MANUAL FOR PREPARATION OF ENVIRONMENTAL IMPACT STATEMENTS FOR WASTEWATER TREATMENT WORKS, FACILITIES PLANS, AND 208 AREAWIDE WASTE TREATMENT MANAGEMENT PLANS

Office of Federal Activities

U.S. ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460
JULY 1974

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Manual for Preparation of Environmental Impact Statements for Wastewater Treatment Works, Facilities Plans, and 208 Areawide Waste Treatment Management Plans

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FOREWORD

This manual provides the framework for preparing environmental impact statements (EIS's) when required on wastewater treatment works, facilities plans, or 208 areawide waste management plans and should serve as a reference to those who must prepare such EIS's. It is intended to provide certain minimum standards of completeness and consistency in those EIS's prepared by EPA in the above categories.

This manual has been prepared pursuant to 1500.6(c)(iii) of CEQ's guidelines of August 1, 1973, which requires agencies to issue substantive guidance to agency personnel in implementing the impact statement process.

I expect this manual to serve continuously as an EIS preparation guide. It will be updated when necessary to incorporate changes and additional information as developed. To improve the usefulness of this manual, we need constructive comments and suggestions reflecting your experience in its use. Such comments should be furnished to the Director, Office of Federal Activities, 4th and M. St., SW., Washington, D.C. 20460.

Sheldon Meyers

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Director
Office of Federal Activities

INTRODUCTION

Authority and Responsibility

The National Environmental Policy Act of 1969 (NEPA), Public Law 91-190, requires all Federal agencies to, "...utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decision-making which may have an impact on man's environment...." Section 102(2)(C) of that Act also requires the agency to prepare an environmental impact statement (EIS) on, "...major Federal actions significantly affecting the quality of the human environment..." This is to be accomplished in consultation with the Council on Environmental Quality (CEQ), established by Title II of the Act.

CEQ has issued, "Preparation of Environmental Impact Statements: Guidelines," August 1, 1973 (40 CFR Chapter V, Part 1500), to guide agencies in the fulfillment of NEPA's requirements. In accordance with these guidelines, the Environmental Protection Agency (EPA) has published regulations for the preparation of environmental impact statements (40 CFR Chapter I, Part 6) on its own actions.

General criteria for deciding when to prepare EIS's are included in CEQ's guidelines (40 CFR 1500.6). More specific criteria for EPA actions can be found in EPA's regulation cited above.

One of the major EPA programs involving actions which are candidates for EIS's is the construction grants program as authorized by Title II - Grants for Construction of Treatment Works, Section 201(g)(1), of the Federal Water Pollution Control Act Amendments of 1972 (FWPCA), (Public Law 92-500). The Act authorizes the Administrator, EPA, "...to make grants to any State, municipality, or intermunicipal or interstate agency for the construction of publicly owned treatment works...." The regional offices, in turn, have been delegated the authority to fund State-approved wastewater treatment projects.

Concurrent with all of these authorities is the responsibility to assure Federal funds will produce a project which will have maximum beneficial effects on man's environment and minimum adverse effects.

The public laws quoted above, along with the CEQ and EPA regulations, constitute the authority and responsibility for the preparation of environmental impact statements on wastewater treatment works or facilities or 208 plans when deemed necessary by the regional offices of EPA.

Purpose

The purpose of this manual is to implement the requirements in 1500.6(c)(iii) of CEQ's guidelines that each agency issue substantive guidance to agency personnel in implementing the impact statement process. This manual provides the framework for the EIS's prepared on wastewater treatment works or facilities or 208 plans. Its use will ensure certain minimum standards of completeness and a consistency in organization and content of EIS's. Standards for completeness are needed to ensure that relevant, available data and analyses are not omitted from the document. Consistency in organization and content will facilitate public and headquarters understanding of the information presented.

The manual will serve as a useful reference for those who must prepare EIS's. Use of the manual should also expedite the headquarters pre-release review of EIS's, and hopefully, as a secondary benefit reduce the need for an in-depth review at the headquarters level on every EIS prepared.

Adhering to the contents of the manual should help ensure clear and objective EIS's -- a candid discussion of the problems to be solved, all feasible alternative solutions to these problems and the environmental effects of these solutions. The CEQ guidelines (40 CFR 1500.7) are clear on the intent of the EIS process --" "....statements are to serve as the means of assessing the environmental impact of proposed agency actions rather than as a justification for decisions already made..." The presentation of facts must be made in a form and context which will allow the public to reach a decision on the merits of the proposed action on their own.

Flexibility in Organization and Content of EIS

Notwithstanding the need for uniformity in the preparation of EIS's, the organization and content of the EIS that is specified in the manual, may be altered provided that the Regional Administrator determines that the proposed action or circumstances related to it warrant such changes. The manual should not be applied so rigidly that assembly line EIS's result. One must recognize that each wastewater treatment works or plan is an individual case. EIS's should be geared to the specific complexity of the environmental problems associated with the wastewater treatment works or plan under review.

In this regard EIS's should be as brief as practicable. To this end, if a proposed action has an obvious overriding environmental problem, the preparer should make this clear in the beginning of the EIS and concentrate on that problem and its analysis while providing summaries of the other analyses required in this manual.

The manual does not recommend techniques for forecasting the environmental effects of proposed actions. The preparers should use any forecasting techniques(s) determined appropriate.

Content of the EIS

The preparer should attempt to provide the information required by this manual to the best of his ability. However, special circumstances may prevent the inclusion in the EIS of certain data and analyses which the manual specifies should be included. Some of these circumstances are:

1. the information may simply not be obtainable;

2. the analysis or information is prohibitively difficult or expensive to obtain;

3. the available data is of questionable reliability; and

4. the material required by the manual is not applicable to the specific project under review.

In each case of omission, a concise explanation of the rationale for not having the data or analyses should be given.

Statements should incorporate relevant, analytical disciplines and should provide meaningful and factual data, information and analyses. The presentation should be simple and concise, yet include all facts necessary to permit independent evaluation and appraisal of the beneficial and adverse environmental effects of alternative actions. The style should not, however, require extensive scientific or technical expertise to comprehend or evaluate the environmental impact.

Although it is not mandatory to select a single, alternative solution to the wastewater treatment problem in the draft EIS, when analysis leads a Regional Administrator to prefer a particular alternative, he should not hesitate to make his preference known. In all final EIS's, however, the Regional Administrator must select and state a single proposed action or plan.

Circumstances may occur in which it is necessary to consider factors not included in the manual. When appropriate, the addition of this information is encouraged. Care should be taken to integrate the additional material into that already suggested by the manual.

All EIS's should contain a summary sheet as required by both the CEQ guidelines and EPA's environmental impact statement regulations.

Relationship of This Manual to Guidance for Facilities and 208 Planning

Sections 201 and 208, Federal Water Pollution Control Act Amendments of 1972, require facilities and areawide planning respectively. EPA has prepared guidance to assist applicants and their design engineers in satisfying these requirements. This manual has been prepared in conjunction with the above guidance and a plan submitted in accordance with the guidance should contain most of the material needed for preparing the EIS. However, the more extensive the communication between the regional office and the applicant before submission of the plan, the greater the chance the planning document will contain the information required for the EIS. Chapter III, "Alternatives," of this manual discusses the differences in the consideration of alternatives in EIS's on wastewater treatment works, facilities plans, and 208 plans.

Format of Manual

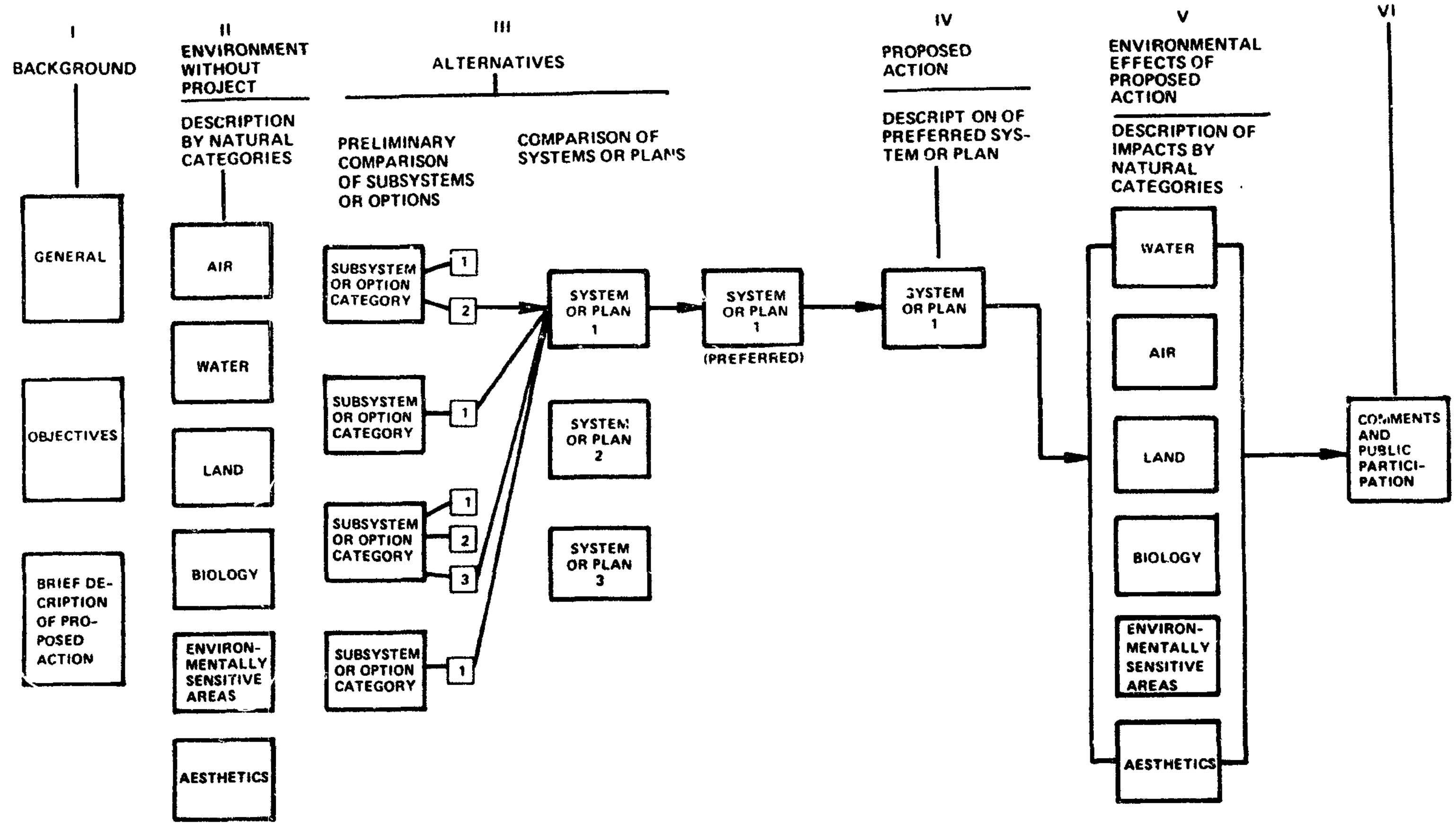
The order of chapters in the manual does not follow the specific order of the "Contents of EIS's" as stated in the CEQ guidelines -- the significant difference being the Alternatives Chapter is located near the beginning, before the discussion of the proposed action. This was done to place more emphasis on the development of alternatives rather than on the justification of the proposed alternative. The Alternatives Chapter provides a logical exposition of the development of the proposal -- explaining the problems and constraints, the subsequent evaluation of possible solutions and finally, the selection of the proposed alternative. Because of the changed order only a brief summary of the proposed action should be provided in the Background Chapter of the EIS.

