Exhibit 17
AR J.1

United States
Environmental Protection
Agency

Office of Water
Regulations and Standards
Washington, DC 20460

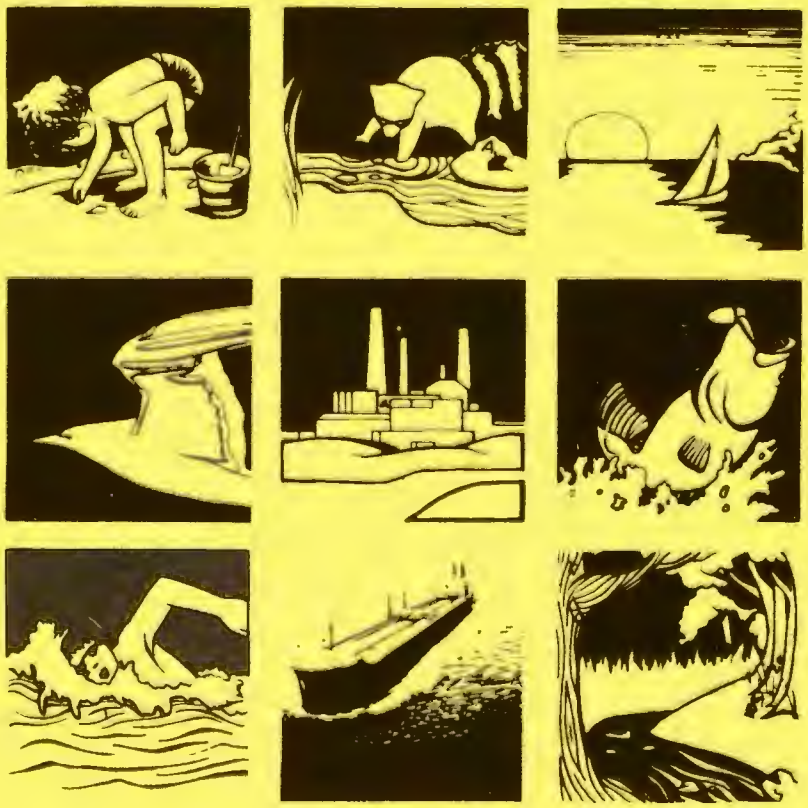
May 1, 1986

EPA

Water

EPA 440/5-86-001

QUALITY CRITERIA for WATER 1986



TO INTERESTED PARTIES

Section 304(a)(1) of the Clean Water Act (33 U.S.C. 1314(a)(1) requires the Environmental Protection Agency (EPA) to publish and periodically update ambient water quality criteria. These criteria are to accurately reflect the latest scientific knowledge (a) on the kind and extent of all identifiable effects on health and welfare including, but not limited to, plankton, fish shellfish, wildlife, plant life, shorelines, beaches, aesthetics, and recreation which may be expected from the presence of pollutants in any body of water including ground water; (b) on the concentration and dispersal of pollutants, or their byproducts, through biological, physical, and chemical processes; and (c) on the effects of pollutants on biological community diversity, productivity, and stability, including information on the factors affecting rates of eutrophication and organic and inorganic sedimentation for varying types of receiving waters. These criteria are not rules and they do not have regulatory impact. Rather, these criteria present scientific data and guidance of the environmental effects of pollutants which can be useful to derive regulatory requirements based on considerations of water quality impacts. When additional data has become available, these summaries have been updated to reflect the latest Agency recommendations on acceptable limits for aquatic life and human health protection.

Periodically EPA and its predecessor agencies has issued ambient water quality criteria, beginning in 1968 with the "Green Book" followed by the 1973 publication of the "Blue Book" (Water Quality Criteria 1972). In 1976, the "Red Book" (Quality

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Washington, D.C. 20402

Criteria for Water) was published. On November 28, 1980 (45 FR 79318), and February 15, 1984 (49 FR 5831), EPA announced through Federal Register notices, the publication of 65 individual ambient water quality criteria documents for pollutants listed as toxic under section 307(a)(1) of the Clean Water Act. On July 29, 1985 (50 FR 30784), EPA published additional water quality criteria documents.

