United States
Environmental Protection
Agency

Environmental Research
Laboratory
Corvallis, OR 97333

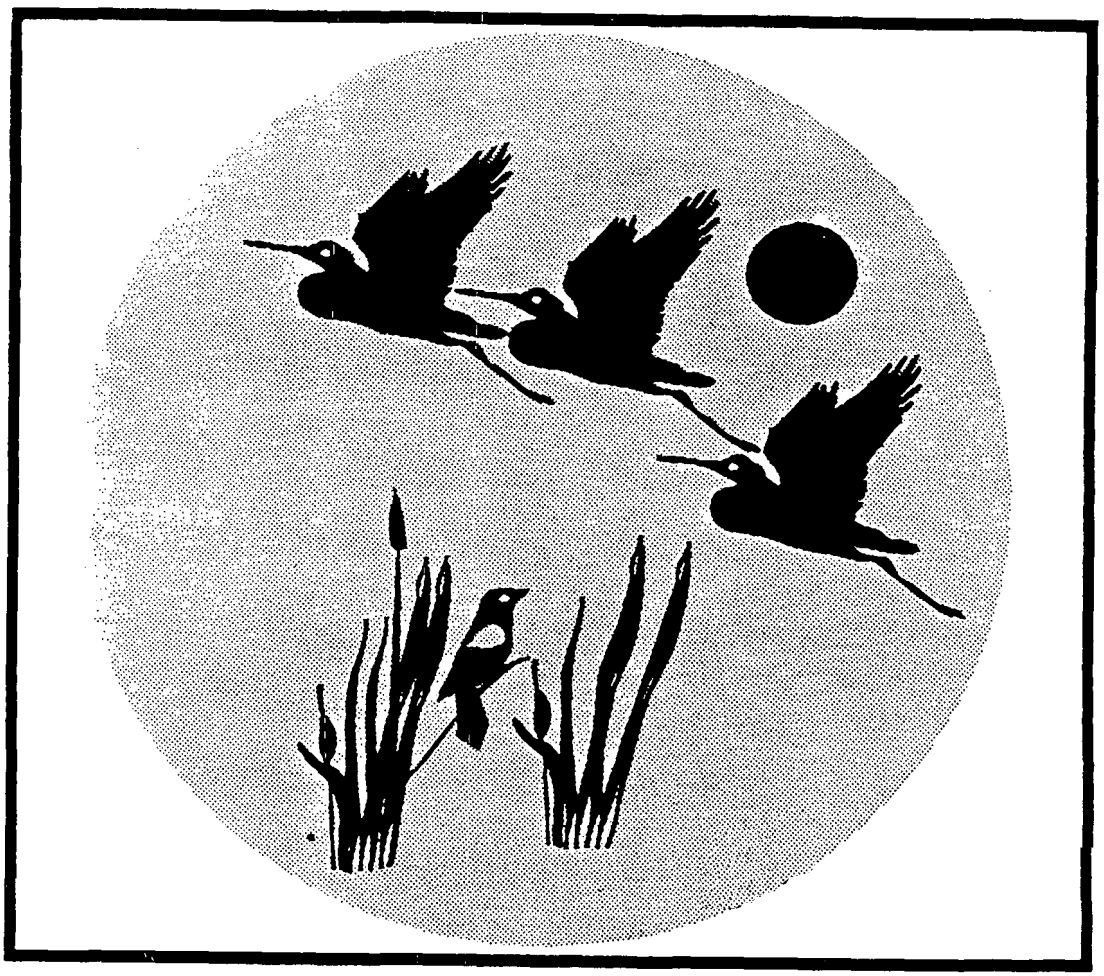
EPA/600/3-89/067
PB 89 220 016

Research and Development

EPA

WATER QUALITY CRITERIA TO PROTECT WILDLIFE RESOURCES

DECEMBER 1989



Water Quality Criteria to Protect Wildlife Resources

Bill Williams*
U.S. Environmental Protection Agency
Environmental Research Laboratory--Corvallis
Corvallis, Oregon

Suzanne Marcy*
U.S. Environmental Protection Agency
Office of Water Regulations and Standards
Washington, D.C.

Sarah Gerould*
U.S. Fish and Wildlife Service
Division of Environmental Contaminants
Washington, D.C.

Workshop Conducted by
Kilkelly Environmental Associates
The Water Garden
P.O. Box 31265
Raleigh, N.C. 27622

EPA Contract No. 68-03-3439

* Workshop Co-Chairpersons

CONTENTS

TABLES

FIGURES

EXECUTIVE SUMMARY

The U.S. Environmental Protection Agency (EPA) Environmental Research Laboratory-Corvallis (ERL-C) sponsored a Water Quality Criteria to Protect Wildlife Resources Workshop, co-chaired by the U.S. EPA Office of Water and the United States Fish and Wildlife Service (USFWS). The workshop was convened to identify and define the need for water quality criteria to protect wildlife species. The workshop's goals were to (1) generate a strategy for developing wildlife criteria based on available toxicological data, (2) recommend an approach to incorporating wildlife criteria into the regulatory process, and (3) identify research needs.

Although workshop participants believe that existing aquatic life water quality criteria will in general protect wildlife species, they identified several important exceptions. The recommended procedures are designed to develop a method for identifying chemicals likely to adversely affect wildlife and to provide a mechanism for developing protective criteria.

Workshop participants recommended an approach that includes modifying the existing National Water Quality Criteria Guidelines by incorporating a Final Wildlife Value into the "Guidelines" framework. They also identified procedures for developing the Final Wildlife Value.

The procedures recommended by workshop participants include two phases: (1) prioritize chemicals based on potential adverse impact on wildlife species and (2) generate a procedure for developing Final Wildlife Values.

The process to prioritize chemicals is a risk assessment based on evaluation of the chemicals' hazard (e.g., toxicity data) and the probability

that wildlife species will be exposed to them (e.g., bioaccumulation, persistence, and discharge rate).

The recommended chemical screening model is an algorithm developed at the workshop and subsequently refined to evaluate the relative hazard of chemicals based on toxicity and tendency for a chemical to bioaccumulate. This algorithm uses basic measures for generating screening-level wildlife criteria designed to establish which of the current criteria may not be protective for wildlife species and to prioritize chemicals for developing wildlife criteria. The algorithm developed was based on the State of Wisconsin's Wild and Domestic Animal Criterion procedure (WDNR 1988). The general equation used in deriving the screening level criteria is:

$$SLWC = \frac{NOEL \times Wta \times SSF}{Wa + (Fa \times BCF)}$$

Where:

SLWC = screening-level wildlife criteria (mg/L)

Wa = average daily water consumption (L/day)

Fa = average food consumption (kg/day)

BCF = aquatic life bioconcentration factor (L/kg)

Wta = average weight of the animal (kg)

SSF = species sensitivity factor (0.01 to 1)

NOEL = no observed effect level (mg/kg-day)

The exposure assessment is necessary because wildlife are particularly vulnerable to toxicity resulting from indirect food-chain exposures to contaminants. Factors to be considered in the exposure assessment included persistence (i.e., rate of degradation), production quantities and use

patterns, and probability of release into ambient water bodies used by wildlife species.

Once chemicals are prioritized the next step would be to derive Final Wildlife Values to incorporate into the Ambient Aquatic Life Water Quality Criteria. Since it would be cost prohibitive to conduct toxicity tests such as those used for the aquatic life water quality criteria on all wildlife species and chemicals, workshop participants have recommended that physiologically based toxicokinetic models be used to develop Final Wildlife Values. An important consideration for this process is the incorporation of characteristics unique to wildlife species.

Physiologically based toxicokinetic models (PB-TK) are mathematical simulations of known anatomical and physiological functions used to predict the blood levels of toxic chemicals in organisms subjected to various dosage regimens. The models also attempt to predict the various organ and tissue levels and extra- versus intracellular concentrations (Bischoff 1987). The models would be based on three representative wildlife groups to derive acceptable ambient water and tissue concentrations for Final Wildlife Values. The PB-TK models would require a selective verification program.

Workshop participants recommended that the following five primary factors be considered when evaluating impacts on wildlife species:

-- Bioaccumulation, especially for chemicals that may not be directly toxic but which may become toxic to wildlife species that are exposed to the chemicals through food webs
-- Persistence of chemicals in the environment if prolonged exposure increases the potential for bioconcentration and biomagnification in wildlife species

-- Potential physiological differences in metabolic mechanisms between wildlife species and aquatic life, as well as unique results of toxicity

-- Unique behavioral characteristics that may increase exposure and result in different relative risks among wildlife species

-- Life history characteristics that may expose certain wildlife species to higher levels of contamination or result in unique toxicity effects.

Workshop participants identified preliminary research needs that were intended to address the prioritization of chemicals and to refine Final Wildlife Value procedures. The primary purpose of the proposed research is to establish and validate the needed toxic effect and PB-TK models of representative wildlife species (i.e., a mammal, an avian, and a reptile or amphibian selected to meet ecological, toxicological, and experimental considerations) for generating Final Wildlife Values. These studies would also seek to relate wildlife residue concentrations to water/sediment contaminant levels (major omission in current water quality criteria) by predicting contaminant partitioning in the food chain and subsequently applying specific PB-TK models that predict residue uptake, accumulation, distribution, and elimination in the organism. The research needs are consistent with the role identified for the use of models in the development of Final Wildlife Values to be incorporated into the Ambient Water Quality Criteria Guidelines.

SECTION 1

INTRODUCTION

Wildlife are frequently impaired by exposure to environmental contaminants. Current ambient water quality criteria published by the U.S. EPA Office of Water Regulations and Standards are based on toxicological testing of aquatic organisms. Research conducted in the last 30 years indicates that the series of aquatic life toxicity tests used in the development of water quality criteria does not always account for exposures and mechanisms typical of wildlife species (e.g., DDT causing eggshell thinning). Some chemicals such as DDT, selenium, and PCBs have been evaluated for wildlife effects. However, many chemicals that may pose hazards to wildlife species have not been considered. In this document, the term wildlife denotes birds, mammals, reptiles, and amphibians that use aquatic resources. Aquatic life such as fish, shellfish, and benthic organisms are not included in this category. Unique physiological and behavioral characteristics of wildlife may increase their relative sensitivity to some chemicals, making current criteria inadequate for wildlife protection. Studies conducted by the U.S. Fish and Wildlife Service (USFWS) document adverse effects in natural wildlife populations from surface water contamination in National Wildlife Refuges (USFWS 1986). Toxicological studies by the USFWS and the U.S. Environmental Protection Agency (EPA) have also defined specific adverse effects on wildlife species from exposure to chemical contaminants (Smith 1987). It is imperative to develop wildlife criteria for all chemicals likely to impair wildlife.

The U.S. EPA Environmental Research Laboratory-Corvallis (ERL-C) sponsored the Water Quality Criteria to Protect Wildlife Resources Workshop,

co-chaired by EPA and the USFWS, on November 1-3, 1988. The workshop was conducted to identify and define the need for water quality criteria that are protective of wildlife. The workshop's goals were to (1) generate a strategy for developing wildlife criteria based on available toxicological data, (2) identify research areas to fill data gaps, and (3) recommend ways to incorporate these criteria into the regulatory process. This document summarizes the workshop results.

Workshop Organization

Twenty-six professionals from a variety of institutions (e.g., EPA, USFWS, State government, academia, and consultants) participated in the workshop. Participants with expertise in wildlife toxicology, aquatic toxicology, ecology, environmental risk assessment, and conservation were selected to provide a variety of perspectives on the wildlife criteria issue. (see Appendix A for a list of workshop participants). Workshop participants generated three objectives to accomplish workshop goals:

1. Propose a strategy to incorporate wildlife criteria into the water quality criteria program.
2. Develop a technique for screening chemicals to prioritize criteria development efforts based on the chemical's potential to cause adverse effects for wildlife.
3. Develop a research plan for establishing wildlife criteria.

Document Organization

This document is organized into five topic areas. Section 2 provides background on the legislative authority for wildlife criteria development and

a justification for this effort based on observed wildlife impacts. Section 3 outlines a strategy for incorporating wildlife criteria values into the current water quality criteria framework for regulation of chemicals toxic to wildlife. Section 4 provides a strategy for determining which chemicals are most likely to impact wildlife species; this will help direct research and regulatory efforts. Section 5 provides a recommended research strategy for generating actual wildlife criteria values. Section 6 briefly summarizes the current status of research efforts that will contribute to wildlife criteria development and outlines additional research needs.

SECTION 2

NEED FOR WATER QUALITY CRITERIA TO PROTECT WILDLIFE

Public awareness of adverse effects to wildlife caused by exposure to environmental contaminants has increased. Articles documenting wildlife impairments caused by these contaminants have appeared more frequently in both scientific journals (e.g., Hunter et al. 1984, Ringer 1983, Veith et al. 1979) and popular literature (e.g., McIntyre 1989). Public awareness has also supported new legislation that requires protecting wildlife species from deleterious contamination.

Legislative Mandate

Section 101(a)(2) of the Clean Water Act (CWA) requires maintaining water quality for the protection and propagation of fish, shellfish, and wildlife. Section 304(a)(1) requires the Administrator to develop and publish criteria for water quality that accurately reflect the latest scientific knowledge on

the (1) kind and extent of all identifiable effects on health and welfare including, but not limited to wildlife, that may be expected from the presence of pollutants in any body of water; (2) concentration and dispersal of pollutants through biological, physical, and chemical processes; and (3) effects of pollutants on biological diversity, productivity, and stability. Section 304(a)(2)(B) requires the Administrator to develop and publish information on the factors necessary for the protection and propagation of shellfish, fish, and wildlife. In addition to the CWA, there are several other national legislative acts that specifically mandate the protection of wildlife from environmental hazards (Table 1).

To meet the requirements of the CWA to establish and publish water quality criteria, EPA developed the Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses. EPA uses these guidelines to establish water quality criteria for a variety of compounds (EPA 1986). These criteria were based on toxicity testing of aquatic organisms. Although wildlife may be protected by these criteria, the criteria are designed to protect human health and aquatic life; they do not systematically incorporate unique characteristics of wildlife species.

GAO Report

In July, 1987, the Government Accounting Office (GAO) issued a report titled National Refuge Contamination is Difficult to Confirm and Clean Up (GAO 1987) that documented (1) clean-up activities in Kesterson National Wildlife Refuge (a site where selenium contamination has caused deformities in waterfowl), (2) adverse effects of contaminant problems at other refuges, and (3) limited federal efforts to develop water quality criteria to protect

Table 1. Protective Legislation that Augments Protection of Wildlife

Endangered Species Act
Fish and Wildlife Act of 1956
Migratory Bird Treaty Act of 1918
Bald Eagle Act
Wild and Scenic Rivers Act
Marine Mammal Protection Act
Fish and Wildlife Coordination Act
National Environmental Policy Act
Federal Insecticide, Fungicide and Rodenticide Act
Toxic Substances Control Act
Comprehensive Environmental Response Compensation and Liability Act of 1980
Superfund Amendments and Reauthorization Act of 1986
Land and Water Conservation Fund Act of 1965

wildlife and refuge habitat from adverse effects of contamination. The GAO report concluded, "progress in cleaning up contaminated sites was likely to be slow [because of] a lack of water quality criteria to determine when wildlife and refuge habitat are threatened". In response to the GAO report, EPA modified the water quality criteria for selenium to include wildlife effects.

Need for Criteria Specific to Wildlife

As the GAO Report suggested, water quality criteria for wildlife are needed by wildlife managers to determine what levels are safe for wildlife habitat. Wildlife managers are frequently faced with moderately contaminated

aquatic habitat that support wildlife populations. Environmental effects of the contamination may be subtle. Costly, extensive studies may be required to determine whether populations are affected and remediation is necessary. Water quality criteria for wildlife would be extremely useful to determine whether termination of pollutant discharge or cleanup of wildlife habitat is needed. With water quality criteria in their present form, the manager cannot be assured that water quality criteria will provide the protection that is needed.

For many chemicals it is likely that water quality criteria are protective of wildlife species. However, selenium, mercury, DDT, and PCB Ambient Aquatic Life Water Quality Criteria were determined to be insufficiently protective of wildlife. Based on empirical evidence of wildlife impairment, these criteria were subsequently modified to incorporate a wildlife component; the criteria became more stringent as a result. These criteria illustrate the need to incorporate wildlife considerations during development of the criteria before adverse impacts occur. Since wildlife data are not routinely generated for, or incorporated in, ambient aquatic life water quality criteria, existing criteria cannot always provide assurance to managers that wildlife are protected. Only when the guidelines for establishing criteria specifically considered wildlife will users be assured that the criteria are adequate for protecting wildlife and wildlife habitat.

Procedures for deriving criteria presently incorporate a Final Residue Value. The FDA Action Level is used (when available) as the tissue concentration in aquatic life that must not be exceeded due to bioaccumulation of an aquatic contaminant. However, the FDA Action Level has not yet been established for most chemicals. Even where it is set, it is based on typical

consumption patterns for humans. A more realistic scheme would estimate tissue concentration based on wildlife behavior (e.g., feeding, drinking, swimming) and sensitivity to contaminants.

Although aquatic species are immersed in surface waters and are therefore directly exposed, some contaminants may have a greater impact on wildlife species than aquatic species because of (1) contaminant bioaccumulation and (2) differences in species sensitivity to specific toxicants. Both of these factors need to be assessed to adequately protect wildlife. These factors are discussed in greater detail in Section 4.