Flowchart of Content of EIS

Figure 1 is a flowchart to assist in visualizing the systematic gathering of information for the EIS and the processing of that information into the completed document.

FIGURE 1

FLOWCHART OF CONTENTS OF EIS



I. Background

A. Identification of Grant Applicants and/or Planners

Potential grant applicants should be identified as well as the entity that prepared the facilities or 208 plan, if appropriate. The identification of applicants should include the Grants Administration digital identification number as shown in Chapter 12, Part I, "Grants Administration Manual" if available.

B. Description of the Proposed Actions

A brief description of both structural and non-structural actions should be provided. Specific details should not be given here. These should be covered in Chapter IV, "Description of the Proposed Action."

C. General and Specific Location of the Proposed Actions

To minimize the narrative, a clearly defined map of the planning area or the general area in which the proposed action will take place should be provided if available. All relevant treatment works and other structural alternatives should then be specifically located on the same map. The narrative should briefly describe the location of the works, referencing river systems, drainage basins and major surface and groundwaters.

D. Water Quality and Water Quantity Problems in the Area

A very brief summary discussion of the major water quality and water quantity problems in the area should be provided. (A more detailed description should be included in Chapter II). Include those problems which occur within the area even though the proposed action will not provide a complete solution at this time. Where appropriate, summarize or reference water quality standards or effluent limitations.

E. Water Quality and Water Quantity Objectives in the Area Other Than Solution of Preceding Problems

Examples of additional objectives and goals are:

1. streamflow augmentation for enhancing water supplies downstream, stream fisheries, recreation or aesthetic values;

2. preservation or development of recreation areas, wetlands or attractive open spaces;

3. preservation or enhancement of high quality waters with recreational, fish and wildlife or aesthetic values;

4. groundwater recharge for augmenting water supply and/or preventing salt-water intrusion;

5. alleviation of groundwater pollution; and

6. reuse of treated wastewater such as recycling of nutrients in treated wastewater.

F. Costs and Financing

Enumerate the total anticipated cost, the amount eligible for a grant under Section 201(g)(1), Public Law 92-500 and the Federal and State dollar contributions and percentages of the total cost each will pay if the proposed actions are recommended and approved.

G. History of the Application

If a grant application has been received, briefly describe the origin of the application, its priority determination and State certification.

II. The Environment Without the Proposed Action

A. General

The social, economic and environmental setting of the area of the proposed action is important for the decision maker and the public. The environmental setting is the starting point from which forecasts of the environmental impact of the proposed action must be made. The same environmental categories used in this chapter to describe the environmental setting are used in Chapter 5, "Environmental Effects of the Proposed Action," to describe the environmental impacts after implementing the proposed actions. While the focus should be on the immediate area of the proposed actions, where appropriate, parts of the surrounding area should also be included to avoid the risk of overlookin any important interbasin or regional impacts.

The importance of using maps to illustrate topics is stressed--especially where environmentally sensitive areas are concerned. The narrative should be concise, not exhaustive. Only those characteristics of the social and environmental setting which are most important in relationship to the proposed action should be discussed in any detail, and those which are not particularly relevant should be omitted.

B. Detailed Description

The environmental description should include the following items when they are relevant to the analysis of alternatives or determination of environmental impacts of the proposed action. Note that in many instances certain of these items will not be relevant to the decisions to be made, or their significance can be appropriately covered by a very brief description. See the note below for mandatory items.

NOTF: Only those items with asterisks need be included in all EIS's.

1. Climate

Describe the climatic conditions for the general area of the proposed actions including temperature, precipitation, humidity, and wind direction and velocity. List any specific weather conditions, such as inversions, fog, tornadoes, and hurricanes, and the frequency at which they may be anticipated. Also describe any topographic features which influence the weather.

2. Topography

Describe the topography of the area of the proposed actions delineating the major and minor drainage basins along with their characteristics--area, slope, elevation, natural and artificial drainage nets, erosion, and deposition.

3. Geology

Describe the geology of the appropriate area. Geologic structures or formations that have a direct influence on either groundwater or surface water resources should be specifically mentioned. Areas which are particularly susceptible to earthquakes, landslides, subsidence or other earth movement should be located on an area map and described briefly.

4. Soils

Identify soil types and their permeability, erosion potential, expansion, compaction and other characteristics in the appropriate areas.

5. Hydrology (Water)

a. General

Describe the relevant surface water bodies and groundwater aquifers in the area.

b. Water Quality

Describe the existing surface and groundwater quality using physical, chemical and biological parameters.

c. Water Quantity

Describe the existing surface and groundwater quantity and relate to water uses in section e below. Include a discussion of surface water volume, stream flow rates and the frequency and duration of seasonal variations (specify the 7-day 10-year low flow, groundwater storage volume or extent and depth of the major aquifers, and their rate of recharge and/or depletion. Where relevant to decision making the following material should also be included. If regulating (dams; locks) or diversion (dams; tunnels; canals) structures are in place, or proposed, these should be identified. Structures influencing stream-flow should be located on an area map; the recharge areas for replenishing ground water should also be identified on this map.

***** d. Water Quality and Quantity Problems

Identify existing and potential water quality and quantity problems in the area. Address specifically the relevant point and non-point sources of pollution such as those arising from industry, municipalities, combined sewers, storm water run-off, agriculture, silviculture, aquaculture, mines or mine drainage, and salt water intrusion.

***** e. Water Uses

Describe the type and extent of existing and future surface and groundwater uses. If reuse or reclamation of water is practical in the area, this should be explained. Regulatory and administrative procedures in force to reduce water consumption (thereby reducing waste volume) should be noted if significant.

***** f. Water Quality Management

Describe or reference all pertinent areawide or basin water quality management plans, court ordered allotments or interstate compacts involving water quality/quantity in the project area. If State or local water pollution control agencies have issued permits or orders on specific water resources, these should also be identified.

g. Flood Hazards

Indicate the 25, 50 and 100-year flood levels for the area. Identify any Corps of Engineers flood-plain plan or proposed project.

6. Biology

a. Indicate those species in the area which have been designated rare or endangered, either at the State level or nationally.

b. Describe wildlife habitat or portion thereof which might be affected by the project.

***** 7. Air Quality (Air)

To the extent pertinent discuss the major factors directly affecting air quality and the current and anticipated future air quality in the project area. Identify and reference the air implementation plan for the area.

8. Land Uses - The following should be provided any time interceptors or collectors are being proposed to service presently undeveloped areas or will be routed through such areas. The material should be prepared in conjunction with that required in Chapter V, Section B.3.

a. If available, include a map of existing land uses such as residential, commercial and services, industrial, cluster housing, strip development, extractive (mining, etc.), transportation, communications and utilities, institutional, open space and outdoor recreation, agricultural, forest land, water, archaeological, historical and other points of interest in the area of the interceptors.

b. If available, include a map of land uses, both private and public, for those categories listed above, which are currently being proposed by local, State, national or regional governments in the areas of the interceptors.

c. Describe the extent and effectiveness of current land use planning by all levels of government.

d. Describe the administrative and regulatory land use controls now in effect.

e. Describe development trends for the industrial, agricultural, commercial, residential, and recreational sectors -- especially those near or around bodies of water.

f. Describe any aspects of these trends which might threaten air or water quality or bring about other environmental problems.

***** 9. Identification of Significant Environmentally Sensitive Areas

Identify and show on a map any of the following which may be significantly impacted by the proposed action, and which are not described elsewhere in this chapter:

1. surface waters,
2. marshland, wetlands, and estuaries,
3. flood plains or flood-retention areas,
4. groundwater recharge areas,
5. steeply sloping lands,
6. forests and woodlands,
7. prime agricultural lands,
8. habitats of rare and endangered species,
9. public outdoor recreation areas,
10. sensitive geologic areas, and
11. archaeological and historic sites.

***** 10. Population Projections and Economic Forecasts

Designate the current and projected population levels (5, 10, and 20 years). In discussing these population trends, the rates of growth for the region contained in reports for the Water Resources Council by the Bureau of Economic Analysis, Department of Commerce and the Economic Research Service, Department of Agriculture (the OBERS projections) should be considered. The reasons for using a particular projection or forecast should be stated briefly.

***** 11. Other Programs in the Area

Describe local, State, and Federal projects, planned or underway which have or will have an impact (social, economic, or environmental) on the area, if there will be a major interaction between these projects and the proposed water quality action. Also discuss the interaction.

12. Aesthetics

Describe the area's general aesthetic quality. Where appropriate, discuss noise levels, man-made objects, other items not handled elsewhere, and the overall "composition" mirrored by the total aesthetic picture.

