Proposed Stream Nutrient Assessment Procedure (SNAP)

STEP 1	*STEP 2*	*STEP 3*	*STEP 4*	
Biological Criteria	**DO Swing** [2]	**Benthic Chlorophyll** [3]	**Preliminary Assessment: Trophic Condition Status of Evaluated ~~Reach~~ Segment or Waterbody**	
All indices attaining or in non-significant departure[1]	Normal or low swings (≤6.5 mg/l)	Low to moderate (≤320 mg/m^2)	Attaining use / Not threatened	
		High (>320 mg/m^2)	Attaining use, but may be threatened	*See Flow Chart A*
	Wide swings (>6.5 mg/l)	Low (≤182 mg/m^2)		
		Moderate to high (>182 mg/m^2)		
Non-attaining (one or more indices below non-significant departure)	Normal or low swings (≤6.5 mg/l)	Low to moderate (≤320 mg/m^2)	Impaired, but cause(s) other than nutrients	*See Flow Chart B*
		High (>320 mg/m^2)	Impaired; likely nutrients over-enrichment	*See Flow Chart C*
	Wide swings (>6.5 mg/l)	Low (≤182 mg/m^2)		
		Moderate to high (>182 mg/m^2)	Impaired; Nutrients over-enrichment	

Proposed Stream Nutrient Assessment Procedure (SNAP) -- continued

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Notes:

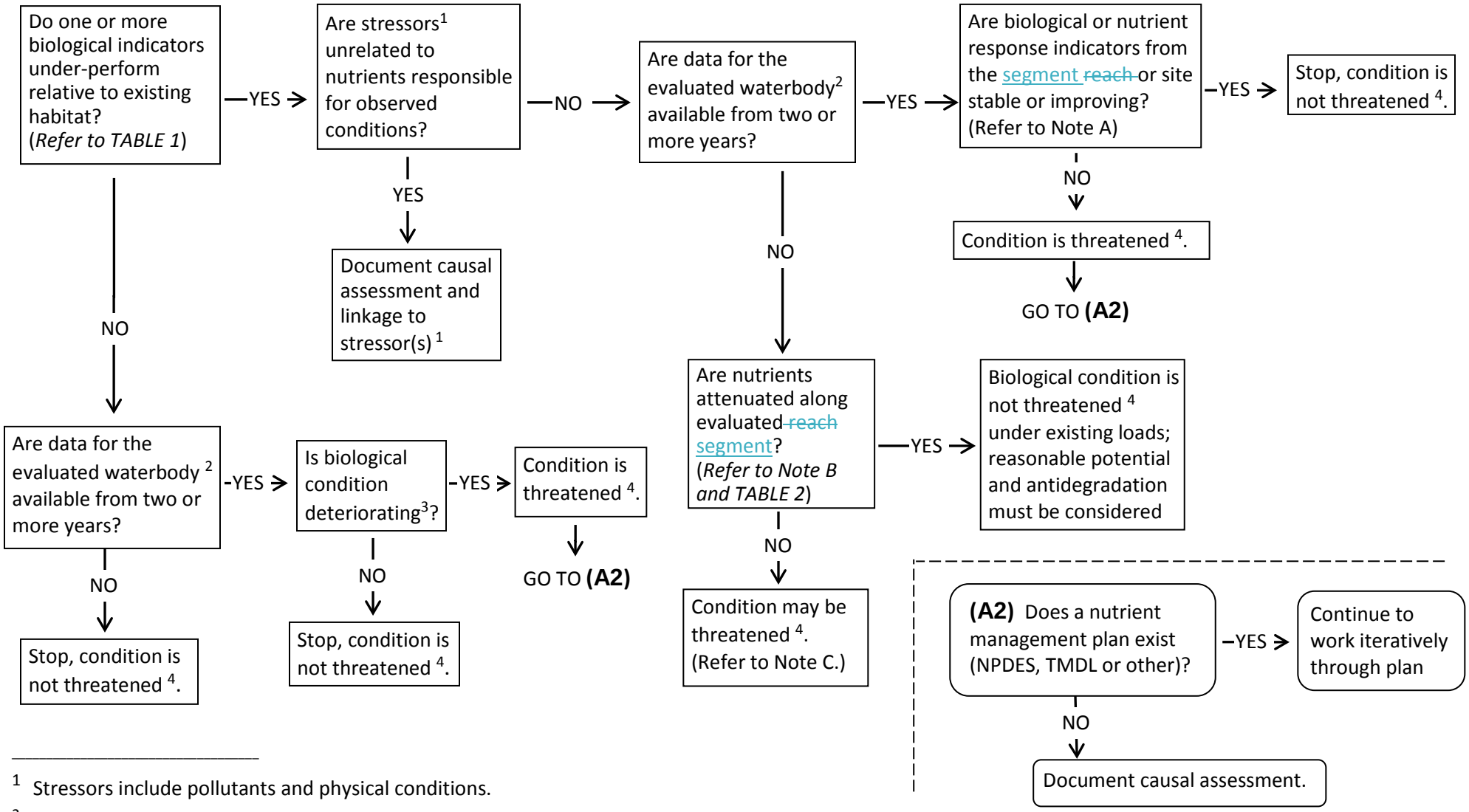
[1] Non-significant departure from biocriteria values accounts for background variability in measurements for biological indices. In accordance with "*Biological Criteria for the Protection of Aquatic Life: Volume II: Users Manual for Biological Field Assessment of Ohio Surface Waters*", Ohio EPA (1987, updated 1988, 1989, 2006), non-significant departure is 4 points for IBI and ICI, and 0.5 point for MIwb.