The development and publication of ambient water quality criteria has been pursued over the past 10 years and is an ongoing process. EPA expects to publish about 10 final criteria documents each year. Some of these will update and revise existing criteria recommendations and others will be issued for the first time.

In a continuing effort to provide those who use EPA's water quality and human health criteria with up-to-date criteria values and associated information, this document Quality Criteria for Water 1986 was assembled. This document includes summaries of all the contaminants for which EPA has developed criteria recommendations (Appendix A-C). The appropriate appendix is identified at the end of each summary. A more detailed description of these procedures can be found in the appropriate Appendix. Copies of this document can be obtained by contacting the U.S. Government Printing Office at:

U.S. Government Printing Office
Superintendent of Documents
N. Capitol and H Street N.W.
Washington, D.C. 20401

A fee is charged for this document.

Copies of the complete background ambient water quality

criteria documents containing all the data used to develop the criteria recommendations summarized herein and the "Red Book", including complete bibliographies are available only from:

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161

Telephone: (703) 487-4650

The NTIS order numbers for the criteria documents can be found in the Index. A fee is charged for copies of these documents.

As new criteria are developed and existing criteria revised, updated criteria summaries will be made available once a year to those who purchase this document through the U.S. Government Printing Office. You will automatically be placed on the mailing list to receive annual updates. The cost for receiving annual updates is included in the purchase price of the document.

Quality Criteria for Water, 1986 is designed to be easily updated to reflect EPA's continuing work to present the latest scientific information and practices. Our planned schedule for future criteria development in the next few years is attached for your information.

The Agency is currently developing Acceptable Daily Intake (ADI) or Verified Reference Dose (RfD) values on a number of chemicals for Agency-wide use. Based upon this new analysis the values have changed significantly for 5 chemicals from those used in the original human health criteria calculation done in 1980. The chemicals affected are as follows:

Chemical	1980 WQC	Draft RfD
1. Cyanide	200 ug/L	.02 mg/kg/day
2. Ethylbenzene	1.4 mg/L	.01 mg/kg/day
3. Nitrobenzene	19.8 mg/L	.0005 mg/kg/day
4. Phenol	3.5 mg/L	0.1 mg/kg/day
5. Toluene	14.3 mg/L	0.3 mg/kg/day

FOR FURTHER INFORMATION CONTACT:

Dr. Frank Gostomski at the above address or by phoning (202) 245-3030.

It is EPA's goal to continue to develop and make available ambient water quality criteria reflecting the latest scientific practices and information. In this way we can continue to improve and protect the quality of the Nation's waters.

James M. Conlon

James M Conlon

Acting Director,
Office of Water Regulations
and Standards

DRAFT CRITERIA DOCUMENTS TO BE PROPOSED

LATE FY 86/EARLY FY 87

Diethyhexylphthalate
1,2,4, Trichlorobenzene
Silver
Phenanthrene
2,4,5, Trichlorophenol
Organotins
Tributyltin
Selenium (no saltwater criteria)
Hexachlorobenzene
Antimony III
Acrolein (no saltwater criteria)

LATE FY 87/EARLY 88

Thallium (no saltwater criteria)
Tetrachloroethylene (no saltwater criteria)
Phenol
Toluene
Chloroform (no saltwater criteria)
Analine
Acrylontrile
Hexachlorocyclopentadiene (no saltwater criteria)
Dimethylphenol
Hexachlorobutadiene (no saltwater criteria)

- Both lists will incorporate aquatic and human health values.

- All above are toxic pollutants except for organotins and analine which are non-conventionals.