III. Alternatives

A. General

1. Purpose

The chapter on "Alternatives" should contain:

a. a systematic development of all feasible alternatives for the solution of the identified water quality problems; and

b. a rational comparison of all feasible alternatives, including the identification of critical differences leading to the selection of one (or more) alternative(s) over another.

Both the development and comparison should be presented in a clear and concise manner so the reader can follow the logic of the Agency's decision-making process. A single preferred alternative representing the Agency's proposed action does not have to be selected in the draft EIS but must be selected in the final EIS.

The type of information to be included, how it should be presented to the reader, and guidance for the alternative to be developed and comparison processes are contained herein.

2. Differences in Alternatives in EIS's on Treatment Works, Facilities Plans, and 208 Plans

The types of alternatives that should be included in an EIS will depend in part on whether it is an EIS on a treatment work, facilities plan, or 208 plan. A description of what should be considered in the alternatives section in each of the above kinds of EIS's is discussed in Sections B and C below.

3. Constraints on the Consideration and Selection of Alternatives

Regardless of the type of EIS, the alternatives section should contain a discussion of limiting factors, assumptions, or conditions that affect the scope of alternatives considered or analyses performed. These constraints may be sufficient reason to reject a large number of alternatives outright, eliminate a portion of the analysis without further consideration, or they may reflect on the effectiveness or scope of available alternatives. Examples of such constraints include:

a. the proposed treatment work is intended to demonstrate a particular technology (example: nitrogen removal);

b. a substantial investment in existing facilities may preclude certain alternatives;

c. the treatment work is limited in scope and only a partial analysis is necessary (example; modification of an existing facility); and

d. an EIS has already been prepared adequately covering certain portions of the facility, problem, or area and need not be repeated in this evaluation, except by reference (example: EIS on the effects of ocean outfalls -- over an extensive portion of a coastline). The region may in fact, wish to prepare similar standard or generic EIS's to preclude having to repeat the same material in each EIS to be prepared.

B. Analysis of Alternatives in EIS's on Wastewater Treatment Works and Facilities Plans

1. Facilities Planning

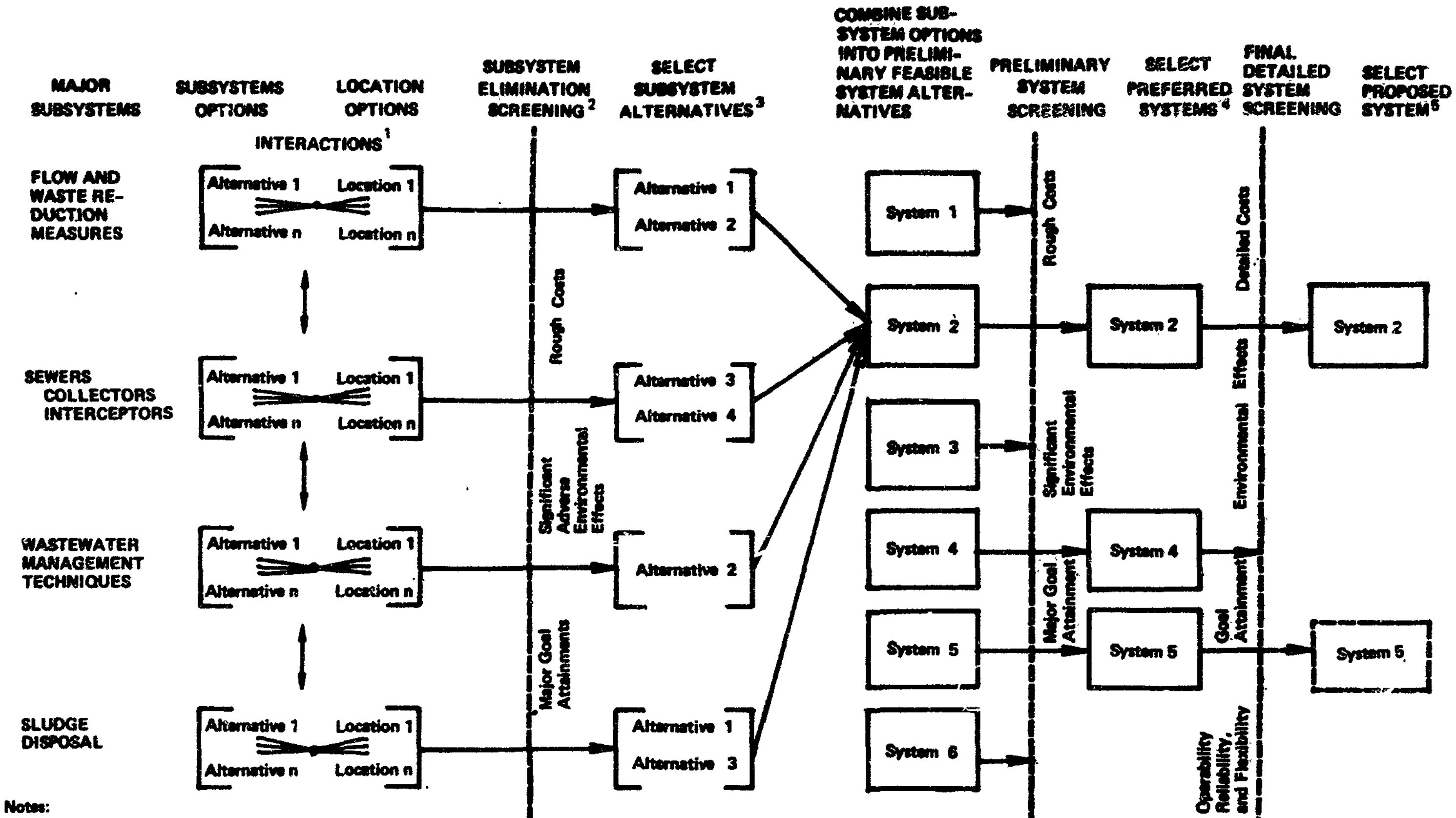
Facilities planning is designed to provide for cost-effective, environmentally sound and implementable treatment works which will meet the applicable requirements of the Federal Water Pollution Control Act Amendments of 1972. The major emphasis is on the prevention and solution of point source water quality problems. Alternatives developed to accomplish this are technical alternatives, and include both structural and non-structural alternatives.

2. General Analytical Approach

Alternatives for EIS's on treatment works and facilities plans should be systematically developed and selected through a combination of subsystems and systems analysis. The analysis should be broken down into the structural and nonstructural subsystems specified in section 3. For each subsystem there are a number of alternatives available to the design engineer. These subsystem alternatives should be screened and compatible subsystems should be combined into system alternatives. Finally, a preferred system(s) is selected after a more detailed comparative analysis or screening process. The entire process is shown schematically in Figure 2.

FIGURE 2

DEVELOPMENT AND EVALUATION OF ALTERNATIVE WASTEWATER TREATMENT SYSTEMS



Notes:

1. Only compatible subsystems and locations can be combined.
2. If there is an overriding reason for rejecting a subsystem, all factors need not be evaluated.
3. Only compatible subsystems can be combined.
4. The preferred systems are used to develop subplans in a 208 plan EIS.
5. In the draft EIS more than one system alternative may be proposed.

To simplify the alternatives section, the Regional Administrator may wish to provide a standard document on subsystem alternatives which must be rejected for a particular area. For example, shallow well injection of treated effluent may be unacceptable due to groundwater formations. This document could then be referenced in the individual project EIS.

One alternative which should always be included is that of "no action" -- allowing the existing wastewater treatment works or septic tanks to continue in use -- so that the public will understand the environmental implication of allowing the status quo to continue.

3. <u>Subsystem Alternatives to be Considered</u>

The four major subsystems and the alternatives within each that should be considered are:

a. <u>Flow and Waste Reduction Measures</u>

1) infiltration/inflow reduction by sewer system rehabilitation and repair and elimination of roof and foundation drains;

2) household water conservation, measures, such as household water saving appliances and fixtures as well as designing more appliances for less water consumption;

3) water and wastewater rates that impose costs proportional to water used and wastewater generated and use of water meters; and

4) educating the public on the value of their water resources in order to reduce their consumption.

b. <u>Sewers - Collectors and Interceptors</u>

1) Constructing new sewers - alternatives should be developed which differ in the following characteristics:

- routing
- service area
- design capacity
- design period
- phasing of construction

2) Rehabilitation of existing sewers

c. Waste Management Techniques

Alternative waste management techniques should be evaluated to determine the BPWTT[1] for meeting applicable effluent limitations including those related to wasteload allocation. Information pertinent to this evaluation is contained in an EPA document entitled, "Alternative Waste Management Techniques for Best Practicable Waste Treatment" (Proposed in March 1974). Selection of a waste management technique relates closely to the effluent disposal choices that are available. Preliminary alternative systems featuring at least one technique under each of the three categories below (treatment and discharge, wastewater reuses, and land application or land utilization) will be identified and screened, unless adequate justification for eliminating a technique during the screening process is presented.

1) Treatment and Discharge to Surface Waters

Treatment techniques are specified below. Alternative sizing, phasing of construction, and location of treatment works should also be compared.

- Biological treatment including ponds, activated sludge, trickling filters, processes for nitrification, and denitrification.

- Physical-chemical treatment including chemical flocculation, filtration, activated carbon, break-point chlorination, ion exchange, and ammonia stripping.

- Systems combining the above techniques.

- The "no action" alternative such as using septic tanks or not upgrading an existing treatment plant should always be considered for the sake of comparison.

Surface waters can include: rivers, streams, lakes, estuaries, bays, and the ocean. In EIS's where surface discharge is the most promising alternative, a number of different discharge points should be considered.

2) Wastewater Reuse

In comparing waste management techniques and alternative systems, wastewater reuse applications should be evaluated as a means of contributing to local water management goals. Such applications include:

1/ Best practicable waste treatment technology.

- Industrial processes
- Groundwater recharge for water supply enhancement or preventing salt-water intrusion
- Surface water supply enhancement
- Recreation lakes
- Land reclamation

Wastewater reuse needs should be identified and defined by volume, location, and quality. These needs may influence the location of the treatment facilities, the type of process selected, and the degree of treatment required.