[2] Threshold value for 24-hour DO swing based upon a change point of 6.5 mg/l between DO swing and minimum DO. "Low to normal" DO swing is ≤6.5 mg/l. "Wide" DO swing is >6.5 mg/l. Data used for analysis from *Technical Support Document for Nutrient Water Quality Standards for Ohio Rivers and Streams*, Ohio EPA (2011).

[3] Threshold values for benthic chlorophyll *a* are based upon change points between benthic chlorophyll *a* and DO swings or Invertebrate Community Index (ICI). "Low" chlorophyll *a* is ≤182 mg/m^2. "Moderate" chlorophyll *a* is >182 and ≤320 mg/m^2. "High" chlorophyll *a* is >320 mg/m^2. Data used for analysis from *Technical Support Document for Nutrient Water Quality Standards for Ohio Rivers and Streams*, Ohio EPA (2011).

FLOW CHART A. – DECISION TREE FOR DETERMINING WHEN BIOLOGICALLY ATTAINING CONDITION STATUS IS THREATENED BY NUTRIENTS

For application when biological criteria are attaining, but one or both nutrient response indicators (DO swing or benthic chlorophyll) are elevated.



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[1] Stressors include pollutants and physical conditions.

[2] The geographic scope or length of evaluated stream segments ~~reaches or waterbodies~~ are defined in approved study plans.

[3] For a given ~~site~~location, a decrease of 5 or more IBI or ICI points, or 0.6 or more MIWb points between sampling years ~~can~~ represents a significant change. Trends for waterbodies are formally evaluated in Biological and Water Quality Technical Support Documents.

[4] As recommended by US EPA in its integrated reporting guidance (*Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act*), "threatened" waters are currently attaining WQSs but are expected to not meet WQSs by the next listing cycle (every two years). For example, a declining trend may indicate threatened status, whereas a stable or improving trend would not.

Flow Chart A (continued) – Additional Notes:

Note A. Two set of circumstances result in a determination of "threatened" by nutrient impacts – (1) when biological indicators are underperforming relative to habitat and biological or nutrient response indicators are not stable or improving; and (2) when (although biological indicators are not underperforming) the biological condition is deteriorating. For such cases, the Flow Chart at "A2" provides a conditional evaluation for a subset of cases where existing nutrient management plans exist, either via NPDES permit, TMDL, or other. In such cases, the Flow Chart indicates that the nutrient management plan shall continue to be implemented iteratively, reviewing and reassessing the results of implementation.

