Ohio EPA

Division of Industrial Wastewater

Section 316 guidelines

GUIDELINES FOR THE SUBMITTAL OF DEMONSTRATIONS PURSUANT TO SECTIONS 316(a) AND 316(b) OF THE CLEAN WATER ACT AND CHAPTER 3745-1 OF THE OHIO ADMINISTRATIVE CODE

Division of Industrial Wastewater
State of Ohio Environmental Protection Agency
Box 1049, 361 East Broad Street
Columbus, Ohio 43216

September 30, 1978

TABLE OF CONTENTS

STATE OF OHIO ENVIRONMENTAL PROTECTION AGENCY

Guidelines for the Submittal of Demonstrations Pursuant to Sections 316(a) and 316(b) of the Clean Water Act and of the Ohio Administrative Code Chapter 3745-1.

I. INTRODUCTION*

The Federal Water Pollution Control Act (FWPCA) of 1972, Public Law (PL) 92-500, as amended, provided the mechanism through which all discharges to public waters shall come under regulation via the National Pollutant Discharge Elimination System (NPDES) permit program (Section 402) consistent with effluent limitations developed under Sections 301, 306 and certain other sections of PL 92-500. The Clean Water Act of 1977, PL 95-217, has since amended PL 92-500 with accompanying modifications to the NPDES permit procedure.

Heat has been defined in Section 502(6) as a pollutant and accordingly proposed effluent limitations for thermal discharges were developed by the United States Environmental Protection Agency (USEPA). Proposed effluent limitations guidelines and standards for the steam electric point source category were first published in the Federal Register on March 4, 1974 (Vol. 39, No. 43, p. 8294). Final effluent limitations guidelines and standards were published on October 8, 1974 (Fed. Reg. Vol. 39, No. 196, p. 36186) and became effective on November 7, 1974 (40 CFR Part 423). These regulations would have required many electric generating stations to utilize closed-cycle cooling systems with compliance dates being dependent on the age and size of each individual facility. Parts of these regulations, including all thermal limitations, were remanded by the United States Court of Appeals, Fourth Circuit (Appalachian Power Co. et al. v Train. 9ERC 1033) in July 1976 for further consideration by USEPA. Best Available Technology (BAT) guidelines for the steam electric point source category are to be proposed in 1978 and promulgated in 1979.

A. Section 316(a) of the Clean Water Act

The original language of this section of PL 92-500 remains unchanged in the Clean Water Act. Section 316(a) provides the owner or operator of a facility with a thermal discharge the opportunity to demonstrate that effluent limitations proposed under Sections 301, 306, and certain other sections of the Clean Water Act are more stringent than necessary. Specifically the language of Section 316(a) is stated as follows:

"With respect to any point source otherwise subject to the provisions of Section 301 or Section 306 of this Act, whenever the owner or operator of any such source, after opportunity for public hearing, can demonstrate to

---

*NOTE: The following paragraphs, including sections A through E, are intended to provide the reader with some of the major legislative and legal background involving the implementation of Section 316. Fully realizing that these issues and decisions are subject to change, Ohio EPA urges the reader to maintain an awareness of the legislative/legal status of Section 316 beyond the published date of these guidelines.

the satisfaction of the Administrator (or, if appropriate, the State) that any effluent limitation proposed for the control of the thermal component of any discharge from such source will require effluent limitations more stringent than necessary to assure the protection and propagation of a balanced, indigenous population of shellfish, fish and wildlife in and on the body of water into which the discharge is to be made, the Administrator (or, if appropriate, the State) may impose an effluent limitation under such sections for such plant, with respect to the thermal component of such discharge (taking into account the interaction of such thermal component with other pollutants), that will assure the protection and propagation of a balanced, indigenous population of shellfish, fish and wildlife in and on that body of water."

Federal regulations and USEPA procedures on alternative effluent limitations for thermal discharges were proposed on March 28, 1974 (Fed. Reg. Vol. 39, No. 61, P. 11434). Final rules and regulations were promulgated on October 8, 1974 (Fed. Reg. Vol. 39, No. 196, P. 36175) as 40 CFR Part 122 - Thermal Discharges. These regulations established procedures for the imposition of Section 316(a) of PL 92-500. Draft technical guidance manuals were circulated for public comment by USEPA at the time these regulations were proposed.

One of the primary purposes of this document is to provide guidance to owners and operators of facilities with thermal discharges for the submittal of 316(a) demonstrations and to outline decision criteria that will be used by the Ohio Environmental Protection Agency (Ohio EPA) in reviewing 316(a) requests. The objective of a 316(a) review and evaluation is to determine what maximum effluent limitation is compatible with the existence of a balanced, indigenous community based on information submitted by the applicant and that utilized by Ohio EPA.

B. Section 316(b) of the Clean Water Act

Like Section 316(a) the original language of this section of PL 92-500 remains unchanged in the Clean Water Act. Section 316(b) provides the mechanism through which the owner or operator of a facility with a cooling water intake structure may demonstrate that the structure meets the best technology available (BAT) for minimizing adverse environmental impact as follows:

"Any standard established pursuant to Section 301 or Section 306 of this Act and applicable to a point source shall require that the location, design, construction and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impact."

On April 26, 1976, the USEPA promulgated final regulations (40 CFR Parts 401 and 402) for cooling water intake structures (Fed. Reg. Vol. 41, No. 81, p. 17387). Section 401.12 provided that information contained in the Development Document (USEPA 1976a) accompanying these regulations is to be used in determining compliance with the statutory standard. Proposed rules and a draft of the Development Document were public noticed on December 13, 1973 (Fed. Reg. Vol. 38, No. 239, p. 34410).

On November 11, 1977 the U. S. Court of Appeals, Fourth Circuit (Appalachian Power Co. et al. v. Train. Nos. 76-1474 and 76-2057), remanded the 316(b) regulations to USEPA on the grounds that the Development Document (USEPA 1976a) had not been incorporated by reference in the Federal Register notice in accordance with the requirements of the Administrative Procedures Act. The Court has retained jurisdiction to hear objections on the merits of the 316(b) regulations once, and if, they are repromulgated. An important point in this particular case was the Court's ruling that Section 316(b) applies to all cooling water users (including steel mills, refineries, etc.), not just exclusively to electric generating facilities. A similar argument before the U.S. Court of Appeals, Seventh Circuit (U.S. Steel vs. Train, et al. 556 F 2d 822, 849), was previously rejected. In this same ruling the Court also held that 316(b) monitoring requirements do not require any type of "cost-benefit" analysis (556F. 2d 850) and found that requiring such studies was within USEPA's Section 308 authority for USEPA to set intake monitoring requirements (Milburn and Ginsberg, 1977).

