United States Department of Agriculture

Forest Service

Rocky Mountain Forest and Range Experiment Station

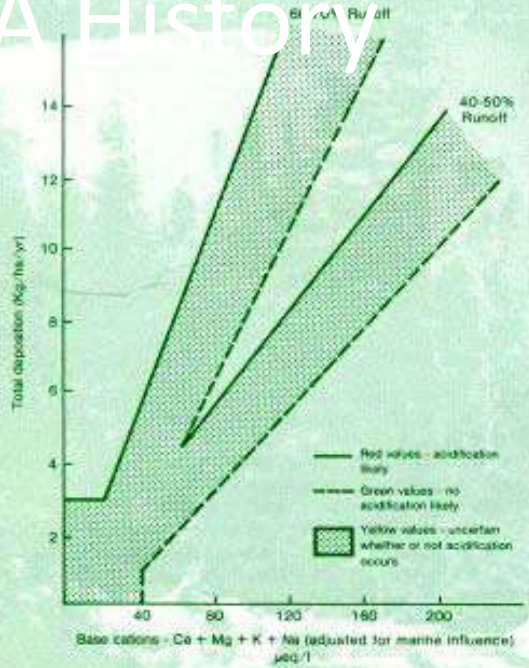
Fort Collins, Colorado 80526

General Technical Report RM-168

A Screening Procedure to Evaluate Air Pollution Effects on Class I Wilderness Areas

Douglas G. Fox, Ann M. Bartuska, James G. Byrne, Ellis Cowling, Richard Fisher, Gene E. Likens, Steven E. Lindberg, Rick A. Linthurst, Jay Messer, and Dale S. Nichols

Screening Methods A History



Douglas G. Fox, Ann M. Bartuska, James G. Byrne, Ellis Cowling, Richard Fisher, Gene E. Likens, Steven E. Lindberg, Rick A. Linthurst, Jay Messer, and Dale S. Nichols. 1988

- This screening procedure is intended to help wilderness managers conduct "adverse impact determinations" as part of Prevention of Significant Deterioration (PSD) applications for sources that emit air pollutants that might impact Class I wildernesses.
- The process provides an initial estimate of susceptibility to **critical loadings** for sulfur, nitrogen, and ozone. It also provides a basis for requesting necessary additional information where potential adverse impacts are identified.

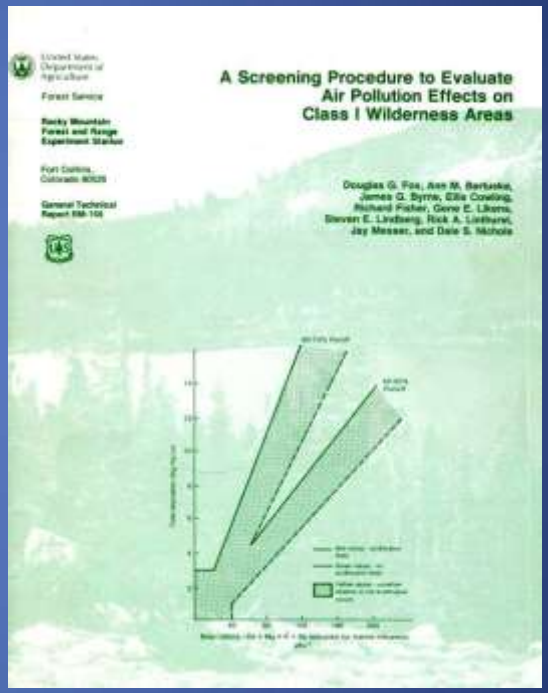


Table 2. – Terrestrial Green and Red Line screening values.