3) Land Application

The application of wastewater effluents on the land involves the recycling of most of the organic matter and nutrients by biological action in the soil plus plant growth for the breakdown and disposal of nutrients. Such treatment generally provides a high degree of pollutant removal. Planning of the land application techniques should reflect criteria and other information contained in the EPA document on "Alternative Waste Management Techniques for Best Practicable Waste Treatment." Different locations for land application should be considered in the analysis.

Land application techniques include:

- Irrigation including spray, ridge and furrow, and flood
- Overland flow
- Infiltration-percolation
- Other approaches such as evaporation, deep well injection, 1/ and subsurface leach fields.

d. Sludge Disposal 2/

The alternatives in each of the categories below should be considered. Alternative sites should also be compared.

1/ Refer to Administrator's Decision Statement No. 5, Feb. 6, 1973, for guidance.

2/ The letters identify the various stages in sludge handling and disposal. The alternatives available for each step are arrayed below each stage.

1) sludge stabilization

-- aerobic and anaerobic digestion

-- composting

-- chemical treatment

-- physical processing

2) other processes

-- thickening

-- conditioning

-- dewatering

-- heat treatment for disinfection

-- drying

3) final disposal

-- incineration

-- land spreading, or other land application methods

-- landfill

-- pyrolysis

-- composting

-- ocean 1/

-- deep well injection

4. Comparative Analysis to be Performed in Developing and Selecting the Preferred System(s)

A number of comparative analyses or screens should be conducted during the systematic development of system alternatives. The basic comparisons to be made in each screen are discussed below.

1/ Refer to EPA - "Ocean Dumping" - Final Regulations and Criteria, Federal Register, Vol. 38, No. 198, Part II (40 CFR, Chapter I, Subchapter H, Part 220 - 227), October 15, 1973.

All comparisons should be discussed in narrative form and displayed in a summary chart. The major reasons for acceptance or rejection of an alternative should be stated in each case.

a. Subsystem Elimination Screening

Subsystem alternatives should be initially screened to eliminate those that are not feasible. The screening should consist of a comparison of the subsystem alternatives with respect to:

1) solution of major water quality problems and progress toward other identified objectives or goals;

2) significant adverse environmental effects; and

3) rough capital, maintenance and operating costs. 1/

In many instances, the interaction of subsystems will be such as to require their selection on the basis of a preferred combination rather than on the basis of an individually preferred subsystem. For example, the method of effluent disposal will determine the level of treatment needed. A few of these interactions are shown in Figure 2 as arrows between the subsystems.

b. Development and Preliminary Screening of Systems

Following the selection of a set of subsystems and subsystem locations, subsystems should be combined into feasible system alternatives. A preliminary systems screening should then be conducted to identify the best of the system alternatives. The same comparisons made during the subsystem screening should be made for this screening.

c. Final Detailed Systems Screening

The systems remaining after the preliminary screening will be compared in more detail on the basis of:

1) contributions to water quality goals and objectives;

2) present value or average annual equivalent value of capital and operating costs for overall alternative and subsystem components;

3) significant environmental effects of each alternative including a specific statement on future development impacts; and

4) operability, reliability and flexibility of each alternative and any subsystem included in each alternative.

1/ Unless subsystem alternatives have been rejected on a cost basis, it is not necessary to prepare cost comparisons until system alternatives are considered.

5. Additional Considerations

When there are overriding and obvious reasons for rejecting an alternative, it is not necessary to develop all of the above comparisons.

When there is no perceptible difference between alternatives during the comparison process, a statement to that effect is sufficient.

If a system contains a subsystem component designed for a period less than the life of the entire facility, at which time it will be replaced or upgraded, the comparative analysis should reflect this. The discussion should also emphasize those alternative systems that appear promising in terms of environmental protection. Different designs for systems that are essentially identical with respect to environmental effects should be considered only if their costs are appreciably different.

The concept of centralized vs. decentralized systems is receiving increased attention in current system proposals. When evaluated on the cost of the facilities alone, the analyses often neglect to discuss adequately the residential, commercial and industrial development that a centralized project can induce. Their vast network of collectors and interceptors often open up many new areas for development, or more rapid growth. The final system screening should specifically speak to these environmental implications of each system.

C. Analysis of Alternatives in EIS's on 208 Areawide Waste Treatment Management Plans

1. 208 Planning

208 planning entails both technical planning, which includes identifying water quality problems and developing alternatives to solve them, and management planning, which includes determining jurisdictional, management, or authority problems, and developing a management system to implement the proposed technical alternatives. The EIS on a 208 plan should concentrate on the technical alternatives, although some outputs of the management planning are likely to be included as objectives or constraints.

The technical alternatives considered in an EIS on a 208 plan should include those designed to solve or prevent both point source and non-point source water quality problems. These technical alternatives should encompass both structural and non-structural alternatives. Land use considerations play an important part in this planning. An important difference between the alternatives considered in an EIS on a 208 plan and a facilities plan is that the latter's alternatives are limited primarily to point source alternatives.

2. General Analytical Approach

The analysis of alternatives in an EIS on a 208 plan will be much more extensive than that required on a facilities plan. The entire process for a 208 plan is shown in Figure 3. The analysis is broken up by types of sources. Alternatives are compared and developed in the categories where there are identified problems. Preliminary comparisons are conducted in two categories - municipal wastewater treatment facilities and nonpoint source discharges. For the former the preliminary analysis is identical to that which would be performed in a facilities plan. For the latter, unfeasible options are eliminated with a preliminary screening analysis. After the preliminary analyses, the remaining systems or options within each of the categories are combined into subplans, which are screened to select the best. Finally, the subplans remaining after the screening are combined into areawide plans. These are then screened to yield the proposed plan.

3. Alternatives to be Considered

Alternatives to be considered are specified below.

a. Point Source Alternatives

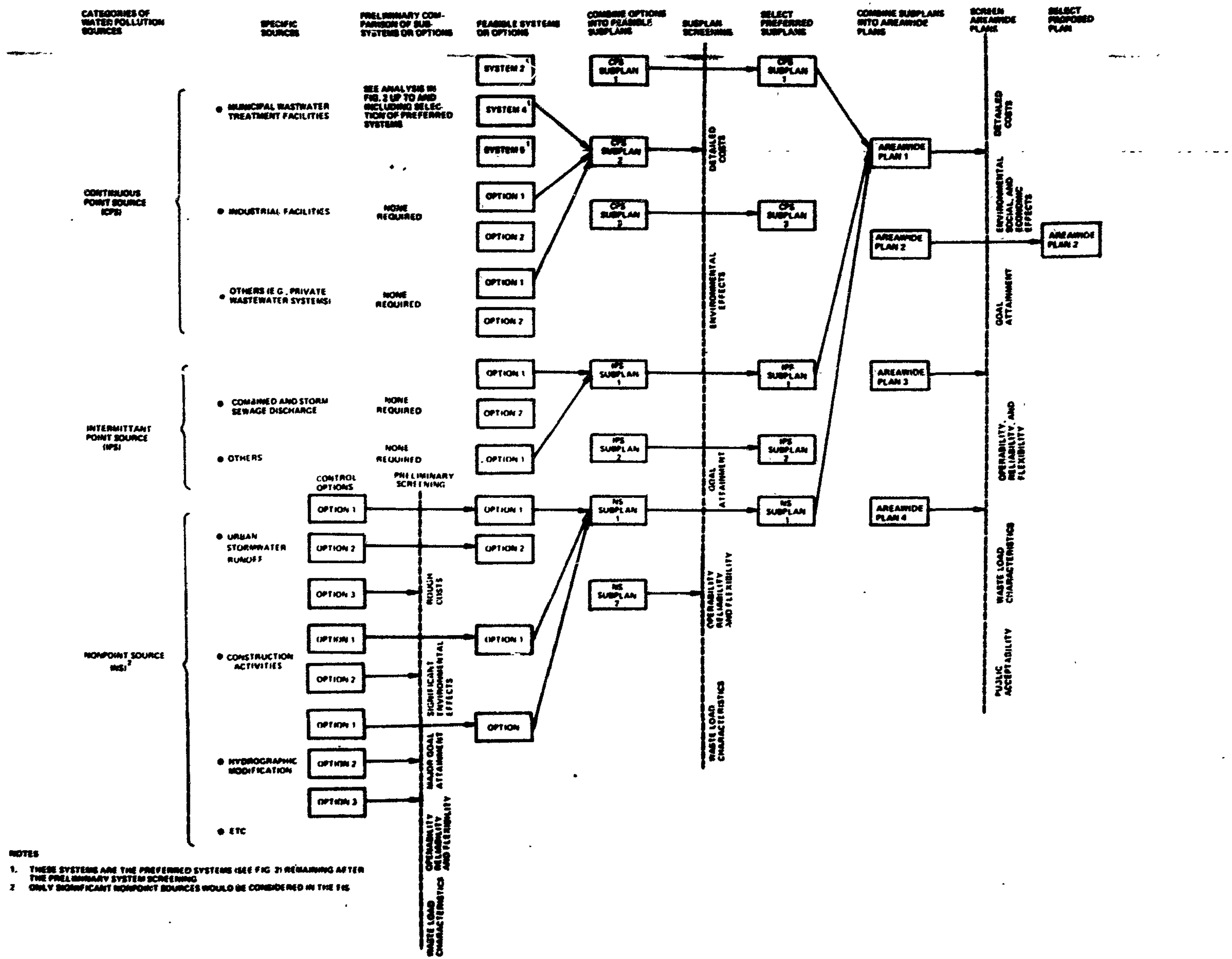
The point source alternatives associated with municipal wastewater treatment facilities, both structural and non-structural, that should be discussed in an EIS on a 208 plan are the same ones that should be discussed in an EIS on a facilities plan. Similar alternatives should be compared for industrial and other facilities when appropriate. Alternatives for intermittant point sources should be developed on a case by case basis. A minor difference in terminology between the facilities and 208 planning guidance exists; the term systems alternative used in this manual and the facilities planning guidance is referred to as point source subplan in the 208 guidance.

b. Nonpoint Source Alternatives

A number of nonpoint source alternatives both structural and non-structural, designed to prevent or alleviate nonpoint source water quality problems, should be considered in an EIS on a 208 plan. The alternatives that should be considered are those that are included in the "Guidelines for Areawide Waste Treatment Management" under the following categories, when those categories are applicable to problems that have been identified:

