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Manual of Instructions for Preparing Aquatic Life Water Quality Criteria Documents

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CONTENTS

I. Introduction

The "Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses" (Stephan et al. 1985), hereinafter referred to as the Guidelines, describe the technical aspects of deriving aquatic life water quality criteria. The purpose of this "Manual of Instructions for Preparing Aquatic Life Water Quality Criteria Documents," hereinafter referred to as the Manual, is to describe other aspects of the preparation of an aquatic life water quality criteria document, such as format, editorial practices, etc.

Although this manual is intended to deal with non-technical aspects of aquatic life criteria documents, some repetition of material that is in the Guidelines is unavoidable. In addition, some technical information that was not in the Guidelines is presented herein, and some clarifications and modifications of material in the Guidelines are presented. As stated on pages 18 and 57 of the Guidelines, good science is more important than blind adherence to the Guidelines. The technical additions, clarifications, and modifications presented in this manual are felt to be examples of "good science" and will be proposed for incorporation into the next version of the Guidelines.

Information is presented here in an order that approximates an idealized order of activities in the preparation of a criteria document. First, a literature search is conducted and copies of all potentially useful material are obtained. Second, all the material is read, each datum is classified, and data are put in Tables 1, 2, 4, 5, and 6 as appropriate. Third, Table 3 is prepared and criteria are calculated. Fourth, the text is written. Fifth, the reference section is prepared. Sixth, the draft criteria document is typed, proofed, and corrected. Seventh, the draft document is sent to

Criteria and Standards Division, U.S. EPA, Washington, DC and an announcement is placed in the Federal Register that the document is available for public comment. Eighth, after the end of the public comment period, the public comments are read, and the draft criteria document is revised as appropriate. Finally, the final version of the criteria document is sent to Criteria and Standards Division, which submits it to NTIS and places an announcement in the Federal Register. Of course, no criteria document has yet been prepared in this manner.

II. Obtaining Data

A. Sources of References

Some of these sources will not provide any useful references, but they should all be checked just to be sure. Other references will probably be obtained in unexpected ways.

1. AQUIRE
   - will be searched using the program AQLIST when work on the criteria document begins and again for new references near the end of the public comment period.
2. Bibliographic Retrieval Services (BRS)
   - BIOZ, NTIS, DISS, CHEB, and CHEM will be searched when work on the criteria document begins and again for new references near the end of the public commend period.
3. Office of Pesticides Programs - only for chemicals that are or were registered as pesticides with U.S. EPA.
4. McKee, J.E. and H.W. Wolf. 1963. Water quality criteria. 2nd ed. Publication No. 3-A. State Water Quality Control Board, Sacramento, CA.
5. Green Book, Blue Book, Red Book, and AFS review of the Red Book.
6. Ambient water quality criteria documents published by U.S. EPA in 1980, 1984, and 1985, if one was published on the same chemical.
7. Annual reviews in the June issues of the Journal of the Water Pollution Control Federation.
8. Monthly checks of new issues of major journals concerning aquatic toxicology in the library from the beginning of work on the criteria document at least to the end of the public comment period.
9. The lists of references in documents obtained for possible use in the criteria document.
10. Comments received during the public comment period.

B. Selecting References

Although most the references obtained from some sources, such as AQUIRE, should be pertinent, many of the references obtained from other sources, such as BRS, will not be pertinent. To prevent the expenditure of too much time and money obtaining documents that will be rejected anyway, the printouts from BRS, as well as the lists of documents obtained from some other sources, should be screened carefully using the following guidelines for selecting documents to be borrowed, purchased, and/or photocopied.

1. Obtain a copy of each document that contains data on toxicity to or uptake by North American aquatic species.
2. It is generally not worthwhile to obtain a copy of a document that:
   a. only contains data on nonresident species, unless there is some reason to believe that the data are especially interesting.
   b. merely reports on methods for measuring the concentration of the pollutant in aquatic organisms, unless there is some reason to believe that the reference also contains useful data on concentrations in aquatic organisms.
   c. only contains data on the concentration of the pollutant in water, sediment, etc.
   d. only contains experimental data on the fate of the pollutant.
3. Obtain copies of documents that are not too difficult to obtain and appear to be major reviews on the fate, chemistry, sources, etc. of the pollutant and appear to be worth mentioning in the Introduction.
4. When in doubt, obtain copies of references that are in English and can be obtained easily and cheaply. Do not bother to obtain copies of marginal references that are not in English and are difficult to obtain or must be purchased because such documents rarely contain useful data.

5. Documents that are in a foreign language and contain important data, such as results of chronic tests with North American species, are always worth purchasing and having translated if necessary.

C. Photocopying

In the long run it will be beneficial to make photocopies of all selected documents that are less than about 30 pages long and to keep these in your office so they are readily available whenever needed. Even rejects should be kept in a reject file, rather than being discarded. When a portion of a book is used, that portion should be photocopied, along with the title page, so that information is readily available concerning titles, editors, publishers, etc.

III. Defining the Pollutant

Most criteria documents should deal with, and contain criteria for, only one pollutant. Criteria documents that deal with more than one pollutant are unnecessarily difficult to write and to read.

A. Each organic chemical should be a separate pollutant except that:

1. an organic acid and its potassium and sodium salts;
2. a phenol and its potassium and sodium salts;
3. an amine and its hydrochloride, nitrate, and sulfate salts;
4. structurally similar organic chemicals that only exist in large quantities as commercial mixtures of the various chemicals and apparently have similar biological, chemical, physical, and toxicological properties, such as PCBs and toxaphene.

B. For metals such as cadmium, copper, and zinc, only data from tests on the chloride, nitrate, and sulfate salts (either anhydrous or hydrated) should be used. Other metals require special consideration on an individual basis. Most mercury is discharged and exists in surface water as the mercuric ion, but the problems are mostly caused by methylmercury that is formed by biomethylation. Chromium exists as the cation Cr(III) and as anions of Cr(VI); it is very unlikely that these two oxidation states are environmentally or toxicologically interchangeable, so they should be treated as two separate pollutants. On the other hand, selenium exists in surface water mainly as anions of both selenium(IV) and selenium(VI); it seemed appropriate and advantageous to treat both oxidation states of selenium in the same criterion document.

C. For chloride, it is necessary to consider the associated cation.

D. Many pesticides are used and disposed of as technical (commercial, use)-grade materials that contain related impurities. It is certainly

desirable to have data that show that such materials have about the same toxicity and bioconcentration factor, on the basis of the active ingredient, as the active ingredient itself. Even if such data are not available, use of data on technical-grade materials is usually acceptable. On the other hand, toxicity and bioconcentration data on formulations, emulsifiable concentrates, and commercial products should be used only if data show that the toxicity, on the basis of the active ingredient, is about the same as that of the active ingredient itself.

Sometimes data in the literature will be very helpful for deciding how to define the pollutant or for deciding which salts provide pertinent data. Thus before defining the pollutant and deciding which salts, formulations, etc. to use, it is usually wise to check the literature to see which salts, formulations, etc. have been tested and to see what data are available concerning the relative toxicity and bioconcentration of the salts, formulations, etc.

IV. Selecting and Evaluating Data

A. Classes of Data

All data obtained for a criteria document must be placed into one of four classes:

1. Data used in Tables, 1, 2, 4, and 5. These are good quality, pertinent data. (Note: The numbers used herein to refer to tables will assume that the criteria document contains all six possible tables.)
2. Data used as "other data," in either the text or Table 6 or both. These are good data, but do not satisfy one or more of the requirements for Tables 1, 2, 4, or 5. Some "other data" might be mentioned in the text on acute or chronic toxicity, toxicity to plants, or bioaccumulation, but not also mentioned in either Table 6 or in the section of the text titled "Other Data."
3. Data included in the section of the text titled "Unused Data," along with a brief explanation as to why they were not used. This section does not have to be exhaustive.
4. Rejected data. These are data that are not mentioned in the criteria document at all for one reason or another.

Each individual datum must be placed in one of these four classes. Some publications might contain data in more than one class. For example, a publication that contains LC50s for four species might contain one LC50 that goes in Table 1, another that goes in Table 6 (possibly because the acute test with this second species was too short for Table 1), one that goes in the section on unused data because control mortality was to high for the third species, and a fourth that is rejected because the species is not resident. (This fourth LC50 could be mentioned in "unused data" if desired.)

There will be a choice as to where to place some data:

1. Some data might go either in Table 6 or in Tables 1, 2, 4, or 5 with a footnote. (Note: Each datum in Table 6 should have enough information with it, preferably not in a footnote, to indicate why it is not in Tables 1, 2, 4, or 5. The reason might be the form of the test material, duration of the test, etc. However, in some cases, if the data are otherwise acceptable but cannot be used in calculations, such as because they are "greater than" or "less than" values or because hardness was not reported for a test on a metal, the data should usually be placed in Table 1, 2, 4, or 5 and footnoted if necessary.
2. If a datum might be placed in either "other data" or "unused data," it is usually wiser to opt for "other data."
3. If a datum might be either "unused" or "rejected," it is often preferable to opt for "unused."

Note: Some data are rejected rather than being used as other data or being put in the section on unused data just because here are so many data available for the pollutant that it is not considered worthwhile to try to include all possible data in the criteria document. For pollutants for which only a few data are available, both "Other Data" and "Unused Data" can be exhaustive without the sections becoming very long.

Usually, data should not be used from secondary sources, but such sources should be searched for primary publications that contain pertinent first-hand data. Reviews are treated in two different ways, depending on the subject:

1. Reviews that deal with such subjects as the fate or analytical chemistry of a pollutant should be used in the Introduction or rejected.
2. Reviews that deal with effects on aquatic organisms should usually be included in the section on "Unused Data" because they are compilations.

However, a review article that contains much data that could go in Table 6, such as a review of the physiological effects of zinc on fishes, might be mentioned in the text on "Other Data" without putting the individual data in Table 6.

Data must be rejected if they are not available in typed, dated, and signed hard copy (publication, manuscript, letter, memorandum, etc.) with enough supporting information to indicate that acceptable test procedures were probably used and that the results are probably reliable. Although it is preferable that data be peer-reviewed and published, it is much more important that the data be good quality and pertinent. (Peer-reviewed data are not necessarily good and some good data have not been published.) In some cases it might be appropriate to obtain additional written information from the investigator if possible.