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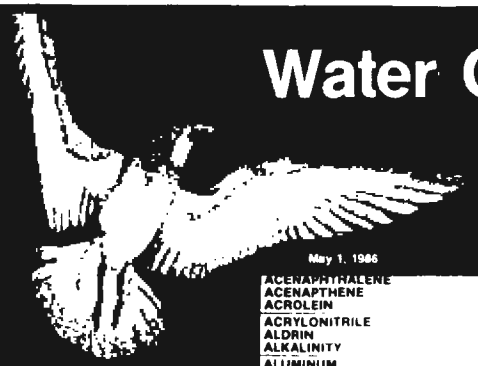
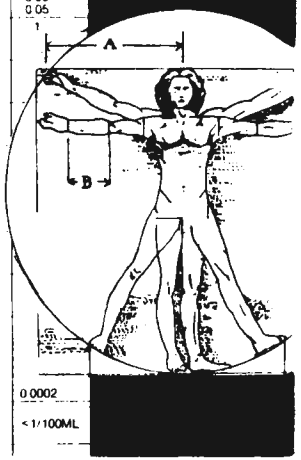
SUMMARY CHART

Water Quality Criteria Summary

May 1, 1986

		CONCENTRATIONS IN:				HUMAN HEALTH							
	Priority Pollutant	Fresh Acute Criteria *L.O.E.L.	Fresh Chronic Criteria *L.O.E.L.	Marine Acute Criteria *L.O.E.L.	Marine Chronic Criteria *L.O.E.L.	Water and Fish Ingestion	Fish Consumption Only	Carcinogen	Date/Reference		States Standard AQ·LI	States Standard HU·H	Drinking Water M.C.L.
ACENAPHTHALENE	N												
ACENAPTHENE	Y	*1,700	*520	*970	*500	20µg			1980 FR	F			
ACROLEIN	Y	*68	*21	*55		320µg	780µg		1980 FR	F			
ACRYLONITRILE	Y	*7,550	*2,600			0.058µg	0.65µg	Y	1980 FR	F			
ALDRIN	Y	3		1.3		0.074ng	0.079ng	Y	1980 FR	F	10	6	
ALKALINITY	N		*20,000						1976 RB	F			
ALUMINUM	N									9/30/86			
AMMONIA TOTAL	N	15.7	3.9						1985 FR	F	23	20	
AMMONIA UN-IONIZED	N	0.092	0.022						1985 FR	F	23	20	
ANALINE	N									9/30/86			
ANTIMONY	Y	*9,000	*1,600			146µg	45,000µg		1980 FR	F			
ARSENIC	N	360	190	36	69	2.2ng	17.5ng	Y	1985 FR	F			0.05
ARSENIC(PENT)	N	*850	*48	*2,319	*5			Y	1985 FR	F	22	28	
ARSENIC(TRI)	Y	4.4	48	69	36			Y	1985 FR	F	22	28	
ASBESTOS	Y					30k f.1		Y	1980 FR	F			
BARIUM	N					1mg			1976 RB	F	13	25	1
BENZENE	Y	*5,300		*5,100	*700	0.66µg	40µg	Y	1980 FR	F			
BENZIDINE	Y	2,500				0.12ng	0.53ng	Y	1980 FR	F	3	4	
BERYLLIUM	Y	*130	*5.3			3.7ng	64.1ng	Y	1980 FR	F	7	4	
BHC	Y	*100		*0.34					1980 FR	F			
BIS 2 CHLOROETHYOXY METHANE	N												
BORON	N								1976 RB	F	5	3	
BOTYLBENZYLPTHALATE	N								1980 RB				
CADMIUM	Y	3.9	1.1	43	9.3	10µg			1985 FR	F	22	27	0.01
CARBAZOLE	N												
CARBON TETRACHLORIDE	Y	*35,200		*50,000		0.4µg	6.94µg	Y	1980 FR	F			
CHLORALKYL ETHERS	Y	*238,000				0.0038ng	1.84ng	Y	1980 FR				
CHLORDANE	Y	2.4	0.0043	0.004	0.07	0.46ng	0.48ng	Y	1980 FR	F			
CHLORINATED BENZENES	Y	*250	*50	*160	*129				1980 FR	F			
CHLORINATED ETHANES	Y							S	1980 FR	F			
CHLORINATED ETHERS	N												