C. Chapter 3745-1 of the Ohio Administrative Code (Ohio Water Quality Standards)

By order of the Director of Ohio EPA proposed amended rules 3745-1-01 to 3745-1-09 of the Ohio Administrative Code (OAC) and proposed new rules 3745-1-10 to 3745-1-14 of the OAC were adopted on January 13, 1978 and became effective on February 14, 1978. Existing rules 3745-1-01 to 3745-1-09 of the OAC (formerly Chapter EP-1) were rescinded at this time. Rules directly related to Section 316(a) are the definitions (3745-1-02) and temperature and thermal mixing zone standards (3745-1-06; 3745-1-07; 3745-1-11; 3745-1-12). Thermal mixing zones will be established pursuant to OAC 3745-1-06 (B), 3745-1-11(B)(2) and 3745-1-12(M). Thermal mixing zone size limitations will be defined as thermal effluent limitations in terms of the facility rejection heat rate in Btu/hr. Procedures used by Ohio EPA in establishing these limitations is detailed in subsequent sections of this document.

D. State of Ohio Environmental Protection Agency NPDES Permit Authority

The National Pollutant Discharge Elimination System (NPDES) requires that all discharges to navigable waters have a discharge permit. Conditions under which a discharge will be allowed are set forth in USEPA's Effluent Guidelines and Ohio EPA regulations (OAC 3745-33; formerly EP-31). On March 11, 1974 the State of Ohio was granted authorization from the USEPA to administer the NPDES permit program within the State of Ohio. Under this program all submittals for the consideration of alternative thermal effluent limitations to those proposed consistent with the provisions of Sections 301 or 306 of the Act, as provided for in Sections 316(a) and 316(b) will be made to Ohio EPA.

E. Relationships to Federal 316(a) and 316(b) Guidance Manuals

Draft technical guidance manuals for the performance of demonstrations pursuant to Sections 316(a) and 316(b) of the Clean Water Act have been circulated for public comment by USEPA. On April 22, 1974 and again on September 30, 1974 (USEPA 1974) the Water Planning Division of USEPA issued a draft manual of proposed guidelines for the administration of the proposed 316(a) regulations. Proposed final federal 316(a) guidelines were public noticed on April 28, 1977 (Fed. Reg. Vol. 42, No. 82 p. 21642) and a draft document (USEPA 1977a) was circulated for public comment on May 1, 1977. These documents described general information requirements to be fulfilled by an owner or operator of a facility with a point source thermal discharge in support of a request for the imposition of alternative thermal effluent limitations pursuant to Section 316(a). The newly proposed final draft document outlined procedures by which overlapping concerns of the USEPA with

Section 316(a) and the Nuclear Regulatory Commission (NRC) with NEPA (National Environmental Policy Act) could be better coordinated between the two agencies and the respective legislative acts from which each gain their regulatory authority. Federal 316(a) regulations (40 CFR, Part 122) provide for three demonstration types. Type I, "Absence of Prior Appreciable Harm", is applicable to existing facilities only. This demonstration type received more attention in the 1974 draft manuals (USEPA 1974) than in the 1977 draft document (USEPA 1977a). Type II, "Protection of Representative Important Species", is applicable to both existing and proposed sources. Much attention is given to this demonstration type in the 1977 draft document (USEPA 1977a). Type III, "Biological, Engineering and Other Data", is applicable to both existing and proposed sources.

The Ohio EPA developed a draft guidance manual (Ohio EPA 1974) for the submittal of 316(a) demonstrations and circulated copies for public comment on October 29, 1974. A second draft outline was issued in December 1975. This document more specifically develops and modifies some of the concepts in the federal documents, revises all previous draft Ohio EPA guidance, and coordinates applicable rules of the Ohio Water Quality Standards with Section 316(a). Comments by the Utility Water Act Group (UWAG) and the Edison Electric Institute (EEI) on the draft federal documents (UWAG-EEI 1976a, 1977a) were reviewed during the preparation of this document. Consistent with the federal 316(a) regulations three demonstration types are available to any 316(a) applicant. However, this document emphasizes the Type I, "Absence of Prior Appreciable Harm", and Type II, "Protection of Representative Aquatic Species"*, demonstrations.

Proposed draft 316(b) guidance (USEPA 1976b) was issued by the Water Planning Division of USEPA in April 1976. Proposed final federal 316(b) guidelines were public noticed on April 28, 1977 (Fed. Reg. Vol. 42, No. 82 p. 21642) and a draft document (USEPA 1977b) was circulated for public comment on May 1, 1977. These documents described general information requirements to be fulfilled by an owner or operator of a facility with a cooling water intake structure in demonstrating that the design, location, construction, and capacity of the cooling water intake minimizes adverse environmental impact. The federal 316(b) manuals stressed that the determination of best technology available is highly site specific. Both of the previous Ohio EPA guidance documents also contained some information on Section 316(b), but only in the form of monitoring requirements. The guidance in this document provides for the determination of best technology available for the design, location, construction, and capacity of existing intakes and proposed or new source intakes. Monitoring requirements for existing intakes are based on a "risk assessment" procedure while those for proposed or new source intakes are based primarily on siting (location) and design considerations. Comments by UWAG and EEI (UWAG-EEI 1976b, 1977b) on the draft federal guidance manuals were reviewed during the preparation of this document.

The need for statewide 316 guidance is justified by the fact that the proposed federal 316(a) (USEPA 1976a, 1977a) and 316(b) (USEPA 1976b, 1977b) guidance documents must be applicable nationwide and cannot take into account the specific needs of each local river or lake basin. By providing guidance on a statewide basis, information required by the federal guidance manuals may be dealt with more effectively by placing the proper emphasis on more pertinent requirements.

---

*NOTE: The term representative aquatic species (OAC 3745-1-02(II)) is used throughout the remainder of these guidelines and replaces the term representative important species although the use and meaning of the two terms is essentially identical.

F. 316 Demonstration and Study Plan of Submittal Procedures

316(a)

Application for the determination of alternative thermal effluent limitations by the Director of Ohio EPA pursuant to Section 316(a) of the Clean Water Act or Chapter 3745-1 of the OAC should be made in accordance with 40 CFR Sec. 122.11. The following procedures are suggested for this process:

1) For facilities without an effective NPDES permit an official request for the determination of alternative thermal effluent limitations should be submitted and may be included as part of an adjudication hearing request when a proposed permit and public notice is issued.

2) For facilities with an effective NPDES permit an official request for the determination of alternative thermal effluent limitations should be submitted as part of a permit modification application.