FIGURE 3

DEVELOPMENT AND EVALUATION OF ALTERNATIVES IN 208 PLAN EIS



1) Urban stormwater runoff

2) Construction activities

3) Hydrographic modification

-- channelization

-- water impoundments

-- urbanization

-- dredging and dredge spoil disposal

4) Land and subsurface disposal of residual waste

-- land and subsurface disposal of liquid wastes

-- land and subsurface disposal of solid wastes

5) Agricultural activities

6) Silvicultural activities

7) Mining activities

8) Salt-water intrusion

4. Comparative Analyses to be Performed in Developing and Selecting the Preferred Plan(s)

A number of comparative analyses or screens should be conducted during the systematic development of areawide plans. The basic comparison to be made in each screen are discussed below. All comparisons should be discussed in narrative form and displayed in a summary chart. The major reasons for acceptance or rejection of an alternative should be stated in each case.

a. Preliminary Comparisons of Subsystems and Systems for Wastewater Treatment Facilities

The same screening analyses included in an EIS on a facilities plan shall be included in an EIS on a 208 plan.

b. Preliminary Comparison of Nonpoint Source Options

Nonpoint source options shall be screened to eliminate those that are not feasible. The screening shall consist of a comparison of the following:

1) contributions to major water quality goals and objectives of each alternative;

2) rough costs;

3) significant environmental effects of each alternative;

4) operability, reliability and flexibility of each alternative; and

5) waste load characteristics of each alternative expressed in appropriate units for relating to the water quality prediction model.

c. Development and Screening of Subplans

Systems and other options remaining after any preliminary analyses shall be combined into subplans for each category of pollution source. The subplans shall then be screened to select the best. The screening shall consist of the following comparisons:

1) contributions to water quality goals and objectives;

2) present value or average annual equivalent value of capital and operating costs for overall alternative and any subsystem components;

3) environmental effects of each alternative including a specific statement on future development impacts;

4) operability, reliability and flexibility and

5) wasteload characteristics of each alternative expressed in appropriate units for relating to the water quality prediction model.

d. Development and Screening of Areawide Plans

The subplans remaining after the subplan screening shall be combined into areawide plans. These in turn shall be screened to select the preferred plan(s). The screening shall consist of a comparison of the same factors used to screen subplans with the addition of:

1) economic and social effects; and

2) public acceptability.

5. Additional Considerations

It is not necessary to repeat the same comparisons in the narrative with each screening process. They need only be briefly noted in the summary chart. The major reason for favoring or rejecting an alternative should always be stated, however.

IV. Description of Proposed Actions

A. General

Both structural and non-structural proposed actions should be described. Depending on the type of EIS, the description should be approached in different ways. For EIS's on wastewater treatment works and facilities plans, the actions should be described in terms of their subsystems. For EIS's on 208 plans, subsystem descriptions should be used when the alternatives making up the plan are like those in a facilities plan. Other alternatives making up the 208 plan should be described in any fashion that is appropriate.

B. Description of Subsystems

The content of the description of each subsystem comprising the proposed action is discussed below. When applicable, the reliability of unit processes should be noted (reference EPA-430-9974-001), especially those design features involved with controlled diversions. If a site plan is available for a structural subsystem it should be provided.

If energy conservation features have been included in the proposed action, these should be described. Examples are the use of processed digester gas as a fuel source or the selection of equipment which minimizes energy consumption.

The Regional Administer may wish to prepare standard descriptions of widely accepted subsystems for use in EIS's. This would reduce the amount of repetitive writing needed for individual EIS's.

1. Flow and Waste Reduction Measures

Describe how the proposed action(s) will be implemented and what the likelihood of success is.

2. Sewers - Collectors and Interceptors

Provide a map of the collector and interceptor network which can be easily compared with the land use map provided in Chapter II. If collectors or interceptors, or both, are planned for an area which is not currently developed, the reason for providing service should be discussed. Include the capacity, size, design period, any phased construction, and other features.

3. Wastewater Management Techniques

Describe the treated effluent disposal system including the location, type, size, design period and other features. If disposal is to the ocean or by well injection, applicable regulations must be considered. Effluent quality, water quality standards, effluent limitations and the maximum daily load of pollutants for receiving waters should be adequately discussed.

Describe the basic wastewater treatment plant with a minimum of engineering detail to avoid confusing a lay audience. Include the size, type, location, design period, any phased construction and other features. Describe influent to the plant and the treatment and hydraulic capacity of the plant in relation to water quality standards and the current population of the community. Include the explanation of any excess capacity. Identify any recirculation systems which w l increase plant efficiency.

4. Sludge Disposal

Describe the sludge treatment, conditioning and disposal processes, including the location, type, size design period and other features. If disposal is to the ocean, applicable regulations must be considered.

C. Description of Additional Alternatives in a 208 Plan

Discuss the additional alternatives that make up the proposed areawide plan in any fashion that is appropriate.

V. Environmental Effects of the Proposed Actions

A. General

This chapter of the EIS is second in importance only to the chapter on Alternatives. Both the beneficial and detrimental environmental effects of the proposed action should be discussed in detail. Where the action will measurably improve or enhance the environment, the effects should be explained. Where an adverse environmental effect is probable, the steps taken to mitigate the results should also be discussed.

While there is no optimum approach for systematically identifying and describing the complete environmental effects of the proposed action, the approach outlined below is recommended. In this approach, the environment is divided into natural categories--the same as those appearing in Chapter II, "The Environment Without the Proposed Action":

-- Water

-- Air

-- Land

-- Biology

-- Environmentally Sensitive Areas

-- Aesthetics

By using the same natural categories appearing in Chapter II, a direct comparison can be made between the environment before and after the project is installed.

In narrative form this chapter should describe the environmental impact of the proposed structural and non-structural actions on each natural category and its subsections. In many cases, the impact on a category and subsection may be associated with a single option, alternative or subsystem. However, if more than one subsystem or alternative impacts a category, the cumulative impact should be described. The subsystem or alternative contributing to the impact should always be identified. Impacts should be characterized as:

-- beneficial or adverse;

-- short or long-term;

-- reversible or irreversible; and

-- primary (direct) or secondary (induced).

Examples of adverse, long-term, irreversible impacts that should be carefully reviewed are:

1. Primary

a. destruction of historical, archaeological, geological,cultural, or recreational areas;

b. contamination of groundwater aquifer from failure or through saltwater intrusion;

c. destruction of sensitive ecosystems (e.g., wetlands);

d. materials consumed in construction and operation: chemicals in treatment process, consumption of energy, construction materials;

e. eutrophication of a body of water;

f. jeopardizing an endangered species;

g. displacement of population; and

h. operational accidents (e.g. chemical spills).

2. Secondary

a. changes in the rate, density, or type of development, including residential, commercial, industrial, or changes in the use of open space or other categories of land;

b. air or water quality standard violations stemming from secondary development; and

c. damage to sensitive ecosystems (e.g. wetlands) or jeopardy to endangered species, resulting from the secondary growth.

B. Environmental Impacts

To reduce the length of this chapter, only selected natural categories will be explored in detail with examples.

1. Water

a. Water Quality

The wastewater treatment plant and treatment effluent disposal subsystems affect water quality, as explained in the following example: The improvement of surface water quality by a higher degree of wastewater treatment would be an environmental benefit. The same high degree of treatment might reduce turbidity and BOD to the point where algae could grow (possible detriment) while the nutrients (nitrates or phosphates) that had not been removed might accelerate this growth. Consequently, there could be a short-term improvement in water quality which would result in a long-term adverse impact. Both would most likely be reversible, however.

The sludge disposal subsystem also affects water quality, as explained in this example. Proper sludge disposal on land would prevent surface water quality degradation over the long-term. If the water table were overlain by pervious strata, however, the quality of the groundwater might suffer over the long-term. Once contaminated the effect would probably be irreversible.

b. Water Quantity

The treated effluent can affect water quality, as explained here: The return of treated effluent to the surface watercourse might produce sufficient flow to allow several beneficial downstream uses over the long-term (recreation, fishery, water supply). By not selecting groundwater recharge as a treated effluent disposal method, threaten future supply (detriment). While depletion can be reversed, once contamination of the aquifer occurs it is not easily corrected.

The same review can be performed on the remaining subsections of this natural category (see below). The relationship between the project environment and the subsystem becomes clear rather quickly. Experience in writing the EIS will probably reduce the individual number of assessments to be made.

c. Water Quality Problems - examples will not be provided.

d. Water Uses - examples will not be provided.

e. Water Quality Management - examples will not be provided.

2. Air

An important factor to consider here is the effect on air quality of the increased availability of sewers in undeveloped areas. High population densities bring improved roads, more motor vehicle miles and finally a decrease in air quality. If the air quality in the project area is marginal, the project may produce air pollution while solving a water quality problem. The air pollution impacts may be adverse, of long-term duration, and irreversible. The proper incineration of sludge (without violation of air quality standards) is a complex problem. The design of air quality standards) is a complex problem. The design and operation of the unit must also consider the water quality (scrubbers) and solid waste (ash) problems involved. Impacts here might be reversible with an appropriate process change.

3. Land

The total picture of land use and the inherent environmental impacts should be explored. This category is especially impacted by new treatment capacity and sewers. Where excess capacity or where sewering of undeveloped areas may encourage population increases, the full importance of this development on air and water quality should be detailed in those categories. Site selection for the proposed actions should be discussed and mitigating steps explained where adverse impacts are involved.

It is especially important to evaluate the effects of collector and interceptor sewers on the probable growth within the project area when the proposed sewers will service or must traverse undeveloped or sparsely developed areas. If these conditions exist the following material should be provided. It should be prepared in conjunction with that in Chapter II, Section B. 8.

a. Maps

If these are available, include in the EIS maps of:

1) existing land uses with existing and proposed sewers, and

2) planned land uses.