SECTION 3

STRATEGY TO INCORPORATE WILDLIFE INTO WATER QUALITY CRITERIA

Two possible approaches for establishing criteria to protect wildlife include: (1) incorporate a Final Wildlife Value into the current framework for developing ambient aquatic life water quality criteria, or (2) develop separate wildlife criteria. Because the first option would require only minor revision to the Guidelines and a regulatory framework is already in place, this strategy was preferred by workshop participants. This decision was based on the assumption that acceptable ambient water concentrations could be derived by incorporating variables unique to wildlife species.

Framework for Ambient Aquatic Life Water Quality Criteria

In the current Guidelines (Figure 1), criteria are developed using an array of aquatic organisms in toxicity tests. A Final Acute Value for freshwater aquatic organisms and their uses is derived from acceptable acute test

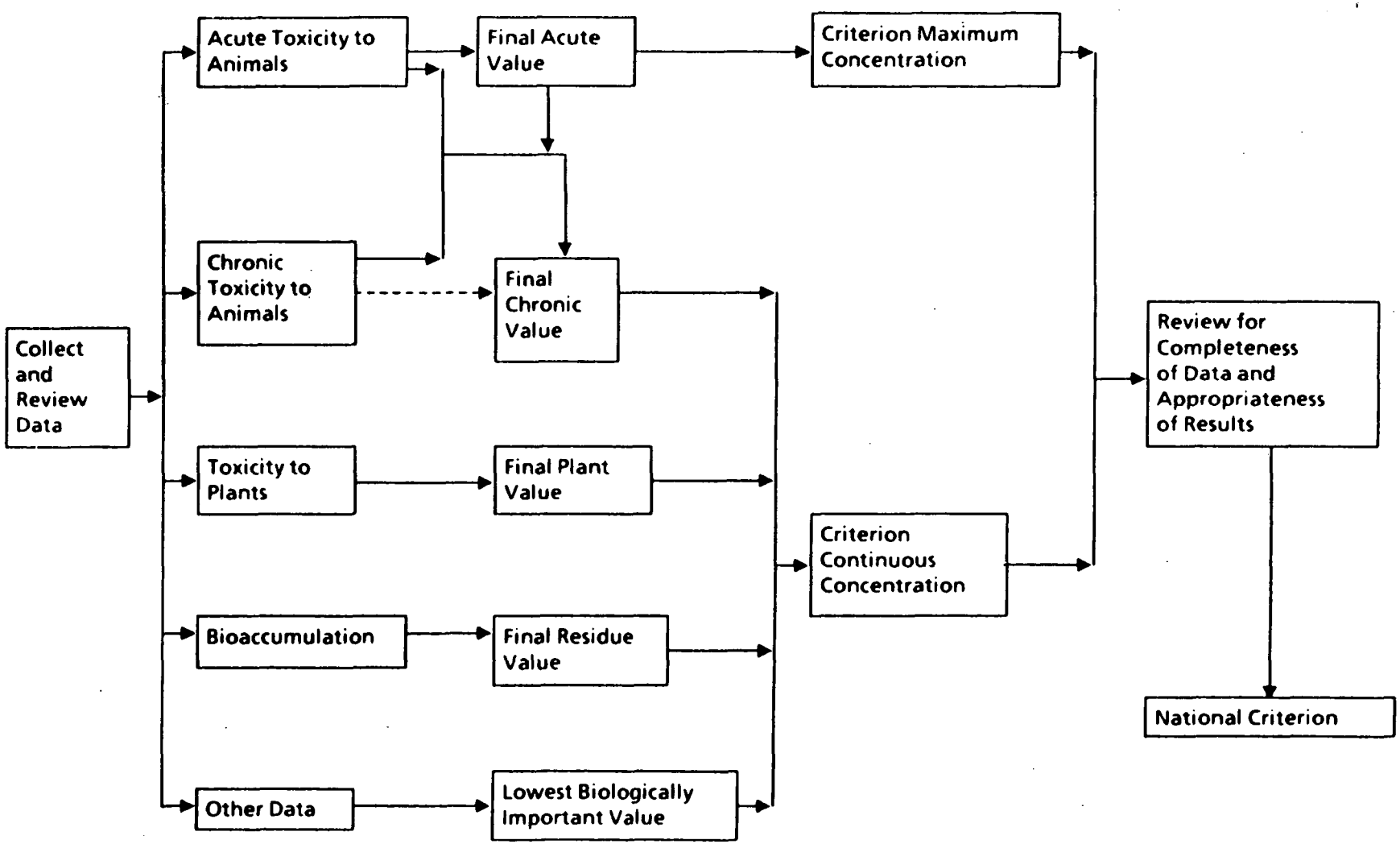


Figure 1. National Water Quality Criteria Guidelines to protect aquatic organisms and their uses.

results. These tests require at least one species of freshwater animal from at least eight different families (Salmonidae, Osteichthyes, a third family in the phylum Chordata, a planktonic crustacean, a benthic crustacean, an insect, a family in a phylum other than Arthropoda or Chordata, and a family in any order of insect or any phylum not already represented). Acute-Chronic Ratios are derived from chronic toxicity tests on three or more species (including one fish, one invertebrate, and one acutely sensitive freshwater species) that are compared to acute tests on the same complement of species. A Final Chronic Value may then be derived.

Criteria are generated from these and other tests (see Figure 1). The Criterion Maximum Concentration (CMC) is derived using the Final Acute Value. The Criterion Continuous Concentration (CCC) is derived from several components: Final Chronic Value, Final Plant Value, Final Residue Value, and Lowest Biologically Important Value. The value with the lowest concentration drives the CCC.

Final Wildlife Value

Workshop participants suggested incorporating a Final Wildlife Value into the CCC (see Figure 2). This value would be derived from estimates of chronic effect values for representative species and bioaccumulation. As with other final values, the Final Wildlife Value would drive the CCC, which would be lowered if wildlife were more sensitive to a contaminant than aquatic life. Recalculation may be required if aquatic organisms were shown to accumulate tissue concentrations of the contaminant that would be toxic if consumed by wildlife.

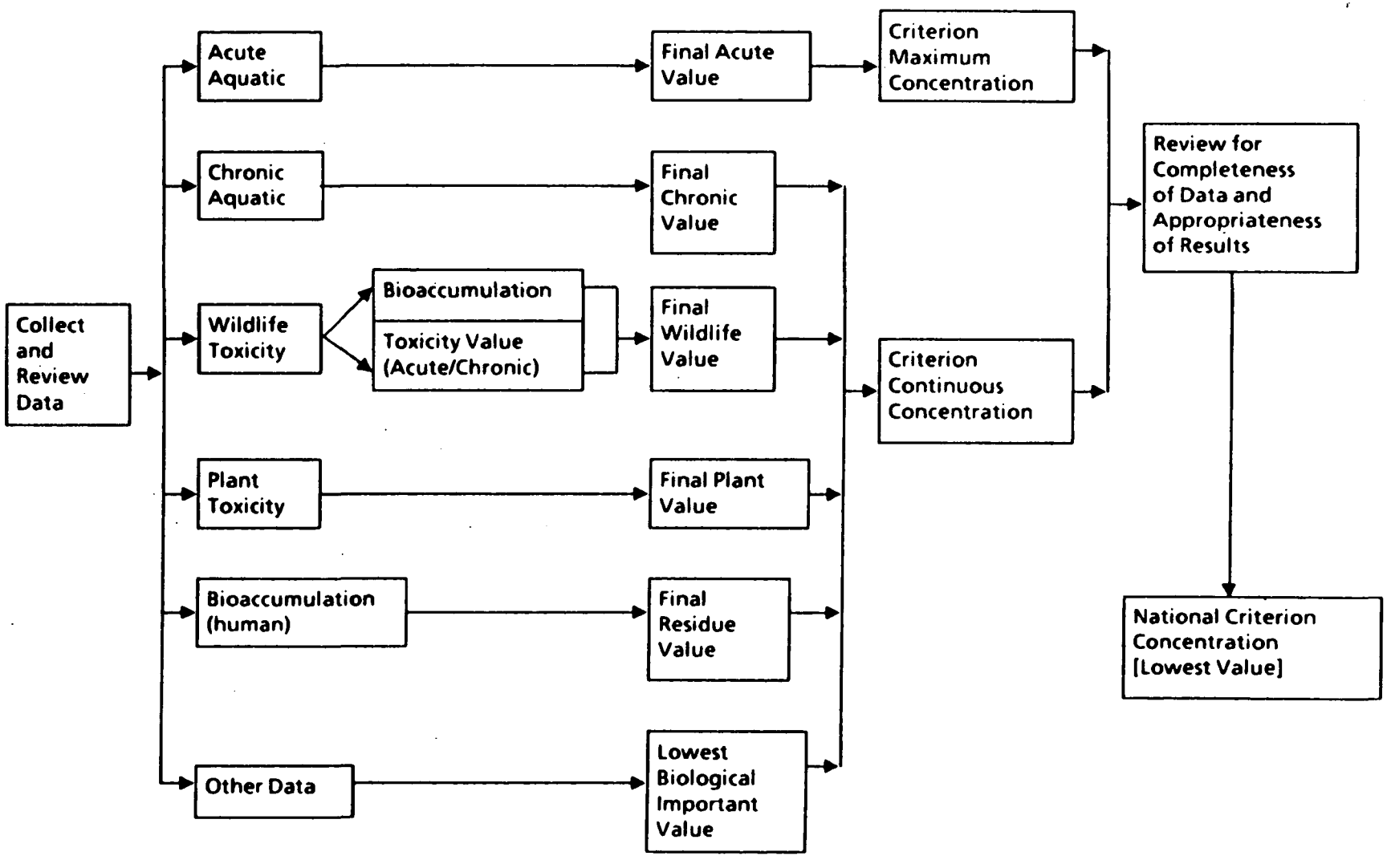


Figure 2. Proposed guidelines to derive numerical water quality criteria to protect all organisms.

Deriving a Final Wildlife Value may be more complex than deriving other final values used in current water quality criteria. Several factors including physiological, behavioral, and life history characteristics of wildlife species must be considered. The persistence and bioaccumulation potential of contaminants are also critical. These factors are further discussed in Section 5.

SECTION 4

STRATEGY TO IDENTIFY RISK AND PRIORITIZE CHEMICALS

No field studies have been conducted to verify that the water quality criteria are protective of wildlife. Studies are currently under way to investigate the concentrations of selenium needed for wildlife protection, and preliminary, unpublished data from field studies of PCBs in cormorants in the Great Lakes have been interpreted by some to suggest that aquatic criteria do not always protect wildlife (Kubiak, pers. comm.).

A risk assessment paradigm can be used to determine which chemicals are most likely to impair wildlife. To assess the risk a chemical presents to wildlife species, two factors must be considered: (1) evaluation of the hazard and (2) the probability of wildlife exposure to the chemical or its metabolites. Chemicals that could pose a risk to wildlife are those that are highly toxic and/or bioaccumulate. Chemicals that increase the probability of exposure are those that are frequently applied, ubiquitous, and/or persist in the environment and are most likely to come into contact with wildlife.

Hazard Assessment

Workshop participants concluded that the relative hazards of a contaminant to wildlife may be assessed and prioritized using three sources of information: (1) toxicity tests on aquatic, domestic and wildlife species; (2) determination of the bioaccumulation potential (bioconcentration factor) of a chemical; and (3) wildlife epidemiological studies. Only limited information for these three categories is currently available. Toxicity tests have been conducted by USFWS and EPA on selected chemicals on a limited number of species. The obvious need for additional toxicity tests on representative species and selected chemicals is discussed in Section 5. A data base of information exists for bioaccumulation potential in aquatic plants and fish for most criteria pollutants. Bioaccumulation potential may also be estimated from the chemical and physical properties of the chemical. Information from categories (1) and (2) above can be combined for use in a chemical screening algorithm. Field evidence suggests reproductive and physiological impairments from exposure to contaminants in natural wildlife populations. However, no rigorous wildlife epidemiological studies exist, and it is difficult to use the existing anecdotal evidence in hazard assessment. Therefore, wildlife epidemiological studies are not discussed in this report.

Toxicity Tests

EPA's Quality Criteria for Water 1986 (EPA 1986) lists 136 chemicals for which a criterion or other value has been generated based on toxicological tests of aquatic organisms. Human health advisories generated from research on mammalian species are also available. Many of these chemicals are listed as a Lowest Observed Effect Level (LOEL) because insufficient data are

currently available for criteria development (see Appendix B). However, relative toxicity values for these chemicals allow an assessment of potential wildlife impact.

The USFWS prepared a list of 138 chemicals that are potential water quality hazards for wildlife (see Appendix C). USFWS personnel in research and operations added chemicals to the water quality criteria list and rated the combined list based on their experience with toxicity to wildlife, bioaccumulation potential, and extent of environmental exposure. The priorities given on the list are intended to suggest an order for incorporating wildlife information into EPA criteria or advisories.

Chemical Screening Algorithm

An algorithm was developed at the workshop and subsequently refined to evaluate the relative hazard of chemicals based on toxicity and tendency for a chemical to bioaccumulate. This algorithm uses basic measures for generating screening-level wildlife criteria designed to (1) establish which of the current criteria may not be protective for wildlife species, and (2) prioritize chemicals for developing wildlife criteria.

The algorithm developed was based on the State of Wisconsin's Wild and Domestic Animal Criterion procedure (WDNR 1988). The general equation used in deriving the screening level criteria is:

$$SLWC = \frac{NOEL \times Wta \times SSF}{Wa + (Fa \times BCF)}$$

Where:

SLWC = screening-level wildlife criteria (mg/L)

Wa = average daily water consumption (L/day)

Fa = average food consumption (kg/day)

BCF = aquatic life bioconcentration factor (L/kg)

Wta = average weight of the animal (kg)

SSF = species sensitivity factor (0.01 to 1)

NOEL = no observed effect level (mg/kg-day)

Data from applicable studies in the scientific literature are used to calculate SLWCs. The lowest SLWC of those calculated is used as the criteria. The SSF depends on applicability of the study to wildlife: SSF of 1.0 is used when the SLWC is derived from a wildlife species; smaller SSF values are used when the SLWC is derived from non-wildlife species, reflecting the uncertainty of extrapolation from non-wildlife to wildlife species. During a post-workshop meeting at the Environmental Research Laboratory Duluth (ERL-D), MN, in January 1989, a core committee from the original workshop proposed to obtain BCFs for organic chemicals from a quantitative structure activity relationship (QSAR) model developed at ERL-D (Bradbury et al. 1989). Utilization of this approach will allow rapid and consistent generation of SLWCs.

Chemicals to be used to calibrate and validate the screening algorithm are those known or expected to impair wildlife including DDT, dieldrin, PCBs, mercury, lead, pentachlorophenol, and selenium. It is generally accepted that chemicals of greatest immediate concern for wildlife are probably those with a

Log P > 2.5 (highly bioaccumulating) and those with documented reproductive effects.

ERL-Duluth generated SLWCs using the above algorithm for current criteria, advisory, and USFWS chemicals of concern. This effort, in conjunction with evidence outlined above, provides a basis for prioritizing chemicals that need wildlife criteria development. A chemical priority list will be generated from evidence of wildlife impairment, chemical toxicity ratings available from EPA and USFWS, and the chemical screening algorithm. The priority list is expected to be complete in October 1989 and will serve as the preliminary hazard assessment for wildlife.

Exposure Assessment

Contaminant impacts on wildlife may result from characteristics that cannot be accounted for by testing aquatic species. The physiological, behavioral, and life history characteristics of different wildlife groups will alter both their probability of exposure and their sensitivity to a contaminant. Wildlife are particularly vulnerable to toxicity resulting from indirect food-chain exposures to contaminants. Some factors to consider when deriving wildlife criteria are persistence (i.e., rate of degradation), production quantities and use patterns, and likelihood of release into ambient water bodies used by wildlife species. These characteristics largely determine the probability of significant exposure of wildlife populations. To determine the risk associated with a contaminant, its inherent toxicity must be combined with an exposure assessment. If exposure is very high, a moderately toxic chemical can be classified as a high environmental risk. Conversely, if the probability of wildlife exposure is extremely low, even a

highly toxic or bioaccumulating chemical may be classified as a low risk contaminant. Additionally, the environmental fate and transformation of toxic chemicals should also be considered in any risk assessment. This is important for such transformations as mercury to methyl mercury, selenium to seleno-methionine, acephate to methamidophos, and others.

Factors and sources of information identified at the workshop that could contribute to an exposure assessment include the following:

1. Exposure to chemicals that occur through oral (water, food, and sediment consumption) and dermal exposures -- Critical variables for assessing risk include exposure pathways for wildlife from bioconcentration/bioaccumulation through the food chain.
2. Production history -- Both historical and current production rates and use of a chemical should be evaluated. Production estimates can help determine whether a chemical is likely to be encountered frequently enough or in sufficient quantities to constitute a hazard. Some persistent chemicals like DDT have been banned from use in the United States (DDT is still in use in other countries). DDT also occurs sometimes as an impurity in other compounds. DDT and other persistent chemicals are still widespread in the environment.
3. Intended use -- Categories of intended chemical use will help determine potential routes of exposure. Chemicals with underestimated exposure values because the chemical is listed as an "inert" ingredient in a pesticide formulation (i.e., not the primary active ingredient of a compound) are of special concern.