Information that is confidential or privileged or otherwise not available for distribution should not be used. Data that are in the files of the Office of Pesticide Programs of the U.S. EPA and concern the environmental effects of pesticides are not legally confidential Many data that are generated and submitted by manufacturers concerning environmental toxicology are stamped "confidential," but can be legally obtained and used if one goes through the procedures established by the Office of Pesticide Programs. This should be done whenever a criteria document is prepared on a pesticide.

B. General Rules

1. Data not pertaining directly to the pollutant of interest usually should be rejected. On the other hand, data demonstrating relationships or data on similar pollutants might be useful in the text in some cases.

2. Data not obtained with resident North American species (see Appendix I of National Guidelines) should usually be either in the section on unused data or rejected. Most should be rejected, but a few might be mentioned in the section on unused data as examples. Particularly interesting data, such as data on the effect of hardness on toxicity, might be discussed in the appropriate place in the text.
3. Data should be in the section on unused data if the scientific name is not given and the test organisms were not obtained from a wild population in North America.
4. If the organisms were obtained from a wild population in North America but the scientific name is not given, the data may be used in Tables 4, 5 and 6, but may not be used in Tables 1 or 2 unless the organisms are identified to genus.
5. Data calculated for a group of test organisms that included organisms from more than one genus should be other data, if they are otherwise acceptable. (This does not apply if different genera are exposed together but results are calculated for each individual genus or species.)
6. Data from tests in which the test species was brine shrimp should be in the section on unused data.
7. Data from tests which used test organisms that had been previously exposed to substantial concentrations of the pollutant or to other pollutants in water or food should usually be in the section on "other data" to show the effect of prior exposure on sensitivity to the pollutant.
8. Data from tests which are not adequately described should be in the section on unused data if source of test organisms, acclimation, or duration of the exposure is not stated.

9. Data from tests on drilling muds, effluents, mixtures, and sludges should be in the section on unused data.

10. Data from tests in which the organisms were exposed to sediment to which the pollutant had been added or from tests in which the pollutant was added to the dilution water but sediment (whether clean or contaminated) was placed in the test chambers should be in the section on unused data, unless the concentration of pollutant in the test solution was measured and the concentration of particulate matter and the concentration of total organic carbon (TOC) in the test solution were each less than 5 mg/L (see #23 below).

11. Data from tests on formulated mixtures and emulsifiable concentrates should be in the section on unused data unless data are available to show that, based on active ingredient, tests on these materials give the same results as tests on the individual pollutant. Tests on technical-grade (or use-grade or commercial-grade) materials may be put in Tables 1, 2, 4, and 5 if otherwise acceptable.

12. Data from tests on materials that are less than 80% pure should usually be in the section on unused data, unless (a) the impurities are known to be much less toxic than the chemical of interest or (b) data are available to show that, based on active ingredient, tests on the impure material give the same results as tests on the pure chemical.

13. Data from tests in which the test organisms were exposed to the pollutant by injection or gavage should be in the section on unused data.

14. Data from tests in which test organisms were exposed by adding the pollutant to food should usually be other data, especially if they

can be used to show whether uptake (and probably resultant effects) from food adds to uptake (and possibly resultant effects) from water.

15. If approved by the Guideline Committee, data on some highly biodegradable, hydrolyzable, oxidizable, reducible, or volatile materials should be in the section on unused data if they are not from flow-through tests in which the concentrations of test material in the test solutions were measured often enough using acceptable analytical methods.

16. For most metals and metalloids, data for only a few salts can be put in Tables 1, 2, 4, and 5 and data for all other salts will either be in the section on other data, or be in the section on unused data, or be rejected. For metals such as cadmium, chromium(III), copper, lead, mercury, nickel, and zinc, only data for chloride, nitrate, and sulfate salts (either anhydrous or hydrated) will be in Tables 1, 2, 4, and 5. Data for other salts of these metals, such as copper sulfide, copper acetate, copper phosphate, copper-EDTA, and copper ammonium sulfate will be other data. For most oxidation states of metals and metalloids that exist as oxyanions, such as arsenic(III), arsenic(V), chromium(VI), and selenium(IV), and selenium(VI), only data for the acid forms or the potassium and sodium salts will be in Tables 1, 2, 4, and 5. Data for chemicals such as lead arsenate will usually be in the section on other data.

17. Data from tests in which enzymes, excised or homogenized tissue, or cell cultures from resident North American aquatic species were exposed to test material should be in the section on unused data.

18. Data obtained in tests which did not have a control treatment should be in the section on unused data.

19. Data obtained in tests in which too few test organisms were used should be in the section on unused data.
20. Data obtained in tests in which too many organisms died in the control treatment should be in the section on unused data.
21. Data from tests in which the test organisms were cultured or held in one water and tested in another without proper acclimation should be in the section on unused data.
22. Data obtained in tests in which distilled or deionized water was used as the dilution water without addition of appropriate salts should be in the section on unused data.
23. Data from tests which were conducted in a dilution water that contained unusual amounts or ratios of inorganic ions should be in the section on unused data.
24. Data from tests which were conducted in a dilution water that contained more than 5 mg of TOC/L or 5 mg of particulate matter/L should be in the section on other data with a comment such as "high TOC" in parentheses, unless a relationship is developed between TOC or particulate matter and toxicity or unless data show that TOC and/or particulate matter do not affect the toxicity or bioavailability of the test material.
25. Data from tests in which an organic solvent that is not water-miscible or a surfactant was used in the preparation of a stock solution or test solution should be in the section on unused data; such data might be used in the section on other data to show a relationship between the solvent or surfactant and toxicity.
26. Data obtained by exposing aquatic organisms to concentrations of test material that exceed the solubility of the material in water usually

should be considered qualitative rather than quantitative data. These and values that are reported as "greater than" or "less than" values can be placed in Tables 1, 2, 4, or 5 if they are otherwise acceptable.

27. Data from tests or field exposures in which the concentration(s) of test material fluctuated substantially, e.g., the highest concentration was more than 5 times (depending on the test material) the lowest concentration, should be in the section on unused data unless the data can be used to compare the effects of exposure to constant and fluctuating, including intermittent, concentrations.
28. Data that are only presented graphically should be placed in Tables 1, 4, or 6 if they are otherwise acceptable. An LC50 obtained from a graph, such as from a plot of LC50 vs. time, that is in Table 1 and is for one of the four most sensitive genera, probably should be footnoted and not used in any calculations.
29. The result of an exposure to only one concentration of test material should be placed in Tables 1, 2, 4, 5, and 6 if it is otherwise acceptable.

C. Acute Toxicity to Animals

1. Data from acute tests in which more than 10% of the control organisms died or showed signs of stress or disease should be in the section on unused data. With the approval of the Guideline Committee, more than 10% mortality might be acceptable for some species such as copepods.
2. Results of tests with single-celled animals should be in the section on other data, even if the duration was 96 hours or more.

3. Data from acute tests in which young were produced should be in the section on unused data if the young and adults cannot be distinguished at the end of the test.

4. Data from acute tests in which a water-miscible solvent was used in the preparation of a stock solution or test solution and its concentration in the test solution exceeded 0.5 mL/L should be in the section on unused data, unless the data are used to show the effect of the solvent on toxicity.

5. For most species the only acceptable acute values are 96-hr LC50s and properly defined 96-hr EC50s. For (a) freshwater daphnids, other cladocerans, and midges, (b) saltwater mysids, and (c) embryos and larvae of saltwater barnacles, bivalve molluscs (clams, mussels, oysters and scallops), sea urchins, lobsters, crabs, shrimps, and abalones, the EC50s and LC50s can be for 48 to 96 hours. Usually, acute values for shorter test durations should be in the section on other data. However, if otherwise acceptable LC50s are published for 24, 48, 72, and 96 hours from one test, the 96-hr LC50 should be placed in Table 1 and other values should be ignored, unless it seems important to mention the ratio of the values for two particular durations. LC50s and EC50s for longer durations might be in the section on other data or might be ignored if they are from the same test as a value in Table 1.

6. An EC50 should be used in Table 1 only if it reflects the total severe acute adverse impact of the test material on the organisms used in the test. Therefore, with freshwater daphnids, other cladocerans, and midges, the EC50 should be based on the percentage of organisms immobilized plus the percentage of organisms killed.

With embryos and larvae of saltwater barnacles, bivalve molluscs, sea urchins, lobsters, crabs, shrimps, and abalones, the EC50 should be based on the percentage of organisms with incompletely developed shells plus the percentage of organisms killed. With all other freshwater and saltwater animal species the EC50 should be based on the percentage of organisms exhibiting loss of equilibrium, plus the percentage of organisms immobilized, plus the percentage of organisms killed. If such an EC50 is not available from a test, the LC50 should be used, if available.

7. Data from acute tests during which the organisms were fed should be in the section on other data, although four exceptions are allowed:

   a. If the test organisms will be severely stressed if they are unfed for 96 hours, either the organisms may be fed a diet that will support survival, growth, and reproduction during a 96-hr test or the test may last only 48 hours with no food. The option which gives the lower acute value is preferable. Because some daphnid foods substantially decrease the toxicities of some metals to daphnids, acute tests with daphnids are usually conducted for 48 hours with no food.

   b. Although feeding during acute tests should be discouraged, results of 96-hr acute tests with saltwater polychaetes should be put in Table 1 even if the organisms were fed during the test. Polychaetes do not have to be fed during a 96-hr test, but most 96-hr values have been obtained as part of a longer exposure in which the organisms were fed from the beginning.

c. Organisms may be fed during acute tests if data are available to show that the concentration or amount of food used does not affect the result of the test.

d. Saltwater mysids should be fed during acute tests and the tests should last for 96 hours.

Note: If otherwise acceptable, an EC50 or LC50 should not be kept out of Table 1 just because it is a "greater than" or "less than" value.

D. Chronic Toxicity to Animals

1. Although life-cycle and partial life-cycle tests can theoretically be conducted with any aquatic animal species, early life-stage tests can be considered to provide useful chronic data only with fishes at the present. The durations of all three tests are dependent on the test species. Thus, for example, although life-cycle tests with Daphnia magna must last at least twenty-one days, life-cycle test with ceriodaphnids do not necessarily have to last for twenty-one days.

2. Data from chronic tests in which too many (usually 20%) of the control organisms died or showed signs of stress or disease (or did not reproduce in a life-cycle or partial life-cycle test) should be in the section on unused data. However, some life-cycle tests with fish that are unacceptable might provide acceptable data for an early life-stage test.

