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STATEMENT OF BASIS AND PURPOSE

TOXIC POLLUTANT EFFLUENT STANDARDS

I. Legislative Basis

Part 104, Title 40, Code of Federal Regulations, establishes rules of practice applicable to public hearings in connection with the establishment of effluent standards for toxic pollutants. Section 104.4 states that "whenever the Administrator publishes a proposed effluent standard, he shall make available to any interested person a statement of the basis and purpose of such standard. Such statement ... shall include:

(a) an explanation of how the proposed standard was derived, including any assumptions or calculations necessary for its derivation;

(b) scientific and technical data and studies supporting the proposed standard; and

(c) such other information as is necessary to fully set forth the basis and purpose of the standard."

II. Summary

The following is a summary of the basis and purpose of the proposed effluent standards: The four basic factors considered in setting the standards were (1) toxicological data, (2) hydrodynamic data, (3) ample margins of safety and (4) calculations of the acute and chronic limitations for the standards. The primary basis

for toxicological considerations came from the Water Quality Criteria which were proposed in October (38 F.R. 29646 et seq., Friday, October 26, 1973). These criteria were based in part on a report by the National Academy of Sciences and the National Academy of Engineering entitled Water Quality Criteria, 1972 which is currently being published by the Environmental Protection Agency. The toxicity of the pollutants on the list, their persistence, degradability, the usual or potential presence of the affected organisms in any waters, the importance of the affected organisms, and the nature and extent of the effect of the toxic pollutant on such organisms, were considered in the establishment of the Water Quality Criteria upon which these standards are based.

Water Quality Criteria published pursuant to Section 304(a) of the Act are those concentrations which are acceptable in the receiving water body. The criteria were developed to protect a variety of water uses including industrial, agricultural, recreational, propagation of fish and wildlife, aesthetics and potable water supplies. The protection of fish and wildlife and potable water supplies was the most sensitive of the fresh water usages. In estuarine and marine waters, the protection of fish and wildlife generally yielded the more restrictive recommended limitations. The criteria, as proposed, were designed for both acute and chronic toxicological protection. Since protection against chronic effects requires more stringent criteria, the proposed Water Quality Criteria were derived from data or calculations designed to afford chronic protection.

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Because proposed Water Quality Criteria utilize both acute and chronic toxicity data to derive a single acceptable ambient water concentration, it was necessary to utilize the data upon which the criteria were based to calculate proposed standards which provide for protection against both acute and chronic toxicological effects.

To avoid the effects of acute toxicity it was determined that organisms need not necessarily be protected at all times from concentrations exceeding the proposed Water Quality Criteria, since brief exposures to higher concentrations may be tolerated. It may be assumed that most mobile organisms will not remain in the immediate vicinity of the outfall for as long as the usual 96-hour test period. Thus, for protection in the immediate vicinity of the outfall, a concentration of one tenth the 96-hour LC_{50} was determined to provide an ample margin of safety. (The 96-hour LC_{50} is that concentration derived from laboratory tests in which 50% of a group of test organisms survive after 96 hours of continuous exposure to a pollutant). In order to achieve a concentration in the vicinity of the outfall which does not exceed the acute threshold, the discharger may either discharge the acute toxicity concentration and provide immediate diffusion through appropriate flow devices or reduce the concentration below the acute threshold.

To avoid the effects of chronic toxicity, an effluent standard is provided which is designed to ensure that, in most cases, the proposed Water Quality Criteria, which are intended to

provide protection from chronic effects, are not exceeded over the long term in the receiving waters. This is achieved by limitation of the total weight of the pollutant which can be discharged into receiving waters of given size. To provide an additional margin of safety, the allowable weight discharged per unit of flow was reduced by safety factors designed to compensate, in part, for non-point sources of the pollutant, multiple discharges in a small area, industrial growth, and the difference in water storage times among lakes, estuaries, streams, and coastal waters. The standard for each type of receiving water is expressed as a number which, when multiplied by the rate of receiving water flow, yields the allowable weight of discharge of the pollutant per day from any facility.

These standards are not intended, however, to assure that Water Quality Criteria would be achieved in all receiving waters, since standards sufficiently restrictive to attain water quality criteria in (for example) small streams with extraordinarily large clusters of dischargers, would be overly restrictive for the usual case. These special "worst-case" situations are to be handled by the application of water quality standards through waste load allocations under Section 303 of the Act. The resulting allocations may then be used to establish effluent limitations, if necessary, more stringent than the effluent standards set forth herein. Those limitations would then be incorporated into permits issued under Section 402 of the Act.

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Since there are no proposed Water Quality Criteria for benzidine, a different methodology was required for the derivation of an effluent standard. The methodology employed was designed to determine a level of discharge which would result in an acceptable level of risk exposure to man, the primary affected organism. Effluent standards for benzidine were derived by the extrapolation of laboratory test animal data using conservative statistical methods, and are based upon a calculated level of risk of less than one case of tumor induction per million people exposed over an entire generation to drinking water from supplies derived from waters contaminated with the maximum permitted concentration of benzidine. It is recognized that certain inadequacies exist in the available data on which the benzidine standard is based. Therefore, it is reasonable to assume that these standards could be revised in the future. The Environmental Protection Agency is initiating research to gather appropriate oral dose-response data, improve analytical sensitivity, and establish monitoring procedures.

Pursuant to paragraph 3 of Section 307(a), any effluent standard promulgated under this section will be reviewed and, if appropriate, revised at least every three (3) years.

The standards for protection from chronic effects are applicable to the total of all discharges from any given facility. Thus, multiple outfalls from a single facility will not affect the total weight of any pollutant permitted to be discharged.

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III. USE OF WATER QUALITY CRITERIA IN SETTING TOXIC POLLUTANT STANDARDS

A. GENERAL

Water Quality Criteria (WQC) are defined as the acceptable limits of constituents in receiving waters based upon an evaluation of the latest scientific information by the Environmental Protection Agency. Almost all of the criteria are taken from the recommendations of the National Academy of Science's report on Water Quality Criteria (In Press October 1973).

The criteria are based upon toxicity studies and other field and laboratory tests which assess the effects of pollutants on agricultural crops, domestic livestock, aquatic life, wildlife and man.

In most cases, propagation of aquatic life was the most sensitive of the water uses and those recommended water quality criteria concentrations were the most restrictive. The acceptable limits specified by the criteria for substances which exhibit toxic effects were derived by the application of scientific judgment to lethal dose or lethal concentration data in a manner that provides a margin of safety to test organisms. When acceptable levels of a toxicant are not specified in the criteria, safe levels are predicted by the use of an application factor. The application factor is usually an estimated factor used to predict chronic safe levels on the basis of acute toxicity data. The recommendations state that the given application factor should be used with the 96-hour LC_{50} derived for the most sensitive important species in the locality of the discharge.

The LC_{50} is the concentration of the material in the water which causes death to 50% of a test population within a specified time period.

Therefore, "Water Quality Criteria" give either an acceptable receiving water concentration of the pollutant or a recommended application factor.

B. RECEIVING WATER BODY CONSIDERATIONS

To derive an effluent standard from a recommended Water Quality Criteria concentration or application factor in conjunction with acute toxicity data, it is necessary to take into account the nature of the receiving waters.