4. Inventories of point source discharges -- These will aid in determining the types, quantities, and locations of discharged contaminants.

5. Sources of nonpoint contamination -- Nonpoint sources should be considered, particularly for pesticides in agricultural areas. Some naturally occurring contaminants may become a problem when naturally concentrated or released (e.g., metals and sulfur compounds from Mt. St. Helen's eruption). Naturally occurring compounds are also concentrated and released in hazardous quantities as a result of anthropogenic activities (e.g., mining activities and irrigation). For example, naturally occurring selenium leached from soil by irrigation and diversion of irrigation waste water surrounding the Kesterson Reservoir and Wildlife Refuge caused reproductive impairments in local waterfowl.

6. Potential contaminant "sinks" that may result in overestimated (and sometimes underestimated) risk of exposure -- Chemical properties that promote or restrict exchange from one matrix to another (i.e., sediment -- water column -- volatilization) will alter exposure potential values.

7. Seasonal effects -- Contaminant concentrations may change with the seasons (e.g., increased contaminant levels could be associated with seasonal snowmelt; low water that exposes contaminated sediment beds during the dry season could result in high exposures).

8. Critical life stages -- Seasonal changes in concentration may or may not coincide with critical life stages such as molting or egg laying. Different life stages of an organism can exhibit different

degrees of sensitivity to toxic chemicals; generally, young wildlife are more sensitive than adults.

Information from the monitoring networks of various agencies (e.g., U.S. Geological Survey (USGS), EPA, USFWS) can provide a basis for determining the extent and magnitude of contaminant distribution. Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA III) requires that owners and operators of certain facilities that manufacture, import, process, or otherwise use certain toxic chemicals annually report their releases of those chemicals to each environmental medium. This information aids research and development of regulations, guidelines, and standards. The most recent updated list from the Federal Register (February 16, 1988) is included as Appendix D.

SECTION 5

DEVELOPMENT OF FINAL WILDLIFE VALUES

It would be cost prohibitive to conduct a number of toxicity tests, such as the series of aquatic life toxicity tests used in the development of water quality criteria, on all wildlife species and chemicals. Workshop participants have recommended using physiologically based (PB-TK) toxicokinetic models to develop most of the data needed for formulating a Final Wildlife Value. However, some toxicity testing will also be required to verify model-derived numbers and to expand the comparative toxicology data base.

Wildlife Factors to Consider

There are five primary factors to consider when evaluating impacts on specific species: bioaccumulation, persistence, physiology, behavior, and life history characteristics.

Although some chemicals may not be directly toxic to aquatic life or wildlife, those that bioaccumulate to toxic levels may become a problem for wildlife species exposed to the chemical through food webs. Except for the Final Residue Value (BCFs based on FDA action levels for humans, when they are available) bioaccumulation is not considered under the Guidelines. Bioaccumulation is based on two mechanisms: bioconcentration and biomagnification. Bioconcentration occurs when organisms are directly exposed to a contaminant in the ambient water, and the contaminant is absorbed and stored in body tissue. Biomagnification occurs when predators consume and accumulate contaminants bioconcentrated in the tissues of prey species. Organic compounds with a log octanol : water partition coefficient (Log P) greater than 2.5 are likely to bioaccumulate. Metals of concern include organometallic forms (e.g.,methylated forms) and those that pose special problems because of their specific characteristics of transformation, sequestration, complexation, and speciation.

If a contaminant persists in the environment, wildlife exposure is prolonged and the potential for bioconcentration and biomagnification increases. One measure of environmental persistence is half-life (T1/2), which quantifies the effects of volatilization, photolysis, biodegradation, and other processes that diminish the concentration in aquatic ecosystems and, thus, the hazard to wildlife.

Potential physiological differences in metabolic mechanisms between wildlife species and aquatic life, as well as unique results of toxicity, should be evaluated. For example, DDT when metabolized to DDE can cause eggshell thinning, an important toxic effect in birds. Unique elimination pathways (e.g., milk) may affect reproduction in wildlife species. Wildlife that are directly exposed to a contaminant may not be the ultimate target of the toxic effect. Animals may also pass their contaminant burden on to their offspring, which are likely to be more sensitive than the adult.

Behavioral characteristics unique to wildlife species may increase exposure that results in different relative risk. For example, ducks consume sediments along with aquatic invertebrates and vegetation and may directly ingest concentrated contaminants. Predators more easily obtain poisoned and sick prey species. Manatee, attracted to warm currents, seek out highly contaminated effluent discharges. Wildlife use aquatic resources that may be exempt from existing water quality criteria. For example, the Galveston ship canal has an industrial use designation and is laden with contaminants, yet waterfowl are attracted to the area. Precious metal extraction processors often use large open pools of water containing cyanide in regions where there are few alternative landing sites for waterfowl. These sites attract and kill large numbers of birds each year. Although alterations in behavior caused by exposure to toxic chemicals may not always result in acute toxicity, it may make animals more susceptible to predation or upset normal patterns of foraging, habitat selection, and mate selection.

Some life history characteristics of wildlife expose them to higher levels of contamination or result in unique toxicity effects. For example, wildlife with semi-aquatic habits have several exposure pathways. Piscivorous

birds may be exposed through drinking water and consumption of fish. Newborn beavers may be exposed dermally from contaminated sediments in the lodge and orally by ingestion of contaminated milk. During periods of migration, estivation or hibernation, some wildlife species mobilize fat-soluble contaminants, thus significantly increasing potential exposure to contaminants.

Procedures for Wildlife Criteria Development

New techniques for developing wildlife criteria are needed because of the high cost and time required to obtain acute toxicity data on each chemical for eight species and chronic toxicity data on each chemical for three species. The current format that relies on FDA action levels and aquatic toxicity is impractical and inadequate. Rather, PB-TK models that predict toxicity effects based on data from representative species are necessary to develop wildlife criteria because few wildlife species are suitable for laboratory culture and testing. Additionally, the cost and complexity of these models are significantly less. Figure 3 illustrates the approach recommended by workshop participants to develop wildlife criteria.

Workshop participants were concerned about relying on the model for simulations it cannot give, i.e., multiple trophic changes, life history, and behavioral interactions with the environment. Exposure pathways unique to wildlife may require an additional form of criteria that will account for contamination from both direct and indirect exposure. Wildlife criteria should be formulated from two values: one for water concentration and one for tissue concentration. Applying criteria to wildlife will be greatly enhanced by using both variables. For each variable, toxicity values for three species would be used, one each for mammals, birds, and amphibian/reptiles. Final

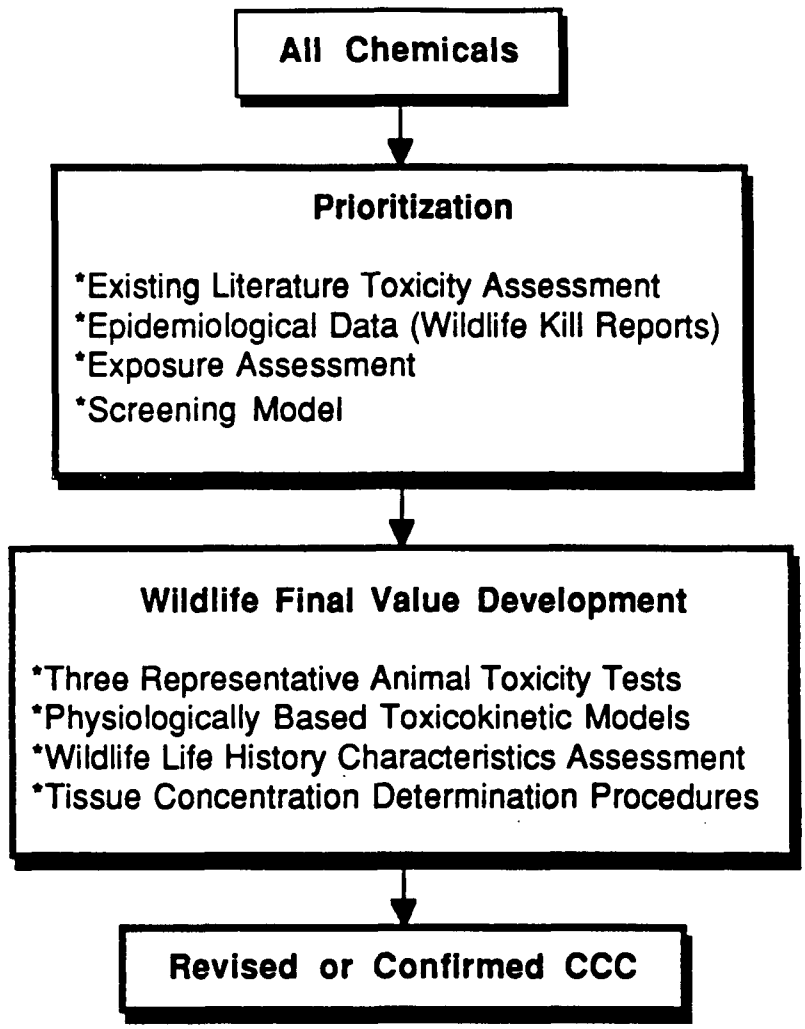


Figure 3. Conceptual framework for developing wildlife criteria.

Criteria Values will be derived from the three PB-TK models that predict toxic effects and steady-state concentrations from concentrations in the tissue of food organisms and the environment of the three groups. The model will extrapolate data generated from the physiologic responses of similar laboratory species. It will ultimately incorporate behavioral data (e.g., food consumption) available from the literature and scientific community in order

to determine input sources of exposure. For example, by basing model interactions on the physiologic basis of chemical effects, a model for rats might be adjusted to more closely resemble the physiological functioning of a mink. Values for contaminant exposure would be modified to more closely resemble the sources and quantities available to mink. The model would then be used to extrapolate between the rat and the mink in terms of the toxic effects and the steady-state concentration.

Water and Tissue Concentrations in Wildlife Criteria

Water quality criteria may not provide sufficient protection for wildlife species, because of multiple ambient exposure pathways. To understand this impact, an alternative tissue based criteria is needed. Direct wildlife exposure to aquatic contaminants results from consuming and swimming in or on contaminated water. Where water bodies are subject to regulation by available Ambient Aquatic Life Water Quality Criteria, wildlife species will generally be protected from direct exposure. However, wildlife come in direct contact with waters not designated for aquatic life (e.g., mine tailings ponds) and where few, if any, aquatic organisms may survive. Wildlife exposure from this contact may be significantly elevated above safe levels.

Indirect exposure through bioaccumulation of persistent chemicals is frequently the primary source of contamination to wildlife species. Although related to ambient water concentrations, characterizing the problem may not be possible from water concentration alone, particularly in wetlands. Measures of tissue burdens will promote characterization of contamination and trophic level impacts. Extrapolation from tissue concentrations to ambient water concentrations may be needed to regulate ambient water concentrations of

pollutants. The New York Department of Environmental Conservation extrapolated from tissue concentration, to solution chemistry, to a water quality criteria value by extrapolating back from critical tissue concentrations to estimate the water concentration. A contaminant dose was derived from this estimated water concentration (Newell et al. 1987). Uncertainty exists with this back calculation; this technique should receive further evaluation before being used in developing wildlife tissue criteria.

Establishing a tissue concentration criterion will also help account for other exposure routes (e.g., direct consumption through ingestion of sediments or grooming activity). Developing the residue-based criteria that protect wildlife from waterborne pollutants requires (1) defining the relationship between contaminant concentrations in water/sediment and those in wildlife species, and (2) developing the knowledge base to estimate the probability of harmful effects based on contaminant-residue levels in tissue.

Tissue concentration criteria can be used effectively in an assessment and regulatory framework. Residue-based tissue criteria will be valuable to the USFWS programs for assessing the impact to wildlife on and off USFWS lands. The EPA Wetlands program would benefit from tissue-based criteria because ambient water concentrations are not always measurable in wetlands. For contaminants that are readily metabolized, it is often necessary to look at the chemical breakdown products. Using this approach may also provide a basis by which risk assessments of contaminated and hazardous waste sites may be completed and remedial action implemented. However, serious problems exist in determining the sources of tissue contaminants, especially in global migrant species.

Three Representative Animals

Sensitivity to a toxic chemical can vary greatly among different species. Workshop participants identified three wildlife subgroups (mammals, birds, and amphibian/reptiles) for which predictive/extrapolative models should be developed to generate criteria (see Figure 3), and for which validation testing should be conducted. This approach will help account for species differences in physiology and behavior, including diet, food intake, length and intensity of exposure, storage, reabsorption, metabolism, periodic starvation and associated metabolic changes, and differences in hibernation or migration.

The models will account for the major variables that directly impact contaminant exposure, and will predict the kind and amount of anticipated exposure for each representative animal. Limited empirical research will be required to develop and verify model predictions; verification will be done with laboratory and field experiments. Water concentration criteria should be based on these representative animals.

The tissue concentration portion of the model predicts that each representative animal will bioaccumulate total body levels of contaminant based on variables unique to the animal group. Body burdens will result from contact with or consumption of sediments, water, and aquatic organisms. Also included is a grooming factor to account for possible consumption through removing contaminants on skin, feathers, or fur. Water concentration and tissue concentration extrapolations would be combined to derive a Final Wildlife Value.

Physiologically Based Toxicokinetic Modeling to Generate Criteria

Performing toxicity tests with wild mammals and birds is expensive and often impractical; the workshop recommendation is to develop most wildlife criteria from predictive/extrapolative techniques based on PB-TK models. The models presently developed are mathematical simulations of known anatomical and physiological functions to predict the blood levels of various dosage regimens. The models also attempt to predict the various organ and tissue levels as well as extra- versus intracellular concentrations. PB-TK modeling establishes the uptake, elimination, distribution, and body burden of contaminants within an organism. Broad application of the models is based on the many similarities in the anatomy and physiology of mammalian species. The same blood flow diagram could be used for all mammals, and most organs and tissues are similar fractions of the body weight. Major qualitative differences, such as the absence of a gallbladder in some species, are the exception (Bischoff 1987). As noted above, the PB-TK models will be based on three representative wildlife groups to derive acceptable ambient water and tissue concentrations for Final Wildlife Values. The models would require a selective verification program (see Section 6). The implementation of a model-generated data program with verification is a major commitment that should be identified and discussed in more detail.

SECTION 6

RESEARCH

Once we prioritize our research effort to reflect the relative risk of wildlife contamination for individual chemicals, developing PB-TK models to

generate wildlife criteria will require understanding the relationship between body and/or tissue contaminant levels for both acute and chronic toxic effects.

Current Status

Preliminary efforts to establish wildlife criteria have begun. The wildlife criteria workshop was a major step toward establishing direction in the initiative and determining how to use ongoing research conducted by the USFWS and EPA laboratories. The EPA Environmental Research Laboratories in Athens, GA, and Duluth, MN, have developed and are refining fate and transport models that can be used to predict how contaminants partition in ecosystems. Sediment criteria research at USFWS and EPA laboratories is evaluating the relationship between water/sediment contaminants and food chain species. Research on toxicant accumulation is in progress at ERL-Corvallis. Development of toxic effects models in aquatic organisms and wildlife species are in progress at ERL-Duluth. These techniques and corresponding expertise provide a broad foundation of knowledge that can be applied toward developing wildlife criteria.

ERL-Duluth is prioritizing chemicals with the screening level wildlife criteria algorithm (see Section 4). To help verify this effort, work at ERL-Corvallis was initiated in spring 1989 to test the effects of dieldrin and other selected toxic compounds on mallard ducks and leopard frogs and to obtain acute 96-hr LC50 values, chronic NOEL values, and bioconcentration data from water-only (drinking, paddling, and preening) and feeding exposures. Data will be compared to information in the criteria documents for fish and invertebrates and to screening level criteria predictions from ERL-Duluth.

The experimental design used in feeding studies will include both commercial and natural foods that contain dieldrin. In addition, the design will examine the impact of oral and dermal exposures by including drinking and paddling water both with and without dieldrin.

Research Needs

Contaminant residues in representative wildlife species (e.g., mammal, avian, and reptile or amphibian selected on ecological, toxicological, and experimental considerations) needs to be correlated to acute and chronic toxicity endpoints through the development of toxic effect models. In turn, wildlife residue concentrations will be related to water/sediment contaminant levels based on predicting contaminant partitioning in the food chain by applying specific PB-TK models that predict residue uptake, accumulation, distribution, and elimination in the organism. Models will not be able to predict uptake from sediment without some idea of sediment consumption by wildlife in the field. As far as is known, these values are not available in the literature.

Expanded research efforts will be required to establish and validate the needed toxic effect and PB-TK models for generating wildlife criteria. The comparative toxicology data base for wildlife species should be expanded to document correlations between dose and effect as well as dose and body burden. Future research will deal with selected representative chemicals and with a limited number of animals. Initial efforts will use one bird (such as the mallard) and one mammal (such as the mink). There is also a need for studies to develop methods to better estimate food chain bioaccumulation pathways.

Extensive literature searches will be conducted to obtain toxicity and exposure information on domestic animals (including ducks, chickens, mice, and rats) to compare with the limited available information for wild species. Extrapolation from existing data to wild species will show us where research needs to be conducted to generate missing information. Residue/toxic effect data will be obtained from existing data bases, tests for specific toxic mechanisms, and ongoing residue monitoring studies. Physiological parameters for developing PB-TK models (e.g., tissue volumes, lipid content, and blood flow rates) will be derived from the literature and through empirical experimentation. The approach will be validated by comparing predicted residue effect levels and accumulation to those empirically determined in the laboratory.