3. Data from chronic tests that were not renewal or flow-through should be in the section on unused data.

4. Data from chronic tests during which the concentrations of test material in the test solutions were not measured adequately and data

that were not calculated based on measured concentrations should be in the section on other data. (Note: It is not enough to measure the concentration of test material in the stock solution(s); measurements must be made on samples of test solutions.)

Note: If otherwise acceptable, the result of a chronic test should not be kept out of Table 2 just because it is a "greater than" or a "less than" value.

E. Toxicity to Plants

1. Data from tests with algae that are not known to have lasted for at least 96 hours should be other data.
2. Data from tests on metals in which the medium contained an excessive amount of EDTA or similar complexing agent (for example, more than 200 ug/L) should be in the section on unused data.

Note: If otherwise acceptable, the result of a test with a plant species should not be kept out of Table 4 just because it is a "greater than" or a "less than" value.

F. Bioaccumulation

1. Data from bioconcentration tests that were not renewal or flow-through should be in the section on unused data.
2. Data from bioconcentration tests during which the concentrations of test material in the test solutions were not measured adequately should be in the section on unused data. (Note: It is not enough to measure the concentration of test material in the stock solution(s); measurements must be made on samples of test solutions.)

3. Data from bioconcentration tests with a duration of less than 28 days should be in the section on other data, unless data show that steady-state had been reached.

4. Data from bioconcentration tests in which more than ten percent of the control organisms died or showed signs of stress or disease should be in the section on unused data. If data on bioconcentration are obtained by analyzing organisms from a life-cycle, partial life-cycle, or early life-stage test, the data should be in the section on unused data if the organisms were unacceptably affected during the test. Data from a test concentration which affected the test organisms can be put in Table 5 if the bioconcentration factor is similar to those obtained at lower concentrations of the test material.

5. Bioaccumulation factors (BAFs) may be calculated from organisms collected in the field if:

   a. the concentration of pollutant was measured in tissue,

   b. the concentration in the water was measured often enough over a long enough period of time over the range of territory inhabited by the species, and

   c. the concentration in water did not vary too much.

   It is being found for more and more pollutants that BAFs determined in the field are substantially higher than BCFs determined in the laboratory. This should probably be suspected for all pollutants that are persistent, e.g., metals, metalloids, organometallics, and highly chlorinated organic chemicals. Field data should not be expected to satisfy the same requirements as laboratory data, but field data should not be unconditionally accepted either

6. Only data for total soft tissue of bivalve molluscs, whole body or muscle of other animals, and whole plants should be in Table 5. BCFs and BAFs for other tissues may be used in the section on other data, but are usually rejected.

Note: BCFs determined using radiolabled materials are acceptable, except that with degradable organic chemicals, the identity of the material in the tissue must be verified.

G. Other Data

Topics that might be discussed in the section on other data or at another place in the text include:

a. synergism and antagonism
b. acclimation and other effects of prior exposure
c. intermittent exposures and fluctuating concentrations
d. effects on protozoa (amoeba, paramecia, tetrahymena, bacteria, fungi, etc.)
e. delayed effects, i.e., effects that occurred after the end of the exposure.
f. field studies, if the concentrations in water were adequately measured.
g. behavioral, biochemical, histological, and physiological effects
h. carcinogenicity, mutagenicity and teratogenicity
i. microcosm studies
j. results obtained in unusual dilution waters
k. results of exposures by consumption of contaminated food.

V. Reading the Literature

With a little experience, it should be possible to completely process most documents during the first reading. One advantage of a dedicated copy of each document is that notes and calculations may be written on the copy. If you do not write notes and calculations on photocopies, you will often wish you had if you ever reexamine the document. Anyone else who tries to use the document later for the same or a different pollutant will usually feel that notes and calculations are invaluable.

In order to avoid wasting too much time, it is important that the pollutant be defined well as early as possible (see Section III). If information that requires a change in the definition is found, the change should be made and necessary documents reread.

If the whole document is to be rejected, simply write "Reject" and the reason on the first page and put the document in the "Reject File" (not in the garbage can.)

If the whole document is to be put in the section on unused data, write "Unused" and the reason on the first page and put the document in the "Unused File." If only some of the data are to be in the unused section, make a note on a separate piece of paper and put the note in the "Unused File."

If the document is to be used in the Introduction, write on the first page what is to be said in the Introduction and put the document in the "Introduction File."

If the document contains data that are to be put in Tables 1, 2, 4, 5, or 6, fill out the appropriate blank table forms (see Appendix 1), file the forms, and put the document in the file of documents that will be included in the criteria document.

Notes should be kept for each section of the text to identify such things as data in Table 6 that should be mentioned in the text concerning "Acute Toxicity to Aquatic Animals."

Documents that go in the section on unused data and those mentioned in the Introduction will probably have to be handled briefly a second time when these sections are prepared. All documents will have to be processed again when the reference section is prepared. Also, the documents will have to be handled again when the tables and references are proofed against the documents.

VI. Format for Citations

The name-and-year system will be used for citations in the text and tables:

One author: (Hansen 1978) or Hansen (1978)

Two authors: (Chapman and Hansen 1980) or Chapman and Hansen (1980)

Three authors: (Hansen et al. 1981) or Hansen et al. (1981).

Whenever this system does not uniquely identify a reference, use an a, b, etc., after the year, according to the order in which they appear in the list of references, even if the documents are by different authors.

If two or more citations are together in the text, they should be put in alphabetical order and separated with a semicolon because:

1. The references will be in alphabetical order, and
2. This allows use of a condensed form in some situations: (Chapman and Garton 1979a,b,1981,Manuscript; Hansen et al. 1978,1980) or "Chapman and Garton (1979a,b,1981,Manuscript). Hansen et al. (1978,1980). . ."

Multiple citations for a datum in a table should be in historical order.

For manuscripts, the form for citations will be "Chapman, Manuscript" or "Chapman and Stevens, Manuscript" or "Chapman et al. Manuscript". Because they are vague or often misused, phrases such as "in press" and "in preparation" should not be used. Also, "personal communication" should not be used; "letter" or "memorandum" should be used as appropriate.

Notes:
1. Spell out "and" between two authors.
2. Do not use a comma between the first author and "et al." in either the text or the tables.
3. Diacritical marks will not be used in authors' names, but apostrophies will, e.g., Danil'chenko.

VII. Preparation of Tables

A. General

1. When initially preparing tables for typing, use copies of the blank tables in Appendix 1. On each page put only one species from one reference so the data can be easily put in proper order for typing.
2. The column for "Chemical" on Tables 1, 2, 4, 5 and 6 will be used for almost all inorganic and ionizable organic pollutants and for many pesticides. It will rarely be used for other pollutants. In some cases abbreviations may be used for the name of the chemical, e.g., PCP and NaPCP for pentachlorophenol and sodium pentachlorophenate, respectively.
3. The column for "Hardness" on Tables 1, 2, 4, 5 and 6 should be used for all pollutants in fresh water. In salt water it should be replaced by "Salinity (g/kg)." For ionizable organics both hardness and salinity should be replaced by "pH."
4. Unless approved by Charles Stephan, only animal species listed in Appendix I of the National Guidelines may be used. (The purposes of this requirement are to ensure that the status of each new species is verified, that Appendix I is kept up to date, and that new species are only verified once.) The order of species and the scientific and common names listed in Appendix I must be used in Tables 1, 2, 5, and 6. In Table 3 the correct common and scientific names must also be used and species must be in alphabetical order within a genus.
5. Each concentration transcribed from publications, etc., should contain all the digits presented by the original authors except that the concentration should be rounded to four significant digits if the author gave more than four. All values calculated in the criteria

document, such as SMAVs, GMAVs, slopes, FAVs, ACRs, etc., should be presented to four significant digits.

6. When data have been published in more than one source by the original author(s), the replicate citations will be listed in order of year of publication. Do not use a comma before or after "et al." When there are two authors, spell out "and" between their last names.

B. Table 1

1. If such information is available, give the age, size, or life stage of the test organisms in parentheses after the common name in the column for "Species." (Life stage should be singular, e.g., embryo, not embryos.)
2. Use S, R, F, M, and U as abbreviations for static, renewal, flow-through, measured, and unmeasured, respectively, in the column for "Method."
3. For each species, list the results of tests that are not "F,M" in order by year of first publication from earliest to latest with manuscripts last, and then list the results of tests that are "F,M" in order by year of first publication.

C. Table 2

D. Table 3

1. Give both the common and scientific names, but do not specify age, size, or life stage.

E. Table 4

1. Use LC50, EC50, etc., for the effect when the concentration was statistically calculated. If the result is an actual percent dead or

percent affected in a treatment, give the percent, exposure concentration, and duration.

2. Whenever EC50, etc., is used as the effect, give the actual effect in parentheses underneath "EC50" in the column for "Effect."
3. Within a species, put data in order by year of publication from the earliest to latest with manuscripts last.

F. Table 5

1. If it is a field study, refer to a footnote in the column for either "Duration" or "Effect."
2. The columns for "Percent Lipids" and "Normalized BCF or BAF" should be used only for organic chemicals and should be deleted for all other chemicals.

G. Table 6

1. Use LC50, EC50, etc., for the effect when the concentration was statistically calculated. If the result is an actual percent dead or percent affected in a treatment, give the percent, exposure concentration, and duration.
2. Whenever EC50, etc., is used as the effect, give the actual effect in parentheses underneath "EC50" in the column for "Effect."
3. Within a species, put data in order by year of publication from earliest to latest with manuscripts last.
4. In the column for "Duration," use "hr" as the abbreviation for both "hour" and "hours." Similarly, use "wk" for "week" and "weeks" and "mo" for "month" and "months." Do not abbreviate either "day" or "days."

VIII. Preparation of Text

A. Introductory Pages

Use the 1987 criteria document for 1,2,4-trichlorobenzene as a prototype and make only changes that are absolutely necessary on pages i to vi.

B. Introduction

The first, and possibly a second, paragraph should discuss any items that are important for understanding the aquatic toxicology of the pollutant or the particular criteria document. Published information on sources, fate, speciation, concentrations in pristine and other waters, etc., might be mentioned, but extensive discussions of such topics should be avoided. For priority pollutants (i.e., the list of 65), the Introduction should contain a reference to Callahan et al. (1979). The Introduction should not contain Guideline terminology such as "Final Acute Value."