~~The top row provides a conditional evaluation for a subset of cases where existing nutrient management plans exist, either via NPDES permits or a TMDL. To enter this row, the determination has already been made that nutrient response indicators are elevated, and biological indicators are under-performing relative to habitat. This evaluation identifies cases where biology may be under-performing, but is on an improving trajectory due to management. An existing management plan implies historic data exist, and that the reach was likely flagged as impaired; therefore, in most cases, to get to the right hand side of this row presupposes that the biological condition has already improved.~~

Note B. Attenuation of nutrients in an evaluated ~~reach~~ segment is demonstrated by nutrient concentrations measured at two or more successive sites downstream from a defined source decreasing through uptake, sequestration or dilution such that concentrations fall to either background levels or levels where risk of eutrophication to downstream waters is minimal (see Table 2). Where there are no historic data on which to base trends, attenuation of nutrients within the ~~reach~~ segment implies assimilation within what the waterbody can handle under existing conditions, and that stress from the nutrient load is spatially transient (i.e., localized to the immediate ~~reach~~segment).

Note C. If attenuation appears ambiguous or cannot be determined because of an insufficient number of downstream sampling points between the source in question and the next downstream receiving water or the next downstream major source contributor, additional sampling is needed to determine condition status.

TABLE 1 – Equations used as guidance to help determine whether biological indicators are underperforming relative to existing habitat.

To assist in determining whether measured biological indicator values at the site being assessed underperform relative to the existing habitat, the measured value(s) are compared with the 25th and 15th percentile values of all data classified as unimpaired in the Ohio EPA assessment database and stratified by the designated classification (EWH, WWH or MWH) within the specific ecoregion for the site. The 25th and 15th percentiles represent levels that most sites equal or exceed. If the respective measured biological indicator value is less than the 15th percentile value then the site is likely underperforming relative to what could be expected given the local habitat quality (QHEI). If the indicator value is between the 15th and 25th percentile values, additional information or observations should be used to determine whether ~~or not~~ the site is underperforming with respect to its habitat. If the indicator value is above the 25th percentile value, the site ~~would be considered~~ is performing within the range expected for the existing habitat.

The following equations calculate the 25th and 15th percentile values as determined by regression analysis for the respective biological indicators for a given QHEI score, or a combination of QHEI score and drainage area. For small streams where insufficient stream flow prevents collection of a quantitative sample, thereby precluding calculation of an ICI score, the number of EPT taxa is used as the macroinvertebrate indicator. Such small streams are typically less than 20 square miles in drainage area, or larger if stream velocity is insufficient to collect a quantitative sample.

Class / Ecoregion		Percentile	IBI (fish)	MIWb (fish)	EPT Taxa (macroinvertebrates)	ICI (macroinvertebrates)
EWH / All Ecoregions		25th	40.67 + 0.118·QHEI	8.21 + 0.006·QHEI + 0.385·Log10(DA)	4.65 + 0.123·QHEI + 1.182·Log10(DA)	= 46
		15th	39.60 + 0.113·QHEI	NA	1.47 + 0.151··QHEI + 1.084·Log10(DA)	NA
WWH & MWH	HELP	25th	23.65 + 0.150··QHEI	5.64 + 0.959·Log10(DA)	4.26 + 2.585·Log10(DA)	All Ecoregions: 25th percentile: 25.60 + 0.160·QHEI 15th percentile: 19.32 + 0.213·QHEI
		15th	22.00 + 0.121·QHEI	NA	2.54 + 2.659·Log10(DA)	
	EOLP	25th	22.00 + 0.316·QHEI	4.76 + 0.043·QHEI + 0.491·Log10(DA)	NA	
		15th	18.24 + 0.336·QHEI	4.55 + 0.045·QHEI + 0.397·Log10(DA)	= 9 taxa	
	WAP	25th	31.30 + 0.200·QHEI	7.94 + 0.537·Log10(DA)	3.94 + 0.114·QHEI	
		15th	27.78 + 0.225·QHEI	7.58 + 0.543·Log10(DA)	2.14 + 0.113·QHEI	
	ECBP & IP	25th	29.96 + 0.157·QHEI	4.94 + 0.036·QHEI + 0.388·Log10(DA)	-0.95 + 0.147·QHEI + 0.927·Log10(DA)	
		15th	29.47 + 0.133·QHEI	4.96 + 0.034·QHEI + 0.362·Log10(DA)	-2.19 + 0.138·QHEI + 1.010·Log10(DA)	

NA = Not Available. Could not be determined because of limited data or data distribution.
DA = Drainage Area (in square miles)

TABLE 2 – Concentrations of total phosphorus (TP) and dissolved inorganic nitrogen (DIN) arrayed by narrative levels of ecological risk.