CHLORINATED NAPHTHALENES	Y	*1,600		*7.5					1980 FR	F			
CHLORINATED PHENOLS	Y	*500,000	970	440					1980 FR	F			
CHLORINE	N	19	11	13	7.5				1985 FR	F			
CHLORO-4 METHYL-3 PHENOL	N	*30											
CHLOROFORM	Y	*28,900	*1,240			0.19µg	15.7µg	Y	1980 FR	F			
CHLOROPHENOL	N			*440									
CHLOROPHENOL 2	Y	*4,380	*2,000				0.1µg		1980 FR	F			
CHLOROPHENOL 4	N			*29,700									
CHLOROPHENOXY HERBICIDES	N								1976 RB	F			
CHROMIUM (HEX)	Y	16	11	1,100	50	50µg			1985 FR	F	2	24	0.05
CHROMIUM (TRI)	Y	1,700	210	10,300					1985 FR	F	2	24	0.05
COPPER	Y	18	12	2.9		170mg	3.433mg		1985 FR	F	20	22	1
CYANIDE	Y	22.	5.2	1		200µg			1985 FR	F	19	16	
DDE	Y	*1,050		*14							10	11	
DDT	Y	1.1	0.001	0.13	0.001	0.024ng	0.024ng	Y	1980 FR	F	10	11	
DEHP	N									9/30/86			
DEMETON	N		*0.1		*0.1				1976 RB	F			
DIAMINO TOLUENE	N												
DIBENZOFURANS	N									9.30/86			
DICHLORINATED ETHANES	N	*11,800?	*20,000	*113,000									
DICHLOROBENZENES	Y	*1,120	*763	*1,970		400µg	2.6mg		1980 FR	F			
DICHLOROBENZIDINES	Y					0.0103µg	0.0204µg	Y	1980 FR	F			
DICHLOROETHYLENE	Y	*11,600		*224,000		0.033µg	1.85µg		1980 FR	F			
DICHLOROPHENOL 2 4	N	*2,020	*365				0.3µg		1980 FR	F			
DICHLOROPROPANE	Y	*23,000	*5,700	10,300	*3,040				1980 FR	F			
DICHLOROPROPENE	Y	*6,060	*244	*790		87µg	14.1mg		1980 FR	F			
DIELDRIN	Y	2.5	0.0019	0.71	0.0019	0.071ng	0.076ng	Y	1980 FR	F	12	10	
DIMETHYL PHENOL	Y								1980 FR	F			
DIMETHYL PHENOL 2,4	Y	*2,120					400		1980 FR	F			
DIMETHYLSULFOXIDE	N												
DINITROBENZENE 1,3	N												
DINITROTULUENE 2,4	Y	*330	*230	*590	*370	0.11µg	9.1µg	Y	1980 FR	F			
DIOXANE P	N												
DIOXIN	Y	*0.01	*0.0056					Y	1984 FR	F			
DIPHENYLHYDRAZINE	Y	*270			Y	0.42ng	0.56ng		1980 FR	F			
DISSOLVED OXYGEN	N	6,500	4,000						1986 FR	F			
ENDOSULFAN	Y	0.22	0.056	0.034	0.0087	74µg	159µg		1980 FR	F	6	4	
ENDRIN	Y	0.18	0.0023	0.037	0.0023	1µg			1980 FR	F	13	10	0.0002
ETHYLBENZENE	Y	*32,000		*430		1.4mg	3.28mg		1980 FR	F			
FECAL COLIFORM	N												<1/100ML
FLUORANTHENE	Y	*3,980		*40	*16	42µg	54µg		1980 FR	F			