Documents on metals and metalloids will contain a nearly standard discussion of "acid-soluble."

The last paragraph of the Introduction should be changed only as absolutely necessary.

C. Acute toxicity to Aquatic Animals

The first sentence of this section is a format sentence.

Data that are adequately presented in Table 1 should not be unnecessarily also presented in the text. Generally data should only be presented in the text if they are used to make a point. It is usually possible to say that the range of sensitivities of invertebrates completely overlaps that of fishes, but this is not suprising because the fishes are all in one class whereas the invertebrates are from a number of phyla.

It is generally best to discuss anything especially unusual or interesting and then discuss things that have been shown to affect acute toxicity. There is a format paragraph for discussing the derivation of a slope based on hardness or pH.

The last paragraph of the discussion of acute toxicity to freshwater animals is a format pargraph. It discusses calculation of Species Mean Acute Values, Genus Mean Acute Values, the Final Acute Value, the range of GMAVs, the agreement between SMAVs in the same Genus, and the relationship between the FAV and the lowest SMAVs in Table 3. If the FAV was lowered to protect an important species, say so.

D. Chronic Toxicity to Aquatic Animals

The first sentence of this section is a format sentence.

It is usually desirable to discuss each test individually and state the observed percent reduction in survival, growth, and reproduction at the upper and lower chronic limits. Then discuss the acute chronic ratios, the derivation of the Final Acute-Chronic Ratio and the calculation of the Final Chronic Value. Briefly discuss the relationship between the FCV and the chronic values in Table 2 and any especially pertinent chronic data in Table 6.

E. Toxicity to Aquatic Plants

F. Bioaccumulation

G. Other Data

H. Unused Data

The purpose of the section on "Unused Data" in the criteria document is to explain why certain data were not used. If this section is to be useful, the reasons given must be valid, specific, and stated clearly. The reasons listed below are used in so many documents that format sentences can be used and it is only necessary to fill in the names of the references. It is not necessary to make the list of unused references as comprehensive as possible. For many of the reasons, especially the first (i.e., nonresident species), it is only necessary to list examples. Blanks forms for the major sixteen reasons are given in Appendix 2. These sixteen reasons are numbered in the order in which they should usually be used in the section on "Unused Data" in the text of the criteria document. Usually two or more of them can be combined into one paragraph.

Use of these format sentences will greatly facilitate combining the freshwater and saltwater components of the section on unused data.

Of course, whenever appropriate, references can be listed as unused for additional reasons, and placed in the text of this section where appropriate, but the reasons must be specific and clearly stated. The first half of reason #1 will always be at the beginning of the section on "Unused Data," even if no specific references are cited, in order to at least remind readers of this major reason.

When two or more references are cited together, they should be in the same order that they are in in the reference section, not in order by year of publication.

The easiest way to deal with the bulk of the references mentioned in the section on unused data is to make photocopies of the pages in Appendix 2 and cite each publication where appropriate the first time it is read. Before the

text is given to the typist, all the references on each page (or each section of pages that contain two or more sections) should be put in proper order.

Some reasons that might cause data to be put in the section on "Unused Data" are not valid. Data from acute and bioconcentration tests that are too short should be put in Table 6. Results that are presented graphically can often be used. The possibility of isotopic discrimination is not a valid reason for not using bioconcentration data.

I. Summary

The Summary must be capable of standing alone, i.e., it must be understandable if removed from the criteria document. It should be a concise summary of what is known about the effects of the pollutant on aquatic organisms and their uses. The summary should not contain any references or Guideline terminology. The summary should be written in the present tense as much as possible.

J. National Criteria

The standard version of the criterion statement is presented in the National Guidelines. Modifications are necessary if the CMC or CCC or both are the same (see criteria document for aluminum). The 1985 criterion statement for mercury is a special non-standard format. The concentration given in the criterion statements should be rounded to two significant digits.

Caveats should be added to the criterion statement in some situations:

1. If data for a commercially or recreationally important species indicate that the species might not be adequately protected by the criterion, but the data do not justify lowering the criterion (for

example, because the concentrations of test material were not measured), a caveat should be added stating that the species might not be adequately protected.

2. If EC50s for a variety of species of algae (or aquatic plants in general) are below the criterion, a caveat should be added stating that algae (or aquatic plants) might not be adequately protected.

K. Implementation

This is a format section and should not be changed. The format paragraph on metals and metalloids will be included only in criteria documents on metals and metalloids.

IX. Terminology

Note: Terminology derived from the National Guidelines should be used sparingly and as used in the National Guidelines. Several of the terms listed below will be used rarely in criteria documents, but they are listed here just in case.

1. "Toxicity tests" should not be called "bioassays." These are two different kinds of tests. The first term clearly and accurately describes what is meant.
2. "Dose" and "level" should not be used when "concentration" is meant.
3. The terms "LC50," "EC50," etc., should be typed with letters and numbers on the same line, not with the numbers as subscripts (i.e., not as "LC_{50}").
4. "LC50" should be used instead of the obsolete "TLm" and "TL50." (Note that although a "TL50" is the same as an "LC50," a "TL10" is the same as and "LC90.")
5. "LD50" should not be used when referring to a concentration in water, air, or food.
6. "EC50" should be used instead of "LC50" when death is not actually meant or determined, such as in most acute tests with daphnids.
7. Unnecessary words like "concentration" and "value" should not be used after "LC50," etc.
8. The plural of "LC50" is "LC50s," not "LC50's."
9. "Data" is plural because it is a synonym for "values."
10. "Test chamber" should be used rather than "test tank," "vessel," "beaker," etc.
11. "Test material" should be used rather than "test substance," "toxin," etc.

12. The phrase "static renewal" should not be used because it is internally contradictory. If the test solution is renewed, it is a renewal test, and use of the word "static" is inappropriate.

13. "Flow-through" should be used instead of "continuous-flow" or "intermittent-flow" when referring generically to types of tests or metering systems. "Continuous-flow" and "intermittent-flow" may be used when referring to that specific type of test or metering system. For example, metering systems such as the Mount-Brungs proportional diluter are both flow-through and intermittent-flow, but not continuous-flow. Because all three terms should always be used as adjectives, they should always be hyphenated.

14. "Dynamic" should not be used to mean "flow-through" because a renewal test might be considered "dynamic."

15. Use "dilution water" instead of "diluent" when referring to the water in which the test is conducted.

16. Use "salt water" instead of "sea water."

17. When used as a noun, "salt water" is correct; when used as an adjective, "saltwater" is correct. Similarly, "fresh water", "warm water", and "cold water" are two words when used as nouns, and one word when used as adjectives.

18. Use "reconstituted fresh water" instead of "synthetic fresh water" or "artificial fresh water."

19. Salinity should be reported in the metric units "g/kg," not as the synonymous, but less desirable, "parts per thousand" or "o/oo." The units "g/litre" are incorrect and should not be used.

20. The adjective "euryhaline" should be used when referring to widely varying salinities in salt water (e.g., euryhaline conditions) or to organisms or species tolerating wide-ranging salinities (e.g., 5 to 20 g/kg). Use the adjective "stenohaline" to refer to "true marine" conditions (i.e., salt water with a high and constant salt content) and to organisms unable to tolerate low salinity.

21. The adjective "saltwater" should be used instead of the vague "marine" (which might or might not be intended to mean "true marine") or the cumbersome "marine plus estuarine." Unfortunately, many laypersons use "marine" to mean "aquatic."

22. Singular and plural usage of the following terms should be as indicated below:

Singular Usage	Plural Usage
fish (one individual or one species)	fishes (more than one species)
toxicity (of a chemical)	toxicities (of several chemicals)
sensitivity (of one individual or species)	sensitivities (of several individuals or species)

23. Usually it is appropriate to refer to the "test species" rather than the "test organisms."

24. The common and scientific names listed in Appendix I of the National Guidelines should be used instead of other names.

25. Do not use brand names (e.g., Tygon) when a more general term (e.g., PVC = polyvinyl chloride) is appropriate.

26. "Litre" should be used instead of "liter."

27. "L" should be used instead of "l" as the abbreviation for "litre."

28. The form "mg of copper/L" should be used instead of mg/L of copper." In most cases "of copper" is not needed at all.

29. It is usually more appropriate to refer to the effect of a test material on a species rather than to refer to the response of the species to the material. In particular, deformities and death are effects, not responses.

30. "Embryos" should only be used to refer to fertilized eggs.

31. "Eggs" should only be used to refer to unfertilized eggs.

32. "Life cycle" should be two words when used as a noun and hyphenated when used as an adjective. For example, "In life-cycle tests, organisms are exposed throughout a life cycle." Similarly, "life stage" is hyphenated when used as an adjective (e.g., life-stage tests), but is two words when used as a noun.

33. There are only three kinds of tests from which chronic limits and chronic values can be obtained:

    Life-cycle tests with aquatic animals.
    Partial life-cycle tests with aquatic animals.
    Early life-stage tests with fishes.

34. Early life-stage tests should not be called "embryo-larval tests" or "egg-fry tests."

35. Use "acute-chronic ratio" instead of "acute/chronic ratio" or "application factor" and abbreviate it "ACR," not "A/C ratio."

36. Use "upper and lower chronic limits" to refer to results of chronic tests, rather than "MATC," "NOEC," etc. Use "chronic value" to refer to the geometric mean of the upper and lower chronic limits from a test.

37. The phrases "no effect" and "no observed effect" should not be used, either with or without hyphens or quotation marks. Both terms are usually used to mean "no statistically significant effect," but usually only refer to one or a few specific effects. Tested

concentrations that are called "NOECs" usually cause 5 to 35% adverse effect and therefore the term "NOEC" is a misnomer. However, you may say, for example, "In an early life-stage test with the fathead minnow, 6 mg/L caused an unacceptable reduction in survival, but 3 mg/L did not."

38. "Bioconcentration" covers only uptake directly from water whereas the broader "bioaccumulation" covers both uptake directly from water and uptake directly from food, although in some situations both might not actually take place. "Bioaccumulation factor" (BAF) should be used instead of "bioconcentration factor" (BCF) when a factor is determined in a field situation, because uptake might be from both food and water.

39. Whenever the words "replicate" or "duplicate" are used, it should be clearly specified what was "replicated" or "duplicated." For example, was the whole test (including the stock solution) duplicated at a different time or place or were the test chambers duplicated within a treatment.

