

**Impact Assessment Model for Clear Water Fishes
Exposed to Conditions of Reduced Water Clarity**

Visual clarity of water (yBD) and related variables:				Duration of exposure to conditions of reduced VISUAL CLARITY (log _e hours)											Fish reactive distance: calibrated for trout			
alternate		preferred		0	1	2	3	4	5	6	7	8	9	10	ψ _{BD}	xRD		
NTU	zSD	BA	yBD	Severity-of-ill-effect Scores (SEV) -- Potential											ψ _{BD}	xRD		
(Δ ntu _{z,λ})	(m)	(m ⁻¹)	(m)	SEV = - 4.49 + 0.92(log _e h) - 2.59(log _e yBD)											(cm)	(cm)		
1100	0.01	500	0.010	7	8	9	10	11	12	13	14					1		
			0.014	7	7	8	9	10	11	12	13	14					1	
400	0.03	225	0.02	^P 6 ^π	7	7	8	9	10	11	12	13	14			2		
			0.03	4	5	6	7	8	9	10	11	12	13	14			3	
150	0.07	100	0.05	3	^P 4 ^π	^P 5 ^π	6	7	8	9	10	11	12	13			5	
			0.07	2	3	4	5	6	7	8	9	10	11	11			7	
55	0.15	45	0.11	^P 1 ^π	2	3	4	5	6	7	8	9	10	10			11	6
			0.16	<u>0</u>	<u>1</u>	2	3	4	<u>5</u>	6	7	8	9	9			16	17
20	0.34	20	0.24	<u>0</u>	^P 0 ^π	^P 1 ^π	2	3	4	5	6	7	<u>8</u>	8			24	30
			0.36	<u>0</u>	<u>0</u>	<u>0</u>	1	2	3	4	5	6	6	7			36	42
7	0.77	9	0.55	<u>0</u>	^P 0 ^π	<u>0</u>	<u>0</u>	1	2	3	4	4	5	6			55	55
			0.77	<u>0</u>	^P 0 ^π	^P 0 ^π	<u>0</u>	<u>0</u>	1	2	3	4	4	5			77	66
3	1.53	4	1.09	<u>0</u>	^P 0 ^π	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	1	2	3	4	5			109	77
			1.69	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	1	2	2	3			169	90
1	3.68	2	2.63	^P 0 ^π	^P 0 ^π	^P 0 ^π	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	1	2			263	104
				1	3	7	1	2	6	2	7	4	11	30				
				Hours			Days			Weeks		Months						
				a	b	c	d	e	f	g	h	i	j	k				

- yBD Black disk sighting range (m): horizontal measurement in water of any depth (reciprocal of beam attenuation).
 - ψ_{BD} Black disk sighting range (cm) -- a convenient calibration for measurements made in very cloudy water.
 - BA Beam attenuation (m⁻¹): measures absorption and scattering of light by "water constituents"-- clay and colour.
 - zSD Secchi disk sighting range (m): vertical measurement, usually in deep water.
 - xRD Trout reactive distance as a function of black disk sighting range (at ≥ 50 lux): this calibration has the form y = a + bln(x) -- where y represents reactive distance (cm), and x represents visual clarity (black disk sighting range, cm), and where a and b are intercept and slope respectively -- such that y = - 68.0546 + 30.8307 ln(x).
 - NTU Nephelometric turbidity units: a measure of light-scattering by suspended clay particles (0.2 to 5 μm diameter).
 - Δ ntu_z Ambient < acceptable short-term increase in turbidity ≤ 8-NTU; 0-hour < duration ≤ 24-hours (a guideline).
 - Δ ntu_λ Ambient < acceptable long-term increase in turbidity ≤ 2-NTU; 1-day < duration ≤ 30-days (a guideline).
 - SEV Severity-of-ill-effect scale: 0 ≤ nil < 0.5; 0.5 ≤ minor < 3.5; 3.5 ≤ moderate < 8.5; 8.5 ≤ severe < 14.5. Impact assessment is based on net duration (less clear-water intervals) and weighted-average visual clarity data. Recurrent events sum when integrated over relevant intervals: for a year class (a life-history phase, or a life cycle); a population ('year-over-year' events); habitat damage (hours < duration ≤ years); and restoration (year < time ≤ years). For events involving suspended sediment (may include clay), see Newcombe and Jensen 1996; References, over.
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| | <i>Ideal.</i> Best for adult fishes that must live in a clear water environment most of the time. |
| | <i>Slightly impaired.</i> Feeding and other behaviours begin to change: severity of effect increases with duration. |
| | <i>Significantly impaired.</i> Marked increase in water cloudiness could reduce fish growth rate, habitat size, or both. |
| | <i>Severely impaired.</i> Profound increases in water cloudiness could cause poor 'condition' or habitat alienation. |
| | Areas with least supporting data (1 day to 11 months), or least likelihood of problems (30 months), or both. |
| | Some predatory fish (P) catch more prey fish (π) in clear water (P _π) than they do in cloudy water. |
| | Survival of some fishes (e.g. young juvenile Pacific salmon) is enhanced (P ^π) by natural, seasonal, cloudiness. |
| | Data sources: predator-prey dynamics, see Newcombe 2003; References, over. |
| | Data sources: severity of ill effects (any SEV with underscore), see Newcombe 2003; References, over. |
- aA, kO Row labels (upper case) and column labels (lower case); paired, as shown, these serve as cell coordinates.