These maps may be presented as overlays or any other suitable display technique.

b. Analysis of Land Use

With the above maps, determine those areas where the greatest probability exists for sewers to induce a change in land use either existing or proposed. The evaluation should discuss the anticipated rate of change of development both existing and proposed, population densities and how the design capacity of the sewers and the phasing of construction thereof might influence these considerations. Relate these possible changes in land use to the probable environmental, economic and social effects of the change. Discuss the reliability of existing or proposed zoning to adequately control development in the open space or lightly developed land areas.

c. Identification of Potential Problems

Where a land use plan for the area exists, there should be a brief discussion of the consistency of anticipated growth within the project area and the growth forecast by the plan.

Where land use plans and maps are sketchy or unavailable, an evaluation of the above factors should be made -- within the ability of the region to do so.

4. Biology - examples will not be provided.

5. Environmentally Sensitive Areas - examples will not be provided.

6. Aesthetics

Aesthetics is an elusive quality, difficult to evaluate and virtually impossible to value. However, aesthetics is a very essential part of a quality environment and society has become increasingly critical of those actions which will erode that quality in any way. This part should advise the public and the decisionmaker what the consequences of the action will be on the aesthetics of the area. This will necessarily be a subjective analysis.

C. Additional Impacts to Consider

The outlines provided in (B) above are not all inclusive. The preparer may find it appropriate to expand or decrease the factors to be considered in each category.

The process of project site selection should be examined in detail. This determination cuts across and impacts several categories. For example, some European countries have felt it was important enough environmentally to place the entire wastewater treatment plant underground. This was admittedly brought about by severe population densities, but points out that techniques are available to effect some very unconventional approaches to solve potentially adverse environmental impacts.

Where the engineering design has incorporated important environmental benefits, these should be given credit through an adequate exposure in the narrative. For example, energy conservation design for fuel.

D. "No Action" Alternative

The environmental impact (short and long-term) of allowing existing wastewater treatment works to continue without modification, upgrading or replacement, should be discussed, so the reader can compare the impacts of the proposed action to this alternative.

E. Summary

In addition to the narrative, the environmental impacts occurring in each environmental category should be displayed in a summary chart.

VI. Federal/State Agency Comments and Public Participation

The participation of local, State, and Federal agencies, individual citizens and interested environmental groups, in the review of environmental impact statements is of the utmost importance. Their suggestions, criticisms and objections should be given full consideration.

In general;

1. the EIS should cite and discuss each substantive suggestion, criticism or objection;

2. the author(s) of each comment should be identified;

3. if a comment has resulted in a change in the project or the EIS, the impact statement should say so and identify the change;

4. if a comment has been rejected, the EIS should explain the reason for rejection; and

5. a copy of any substantive comment (or summary thereof if the comment is voluminous) received on the draft statement must be attached to the final statement.

Agency and public participation in the review of the proposed action, through formal public hearings, should be identified and briefly discussed. If public hearings have not been held, or are not anticipated, this fact should also be noted.

The EIS should contain a complete reference of any hearings related to the proposed action. The reference should state the official title, time, date and place of the hearing and the specific reason why it was held. A summary of the hearing should be appended to the EIS.

If a public hearing is anticipated subsequent to the publication of the EIS, this should also be noted.

breakdown and decomposition of detritus, thus contributing to detrital food chains, detrital transport, and nutrient cycling. Estuarine systems are particularly important because of their high productivity and their role as nursery areas for benthic species.

A thermal discharge may have a variety of effects on macroinvertebrates. Aquatic insects having an emergent stage may enter the atmosphere early as a result of artificial heating of the water. The adults may emerge into cold air and die because of exposure, because food items are not in phase, or because normal egg laying conditions do not exist. Larval forms of marine invertebrates may develop at such high metabolic rates that the survival of individuals may be reduced during settling or maturation. Thermal discharges may stress ecosystems and cause shifts in community structure such that although the total biomass may not change significantly, desirable species may be replaced by less desirable species not involved directly in the food chain. The discharge of heat may cause stratification, which may diminish dissolved oxygen in the bottom layer and possibly eliminate benthic fauna.

Specific types of data are useful for the following reasons:

A. Standing Crop Estimates. These estimates are useful in determining the importance of macroinvertebrates to the productivity of the river or stream being impacted by the discharge. As previously discussed, the productivity of the affected portion of the system is a key factor in defining low and high impact areas.

B. Community Structure. The total number of species and the relative abundance of individual species (both components of diversity) in an aquatic system are a function of the physical, chemical, and biological characteristics of the system. Because diversity is sensitive to significant changes in the characteristics of the system (such as introduced heat), it can be an indicator of environmental stress. Additionally, a reduction in the diversity of a system frequently results in a diversion of production into non-useful forms.

C. Drift. In flowing waters, drift is an important survival mechanism for many species of macroinvertebrates. Since it is a passive function, the drifting organisms are subject to lethal temperatures occurring in a thermal plume. Drift is a stepwise downstream phenomenon, and many aquatic insects have a concomitant upstream movement of reproducing adults. The plume may thus affect populations both upstream and downstream from the area where mortality actually occurs.

D. Mapping. Mapping is necessary for a detailed representation of the distribution of substrates. This graphic information is important in the design of sampling studies, evaluating the suitability of the system for various benthic forms.

5. Fish. The discharge of waste heat can affect fish populations in many ways. The various data required are necessary in order to provide characterization of the indigenous fish community for the development of the RIS concept, to identify habitat utilization by the various populations, and to provide baseline information for comparison with post-operational studies.

Specific data parameters are related to possible adverse impacts from thermal discharge:

A. Species Level. Information on the spawning habits of individual species are necessary for assessing impact because spawning times may be shifted by thermal additions or habitats may be altered by scour or by changes in the habitat former community. Habitat use by any life stage may similarly be affected. Migration is an important factor to consider because thermal discharges can block upstream migration routes of spawning adults and downstream movements of small fish. Condition factors are useful in evaluation because heat additions may cause a loss of condition in certain species, especially in winter when their metabolic rate is still high but food supply is low.

The incidence of disease and parasitism may increase with a rise in water temperature. Age and growth data are helpful in comparing affected and non-affected areas, pre- and post-operational conditions.

B. Community Level. Data on species composition, relative abundance, and principal associations will define the dominant fish species at the site. Any appreciable change in these parameters signals an imbalance in the community and may indicate an adverse impact resulting from the thermal discharge. Species information is also necessary for developing thermal limits for the effluent.

C. Mapping. Maps are required in order to represent habitat areas (used for spawning, migration, etc.) in relation to the configuration of the discharge plume.

6. Other Vertebrate Wildlife. Data will be required in relatively few cases for this biotic category. In those cases where data is required, the type of data needed is decided by the applicant. The data selected should be the least amount of data necessary to complete this section of the demonstration.

7. Representative Important Species. Making predictions about "what will happen" are difficult without detailed information on the environmental requirements of communities or at least many populations and species. As mentioned in section 3.5.2, it is not economically feasible to study each species in great detail at each site. Therefore a few species are selected for detailed laboratory and literature survey. The data requirements of Tables A and B (section 3.5.2.2) are recommended as being helpful to those making 316(a) decisions for the following reasons:

A. They allow an estimation of the size of the areas which will be excluded for key biological functions and the duration of the exclusion.

B. They provide the basis for at least rough predictions of high temperature survival, heat and cold shock, and effects on reproduction and growth.

3.6 Type III Low Potential Impact Determinations

If the Regional Administrator/Director determines, after early screening studies, that the site is one of low potential impact for all biotic categories, the applicant may elect to do a "short form" demonstration, the "Low Potential Impact Type III Demonstration." The basic concept is that those applicants which have sites and proposed facilities which obviously pose little potential threat to the balanced indigenous population should be required to do less extensive (and expensive) aquatic studies than other (more poorly sited or otherwise having more potential for adverse impact) applicants.

Type III demonstrations in general are essentially any alternative demonstration type agreed upon by the applicant and the Regional Administrator/Director. The Low Potential Impact Type III demonstration proposed here is simply a recommended "short form" demonstration which considers information from each biotic category. This ensures that no major biotic category is ignored altogether and thus ensures that both the regulatory agencies and the applicant have examined and made judgments for each biotic category, but discourages collection of excess or unneeded data.

After the preliminary screening studies and determinations that all biotic categories are of low potential impact, the applicant summarizes this information (along with engineering and hydrological data and any other pertinent information) in one master rationale and submits the demonstration to the Regional Administrator/Director.

The format of the submittal should be similar to that suggested in section 3.5.5 except that the RIS sections should be deleted.

3.7 Other Type III Demonstrations (Biological, Engineering, and Other Data)

Those applicants not qualifying for a Low Potential Impact demonstration and not desiring to do a Type II demonstration, may (with the written concurrence of the Regional Administrator/Director) do a regular Type III demonstration. A Type III demonstration provides for the submittal of any information which the Regional Administrator/Director believes may be necessary or appropriate to facilitate evaluation of a particular discharge. This demonstration also provides for submittal of any additional information which the applicant may wish to have considered. Each Type III demonstration should consist of information and data appropriate to the case.

Detailed definition of a generally applicable Type III demonstration is not possible because of the range of potentially relevant information; the developing sophistication of information collection and evaluation techniques and knowledge, and the case-specific nature of the demonstration. Prior to undertaking any Type III demonstration, the applicant should consult with and obtain the advice of the Regional Administrator/Director regarding a proposed specific plan of study and demonstration. Decision guidance may also be suggested.

If the site is one of low potential impact for most biotic categories and/or there are other factors (small size or volume of water impacted, low percentage of cross section of receiving water affected, etc.) suggesting low potential for aquatic impact, the demonstration may not need to be completed in much more detail than the Low Potential Impact demonstration outlined in section 3.6. For most other sites, the demonstration should reflect a degree of detail and degree of proof comparable to the Type II demonstration (section 3.5). While Type III information may be different in thrust and focus, proofs should be generally as comprehensive as in Type II demonstrations and should result in similar levels of assurance of biotic protection.

Each item of information or data submitted as a part of a Type III demonstration should be accompanied by rationales comparable to those outlined in sections 3.5.1 and 3.5.4. The format of the demonstration should be similar to that outlined in section 3.5.5 except that the RIS sections should be deleted.

3.8 Decision Criteria

3.8.1 Biotic Categories

Decision criteria for each biotic category are given in section 3.3. The Regional Administrator/Director will compare the rationales (and other data) for each biotic category with the decision criteria in section 3.3 and determine if the decision criteria have been met.