A limited number of acute and chronic tests will be conducted to verify model predictions. There are no plans to conduct tests with each criteria chemical for several species of animals, as has been done in the past with fish and invertebrates. A major consideration in applying criteria, both for aquatic and wildlife species, is the uncertainty associated with using either empirically-based or mechanistic model-derived results under field conditions. Thus, as is being done for laboratory-derived aquatic life criteria, model-derived criteria for wildlife also should be assessed in controlled field studies.

Identifying new test species and developing new test procedures, especially for more diverse groups of waterfowl and amphibians, is needed. Additionally, adapting existing fish exposure systems for waterfowl and amphibians can be very productive; some studies in this regard have been initiated at ERL-Corvallis. Verification of model predictions with laboratory

testing is critical to ensure model usefulness and acceptance by the scientific and industrial community. For example, chronic laboratory reproductive studies exposing mallards to selenium could simulate conditions at Kesterson Reservoir and provide valuable model-verification data.

REFERENCES

Bischoff, K.B. 1987. Physiologically Based Pharmacokinetic Modeling: Pharmacokinetics in Risk Assessment, Drinking Water and Health, Vol. 8. National Academy Press. Washington, DC. 1987.

Bradbury, S., P. Fitzsimmons, and E. Anderson. 1989. Screening study for Wildlife Criteria development. Prepared for U.S. EPA Office of Water, Office of Water Regulations and Standards. ERL-Duluth, Duluth, MN.

Hunter, M.L., J.W. Witham, and H. Dow. 1984. Effects of a carbaryl-induced depression in invertebrate abundance on the growth and behavior of American black duck and mallard ducklings. Can. J. Zool. 62:452-456.

Kubiak, T. 1989. U.S. Fish and Wildlife Service, East Lansing, MI. Telephone conversation with Dr. Suzanne Marcy. Office of Water Regulations and Standards, USEPA, Washington, DC.

McIntyre, J. 1989. The common loon calls for help. National Geographic, 175:510-524, April.

Newell, A.J., D.W. Johnson, and L.K. Allen. 1987. Niagara River biota contamination project: fish flesh criteria for piscivorous wildlife. Technical Report 87-3, Division of Fish and Wildlife, Bureau of Environmental Protection, New York State Department of Environmental Conservation.

Ringer, R. 1983. Toxicology of PCBs in mink and ferrets. Pages 227-290. In: F. D'Itri and M. Kamrin, eds. PCBs: Human and Environmental Hazards. Butterworth Pub., Woburn, MA.

Smith, G. J. 1987. Pesticide Use and Toxicology in Relation to Wildlife: Organophosphorus and Carbamate Compounds. U.S. Fish and Wildlife Service. U.S. Department of Interior Resource Publication 170.

U.S. Environmental Protection Agency. 1986. Quality Criteria for Water 1986 (Gold Book). EPA 440/5-86-001. Office of Water Regulations and Standards, Washington, DC (with updated Criteria Documents and advisories as they become available).

U.S. Fish and Wildlife Service. 1986. Preliminary Survey of Contaminant Issues of Concern on National Wildlife Refuges. Division of Refuge Management, Department of Interior. Washington, DC.

U.S. General Accounting Office. 1987. National refuge contamination is difficult to clean up. Resources, Community, and Economic Development Division. GAO/RCED-87-128. Washington, DC.

Veith, G., D. Kuehl, E. Leonard, F. Puglisi, and A. Lemke. 1979. Polychlorinated biphenyls and other organic chemical residues in fish from major watersheds of the United States, 1976. Pest. Monit. J. 13:1-20.

Wisconsin Department of Natural Resources. 1988. Technical Support Document for Chapter NR105 of the Wisconsin Administrative Code. Madison.

APPENDIX A

WORKSHOP PARTICIPANTS

WORKSHOP LIST OF PARTICIPANTS

Water Quality Criteria to Protect Wildlife Resources
Beaverton, OR, November 1, 2, and 3, 1988

Participant	Address	Telephone	Expertise
Harold Bergman	Zoology Department Box 3166 University of Wyoming University Station Laramie, WY 82071	307/766-4331	Environmental Toxicologist
Steven Bradbury	U.S. EPA Environmental Research Laboratory 6201 Congdon Boulevard Duluth, MN 55804	218/720-5527	Environmental Toxicologist
Denny B. Buckler	U.S. Fish and Wildlife Service The National Fisheries Contaminant Research Center Route 2 Columbia, MO 65201	314/875-5399	Aquatic Toxicologist
Clayton Creager	Kilkelly Environmental Associates P.O. Box 31265 Raleigh, NC 27622	919/781-3150	Environmental Scientist
Bruce Duncan	U.S. EPA Region X Environmental Services Division 1200 6th Avenue Seattle, WA 98101	206/442-8086	Ecologist
John Finn	Department of Forestry and Wildlife Management Holsworth Hall University of Massachusetts Amhurst, MA 01003	413/545-2757	Systems Ecologist/ Flow Analysis
Sarah Gerould*	U.S. Fish and Wildlife Service Div. of Environmental Contaminants 1000 North Glebe Road Room 601 Arlington, VA 22201	703/358-2148	Environmental Contaminants
Charles J. Henny	U.S. Fish and Wildlife Service Pacific Northwest Field Station 480 S.W. Airport Road Corvallis, OR 97333	503/757-4840	Wildlife Biologist

Participant	Address	Telephone	Expertise
Elwood F. Hill	U.S. Fish and Wildlife Service Patuxent Wildlife Research Center Laurel, MD 20708	301/498-0348	Research Toxicologist
Stephen Hornick	Kilkelly Environmental Associates P.O. Box 31265 Raleigh, NC 27622	919/781-3150	Environmental Scientist
Clarence Johnson	U.S. Fish and Wildlife Service Office of Research Support Room 513, Matomic Building 1717 H Street, N.W. Washington, D.C. 20240	202/653-8766	Environmental Contaminants
Stephen Jordan	Maryland Dept. of Natural Resources Chesapeake Bay Program B3 Pawes State Office Building Annapolis, MD 21401	301/974-2767	Aquatic Biologist
Tim Kubiak	U.S. Fish and Wildlife Service 301 Manly Miles Building 1205 S. Harrison Road East Lansing, MI 48823	517/337-6650	Environmental Contaminants
Suzanne Marcy*	U.S. EPA Office of Water (WH-585) 401 M Street, S.W. Washington, D.C. 20460	202/382-7144	Behavioral Ecology
John Maxted	U.S. EPA Office of Terrestrial Wetlands Protection (A-104-F) 401 M Street, S.W. Washington, D.C. 20460	202/382-5907	Environmental Scientist/Water Quality
Alan Nebeker	U.S. EPA Environmental Research Laboratory 200 S.W. 35th Street Corvallis, OR 97333	503/757-4875	Research Biologist
Benjamin Parkhurst	Western Aquatics, Inc. P.O. Box 546 203 Grand Avenue Laramie, WY 82070	307/742-7624	Environmental Toxicologist
Thomas W. Purcell	U.S. EPA Office of Water Criteria and Standards Division (WH-585) 401 M Street, S.W. Washington, D.C. 20460	202/475-7321	Water Quality Criteria

Participant	Address	Telephone	Expertise
Robert K. Ringer	Department of Animal Science Room 132 Anthony Hall Michigan State University East Lansing, MI 48824	517/355-8414	Environmental Toxicologist
David Schmedding	NSI Technology Services Wildlife Toxicology Program 200 S.W. 35th Street Corvallis, OR 97333	503/757-4746	Wildlife Toxicologist
Gerald Schuytema	U.S. EPA Environmental Research Laboratory 200 S.W. 35th Street Corvallis, OR 97333	503/757-4764	Research Biologist
Robert Spehar	U.S. EPA Environmental Research Laboratory 6201 Congdon Boulevard Duluth, MN 55804	218/720-5564	Aquatic Biologist
Kenneth Stromborg	U.S. Fish and Wildlife Service University of Wisconsin-Green Bay Room WH-480 2420 Nicolet Drive Green Bay, WI 54311	414/465-2682	Wildlife Toxicologist
Paul Wickster	NSI Technology Services Wildlife Toxicology Program 200 S.W. 35th Street Corvallis, OR 97333	503/757-4727	Environmental Toxicologist
Bill Williams*	U.S. EPA Environmental Research Laboratory 200 S.W. 35th Street Corvallis, OR 97333	503/757-4679	Environmental Toxicologist
Chieh Wu	U.S. EPA Office of Research and Development OEPER (RD-682) 401 M Street, S.W. Washington, D.C. 20460	202/382-5977	Environmental Engineer

* co-chairperson

APPENDIX B

1986 U.S. EPA WATER QUALITY CRITERIA SUMMARY

Water Quality Criteria Summary

	Concentrations In µgL						Units Per Liter				
	Priority Pollutant	Carcinogen	Fresh Acute Criteria	Fresh Chronic Criteria	Marine Acute Criteria	Marine Chronic Criteria	Water and Fish Ingestion	Fish Consumption Only	Drinking Water M.C.L.	Date Reference	# of States With Aquatic Life Standard
Acenapthene	Y	N	1,700.*	520.*	970.*	710.*				1980FR	1
Acrolein	Y	N	68.*	21.*	55.*		320.µg	780.µg		1980FR	1
Acrylonitrile	Y	Y	7,550.*	2,600.*			0.058µg**	0.66µg**		1980FR	
Aldrin	Y	Y	3.0		1.3		0.074ng**	0.079ng**		1980FR	16
Alkalinity	N	N		20,000.						1976RB	
Ammonia	N	N	Criteria	pH and	Temperature	Dependent-	See Document.			1985FR	24
Antimony	Y	N	9,000.*	1,600.*			146.µg	45,000.µg		1980FR	1
Arsenic	Y	Y					2.2ng**	17.5ng**	0.05mg	1980FR	21
Arsenic (PENT)	Y	Y	850.*	48*	2,319*	13.*				1985FR	21
Arsenic (TRI)	Y	Y	360.	190.	69.	36.				1985FR	21
Asbestos	Y	Y					30kf/L**			1980FR	
Bacteria	N	N	For Primary	Recreation	and	Shellfish	Uses	See Document.	<1/100ml	1986FR	56
Barium	N	N					1.mg		1.0mg	1976RB	8
Benzene	Y	Y	5,300.*		5,100.*	700.*	0.66µg**	40.g**		1980FR	1
Benzidine	Y	Y	2,500.*				0.12ng**	0.53ng**		1980FR	6
Beryllium	Y	Y	130.*	5.3*			6.8ng**	117.ng**		1980FR	8
BHC	Y	N	100.*		0.34*					1980FR	
Cadmium	Y	N	3.9+	1.1+	43.	9.3	10.µg		0.010mg	1985FR	21
Carbon Tetrachloride	Y	Y	35,200.*		50,000*	0.004	0.4µg**	6.94µg**		1980FR	1
Chlordane	Y	Y	2.4	0.0043	0.09	129*	0.46ng**	0.48ng**		1980FR	12
Chlorinated Benzenes	Y	Y	250.*	50*	160*					1980FR	1
Chlorinated Naphthalenes	Y	N	1,600.*		7.5*					1980FR	1
Chlorine	N	N	19.	11.	13.	7.5				1985FR	21
Chloroalkyl Ethers	Y	N	238,000.*							1980FR	1

g = grams
mg = milligrams
µg = micrograms
ng = nanograms
f = fibers

Y = Yes
N = No

\+ = Hardness Dependent Criteria (100 mg L used).
* = Insufficient Data to Develop Criteria.
Value Presented is the L.O.E.L. - Lowest Observed Effect Level.
** = Human Health Criteria for Carcinogens Reported for Three Risk Levels. Value Presented is the 10-5 Risk Level.
*** = pH Dependent Criteria (7.8 pH used).

M.C.L. - Maximum Contaminant Level

FR = Federal Register
RB = Quality Criteria for Water, 1976 (Redbook).

Water Quality Criteria Summary

	Concentrations In µgL						Units Per Liter				
	Priority Pollutant	Carcinogen	Fresh Acute Criteria	Fresh Chronic Criteria	Marine Acute Criteria	Marine Chronic Criteria	Water and Fish Ingestion	Fish Consumption Only	Drinking Water M.C.L.	Date Reference	# of States With Aquatic Life Standard
Chloroethyl Ether (BIS-2)	Y	Y					0.03µg**	1.36µg**		1980FR	
Chloroform	Y	Y	28,900.*	1,240.*			0.19µg**	15.7µg**		1980FR	1
Chloroisopropyl Ether (BIS-2)	Y	N					34.7µg	4.36mg		1980FR	
Chloromethyl Ether (BIS)	N	Y					0.00000378mg**	0.00184µg**		1980FR	
Chlorophenol 2	Y	N	4,380.*	2,000.*						1980FR	1
Chlorophenol 4	N	N			29,700.*					1980FR	1
Chlorophenoxy Herbicides (2,4,5,-TP)	N	N					10.µg			1980FR	
Chlorophenoxy Herbicides (2,4-D)	N	N					100.µg			1976RB	7
Chlorpyrifos	N	N	0.063	0.041	0.011	0.0056				1986FR	
Chloro-4 Methyl-3 Phenol	N	N	30.*							1980FR	
Chromium (HEX)	Y	N	16.	11.	1,100.	50.	50.µg		0.05mg	1985FR	24
Chromium (TRI)	N	N	1,700.+	210.+	10,300.*		170.mg	3,433.mg	0.05mg	1985FR	24
Color	N	N	Narrative	Statement	See Document					1976RB	
Copper	Y	N	18.+	12.+	2.19	2.9				1985FR	20
Cyanide	Y	N	22.	5.2	1.	1.	200.µg			1985FR	23
DDT	Y	Y	1.1	0.001	0.13	0.001	0.024ng**	0.024ng**		1980FR	16
DDT Metabolite (DDE)	Y	Y	1,050.*		14.*					1980FR	
DDT Metabolite (TDE)	Y	Y	0.06*		3.6*					1980FR	
Demeton	Y	N		0.1		0.1				1976RB	
Dibutylphthalate	Y	N					35.mg	154.mg		1980FR	
Dichlorobenzenes	Y	N	1,120.*	763.*	1,970.*		400.µg	2.6mg		1980FR	1
Dichlorobenzidine	Y	Y					0.01µg**	0.020µg**		1980FR	1
Dichloroethane 1,2	Y	Y	118,000.*	20,000.*	113,000.*		0.94µg**	243.µg**		1980FR	1
Dichlorethylenes	Y	Y	11,600.*		224,000.*		0.033µg**	1.85µg**		1980FR	1

g = grams
mg = milligrams
µg = micrograms
ng = nanograms
f = fibers

Y = Yes
N = No

\+ = Hardness Dependent Criteria (100 mg L used).
* = Insufficient Data to Develop Criteria.
Value Presented is the L.O.E.L. - Lowest Observed Effect Level.
** = Human Health Criteria for Carcinogens Reported for Three Risk Levels. Value Presented is the 10-6 Risk Level.
*** = pH Dependent Criteria (7.8 pH used).

M.C.L. - Maximum Contaminant Level

FR = Federal Register
RB = Quality Criteria for Water, 1976 (Redbook).

Water Quality Criteria Summary

	Concentrations In µgL						Units Per Liter				
	Priority Pollutant	Carcinogen	Fresh Acute Criteria	Fresh Chronic Criteria	Marine Acute Criteria	Marine Chronic Criteria	Water and Fish Ingestion	Fish Consumption Only	Drinking Water M.C.L.	Date Reference	# of States With Aquatic Life Standard
Dichlorophenol 2,4	N	N	2,020.*	366.*			3.09mg			1980FR	1
Dichloropropane	Y	N	23,000.*	5,700.*	10,300.*	3,040.*				1980FR	1
Dichloropropene	Y	N	6,060.*	244.*	790.*		87.µg	14.1mg		1980FR	1
Dieldrin	Y	Y	2.6	0.0019	0.71	.0019	0.071ng**	0.076ng**		1980FR	16
Diethylphthalate	Y	N					350.mg	1.8g		1980FR	
Dimethylphenol 2,4	Y	N	2,120.*							1980FR	
Dimethylphthalate	Y	N					313.mg	2.9g		1980FR	
Dinitrotoluene 2,4	N	Y					0.11µg**	9.1µg**		1980FR	
Dinitrotoluene	Y	N					70.µg	14.3mg		1980FR	
Dinitrotoluene	N	Y	330.*	230.*	590.*	370.*				1980FR	1
Dinitro-o-cresol 2,4	Y	N					13.4µg	786.µg		1980FR	
Dioxin (2,3,7,8-TCDO)	Y	Y	0.01*	0.00001*			0.000013ng**	0.000014ng**		1984FR	1
Diphenylhydrazine	Y	N					42.ng**	0.66µg**		1980FR	1
Diphenylhydrazine 1,2	Y	N	270.*							1980FR	
Di-2-Ethylhexyl Phthalate	Y	N					15.mg	50mg		1980FR	
Endosulfan	Y	N	0.22	0.056	0.034	0.0067	74.µg	159µg		1980FR	10
Endrin	Y	N	0.18	0.0023	0.037	0.0023	1.µg		0.0002mg	1980FR	18
Ethylbenzene	Y	N	32,000.*		430.*		1.4mg	3.28mg		1980FR	
Fluoranthene	Y	N	3,960.*		40*	16.*	42.µg	64.µg		1980FR	1
Gases, Total Dissolved	N	N	Narrative	Statement	See Document					1976RB	
Guthion	N	N		0.01		0.01				1976RB	8
Haloethers	Y	N	360.*	122.*						1980FR	
Halomethanes	Y	Y	11,000.*		12,000*	6,400.*	0.19µg**	15.7µg**		1980FR	
Heptachlor	Y	Y	0.52	0.0038	0.053	0.0036.	0.26ng**	0.29ng**		1980FR	12
Hexachloroethane	N	Y	980.*	540.*	940.*		1.9µg	8.74µg		1980FR	1
Hexachlorobenzene	Y	N					0.72ng**	0.74ng		1980FR	
Hexachlorobutadiene	Y	Y	90.*	9.3*	32.*		0.45µg**	50.µg**		1980FR	2

g = grams
mg = milligrams
µg = micrograms
ng = nanograms
f = fibers

Y = Yes
N = No

\+ = Hardness Dependent Criteria (100 mg L used).
* = Insufficient Data to Develop Criteria.
Value Presented is the L.O.E.L. - Lowest Observed Effect Level.
** = Human Health Criteria for Carcinogens Reported for Three Risk Levels. Value Presented is the 10-6 Risk Level.
*** = pH Dependent Criteria (7.8 pH used).