DISSOLVED OXYGEN	N	6.500	4.000						1986 FR	F				
ENDOSULFAN	Y	0.22	0.056	0.034	0.0087	74µg	159µg		1980 FR	F	6	4		
ENDRIN	Y	0.18	0.0023	0.037	0.0023	1µg			1980 FR	F	13	10	0.0002	
ETHYLBENZENE	Y	*32.000		*430		1.4mg	3.28mg		1980 FR	F				
FECAL COLIFORM	N												<1/100ML	
FLUORANTHENE	Y	*3.980		*40	*16	42µg	54µg		1980 FR	F				
FLUORIDE	N												1.4 2.4	
GUTHION	N		*0.01		*0.01				1976 RB	F				
HALOETHERS	Y	*360	*122						1980 FR	F				
HALOMETHANES	Y	*11.000		*12.000	*6.400	0.19µg	*5.7µg	Y	1980 FR	F				
HARDNESS	N													
HEPTACHLOR	Y	0.52	0.0038	0.053	0.0016	0.28ng	0.29ng	Y	1980 FR	F	5	3		
HEXACHLOROBENZYENE	Y	250	30	160	129									
HEXACHLOROBUTADIENE	Y	*90	*9.3	*32		0.45µg	90µg	Y	1980 FR	F				
HEXACHLOROCYCLOHEXANE (LINDANE)	Y	2	0.08	0.16		9.2mg	31mg	Y	1980 FR	F	7	11	0.004	
HEXACHLOROCYCLOPENTADIENE	Y	*7	*5.2	*7		260µg			1980 FR	F				
HEXACHLOROETHYLENES	N													
HEXACHLORINATED ETHANES	Y	*980	*540	*940		1.9µg	6.4µg	Y	1980 FR	F				
IRON	N	*1.000				2.3mg			1976 RB	F	16	17	0.3	
ISOPHORONE	Y	*117.000		*12.900		5.2mg	520mg		1980 FR	F				
LEAD	Y	8.2	3.2	140	5.6	50µg			1985 FR	F	25	24	0.05	
MALATHION	N		*0.1		*0.1				1976 RB	F				
MANGANESE	N					50µg	1.0mg		1976 RB	F	9	11	0.05	
MERCURY	Y	2.4	0.012	2.1	0.025	144ng	146ng		1985 FR	F	20	21	0.002	
METHOXYCHLOR	N	0.03	*0.03		*0.03	100µg			1976 RB	F			0.1	
MIREX	N		*0.001		*0.001				1976 RB	F				
NAPHTHALENE	Y	*2.300	*620	*2.350					1985 FR	F				
NICKEL	Y	1.800	96	140	7.1	13.4µg	100µg		1980 FR	F	11	7		
NITRATES	N					10mg			1976 RB	F	20	25	10	
NITROANILINE	N													
NITROBENZENE	Y	*27.000		*6.680		30µg			1980 FR	F				
NITROPHENOLS	Y	*230	*150	*4.850		13.4µg	765µg		1980 FR	F				
NITROSAMINES	Y	*5.850		*3.300.000		31.4µg	1.240mg	Y	1980 FR	F				
OIL AND GREASE	N								1976 RB	F				
ORGANOTINS	N													
PARATHION	N		*0.04		*0.04				1976 RB	F				
PCB's	Y	2	0.014	10	0.03	0.079ng	1.9ng	Y	1980 FR	F	11	7		
PENTACHLORINATED ETHANES	Y	*1.240	*1.100	*390	*25									
PENTACHLOROPHENOL	Y	*55	*3.2	*53	*34	1.0mg			1980 FR	F				
PH	N		*6.5-9		*6.5-8.5	5.9			1976 RB	F				
PHENOL	Y	*10.200	*2.560	*5.800		30µg			1980 FR	F	19	20		
PHOSPHORUS	N				*0.01				1976 RB	F	25	19		
PHTHALATE ESTERS	Y	*940	*3	*2.944	3.4	15mg	55mg		1980 FR	F	3	5		
POLYCHLORINATED DIPHENYL ETHERS	N													
POLYNUCLEAR AROMATIC HYDROCARBONS	Y			*300		2.8ng	31.1mg	Y	1980 FR	F				
SALINITY	N													
SELENIUM	Y	*260	35	410	54	10µg			1980 FR	F	23	21	0.01	
SILVER	Y	4.1	0.12	2.3		50µg			1980 FR	F	14	18	0.05	
SOLIDS DISSOLVED	N					250mg			1976 RB	F	56	56		
SOLIDS SUSPENDED	N								1976 RB	F	56	56		
STYRENE	N													
SULFIDE-HYDROGEN SULFIDE	N		*2		*2				1976 RB	F				
TAINTING SUBSTANCES	N								1976 RB	F				
TDE	Y	*0.6		*3.6										
TEMPERATURE	N									F				
TETRACHLORINATED ETHANES	Y	*9.320	*2.400	*9.020					1980 FR					
TETRACHLOROBENZENE 1,2,4,5	Y	*250	*50	*160	*129	38µg	48µg		1980 FR	F				
TETRACHLOROETHYLENE	Y	*5.280	*840	*10.200	*450	0.8µg	8.85µg	Y	1980 FR	F				
TETRACHLOROPHENOL 2,3,4,6	Y			440		1µg			1980 FR	F				
TETRAMETHYL LEAD	N													
THALLIUM	Y	*1.400	*40	*2.13		13µg	48µg		1980 FR	F				
TOLUENE	Y	*17.500		*6.300	*5.000	14.3mg	424mg		1980 FR	F				
TOXAPHENE	Y	1.6	0.013	0.07		0.71ng	0.73ng	Y	1980 FR	F			0.005	
TRICHLORINATED ETHANES	Y	*18.000	*9.400	*31.200		0.6µg	41.8µg	Y	1980 FR	F				
TRICHLOROBENZENE	Y								1980 FR	F				
TRICHLOROBENZENE 1,2,3	Y								1980 FR	F				
TRICHLOROETHYLENE	Y	*45.000	*21.900	*2.000		2.7µg	80.7µg	Y	1980 FR	F				
TRICHLOROPHENOL 2,3,6	Y													
TRICHLOROPHENOL 2,4,5	Y					1µg			1980 FR	F				
TRICHLOROPHENOL 2,4,6	N		*970			1.2µg	3.6µg	Y	1980 FR	F				
VINYL CHLORIDE	Y					2µg	525µg	Y	1980 FR	F				
XYLENE	N													
ZINC	Y	320	47	*170	58	5mg			1980 FR	F	17	18	5	