Developing a hydrodynamic model of any type is accompanied by many frustrating problems. When examined from a National Effluent Standards point of view, this is especially true. Many engineers and ecologists have

doubted the utility of water body models. These engineers and ecologists are aware of the many complex and variable interactions that exist in aquatic ecosystems and feel that models tend to oversimplify these relationships.

Models that have been developed for a specific body of water in which measured parameters are "plugged" into the model in its developmental stages have in many cases been successful. Although somewhat less accurate, the generalized models into which a few specific measurable parameters of a water body can be inserted have been useful. The derivation of a water body model that is general to the extent that every stream, lake, or estuary can be described without the use of measured parameters immediately loses all usefulness since the number of assumptions and generalizations required leaves only a definition of the type of water body. Application of national effluent standards requires some descriptions of each water body in terms of parameters that are either readily available or easily measured.

The following definitions of water bodies and the method of quantitating them on the basis of available information are offered as a solution to the water modeling problem.

Streams:

Streams are defined as all water bodies having a flow gradient from an upper elevation to a lower elevation. Streams would include all rivers. All discharges into streams will be governed by stream toxic effluent standards except in those cases in which the receiving stream flows directly into an impoundment: in such cases the impoundment effluent standard will govern. Streams will be quantitated by their flow rate in cubic feet per second (cfs) as expressed in terms of probable low rate of stream flow occurring during a 7 consecutive day period once in 10 years at the effluent or the nearest upstream monitoring station.

Lakes and Impoundments:

Lakes and impoundments are defined as all bodies of water in which the flow velocity is impeded by a natural or man-made barrier in such a way that water is stored for more than 60 days. Those water bodies with less than 60 days retention time are considered streams. Quantitation of lakes and impoundments will be based on the addition of probable low rate of flow of the tributary water bodies occurring during a 7 consecutive day period once in 10 years. Impoundments, sumps, retention ponds or similar structures constructed for the storage, retention, or disposal of toxic effluents are exempt from this definition.

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Estuaries:

Estuaries are defined as those water bodies from the coastal water baseline extending inland as far as the ebb and flow of the tide. For the calculation of maximum daily discharge which will not exceed the chronic critical limit, the size of the estuary will be determined using the additive probable low rate of stream flow occurring during a 7 consecutive day period once in 10 years of the tributaries entering the estuary above the point of discharge.

Coastal Waters:

Coastal waters are those waters of the open sea lying seward of the baseline from which the territorial sea is measured, as provided for in the Convention on the Territorial Sea and the Contiguous Zone (15 UST 1606; TIAS 5639). For the calculation of maximum daily discharge which will not exceed the chronic critical limit, the rate of flow of the coastal waters will be determined by the volume of water in the vicinity of the outfall which is influenced by the tidal range developed during the normal tidal cycle. The following calculation illustrates the above:

Assumptions - See Figure 1

1. Tidal action extends 1 nautical mile (6080 Ft.)
2. Tidal range = 4 feet
3. Tidal cycle = 12 hours
4. Plant owned shoreline in vicinity of outfall = 1 mile (5280 Ft.)

$$\frac{6080' \times 4' \times 5280'}{12\ hr} = \frac{4.08 \times 10^3 \times 5.28 \times 10^3\ ft^3}{1.2 \times 10\ hr} \times \frac{1\ hr}{3600\ sec} = 2970\ cfs/5280\ ft\ shoreline$$

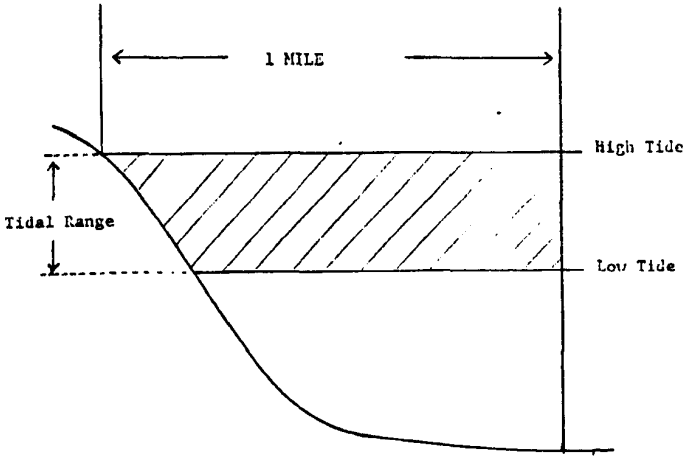
Therefore there will be the equivalent of .5625 cfs/ft. shoreline

Those situations in which a facility has a coastal outfall but no shoreline footage will be handled on a case-by-case basis. It is also realized that the above hypothetical calculation of flow in the vicinity of a coastal outfall could be more scientifically accomplished by using dye studies.

The stream definition and quantitation should be adequate for the calculation of maximum daily discharge. Streams and rivers undergo rapid vertical mixing with longitudinal mixing proportional to flow velocity. Lateral mixing is generally achieved within a few miles, thus achieving nearly complete mixing.

The simplified descriptions of impoundments and estuaries are inadequate when one considers the possibility of discharge pooling, resulting in incomplete mixing. An additional safety factor can be applied to calculate maximum daily discharge.

FIGURE 1



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Having defined water bodies and the method of quantitation, approaches to establishing effluent standards for protection against chronic affects are available.

1. Breakdown and grouping of receiving water body size.

   In this approach, receiving waters are grouped according to their size as measured by the flow rate of the streams themselves or the cumulative total of streams which serve as tributaries to impoundments and estuaries. The following table depicts the total length of water channels in various low flow rate categories.

cfs	Total Mileage of Streams	
10-100	100,000	
100-1000	80,000	
1000-10,000	22,000	
10,000	7,000	(1500 in lower Mississippi)

   The daily discharge maximum can be calculated on the basis of a percentile within each group. For example, in a 10-100 cfs grouping, the chronic critical limit can be used in conjunction with the 10 cfs flow value to calculate a daily maximum that will protect 100% of the streams within that group. Calculations based on 20 and 30 cfs would protect 90% and 80% of the group respectively. The use of any such grouping creates inequities because the discharger into a stream with a flow at the upper end of the group is forced to meet standards based on a stream at the lower end of the group. Conversely, if such a calculation were based on the 70th percentile, 30% of the water bodies in that group would be in danger of receiving damaging quantities of the pollutant.

2. Daily discharge maximum based on each receiving water flow rate. This method would be the most equitable and would insure protection of all receiving waters since the actual flow of each receiving water body would be used to calculate the maximum permissible daily loading in units of weight per day (lbs/day or kg/day). Once the safe chronic concentration is established on the basis of Water Quality Criteria, the discharger can calculate the daily maximum by determining from records the probable low rate of stream flow occurring during a 7 consecutive day period once in 10 years of the receiving stream, lake, or estuary. This approach offers the advantages of being simple to apply and enforce, as well as equitable and protective.

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C. EFFLUENT STANDARD SETTING FOR ACUTE AND CHRONIC TOXICOLOGICAL PROTECTION

The setting of the effluent standards using this alternative employs the use of 1) critical limit determination for both acute and chronic toxicity 2) establishment of ample margins of safety and 3) consideration of the water bodies which receive the discharge.