3.8.2 Representative Important Species

The Regional Administrator/Director will find the Representative Important Species Rationale and other RIS information to be unacceptable if the information presented:

1. is too incomplete to allow a clear assessment; or

2. suggests (or does not provide a convincing argument to the contrary) that the balanced indigenous population may suffer appreciable harm because of:

   A. high temperature survival factors;

   B. heat or cold shock;

   C. improper temperature for growth, development, and reproduction; or

   D. the exclusion of areas and volumes of water from the above functions in critical combinations of time and space.

3.8.3 Resource Zones in Aquatic Systems

The strategies for reproduction, growth, and survival of the indigenous biota of freshwater, estuarine, and marine ecosystems are keyed to spatial and temporal variations in the structure (physical and chemical) of the environment. This structural variation in the environment, as it relates to the biota and to uses by man, has led to the concept of resource or "value zones" for use in evaluating or predicting the level of damage to aquatic systems from human activities. Since such zones vary in location, size, season of utilization, and criticality of function, their identification is also useful in planning purposes such as the siting of mixing zones for heated discharges. Application of this concept involves the identification and mapping of resource zones and critical functions* so that mixing zones can be sited in areas having minimum adverse impact on aquatic resources. Basic precepts necessary to application of the resource zoning concept include:

1. All discharges in the water body segment must be considered.

2. The acceptable area of damage is related to the resource value of the impacted area.

3. In cases where the effects of the discharged waste are transitory, the timing of mixing zone use is related to seasonal utilization of the impacted area.

4. The acceptable area of damage is related to the total amount of equivalent area available in the water body segment.

5. Areas supporting "critical functions" should be avoided (note item 3 above).

6. Acceptable damage is related to species generation time and/or fecundity.

7. For a given location, the smaller the damaged area the better.

3.8.3.1 Typical Resource Value Zones.

The following annotated list includes resource value zones which should be considered in the designation of mixing zones for heated discharges:

1. Spawning Sites. Reproduction is obviously a critical function in the survival of a species. Two factors of importance in designating mixing zones are the often limited area of habitat suitable for the spawning of a species and the limited time during which spawning occurs.

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* A zone having a "critical function" is one that provides a major contribution to primary productivity or is one that is limited in extent and necessary for the propagation and survival of a species.

If the availability of spawning sites for an important species is limited in extent, then such areas can generally be avoided and should not be designated for the disposal of waste heat. If it is totally impossible to avoid such sites, then the use for mixing should be timed to avoid the period of spawning. Seasonal avoidance is only feasible if the effects of the discharge are transitory.

2. <u>Food-Producing Areas</u>. The productivity of aquatic systems is directly related to the inputs of organic matter from green plants. The free-floating, relatively immotile microscopic plants (phytoplankton) are short-lived with rapid turnover rates and thus may not be critical in terms of mixing zones for heated discharges. The rooted vascular plants and macroalgae (macrophytes) which, with suitable substrate, grow from the shoreline to the depth of the photic zone (depth to which 1 percent of incident light penetrates) are relatively long-lived and perform a number of "critical functions" including:

   A. The production and export of vast quantities of organic fuel in the form of detritus—some are among the most productive plant communities known.

   B. As a result of an abundance of food and cover, they serve as nursery areas for the immature stages of many finfish and shellfish.

   C. The trapping and recycling of nutrients.

   D. The stabilization and building of substrate.

   Included in the category of food-producing areas are the wetlands—the interface between terrestrial and aquatic environments—which, in addition to the above enumerated functions, serve as freshwater recharge areas that meter freshwater inputs to lakes, rivers, and estuaries.

   Because of the many important and critical functions performed, the wetlands and other areas of macrophyte production in aquatic systems should be avoided when planning and designating mixing zones for heated discharges.

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3. Nursery Areas. These are areas having an abundance of food and cover for the growth and development of the early life stages of many finfish and shellfish. Since the early life stages are the periods of maximum growth rates and maximum vulnerability to predation, the availability of suitable nursery areas may be the limiting factor determining the abundance of a species. Thus, the zones of freshwater, estuarine, and marine ecosystems identified as nursery areas have high resource value and should generally be avoided when designating mixing zones.

4. Migratory Pathways. Included in this category are routes utilized for movement to and from spawning grounds, feeding grounds, and nursery areas; thus, the life stage involved may be adult, egg, larval, or juvenile. In some cases, these pathways are very circumscribed; and total blockage could result in extermination of a population in the water body segment. Since these pathways serve a "critical function," they have high resource value and should be avoided when planning the discharge of waste heat. In situations where the usage of pathways is seasonal and the effects of the discharge are transitory, deleterious effects may be avoided by proper timing of disposal. In terms of power plants, this seasonal usage is important in evaluating the feasibility of seasonal mode operation of cooling devices.

A consideration of zones critical to endangered species, usage by waterfowl and wildlife, and shellfish beds are additional resource values that must be considered when selecting mixing zones for heated discharges.

3.8.3.2 Methodology.

As discussed above, discharge sites should be selected which will have the least impact on important resource zones and "critical functions." The application of this concept to the selection of mixing zones is a stepwise procedure involving:

- A definition of the water body segment.

- Selection and listing of RIS in the water body segment and an enumeration of their strategies for propagation and survival.

- Preparation of a map of the water body segment showing zones of resource use, including areas supporting "critical functions."

- Assignment of a numerical value, per unit area, to each resource use.

- Superimpose predicted plumes on resource maps and select sites having least adverse impact on resource values.

1. Water Body Segment. In lakes and estuaries having discrete and easily definable physical boundaries, the designation of the water body segment will be a straightforward process. In large water bodies such as the Great Lakes, open coastal sites, and major river systems having no definable and reasonably sized physical boundaries, the selection of the water body segment may pose a difficult problem. Where they have been defined, the water body segments determined by the State Continuing Planning Process under section 303(e) of the Act will apply.

   The seasonal movements of important species of aquatic life must be considered when defining a water body segment. The spawning sites, nursery sites, and adult habitat sites of many freshwater and marine species (examples include salmonids, shrimps, crabs, spot, croaker, flounder, white bass, walleye, etc.) may be widely separated and include physically different water bodies. Seemingly slight impacts in the different areas used by such species may result in effects which, if considered cumulatively, would be intolerable. To avoid the potentially disastrous consequences of piecemeal consideration of adverse impacts, the water body definition should be sufficient to consider potential impacts throughout the contiguous range of populations of important species.

2. Representative Important Species. In general, this should include all species and communities of species that are critical to the functioning and the productivity of the aquatic system defined by the water body segment. Specifically included are species or communities which are:

   - Commercially and/or recreationally valuable.

   - Threatened or endangered.

- Primary producers—particularly those communities supporting relatively long-lived, fixed-location species that perform multiple services (form and stabilize habitat, produce organic matter, provide cover).

- Necessary (e.g., in the food chain) for the well-being of species determined in 1 and 2 above. Included here are the scavengers and decomposers critical to the breakdown and utilization of organic matter.

3. Map Preparation. Maps of the water body segment should, as a minimum, include depth contours, adjacent wetlands, tributaries and, in estuarine situations, the average salinity gradient and salinity stratification should be visually expressed in cross section. Resource zones and areas performing "critical functions" should be superimposed on the same or on a similarly scaled map. To avoid overlapping detail, it may sometimes be desirable to prepare separate maps for selected species.

4. Assignment of Values. Once the resource zones and zones supporting "critical functions" have been identified and mapped, then values per unit area can be assigned. If the effects of the discharge are transitory and the use of the resource zone is seasonal, the values may change throughout the year. If the zone supporting a "critical function" is li-ited in extent and is a function which limits the abundance and/or survival of a species, then that zone should be given a value of infinity and thus excluded from mixing zone use. Other zones may be assigned values according to their area and their importance in maintaining different species.

3.8.4 "Master" Rationale, Demonstration As a Whole

The Regional Administrator/Director will find the demonstration successful if:

1. It is found to be acceptable in all of the considerations outlined in steps 20-25 of the decision train (section 3.3.2).

2. There is no convincing evidence that there will be damage to the balanced, indigenous community, or community components, resulting in such phenomena as those identified in the definition of appreciable harm.

3. Receiving water temperatures outside any (State established) mixing zone will not be in excess of the upper temperature limits for survival, growth, and reproduction, as applicable, of any RIS occurring in the receiving water.

4. The receiving waters are not of such quality that in the absence of the proposed thermal discharge excessive growths of nuisance organisms would take place.

5. A zone of passage will not be impaired to the extent that it will not provide for the normal movement of populations of RIS, dominant species of fish, and economically (commercial or recreational) species of fish, shellfish, and wildlife.

6. There will be no adverse impact on threatened or endangered species.

7. There will be no destruction of unique or rare habitat without a detailed and convincing justification of why the destruction should not constitute a basis for denial.

8. The applicant's rationales present convincing summaries explaining why the planned use of biocides such as chlorine will not result in appreciable harm to the balanced indigenous population.

4.0 Definitions and Concepts

The definitions and descriptions in this section pertain to a number of terms and concepts which are pivotal to the development and evaluation of 316(a) studies. These are developed for the general case to aid the Regional Administrator/Director in delineating a set of working definitions and concise endpoints requisite to a satisfactory demonstration for a given discharge.

Adverse Environmental Impact

Adverse aquatic environmental impacts occur whenever there will be damage as a result of thermal discharges. The critical question is the magnitude of any adverse impact.

The magnitude of an adverse impact should be estimated both in terms of short term and long term impact with reference to the following factors:

(1) Absolute damage (# of fish or percentage of larvae thermally impacted on a monthly or yearly basis);

(2) Percentage damage (% of fish or larvae in existing populations which will be thermally impacted, respectively);

(3) Absolute and percentage damage to any endangered species;

(4) Absolute and percentage damage to any critical aquatic organism;

(5) Absolute and percentage damage to commercially valuable and/or sport fisheries yield; or

(6) Whether the impact would endanger (jeopardize) the protection and propagation of a balanced population of shellfish and fish in and on the body of water to which the cooling water is discharged (long term impact).

Aquatic Macroinvertebrates

Aquatic macroinvertebrates are those invertebrates that are large enough to be retained by a U.S. Standard No. 30 sieve (0.595-mm openings) and generally can be seen by the unaided eye.