* WATER QUALITY DEPENDENT CRITERION. SEE DOCUMENT.

mg milligrams per liter
ng nanograms per liter
µg micrograms per liter

Y YES
N NO

L.O.E.L. LOWEST OBSERVED EFFECT LEVEL

Y YES
S SUSPECT

FR FEDERAL REGISTER
RD RED BOOK

F FINAL
M.D.Y EXPECTED DATE OF FINAL DOCUMENT

CHANGES, CORRECTIONS AND SUGGESTIONS SHOULD BE ADDRESSED TO
CHRISTOPHER S. ZARBA
U.S. ENVIRONMENTAL PROTECTION AGENCY
401 M STREET, S.W. (WH-585)
WASHINGTON, DC 20460

PHOSPHORUS

CRITERION::

0.10 ug/L yellow (elemental) phosphorus for marine or estuarine water.

INTRODUCTION:

Phosphorus in the elemental form is particularly toxic and is subject to bioaccumulation in much the same way as mercury. Phosphorus as phosphate is one of the major nutrients required for plant nutrition and is essential for life. In excess of a critical concentration, phosphates stimulate plant growths. During the past 30 years, a formidable case has developed for the belief that increasing standing crops of aquatic plants, which often interfere with water uses and are nuisances to man, frequently are caused by increasing supplies of phosphorus. Such phenomena are associated with a condition of accelerated eutrophication or aging of waters. Generally, it is recognized that phosphorus is not the sole cause of eutrophication but there is substantiating evidence that frequently it is the key element of all of the elements required by freshwater plants, and generally, it is present in the least amount relative to need. Therefore, an increase in phosphorus allows use of other already present nutrients for plant growth. Further, of all of the elements required for plant growth in the water environment, phosphorus is the most easily controlled by man.

Large deposits of phosphate rock are found near the western shore of Central Florida, as well as in a number of other States. Deposits in Florida are found in the form of pebbles which vary

in size from fine sand to about the size of a human foot. These pebbles are embedded in a matrix of clay and sand. The phosphate rock beds lie within a few feet of the surface and mining is accomplished by using hydraulic water jets and a washing operation that separates the phosphates from waste materials. The process is similar to that of strip-mining. Florida, Idaho, Montana, North Carolina, South Carolina, Tennessee, Utah, Virginia, and Wyoming share phosphate mining activities.