40. "Variability" and "variation" should be used to refer to observed differences between replicates, but not to real differences between things that are not replicates. For example, it is not appropriate to refer to "variability" between the fathead minnow and the bluegill because there is no reason why they should have the same sensitivities, weights, life spans, etc.

41. "α" should be used to refer to a probability value selected as the basis for a decision before a hypothesis test is conducted. "P" should be used to refer to the comparable value calculated from the experimental data. In a hypothesis test the calculated value of P is

compared to the preselected value of α to determine whether the result is considered statistically significant. Although α is often set at 0.05, P will rarely ever be 0.05. It is more informative to give the value of P and say whether it was considered statistically significant than to simply say whether P was above or below a preselected value of α.

42. "P = 0.17" should be used instead of "p = 0.17."

43. Regardless of whether results of chronic tests are discussed in terms of statistical significance, it is important to discuss the actual percent reductions that were observed in survival, growth, and reproduction.

44. The control treatment is one of the treatments in a toxicity test. Thus it is correct to say "Hypothesis testing was used to compare the other treatments to the control treatment" but it is not correct to say "Hypothesis testing was used to compare the treatments to the control."

45. "Oxidation state" should be used with metals instead of "valence" or "valence state." Do not use terms like "pentavalent."

X. Preparation of References

A. Format

Note: The format specified here is similar to those used in the journals Aquatic Toxicology, Environmental Toxicology and Contamination, and Limnology and Oceanography. It is designed to give all necessary information in a manner that is not confusing, without the use of italics, boldface, or quotation marks. Underlining is only used for scientific names of species.

Because citations in the text and tables will be in the name-and-year system, the year will immediately follow the names of the authors in the references.

All authors will be listed. The initials of the first author will be after the last name of the first author, but the initials for all other authors will be before the last name. If a first name or middle name is hyphenated (e.g., Hyang-Kui), the abbreviation will consist of only the first initial (i.e., "H.", not "H.-K."). When there are two or more authors, there will not be a comma before the "and" before the last author. Diacritical marks will not be used in authors' names but apostrophies (e.g., Danil'chenko) will be used. Use whatever initials are given on the publication, even if they are wrong or if there are three.

In titles of articles, books, reports, chapters, etc., only capitalize the first word in the title, the first word after a period or colon in a title, proper nouns and adjectives, and the name of a genus, family, order, or phylum in scientific names of species. If a book has a title and is also the proceedings of a symposium, give the title but do not also state that it is the proceedings unless this is an integral part of the title. Titles should be reproduced exactly as in the original, with three exceptions:

1. Capitalization will be as described above.
2. Scientific names of species will be underlined.
3. If the original title of the publication is in a foreign language, give an English translation rather than the original title.

Titles of journals will be abbreviated as per Appendix 3.

When not in a title, names of states will be abbreviated using the ZIP CODE abbreviations (two capital letters with no period or space between the letters; see Table X-1). Specify the state for all cities in the United States, including New York (e.g., New York, NY.) If the city is not in the United States, give the country.

Document and report numbers should be given when available. If there are two, give both with an "or" between them so that people know the two numbers refer to the same report.

For publications that are not in journals or books, it is important to give enough information to make it as easy as possible to get a copy.

1. All reports available from NTIS will be referenced only to: National Technical Information Service, Springfield, VA. Nearly all reports or documents with the following kinds of numbers on them are available from NTIS: PB, EPA, CONF, ADA, ORNL, EUR, and NSF.
2. Do not refererence Dissertation Abstracts for a thesis or dissertation (see below under "Thesis or dissertation.").
3. There are several Canadian report series. Thus, although the "J. Fish. Res. Board Can." and "Can. J. Fish. Aquat. Sci." should be treated as journals, the report series should not be treated as journals because this does not tell people how they can get copies of the reports. The reference must include the title of the series, number of the report, institution, and city, province, and country. Some of these reports are

a single article, whereas others are proceedings for which editors and page numbers must be given.

For all other reports, bulletins, manuscripts, letters, memoranda, etc., the institutuion, city and state (and country if not U.S.A.) must be given.

If the reference is to a whole book or report, do not give the number of pages in the publication.

Do not abbreviate names of organizations, institutions, universities, departments, etc., unless they are part of a journal abbreviation (see Appendix 3).

Spell out "report," "bulletin," "circular," etc., except when they are part of a journal abbreviation (see Appendix 3). Use "No." and "Vol." instead of "Number" and "Volume," respectively.

Always put dashes as indicated in the following:

EPA-600/3-07-086

PB-65217

PB83-41296

Order No. 17692

Order No. 83-65912

Use the following for these three organizations:

1. U.S. EPA
2. U.S. Food and Drug Administration
3. U.S. Fish and Wildlife Service

(Do not give other information, such as Department of Interior, etc.)

Do not use an EPA number as a primary reference if it has an "S" or "J" in it, e.g., do not use EPA-600/S2-78-124 or EPA-600/J-78-125. An "S" means it is a summary; the publication (i.e., EPA-600/2-78-124) should be obtained

and cited if appropriate. A "J" means it is a journal article; the reference should be to the journal of original publication, not to NTIS.

B. Examples

Journal article:

White, J.W., III, B.D. Waltz, Jr., A.C. Briggs and J. Evans. 1970. The toxicity of zinc. II. Fishes. Water Res. 5:62-89.

Whole book:

Osler, A.G. 1982. The toxicity of copper. 3rd ed. Academic Press, New York, NY.

Rhodes, A.J. and E.G. Strauss (Eds.). 1983. The toxicity of nickel: Mechanisms and selectivity. Vol. 3. Wiley. Philadelphia, PA.

Section of edited publication (see also appendix 4):

Foster, R.B. and R.G. Lile, Jr. 1942a. The toxicity of lead. In: Aquatic toxicology. Eaton, A.B., C.D. Ells and F.G. Hiu (Eds.). ASTM STP 777. American Society for Testing and Materials, Philadelphia, PA. pp. 13-26.

Hall, D. and J. Oats. 1981. The toxicity of chloride. In: Trace substances in environmental health - XIV. Hemphill, D.D. (Ed.). University of Missouri, Columbia, MO. pp. 68-70.

Highland, T.L. 1983c. The toxicity of boron. In: Proceedings of the thirtieth annual aquatic toxicity workshop. Heintz, S. and J.L. Rudman

(Eds.). Canadian Technical Report of Fisheries and Aquatic Sciences No. 3962. Department of Fisheries and Oceans, Ottawa, Ontario, Canada. pp. 8-12.

Reports:

Willis, J.C., J. Dimon and J.T. Bryans, III. 1982. The toxicity of silver. PB82-123456 or EPA-600/3-79-082. National Technical Information Service, Springfield, VA.

Wilson, D.J. 1923. The toxicity of chromium: Theory and practice. Circular 124. Illinois State Geology Survey, Urbana, IL. pp. 8-20.

Thesis or dissertation:

Gordon, L.E. 1983. The toxicity of arsenic. Ph.D. thesis. University of Maryland, College Park, MD. Available from: University Microfilms, Ann Arbor, MI. Order No. 83-145217.

Note: Do not reference Dissertation Abstracts. Whenever possible, get the name of the university, the city and state, and the University Microfilm Order No. Get a copy of the thesis if the data are in Tables 1, 2, 4, or 5. Masters theses and foreign theses are rarely available from University Microfilms.

Letter or memorandum:

Darwin, C. 1973. U.S. EPA, Duluth, MN. (Memorandum to C.E. Stephan, U.S. EPA, Duluth, MN. April 25.)

Manuscript:

Jones, J.F.K. and P. Smith. Manuscript. The toxicity of mercury. University of Wisconsin-Superior, Superior, WI.

Abstract from an abstracting journal:

Bath, J.R. 1982. The toxicity of antimony. Rev. Trav. Inst. Peaches. Marit. Nantes 45:5071; Aquat. Sci. Fish. Abstr. Part I. 1983. 12(12):141. Abstr. No. 11472-1Q12.

Note: Abstracts from abstracting journals will be used only in special situations. If the title of the original publication is not in English, give an English translation. The formats to be used for the second portions of the references (i.e., the reference to the abstracting journals) are:

Aquat. Sci. Fish. Abstr. Part I. 1983. 12(12):141. Abstr. No. 11472-1Q12.

Biol. Abstr. 1978. 66(5):2892. Abstr. No. 29374.

C. A. Sel.: Environ. Pollut. 1985. (14):3. Abstr. No. 103:17404.

Fish. Rev. 1986. 31(1):19. Abstr. No. 860-000170.

Nucl. Sci. Abstr. 1985. 25:39806.

Sel. Water. Resour. Abstr. 1985. 18(4):9. Abstr. No. W85-D1937.

Sport Fish. Abstr. 1985. 30(2):26. Abstr. No. 85-001130.

C. Order

1. Put references in alphabetical order according to the last name of the first author.
2. If two first authors spell their last names the same, put them in alphabetical order according to first initial, second initial, etc.

3. If the same author has one initial on some publications and two initials on other publications, for the purposes of alphabetical order all the publications should be treated as if they had both initials on them.

4. If an author is the sole author on two or more papers published in the same year or if two different sole authors with the same last name publish papers in the same year, use "a", "b", "c", etc., after the year so that the publications can be distinguished in the citations in the text and tables.

5. If a sole author also is first author in references with coauthors, all the references with only one author go before the references with coauthors.

6. Because of the use of "et al." in citations in the text and tables when there are more than two authors, if the same first author has one or more publications with one coauthor and one or more papers with two or more coauthors, all the publications with one coauthor will be placed (in alphabetical order according to last name of the second author) before all the publications with two or more coauthors. All the publications with more than two authors with the same first author will be put in order by year of publication regardless of the number or names of the additional authors. If two or more of these publications with more than two authors were published in the same year, they must be distinguished by a, b, c, etc., after the year so that the references can be distinguished in the citations in the text and tables.

D. Typing

1. All drafts of text and references must be double spaced. A special set of instructions for use of the Multimate Word Processor is maintained by the typist.

2. Unless you can find a typist who will type references directly from the reprints, a reference card should be prepared in the proper format for each reprint. The individual cards can be put in proper order and checked for duplication before being given to the typist. The references for (a) the last paragraph of the Introduction and (b) the section at the end of the text titled "Implementation" are saved in a file on the word processor.