Table 2 presents narrative descriptions of various levels of ecological condition and potential risk, arrayed with ranges of nutrient concentrations commonly observed at the respective ecological condition levels. This information may be useful reference for nutrient assessment using Charts A or C. **Chart A**: Attenuation from a defined source may be inferred by nutrient concentrations measured at successive stations within an evaluated decreasing from a higher risk level to a lower risk level. **Chart C**: Table 2 may be used as a general reference in assessing impairment risk. Actual risks and the potential benefits of abatement are site-specific determinations.

		← *DECREASING RISK*				
	TP Conc. (mg/l)	**DIN Concentration** (mg/l)				
		<0.44	0.44 < 1.10	1.10 < 3.60	3.60 < 6.70	≥6.70
DECREASING RISK →	<0.040	background levels typical of least disturbed conditions	levels typical of developed lands; little or no risk to beneficial uses	levels typical of modestly enriched condition in phosphorus limited systems; low risk to beneficial use if allied responses are within normal ranges	levels typical of enriched condition in phosphorus limited systems; moderate risk to beneficial use if allied responses are elevated	characteristic of tile-drained lands; otherwise atypical condition with moderate risk to beneficial use if allied responses are elevated (1.1% of observations)
	0.040-<0.080	levels typical of developed lands; little or no risk to beneficial uses	levels typical of developed lands; little or no risk to beneficial uses	levels typical of working landscapes; low risk to beneficial use if allied responses are within normal ranges	levels typical of enriched condition in phosphorus limited systems; moderate risk to beneficial use if allied responses are elevated	characteristic of tile-drained lands; moderate risk to beneficial use if allied responses are elevated (1.1% of observations)
	0.080-<0.131	levels typical of modestly enriched condition in nitrogen limited systems; low risk to beneficial use if allied responses are within normal ranges	levels typical of working landscapes; low risk to beneficial use if allied responses are within normal ranges	levels typical of working landscapes; low risk to beneficial use if allied responses are within normal ranges	characteristic of tile-drained lands; moderate risk to beneficial use if allied responses are elevated; increased risk with poor habitat	characteristic of tile-drained lands; moderate risk to beneficial use if allied responses are elevated (1.0% of observations)
	0.131-<0.400	levels typical of modestly enriched condition in nitrogen limited systems; low risk to beneficial use if allied responses are within normal ranges	levels typical of enriched condition; low risk to beneficial use if allied responses are within normal ranges	levels typical of enriched condition; low risk to beneficial use if allied responses are within normal ranges; increased risk with poor habitat	enriched condition; generally high risk to beneficial uses; often co-occurring with multiple stressors; increased risk with poor habitat	enriched condition; generally high risk to beneficial uses; often co-occurring with multiple stressors
	≥0.400	atypical condition (1.3% of observations)	atypical condition (1% of observations);	enriched condition; generally high risk to beneficial uses; often co-occurring with multiple stressors; increased risk with poor habitat	enriched condition; generally high risk to beneficial uses; often co-occurring with multiple stressors ; increased risk with poor habitat	enriched condition; generally high risk to beneficial uses; often co-occurring with multiple stressors

”allied responses” = allied response indicators (24-hour DO swing, benthic chlorophyll)

TABLE 2 (continued)