M.C.L. - Maximum Contaminant Level

FR = Federal Register
RB = Quality Criteria for Water, 1976 (Redbook).

Water Quality Criteria Summary

	Concentrations In µgL						Units Per Liter				
	Priority Pollutant	Carcinogen	Fresh Acute Criteria	Fresh Chronic Criteria	Marine Acute Criteria	Marine Chronic Criteria	Water and Fish Ingestion	Fish Consumption Only	Drinking Water M.C.L.	Date Reference	# of States With Aquatic Life Standard
Hexachlorocyclohexane (Lindane)	Y	Y	2.0	0.06	0.16				0.004mg	1980FR	12
Hexachlorocyclohexane-Alpha	Y	Y					9.2ng**	31.ng**		1980FR	
Hexachlorocyclohexane-Beta	Y	Y					16.3ng**	54.7ng**		1980FR	
Hexachlorocyclohexane-Gama	Y	Y					18.6ng**	62.6ng**		1980FR	
Hexachlorocyclohexane-Technical	Y	Y					12.3ng**	41.4ng**		1980FR	
Hexachlorcyclopentadiene	Y	N	7.*	5.2*	7.*		206.µg			1980FR	3
Iron	N	N		1,000.			0.3mg			1976RB	15
Isophorone	Y	N	117,000.*		12,900.*		5.2mg	520.mg		1980FR	
Lead	Y	N	82.+	3.2+	140.	5.6	50.µg		0.05mg	1985FR	20
Malathion	N	N		0.1		0.1				1976RB	7
Manganese	N	N					50.µg	100.µg		1976RB	7
Mercury	Y	N	2.4	0.012	2.1	0.025	144.ng	146.ng	0.002mg	1985FR	17
Methoxychlor	N	N		0.03		0.03	100.µg		0.16mg	1976RB	12
Mirex	N	N		0.001		0.001				1976RB	7
Monochlorobenzene	Y	N					486.µg			1980FR	
Naphthalene	Y	N	2,300.*	620.*	2,360.*					1980FR	1
Nickel	Y	N	1,400.+	160+	75	8.3	13.4µg	100.µg		1986FR	10
Nitrates	N	N					10.mg		10mg	1976RB	6
Nitrobenzene	Y	N	27,000.*		6,680.*		19.8mg			1980FR	1
Nitrophenols	Y	N	230.*	150.*	4,850.*					1980FR	1
Nitrosamines	Y	Y	5,850.*		3,300,000*					1980FR	1
Nitrosodibutylamine N	Y	Y					6.4ng**	587.ng**		1980FR	
Nitrosodiethylamine N	Y	Y					0.8ng**	1,240.ng**		1980FR	
Nitrosodimethylamine N	Y	Y					1.4ng**	16,000.ng**		1980FR	

g = grams
mg = milligrams
µg = micrograms
ng = nanograms
f = fibers

Y = Yes
N = No

\+ = Hardness Dependent Criteria (100 mg L used).
* = Insufficient Data to Develop Criteria.
Value Presented is the L.O.E.L. - Lowest Observed Effect Level.
** = Human Health Criteria for Carcinogens Reported for Three Risk Levels. Value Presented is the 10-6 Risk Level.
*** = pH Dependent Criteria (7.8 pH used).

M.C.L. - Maximum Contaminant Level

FR = Federal Register
RB = Quality Criteria for Water, 1976 (Redbook).

Water Quality Criteria Summary

	Concentrations In µgL						Units Per Liter				
	Priority Pollutant	Carcinogen	Fresh Acute Criteria	Fresh Chronic Criteria	Marine Acute Criteria	Marine Chronic Criteria	Water and Fish Ingestion	Fish Consumption Only	Drinking Water M.C.L.	Date Reference	# of States With Aquatic Life Standard
Nitrosodiphenylamine N	Y	Y					4,900.ng**	16,100.ng**		1980FR	
Nitrosopyrrolidine N	Y	Y					16.ng**	91,900.ng**		1980FR	
Oil and Grease	N	N	Narrative	Statement	See Document					1976RB	56
Oxygen Dissolved	N	N	Warmwater	and Coldwater	Criteria Matrix	See Document				1986FR	56
Parathion	N	N	0.065	0.013						1986FR	8
PCB's	Y	Y	2.0	0.014	10	0.03	0.079ng**	0.079ng**		1980FR	16
Pentachlorinated Ethanes	N	N	7,240.*	1,100.*	390.*	281.*				1980FR	1
Pentachlorobenzene	N	N					74.µg	85.µg		1980FR	
Pentachlorophenol	Y	N	20.***	13.***	13.	7.9*	101.mg			1986FR	2
pH	N	N		6.5-9		6.5-8.5				1976RB	56
Phenol	Y	N	10,200.*	2,560.*	5,800.*		3.5mg			1980FR	23
Phosphorus Elemental	N	N				0.1				1976RB	
Phthalate Esters	Y	N	940.*	3.*	2,944.*	3.4*				1980FR	6
Polynuclear Aromatic Hydrocarbons	Y	Y			300.*		2.8ng**	31.1ng**		1980FR	1
Selenium	Y	N	260.	35.	410.	54.	10.µg		0.01mg	1980FR	15
Silver	Y	N	4.1 +	0.12	2.3		50.µg		0.05mg	1980FR	14
Solids Dissolved and Salinity	N	N					250.mg			1976RB	56
Solids Suspended and Turbidity	N	N	Narrative	Statement	See Document					1976RB	44
Sulfide-Hydrogen Sulfide	N	N		2.		2.				1976RB	
Temperature	N	N	Species	Dependent	Criteria	See Document				1976RB	56
Tetrachlorinated Ethanes	Y	N	9,320.*							1980FR	
Tetrachlorobenzene 1,2,4,5	Y	N					38.µg	48µg		1980FR	
Tetrachloroethane 1,1,2,2	Y	Y		2,400.*	9,020.*		0.17µg**	10.7µg**		1980FR	1
Tetrachloroethanes	Y	N	9,320.*							1980FR	1

g = grams
mg = milligrams
µg = micrograms
ng = nanograms
f = fibers

Y = Yes
N = No

\+ = Hardness Dependent Criteria (100 mg L used).
* = Insufficient Data to Develop Criteria.
Value Presented is the L.O.E.L. - Lowest Observed Effect Level.
** = Human Health Criteria for Carcinogens Reported for Three Risk Levels. Value Presented is the 10-5 Risk Level.
*** = pH Dependent Criteria (7.8 pH used).

M.C.L. - Maximum Contaminant Level

FR = Federal Register.
RB = Quality Criteria for Water, 1976 (Redbook).

Water Quality Criteria Summary

	Concentrations In µgL						Units Per Liter				
	Priority Pollutant	Carcinogen	Fresh Acute Criteria	Fresh Chronic Criteria	Marine Acute Criteria	Marine Chronic Criteria	Water and Fish Ingestion	Fish Consumption Only	Drinking Water M.C.L.	Date Reference	# of States With Aquatic Life Standard
Tetrachloroethylene	Y	Y	5,280.*	840.*	10,200.*	460.*	0.8µg**	8.85µg**		1980FR	1
Tetrachlorophenol 2,3,5,6	Y	N				440.*				1980FR	
Thallium	Y	N	1,400.*	40.*	2,130.*		13.µg	48.ng**		1980FR	2
Toluene	Y	N	17,500.*		6,300.*	5,000.*	14.3mg	424.mg		1980FR	1
Toxaphene	Y	Y	0.73	0.0002	0.21	0.0002	0.71ng**	0.73ng**	0.006mg	1986FR	17
Trichlorinated Ethanes	Y	Y	18,000.*							1980FR	
Trichloroethane 1,1,1	Y	N			31,200.*		18.4mg	1.03g		1980FR	1
Trichloroethane 1,1,2	Y	Y		9,400.*			0.6µg**	41.8µg**		1980FR	1
Trichloroethylene	Y	Y	45,000.*	21,900.*	2,000.*		2.7µg**	80.7µg**		1980FR	1
Trichlorophenol 2,4,5	N	N					2,600.µg			1980FR	
Trichlorophenol 2,4,6	Y	Y		970.*			1.2µg**	3.6µg**		1980FR	
Vinyl Chloride	Y	Y					2.µg**	525.µg**		1980FR	
Zinc	Y	N	120.+	110+	95	95				1987FR	19

g = grams
mg = milligrams
µg = micrograms
ng = nanograms
f = fibers

Y = Yes
N = No

\+ = Hardness Dependent Criteria (100 mg L used).
* = Insufficient Data to Develop Criteria.
Value Presented is the L.O.E.L. - Lowest Observed Effect Level.
** = Human Health Criteria for Carcinogens Reported for Three Risk Levels. Value Presented is the 10-5 Risk Level.
*** = pH Dependent Criteria (7.8 pH used).

M.C.L. - Maximum Contaminant Level

FR = Federal Register

RB = Quality Criteria for Water, 1976 (Redbook).

APPENDIX C

U.S. FISH AND WILDLIFE SERVICE CHEMICAL PRIORITIZATION LIST

CHEMICAL	RATING
Acenaphthene	L
Acephate	M
Acrolein	L
Acrylonitrile	L
Alachlor	L
Aldicarb	M
Aldrin/Dieldrin	M
Aluminum	L
Ammonia	L
Antimony	L
Arsenic	H
Asbestos	L
Atrazine	M
Azinphos methyl	L
Azoxybenzenes	H
Azobenzenes	H
Barium	L
Benzene	M
Benzidine	L
Beryllium	L
Boron	M
Cadmium	H
Carbaryl	L
Carbofuran	M
Carbon tetrachloride	L
Chlordane	H
Chlordimeform	L
Chlorinated biphenyls	H
Chlorinated benzenes	H
Chlorinated biphenylenes	H
Chlorinated diphenylethers	H
Chlorinated ethanes	L
Chlorinated hydrazobenzenes	H
Chlorinated naphthalene	H
Chlorinated phenols	M
Chlorine	L

CHEMICAL	RATING
Chloralkyl ethers	L
Chloroform	L
2-Chlorophenol	L
Chlorostyrenes	M
Chlorpyrifos	M
Chlorsulfron	L
Chromium	M
Copper	M
Creosote	M
Cyanides	H
Cypermethrin	L
2,4-D	M
2,4-DP	M
DDT metabolites	H
Diazinon	M
Dibenzodioxins	H
Dibenzofurans	H
Dicamba	L
Dichlorobenzidine	L
Dichloroethylenes	L
2,4-dichlorophenol	L
Dimethoate	M
2,4-dimethylphenol	L
Dinitrotoluene	M
Diphenylhydrazine	M
Disulfoton	M
Diuron	L
Endosulfan	M
Endrin	H
Eptam	L
Ethylbenzene	M
Famphur	L
Fenvalerate	M

CHEMICAL	RATING
Fluroanthene	M
Fluoride	M
Fluridone	M
Freon 113	L
Glyphosate	L
Guthion	M
Haloethers	M
Halomethanes	L
Heptachlor	H
Hexachlorobutadiene	H
Hexachlorocyclohexane	H
Hexachlorocyclopentadiene	M
Isophorone	M
Lead	H
Linuron	L
Malathion	L
Mercury	H
Methomyl	M
Methoxychlor	L
Methyl mercury	H
Mirex	H
Naphthalene	L
Neburon	L
Nickel	M
Nitrobenzene	M
Nitrophenols	M
Nitropyrenes	M
Nitrosamines	L
Organotins	H
Organolead	M
Paraquat	M
Parathion (ethyl and methyl)	M
Pendimethalin	L
Pentachlorophenol	M
Permethrin	L
pH	L

CHEMICAL	RATING
Phenol	M
Phosphate	L
Phthalate esters	L
Picloram	M
Polybrominated biphenyls	H
Polynuclear aromatic hydrocarbons	H
Proban	L
Propanil	L
Resmethrin	M
Selenium	H
Silver	M
Sulfometuron methyl	L
Temephos	H
Terbufos	M
Tetrachloroethene	L
Tetrachlorethylene	L
Terphenyls	H
Thallium	M
Thiobencarb	L
Toluene	L
Toxaphene	M
Trichloroethylene	L
Trifuralin	M
Vanadium	L
Vinyl chloride	L
Xylene	L
Zinc	M

APPENDIX D

SARA TITLE III SUPERFUND LIST

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 372

[OPTS-400002A; FRL 3298-2]

Toxic Chemical Release Reporting; Community Right-to-know

AGENCY: Environmental Protection Agency (EPA).

ACTION: Final rule.

SUMMARY: This rule contains the uniform toxic chemical release reporting form as required by section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986. Section 313 requires that owners and operators of certain facilities that manufacture, import, process, or otherwise use certain toxic chemicals report annually their releases of those chemicals to each environmental medium. This rule also requires certain suppliers of toxic chemicals to notify recipients of such chemicals in mixtures and trade name products.

DATE: This rule is effective March 17, 1988.

FOR FURTHER INFORMATION CONTACT: Sam K. Susnett, Deputy Project Coordinator (TS-779), Emergency Planning and Community Right-to-Know Hotline, Environmental Protection Agency, Room. WH 562A, 401 M Street, SW. (Washington, DC 20460, (800-535-0202), In Washington, DC and Alaska, 202-479-2449).

SUPPLEMENTARY INFORMATION:

I. Authority

The Agency is promulgating this rule pursuant to sections 313 and 328 of Title III of the Superfund Amendments and Reauthorization Act of 1986, Pub. L. 99-499 (42 U.S.C. 11013 and 11028). Title III is also titled "The Emergency Planning and Community Right-To-Know Act of 1986." Section 313 of Title III requires owners and operators of covered facilities to report annually their releases of listed toxic chemicals. Section 313 also specifies that EPA must publish a uniform toxic chemical release form. In addition, section 328 provides EPA with the authority to promulgate such regulations as may be necessary to carry out the purposes of Title III.

II. Background

A. Regulatory History and Summary of Public Participation

On October 17, 1986, the President signed into law the Superfund Amendments and Reauthorization Act of 1986 (SARA), Pub. L. 99-499. The major function of this legislation is to amend and reauthorize provisions of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). However, Title III of SARA is a free-standing statute (not part of CERCLA) that is titled "The Emergency Planning and Community Right-To-Know Act of 1986." In general, Title III contains authorities relating to emergency planning, emergency notification, community right-to-know on chemicals, and a toxic chemical release inventory.

The focus of this rule is the toxic chemical release inventory provision contained in section 313 of Title III of SARA. Section 313 requires owners and operators of certain facilities that manufacture, process, or otherwise use a listed chemical to report annually their releases of such chemicals to any environmental medium. The reports are to be sent to both EPA and the State in which the facility is located. The basic purpose of this provision is to make available to the public information about releases of certain toxic chemicals that result from operations of certain facilities in their community.

EPA issued a proposed rule, published in the Federal Register of June 4, 1987 (52 FR 21152). The proposed rule contained the toxic chemical release inventory reporting form and interpretive requirements for reporting. The preamble of the proposed rule outlined the public participation activities that led up to the development of the proposal. After publication, EPA received over 100 written comments on the proposed rule. In addition, EPA held public meetings in Washington, DC, Chicago, IL and San Francisco, CA. Attendees at these meetings presented oral comments representative of wide range of interests including the affected industry, environmental and other public interest groups, State and local governments, and individual citizens.

In addition, EPA has held other meetings with, and received other communications from, interested parties.

B. Overview of Final Rule Requirements

The reporting requirements of this rule apply to owners and operators of covered facilities that manufacture, process, or otherwise use listed toxic chemicals. A covered facility is one that:

Has 10 or more full-time employees.

Is in SIC codes 20 through 39.

Exceeds an applicable manufacture, process, or use threshold.

EPA interprets "in SIC codes 20 through 39" to relate to the primary SIC code of the facility. If the facility is comprised of multiple establishments, facility coverage is based on a relative comparison of the value of products shipped and/or produced at 20 through 39 establishments versus non-20 through 39 establishments in that facility.

EPA has included a definition of "full-time employee" and guidance on determining SIC coverage.