A written 316(a) study plan proposal should be submitted to Ohio EPA in accordance with 40 CFR Sec. 122.11(b)(2) and Sec. 122.13. Applicants are urged to submit the study plan proposal prior to the initiation of field sampling. The following items should be described as completely as possible by the applicant in the 316(a) study plan proposal:

1) thermal effluent limitation desired in Btu/hr;

2) identification of the demonstration type being pursued consistent with 40 CFR Sec. 122.15;

3) a comprehensive and detailed description of all field methods, analytical methods, sampling locations, and the study area;

4) a proposed schedule for the completion and submittal of the 316(a) demonstration; and,

5) data and information that may assist Ohio EPA in the selection of representative aquatic species (RAS) pursuant to 40 CFR Sec. 122.15(b)(2)(ii)(A) (Type II demonstrations only).

The 316(a) study plan proposal should be submitted prior to the initiation of field sampling and in a timely manner (90 days) so as to provide Ohio EPA time to review the proposal and to advise an applicant of any possible changes pursuant to 40 CFR Sec. 122.13. Applicants choosing to pursue a Type II demonstration should be aware that Ohio EPA, in accordance with 40 CFR 122.15(b)(2)(ii)(B), may require additional information as may be necessary to select RAS.

316(b)

Evidence in support of a request for the determination of best technology available (BAT) for the design, location, construction, and capacity of cooling water intake structures pursuant to Section 316(b) of the Clean Water Act should be submitted directly to the Division of Industrial Wastewater, Central Office, Columbus. A written 316(b) study plan proposal should also be submitted prior to the initiation of field sampling and in a timely manner (90 days) so as to provide Ohio EPA time for review and to advise an applicant of any possible changes. The following items should be described as completely as possible by an applicant in the 316(b) study plan proposal for an existing intake:

1) the potential impact of the applicant's cooling water intake based on the risk assessment guidelines;

2) a comprehensive and detailed description of all field methods, analytical methods, and the study area;

3) a detailed description of the sampling locations, frequency, and duration for each method and gear type used, and;

4) a schedule of the duration, completion, and submittal of the final 316(b) demonstration.

For proposed cooling water intakes the pre-construction sampling program should be fully described in a 316(b) study plan proposal. Such a plan should describe as completely as possible the following:

1) a comprehensive and detailed description of all field methods, analytical methods, and the study area;

2) a detailed description of the sampling frequency, duration, and location of sampling for each method and gear type used;

3) a rationale describing how the results of the pre-construction sampling program will be used to select the intake design, location, and capacity, and;

4) a schedule of the duration, completion, and submittal of the final 316(b) demonstration.

Upon completing its review of a 316(b) study plan proposal for either an existing or proposed cooling water intake Ohio EPA will advise an applicant as to the acceptability of the plan and may suggest any changes at that time.

As a general guideline all final 316 demonstrations and 316 study plan submittals should include an interpretive, comprehensive narrative with the supporting information, relevant reports, documents, publications, and literature citations. Thorough descriptions of field and laboratory methods should be included in the submittals. Ohio EPA requests that six (6) copies of the final demonstration and supporting documents and the 316 plan of study be submitted directly to:

Chief, Division of Industrial Wastewater
State of Ohio Environmental Protection Agency
Box 1049, 361 East Broad Street
Columbus, Ohio 43216

II. DEFINITIONS

Technical terms used in the 316 guidance manual shall be defined as follows:

Adverse Environmental Impact is damage that occurs whenever there is entrainment or impingement of aquatic organisms as a result of the operation of a cooling water intake structure. The acceptability of this damage is dependent upon the following:

1) the number of organisms entrained and impinged;
2) the percentage of each representative species population lost due to entrainment and impingement damage (when applicable to certain high risk intakes);
3) magnitude of damage to endangered species;
4) magnitude of damage to commercial or sport species;
5) magnitude of damage to ecologically valuable species; and,
6) whether the observed entrainment and impingement damage contributes to community unbalance.

Ambient Water Temperature is the spatial (longitudinal, lateral and vertical) and temporal water temperature structure that is actually measured before a specific waste heat discharge, and is outside the influence of any thermal mixing zone.

Applicant is a person or entity that requests the determination of alternative thermal effluent limitations pursuant to Section 316(a) or the determination of best technology available for cooling water intake structures pursuant to Section 316(b).

Appreciable Harm is unacceptable damage done to communities or populations that is not consistent with the goal of maintaining existing balanced communities or populations or the recovery of perturbed ones, and is the result of unacceptable environmental stress.

Average Temperature represents the arithmetic mean of multiple, equally spaced, daily average temperatures over a consecutive 15 or 30 day period, expressed as a 15 or 30 day average.

Balanced, Indigenous Community is an assemblage of balanced species populations living in a prescribed physical habitat that have a definite funcional unity, characteristic trophic structure, patterns of energy flow, and a compositional unity in that there is a certain probability that certain species will occur together. This definition shall include the goal of maintaining existing balanced communities and the recovery of perturbed ones. The characteristics of a balanced, indigenous community should reflect this goal and include the following:

1) all trophic levels necessary to the functioning of the community are present (includes necessary food web organisms);

2) non-domination by pollution (includes thermal) tolerant organisms, unless their presence is expected or cannot be directly attributed to environmental stress;

3) expected species are present and are in numerical proportion (relative abundance) to each other indicating that environmental stress is absent or minimal;

4) the ability of representative species to reproduce in numbers sufficient to maintain levels of relative abundance, and;

5) previous trends (taking into acount normal dynamic patterns) in community diversity, abundance, composition, and well-being are maintained.

A balanced, indigenous community shall not include species whose presence or abundance is attributable to point source discharges of pollutants that will be eliminated by compliance with Section 301(b)(2) of the Clean Water Act including alternative thermal effuent limitations pursuant to Section 316(a).

Biological Richness is a measurement or an indication of the amount and kinds of biological communities that a particular region, area, site, or water body supports or is capable of supporting. This may be measured in terms of community abundance, diversity and productivity, and the occurence of endangered, economically valuable, or ecologically valuable species.

Capacity refers to the volume of water that a cooling water intake structure is capable of withdrawing from a source water body, expressed as volume of water per unit time (e.g., m^3/sec, cfs).

Closed-cycle Blowdown is water released from a closed-cycle or continuous recycle cooling system for the purpose of preventing the concentration of dissolved solids within the system and to reduce corrosion, bio-fouling, or scaling.

Closed-cycle Cooling System is a continuous recycle of cooling water through a mechanical device or other closed system for the purpose of restricting the rejection of waste heat to waters of the State.

Community is an assemblage of species populations living in a prescribed physical habitat that have a definite functional unity, characteristic trophic structure, patterns of energy flow, and a compositional unity in that there is a certain probability that certain species will occur together. It is typically characterized by density (numbers), biomass (weight), diversity, trophic structure, and interspecific ecological processes (competition, predation, succession). These are basic characteristics that are common to both balanced and unbalanced communities.