Table X-1. State Abbreviations

Alabama AL
Alaska AK
Arizona AZ
Arkansas AR
American Samoa AS
California CA
Canal Zone CZ
Colorado CO
Connecticut CT
Delaware DE
District of Columbia DC
Florida FL
Georgia GA
Guam GU
Hawaii HI
Idaho ID
Illinois IL
Indiana IN
Iowa IA
Kansas KS
Kentucky KY
Louisiana LA
Maine ME
Maryland MD
Massachusetts MA
Michigan MI
Minnesota MN
Mississippi MS
Missouri MO
Montana MT
Nebraska NE
Nevada NV
New Hampshire NH
New Jersey NJ
New Mexico NM
New York NY
North Carolina NC
North Dakota ND
Ohio OH
Oklahoma OK
Oregon OR
Pennsylvania PA
Puerto Rico PR
Rhode Island RI
South Carolina SC
South Dakota SD
Tennessee TN
Trust Territories TT
Texas TX
Utah UT
Vermont VT
Virginia VA
Virgin Islands VI
Washington WA
West Virginia WV
Wisconsin WI
Wyoming WY

XI. Final Checks

1. Check that the page numbers in the table of contents and in the list of tables agree with the page numbers in the text and tables.
2. Check that all animal species in Tables 1, 2, 5, and 6 are in Appendix 1 of the Guidelines and are listed in the same order and that the scientific and common names are spelled correctly.
3. Check the calculation of the Species Mean Acute Values in Table 1.
4. Check the calculation of the Chronic Values in Table 2.
5. Check the acute values in Table 2 against the acute values in Table 1.
6. Check the calculation of the Acute-Chronic Ratios in Table 2.
7. Check the transfer of Species Mean Acute Values from Table 1 to Table 3.
8. Check the transfer of Acute-Chronic Ratios from Table 2 to Table 3.
9. Check that each freshwater genus and each saltwater genus is in Table 3 only once.
10. Check that the eight requirements for acute toxicity data are satisfied in Table 3.
11. Check that the requirement for three ACRs is satisfied in Table 3.
12. Check the calculation of Genus Mean Acute Values in Table 3.
13. Check the calculation of the Final Acute Value in Table 3.
14. Check whether any Species Mean Acute Values are lower than the Final Acute Value.
15. Check the calculation of the Final Acute-Chronic Value in Table 3.
16. Check the calculation of the Final Chronic Value in Table 3.
17. Check whether any chronic values or estimated chronic values are lower than the Final Chronic Value.
18. Check all the information in all the references against copies of the publications, not against reference cards.

19. Check all the citations in the text and tables against the references to be sure that (a) the names and dates in the citations are correct, (b) there is a reference for each citation, and (c) there is a citation for each reference. Items (b) and (c) are most easily accomplished by putting a check mark by each reference as it is checked in item (a)

XII. Submittal for Public Comment

XIII. Preparation of Final Document

A. BRS Update

B. Revision of Document

C. Response to Public Comment

D. Final Checks

References

Callahan, M.A., M.W. Slimak, N.W. Gabel, I.P. May, C.F. Fowler, J.R. Freed, P. Jennings, R.L. Durfee, F.C. Whitmore, B. Maestri, W.R. Mabey, B.R. Holt and C. Gould. 1979. Water-related environmental fate of 129 priority pollutants. Vol I (or II). EPA-440/4-79-029a (or b). National Technical Information Service, Springfield, VA. pp. ?-?.

Stephan, C.E., D.I. Mount, D.J. Hansen, J.H. Gentile, G.A. Chapman and W.A. Brungs. 1985. Guidelines for deriving numerical national quality criteria for the protection of aquatic organisms and their uses. PB85-227049. National Technical Information Service, Springfield, VA.

Appendix 1. Blank Tables

Table 1. Acute Toxicity of to Aquatic Animals

Species	Method[a]	Chemical	Hardness (mg/L as $CaCO_3$)	LC50 or EC50 (µg/L)[b]	Species Mean Acute Value (µg/L)	Reference
FRESHWATER SPECIES						

[a] S = Static, R = Renewal; Flow-through; M = Measured; U = Unmeasured.

[b] Concentration of not the chemical.

Table 2. Chronic Toxicity of to Aquatic Animals

Species	Test[a]	Chemical	Hardness (mg/L as $CaCO_3$)	Chronic Limits (µg/L)[b]	Chronic Value (µg/L)	Reference
FRESHWATER SPECIES						

LC = Life-cycle or partial life-cycle; ELS = early life-stage

Results are based on measured concentrations of

Table 2. (Continued)

Species	Hardness (mg/L as $CaCO_3$)	Acute-Chronic Ratio: Acute Value (ug/L)	Acute-Chronic Ratio: Chronic Value (ug/L)	Acute-Chronic Ratio: Ratio

Table 3. Ranked Genus Mean Acute Values with Species Mean Acute-Chronic Ratios

Rank[a]	Genus Mean Acute Value (µg/L)	Species	Species Mean Acute Value (µg/L)[b]	Species Mean Acute-Chronic Ratio[c]
		FRESHWATER SPECIES		

[a]Ranked from most resistant to most sensitive based on Genus Mean Acute Value. Inclusion of "greater than" or "less than" values does not necesarily imply a true ranking, but does allow use of all genera for which data are available so that the Final Acute Value is not unnecessarily lowered.

[b]From Table 1

[c]From Table 2.

Table 3. (Continued)

Fresh water

Final Acute Value =

Criterion Maximum Concentration =

Final Acute-Chronic Ratio = (see text)

Final Chronic Value =

Salt water

Final Acute Value =

Criterion Maximum Concentration =

Final Acute-Chronic Ratio = (see text)

Final Chronic Value =

Table 4. Toxicity of to Aquatic Plants

Species	Chemical	Hardness (mg/L as $CaCO_3$)	Duration (days)	Effect	Concentration (μ/L)[a]	Reference
FRESHWATER SPECIES						

[a] Concentration of not the chemical.

Table 5. Bioaccumulation of by Aquatic Organisms

Species	Chemical	Concentration in Water (µg/L)[a]	Hardness (mg/L as $CaCO_3$)	Duration (days)	Tissue	Percent lipids	BCF or BAF[b]	Normalized BCF or BAF[c]	Reference
FRESHWATER SPECIES									

[a] Measured concentration of

[b] Bioconcentration factors (BCFs) and bioaccumulation factors (BAFs) are based on measured concentrations of in water and in tissue.

[c] When possible, the factors were normalized to 1% lipids by dividing the BCFs and BAFs by the percent lipids.

Table 6. Other Data on Effects of on Aquatic Organisms

Species	Chemical	Hardness (mg/L as $CaCO_3$)	Duration	Effect	Concentration ($\mu g/L^a$)	Reference
FRESHWATER SPECIES						

[a] Concentration of not the chemical.

Appendix 2. Blanks for "Unused Data"

1. Some data on the effects of xxxxxx on aquatic organisms were not used because the studies were conducted with species that are not resident in North America or because the test species was not obtained from a wild population in North America and was not identified well enough to determine whether it is resident in North America (e.g., ...).

2. Results (e.g., ...) of tests conducted with brine shrimp, Artemia sp., were not used because these species are from a unique saltwater environment.

3. ..... compiled data from other sources.

Notes: a. Generally this should not be used if the the original investigators republished their own data. Such republication should be handled by duplicate references in tables or text or both.

b. Only list publications that contain data concerning aquatic organisms. Do not include reviews of chemical properties, etc.

4. Results were not used ~~if~~ when either the test procedures, test material, or dilution water was not adequately described (e.g., ...).

5. Data were not used if xxxxxxx was a component of a drilling mud, effluent, fly ash, mixture, sediment, or sludge (e.g., ...)

6. Data were not used if the organisms were exposed to xxxxxxx by injection or gavage (e.g., ...).

   Note: Exposure to the test material in food should generally be in the section on "Other Data" if otherwise acceptable.

7. ..... exposed plasma, enzymes, excised or homogenized tissue. tissue extracts, or cell cultures.

8. Tests conducted without controls or with too few test organisms were not used (e.g., ...).

9. High control mortalities occurred in tests reported by ..... .

10. ..... . cultured or acclimated organisms in one water and conducted tests in another.

11. . . . . did not acclimate the test organisms to the dilution water for a long enough period of time.

12. Results of some laboratory tests were not used because the tests were conducted in distilled or deionized water without addition of appropriate salts or were conducted in chlorinated or "tap" water (e.g., ...)

13. ... were not used because the results were not adequately described or could not be interpreted.

14. BCFs and BAFs from laboratory tests were not used when the tests were static or when the concentration of xxxxxxxxxx in the test solution was not adequately measured or varied too much (e.g., ...).

Note: If a test was otherwise acceptable but was too short to be used in Table 4, use it in Table 6.

15. Reports of the concentrations of xxxxxxx in wild aquatic organisms (e.g. .....) were not used to calculate BAFs ~~if~~ either the number of measurements of the concentration in water was too small or the range of the measured concentrations in water was too large.

Note: BAFs should be calculated from field data whenever the data are reasonably good. Field data are expected to have a greater variance than laboratory data.

16. BCFs obtained from microcosm or model ecosystem studies were not used in the concentration of xxxxx in water decreased with time (e g.,)

Appendix 3. Abbreviations of Journal Titles

All one-word journal titles will be spelled out with no period after the title (e.g., Ambio, Estuaries, Nature, Science). Periods will be placed at the end of an abbreviated journal title only if the last word is abbreviated. For journals that have series or sections, such as A, B, etc., give the letter after the volume number as shown for the pertinent journals.

Acad. Sci.

Acta Anat.

Acta Biol. Acad. Sci. Hung.

Acta Bot. Indica

Acta Hydrobiol.

Acta Hydrochim. Hydrobiol.

Acta Microbiol. Pol. 99A:42-45.

Acta Oecol. Oecol. Appl

Acta Pharmacol. Toxicol.

Adv. Environ. Sci. Technol. [Note: Do not use; this is the title of a series of books published by Wiley.]

Adv. Mar Biol.

Adv. Microb. Ecol.

Adv. Water Pollut. Res.

Agric. Biol Chem.

Agric. Environ.

Air Water Pollut. [Note: Do not use; see "Int. J. Air Water Pollut."]

Air Water Pollut. Int. J. [Note: Do not use; see "Int. J. Air Water Pollut."]

Ambio

A.C.S. Symp. Ser. [Note: Do not use; reference these as books so people can find them.]

Am. J. Bot.

Am. J. Clin. Nutr.

Am. J. Forensic Med. Pathol.