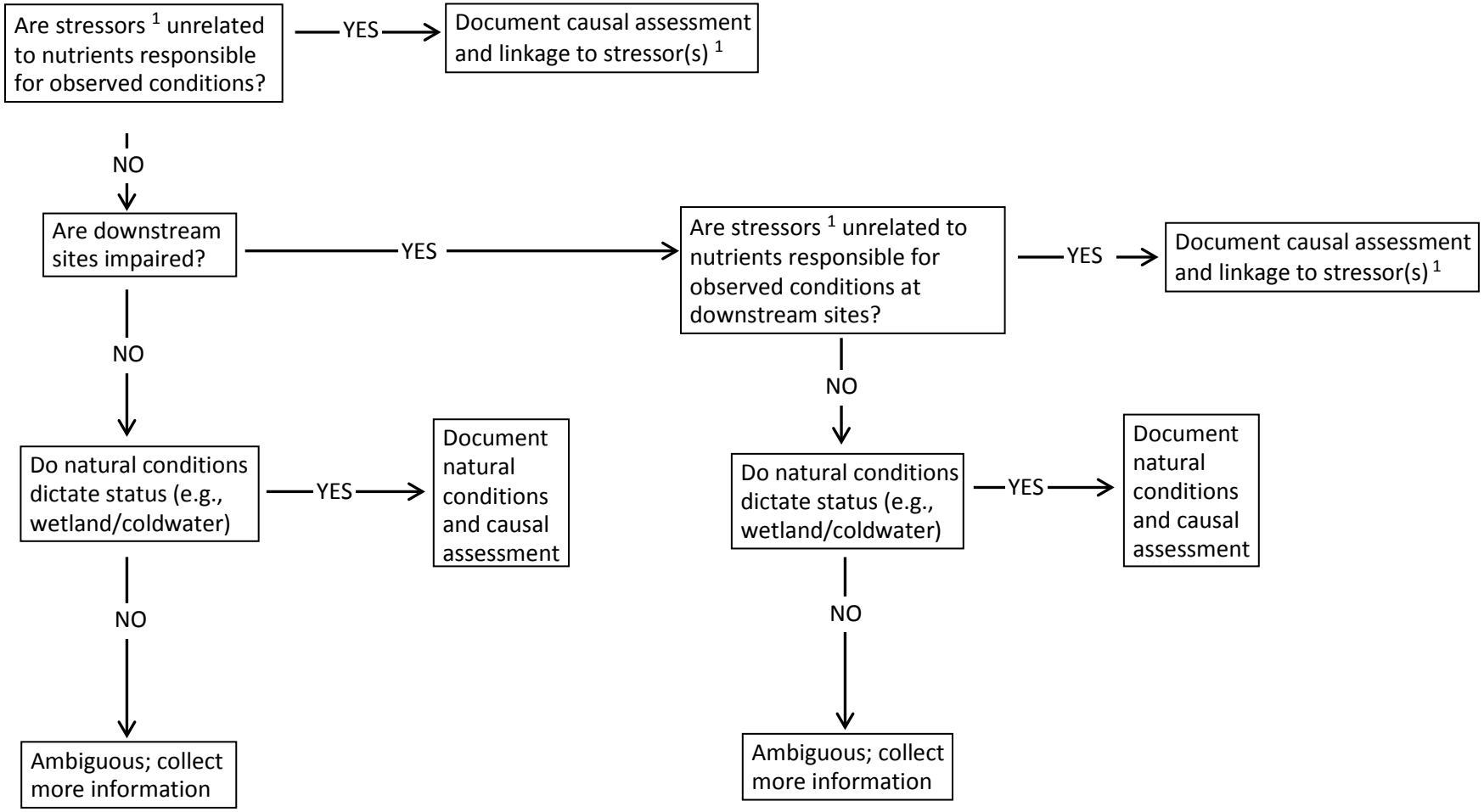
Ohio EPA's monitoring data for the years 1981 through 2011 (n = 16,870), from index period samples (June-October) and all stream sizes, was used to derive the information presented in Table 2. Following is the frequency of occurrence in the database for each nutrient concentration range, expressed as percent of total data values.

Frequency of Occurrence in Database, as Percent of Total (n=16,870)

Total Phosphorus (TP) [mg/l]	**Dissolved Inorganic Nitrogen (DIN)** [mg/l]				
	<0.44	0.44 < 1.10	1.10 < 3.60	3.60 < 6.70	≥6.70
<0.040	18.14%	5.00%	4.26%	1.13%	0.66%
0.040 < 0.080	6.50%	5.66%	4.87%	1.11%	0.29%
0.080 < 0.131	3.30%	3.77%	5.20%	1.01%	0.31%
0.131 < 0.400	3.62%	4.31%	11.39%	3.01%	1.45%
≥0.400	1.33%	0.99%	4.84%	4.07%	3.78%