Wilderness area[1]	Nitrogen deposition[2]		Sulfur deposition	
	Green Ln	Red Line	Green Ln	Red Line
	-----kg N/ha-y-----		---kg S/ha-y---	
Alpine Lakes, WA	5-7	15	3-5	20
Hoover, CA	3-5	10	3-5	20
San Gorgonio, CA	5	15	3-5	20
Bob Marshall MT	3-5	10-15	5	20
Bridger, WY	3-5	10	5	20
Joyce Kilmer, NC/Slick Rock, TN	7-10	15	5-7	20
Otter Creek, WV	7	10-15	5	20
Boundary Waters Canoe Area, MN	3-5	10	5	20

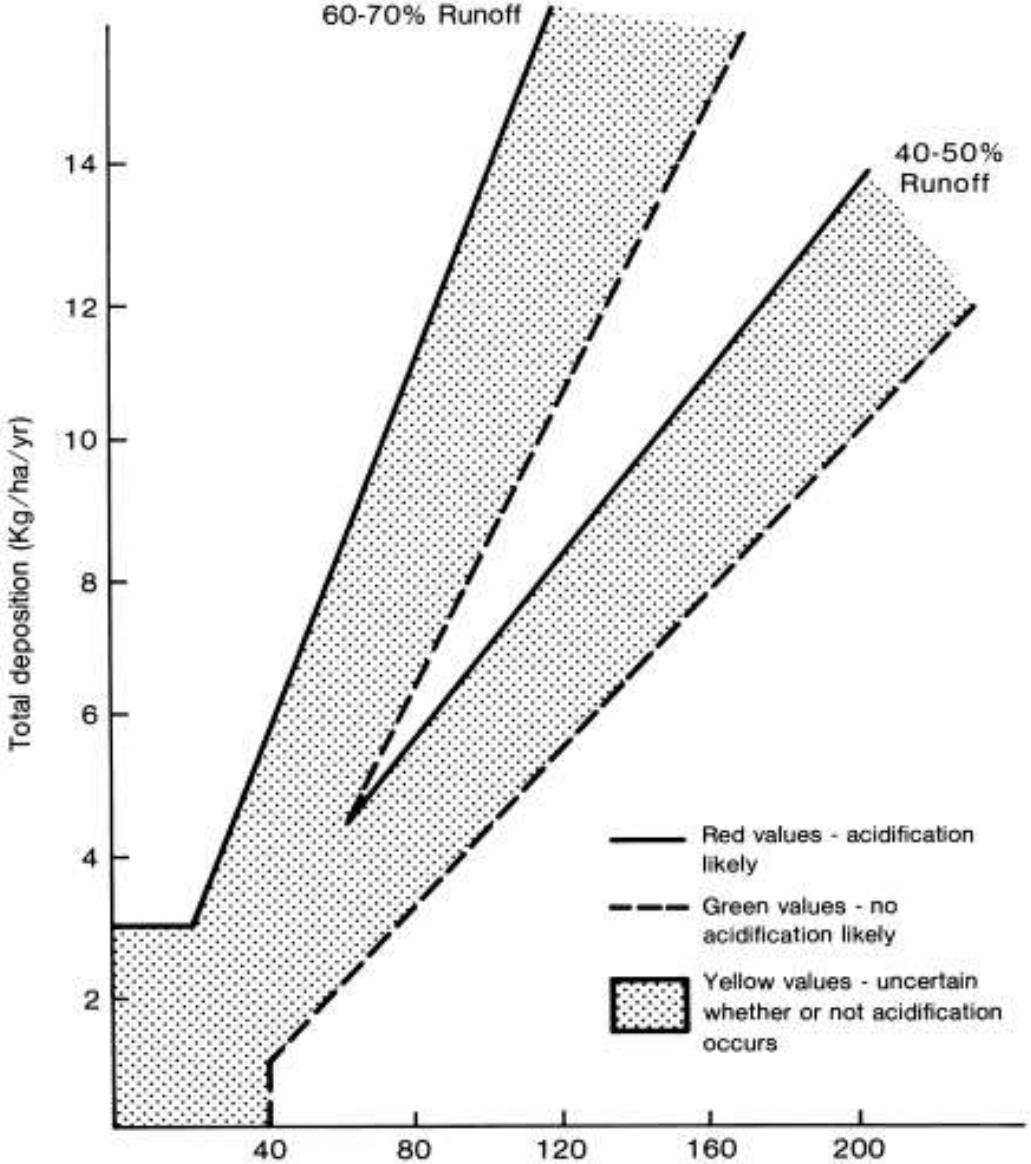


Figure 1.--Green and Red Line values for effects of deposition on freshwater systems. Total deposition is total sulfur deposition except for selected locations as noted in the text where 25% of total Nitrogen deposition should be included.