Construction is any activity related to the installation and building of a cooling water intake structure.

Cooling Water is water used as a medium for the disposal of waste heat from an industrial process.

Cooling Water Intake Structure is a device used to divert water from a source water body into and through a facility for the purpose of absorbing waste heat.

Daily Average Temperature is the arithmetic mean of multiple, equally spaced temperature measurements to be taken at least once per hour during a 24-hour day.

Design refers to the plans, parts, components, details, and form of a cooling water intake or discharge structure.

Director is the Director of the State of Ohio Environmental Protection Agency (Ohio EPA).

Endangered Species are those species of the State's biota which are threatened with statewide extirpation as listed in Rule 1501:31-23-01 of the Ohio Administrative Code, or national extinction as listed in 50 CFR Part 17.

Entrainment is the pumping of organisms into and through a condenser cooling water system or similar cooling water process.

Estuary is the section of a Lake Erie tributary at the mouth where tributary and Lake Erie waters mix. This area is characterized by flow reversals, seiche influences and is generally located between the farthest downstream riffle of the tributary and Lake Erie proper. All tributaries of estuaries shall be considered estuaries below the Lake Erie mean high water level.

Expected Species are those species which, based on available historical distributional records and knowledge of the biology of such species, would reasonably be expected to occur in a given water body since its most recent permanent physical alteration in an expected abundance proportional to associated species in the absence of man-induced limiting conditions.

Facility is the structure and property that houses the process which requires cooling water and includes the structures and equipment necessary for the withdrawal, discharge, modification and treatment of cooling water.

Ichthyoplankton is the essentially free-floating (planktonic) egg or larval stage of fish.

Impingement is an event in which screenable aquatic organisms are caught, trapped, or pinned against the screening device of a cooling water intake as a result of cooling water withdrawal from the source water body through the screening system.

Irreversible Response is a reaction (usually negative) to stress by an aquatic population or community that is irreversible only as long as the stress is present.

Location is the physical placement or site of a cooling water intake structure.

Long-term Avoidance is the permanent or prolonged avoidance by a species population of an area or habitat that was formerly inhabited by that species population, but is absent or significantly reduced in density, biomass, and distribution as a result of limiting or unfavorable environmental conditions.

Long-term Survival is the indefinite survival of a species population under sub-optimal or sub-preferred environmental conditions.

Maximum Daily Temperature is the maximum hourly temperature observed during a 24-hour day.

Once-through Cooling is a process by which water is continuously diverted via a cooling water intake structure through a condenser where waste heat is continuously rejected into the cooling water and passed through a discharge structure into a receiving water body.

Owner/Operator is a person or company that owns, operates, and/or maintains a cooling water using facility.

Plume Entrainment is the passage of drifting aquatic organisms into and through a thermal plume.

Point Source is any discernable, confined or discrete conveyance from which a pollutant is or may be discharged to the surface waters of the state.

Population is an assemblage of individual organisms of the same species that have a definite functional unity and occupies a prescribed physical habitat. A population is typically characterized by density (numbers) and biomass (weight), production (growth and reproduction), structure (age-class relationships, recruitment) and intraspecific relationships (competition).

Receiving Water Body is surface waters of the state into which condenser cooling water is discharged.

Representative Aquatic Species are those organisms, either natural or introduced, which presently exist or have existed in the surface waters of the state prior to July 1, 1977; with exception of those banned species outlined in Rule 1501:31-19-01 of the Ohio Administrative Code. In addition, it will include any species that are legally introduced into the surface waters of the state. Specifically included are those species which:

1) represent the full range of response to environmental conditions from sensitive through tolerant;
2) are commercially or recreationally valuable;
3) are representative of each community trophic level;
4) are threatened, rare, or endangered;
5) are critical to the structure and function of the ecosystem;
6) dominate the community in terms of density and biomass;
7) are potentially capable of becoming localized nuisance species, or;
8) are indicative of the ecological and physiological requirements of species determined in 1-7, but which themselves may not be representative.

Short-term Avoidance is the temporary avoidance by a species population of an area or habitat caused by the onset of limiting or unfavorable environmental conditions.

Short-term Survival is the temporary survival of a species population under sub-optimal or sub-preferred conditions in which survival is time dependent.

Source Water Body is surface waters of the state from which cooling water is withdrawn.

Stability (Balance) is the dynamic persistence or constancy of numbers within a population or community that is characterized by the ability to withstand environmental stress without undergoing significant modification in structure, function, or composition.

Sympatric Species are two presumably closely related (ecologically and taxonomically) species which are competitors and have the same or overlapping areas of geographical distribution.

Thermal Effluent or Discharge is a point source discharge of cooling water.

Thermal Effluent Limitation is a limit placed on the amount of reject or waste heat (Btu/hr) that can be discharged to surface waters of the state.

Thermal Mixing Zone is a region of a water body into which waste heat is discharged that is of a different temperature structure than the receiving water body, and within which the average and maximum daily temperature standards are not met, except as prescribed by Chapter 3745-1 of the Ohio Administrative Code.

Waste Heat Discharge is a point source discharge through which excess heat is rejected into the surface waters of the state.

Worst Case is the most stressful combination of environmental conditions that are likely to occur (i.e., once in ten years) at the same time during a given season or given year. For the purposes of Section 316(a) this usually refers to the occurrence of high summer ambient temperature with low-flow or low-volume conditions and high facility waste heat output.

III. SECTION 316(a) PROCEDURES AND GUIDELINES

A. Introduction

The main objective of any 316(a) demonstration should be to provide the NPDES permitting authority with adequate information upon which thermal effluent limitations for individual facilities can be established which will insure the protection and propagation of a balanced, indigenous community. In order for Ohio EPA to accomplish this task certain information should be provided by the applicant.

The amount and sophistication of the information provided in a particular 316(a) demonstration should be directly commensurate with the known or potential impact that the thermal discharge in question has on the aquatic populations and communities resident to the receiving water body. Site-specific chemical, hydrological, and engineering information should also be provided. Biological information objectives will vary from site to site, but it will be generally recommended that all 316(a) demonstrations emphasize studies of the resident fish community.

Ohio Water quality standards (OAC Chapter 3745-1) for temperature and thermal mixing zones will naturally play an important role in the establishment of site-specific thermal effluent limitations. These limitations will be established by Ohio EPA in accordance with OAC 3745-1-06(B), 3745-1-11(B)(2), and 3745-1-12(M). Procedures used by Ohio EPA to establish site-specific thermal effluent limitations are discussed.

B. 316(a) Demonstration Types

Consistent with 40CFR Part 122 three demonstration types are currently available to 316(a) applicants. This document chooses to emphasize two of these three, the Type I "Absence of Prior Appreciable Harm" and Type II "Protection of Representative Aquatic Species" demonstrations.