Area of Potential Damage

The area of potential damage for RIS is defined as that area of the thermal plume enclosed by the isotherm which coincides with the appropriate (designated by the Regional Administrator/Director) water quality criteria for that particular RIS. This area can be determined from the plume rose data specified in section 3.5.3.

Balanced, Indigenous Community

The term "balanced, indigenous community" as defined here is consistent with the term "balanced, indigenous population" in section 316(a) of the Federal Water Pollution Control Act and 40 CFR section 122.9. A balanced, indigenous community consists of desirable species of fish, shellfish, and wildlife, including the biota at other trophic levels which are necessary as a part of the food chain or otherwise ecologically important to the maintenance of the community. In keeping with the objective of the Act, the community should be consistent with the restoration and maintenance of the biological integrity of the water. (See section 101(a).) However, it may also include species not historically native to the area which:

1. Result from major modifications to the water body (impoundments) or to the contiguous land area (deforestation attributable to urban or agricultural development) which cannot reasonably be prevented, removed, or altered.

2. Result from management intent, such as deliberate introduction in connection with a wildlife management program.

3. Are species or communities whose value is primarily scientific or aesthetic.

For purposes of a 316(a) demonstration, distribution and composition of the indigenous population should be defined in terms of the population which would be impacted by the thermal discharge caused by the alternative effluent limitation proposed under 316(a). A determination of the indigenous population should take into account all impacts on the population except the thermal discharge. Then, the discrete impact of the thermal discharge on the indigenous population may be estimated in the course of a 316(a) demonstration. In order to determine the indigenous population which will be subject to a thermal discharge under an alternative 316(a) effluent limitation, it is necessary to account for all non-thermal impacts on the population such as industrial pollution, commercial fishing, and the entrapment and entrainment effects of any withdrawal of cooling water through intake structures under the alternative 316(a) effluent limitation. The above considerations will then make it possible to estimate the true impact of the thermal discharge on the population.

Balanced, Indigenous Population (BIP)

For the purposes of 316(a) demonstrations, the term "balanced, indigenous population" is synonymous with the term "balanced, indigenous community" as defined above.

Community

A community in general is any assemblage of populations living in a prescribed area or physical habitat; it is an organized unit to the extent that it has characteristics additional to its individual and population components, and functions as a unit through coupled metabolic transformations.

Critical Function Zone

A zone that provides a major contribution to primary productivity or is one that is limited in extent and necessary for the propagation and survival of a species.

Director

The Director of the State NPDES permit program in those States which have been delegated the program by EPA.

Discharge Vicinity

The "discharge vicinity" is that area described by a radius that is 1.5 times the maximum distance from point of discharge to within 1°C of ambient. The area of the discharge vicinity is based on a 30-50% variation in the predictive thermal plume modeling.

Dominant Species

Dominant species are defined as any species representing five percent of the total number of organisms in the sample collected according to recommended sampling procedures.

Estuary

An estuary is defined as a semi-enclosed coastal body of water which has a free connection with the open sea; it is thus strongly affected by tidal action, and within it sea water is mixed (and usually measurably diluted) with fresh water from land drainage. It may be difficult to precisely delineate the boundary of estuarine and river habitats in the upper reaches of a fresh water river discharging into marine waters. The interface is generally a dynamic entity varying daily and seasonally in geographical location. In such cases, determination of habitat boundaries should be established by mutual agreement on a case-by-case basis. Where boundary determination is not clearly established, both estuary and river habitat biological survey requirements should be satisfied in a combined determination for environmental effects and best available technology for minimizing adverse impact.

Far Field Effect

A far field effect is any perturbation of the aquatic ecosystem outside of the primary study area that is attributable to, or could be expected, from the thermal discharge (taking into account the interaction of the thermal component with other pollutants).

Far Field Study Area (FFSA)

The far field study area is that portion of the receiving water body, exclusive of the primary study area, in which impacts of the thermal discharge and its interaction with other pollutants are likely to occur. The area shall include:

1. The zones where the habitats are comparable to those existing in the primary study area, and

2. The zones inhabited by populations of organisms that may encounter the thermal effluent during their life history.

The actual boundary of the far field study area should be agreed upon by the Regional Administrator/Director.

Habitat Formers

Habitat formers are any assemblage of plants and/or animals characterized by a relatively sessile life stage with aggregated distribution and functioning as:

1. A living and/or formerly living substrate for the attachment of epibiota;

2. Either a direct or indirect food source for the production of shellfish, fish, and wildlife;

3. A biological mechanism for the stabilization and modification of sediments and contributing to the development of soil;

4. A nutrient cycling path or trap; or

5. Specific sites for spawning and providing nursery, feeding, and cover areas for fish and shellfish.

Macroinvertebrates

For this document, the term "macroinvertebrates" may be considered synonymous with "aquatic macroinvertebrates" as defined above.

Meroplankton

For the purposes of this document, meroplankton are defined as planktonic life stages (often eggs or larvae) of fish or invertebrates.

Migrants

Migrants are nonplanktonic organisms that are not permanent residents of the area but pass through the discharge zone and water contiguous to it. Examples include the upstream migration of spawning salmon and subsequent downstream migration of the juvenile forms, or organisms that inhabit an area only at certain times for feeding or reproduction purposes.

Nuisance Species

Any microbial, plant or animal species which indicates a hazard to ecological balance or human health and welfare that is not naturally a dominant feature of the indigenous community may be considered a nuisance species.

Nuisance species of phytoplankton include those algae taxa which in high concentration are known to produce toxic, foul tasting, or odoriferous compounds to a degree that the quality of water is impaired.

Other Vertebrate Wildlife

The term "other vertebrate wildlife" includes wildlife which are vertebrates (i.e., ducks, geese, manatees, etc.) but not fish.

Phytoplankton

Plant microorganisms such as certain algae, living unattached in the water.

Plankton

Organisms of relatively small size, mostly microscopic, that either have relatively small powers of locomotion or drift in the waters subject to the action of waves and currents.

Primary Study Area

The primary study area is the entire geographic area bounded annually by the locus of the 2°C above ambient surface isotherms (determined in section 3.5.3.5) as these isotherms are distributed throughout an annual period. The reference ambient temperature shall be recorded at a location agreed upon by the Regional Administrator/ Director.

Principal Macrobenthic Species

Principal macrobenthic species are those dominant macroinvertebrates and plants attached or resting on the bottom or living in bottom sediments. Examples include, but are not limited to, crustaceans, mollusks, polychaetes, certain macroalgae, rooted macrophytes, and coral.

Regional Administrator (Director)

This term refers to the Regional Administrator of the U.S. EPA except that in those States which have been delegated the NPDES permit program, the term refers to the Director of the State NPDES permit program.

Representative, Important Species (RIS)

Representative, important species are those species which are: representative, in terms of their biological requirements, of a balanced, indigenous community of shellfish, fish, and wildlife in the body of water into which the discharge is made. Specifically included are those species which are:

1. Commercially or recreationally valuable (i.e., within the top ten species landed--by dollar value);

2. Threatened or endangered;

3. Critical to the structure and function of the ecological system (e.g., habitat formers);

4. Potentially capable of becoming localized nuisance species;

5. Necessary in the food chain for the well-being of species determined in 1-4; or

6. Representative of the thermal requirements of important species but which themselves may not be important.

Shellfish

All mollusks and crustaceans (such as oysters, clams, shrimp, crayfish, and crabs) which, in the course of their life cycle, constitute important components of the benthic, planktonic, or nektonic fauna in fresh and salt water.

Threatened or Endangered Species

A threatened or endangered species is any plant or animal that has been determined by the Secretary of Commerce or the Secretary of the Interior to be a threatened or endangered species pursuant to the Endangered Species Act of 1973, as amended.

Water Body Segment

A water body segment is a portion of a basin the surface waters of which have common hydrologic characteristics (or flow regulation patterns); common natural physical, chemical, and biological processes, and which have common reactions to external stress, e.g., discharge of pollutants. Where they have been defined, the water body segments determined by the State Continuing Planning

regulation patterns); common natural physical, chemical, and biological processes, and which have common reactions to external stress, e.g., discharge of pollutants. Where they have been defined, the water body segments determined by the State Continuing Planning Process under section 303(e) of the Federal Water Pollution Control Act apply.

Zooplankton

Animal microorganisms living unattached in water. They include small crustacea such as daphnia and cyclops, and single-celled animals such as protozoa, etc.

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MANUAL FOR PREPARATION OF ENVIRONMENTAL IMPACT STATEMENTS FOR WASTEWATER TREATMENT WORKS, FACILITIES PLANS, AND 208 AREAWIDE WASTE TREATMENT MANAGEMENT PLANS

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Environmental Protection Agency
Washington, D. C.

August 1973

BIBLIOGRAPHIC DATA SHEET	1. Report No.	2.	PB 235 280

4. Title and Subtitle Manual for Preparation of Environmental Impact Statements for Wastewater Treatment Works, Facilities Plans, and 208 Areawide Waste Treatment Management Plans	5. Report Date August 1973 - Date of issu
	6.
7. Author(s) Peter L. Cook and Ned Cronin	8. Performing Organization Rept. No. N/A
9. Performing Organization Name and Address Environmental Protection Agency, A-104 Office of Federal Activities 401-M Street S.W., Rm. 537WT Washington, D.C. 20460	10. Project/Task/Work Unit No. N/A
	11. Contract/Grant No. N/A
12. Sponsoring Organization Name and Address Same as above.	13. Type of Report & Period Covered Final
	14.
15. Supplementary Notes	

16. Abstracts

The volume presents detailed guidance for the preparation of environmental impact statements on wastewater treatment works and related plans.

17. Key Words and Document Analysis. 17a. Descriptors

Environmental Impact Statement
Wastewater treatment work
Facilities Plan
208 Areawide Waste Treatment Management Plan
Environmental Assessment
Primary or direct Impacts
Secondary or indiced Impacts

17b. Identifiers/Open-Ended Terms

17c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report)	21. No. of Pages
Rleease unlimited	UNCLASSIFIED	43
	20. Security Class (This Page) UNCLASSIFIED	22. Price 3.25-1.45