Am. Midl. Nat.

Am. Soc. Civ. Eng. [Note: Do not use; see "J. Sanit. Eng. Div."]

Am. Water Resour. Assoc. Bull.

Am. Water Works Assoc. J. [Note: Do not use; see "J. Am. Water Works Assoc "]

Am. Zool.

An. Fac. Farm. Porto

Anal. Chem.

Anal. Chim. Acta

Anal. Proc.

Angew. Bot.

Ann. Appl. Biol.

Ann. Bot. (Lond.)

Ann. Bot. (Rome)

Ann. Bot. Fenn.

Ann. Entomol. Soc. Am.

Ann. Limnol.

Ann. N. Y. Acad. Sci.

Ann. Trop. Med. Parasitol.

Annu. Rev. Microbiol.

Antonie Leeuwenhoek J. Microbiol.

Antonie Leeuwenhoek J. Microbiol. Serol.

Appl. Environ. Microbiol.

Aquacult. Fish. Manage.

Aquat. Bot.

Aquat. Toxicol.

Aquat. Toxicol. (N. Y.) [Note: This journal is published infrequently and is rarely if ever used.]

Arch. Biochem. Biophys.

Arch. Environ. Contam. Toxicol.

Arch. Environ. Health

Arch. Fischereiwiss.

Arch. Hydrobiol.

Arch. Hydrobiol. Suppl.

Arch. Inst. Pasteur Tunis

Arch. Microbiol.

Arch. Mikrobiol.

Arch. Toxicol.

Arkansas Farm Res.

Assoc. Southeastern Biologists Bull.

ASTM STP [Note: Do not use; reference these as books so people can find them.]

Aust. J. Mar. Freshwater Res.

Aust. J. Plant Physiol

Bamidgeh

Biochem. Biophys. Res. Commun.

Biochem. Pharmacol.

Biochem. Physiol. Pflanz.

Biochim. Biophys. Acta

Biokon Rep.

Biol. Bull. (Woods Hole)

Biol. Bull. India

Biol. Conserv.

Biol. Nauki

Biol. Reprod.

Biol. Rev. Camb. Philos. Soc.

Bios

BioScience

Biotechnol. Bioeng.

Biotechnol. Lett.

Black Hills Eng.

Bot. Gaz.

Bot. Mar.

Botyu-Kagaku [Note: Do not use; see "Sci. Pest Control."]

Br. J. Exp. Biol.

Br. J. Ind. Med.

Br. J. Nutr.

Bryologist

Bull. Agric. Chem. Insp. Stn. (Tokyo) [Note: Use instead of "Noyaku Kensasho Hokoku."]

Bull. Bur. Fish.

Bull. Environ. Contam. Toxicol.

Bull. Freshwater Fish. Res. Lab. (Tokyo) [Note: Use instead of "Tansuika Suisan Kenkyusho Kenkyu Hokoku."]

Bull. Jpn. Soc. Sci. Fish.

Bull. Mar. Sci.

Bull. Mt. Desert Isl. Biol. Lab.

Bull. N. J. Acad. Sci.

Bull. Natl. Inst. Hyg. Sci. (Tokyo) [Note: Use instead of "Eisei Shikenjo Hokoko."]

Bull. Soc. Pathol. Exot.

Bull. Tokai Reg. Fish. Res. Lab.

Bull. Torrey Bot. Club

Bull. W. H. O.

C. R. Hebd. Seances Acad. Sci.

C. R. Hebd. Seances Acad. Sci. (Series D)

C. R. Seances Acad. Sci. (Series III)

C. R. Seances Soc. Biol. Fil.

Calif. Fish Game

Can. Fish Cult.

Can. J. Bot.

Can. J. Comp. Med.

Can. J. Fish. Aquat. Sci.

Can. J. Microbiol.

Can. J. Zool.

Can. Tech. Rep. Fish. Aquat. Sci. [Note: Do not use; reference these [redacted] as books so people can find them.]

Caryologia

Ceylon J. Sci. Biol. Sci. [Note: Started sometime before 1978.]

Ceylon J. Sci. 99C:42-45. [Note: Discontinued sometime before 1978.]

Chem.-Biol. Interact.

Chem. Geol.

Chem. Scr.

Chesapeake Sci.

Clin. Toxicol.

Colonial Waterbirds

Comp. Biochem. Physiol. 72A:205-210. [Note: The A, B, and C series began in 1971. Include the series designation after 1970.]

Comp. Physiol. Ecol.

Compt. Rend. Soc. Biol.

Contrib. Boyce Thompson Inst.

Contrib. Mar. Sci.

Copeia

Cornell Vet.

Crit. Rev. Environ. Control

Crit. Rev. Microbiol.

Crit. Rev. Toxicol.

Curr. Sci.

Dev. Ind. Microbiol.

Down Earth

Drug Metab. Dispos.

Dtsch. Gewasserkd. Mitt.

Ecol. Bull.

Ecol. Model.

Ecol. Monogr.

Ecotoxicol. Environ. Saf.

Effluent Water Treat. J.

Eisei Shikenjo Hokoku [Note: Do not use; see "Bull. Natl. Inst. Hyg. Sci. (Tokyo)."]

Eng. Bull.

Environ. Biol. Fishes

Environ. Conserv.

Environ. Entomol

Environ. Exp. Bot.

Environ. Health Perspect.

Environ. Int.

Environ. Manage.

Environ. Monit. Assess.

Environ. Pollut. Ser. A. 23A:19-25. [Note: The series designation started in 1980. Include the series designation after 1979.]

Environ. Qual. Saf.

Environ. Res.

Environ. Sci. Res.

Environ. Sci. Technol.

Environ. Technol. Lett.

Environ. Toxicol. Chem.

Estuaries

Estuarine Coastal Mar. Sci.

Estaurine Coastal Shelf Sci.

Fed. Proc.

Federal Regist.

Finn. Mar. Res.

Fish. Bull. (Dublin)

Fish. Bull. S. Afr.

Fiziol. Rast. ~~(Engl. Transl. Plant Physiol.) [Note: Give all info as in the title.]~~ (Note: Use only for articles in Russian. For translations, see "Plant Physiol." and "Sov. Plant Physiol."]

Food Cosmet. Toxicol.

Fresenius' Z. Anal. Chem. [Note: Do not use; see "Z. Anal. Chem."]

Freshwater Biol.

Fundam. Appl. Toxicol.

Gas-Wasserfach

Gen. Comp. Endrocrinol.

Geochim. Cosmochim. Acta

Gesundh.-Ing.

Gewasser Abwasser

Gidrobiol. Zh. [Note: Do not use; see "Hydrobiol. J."]

Haustech. Bauphys. Unwelttech.

Helgol. Meeresunters.

Helgol. Wiss. Meeresunters.

Hilgardia

Hiroshima J. Med. Sci.

Holarct. Ecol.

Huanjing Kexue

Hydrobiol. J. (Engl. Transl. Gidrobiol. Zh.) 24(2):8-12. [Note: Give all info including issue number.]

Hydrobiologia

Ill. Nat. Hist. Surv. Bull.

Indian J. Environ. Health

Indian J. Exp. Biol.

Indian J. Phys. Nat. Sci.

Ind. Eng. Chem.

Ind. Water Wastes

Ind. Wastes

Inorg. Chem.

INSERM (Inst. Nat. Sante Rech. Med.) Colloq.

INSERM (Inst. Nat. Sante Rech. Med.) Symp.

Int. Assoc. Great Lakes Res. [Do not use; see "J. Great Lakes Res."]

Int. Counc. Explor. Sea, Marine Comm. Ctes

Int. J. Air Water Pollut. [Note: Use instead of "Air Water Pollut." or "Air Water Pollut. Int. J."]

Int. J. Appl. Radiat. Isot.

Int. J. Environ. Stud.

Int. J. Environ. Anal. Chem.

Int. Pest Control

Int. Rev. Gesamten Hydrobiol.

Int. Ver. Theor. Angew. Limnol. Verh.

Invest. Pesq.

Iowa State J. Res.

Isr. J. Zool.

J. Agric. Food Chem.

J. Am. Coll. Toxicol.

J. Am. Water Works Assoc. [Note: Use instead of "Am. Water Works Assoc. J."]

J. Anim. Sci.

J. Appl. Ecol.

J. Appl. Polymer Sci.

J. Appl. Toxicol.

J. Assoc. Off. Agri. Chem. [Note: Through at least 1962.]

J. Assoc. Off. Anal. Chem. [Note: Started on or before 1969.]

J. Bacteriol.

J. Biol. Educ.

J. Cell Biol.

J. Cell Sci.

J. Nutr. Exp. Diets

J. Commun. Dis.

J. Comp. Physiol. 98B:42-45.

J. Econ. Entomol.

J. Environ. Pathol. Toxicol.

J. Environ. Qual.

J. Environ. Sci.

J. Environ. Sci. Health 13A:62-70.

J. Exp. Biol.

J. Exp. Mar. Biol. Ecol.

J. Exp. Med.

J. Fish Biol.

J. Fish Dis.

J. Fish. Res. Board Can.

J. Food Sci.

J. Fr. Hydrol.

J. Gen. Appl. Microbiol.

J. Great Lakes Res.

J. Hazard. Mater.

J. Hydrol. (Amst.)

J. Hydrol. (Dunedin)

J. Hyg. Epidemiol. Microbiol. Immunol. (Prague)

J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 24(4):134-140. [Note: Give all info. There is no issue number prior to 1979 but it must be given for 1979 and later.]

J. Inl. Fish. Soc. India

J. Kans. Entomol. Soc.

J. Mar. Biol. Assoc. U. K.

J. Microbiol. [Note: Do not use; see "Antonie..."]

J. Microbiol. Serol. [Note: Do not use; see "Antonie.. "]

J. Miss. Acad. Sci.

J. Nutr.

J. Paint Technol.

J. Pestic. Sci.

J. Pharmacol. Exp. Ther.

J. Phycol.

J. Plankton Res.

J. Protozool.

J. Radioanal. Chem.

J. Sanit. Eng. Div. Proc. Am. Soc. Civ. Eng.

J. Tenn. Acad. Sci.

J. Test. Eval.

J. Therm. Biol.

J. Toxicol. Environ. Health

J. Water Pollut. Control Fed.

J. Wildl. Manage.

J. World Maricul. Soc.

Jpn. J. Exp. Med.

Jpn. J. Limnol.