Type I 316(a) Demonstration, "Absence of Prior Appreciable Harm"

The Type I 316(a) demonstration is applicable only to facilities which have commenced operation and thermal discharge prior to the filing of notice required by 40 CFR, Sec. 122.11(a). In order to receive a requested alternative thermal effluent limitation an applicant must demonstrate to the satisfaction of Ohio EPA:

1) that no appreciable harm has resulted from the thermal discharge (taking into account the interaction of the thermal component of the discharge with other pollutants and the cumulative effect of other thermal sources) to a balanced, indigenous community of fish, shellfish, and wildlife in and on the receiving water body; and,

2) that despite the occurrence of prior appreciable harm the desired alternative thermal effluent limitations (or appropriate modifications thereof) will nevertheless assure the protection and propagation of a balanced indigenous community of fish, shellfish, and wildlife in and on the receiving water body.

In considering whether or not appreciable harm has occurred Ohio EPA will consider information demonstrating compliance or noncompliance with current Ohio water quality standards during the period of facility operation together with information submitted by an applicant in the 316(a) demonstration. Additional information in the form of relevant scientific publications, reports, or oral communication may also be considered by Ohio EPA.

Type II 316(a) Demonstration, "Protection of Representative Aquatic Species"

The Type II 316(a) demonstration is available to owners and operators of facilities regardless of whether or not they have commenced operation and thermal discharge prior to the filing of notice required by 40 CFR Sec. 122.11(a). The term representative aquatic species is substituted for the term representative important species (40 CFR Sec. 122.15(b)(2)) throughout this document pursuant to its definition in OAC 3745-1-02(II). Alternative thermal effluent limitations may be granted by Ohio EPA if:

1) the applicant has demonstrated to the satisfaction of Ohio EPA that the thermal discharge in question will assure the protection and propagation of representative aquatic species, which were selected in accordance with these guidelines and 40 CFR Sec. 122.15(b)(2)(ii), whose protection and propagation, if assured, will assure the protection and propagation of a balanced, indigenous community of fish, shellfish, and wildlife in and on the receiving water body unless;

   i) the species selected by Ohio EPA are not representative in terms of the biological needs of a balanced, indigenous community in the receiving water body;

   ii) the temperature requirements employed in calculating the proposed alternative thermal effluent limitations are not adequate to assure the protection and propagation of those aquatic species in and on the receiving water body; or,

   iii) the temporal or spatial (area, volume, location, configuration) distribution of the thermal mixing zone is excessively large or otherwise inconsistent with the purposes of Section 316(a) or OAC Chapter 3745-1.

Ohio EPA may additionally consider information which demonstrates compliance or noncompliance with current Ohio water quality standards together with information submitted by the applicant, relevant scientific publications, reports, or oral communication.

Type III 316(a) Demonstration, "Biological, Engineering, and Other Data"

This demonstration type is available to owners and operators of any source regardless of whether or not it has commenced operation and thermal discharge prior to the filing of notice required by 40 CFR Sec. 122.11(a) or has attempted to pursue a Type I or Type II demonstration. Alternative thermal effluent limitations may be established by Ohio EPA on the basis of information submitted by the applicant that such limitations will assure the protection and propagation of a balanced indigenous community of fish, shellfish, and wildlife in and on the receiving water body. This information may consist of that submitted pursuant to a Type I or Type II demonstration, or any new or historical biological data, physical monitoring data, engineering models, or other relevant data, documents, or reports.

C. General Information Considerations

Certain minimum information should be provided in every 316(a) demonstration regardless of demonstration type or site specific characteristics. The detail and extent of the information provided should be commensurate to the known or potential impact of the thermal discharge in question although several general information categories will be the same for all facilities, regardless of impact. Differences between existing and proposed facilities should be obvious and are specified.

Location of Important Site Characteristics

Information about the location of the facility, thermal discharge, and relevant site-specific characteristics should include, but is not limited to, the following:

1) maps showing the regional location of the facility, adjacent point source discharges and water intakes, adjacent tributaries, and major population centers;

2) location and extent of the study area for each field method and technicque used (sampling locations); and

3) a description of the morphometry, substrate, shoreline, and artificial structures in and on the receiving water body.

Hydrological Information

Information regarding the hydrological characteristics of the receiving water body should include, but is not limited to, the following:

1) Rivers and Streams - monthly flow (cfs) duration analysis (including at least ten years of data), lowest monthly flows during each year of the ten year period, the seven-day, once-in-ten-year low-flow, the flow exceeded 90, 75, and 50 percent of the time, and the average flow;

2) Lake Erie Estuaries and Embayments - the mean high lake level and highest lake level on record, a description of the seasonal exchange of water between the estuary and embayment and Lake Erie including flow patterns, episodes of stagnation, wind effects, and flushing rates (up to ten years of data when available);

3) Reservoirs - spatial and temporal trends in flow-through time, release schedules, and water level; and,

4) Lake Erie - the mean high lake level and highest lake level on record, spatial and temporal variations in prevailing offshore and nearshore currents, and wind directions and effects.

This information should be provided for both existing and proposed facilities.

Meteorological Information

All relevant meteorological data used for any part of a 316(a) demonstration should be included as an appendix to the final demonstration and a discussion included in the text as to how the information was used. Meteorological data used for thermal modeling purposes should represent worst case, normal or typical, and average year conditions. Data is available for major weather stations from the National Weather Records Center, Asheville, North Carolina, for the period 1957 - present based on hourly readings during 1957-64 and tri-hourly readings during 1965 - present. The meteorological information includes a wide variety of parameters used in thermal modeling compiled on magtape in a card format and can be tailored to fit an investigator's own special needs.

Chemical and Water Quality Information

Section 316(a) of the Clean Water Act specifies that the thermal component of the applicant's discharge must be evaluated ".....taking into account the interaction of such thermal component with other pollutants....." Information provided in the 316(a) submittal on certain water quality parameters will assist Ohio EPA in assessing potentially harmful interactions. Chemical discharges to the receiving water body from point and non-point sources in close proximity to the applicant's facility and the facility itself may act synergistically with the thermal discharge. The amount of attention given to this particular subject in the 316(a) demonstration should increase as the actual quality of the receiving water decreases. Generally, each 316(a) demonstration should consider the interaction of the thermal component of the discharge with the following:

1) variations in the frequency, duration, and amount of chlorine used and the total chlorine residual and free available chlorine at the point of discharge and in the thermal mixing zone;

2) variations in the frequency, duration, and amounts of any other chemicals, biocides, additives, or other discharges which are contained in the cooling water discharge; and;

3) any chemical constituents or water quality parameters which, to the applicants best knowledge, exceed the standards set forth in Chapter 3745-1 of the OAC in the receiving water body.