1. Standard Setting for Chronic Toxicological Protection

As was noted in the water body discussion, there are several options available for this step of the analysis. The attached calculations are illustrative of detailed calculations for the rivers, lakes, estuaries and coastal waters which were used to determine the total weight per day which could be allowed from a discharge. It was determined that the step increment approach using percentile of flow was limited by the fact that any steps were arbitrary. Because of the conviction that dilution is not the solution to pollution, a careful evaluation of these increments was made which involved an examination of the maximum and minimum discharge amounts which coastal diffusion coefficients indicated.

It was determined that there should be defined a minimum size water body into which discharges of toxic pollutants would not be allowed. This was set at 10 cfs for streams and 500 acres for lakes. It was further determined that if the major needs for the incremented water body size were to assure reasonableness, then a continuous relationship defined as the slope of these incremental steps would be most reasonable. However, there must be an upper limit. Therefore, the chronic toxicological protective part of the effluent standards was determined as illustrated below.

In order to illustrate HATS usage of the WQC to set effluent standards for chronic protection, a detailed analysis is shown using Dieldrin discharges into fresh water streams.

The proposed "Criteria for Water Quality" (p. 125) October, 1973), show a value of 0.005 ug/l for the maximum permissible concentration of Dieldrin in whole (unfiltered) water sampled at any time and place. The above concentration was determined by multiplying the acute toxicity values for the more sensitive species by an application factor of 0.01 which results in an estimated safe chronic exposure level. To protect against chronic toxicity effects, a limit must be set on the total pounds of Dieldrin which can be discharged each day. This maximum value for a stream is obtained in the following manner:

$$5.4 \times \begin{matrix}\text{stream flow} \\ \text{in cfs}\end{matrix} \times \begin{matrix}\text{chronic critical} \\ \text{limit in PPM} = \text{lbs/day}\end{matrix}$$

$$5.4 \times 10{,}000 \text{ cfs} \times 0.003 \text{ ug.l} \times 10^{-3} \text{ mg/ug}$$

$$5.4 \times 10^{4} \times 3 \times 10^{-3} \times 10^{-3} = 16.2 \times 10^{-2} = 0.162 \text{ lbs/day}$$

which is the maximum quantity of Dieldrin which can be discharged into a 10,000 cfs fresh water stream. To convert this value from lbs/day to kg/day, divide 1.62×10^{-1} by 2.205 to obtain $.73 \times 10^{-1}$ or 0.073 kg/day.

Explanation of terms in lbs/day effluent formula.

(1) "5.4" this conversion factor converts the flow in ft/sec. and the acceptable toxic pollutant concentration in mg/liter to lbs/day of pollutant discharge. Therefore:

$$\frac{ft^3}{sec} \times \frac{mg}{l} \times \frac{2.205 \times 10^{-6} \#}{mg} \times \frac{8.64 \times 10^4 \text{ sec}}{day} \times \frac{7.832 \times 10 \text{ l}}{ft^3} = 5.4 \text{ lbs/day}$$

(2) "Chronic critical' limit is the Water Quality Criteria estimated acceptable chronic exposure concentration multiplied by a safety factor of 0.6 which takes into account non-toxicological factors such as background levels of the toxic pollutant from non-point sources, multiple discharges and clustering of industrial or point source discharges into a relatively small geographical area and an allowance for the expected industrial growth potential and the resulting increased propensity for discharging the toxic pollutant.

(3) "Stream flow in cfs" is the probable low rate of stream flow occurring during a 7 consecutive day period once in 10 years.

A question that should be addressed is why must there be a maximum cutoff and why is it at the 10,000 cfs flow? The answer to this question is part philosphy and intent of law interpretation and in part knowledge gained from experience. The use of diffusion is only desirable under carefully controlled and monitored conditions and at levels where a high degree of assurance can be given to the public that no harm can result. There has been a nondegradation philosphy relative to upgrading the quality of our waters which must not be violated. By placing no maximum on the total weight discharged, there is an open invitation to industry to abandon their facilities for new facilities to be located on large major inland waters and coastlines. Treatment technology does exist to provide significant removal of toxic pollutants and it is being used now. An incentive should be given to continue and expand its use. The river miles above 10,000 cfs have been estimated to be 7,000 and include some 20 rivers most of which have industrial development. The most severe need for a maximum cutoff is the lack of confidence in the simplistic models used to describe these water bodies. Also, it is not desirable to induce clustering of industries on extremely large water bodies because of more liberal effluent limitations.

Therefore, the chronic toxicological protection part of the effluent standard will be expressed as:

a. Into streams or estuaries with a low flow of less than or equal to 0.283 cubic meters per second (10 cfs) or into lakes with an area of less than or equal to 202 hectares (500 acres), there shall be no discharge of the listed pollutants.

b. Into streams or estuaries with a low flow greater than 0.283 cubic meters per second (10 cfs) or into lakes with an area of greater than 202 hectares (500 acres), the total daily weight of the pollutant discharged from any facility shall not exceed a factor derived by the above calculations and given for each respective pollutant multiplied by the low flow of the receiving water body. 283 cubic meters per second (10,000 cfs) shall be the maximum value for the low flow of the receiving water body used in this calculation.

2. Standard Setting for Acute Toxicological Protection

To protect the affected important organisms from acute toxicity, three considerations must be noted: time of exposure, concentration of toxicant during exposure and sensitivity of the receptor. In establishing effluent standards the sensitivity of the receptor is given and fixed. It is difficult to control the time of exposure of the receptor except by controlling the rate of diffusion of the toxicant into the receiving water body which is related to controlling the concentration in the discharge pipe. It is important to realize that TLm or LC_{50} concentrations (e.g., 96-hour TLm) will kill 50 percent of the animal population when they are exposed to the toxicant for 96 hours. If significant fish kills in the area of the outfall are to be prevented when discharging the toxicant at the 96-hour TLm level, it is imperative that the discharge be rapidly diffused into the receiving water body. This action is required to drastically minimize the time of exposure and concentration of exposure to the fish in the area. In order to provide this rapid diffusion it is important that the ratio of the discharge of the effluent to the receiving water flow rate be sufficiently low (e.g., 1:10). The only other alternative to provide this protection is to use an application factor on the TLm level so that the resulting concentration in the effluent pipe is reduced to a safe acute level.

Again using Dieldrin to illustrate the use of proposed Water Quality Criteria in the derivation of acute toxicity limitations and standards, it is recalled that the dieldrin criteria for fresh water is 0.005 ug/l which is 0.01 times the 96-hour LC_{50} of an important species.

$$0.01 \times LC_{50} = 0.005 \text{ ug/l}$$

or,

$$LC_{50} = 0.5 \text{ ug/l}$$

It now follows that .5 ug/l is the acute toxicity level of Dieldrin that, if discharged without appropriate controls, would cause damage to the aquatic environment. Therefore, EPA's proposed standard must provide for acute toxicological protection by requiring a minimum of ten-fold diffusion when Dieldrin is discharged into water bodies. Therefore, the effluent concentration must be 0.5 ug/l or less with appropriate diffusion. The

effluent standards to protect against acute toxicological damage are as follows:

a. Into streams or estuaries with a low flow of less than or equal to 0.283 cubic meters per second (10 cfs) or into lakes with an area of less than or equal to 202 hectares (500 acres), there shall be no discharge of the listed pollutants.

b. Into streams or estuaries with a low flow greater than 0.283 cubic meters per second (10 cfs) or into lakes with an area of greater than 202 hectares (500 acres)

(1) the daily average pollutant concentration shall not exceed

(aa) 0.5 ug/l in waste streams which are diffused in water bodies which have a low flow greater than or equal to 10 times the water stream flow or

(bb) 0.05 ug/l in waste streams which flow into water bodies which have a low flow less than 10 times the waste stream flow.