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A Screening Procedure to Evaluate Air Pollution Effects in Region 1 Wilderness Areas. 1991

Table 4. Limits of Acceptable Change (LACs) for screening parameters for lakes within Class I wilderness areas in Region 1.

Screening parameter	Threshold or range	Description of LAC
ANC[a] (μeq/l)	>100	Not a sensitive indicator.
	100-10	Cumulative change should be <10% of baseline condition.
	<10	Any significant change from baseline will likely damage biota (pH ~6.0); no change allowed.
pH	>pH 7	Not a sensitive indicator.
	pH 7.0-6.0	Cumulative change should be <10% of baseline condition.
	pH 6.0	Any significant change from baseline will likely damage biota (pH ~6.0); no change allowed.
Specific Conductance		No LAC developed
Anions		
$\Sigma (SO_4^{2-}+NO_3^-)$ (μeq/l) should	ANC = 10-100	Cumulative change in anions should be < 10% of baseline concentration of total base cations; $(SO_4^{2-}+NO_3^-)$ not be elevated to >10% of total base cation[b].
Water clarity[c]		Cumulative change should be <10% of baseline condition.
Total P		No LAC developed
Al^{+n} (μg/l)		Should not be elevated to >50 μg/l

[a] *Minimal measurable ANC any time during the year.*

[b] *Some dilute lakes in Region 1 have natural anion:cation ratios as high as 0.46, hence this LAC applies to lakes with naturally low anion:cation ratios.*

[c] *Related to any changes in N:P that would produce such a response.*

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Guidelines for Evaluating Air Pollution Impacts on Wilderness Within the Rocky Mountain Region: Report of a Workshop, 1990

Table 2. Sensitive receptors and limits of acceptable change related to acidic deposition.

Sensitive receptor	Ambient condition	Limits of acceptable change
Chemical composition of wet deposition	current snow pack pH < 6.0	not more than double current snowpack H^+ concentration
ANC of lake or stream surface waters	ANC > 100 $\mu eq\ L^{-1}$ ANC = 25-100 $\mu eq\ L^{-1}$ ANC < 25 $\mu eq\ L^{-1}$	10% change from established baseline 10% change from established baseline no further decrease is acceptable
Aquatic organisms		none recommended

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Pacific Southwest Research Station

General Technical Report PSW-GTR-136

Guidelines for Evaluating Air Pollution Impacts on Class I Wilderness Areas in California

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Table 17—Sensitive receptors and associated condition classes for aquatic resources proposed at the workshop.

Sensitive receptor	Condition class	Class Description
Lake/stream pH	No change	— Long-term reduction of pH < 0.5 pH units
	Significant deterioration	— Long-term reduction of pH > 0.3 pH units
	Severe deterioration[1]	— pH < 5.5 during and immediately following hydrologic events
Lake/stream ANC[2]	No change	— Long-term reduction of ANC < 10 μeq/L
	Significant deterioration	— Long-term reduction of ANC between 5 and 10 μeq/L
	Severe deterioration	— Reduction of ANC ≤ 0 during and immediately following hydrologic events
Lake clarity	No change	— Reduction in optical density of < 0.003 optical density units (ODU)
	Significant deterioration	— Reduction in optical density of 0.003 to 0.01 ODU
	Severe deterioration	— Reduction in optical density of > 0.01 ODU
Lake/stream fish populations	No change	— Young-of-the-year present each year in which reproducing populations and suitable habitat exist
	Significant deterioration	— Not specified
	Severe deterioration	— Long-term loss in reproductive capacity—ranging from 3 years to no reproduction
	Non-functional	— Abnormal adult mortality observed
Stream macroinvertebrates	No change	— No loss of sensitive species
	Significant deterioration	— Loss of some sensitive species
	Severe deterioration	— Loss of all sensitive species

[1] There was some concern expressed subsequent to the workshop that episodic reductions in pH and/or ANC contribute the first warning signals of acidification damage, rather than "severe deterioration." This discrepancy illustrates the generally poor knowledge base regarding episodic acidification in these systems.