Ohio EPA realizes that such information and analyses may be more difficult to provide in predictive (i.e., Type II) demonstrations because of a paucity of literature on the subject. However, these problems should nevertheless be addressed as completely as possible. Discussion of the relative impact of the interaction of the applicant's thermal discharge and other pollutants should be included in the text of the 316(a) demonstration.

Thermal Characteristics

Information about the temperature and dispersal of a thermal discharge should be described and illustrated for the following periods and conditions:

1) Seasonal - summer (mid-June through mid-September), fall (mid-September through November), winter (December through March), and spring (April through mid-June);

2) Flow (rivers and streams only) - at least one to four times the seven-day, once-in-ten-years low-flow during summer (for predictive modeling only);

3) Facility Operation - all usual phases of facility operation describing the coincidental occurrence of normal and extreme operational modes with flow (critical low-flow, 90%, 75%, 50%, and average flows) and ambient temperature conditions; and

4) Annual Trends - during worst case, normal or typical, and average meteorological conditions based on data available from the National Weather Records Center, or elsewhere.

Based on the conditions set forth in 1-4 above the following information about the temperature and dispersal of the applicant's thermal discharge should be included in the 316(a) demonstration:

1) percent duration of actual and predicted mixed river temperatures, with accompanying heat loads (Btu/hr);

2) maximum daily and daily average discharge temperatures with accompanying heat loads (Btu/hr);

3) maximum daily and average (15 or 30 day) mixed river temperatures with accompanying heat loads (Btu/hr);

4) actual and predicted downstream (rivers and streams) temperature decay and plume dispersal with time of travel and distance between isotherms (to the nearest $1^{o}C$ whenever possible) with accompanying heat loads (Btu/hr);

5) actual and predicted (if feasible) plume dispersal in lakes, reservoirs, embayments, and estuaries with time of travel and distance between isotherms (to the nearest 1°C whenever possible) with accompanying heat loads (Btu/hr); and,

6) cross-sectional description of the thermal plume with accompanying depth measurements.

It is important that each 316(a) demonstration contain the information required in 1-6 so that interim and final effluent limitations (Btu/hr) can be determined, and a thermal mixing zone can be defined pursuant to Chapter 3745-1 of the OAC.

Facility Operating and Design Information

Information about observed or expected facility operational modes should be done for a period of record which would preferably include the period of facility operation and the last ten years of meteorological, hydrological, and water temperature data. The following analyses should be done on a monthly basis for the period of record (e.g., one for January during the period of record, one for February, etc.):

1) monthly load (MWe) duration analysis for the period of operation (load increments not to exceed 10 percent of maximum rated capacity or 50 MWe, whichever is smaller vs. percent of time of operation within each load increment);

2) monthly reject heat rate (Btu/hr) duration analysis for the period of operation (reject heat rate in 1000 Btu/hr increments vs. percent of time of operation within each heat rate increment);

3) monthly load factor (MWe) in increments not to exceed 10 percent of maximum rated capacity or 50 MWe, whichever is smaller vs. river flow in increments not to exceed 10 percent of the seven-day, once-in-ten-years low-flow of the receiving water body or 50 cfs, whichever is smaller;

4) monthly reject heat rate (Btu/hr) in 1000 Btu/hr increments vs. river flow in increments not to exceed 10 percent of the seven-day, once-in-ten-years low-flow of the receiving water body or 50 cfs, whichever is smaller;

5) monthly cooling water discharge flow (cfs) in increments not to exceed 10 percent of the maximum cooling water demand or 100 cfs, whichever is less vs. river flow (cfs) in increments not to exceed 10 percent of the seven-day, once-in-ten-years low-flow of the receiving water body or 50 cfs, whichever is less;

6) age and start-up date of each unit and projected retirement dates if known; and,

7) complete description of the facility cooling water system (outfall configuration, discharge velocity, length of discharge canal(s), time of travel from condensers to outfall, angle of discharge).

Owners or operators of facilities discharging to surface waters other than rivers need only provide the information required by numbers 1, 2, 6, and 7. Owners and operators of proposed facilities need only provide the information required by numbers 1-5 if such can be provided. Information required by numbers 1 and 3 are applicable to electric generating facilities only. The requested facility operating information will provide Ohio EPA with the necessary baseline information against which biological information can be evaluated and from which interim and final thermal effluent limitations can be determined.

Records of Periods of Interrupted Thermal Discharge

Information is requested describing all variations in facility operations which have resulted in the discontinuation of the thermal discharge during the life of the facility. An assessment of the effects of discontinuance of the thermal discharge on the resident aquatic organisms in the receiving water body should be included. If the applicant has no information regarding the biological effects of prior interruptions of the thermal load, this should be clearly stated in the 316(a) submittal. The assessment should include a rationale stating why the cessation of the thermal discharge did or did not adversely affect the biological communities or populations of the receiving water body.

Correspondence Concerning Facility Thermal Discharge

The 316(a) submittal should include copies of all correspondence (excluding permit applications, monthly operating reports) between the applicant and any governmental agency or persons which deal directly with the thermal discharge of the facility in question. Any concerns expressed prior to approval of a study plan by Ohio EPA in the correspondence about possible harm to the biological communities or populations of the receiving water body should be addressed in the 316(a) study plan proposal.

D. Biological Information Considerations

The amount, precision, and detail of information that will need to be provided about the populations and communities resident to the receiving water body should be commensurate with the known, expected, or potential impact of the applicant's thermal discharge on these populations and communities. These are intended to be general guidelines and detailed needs of individual 316(a) demonstrations will be dealt with through agency-applicant interaction during the study plan review and evaluation. The primary emphasis of the biological information should be placed on assessing the status of the resident fish community relative to the applicants thermal discharge.

General Considerations

Certain information will be common to both the Type I and II demonstrations regardless of location, potential thermal impact, or whether the facility is existing or proposed.

Information about the distribution and abundance of biological populations and communities should be described according to the following:

1) Seasonal - emphasis in the majority of cases will be during the summer, but certain situations may demand detailed information during spawning (spring), spring and fall transitional periods, and during the winter months;

2) Flow - this is a concern in rivers and streams only and should include a variety of seasonal flow conditions, particularly during summer and fall low flow periods, and;

3) Receiving Water Body - areas that will need to be considered are reference or control areas, thermal mixing zone, well-mixed thermally influenced areas, and downstream or offshore recovery areas.

The commercial, recreational, and ecological value of the resident aquatic communities or populations in the study area, past and present, should be briefly discussed considering the following:

1) historical trends in commercial uses and yields and the value of each to the local and state residents (when such information is available);

2) historical trends in recreational uses and yields and the value of each to the local and state residents; and

3) ecologically unique aquatic populations and communities and the value of these to local and state residents; and,

4) endangered species.