Phosphates enter waterways from several different sources. The human body excretes about one pound per year of phosphorus expressed as "P". The use of phosphate detergents and other domestic phosphates increases the per capita contribution to about 3.5 pounds per year of phosphorus as P. Some industries, such as potato processing, have wastewaters high in phosphates. Crop, forest, idle, and urban land contribute varying amounts of phosphorus-diffused sources in drainage to watercourses. This drainage may be surface runoff of rainfall, effluent from tile lines, or return flow from irrigation. Cattle feedlots, concentrations of domestic duck or wild duck populations, tree leaves, and fallout from the atmosphere all are contributing sources.

Evidence indicates that: (1) high phosphorus concentrations are associated with accelerated eutrophication of waters, when other growth-promoting factors are present; (2) aquatic plant problems develop in reservoirs and other standing waters at phosphorus values lower than those critical in flowing streams; (3) reservoirs and lakes collect phosphates from influent streams

and store a portion of them within consolidated sediments, thus serving as a phosphate sink; and (4) phosphorus concentrations critical to noxious plant growth vary and nuisance growths may result from a particular concentration of phosphate in one geographical area but not in another. The amount or percentage of inflowing nutrients that may be retained by a lake or reservoir is variable and will depend upon: (1) the nutrient loading to the lake or resevoir; (2) the volume of the euphotic zone; (3) the extent of biological activities; (4) the detention time within a lake basin or the time available for biological activities; and (5) the level of discharge from the lake or of the penstock from the reservoir.

Once nutrients are combined within the aquatic ecosystem, their removal is tedious and expensive. Phosphates are used by algae and higher aquatic plants and may be stored in excess of use within the plant cell. With decomposition of the plant cell, some phosphorus may be released immediately through bacterial action for recycling within the biotic community, while the remainder may be deposited with sediments. Much of the material that combines with the consolidated sediments within the lake bottom is bound permanently and will not be recycled into the system.

RATIONALE:

Elemental Phosphorus

Isom (1960) reported an LC50 of 0.105 mg/L at 48 hours and 0.025 mg/L at 160 hours for bluegill sunfish, Lepomis macrochirus, exposed to yellow phosphorus in distilled water at

26 °C and pH 7. The 125-and 195-hour LC50's of yellow phosphorus to Atlantic cod, Gadus morhua, and Atlantic salmon, Salmo salar, smolts in continuous-exposure experiments were 1.89 and 0.79 ug/L, respectively (Fletcher and Hoyle, 1972). No evidence of an incipient lethal level was observed since the lowest concentration of P_4 tested was 0.79 ug/L. Salmon that were exposed to elemental phosphorus concentrations of 40 ug/L or less developed a distinct external red color and showed signs of extensive hemolysis. The predominant features of P_4 poisoning in salmon were external redness, hemolysis, and reduced hematocrits.

Following the opening of an elemental phosphorus production plant in Long Harbour, Placentia Bay, Newfoundland, divers observed dead fish upon the bottom throughout the Harbour (Peer, 1972). Mortalities were confined to a water depth of less than 18 meters. There was visual evidence of selective mortality among benthos. Live mussels were found within 300 meters of the effluent pipe, while all scallops within this area were dead.

Fish will concentrate elemental phosphorus from water containing as little as 1 ug/L (Idler, 1969). In one set of experiments, a cod swimming in water containing 1 ug/L elemental phosphorus for 18 hours concentrated phosphorus to 50 ug/kg in muscle, 150 ug/kg in fatty tissue, and 25,000 ug/kg in the liver (Idler, 1969; Jangaard, 1970). The experimental findings showed that phosphorus is quite stable in the fish tissues.

The criterion of 0.10 ug/L elemental phosphorus for marine or estuarine waters is .1 of demonstrated lethal levels to important marine organisms and of levels that have been found to result in significant bioaccumulation.

Phosphate Phosphorus

Although a total phosphorus criterion to control nuisance aquatic growths is not presented, it is believed that the following rationale to support such a criterion, which currently is evolving, should be considered.

Total phosphate phosphorus concentrations in excess of 100 ug/L P may interfere with coagulation in water treatment plants. When such concentrations exceed 25 ug/L at the time of the spring turnover on a volume-weighted basis in lakes or reservoirs, they may occasionally stimulate excessive or nuisance growths of algae and other aquatic plants. Algal growths inpart undesirable tastes and odors to water, interfere with water treatment, become aesthetically unpleasant, and alter the chemistry of the water supply. They contribute to the phenomenon of cultural eutrophication.