[2] ANC = acid neutralizing capacity.

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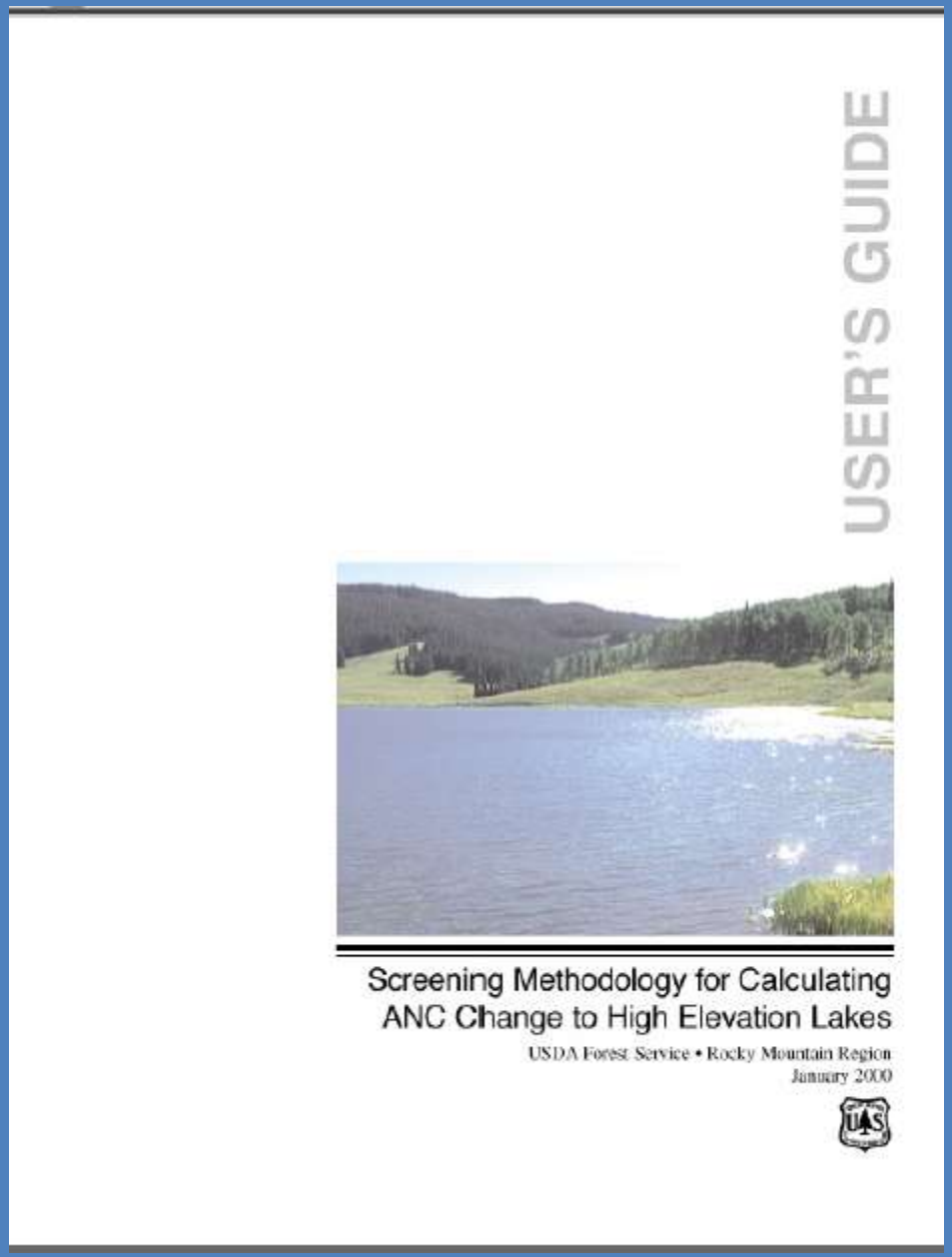
Guidelines for Evaluating Air Pollution Impacts on Class I Wilderness Areas in the Pacific Northwest