FLOW CHART B – DECISION TREE FOR DETERMINING BIOLOGICAL IMPAIRMENT CAUSED BY STRESSORS OTHER THAN NUTRIENTS

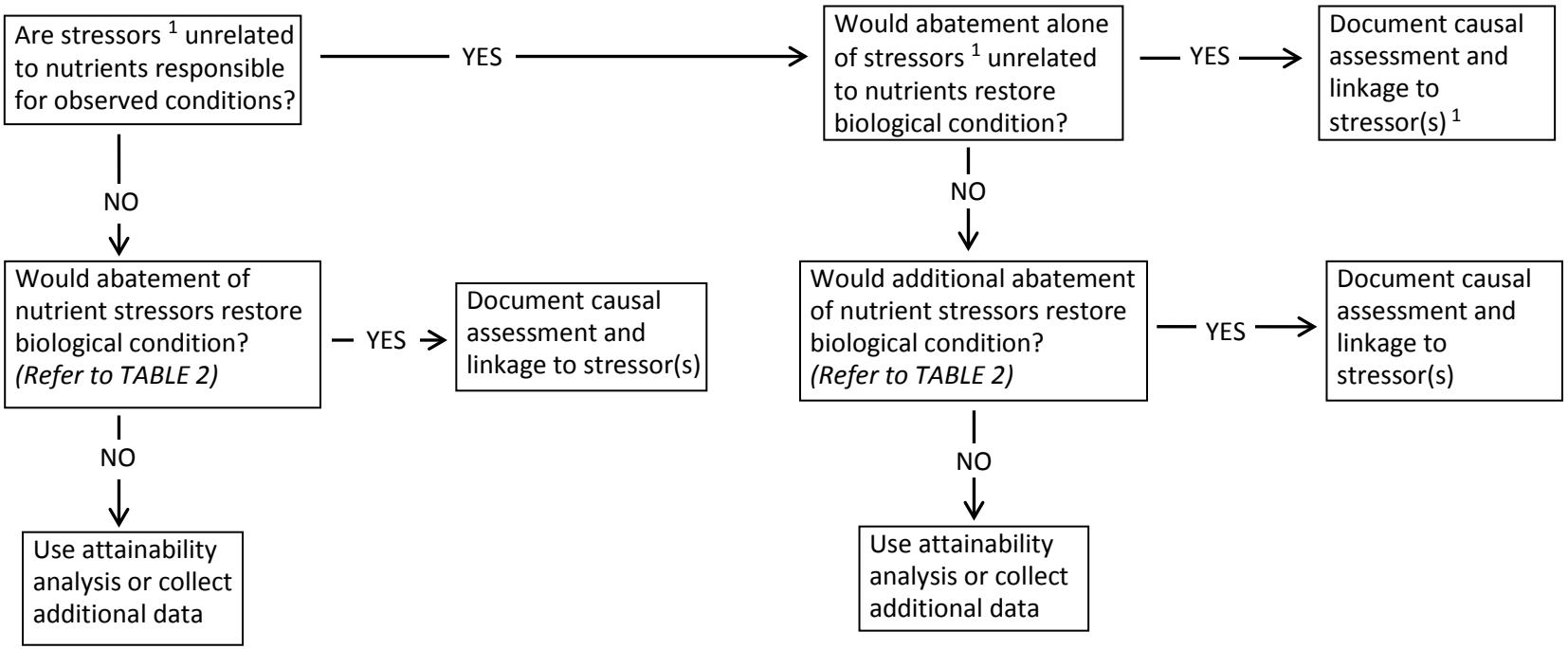
For application when one or more biological criteria are non-attaining, but no nutrient response indicators (DO swing or benthic chlorophyll) are elevated.



[1] Stressors include pollutants and physical conditions.

FLOW CHART C – DECISION TREE FOR CONFIRMING BIOLOGICAL IMPAIRMENT CAUSED BY NUTRIENTS

For application when one or more biological criteria are non-attaining, and either nutrient response indicator (DO swing or benthic chlorophyll) is elevated.



[1] Stressors include pollutants and physical conditions.