EPA has not included a small business exemption in this rule different from that provided by section 313. However, the Agency is allowing reporting in ranges for releases to an environmental medium and for off-site transfers of wastes that are below 1,000 pounds per year. EPA expects that small businesses will benefit most from this provision. The range reporting is for calendar years 1987, 1988, and 1989 only.

The thresholds are those provided by the statute:

For manufacturing or processing as defined—75,000 pounds for 1987, 50,000 pounds for 1988, 25,000 pounds per year for 1989 and thereafter.

For toxic chemicals otherwise used the threshold is 10,000 pounds per year for all years.

Reports must be submitted annually on or before July 1 for the preceding year's data.

The chemicals subject to reporting initially are those chemicals as provided by section 313(c), with certain technical modifications.

Additions or deletions of chemicals from the list may result from petitions or EPA's own review of the list. Any such changes will be by notice and comment rulemaking, and EPA will identify the reporting years which they apply.

Mixtures and trade name products imported, processed, or used at a facility must be evaluated for the presence of listed toxic chemicals. However, EPA has applied a *de minimis* concentration limitation of 1 percent (or 0.1 percent if the chemical is a carcinogen) consistent with the Occupational Safety and Health Administration (OSHA) Hazard Communications Standard (HCS) in 29 CFR 1910.1200. Toxic chemicals present in concentrations below the *de minimis* limit do not have to be factored into threshold and release reporting calculations.

In relation to reporting on mixtures, EPA has developed a supplier requirement. Owners or operators of facilities in SIC codes 20 through 39 who supply mixtures or trade name products containing listed toxic chemicals must notify their customers about the presence and concentration of those chemicals in their products. However, the *de minimis* limit as described above also applies to this requirement. The supplier notification requirement takes effect with the first product shipment in 1989.

the product to be a trade secret. The notice would indicate that the toxic chemical is present in the mixture in a concentration of no more than 15 percent by weight. The upper bound value chosen must be no larger than necessary to adequately protect the trade secret.

(g) A person is not subject to the requirements of this section to the extent the person does not know that the facility or establishment(s) is selling or otherwise distributing a toxic chemical to another person in a mixture or trade name product. However, for purposes of this section, a person has such knowledge if the person receives a notice under this section from a supplier of a mixture or trade name product and the person in turn sells or otherwise distributes that mixture or trade name product to another person.

(h) If two or more persons, who do not have any common corporate or business interest (including common ownership or control), as described in § 372.38(f), operate separate establishments within a single facility, each such persons shall treat the establishment(s) it operates as a facility for purposes of this section. The determination under paragraph (a) of this section shall be made for those establishments.

Subpart D—Specific Toxic Chemical Listings

§ 372.65 Chemicals and chemical categories to which this Part applies.

The requirements of this Part apply to the following chemicals and chemical categories. This section contains three listings. Paragraph (a) of this section is an alphabetical order listing of those chemicals that have an associated Chemical Abstracts Service (CAS) Registry number. Paragraph (b) of this section contains a CAS number order list of the same chemicals listed in paragraph (a) of this section. Paragraph (c) of this section contains the chemical categories for which reporting is required. These chemical categories are listed in alphabetical order and do not have CAS numbers. Each listing identifies the effective date for reporting under § 372.30.

(a) *Alphabetical listing.*

Chemical name	CAS No.	Effective date
Acetaldehyde	75-07-0	01/01/87
Acetamide	60-35-5	01/01/87
Acetone	67-64-1	01/01/87
Acetonitrile	75-05-8	01/01/87
2-Acetylaminofluorene	53-96-3	01/01/87
Acrolein	107-02-8	01/01/87
Acrylamide	79-06-1	01/01/87
Acrylic acid	79-10-7	01/01/87
Acrylonitrile	107-13-1	01/01/87
Aldrin[1,4:5,8-Dimethanonaphthalene,1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-(1.alpha.,4.alpha.,4a.beta.,5.alpha.,8.alpha.,8a.beta.)-]	309-00-2	01/01/87
Allyl chloride	107-05-1	01/01/87
Aluminum (fume or dust)	7429-90-5	01/01/87
Aluminum oxide	1344-28-1	01/01/87
2-Aminoanthraquinone	117-79-3	01/01/87
4-Aminoazobenzene	60-09-3	01/01/87
4-Aminobiphenyl	92-67-1	01/01/87
1-Amino-2-methylanthraquinone	82-28-0	01/01/87
Ammonia	7664-41-7	01/01/87
Ammonium nitrate (solution)	6484-52-2	01/01/87
Ammonium sulfate (solution)	7783-20-2	01/01/87
Aniline	62-53-3	01/01/87
o-Anisidine	90-04-0	01/01/87
p-Anisidine	104-94-9	01/01/87
o-Anisidine hydrochloride	134-29-2	01/01/87
Anthracene	120-12-7	01/01/87
Antimony	7440-36-0	01/01/87
Arsenic	7440-38-2	01/01/87
Asbestos (friable)	1332-21-4	01/01/87
Barium	7440-39-3	01/01/87
Benzal Chloride	98-87-3	01/01/87
Benzamide	55-21-0	01/01/87
Benzene	71-43-2	01/01/87
Benzidine	92-87-5	01/01/87
Benzoic trichloride (Benzotrichloride)	98-07-7	01/01/87
Benzoyl chloride	98-88-4	01/01/87
Benzoyl peroxide	94-36-0	01/01/87
Benzyl chloride	100-44-7	01/01/87
Beryllium	7440-41-7	01/01/87
Biphenyl	92-52-4	01/01/87
Bis(2-chloroethyl)ether	111-44-4	01/01/87
Bis(chloromethyl)ether	542-88-1	01/01/87
Bis(2-chloro-1-methylethyl)ether	108-60-1	01/01/87
Bis(2-ethylhexyl)adipate	103-23-1	01/01/87
Bromoform (Tribromomethane)	75-25-2	01/01/87
Bromomethane (Methyl bromide)	74-83-9	01/01/87
1,3-Butadiene	106-99-0	01/01/87
Butyl acrylate	141-32-2	01/01/87
n-Butyl alcohol	71-36-3	01/01/87
sec-Butyl alcohol	78-92-2	01/01/87
tert-Butyl alcohol	75-65-0	01/01/87
Butyl benzyl phthalate	85-68-7	01/01/87
1,2-Butylene oxide	106-88-7	01/01/87
Butyraldehyde	123-72-8	01/01/87

Chemical name	CAS No.	Effective date
C.I. Acid Blue 9, diammonium salt	2650-18-2	01/01/87
C.I. Acid Blue 9, disodium salt	3844-45-9	01/01/87
C.I. Acid Green 3	4680-78-8	01/01/87
C.I. Basic Green 4	569-64-2	01/01/87
C.I. Basic Red 1	989-38-8	01/01/87
C.I. Direct Black 38	1937-37-7	01/01/87
C.I. Direct Blue 6	2602-46-2	01/01/87
C.I. Direct Brown 95	16071-86-6	01/01/87
C.I. Disperse Yellow 3	2832-40-8	01/01/87
C.I. Food Red 5	3761-53-3	01/01/87
C.I. Food Red 15	81-88-9	01/01/87
C.I. Solvent Orange 7	3118-97-6	01/01/87
C.I. Solvent Yellow 3	97-56-3	01/01/87
C.I. Solvent Yellow 14	842-07-9	01/01/87
C.I. Solvent Yellow 34 (Aunmine)	492-80-8	01/01/87
C.I. Vat Yellow 4	128-66-5	01/01/87
Cadmium	7440-43-9	01/01/87
Calcium cyanamide	156-62-7	01/01/87
Captan[1H-Isoindole-1,3(2H)-dione,3a,4,7,7a-tetrahydro-2-[(trichloromethyl)thio]-]	133-06-2	01/01/87
Carbaryl[1-Naphthalenol, methylcarbamate]	63-25-2	01/01/87
Carbon disulfide	75-15-0	01/01/87
Carbon tetrachloride	56-23-5	01/01/87
Carbonyl sulfide	463-58-1	01/01/87
Catechol	120-80-9	01/01/87
Chloramben [Benzoic acid,3-amino-2,5-dichloro-]	133-90-4	01/01/87
Chlordane[4,7-Methanoindan,1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-]	57-74-9	01/01/87
Chlorine	7782-50-5	01/01/87
Chlorine dioxide	10049-04-4	01/01/87
Chloroacetic acid	79-11-8	01/01/87
2-Chloroacetophenone	532-27-4	01/01/87
Chlorobenzene	108-90-7	01/01/87
Chlorobenzilate [Benzeneacetic acid, 4-chloro-.alpha.-(4-chlorophenyl)-.alpha.-hydroxy-, ethyl ester]	510-15-6	01/01/87
Chloroethane (Ethyl chloride)	75-00-3	01/01/87
Chloroform	67-66-3	01/01/87
Chloromethane (Methyl chloride)	74-87-3	01/01/87
Chloromethyl methyl ether	107-30-2	01/01/87
Chloroprene	126-99-8	01/01/87
Chlorothalonil[1,3-Benzenedicarbonitrile,2,4,5,6-tetrachloro-]	1897-45-6	01/01/87
Chromium	7440-47-3	01/01/87
Cobalt	7440-48-4	01/01/87
Copper	7440-50-8	01/01/87
p-Cresidine	120-71-8	01/01/87
Cresol (mixed isomers)	1319-77-3	01/01/87
m-Cresol	108-39-4	01/01/87
o-Cresol	95-48-7	01/01/87
p-Cresol	106-44-5	01/01/87
Cumene	98-82-8	01/01/87
Cumene hydroperoxide	80-15-9	01/01/87
Cupferron[Benzeneamine, N-hydroxy-N-nitroso, ammonium salt]	135-20-6	01/01/87
Cyclohexane	110-82-7	01/01/87
2,4-D [Acetic acid, (2,4-dichlorophenoxy)-1]	94-75-7	01/01/87
Decabromodiphenyl oxide	1163-19-5	01/01/87
Diallate [Carbamothioic acid, bis(1-methylethyl)-, S-(2,3-dichloro-2-propenyl) ester]	2303-16-4	01/01/87
2,4-Diaminoanisole	615-05-4	01/01/87
2,4-Diaminoanisole sulfate	39156-41-7	01/01/87
4,4'-Diaminodiphenyl ether	101-80-4	01/01/87
Diaminotoluene (mixed isomers)	25376-45-8	01/01/87
2,4-Diaminotoluene	95-80-7	01/01/87
Diazomethane	334-88-3	01/01/87
Dibenzofuran	132-64-9	01/01/87
1,2-Dibromo-3-chloropropane (DBCP)	96-12-8	01/01/87
1,2-Dibromoethane (Ethylene dibromide)	106-93-4	01/01/87
Dibutyl phthalate	84-74-2	01/01/87
Dichlorobenzene (mixed isomers)	25321-22-6	01/01/87
1,2-Dichlorobenzene	95-50-1	01/01/87
1,3-Dichlorobenzene	541-73-1	01/01/87
1,4-Dichlorobenzene	106-46-7	01/01/87
3,3'-Dichlorobenzidine	91-94-1	01/01/87
Dichlorobromomethane	75-27-4	01/01/87
1,2-Dichloroethane (Ethylene dichloride)	107-06-2	01/01/87
1,2-Dichloroethylene	540-59-0	01/01/87
Dichloromethane (Methylene chloride)	75-09-2	01/01/87
2,4-Dichlorophenol	120-83-2	01/01/87
1,2-Dichloropropane	78-87-5	01/01/87
1,3-Dichloropropylene	542-75-6	01/01/87
Dichlorvos [Phosphoric acid, 2,2-dichloroethenyl dimethyl ester]	62-73-7	01/01/87
Dicofol [Benzenemethanol,4-chloro-.alpha.-(4-chlorophenyl)-.alpha.-(trichloromethyl)-]	115-32-2	01/01/87
Diepoxybutane	1464-53-5	01/01/87
Diethanolamine	111-42-2	01/01/87
Di-(2-ethylhexyl)phthalate (DEHP)	177-81-7	01/01/87
Diethyl phthalate	84-66-2	01/01/87

Chemical name	CAS No.	Effective date
Diethyl sulfate	64-67-5	01/01/87
3,3'-Dimethoxybenzidine	119-90-4	01/01/87
4-Dimethylaminoazobenzene	60-11-7	01/01/87
3,3'-Dimethylbenzidine (o-Tolidine)	119-93-7	01/01/87
Dimethylcarbamyl chloride	79-44-7	01/01/87
1,1-Dimethyl hydrazine	57-14-7	01/01/87
2,4-Dimethylphenol	105-67-9	01/01/87
Dimethyl phthalate	131-11-3	01/01/87
Dimethyl sulfate	77-78-1	01/01/87
4,6-Dinitro-o-cresol	534-52-1	01/01/87
2,4-Dinitrophenol	51-28-5	01/01/87
2,4-Dinitrotoluene	121-14-2	01/01/87
2,6-Dinitrotoluene	606-20-2	01/01/87
n-Dioctyl phthalate	117-84-0	01/01/87
1,4-Dioxane	123-91-1	01/01/87
1,2-Diphenylhydrazine (Hydrazobenzene)	122-66-7	01/01/87
Epichlorohydrin	106-89-8	01/01/87
2-Ethoxyethanol	110-80-5	01/01/87
Ethyl acrylate	140-88-5	01/01/87
Ethylbenzene	100-41-4	01/01/87
Ethyl chloroformate	541-41-3	01/01/87
Ethylene	74-85-1	01/01/87
Ethylene glycol	107-21-1	01/01/87
Ethyleneimine(Aziridine)	151-56-4	01/01/87
Ethylene oxide	75-21-8	01/01/87
Ethylene thiourea	96-45-7	01/01/87
Fluometuron [Urea, N,N-dimethyl-N'-[3-(trifluoromethyl)phenyl]-]	2164-17-2	01/01/87
Formaldehyde	50-00-0	01/01/87
Freon 113 [Ethane, 1,1,2-trichloro-1,2,2-trifluoro-]	76-13-1	01/01/87
Heptachlor[1,4,5,6,7,8,8-Heptachloro-3a,4,7,7a-tetrahydro-4,7-methano-1H-indene]	76-44-8	01/01/87
Hexachlorobenzene	118-74-1	01/01/87
Hexachloro-1,3-butadiene	87-68-3	01/01/87
Hexachlorocyclopentadiene	77-47-4	01/01/87
Hexachloroethane	67-72-1	01/01/87
Hexachloronaphthalene	1335-87-1	01/01/87
Hexamethylphosphoramide	680-31-9	01/01/87
Hydrazine	302-01-2	01/01/87
Hydrazine sulfate	10034-93-2	01/01/87
Hydrochloric acid	7647-01-0	01/01/87
Hydrogen cyanide	74-90-8	01/01/87
Hydrogen fluoride	7664-39-3	01/01/87
Hydroquinone	123-31-9	01/01/87
Isobutyraldehyde	78-84-2	01/01/87
Isopropyl alcohol (Only persons who manufacture by the strong acid process are subject, no supplier notification.)	67-63-0	01/01/87
4,4'-Isopropylidenediphenol	80-05-7	01/01/87
Lead	7439-92-1	01/01/87
Lindane [Cyclohexane, 1,2,3,4,5,6-hexachloro-(1.alpha.,2.alpha.,3.beta.,4.alpha.,5.alpha.,6.beta.)-]	58-89-9	01/01/87
Maleic anhydride	108-31-6	01/01/87
Maneb [Carbamodithoic acid, 1,2-ethanediylbis-, manganese complex]	12427-38-2	01/01/87
Manganese	7439-96-5	01/01/87
Melamine	108-78-1	01/01/87
Mercury	7439-97-6	01/01/87
Methanol	67-56-1	01/01/87
Methoxychlor [Benzene, 1,1'-(2,2,2-trichloroethylidene)bis[4-methoxy-]	72-43-5	01/01/87
2-Methoxyethanol	109-86-4	01/01/87
Methyl acrylate	96-33-3	01/01/87
Methyl tert-butyl ether	1634-04-4	01/01/87
4,4'-Methylenebis(2-chloro aniline) (MBOCA)	101-14-4	01/01/87
4,4'-Methylenebis(N,N-dimethyl) benzenamine	101-61-1	01/01/87
Methylenebis(phenylisocyanate) (MBI)	101-68-8	01/01/87
Methylene bromide	74-95-3	01/01/87
4,4'-Methylenedianiline	101-77-9	01/01/87
Methyl ethyl ketone	78-93-3	01/01/87
Methyl hydrazine	60-34-4	01/01/87
Methyl iodide	74-88-4	01/01/87
Methyl isobutyl ketone	108-10-1	01/01/87
Methyl isocyanate	624-83-9	01/01/87
Methyl methacrylate	80-62-6	01/01/87
Michler's ketone	90-94-8	01/01/87
Molybdenum trioxide	1313-27-5	01/01/87
Mustard gas [Ethane, 1,1'-thiobis[2-chloro-]	505-60-2	01/01/87
Naphthalene	91-20-3	01/01/87
alpha-Naphthylamine	134-32-7	01/01/87
beta-Naphthylamine	91-59-8	01/01/87
Nickel	7440-02-0	01/01/87
Nitric acid	7697-37-2	01/01/87
Nitrilotriacetic acid	139-13-9	01/01/87
5-Nitro-o-anisidine	99-59-2	01/01/87
Nitrobenzene	98-95-3	01/01/87
4-Nitrobiphenyl	92-93-3	01/01/87
Nitrofen [Benzene, 2,4-dichloro-1-(4-nitrophenoxy)-]	1836-75-5	01/01/87