D. APPARENT DIFFERENCE

There may be some differences between the Water Quality Criteria numbers and the effluent standard concentration numbers proposed here. It should be remembered that these effluent standards are designed to cover both the acute and chronic toxicity situations. In regard to the above possible differences it is fairly certain, when using 96-hour LC_{50} values, that the fish will not remain in the vicinity of the outfall for 96 hours and therefore, even though these effluent concentration numbers may be less strict than Water Quality Criteria, when the chronic toxicity (lbs/day) portion of the effluent standard is considered, the total effluent standard is designed to meet and be directly related to the receiving water quality criteria.

E. SPECIFIC CALCULATIONS AND DERIVATIONS OF 307(a) TOXIC POLLUTANT EFFLUENT STANDARDS

The following discussion is designed to illustrate a) the toxicological data and their source, b) their relationship to Water Quality Criteria, c) any adjustments necessary to use these data for effluent standard setting, d) the actual calculations following the steps previously defined and e) the numbers that are proposed to be used in the Federal Register document as standards.

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This discussion is broken down into the nine toxic pollutants. The discussion for Aldrin-Dieldrin is more detailed so that, having it in mind, one can follow annotated versions for the rest of the toxic pollutants.

1. Aldrin-Dieldrin

a. Fresh water

The proposed "Criteria for Water Quality" October 1973 (p. 125) list the following fresh water values for aldrin and dieldrin in whole (unfiltered) water sampled at any time and place.

	Permissible Maximum Concentration* (ug/l)
Aldrin	0.01
Dieldrin	0.005

*These concentrations were determined by multiplying the acute toxicity values for the more sensitive species by an application factor of 0.01. The reference for these values is "Water Quality Criteria of 1972" National Academy of Science Report, in press. Since aldrin is rapidly oxidized in the aquatic environment to dieldrin, it was decided to use the Water Quality Criteria values for dialdrin throughout the following calculations.

(a) Effluent Concentration: (Critical Acute Limit)

Since the dieldrin Water Quality Criteria value of 0.005 ug/l was obtained using a 0.01 application factor times the 96-hour LC_{50} for the more sensitive species, a freshwater maximum allowable effluent concentration of 100 times the Water Quality Criteria value or 0.5 ug/l at the outfall is suggested. It should be noted that the standard for aldrin-dieldrin requires that the outfall be diffused at least ten-fold in the receiving water and it is highly unlikely that the affected species will remain in the outfall area for 96 hours.

(b) Daily Load:

Since aldrin-dieldrin not only have an acute toxicity but also exhibit a chronic toxicity which may manifest itself in the form of bioconcentration in various organisms, a daily limit on the weight of aldrin-dieldrin

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is proposed to be placed on outfalls. This daily limit is established using the Water Quality Criteria value of 0.005 ug/l and performing the calculations which are shown on the following pages and thereby derive the effluent standards.

b. Salt Water

The proposed values listed in "Criteria for Water Quality" (October 1973 p. 297-8) are:

. Aldrin LC_{50} = 5.5 ug/l (acute)

0.01 x LC_{50} = 0.055 ug/l (chronic)

. Dieldrin LC_{50} = 5.5 ug/l (acute)

0.01 x LC_{50} = 0.055 ug/l (chronic)

In a similar manner as described under fresh water the above numbers were used, as the following illustrates, to calculate the acute and chronic limitations for the various water bodies.

(a) Effluent Concentration: (Critical Acute Limit)

Water Body	Max. Allow. Effluent Conc.
F.W. Stream	0.5 ug/l
F.W. Lake	0.5 ug/l
Estuary	5.5 ug/l
Coastal	5.5 ug/l

(b) Daily Load:

Water Body	WQC Chronic Limit	Safety Factor (%)	Correction for Safety	Critical Chronic Limit (ppb) (WQC Chronic Limit x Correction for Safety
F.W. Stream	0.005 ug/l	40	0.6	0.003 ug/l
F.W. Lake	0.005 ug/l	50	0.5	0.0025 ug/l
Estuary	0.055 ug/l	50	0.5	0.028 ug/l
Coastal	0.055 ug/l	40	0.6	0.033 ug/l

5.4 x cfs x Crit. Chronic Lim. in ppm = lbs/day ÷ 2.205 = kg/day

F.W. Stream: 5.4 x 10,000 x .000003 = 0.162 lbs/day ÷ 2.205 = 0.0735 kg/day

F.W. Lake: 5.4 x 10,000 x .0000025 = 0.135 lbs/day ÷ 2.205 = 0.0612 kg/day

Estuary: 5.4 x 10,000 x .000028 = 1.512 lbs/day ÷ 2.205 = 0.6857 kg/day

Coastal: 5.4 x 10,000 x .000033 = 1.782 lbs/day ÷ 2.205 = 0.808 kg/day

Effluent Standard Factors Aldrin-Dieldrin

The values to be used in determining Effluent Standards are tabulated below:

	Metric Unit Factors		English Unit Factors	
	Column 1 Maximum Effluent Concentration Critical Acute Limit (ug/l)	Column 2 Maximum Effluent Concentration Loading kg/day/m^3/sec	Column 3 Maximum Effluent Concentration Critical Acute Limit (ppb)	Column 4 Maximum Effluent Loading lbs/day/ft^3/s
Stream	0.5	0.000259	0.5	0.0000162
Lakes	0.5	0.000216	0.5	0.0000135
Estuaries	5.5	0.00242	5.5	0.000151
Coastal Waters	5.5	0.00286	5.5	0.000178

To determine allowable loading for a specific water body multiply column 2 figure by flow in m^3/sec or column 4 by flow in cfs providing flow is within the range 0.283 to 283 in m^3/sec or 10 to 10,000 cfs.

2. Benzidine

There are no Water Quality Criteria for this material and the derivation of its effluent standards is given as follows:

The data presented in the paper of Spitz, Maguigan, and Dobriner (Cancer 3, 789, 1950) on the carcinogenicity of injected benzidine in Sherman rats were used. In this experiment, rats were injected subcutaneously in the back once per week with 15 milligrams of benzidine throughout life or until illness or weight loss were evident. Among a total of 387 rats so injected, 107 had tumors at death, a tumor incidence of 0.276. We can therefore, state with 99% assurance that the "true" tumor incidence at the dose employed is no greater than 0.34.

The dose administered to the rats was 15 mg benzidine per week, and the rats achieved a weight averaging approximately 265 grams. To calculate the equivalent dose in humans, the experimental dose was multiplied by the two-thirds power of the ratio of human weight (taken as 60 kg) to the average rat weight on the assumption that the effects of a toxic compound are roughly proportional to the surface area of the animal species which, in turn, is roughly proportional to the two-thirds power of the weight. Thus, if the human dose equivalent to the experimental dose is H, then:

$$H = 15 \text{ mg/week} \times \left(\frac{60 \text{ kg}}{0.265 \text{ kg}}\right)^{2/3} = 557 \text{ mg/week} = 79.6 \text{ mg/day}$$

Thus, equating average human and rat responses to equivalent doses, we conclude with 99% assurance that a human dose of 79.6 mg/day will result in a tumor incidence in humans no greater that 34%.