Jpn. J. Parasitol.

Lab. Anim. Care

Limnol. Oceanogr.

La. Acad. Sci.

Mar. Biol. (Berl.)

Mar. Biol. (N. Y.)

Mar. Biol. Lett.

Mar. Chem.

Mar. Ecol. Prog. Ser

Mar. Environ. Res.

Mar. Pollut. Bull.

Mar. Sci. Commun.

Med. Clin. N. Am.

Medd. Dan. Fisk. Havunders.

Medd. Komm Havundusog., Kbh.

Meded. Fac. Landbouwwet. Rijksuniv Gent.

Mich. Acad.

Microb. Ecol.

Microbios Lett.

Micron Microsc. Acta

Microsc. Acta

Miner. Environ.

Mitt. Int. Ver. Theor. Angew. Limnol.

Monit. Zool. Ital.

Mosq. News

Mutat. Res.

Natl. Acad. Sci. Lett. (India)

Natl. Oceanogr. Atmos. Admin. Fish. Bull.

Natl. Speleological Soc. Bull.

Natl. Spelunkers Soc.

Nature

Naturwissenschaften

Nautilus

Neth. J. Sea Res.

New Phytol.

Nogaku Kenkyu

Nova Hedwigia

N. Y. Fish Game J.

N. Z. J. Mar. Freshwater Res.

N. Z. Med. J.

Nippon Nogeikagaku Kaishi

Northeast Gulf Sci.

Northwest Sci.

Not. Nat. (Phila.) 361:6-12. [Note: Use the "number" as the volume.]

Noyaku Kensasho Hokoku [Note: Do not use; see "Bull. Agric. Chem. Insp. Stn."]

Nutr. Rep. Int.

Ohio J. Sci.

Pergamon Ser. Environ. Sci. [Note: Do not use; reference these as books so people can find them.]

Period. Biol.

Pestic. Biochem. Physiol.

Pestic. Monit. J.

Philos. Trans. R. Soc. Lond. 262B:42-50.

Photogr. Sci. Eng.

Physiol. Plant.

Physiol. Zool.

Phytochemistry

Plant Cell Physiol.

Plant Physiol. (Bethesda)

Plant Physiol. ~~[Note: Do not use for the English translation, see "Fiziol. Rast."]~~ (Engl. Transl. Fiziol. Rast.) [Note: Give all info. See also "Sov. Plant Physiol."]

Plant Sci. Lett.

Pol. Arch. Hydrobiol.

Proc. Acad. Nat. Sci. Phila.

Proc. Annu. Conf. Southeast. Assoc. Fish Wildl. Agencies 30:28-42 [Note: From 1976, Vol. 30, to present. The volume number is the number of the conference. The year is the year of the conference.]

Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 29:179-184 [Note: Through 1975, Vol. 29]

Proc. Annu. Meet. Utah Mosq. Abatement Assoc.

Proc. Entomol. Soc. Ont.

Proc. Ind. Waste Conf. Purdue Univ. 26:340-351. [Note: Give the number of the eight > conference, not the Engineering Extension Series Number.]

Proc. Mont. Acad. Sci.

Proc. N. J. Mosq. Control Assoc.

Proc. Natl. Acad. Sci. India 99A:41-47.

Proc. Natl. Acad. Sci. U. S. A.

Proc. Natl. Shellfish Assoc.

Proc. N. S. Inst. Sci.

Proc. Pa. Acad. Sci.

Proc. Pap. Annu. Conf. Calif. Mosq. Control Assoc. [Note: Through at least 1974.]

Proc. Pap. Annu. Conf. Calif. Mosq. Vector Control Assoc. [Note: From at least 1977.]

Proc. R. Soc. Lond. B Biol. Sci.

Proc. R. Soc. Queensl.

Proc. S. D. Acad. Sci.

Proc. Soc. Exp. Biol. Med.

Proc. Soc. Water Treat. Exam.

Proc. Univ. Mo. Annu. Conf. Trace Subst. Environ. Health [Note: Do not use; not right > reference these as books so people can find them.]

Proc. Utah Acad. Sci. Arts Lett.

Proc. W. Va. Acad. Sci.

Proc. West. Pharmacol. Soc.

Proc. World Maricul. Soc. [Note: Do not use; reference this as a book.]

Prog. Fish-Cult.

Prog. Water Technol. [Note: Do not use; this is the title of a series of books published by Pergamon.]

Public Health Rep.

Q. Rev. Biol.

Rapp. P.V. Reun. Cons. Int. Explor. Mer. [Note: Do not use; reference these as books so people can find them.]

Regul. Toxicol. Pharmacol.

Residue Rev.

Rev. Biol. (Lisb.)

Rev. Brás. Malariol. Doencas Trop.

Rev. Int. Oceanogr. Med.

Rev. Plant Prot. Res.

Rev. Suisse Zool.

Riv. Parassitol.

Rocz. Nauk. Roln. 99B:102-189.

Rocz. Panstw. Zakl. Hig.

S. Afr. J. Sci.

Salmon Trout Mag.

Schweiz Z. Hydrol.

Science

Sci. Cult.

Sci. Pest Control [Note: Use instead of "Botyu-Kagaku."]

Sci. Total Environ.

Sep. Sci. Technol.

Sewage Ind. Wastes

Sewage Works J.

Soil Sci.

Sonderdruck aus Fleishwirtschaft

Southeast Asian J. Trop. Med. Public Health

Southwest. Nat.

Suom. Kemistil. 99B:81-83.

Symp. Biol. Hung.

Tansuiku Suisan Kenkyusho Kenkyu Hokoku [Note: Do not use; see "Bull. Freshwater Fish. Res. Lab. (Tokyo)."]

Tex. J. Sci.

Thalassia Jugosl.

Tissue & Cell

TNO Nieuws

Toxicol. Appl. Pharmacol.

Toxicol. Lett.

Trans. Am. Fish. Soc.

Trans. Am. Microsc. Soc.

Trans. Ill. State Acad. Sci.

Trans. Kans. Acad. Sci.

Trans. Mo. Acad. Sci.

Trans. R. Soc. Trop. Med. Hyg.

Ukr. Bot. Zh.

Va. J. Sci.

Verh. Int. Ver. Theor. Angew. Limnol. [Note: Do not use; see "Int. Ver. Theor. Angew Limnol. Verh."]

Veröff. Inst. Meeresforsch. Bremerhaven

Versl. Landbouwkd. Onderz. (Agric. Res. Rep.) [Note: Give all info as title]

Vet. Arh.

Vom Wasser

Vopr. Ikhtiol. [Note: Do not use; see "J. Ichthyol."]

W. Va. Acad. Sci.

Water Air Soil Pullut.

Water Pollut. Control

Water Pollut. Res. Can.

Water Res.

Water Resour. Bull.

Water Resour. Res.

Water S A

Water Sci. Technol.

Water Sewage Works

Water Treat. Exam.

Water Waste Treat.

Wilson Bull.

Wiss. Z. Univ. Rostock Math. Naturwiss. Reihe

Z. Anal. Chem. [Note: Use this instead of "Fresenius' Z. Anal. Chem."]

Z. Angew. Zool.

Z. Lebensm. Unters. Forsch.

Z. Mikrosk. Anat. Forsch. (Leipz.)

Z. Naturforsch. 39C:90-92.

Z. Pflanzenphsiol.

Z. Tierphysiol. Tierernaehr. Futtermittelkd.

Z. Wasser Abwasser Forsch.

Zentralbl. Bakteriol. Parasitenkd. Infektionskr. Hyg. Abt. I. Org.

Zool. Afr.

Zool. Anz.

Zool. Beitr.

Zool. J. Linn. Soc.

Most of the above journal abbreviations were taken from the "Serial Sources for the Biosis Data Base" Volume 1985. These abbreviations generally follow the abbreviation rules set by the American National Standards Institute. Most of the other journal abbreviations were taken from "List of Periodicals" published by Chemical Abstracts in 1961.

1967. In: Advances in water pollution research. Jaag, O. and H. Liebmann (Eds.), Water Pollution Control Federation, Washington, DC. Vol. 1. pp. (Conference in Munich, 1965) [ERLD Library - TD420.A22]

Appendix 4. Proceedings of Symposia, etc.

The following is a list of edited publications that are sometimes difficult to identify from computerized literature searches and are sometimes referenced incorrectly. For each, the available bibliographic information is provided and additional notes are provided for some. The documents are in order by year of publication, but are in no particular order within a year. To create the references actually used in Criteria Documents, the author(s) must be added before the year, the title of the article inserted between the year and "In:", and the page numbers added at the end. See section X of the Manual for additional information concerning the format of references.

In order to save space, two series of edited publications are not included on this list. "Trace substances in environmental health" is edited by D.D. Hemphill and published by the University of Missouri. The "Purdue Waste Conference" is published by Purdue University. See section X for the format to be used for these two series.

1957. In: Biological problems in water pollution. Tarzwell, C.M. (Ed.). U.S. Department of Health, Education, and Welfare, Cincinnati, OH. pp.
[ERLD Library - Document Control #000443]

1959. In: Proceedings of the 1st conference of waste disposal in the marine environment. Pearson, E.A. (Ed.). Berkeley, CA. pp.

1959. In: Proceedings of the symposium on coordination of mosquito control and wildlife management. Washington, DC. pp.

1959. In: Transactions of the 24th North American wildlife conference. Wildlife Management Institute, Washington, DC. pp.

1960. In: Biological problems in water pollution. Second seminar. Tarzwell, C.M. (Ed.). Technical Report W60-3. U.S. Department of Health, Education, and Welfare, Cincinnati, OH. pp.
[ERLD Library - Document Control #001129]

1963. In: Radioecology. Shultz, V. and A.W. Klement, Jr. (Eds.). Reinhold Publishing Corporation, New York, NY. pp.

1963. In: Symposium on marine microbiology. Oppenheimer, C.M. (Ed.). Thomas Publishers, Springfield, MA. pp.

1965. In: Biological problems in water pollution. Third seminar. Tarzwell, C.M. (Ed.). 999-WP-25. U.S. Department of Health, Education, and Welfare, Cincinnati, OH. pp.
[ERLD Library - Document Control #000089]

1966. In: Organic pesticides in the environment. Rosen, A.A. and H.F. Kraybill (Eds.). Advances in Chemistry Series No. 60. American Chemical Society, Washington, DC. pp.
[ERLD Library - QD1A355]

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