0.7
	Totals	**69,005**	**100**

RECOMMENDATION: Apply framework for fish and benthos to all rivers and streams in NC until more data become available

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QUESTIONS?