We now want to calculate the dose which would correspond to a tumor incidence no greater than one per million (10^{-6}). The probit method of Mantel and Bryan is based on the assumption that susceptibility to the carcinogenic effects of a chemical is distributed normally among the human population, and that the incidence of cancer will decrease with decreasing dose at a rate of no less than one normal deviate (probit) per 10-fold decrease in dose. An incidence of 10^{-6} corresponds to a normal deviate of -4.753. The "observed" incidence of 0.34 corresponds to a normal deviate of -0.412. Thus, moving from a risk of 0.34 to a risk of 10^{-6} corresponds to a movement of -4.753 - (-0.412) = -4.341 normal deviates. On the assumption that a ten-fold reduction in dose will result in a decrease in risk corresponding to one normal deviate, the dose corresponding to a risk of 10^{-6} is calculated to be:

Maximum permissible human dose =

$$79.6 \text{ mg/day} \times 10^{-4.341} = 3.63 \text{ ug/day}$$

Toxic Substance Benzidine

(a) Water Body	Max. Allow. Effluent Conc.
F.W. Stream	1.8 ug/l
F.W. Lake	1.8 ug/l
Estuary	1.8 ug/l
Coastal	1.8 ug/l

(b) Daily Load

Water Body	Critical Chronic Limit	Safety Factor	Correction For Safety	(Chronic Critical Limit Times Correction For Safety) Adjusted Critical Chronic Limit (PPB)
F.W. Stream	1.8 ug/l	99	0.01	0.018 ug/l
F.W. Lake	1.8 ug/l	99	0.01	0.018 ug/l
Estuary	1.8 ug/l	99	0.01	0.018 ug/l
Coastal	1.8 ug/l	99	0.01	0.018 ug/l

Calculation: 5.4 x cfs x Adj. critical chronic limit in ppm = Maximum lbs/day ÷ 2.205 = maximum kg/day

F.W. Stream: 5.4 x 10,000 x 0.000018 = 0.97 lbs/day ÷ 2.205 = 0.44 kg

F.W. Lake: 5.4 x 10,000 x 0.000018 = 0.97 lbs/day ÷ 2.205 = 0.44 kg

Estuary: 5.4 x 10,000 x 0.000018 = 0.97 lbs/day ÷ 2.205 = 0.44 kg

Coastal: 5.4 x 10,000 x 0.000018 = 0.97 lbs/day ÷ 2.205 = 0.44 kg

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Effluent Standard

In no case shall the levels of benzidine in discharges from facilities identified in 129.20 exceed the values tabulated below. Because of the inadequacies of the analytical methodology currently available, measurement of this material early in the process waste stream is regarded as sufficient for the determination of compliance when evaluated along with actual waste stream flows to calculate the effluent levels.

	Metric Unit Factors		English Unit Factors	
	Column 1 Maximum Effluent Concentration Critical Acute Limit (ug/l)	Column 2 Maximum Effluent Loading kg/day/m^3/sec	Column 3 Maximum Effluent Concentration Critical Acute Limit (ppb)	Column 4 Maximum Effluent Loading lbs/day/ft^3/sec
Streams	1.8	0.0016	1.8	0.0001
Lakes	1.8	0.0016	1.8	0.0001
Estuaries	1.8	0.0016	1.8	0.0001
Coastal Waters	1.8	0.0016	1.8	0.0001

3. Cadmium

a. Fresh water

The fresh water WQC recommended levels were noted as follows:

*30 ug/1 (Hard > 100 ug/1 as $CaCO_3$)

* 4 ug/1 (Soft ≤ 100 mg/1 as $CaCO_3$)

*Note: Where crustacea and eggs and larvae of salmonids develop limits are:

3 ug/1 (Hard water)

0.4 ug/1 (Soft water)

Ref: WQC Page 104-105 Show following:

Safe levels Cd for fathead minnows and bluegill in Hard water = 30-60 ug/1

Safe levels coho salmon fry are 1-4 ug/1 in soft water.

0.5 ug/1 reduce reproduction of daphnia magna in one generation three week exposure.

Therefore, the 0.4 ug/1 was used as though it represented a 1/100 acute level and the acute and chronic protection limitations were so derived as shown on the calculation sheet.

b. Salt water

Ref: WQC p. 265 Max Cd. Conc of 10 ug/1

The salt water WQC recommended level above was noted. Therefore 1000 ug/1 and 10 ug/1 should be the acute and chronic toxicity values respectively.

However, additional data gathered and reviewed by OAWP indicated the following:

Sand Shrimp: 96 hr. LC_{50} = 320 ug/1

Grass Shrimp: 96 hr. LC_{50} = 420 ug/1

Hermit Crab: 96 hr. LC_{50} = 320 ug/1

Therefore the acute limit was set at 320 ug/1 and the chronic level at 3.2 ug/1

Calculations

Toxic Substance Cadmium

(a) Effluent Concentration: (Critical Acute Limit)

Water Body	Max. Allow. Effluent Conc.
F.W. Stream	40 ug/1
F.W. Lake	40 ug/1
Estuary	320 ug/1
Coastal	320 ug/1

(b) Daily Load

Water Body	WQC Chronic Limit	Safety Factor	Correction For Safety	(WQC Chronic Limit Times Correction For Safety) Critical Chronic Limit (PPB)
F.W. Stream	0.4 ug/1	40	0.6	0.24 ug/1
F.W. Lake	0.4 ug/1	50	0.5	0.2 ug/1
Estuary	3.2 ug/1	50	0.5	1.6 ug/1
Coastal	3.2 ug/1	40	0.6	1.9 ug/1

Calculation:

5.4 x cfs x critical chronic limit in ppm = lbs/day ÷ 2.205 = kg/day

F.W. Stream: 5.4 x 10,000 x .00024 = 12.96 lbs/day ÷ 2.205 = 5.88 kg/day

F.W. Lake: 5.4 x 10,000 x .00020 = 10.80 lbs/day ÷ 2.205 = 4.90 kg/day

Estuary: 5.4 x 10,000 x .00016 = 86.40 lbs/day ÷ 2.205 = 39.2 kg/day

Coastal: 5.4 x 10,000 x .00190 = 102.6 lbs/day ÷ 2.205 46.5 kg/day

Effluent Standard Factors Cadmium

The values to be used in determining Effluent Standards are tabulated below:

	Metric Unit Factors		English Unit Factors	
	Column 1 Maximum Effluent Concentration Critical Acute Limit (ug/l)	Column 2 Maximum Effluent Loading $kg/day/m^3/sec$	Column 3 Maximum Effluent Concentration Critical Acute Limit (ppb)	Column 4 Maximum Effluent Loading $lbs/day/ft^3/sec$
Streams	40	0.0206	40	0.00130
Lakes	40	0.0173	40	0.001080
Estuaries	320	0.139	320	0.008640
Coastal Waters	320	0.164	320	0.01026

To determine allowable loading for a specific water body multiply Column 2 figure by flow in m^3/sec or Column 4 by flow in cfs providing flow is within the range 0.283 to 283 in m^3/sec or 10 to 10,000 cfs.