To prevent the development of biological nuisances and to control accelerated or cultural eutrophication, total phosphates as phosphorus (P) should not exceed 50 ug/L in any stream at the point where it enters any lake or reservoir, nor 25 ug/L within the lake or reservoir. A desired goal for the prevention of plant nuisances in streams or other flowing waters not discharging directly to lakes or impoundments is 100 ug/L total P (Mackenthun, 1973). Most relatively uncontaminated lake districts are known to have surface waters that contain from 10 to 30 ug/L total phosphorus as P (Hutchinson, 1957).

The majority of the Nation's eutrophication problems are associated with lakes or reservoirs and currently there are more

data to support the establishment of a limiting phosphorus level in those waters than in streams or rivers that do not directly impact such water. There are natural conditions, also, that would dictate the consideration of either a more or less stringent phosphorus level. Eutrophication problems may occur in waters where the phosphorus concentration is less than that indicated above and, obviously, such waters would need more stringent nutrient limits. Likewise, there are those waters within the Nation where phosphorus is not now a limiting nutrient and where the need for phosphorus limits is substantially diminished. Such conditions are described in the last paragraph of this rationale.

There are two basic needs in establishing a phosphorus criterion for flowing waters: one is to control the development of plant nuisances within the flowing water and, in turn, to control and prevent animal pests that may become associated with such plants; the other is to protect the downstream receiving waterway, regardless of its proximity in linear distance. It is evident that a portion of that phosphorus that enters a stream or other flowing waterway eventually will reach a receiving lake or estuary either as a component of the fluid mass, as bed load sediments that are carried downstream, or as floating organic materials that may drift just above the stream's bed or float on its water's surface. Superimposed on the loading from the inflowing waterway, a lake or estuary may receive additional phosphorus as fallout from the air shed or as a direct introduction from shoreline areas.

Another method to control the inflow of nutrients, particularly phosphates, into a lake is that of prescribing an annual loading to the receiving water. Vollenweider (1973) suggests total phosphorus (P) loadings in grams per square meter of surface area per year that will be a critical level for eutrophic conditions within the receiving waterway for a particular water volume where the mean depth of the lake in meters is divided by the hydraulic detention time in years. Vollenweider's data suggest a range of loading values that should result in oligotrophic lake water quality.

Mean Depth/Hydraulic Detention Time	Oligotrophic or Permissible Loading	Eutrophic or Critical Loading
(meters/year)	(grams/meter^2/year)	(grams/meter^2/year)
0.5	0.07	0.14
1.0	0.10	0.20
2.5	0.16	0.32
5.0	0.22	0.45
7.5	0.27	0.55
10.0	0.32	0.63
25.0	0.50	1.00
50.0	0.71	1.41
75.0	0.87	1.73
100.0	1.00	2.00

There may be waterways wherein higher concentrations or loadings of total phosphorus do not produce eutrophy, as well as those waterways wherein lower concentrations or loadings of total

phosphorus may be associated with populations of nuisance organisms. Waters now containing less than the specified amounts of phosphorus should not be degraded by the introduction of additional phosphates.

It should be recognized that a number of specific exceptions can occur to reduce the threat of phosphorus as a contributor to lake eutrophy: 1. Naturally occurring phenomena may limit the development of plant nuisances. 2. Technological or cost-effective limitations may help control introduced pollutants. 3. Waters may be highly laden with natural silts or colors which reduce the penetration of sunlight needed for plant photosynthesis. 4. Some waters morphometric features of steep banks, great depth, and substantial flows contribute to a history of no plant problems. 5. Waters may be managed primarily for waterfowl or other wildlife. 7. In some waters nutrient other than phosphorus is limiting to plant growth; the level and nature of such limiting nutrient would not be expected to increase to an extent that would influence eutrophication. 6. In some waters phosphorus control cannot be sufficiently effective under present technology to make phosphorus the limiting nutrient.

No national criterion is presented for phosphate phosphorus for the control of eutrophication.

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SEE APPENDIX C FOR METHODOLOGY