Whenever field work is performed the applicant should maintain a voucher collection as part of the 316(a) support information to be made available to any qualified person or organization upon their request through Ohio EPA. Information concerning scientific collecting permits and possession of wild fishes, or other groups of wildlife, is available from:

Ohio Department of Natural Resources
Division of Wildlife
Fountain Square
Columbus, Ohio 43224

Special permits may be required to collect and possess species considered to be endangered by the State of Ohio. Information about these species is also available from the Division of Wildlife.

Type I Demonstration, "Absence of Prior Appreciable Harm"

A Type I 316(a) demonstration should rely primarily on empirical information. However, certain predictive techniques and thermal criteria may play an important part in the applicant's final demonstration and Ohio EPA's review and evaluation process. Basically there are two questions that should be answered by a Type I 316(a) demonstration. These are:

1) is there any evidence for the existence or occurrence of prior appreciable harm, and;

2) if appreciable harm is in evidence, is the protection and propagation of a balanced, indigenous community nevertheless provided for?

In order to answer these two basic questions certain information about the populations and communities resident to the receiving water body will need to be provided. Many times this type of information is most effectively presented through the use of tables, figures, and an accompanying discussion of each.

In attempting to show an absence of prior appreciable harm certain historical considerations will need to be made. Generally the historical benchmark with which the status of the populations and communities of the receiving water body will be compared is that which exists or did exist following the most recent permanent physical alteration of the receiving water body. Some examples of such permanent physical alterations are permanent impoundment, permanent channel modifications, and basin wide deforestation. Point source influences that are subject to control pursuant to Section 301 of the Clean Water Act and non-point source influences that are subject to control pursuant to Section 208 of the Clean Water Act will not be considered as permanent physical alterations.

In order to determine the extent or existence of prior appreciable harm the following information about individual populations should be provided:

1) an annotated list of the composition of aquatic communities (primarily fish) with an indication of each species relative abundance, commercial and recreational value, ecological role or function, endangered status, and any other relevant information based on historical records and data collected during the 316(a) studies;

2) activities associated with the reproduction of representative aquatic species, including pre and post-spawning movements, location(s) of spawning, dispersal of eggs and larvae;

3) attraction of fish to the thermal mixing zone during fall, winter, and spring, noting for each representative species general age (young-of-the-year, juvenile, adult) and relative abundance (seasonal development and maturation of reproductive organs of an abundant aquatic species should be considered by the applicant whenever there is evidence of an attraction of large numbers of individuals to the discharge zone);

4) avoidance by any species of any area of the receiving water body that is influenced by the applicant's thermal discharge;

5) thermal tolerance criteria for each of the species principally involved with the applicant's thermal discharge should be discussed relative to observed or predicted thermal responses (avoidance, growth, attraction, mortality) considering those species for which reliable criteria is available and at the same time representing a range of thermal responsiveness from sensitive through tolerant;

6) interaction of temperature with other chemical or water quality parameters noting any synergistic reactions that may adversely affect any representative aquatic species; and,

7) historical trends considering species that were formerly abundant, but are presently reduced in relative abundance or absent in the study area, stating a rationale as to why the decrease in abundance may not be attributable to the applicant's thermal discharge.

Although a Type I demonstration relies primarily on empirical data the rarity of many species observed during field sampling may limit their meaningful contribution to the final demonstration. Only the most abundant species will lend themselves to any detailed analyses and should receive the most emphasis in the final demonstration. Species found to be rare that were historically abundant (number 7 above) should receive the same emphasis.

In order to determine if the protection and propagation of a balanced, indigenous community is nevertheless maintained the applicant should consider the following community information:

1) spatial, temporal, and annual shifts or changes in community composition in the study area (by numbers and weight), and;

2) spatial, temporal, and annual changes and variations in community abundance (numbers and weight), diversity, and well-being.

Spatial and temporal changes and trends in any of the aforementioned population and community information categories between the previously described seasons and sections of the study area during the described events should be discussed as to why the observed situation does or does not constitute evidence of appreciable harm and if the protection and propagation of a balanced, indigenous community is nevertheless provided for.

Type II Demonstration, "Protection of Representative Aquatic Species"

A Type II 316(a) demonstration will primarily be predictive in nature, however, applicants are urged to develop an empirical information base, particularly with respect to the development of representative aquatic species (RAS) lists. Pursuant to 40 CFR Sec. 122.15(b)(2)(ii)(A), upon notification by an applicant of intent to pursue a Type II 316(a) demonstration Ohio EPA will promptly notify USEPA, Region V, the designee of the Secretary of Commerce, the U. S. Fish and Wildlife Service, and the Ohio Department of Natural Resources that representative aquatic species (RAS) will be identified and will consider any timely (30 days) recommendations. The applicant may submit any information that may be available to assist Ohio EPA in selecting appropriate RAS, at the time of the initial notification.

In selecting RAS for a particular situation Ohio EPA will adhere to the RAS definition that appears in the Ohio water quality standards (OAC Chapter 3745-1). As found in OAC rule 3745-1-02(II) the definition is stated as follows:

> "Representative Aquatic Species are those organisms, either natural or introduced, which presently exist or have existed in the surface waters of the state prior to July 1, 1977; with the exception of those banned species outlined in Rule 1501:31-19-01 of the Ohio Administrative Code, in addition, it will include any species that are legally introduced into the surface waters of the state. Specifically included are those species which:
>
> 1) represent the full range of response to environmental conditions from sensitive through tolerant;
> 2) are commercially or recreationally valuable;
> 3) are representative of each community trophic level;
> 4) are threatened, rare, or endangered;
> 5) are critical to the structure and function of the ecosystem;
> 6) dominate the community in terms of density and biomass;
> 7) are potentially capable of becoming localized nuisance species; and,
> 8) are indicative of the ecological and physiological requirements of species determined in 1-7, but which themselves may not be representative."

Selection of RAS should be focused primarily on fishes and criteria 1 through 8 will apply directly to them. Each species selected should satisfy at least one of the eight selection criteria. In order to be representative of the environmental requirements of a balanced, indigenous community it will be important that the RAS list be representative of the sensitivity of the community to thermal alterations. Species that have or are currently providing commercial and recreational benefits should be included. The term trophic level in the third criterion does not mean the entire ecosystem food web, but means the different trophic levels within a taxonomic group such as fishes. Threatened, rare, and endangered species are primarily those species recognized as such pursuant to OAC Rule 1501:31-23-01 and 50 CFR Part 17, but may include species not in these lists which according to recent information are declining in abundance and range. Species that are critical to the structure and function of the ecosystem are those species that contribute significantly to the existence of community balance. The most abundant species by number and weight may be determined by a field sampling program and should be designated as RAS. Nuisance species are those that have the capability to become so abundant that they may seriously affect other species and contribute to community unbalance. Species that are not necessarily representative according to the first seven criteria may be substituted for a closely related representative species for which inadequate physiological or ecological information exists. In addition to species selected according to these criteria any species included in the development of the Ohio water quality standards (OAC Chapter 3745-1) shall also be considered for designation as RAS. If available information is insufficient to enable the selection of RAS Ohio EPA may request the applicant to conduct field studies in order to furnish such information. Field studies should consider the same seasons, conditions, and events as were outlined for the Type I demonstration. However, the amount and detail of the field information provided should be commensurate with the known or potential impact of the thermal discharge under consideration.