4. Cyanide

a. Fresh water

The WQC for cyanide was noted as 1/20 of 96 hr LC_{50} not exceeding 5 ug/l Acute = 100 (20 x 5 ug/l)

Ref: WQC p. 113

Therefore the acute limit was set at 100 ug/l and the chronic limit at 5 ug/l.

b. Salt water

The WQC for cyanide was noted as 1/10 96-hr LC_{50}

Ref: WQC p.289 max. of 10 ug/l of cyanides in marine or estuarine waters.

However, based upon additional data gathered by OAWP the following was noted:

Pin Perch: LC_{50} = 70 ug/l

Pink Shrimp: LC_{50} = 100 ug/l

CN^- = 10 ug/l (Chronic WQC)

Therefore, the acute limit was set at 100 ug/l and the chronic was set at 10 ug/l.

It was determined, however, that chronic protection was not required for cyanide, since it is primarily an acute toxic pollutant. Therefore, only a concentration limitation was established.

Calculations

Toxic Substance Cyanide

(a) Effluent Concentration: (Critical Acute Limit)

Water Body	Max. Allow. Effluent Conc.
F.W. Stream	100 ug/l
F.W. Lake	100 ug/l
Estuary	100 ug/l
Coastal	100 ug/l

(b) Daily Load: Not applicable

5. DDT

a. Fresh water

From the WQC the recommended levels were noted as:

DDT = 0.002 ug/l (0.01 x LC_{50}) Chronic

Acute = 0.2 ug/l

Ref: Same as Aldrin WQC p. 125 Table 1

b. Salt water

From the WQC the recommended levels were noted as:

DDT = .006 ug/l (0.01 LC_{50}) Chronic

Ref: WQC p.297 Sand Shrimp 96-hr. LC_{50} = 0.6 ug/l Acute

Calculations

Toxic Substance DDT

(a) Effluent Concentration: (Critical Acute Limit)

Water Body	Max. Allow. Effluent Conc.
F.W. Stream	0.2 ug/l
F.W. Lake	0.2 ug/l
Estuary	0.6 ug/l
Coastal	0.6 ug/l

(b) Daily Load

Water Body	WQC Chronic Limit	Safety Factor	Correction For Safety	(WQC Chronic Limit Times Correction For Safety) Critical Chronic Limit (ppb)
F.W. Stream	.002 ug/l	40	0.6	0.0012 ug/l
F.W. Lake	.002 ug/l	50	0.5	0.001 ug/l
Estuary	.006 ug/l	50	0.5	0.003 ug/l
Coastal	.006 ug/l	40	0.6	0.0036 ug/l

Calculation:

5.4 cfs x critical chronic limit in ppm = lbs/day ÷ 2.205 = kg/day

F.W. Stream: 5.4 x 10,000 x .0000012 = 0.0648 lbs/day ÷ 2.205 = 0.0294 kg/day

F.W. Lake: 5.4 x 10,000 x .000001 = 0.054 lbs/day ÷ 2.205 = 0.02[illegible] kg/day

Estuary: 5.4 x 10,000 x .000003 = 0.16[illegible] lbs/day ÷ 2.205 = 0.0734 kg/day

Coastal: 5.4 x 10,000 x .0000036 = 0.194 lbs/day ÷ 2.205 = 0.088 kg/day

Effluent Standard Factors DDT, DDD, DDE

The values to be used in determining Effluent Standards are tabulated below:

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	Metric Unit Factors		English Unit Factors	
	Column 1 Maximum Effluent Concentration Critical Acute Limit (ug/l)	Column 2 Maximum Effluent Loading $kg/day/m^3/sec$	Column 3 Maximum Effluent Concentration Critical Acute Limit (ppb)	Column 4 Maximum Effluent Loading $lbs/day/ft^3/sec$
Streams	0.2	0.000102	0.2	0.00000648
Lakes	0.2	0.0000866	0.2	0.0000054
Estuaries	0.6	0.000260	0.6	0.0000162
Coastal Waters	0.6	0.000311	0.6	0.0000194

To determine allowable loading for a specific water body multiply column 2 figure by flow in m^3/sec or column 4 by flow in cfs providing flow is within the range 0.283 to 283 in m^3/sec or 10 to 10,000 cfs.

6. Endrin

a. Fresh water

From the WQC the following recommended levels were noted:

Endrin LC_{50} = 0.2 ug/l (Acute)

.01 x LC_{50} = .002 ug/l (Chronic)

Ref: Same as Aldrin WQC p. 125 Table 1

b. Salt water

From the WQC the following recommended levels were noted:

Endrin LC_{50} = 0.6 ug/l (Acute)

.01 x LC_{50} = 0.006 ug/l (Chronic)

Ref: WQC p. 298

Calculations

Toxic Substance Endrin

(a) Effluent Concentration: (Critical Acute Limit)

Water Body	Max. Allow. Effluent Conc.
F.W. Stream	0.2 ug/l
F.W. Lake	0.2 ug/l
Estuary	0.6 ug/l
Coastal	0.6 ug/l

(b) Daily Limit

Water Body	WQC Chronic Limit	Safety Factor	Correction For Safety	(WQC Chronic Limit Times Correction for Safety) Critical Chronic Limit (ppb)
F.W. Stream	0.002 ug/l	40	0.6	0.0012 ug/l
F.W. Lake	0.002 ug/l	50	0.5	0.001 ug/l
Estuary	0.006 ug/l	50	0.5	0.003 ug/l
Coastal	0.006 ug/l	40	0.6	0.0036 ug/l

Calculation:

5.4 x cfs x Adj. C.C.L. in ppm = lbs/day ÷ 2.205 = kg/day

F.W. Stream: 5.4 x 10,000 x .0000012 = 0.0648 lbs/day ÷ 2.205 = 0.0294 kg/day

F.W. Lake: 5.4 x 10,000 x .000001 = 0.054 lbs/day ÷ 2.205 = 0.0245 kg/day

Estuary: 5.4 x 10,000 x .000003 = 0.162 lbs/day ÷ 2.205 = 0.0734 kg/day

Coastal: 5.4 x 10,000 x .0000036 = 0.194 lbs/day ÷ 2.205 = 0.088 kg/day

Effluent Standard Factors Endrin

The values to be used in determining Effluent Standards are tabulated below:

	Metric Unit Factors		English Unit Factors	
	Column 1 Maximum Effluent Concentration Critical Acute Limit (ug/l)	Column 2 Maximum Effluent Loading kg/day/m^3/sec	Column 3 Maximum Effluent Concentration Critical Acute Limit (ppb)	Column 4 Maximum Effluent Loading lbs/day/ft^3/sec
Streams	0.2	0.000102	0.2	0.00000648
Lakes	0.2	0.0000866	0.2	0.0000054
Esturaries	0.6	0.000260	0.6	0.0000162
Coastal Waters	0.6	0.000311	0.6	0.0000194

To determine allowable loading for a specific water body multiply column 2 figure by flow in m^3/sec or column 4 by flow in cfs providing flow is within the range 0.283 in m^3/sec or 10 to 10,000 cfs.