Chemical name	CAS No.	Effective date
Nitrogen mustard [2-Chloro-N-(2-chloroethyl)-N-methylethanamine]	51-75-2	01/01/87
Nitroglycerin	55-63-0	01/01/87
2-Nitrophenol	88-75-5	01/01/87
4-Nitrophenol	100-02-7	01/01/87
2-Nitropropane	79-46-9	01/01/87
p-Nitrosodiphenylamine	156-10-5	01/01/87
N,N-Dimethylaniline	121-69-7	01/01/87
N-Nitrosodi-*n*-butylamine	924-16-3	01/01/87
N-Nitrosodiethylamine	55-18-5	01/01/87
N-Nitrosodimethylamine	62-75-9	01/01/87
N-Nitrosodiphenylamine	86-30-6	01/01/87
N-Nitrosodi-*n*-propylamine	621-64-7	01/01/87
N-Nitrosomethylvinylamine	4549-40-0	01/01/87
N-Nitrosomorpholine	59-89-2	01/01/87
N-Nitroso-*N*-ethylurea	759-73-9	01/01/87
N-Nitroso-*N*-methylurea	684-93-5	01/01/87
N-Nitrosonornicotine	16543-55-8	01/01/87
N-Nitrosopiperidine	100-75-4	01/01/87
Octachloronaphthalene	2234-13-1	01/01/87
Osmium tetroxide	20816-12-0	01/01/87
Parathion [Phosphorothioic acid, O,O-diethyl-O-(4-nitrophenyl) ester]	56-38-2	01/01/87
Pentachlorophenol (PCP)	87-86-5	01/01/87
Peracetic acid	79-21-0	01/01/87
Phenol	108-95-2	01/01/87
p-Phenylenediamine	106-50-3	01/01/87
2-Phenylphenol	90-43-7	01/01/87
Phosgene	75-44-5	01/01/87
Phosphoric acid	7664-38-2	01/01/87
Phosphorus (yellow or white)	7723-14-0	01/01/87
Phthalic anhydride	85-44-9	01/01/87
Picric acid	88-89-1	01/01/87
Polychlorinated biphenyls (PCBs)	1336-36-3	01/01/87
Propane sultone	1120-71-4	01/01/87
beta-Propiolactone	57-57-8	01/01/87
Propionaldehyde	123-38-6	01/01/87
Propoxur [Phenol, 2-(1-methylethoxy)-, methylcarbamate]	114-26-1	01/01/87
Propylene (Propene)	115-07-1	01/01/87
Propyleneimine	75-55-8	01/01/87
Propylene oxide	75-56-9	01/01/87
Pyridine	110-86-1	01/01/87
Quinoline	91-22-5	01/01/87
Quinone	106-51-4	01/01/87
Quintozene [Pentachloronitrobenzene]	82-68-8	01/01/87
Saccharin (only persons who manufacture are subject, no supplier notification) [1,2-Benzisothiazol-3(2H)-one,1,1-dioxide]	81-07-2	01/01/87
Safrole	94-59-7	01/01/87
Selenium	7782-49-2	01/01/87
Silver	7440-22-4	01/01/87
Sodium hydroxide (solution)	1310-73-2	01/01/87
Sodium sulfate (solution)	7757-82-6	01/01/87
Styrene	100-42-5	01/01/87
Styrene oxide	96-09-3	01/01/87
Sulfuric acid	7664-93-9	01/01/87
Terephthalic acid	100-21-0	01/01/87
1,1,2,2-Tetrachloroethane	79-34-5	01/01/87
Tetrachloroethylene (Perchloroethylene)	127-18-4	01/01/87
Tetrachlorvinphos [Phosphonic acid, 2-chloro-1-(2,4,5-trichlorophenyl)ethenyl dimethyl ester]	961-11-5	01/01/87
Thallium	7440-28-0	01/01/87
Thioacetamide	62-55-5	01/01/87
4,4'-Thiodianiline	139-65-1	01/01/87
Thiourea	62-56-6	01/01/87
Thorium dioxide	1314-20-1	01/01/87
Titanium dioxide	13463-67-7	01/01/87
Titanium tetrachloride	7550-45-0	01/01/87
Toluene	108-88-3	01/01/87
Toluene-2,4-diisocyanate	584-84-9	01/01/87
Toluene-2,6-diisocyanate	91-08-7	01/01/87
o-Toluidine	95-53-4	01/01/87
o-Toluidine hydrochloride	636-21-5	01/01/87
Toxaphene	8001-35-2	01/01/87
Triaziquone [2,5-Cyclohexadiene-1,4-dione,2,3,5-tris(1-aziridinyl)-]	68-76-8	01/01/87
Trichlorfon [Phosphonic acid, (2,2,2-trichloro-1-hydroxyethyl)-, dimethyl ester]	52-68-6	01/01/87
1,2,4-Trichlorobenzene	120-82-1	01/01/87
1,1,1-Trichloroethane (Methyl chloroform)	71-55-6	01/01/87
1,1,2-Trichloroethane	79-00-5	01/01/87
Trichloroethylene	79-01-6	01/01/87
2,4,5-Trichlorophenol	95-95-4	01/01/87
2,4,6-Trichlorophenol	88-06-2	01/01/87
Trifluralin [Benzenamine, 2,6-dinitro-N,N-dipropyl-4-(trifluoromethyl)-]	1582-09-8	01/01/87
1,2,4-Trimethylbenzene	95-63-6	01/01/87
Tris(2,3-dibromopropyl)phosphate	126-72-7	01/01/87
Urethane (Ethyl carbamate)	51-79-6	01/01/87

Chemical name	CAS No.	Effective date
Vanadium (fume or dust)	7440-62-2	01/01/87
Vinyl acetate	108-05-4	01/01/87
Vinyl bromide	593-60-2	01/01/87
Vinyl chloride	75-01-4	01/01/87
Vinylidene chloride	75-35-4	01/01/87
Xylene (mixed isomers)	1330-20-7	01/01/87
m-Xylene	108-38-3	01/01/87
o-Xylene	95-47-6	01/01/87
p-Xylene	106-42-3	01/01/87
2,6-Xylidine	87-62-7	01/01/87
Zinc (fume or dust)	7440-66-6	01/01/87
Zineb [Carbamodithioic acid, 1,2-ethanediylbis-, zinc complex]	12122-67-7	01/01/87

(b) *CAS Number listing.*

CAS No.	Chemical name	Effective date
50-00-0	Formaldehyde	01/01/87
51-28-5	2,4-Dinitrophenol	01/01/87
51-75-2	Nitrogen mustard [2-Chloro-N-(2-chloroethyl)-N-methylethanamine]	01/01/87
51-79-6	Urethane (Ethyl carbamate)	01/01/87
52-68-6	Trichlorfon [Phosphonic acid, (2,2,2-trichloro-1-hydroxyethyl)-dimethyl ester]	01/01/87
53-96-3	2-Acetylaminofluorene	01/01/87
55-18-5	*N*-Nitrosodiethylamine	01/01/87
55-21-0	Benzamide	01/01/87
55-63-0	Nitroglycerin	01/01/87
56-23-5	Carbon tetrachloride	01/01/87
56-38-2	Parathion [Phosphorothioic acid, 0,0-diethyl-0-(4-nitrophenyl)ester]	01/01/87
57-14-7	1,1-Dimethyl hydrazine	01/01/87
57-57-8	*beta*-Propiolactone	01/01/87
57-74-9	Chlordane [4,7-Methanoindan, 1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-]	01/01/87
58-89-9	Lindane [Cyclohexane, 1,2,3,4,5,6-hexachloro-(1.alpha.,2.alpha.,3.beta.,4.alpha.,5.alpha.,6.beta.)-]	01/01/87
59-89-2	*N*-Nitrosomorpholine	01/01/87
60-09-3	4-Aminoazobenzene	01/01/87
60-11-7	4-Dimethylaminoazobenzene	01/01/87
60-34-4	Methyl hydrazine	01/01/87
60-35-5	Acetamide	01/01/87
62-53-3	Aniline	01/01/87
62-55-5	Thioacetamide	01/01/87
62-56-6	Thiourea	01/01/87
62-73-7	Dichlorvos [Phosphoric acid, 2,2-dichloroethenyl dimethyl ester]	01/01/87
62-75-9	*N*-Nitrosodimethylamine	01/01/87
63-25-2	Carbaryl [1-Naphthalenol, methylcarbamate]	01/01/87
64-67-5	Diethyl sulfate	01/01/87
67-56-1	Methanol	01/01/87
67-63-0	Isopropyl alcohol (only persons who manufacture by the strong acid process are subject, supplier notification not required.)	01/01/87
67-64-1	Acetone	01/01/87
67-66-3	Chloroform	01/01/87
67-72-1	Hexachloroethane	01/01/87
68-76-8	Triaziquone [2,5-Cyclohexadiene-1,4-dione,2,3,5-tris(1-azindinyl)-]	01/01/87
71-36-3	*n*-Butyl alcohol	01/01/87
71-43-2	Benzene	01/01/87
71-55-6	1,1,1-Trichloroethane (Methyl chloroform)	01/01/87
72-43-5	Methoxychlor [Benzene, 1,1'-(2,2,2,-trichloroethylidene)bis [4-methoxy-]	01/01/87
74-83-9	Bromomethane (Methyl bromide)	01/01/87
74-85-1	Ethylene	01/01/87
74-87-3	Chloromethane (Methyl chloride)	01/01/87
74-88-4	Methyl iodide	01/01/87
74-90-8	Hydrogen cyanide	01/01/87
74-95-3	Methylene bromide	01/01/87
75-00-3	Chloroethane (Ethyl chloride)	01/01/87
75-01-4	Vinyl chloride	01/01/87
75-05-8	Acetonitrile	01/01/87
75-07-0	Acetaldehyde	01/01/87
75-09-2	Dichloromethane (Methylene chloride)	01/01/87
75-15-0	Carbon disulfide	01/01/87
75-21-8	Ethylene oxide	01/01/87
75-25-2	Bromoform (Tribromomethane)	01/01/87
75-27-4	Dichlorobromomethane	01/01/87
75-35-4	Vinylidene chloride	01/01/87
75-44-5	Phosgene	01/01/87
75-55-8	Propyleneimine	01/01/87
75-56-9	Propylene oxide	01/01/87
75-65-0	*tert*-Butyl alcohol	01/01/87
77-13-1	Freon 113 [Ethane, 1,1,2-trichloro-1,2,2-trifluoro-]	01/01/87
76-44-8	Heptachlor [1,4,5,6,7,8,8-Heptachloro-3a,4,7,7a-tetrahydro-4,7-methano-1H-indene]	01/01/87
77-47-4	Hexachlorocyclopentadiene	01/01/87

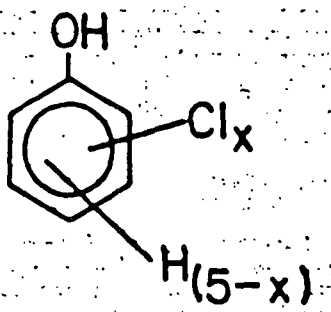
CAS No.	Chemical name	Effective date
77-78-1	Dimethyl sulfate	01/01/87
78-84-2	Isobutyraldehyde	01/01/87
78-87-5	1,2-Dichloropropane	01/01/87
78-92-2	*sec*-Butyl alcohol	01/01/87
78-93-3	Methyl ethyl ketone	01/01/87
79-00-5	1,1,2-Trichloroethane	01/01/87
79-01-6	Trichloroethylene	01/01/87
79-06-1	Acrylamide	01/01/87
79-10-7	Acrylic acid	01/01/87
79-11-8	Chloroacetic acid	01/01/87
79-21-0	Peracetic acid	01/01/87
79-34-5	1,1,2,2-Tetrachloroethane	01/01/87
79-44-7	Dimethylcarbamyl chloride	01/01/87
79-46-9	2-Nitropropane	01/01/87
80-05-7	4,4'-Isopropylidenediphenol	01/01/87
80-15-9	Cumene hydroperoxide	01/01/87
80-62-6	Methyl methacrylate	01/01/87
81-07-2	Saccharin (only persons who manufacture are subject, no supplier notification) [1,2-Benzisothiazol-3(2H)-one,1,1-dioxide]	01/01/87
81-88-9	C.I. Food Red 15	01/01/87
82-28-0	1-Amino-2-methylanthraquinone	01/01/87
82-68-8	Quintozene [Pentachloronitrobenzene]	C12
84-66-2	Diethyl phthalate	01/01/87
84-74-2	Dibutyl phthalate	01/01/87
85-44-9	Phthalic anhydride	01/01/87
85-68-7	Butyl benzyl phthalate	01/01/87
86-30-6	*N*-Nitrosodiphenylamine	01/01/87
87-62-7	2,6-Xylidine	01/01/87
87-68-3	Hexachloro-1,3-butadiene	01/01/87
87-86-5	Pentachlorophenol (PCP)	01/01/87
88-06-2	2,4,6-Trichlorophenol	01/01/87
88-75-5	2-Nitrophenol	01/01/87
88-89-1	Picric acid	01/01/87
90-04-0	*o*-Anisidine	01/01/87
90-43-7	2-Phenylphenol	01/01/87
90-94-8	Michler's ketone	01/01/87
91-08-7	Toluene-2,6-diisocyanate	01/01/87
91-20-3	Naphthalene	01/01/87
91-22-5	Quinoline	01/01/87
91-59-8	*beta*-Naphthylamine	01/01/87
91-94-1	3,3'-Dichlorobenzidine	01/01/87
92-52-4	Biphenyl	01/01/87
92-67-1	4-Aminobiphenyl	01/01/87
92-87-5	Benzidine	01/01/87
92-93-3	4-Nitrobiphenyl	01/01/87
94-36-0	Benzoyl peroxide	01/01/87
94-59-7	Safrole	01/01/87
94-75-7	2,4-D [Acetic acid, (2,4-dichlorophenoxy)-]	01/01/87
95-47-6	*o*-Xylene	01/01/87
95-48-7	*o*-Cresol	01/01/87
95-50-1	1,2-Dichlorobenzene	01/01/87
95-53-4	*o*-Toluidine	01/01/87
95-63-6	1,2,4-Trimethylbenzene	01/01/87
95-80-7	2,4-Diaminotoluene	01/01/87
95-95-4	2,4,5-Trichlorophenol	01/01/87
96-09-3	Styrene oxide	01/01/87
96-12-8	1,2-Dibromo-3-chloropropane (DBCP)	01/01/87
96-33-3	Methyl acrylate	01/01/87
96-45-7	Ethylene thiourea	01/01/87
97-56-3	C.I. Solvent Yellow 3	01/01/87
98-07-7	Benzoic trichloride (Benzotrichloride)	01/01/87
98-82-8	Cumene	01/01/87
98-87-3	Benzal chloride	01/01/87
98-88-4	Benzoyl chloride	01/01/87
98-95-3	Nitrobenzene	01/01/87
99-59-2	5-Nitro-*o*-anisidine	01/01/87
100-02-7	4-Nitrophenol	01/01/87
100-21-0	Terephthalic acid	01/01/87
100-41-4	Ethylbenzene	01/01/87
100-42-5	Styrene	01/01/87
100-44-7	Benzyl chloride	01/01/87
100-75-4	*N*-Nitrosopiperidine	01/01/87
101-14-4	4,4'-Methylenebis(2-chloroaniline) (MBOCA)	01/01/87
101-61-1	4,4'-Methylenebis(*N*,*N*-dimethyl)benzenamine	01/01/87
101-68-8	Methylenebis(phenylisocyanate) (MBI)	01/01/87
101-77-9	4,4'-Methylenedianiline	01/01/87
101-80-4	4,4'-Diaminodiphenyl ether	01/01/87
103-23-1	Bis(2-ethylhexyl) adipate	01/01/87
104-94-9	*p*-Anisidine	01/01/87
105-67-9	2,4-Dimethylphenol	01/01/87
106-42-3	*p*-Xylene	01/01/87
106-44-5	*p*-Cresol	01/01/87