Table 10—Condition class definitions identified for sensitive indicators of aquatic resources [a]

Indicator	Initial condition	No significant deterioration	Significant deterioration	Severe deterioration
ANC ($\mu eq\ L^{-1}$): [c]				
Lakes		< 20%	> 20%	≤ 0 $\mu eq\ L^{-1}$
Streams	ANC < 25	No change	Any change	Any change
	ANC 25-100	< 25%	15-25 $\mu eq\ L^{-1}$	< 15 $\mu eq\ L^{-1}$
	ANC > 100	< 50%	15-25 $\mu eq\ L^{-1}$	< 15 $\mu eq\ L^{-1}$
pH: [c]				
Lakes		> 6.0	5.3-6.0	< 5.3
Streams	pH ≤ 6.3	> 6.3	6.0-6.3	< 6.0
	pH > 6.3	Δ< 0.2	Δ 0.2-0.5	Δ > 0.5
Total aluminum ($\mu g\ L^{-1}$) [c]		< 30	30-50	> 50
Sulfate ($\mu eq\ L^{-1}$) [c]		< 5	5-10	> 10
Nitrate ($\mu eq\ L^{-1}$) [c]		<1	1-3	> 3
Ammonium ($\mu eq\ L^{-1}$) [c]		<1	1-3	> 3
Total phosphorus ($\mu g\ L^{-1}$) [c]		< 5	5-10	> 10
Secchi disk transparency (m) [c]		< 20%	20-30%	> 30%
Dissolved oxygen ($mg\ L^{-1}$) [d]		<1	1-4	> 4



CL = the deposition loading at which <u>something</u> happens to an ecosystem (usually linked to biotic change)

R2 LAC= No more than 10% change in ANC to sensitive lakes

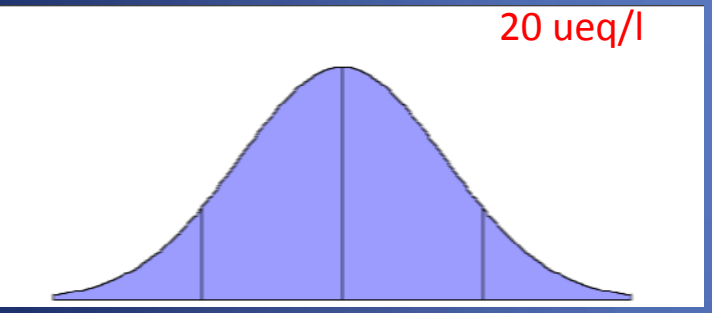
Screening Methodology = simplistic way to "connect the dots" between LAC and CL for use in NEPA and PSD

How much extra deposition would it take to change ANC by10%?

Step 1: get baseline lake data: 10% most sensitive ANC for lake (say 20ueq/l)

Step 2: determine cumulative deposition from (new source + others) (say .05 kg/ha/yr

Step 3: calculate deposition impact to lake ANC based on catchment area and a bunch of assumptions.



Lake ANC data

Step 4: if calculated change to ANC from sources is < 10% (2 ueq/l in this case) impact doesn't exceed sensitive receptor effect) for this system

Not exactly "critical load", since more of a management threshold for desired condition, than biotic change documented by science. But similar concept

DAT: Deposition Analysis Threshold

- Defines “what amount of deposition (related to single- source of emissions) is “insignificant” (so small we don’t care).
- Not related to an “effect” on an ecosystem
- Used in PSD/NEPA: When DAT is exceeded, FLM “might” care, and will look at site specific effects (including whether CL is exceeded) further