7. Mercury

a. Fresh water

From the WQC the following recommended levels and comments were noted:

Mercury = 0.05 ug/l chronic

This chronic level is required because of bioaccumulation of mercury in fish flesh in excess of FDA levels

Acute = 20 ug/l is based on acute toxicity of Hg to aquatic life.

Ref: WQC p. 119-120 Exposure of fish for 3 months to conc. of 0.05 ug/l of Hg in water resulted in conc. of 0.5 ug/g in fish (maximum FDA guideline - edible portions) Maximum acceptable total Hg conc. in water = 0.2 ug/l. Maximum average total Hg conc. in water = 0.05 ug/l.

b. Salt Water

From the WQC the following recommended levels were noted:

Mercury (0.01 x LC_{50})

Ref: WQC p. 275 maximum of 1.0 ug/l (Chronic)
Acute = 100 ug/l

It should be noted that the accumulation factors of mercury are reported to vary, but it is essential that some account be taken of this phenomenon and therefore any difference which may be noted between acute and chronic limitations are so justified.

Toxic Substance Mercury

(a) Effluent Concentration: (Acute Critical Limit)

Water Body	Max. Allow. Effluent Conc.
F.W. Stream	20 ug/l
F.W. Lake	20 ug/l
Estuary	100 ug/l
Coastal	100 ug/l

(b) Daily Load:

Water Body	WQC Chronic Limit	Safety Factor	Correction for Safety	(WQC Chronic Limit Times Correction for Safety) Critical Chronic Limit (ppb)
F.W. Stream	.05 ug/l	40	0.6	0.03 ug/l
F.W. Lake	.05 ug/l	50	0.5	0.025 ug/l
Estuary	1.0 ug/l	50	0.5	0.5 ug/l
Coastal	1.0 ug/l	40	0.6	0.6 ug/l

Calculation: 5.4 x cfs x critical chronic limit in ppm = lbs/day ÷ 2.205 = kg/day

F.W. Stream: 5.4 x 10,000 x 0.00003 = 1.620 lbs/day ÷ 2.205 = 0.735 kg/day

F.W. Lake: 5.4 x 10,000 x 0.000025 = 1.350 lbs/day ÷ 2.205 = 0.612 kg/day

Estuary: 5.4 x 10,000 x 0.0005 = 27.0 lbs/day ÷ 2.205 = 12.24 kg/day

Coastal: 5.4 x 10,000 x 0.0006 =32.4 lbs/day ÷ 2.205 = 14.7 kg/day

Effluent Standard Factors Mercury

The values to be used in determining Effluent Standards are tabulated below:

	Metric Unit Factors		English Unit Factors	
	Column 1 Maximum Effluent Concentration Critical Acute Limit (ug/l)	Column 2 Maximum Effluent Loading kg/day/m^3/sec	Column 3 Maximum Effluent Concentration Critical Acute Limit (ppb)	Column 4 Maximum Effluent Loading lbs/day/ft^3/sec
Streams	20	0.00260	20	0.000162
Lakes	20	0.00216	20	0.000135
Estuaries	100	.0431	100	0.0027
Coastal Waters	100	.0519	100	0.00324

To determine allowable loading for a specific water body multiply column 2 figure by flow in m^3/sec or column 4 by flow in cfs providing flow is within the range 0.283 to 283 m^3/sec or 10 to 10,000 cfs

8. Polychlorinated biphenyls (PCB's)

a. Fresh water

From the WQC the following data were noted:

Chronic = 0.002 ug/l due to bioaccumulation

Acute = 280 ug/l (based on acute Tox to F.W. Fish)

Ref: WQC p. 121

PCB residue levels of 500 ug/l in whole salmon eggs have been suggested as threshold for egg mortality. Such levels in eggs are associated with levels in body tissue of 2.5-5.0 ug/g. PCB's accumulation factors up to 200,000 long term-low level exposure in water have been reported.

b. Salt water

Page 320 of WQC states "The maximum acceptable concentration of PCB's in any sample consisting of a homogenate of 25 or more whole fish of any species that is consumed by fish-eating birds and mammals, within the size range consumed is 0.5 mg/kg (ppm) on a wet weight basis."

Using data gathered by HATS, the upper concentration factor for marine fish is 30,000. Dividing the recommended maximum acceptable residue level by the concentration factor results in:

$$\frac{0.5 \text{ ppm}}{3 \times 10^4} = 0.167 \times 10^{-4} \text{ ppm}$$

or 0.0167 ug/l

which meets "Water Quality Criteria" guidelines for chronic exposure in the marine environment.

For acute protection of important species the following data are presented:

Pink Shrimp, 48 HR LC_{100} = 100 ug/l

" " 48 " LC_0 = 10 ug/l

Oysters 96 HR TL_{100} = 100 ug/l

96 HR TL_{41} = 10 ug/l

Although no fatalities occur to pink shrimp at 10 ug/l in 48 hours, this concentration adversely affected oysters by reducing shell growth by 41% in 96 hours. Therefore, the acute critical limit is:

10.0 ug/l

Calculations

Toxic Substance PCB's

(a) Effluent Concentration: (Critical Acute Limit)

Water Body	Max. Allow. Effluent Conc.
F.W. Stream	280 ug/l
F.W. Lake	280 ug/l
Estuary	10 ug/l
Coastal	10 ug/l

(b) Daily Load:

Water Body	WQC Chronic Limit	Safety Factor	Correction For Safety	(WQC Chronic Limit Times Correction For Safety) C.itical Chronic Limit (ppb)
F.W. Stream	.002 ug/l	40	0.6	0.0012 ug/l
F.W. Lake	.002 ug/l	50	0.5	0.001 ug/l
Estuary	.017 ug/l	50	0.5	0.0085 ug/l
Coastal	.017 ug/l	40	0.6	0.0102 ug/l

Calculation:

5.4 x cfs x Adj. C.C.L. in ppm = lbs/day ÷ 2.205 = kg/day

F.W. Stream: 5.4 x 10,000 x .0000012 = ,0648 lbs/day ÷ 2.205 = 0.0294 kg/day

F.W. Lake: 5.4 x 10,000 x .000001 = .054 lbs/day ÷ 2.205 = 0.0245 kg/day

Estuary: 5.4 x 10,000 x .0000085 = 0.459 lbs/day ÷ 2.205 = 0.208 kg/day

Coastal: 5.4 x 10,000 x .0000102 = 0.551 lbs/day ÷ 2.205 = .250 kg/day

Effluent Standard Factors PCB's

The values to be used in determining Effluent Standards are tabulated below:

	Metric Unit Factors		English Unit Factor	
	Column 1 Maximum Effluent Concentration Critical Acute Limit (ug/l)	Column 2 Maximum Effluent Loading $kg/day/m^3/sec$	Column 3 Maximum Effluent Concentration Critical Acute Limit (ppb)	Column 4 Maximum Effluent Loading $lbs/day/ft^3/sec$
Streams	280	0.000104	280	0.00000648
Lakes	280	0.0000865	280	0.00000540
Estuaries	10	0.000735	10	0.0000459
Coastal Waters	10	0.000883	10	0.0000551

To determine allowable loading for a specific water body multiply column 2 figure by flow in m^3/sec or Column 4 by flow in cfs providing flow is within the range 0.283 to 283 in m^3/sec or 10 to 10,000 cfs.