CAS No.	Chemical name	Effective date
106-46-7	1,4-Dichlorobenzene	01/01/87
106-50-3	*p*-Phenylenediamine	01/01/87
106-51-4	Quinone	01/01/87
106-88-7	1,2-Butylene oxide	01/01/87
106-89-8	Epichlorohydrin	01/01/87
106-93-4	1,2-Dibromoethane (Ethylene dibromide)	01/01/87
106-99-0	1,3-Butadiene	01/01/87
107-02-8	Acrolein	01/01/87
107-05-1	Allyl chloride	01/01/87
107-06-2	1,2-Dichloroethane (Ethylene dichloride)	01/01/87
107-13-1	Acrylonitrile	01/01/87
107-21-1	Ethylene glycol	01/01/87
107-30-2	Chloromethyl methyl ether	01/01/87
108-05-4	Vinyl acetate	01/01/87
108-10-1	Methyl isobutyl ketone	01/01/87
108-31-6	Maleic anhydride	01/01/87
108-38-3	*m*-Xylene	01/01/87
108-39-4	*m*-Cresol	01/01/87
108-60-1	Bis(2-chloro-1-methylethyl)ether	01/01/87
108-78-1	Melamine	01/01/87
108-88-3	Toluene	01/01/87
108-90-7	Chlorobenzene	01/01/87
108-95-2	Phenol	01/01/87
109-86-4	2-Methoxyethanol	01/01/87
110-80-5	2-Ethoxyethanol	01/01/87
110-82-7	Cyclohexane	01/01/87
110-86-1	Pyridine	01/01/87
111-42-2	Diethanolamine	01/01/87
111-44-4	Bis(2-chloroethyl) ether	01/01/87
114-26-1	Propoxur [Phenol, 2-(1-methylethoxy)-, methylcarbamate]	01/01/87
115-07-1	Propylene (Propene)	01/01/87
115-32-2	Dicofol [Benzenemethanol, 4-chloro-.alpha.-(4-chlorophenyl)-.alpha.-(trichloromethyl)-]	01/01/87
117-79-3	2-Aminoanthraquinone	01/01/87
117-81-7	Di(2-ethylhexyl) phthalate (DEHP)	01/01/87
117-84-0	*n*-Dioctyl phthalate	01/01/87
118-74-1	Hexachlorobenzene	01/01/87
119-90-4	3,3'-Dimethoxybenzidine	01/01/87
119-93-7	3,3'-Dimethylbenzidine (o-Tolidine)	01/01/87
120-12-7	Anthracene	01/01/87
120-71-8	*p*-Cresidine	01/01/87
120-80-9	Catechol	01/01/87
120-82-1	1,2,4-Trichlorobenzene	01/01/87
120-83-2	2,4-Dichlorophenol	01/01/87
121-14-2	2,4-Dinitrotoluene	01/01/87
121-69-7	*N,N*-Dimethylaniline	01/01/87
122-66-7	1,2-Diphenylhydrazine (Hydrazobenzene)	01/01/87
123-31-9	Hydroquinone	01/01/87
123-38-6	Propionaldehyde	01/01/87
123-72-8	Butyraldehyde	01/01/87
123-91-1	1,4-Dioxane	01/01/87
126-72-7	Tris-2,3-dibromopropyl) phosphate	01/01/87
126-99-8	Chloroprene	01/01/87
127-18-4	Tetrachloroethylene (Perchloroethylene)	01/01/87
128-66-5	C.I. Vat Yellow 4	01/01/87
131-11-3	Dimethyl phthalate	01/01/87
132-64-9	Dibenzofuran	01/01/87
133-06-2	Captan [1H-Isoindole-1,3(2H)-dione,3a,4,7,7a-tetrahydro-2-[(trichloromethyl)thio]-]	01/01/87
133-90-4	Chloramben [Benzoic acid, 3-amino-2,5-dichloro-]	01/01/87
134-29-2	*o*-Anisidine hydrochloride	01/01/87
134-32-7	alpha-Naphthylamine	01/01/87
135-20-6	Cupferron [Benzeneamine, N-hydroxy-N-nitroso, ammonium salt]	01/01/87
139-13-9	Nitrilotriacetic acid	01/01/87
139-65-1	4,4'-Thiodianiline	01/01/87
140-88-5	Ethyl acrylate	01/01/87
141-32-2	Butyl acrylate	01/01/87
151-56-4	Ethyleneimine (Aziridine)	01/01/87
156-10-5	*p*-Nitrosodiphenylamine	01/01/87
156-62-7	Calcium Cyanamide	01/01/87
302-01-2	Hydrazine	01/01/87
309-00-2	Aldrin[1,4:5,8-Dimethanonaphthalene,1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-(1.alpha.,4.alpha.,4a.beta.,5.alpha.,8.alpha.,8a.beta.)-]	01/01/87
334-88-3	Diazomethane	01/01/87
463-58-1	Carbonyl sulfide	01/01/87
492-80-8	C.I. Solvent Yellow 34 (Auramine)	01/01/87
505-60-2	Mustard gas [Ethane, 1,1'-thiobis[2-chloro-]	01/01/87
510-15-6	Chlorobenzilate[Benzeneacetic acid, 4-chloro-.alpha.-(4-chlorophenyl)-.alpha.-hydroxy-, ethyl ester]	01/01/87
532-27-4	2-Chloroacetophenone	01/01/87
534-52-1	4,6-Dinitro-*o*-cresol	01/01/87
540-59-0	1,2-Dichloroethylene	01/01/87
541-41-3	Ethyl chloroformate	01/01/87
541-73-1	1,3-Dichlorobenzene	01/01/87

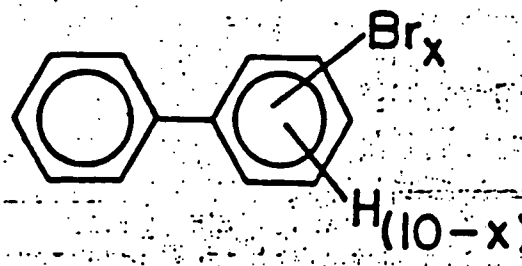
CAS No.	Chemical name	Effective date
542-75-6	1,3-Dichloropropylene	01/01/87
542-88-1	Bis(chloromethyl) ether	01/01/87
569-64-2	C.I. Basic Green 4	01/01/87
606-20-2	2,6-Dinitrotoluene	01/01/87
615-05-4	2,4-Diaminoanisole	01/01/87
621-64-7	*N*-Nitroso-*n*-propylamine	01/01/87
624-83-9	Methyl isocyanate	01/01/87
636-21-5	*o*-Toluidine hydrochloride	01/01/87
680-31-9	Hexamethylphosphoramide	01/01/87
684-93-5	*N*-Nitroso-*N*-methylurea	01/01/87
759-73-9	*N*-Nitroso-*N*-ethylurea	01/01/87
842-07-9	C.I. Solvent Yellow 14	01/01/87
924-16-3	*N*-Nitroso-*n*-butylamine	01/01/87
961-11-5	Tetrachlorvinphos [Phosphonic acid, 2-chloro-1-(2,4,5-trichlorophenyl)ethenyl dimethyl ester]	01/01/87
989-38-8	C.I. Basic Red 1	01/01/87
1120-71-4	Propane sultone	01/01/87
1163-19-5	Decabromodiphenyl oxide	01/01/87
1310-73-2	Sodium hydroxide (solution)	01/01/87
1313-27-5	Molybdenum trioxide	01/01/87
1314-20-1	Thorium dioxide	01/01/87
1319-77-3	Cresol (mixed isomers)	01/01/87
1330-20-7	Xylene (mixed isomers)	01/01/87
1332-21-4	Asbestos (friable)	01/01/87
1335-87-1	Hexachloronaphthalene	01/01/87
1336-36-3	Polychlorinated biphenyls (PCBs)	01/01/87
1344-28-1	Aluminum oxide	01/01/87
1464-53-5	Diepoxybutane	01/01/87
1582-09-8	Trifluralin [Benzeneamine, 2,6-dinitro-*N*,*N*-dipropyl-4-(trifluoromethyl)-]	01/01/87
1634-04-4	Methyl *tert*-butyl ether	01/01/87
1836-75-5	Nitrofen [Benzene, 2,4-dichloro-1-(4-nitrophenoxy)-]	01/01/87
1897-45-6	Chlorothalonil [1,3-Benzenedicarbonitrile,2,4,5,6-tetrachloro-]	01/01/87
1937-37-7	C.I. Direct Black 38	01/01/87
2164-17-2	Fluometuron [Urea, *N*,*N*-dimethyl-*N*'-[3-(trifluoromethyl)phenyl]-]	01/01/87
2234-13-1	Octachloronaphthalene	01/01/87
2303-16-4	Diallate [Carbamothioic acid, bis(1-methylethyl)-, *S*-(2,3-dichloro-2-propenyl)ester]	01/01/87
2602-46-2	C.I. Direct Blue 6	01/01/87
2650-18-2	C.I. Acid Blue 9, diammonium salt	01/01/87
2832-40-8	C.I. Disperse Yellow 3	01/01/87
3118-97-6	C.I. Solvent Orange 7	01/01/87
3761-53-3	C.I. Food Red 5	01/01/87
3844-45-9	C.I. Acid Blue 9, disodium salt	01/01/87
4549-40-0	*N*-Nitrosomethylvinylamine	01/01/87
4680-78-8	C.I. Acid Green 3	01/01/87
6484-52-2	Ammonium nitrate (solution)	01/01/87
7429-90-5	Aluminum (fume or dust)	01/01/87
7439-92-1	Lead	01/01/87
7439-96-5	Manganese	01/01/87
7439-97-6	Mercury	01/01/87
7440-02-0	Nickel	01/01/87
7440-22-4	Silver	01/01/87
7440-28-0	Thallium	01/01/87
7440-36-0	Antimony	01/01/87
7440-38-2	Arsenic	01/01/87
7440-39-3	Barium	01/01/87
7440-41-7	Beryllium	01/01/87
7440-43-9	Cadmium	01/01/87
7440-47-3	Chromium	01/01/87
7440-48-4	Cobalt	01/01/87
7440-50-8	Copper	01/01/87
7440-62-2	Vanadium (fume or dust)	01/01/87
7440-66-6	Zinc (fume or dust)	01/01/87
7550-45-0	Titanium tetrachloride	01/01/87
7647-01-0	Hydrochloric acid	01/01/87
7664-38-2	Phosphoric acid	01/01/87
7664-39-3	Hydrogen fluoride	01/01/87
7664-41-7	Ammonia	01/01/87
7664-93-9	Sulfuric acid	01/01/87
7697-37-2	Nitric acid	01/01/87
7723-14-0	Phosphorus (yellow or white)	01/01/87
7757-82-6	Sodium sulfate (solution)	01/01/87
7782-49-2	Selenium	01/01/87
7782-50-5	Chlorine	01/01/87
7783-20-2	Ammonium sulfate (solution)	01/01/87
8001-35-2	Toxaphene	01/01/87
10034-93-2	Hydrazine sulfate	01/01/87
10049-04-4	Chlorine dioxide	01/01/87
12122-67-7	Zineb [Carbamodithioic acid, 1,2-ethanediylbis-, zinc complex]	01/01/87
12427-38-2	Maneb [Carbamodithioic acid, 1,2-ethanediylbis-, manganese complex]	01/01/87
13463-67-7	Titanium dioxide	01/01/87
16071-86-6	C.I. Direct Brown 95	01/01/87
16543-55-8	*N*-Nitrosonornicotine	01/01/87

CAS No.	Chemical name	Effective date
20816-12-0	Osmium tetroxide	01/01/87
25321-22-6	Dichlorobenzene (mixed isomers)	01/01/87
25376-45-8	Diaminotoluene (mixed isomers)	01/01/87
39156-41-7	2,4-Diaminoanisole sulfate	01/01/87

(c) *Chemical categories in alphabetical order.*

Category name	Effective date
Antimony Compounds: Includes any unique chemical substance that contains antimony as part of that chemical's infrastructure	01/01/87
Arsenic Compounds: Includes any unique chemical substance that contains arsenic as part of that chemical's infrastructure	01/01/87
Barium Compounds: Includes any unique chemical substance that contains barium as part of that chemical's infrastructure	01/01/87
Beryllium Compounds: Includes any unique chemical substance that contains beryllium as part of that chemical's infrastructure	01/01/87
Cadmium Compounds: Includes any unique chemical substance that contains cadmium as part of that chemical's infrastructure	01/01/87
Chlorophenols	01/01/87
	
Where x = 1 to 5	
Chromium Compounds: Includes any unique chemical substance that contains chromium as part of that chemical's infrastructure	01/01/87
Cobalt Compounds: Includes any unique chemical substance that contains cobalt as part of that chemical's infrastructure	01/01/87
Copper Compounds: Includes any unique chemical substance that contains copper as part of that chemical's infrastructure	01/01/87
Cyanide Compounds: $X^+ CN^-$ where $X^+ = H^+$ or any other group where a formal dissociation can be made. For example KCN, or $Ca(CN)_2$	01/01/87
Glycol Ethers: Includes mono- and di- ethers of ethylene glycol, diethylene glycol, and triethylene glycol	01/01/87
$R-(OCH_2CH_2)_n-OR'$	
Where:	
n = 1, 2, or 3	
R = alkyl or aryl groups	
R = R' H, or groups which, when removed, yield glycol ethers with the structure:	
$R-(OCH)_{CH_3}-OR'$	
Polymers are excluded from this category.	
Lead Compounds: Includes any unique chemical substance that contains lead as part of that chemical's infrastructure	01/01/87
Manganese Compounds: Includes any unique chemical substance that contains manganese as part of that chemical's infrastructure	01/01/87
Mercury Compounds: Includes any unique chemical substance that contains mercury as part of that chemical's infrastructure	01/01/87
Nickel Compounds: Includes any unique chemical substance that contains nickel as part of that chemical's infrastructure	01/01/87

Category name	Effective date
Polybrominated Biphenyls (PBBs)	01/01/87



Where x = 1 to 10

Selenium Compounds: Includes any unique chemical substance that contains selenium as part of that chemical's infrastructure	01/01/87
Silver Compounds: Includes any unique chemical substance that contains silver as part of that chemical's infrastructure	01/01/87
Thallium Compounds: Includes any unique chemical substance that contains thallium as part of that chemical's infrastructure	01/01/87
Zinc Compounds: Includes any unique chemical substance that contains zinc as part of that chemical's infrastructure	01/01/87

Subpart E—Forms and Instructions

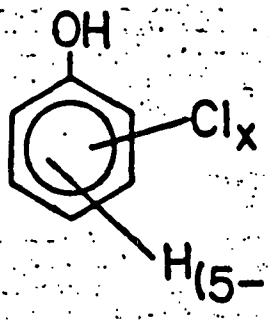
§ 372.85 Toxic chemical release reporting form and instructions.

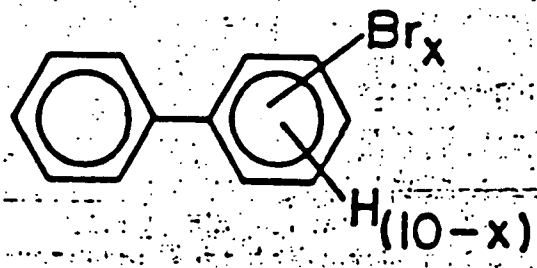
(a) *Reporting form.*

BILLING CODE 6560-50-M

CAS No.	Chemical name	Effective date
20816-12-0	Osmium tetroxide	01/01/87
25321-22-6	Dichlorobenzene (mixed isomers)	01/01/87
25376-45-8	Diaminotoluene (mixed isomers)	01/01/87
39156-41-7	2,4-Diaminoanisole sulfate	01/01/87

(c) *Chemical categories in alphabetical order.*

Category name	Effective date
Antimony Compounds: Includes any unique chemical substance that contains antimony as part of that chemical's infrastructure	01/01/87
Arsenic Compounds: Includes any unique chemical substance that contains arsenic as part of that chemical's infrastructure	01/01/87
Barium Compounds: Includes any unique chemical substance that contains barium as part of that chemical's infrastructure	01/01/87
Beryllium Compounds: Includes any unique chemical substance that contains beryllium as part of that chemical's infrastructure	01/01/87
Cadmium Compounds: Includes any unique chemical substance that contains cadmium as part of that chemical's infrastructure	01/01/87
Chlorophenols	01/01/87
	
Where x = 1 to 5	
Chromium Compounds: Includes any unique chemical substance that contains chromium as part of that chemical's infrastructure	01/01/87
Cobalt Compounds: Includes any unique chemical substance that contains cobalt as part of that chemical's infrastructure	01/01/87
Copper Compounds: Includes any unique chemical substance that contains copper as part of that chemical's infrastructure	01/01/87
Cyanide Compounds: $X^+ CN^-$ where $X^+ = H^+$ or any other group where a formal dissociation can be made. For example KCN, or $Ca(CN)_2$	01/01/87
Glycol Ethers: Includes mono- and di- ethers of ethylene glycol, diethylene glycol, and triethylene glycol	01/01/87
$R-(OCH_2CH_2)_n-OR'$	
Where:	
n = 1, 2, or 3	
R = alkyl or aryl groups	
R = R' H, or groups which, when removed, yield glycol ethers with the structure:	
$R-(OCH)_{(CH_3)}-OR'$	
Polymers are excluded from this category.	
Lead Compounds: Includes any unique chemical substance that contains lead as part of that chemical's infrastructure	01/01/87
Manganese Compounds: Includes any unique chemical substance that contains manganese as part of that chemical's infrastructure	01/01/87
Mercury Compounds: Includes any unique chemical substance that contains mercury as part of that chemical's infrastructure	01/01/87
Nickel Compounds: Includes any unique chemical substance that contains nickel as part of that chemical's infrastructure	01/01/87

Category name	Effective date
Polybromonated Biphenyls (PBBs)	01/01/87
	
Where x = 1 to 10	
Selenium Compounds: Includes any unique chemical substance that contains selenium as part of that chemical's infrastructure	01/01/87
Silver Compounds: Includes any unique chemical substance that contains silver as part of that chemical's infrastructure	01/01/87
Thallium Compounds: Includes any unique chemical substance that contains thallium as part of that chemical's infrastructure	01/01/87
Zinc Compounds: Includes any unique chemical substance that contains zinc as part of that chemical's infrastructure	01/01/87

Subpart E—Forms and Instructions

§ 372.85 Toxic chemical release reporting form and instructions.

(a) *Reporting form.*

BILLING CODE 6560-50-M