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9. Toxaphene

a. Fresh Water

From WQC the following recommended levels were noted:

Toxaphene LC_{50} = 1 ug/l (acute)

.01 x LC_{50} = 0.01 ug/l (chronic)

Ref: WQC p. 125 Table 1

Same as Aldrin

b. Salt Water

From WQC the following recommended levels were noted:

Toxaphene LC_{50} = 1.0 ug/l (acute)

.01 x LC_{50} = .01 ug/l (chronic)

Ref: WQC p. 302

CALCULATIONS

Toxic Substance Toxaphene

(a) Effluent Concentration: (Critical Acute Limit)

Water Body	Max. Allow. Effluent Conc.
F. W. Stream	1.0 ug/l
F. W. Lake	1.0 ug/l
Estuary	1.0 ug/l
Coastal	1.0 ug/l

(b) Daily Load:

Water Body	WQC Chronic Limit	Safety Factor (%)	Correc. for Safety	Crit. Chron. Lim. (ppb) (WQC Chron. Lim. x Correc. for Saf
F. W. Stream	0.01 ug/l	40	0.6	0.006 ug/l
F. W. Lake	0.01 ug/l	50	0.5	0.005 ug/l
Estuary	0.01 ug/l	50	0.5	0.005 ug/l
Coastal	0.01 ug/l	40	0.6	0.006 ug/l

Calculation:

5.4 x cfs x Crit. Chron. Lim. in ppm = lbs/day ÷ 2.205 = kg/day

F.W. Stream: 5.4 x 10,000 x .000006 = 0.324 lbs/day ÷ 2.205 = 0.147 kg/day

F.W. Lake: 5.4 x 10,000 x .000005 = 0.270 lbs/day ÷ 2.205 = 0.122 kg/day

Estuary: 5.4 x 10,000 x .000005 = 0.270 lbs/day ÷ 2.205 = 0.122 kg/day

Coastal: 5.4 x 10,000 x .000006 = 0.324 lbs/day ÷ 2.205 = 0.147 kg/day

Effluent Standard Factors Toxaphene

The values to be used in determining Effluent Standards are tabulated below:

	Metric Unit Factors		English Unit Factors	
	Column 1 Maximum Effluent Concentration (ug/l)	Column 2 Maximum Effluent Loading kg/day/m^3/sec	Column 3 Maximum Effluent Concentration (ppb)	Column 4 Maximum Efflue. Loading lbs/day/ft^3/s.
Streams	1.0	0.000519	1.0	0.0000324
Lakes	1.0	0.000431	1.0	0.0000270
Estuaries	1.0	0.000431	1.0	0.0000270
Coastal Waters	1.0	0.000519	1.0	0.0000324

To determine allowable loading for a specific water body multiply Column 2 figure by flow in m^3/sec or Column 4 by flow in cfs providing flow is within the range 0.283 to 283 in m^3/sec or 10 to 10,000 cfs.

IV. EPA Proposed Water Quality Criteria for PCB's

Sections of the proposed Water Quality Criteria applicable to materials on the List of Toxic Pollutants and used as basic data in the formulation of the effluent standards are included as scientific and technical support for the proposed standards.

Note: For the purpose of this document only those references from the proposed Water Quality Criteria which are applicable to the toxic pollutants have been included.

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V. Freshwater Constituents

A. Aquatic Life

4. Organic Compounds

f. Polychlorinated Biphenyls (PCB's)

Maximum acceptable concentrations of PCB's in water are 0.002 ug/l, and maximum acceptable levels of residues in general body tissues of any aquatic organism are 0.5 ug/g.

Rationale (Polychlorinated Biphenyls):

PCB residue levels of 0.5 mg/l in whole salmon eggs have been suggested as the threshold for egg mortality (6). Such levels in eggs are associated with levels in the body tissue of 2.5 to 5.0 ug/g (1). PCB's are highly cumulative with accumulation factors of up to 200,000 indicated by long term exposure of fish to low PCB concentrations in water (1). Consequently, in order to provide adequate protection for egg development, and to provide an adequate safety factor to protect against excessive accumulations in tissue, the 0.002 ug/l maximum concentration limit in waters shall be observed.

B. Wildlife

4. Specific Harmful Substances

b. Acting After Food Chain Magnification

(3). Polychlorinated biphenyls (PCB's)

The body burdens of PCB's in birds and mammals should not be increased over present levels in order to maintain acceptable levels.

Rationale (Polychlorinated Biphenyls):

Although PCB's are widespread environmental containments, their biological effects at present environmental concentrations are not known (1). Because of the persistence of PCB's and their susceptibility to biological magnification, the body burdens of PCB's in birds and mammals should not be permitted to increase and monitoring programs should be instituted.

C. Public Water Supply Intake

5. Organic Compounds

h. Polychlorinated Biphenyls (PCB's)

No limit of acceptability is prescribed for acceptable concentrations of polychlorinated biphenyls in raw water used for drinking water supplies.

Rationale (PCB's):

Too little is known about the levels in water, the retention and the accumulation in humans and the effects of very low rates of ingestion to permit the establishment of acceptable PCB limits.

VI. Marine Water Constituents

B. Wildlife

2. Specific Harmful Substances

d. Polychlorinated Biphenyls (PCB's)

The maximum acceptable concentrations of PCB in any sample consisting of a homogenate of 25 or more whole fish of any species that is consumed by fish-eating birds and mammals, within the size range consumed is 0.5 mg/kg on a wet weight basis.

Rationale (PCB):

Evidence is accumulating that PCB does not contribute to the shell thinning that has been a major symptom of the reproductive failures and population declines of raptorial and fish-eating birds (3). A PCB effect could not be associated with the thinning of Brown Pelican (Pelecanus occidentalis) eggshells (165) nor did dietary PCB produce any effect on the eggs of Mallard Ducks (Anas platyrhynchos) (166) or Ring Doves (Streptopelia risoria) (167). PCB may increase susceptibility to infectious agents such as virus diseases (168) and like other chlorinated hydrocarbons PCB increases the activity of liver enzymes that degrade steroids, including sex hormones (156, 169). Laboratory studies have indicated that PCB, with its derivatives or metabolites, causes embryonic death of birds (170, 171, 172,

173). Because exceptionally high concentrations are occasionally found in fish-eating and raptorial species (156, 174), it is highly probable that PCB has had an adverse effect on the reproductive capacity of some species of birds that have shown population declines (3). Median PCB concentrations in whole fish of eight species from Long Island Sound, obtained in 1970, were in the order of one mg/kg (158), and comparable concentrations have been reported from southern California (175). On the basis of the high probability that PCB in the environment has contributed to the reproductive failures of fish-eating birds, it is desirable to decrease these levels by at least a factor of two (3).

References: Aquatic Life and Wildlife

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References: Marine Water Constituents

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V. National Academy of Sciences Water Quality Criteria of 1972 for PCB's

Sections of the report of the National Academy of Sciences upon which the proposed Water Quality Criteria were largely based are included as scientific and technical support for the proposed effluent standards.

Note: For the purposes of this document only those references from the National Academy of Sciences Report which apply to the toxic pollutants have been included.