Ohio EPA will notify the applicant of the RAS selections, or the inability to make such selections because of insufficient information, within 60 days after the receipt of notification that the applicant will attempt a Type II demonstration.

The development of an RAS list will be a continuing process beginning with the initial applicant request for the determination of alternative thermal effluent limitations and ending with final Ohio EPA designation of RAS pursuant to 40 CFR Sec. 122.15(b)(2)(ii). Criteria for the designation of RAS have been established, but site-specific interpretation of these criteria requires clarification. Both the qualitative (kinds of species) and quantitative (number of species) characteristics of an RAS list will depend on site-specific factors such as:

1) the known or potential impact of the applicant's thermal discharge upon the populations and communities of the receiving water body;
2) recent water quality trends in the receiving water body;
3) the most recent permanent physical habitat alteration of the receiving water body;
4) the geographical distribution of the aquatic species being considered;
5) the availability of temperature criteria for each species; and,
6) the quality and quantity of information available for the particular site under consideration.

The known or potential thermal impact that an applicant's facility will have on the populations and communities of the receiving water body will directly affect the number of species designated as RAS and the amount and detail of information needed for their selection and use. As a general guideline the number of species designated as RAS should fall between five (5) and fifteen (15). Field studies conducted in support of the RAS designations and conclusions drawn from analyses of them should increase in effort and detail as the potential or reality of thermal impact increases.

A RAS list should consider recent trends in the water quality of the receiving water body. This is an especially important consideration in water bodies with degraded, aquatic life limiting water quality conditions. Water quality in such waters should improve and continue to improve as point sources come into compliance with Section 301 and non-point sources under Section 208 or other applicable limitations. The quality and diversity of aquatic communities should improve as compliance with effluent limitations and water quality standards is attained, therefore the composition of the RAS list should be commensurate with expected improvements in water quality. Thus the establishment of the RAS list should consider community composition under:

(1) existing water quality conditions; and,

(2) water quality conditions that are expected to exist when all point source discharges come into compliance with applicable effluent limitations and water quality standards.

The RAS expected under degraded water quality conditions should take into consideration the time table for attainment of these standards in the study area. It may be necessary in such situations to develop interim RAS lists consistent with the expected improvement of effluent and water quality in the study area through time. The RAS list should also take into account community composition prior to the initial operation of a facility if such information is available. The rationale for this approach is based on the possibility that the facility in question may have impacted one or more species populations to the point where that species would no longer be considered representative because of its reduced abundance. For proposed facilities the RAS selections should at least reflect the present community composition and structure or that which is consistent with the definition of balanced, indigenous community.

Development of an RAS list should take into account the most recent permanent physical alteration to the receiving water body. Some examples of such permanent physical alterations are permanent impoundment, permanent channel modifications, and regional deforestation. Water quality changes that have occured as a direct result of point or non-point sources controllable under Sections 301 or 208 of the Clean Water Act do not constitute permanent alterations.

The natural geographical distribution of the aquatic organisms under consideration for designation as RAS will be taken into account. Species whose local populations in the study area are peripheral to their distributional range will not usually be selected as RAS. Such peripheral local populations may be subject to periodic, but normal range expansions and withdrawals which may mimic or mask effects of the applicant's thermal discharge. Species whose populations appear to be consistently expanding their geographical range may qualify as RAS and will not be discounted. Sympatric species will be considered as RAS whenever this event is observed. The rationale for considering two such related species is that a thermal discharge may create a competitive advantage for one species over the other that would otherwise not have existed.

The availability of temperature criteria for each species will be an important factor in the selection of RAS. The literature abounds with information on temperature criteria for fish with much of it devoted to species with a direct economic or recreational importance to man. Many species that are important to community structure and function and a number of endangered species have received considerably less attention.

The quality and extent of the historical information available for a given area could limit the development of an RAS list. The frequency of occurence of this event in Ohio should be rare since most of the State's waters have been previously surveyed. However, the quantity and quality of such information is not always consistent throughout the state and any deficiencies should be resolved through a field sampling program as previously mentioned. Other possible problems such as the "age" of the historical records combined with recent changes in water quality may necessitate a thorough sampling program at certain locations.

IV. 316(a) DECISION GUIDANCE

A. Ecological Definitions and Criteria for the Assessment of Thermal Discharge Effects

The ecological effects of thermal discharges on aquatic communities and populations have been observed in numerous freshwater rivers and lakes. Many of the criteria used for the assessment of these effects have been subjected to a wide variety of uses and technical interpretations. The opportunity that is provided to owners and operators of facilities with thermal discharges by the provisions of Section 316(a) and the ensuing federal regulations for the determination and imposition of alternative effluent limitations (40 CFR, Part 122) has focused much attention on two concepts, "balanced, indigenous community" and "appreciable harm."

It should be understood by all 316(a) applicants that the purpose of this decision guidance is to present the criteria and rationale that Ohio EPA will use in reviewing and evaluating individual 316(a) demonstrations.

Balanced, Indigenous Community

This term gains importance from its inclusion as an integral part of the language of Section 316(a). Although the superficially similar term balanced, indigenous population appears in the language of Section 316(a) it has been synonomized with balanced, indigenous community (40 CFR, Sec. 122.1 (i)). For the purposes of this document balanced, indigenous community refers to an assemblage of several species populations having a definite functional unity.

It is essential that the concept of balance be defined and its applicability to Section 316(a) discussed and clarified. Pursuant to this need three questions are considered:

1) what is the concept of balance?

2) how is balance measured?

3) what are the characteristics of a balanced indigenous community?

The Balance or Stability Concept

The concept of balance involves the quantitative and qualitative aspects of the structure, composition, and function of a multi-species community. When this concept is applied to the term balanced, indigenous community, as it relates to Section 316(a), it assumes a degree of quality concerning community structure, function, and composition. This means that there is a certain level of desirability to be maintained <u>or</u> recovered. Thus the concept of balance will involve the attainment of <u>a</u> goal, specifically that of maintaining existing balanced communities <u>and</u> the recovery of perturbed or unbalanced ones.

A concept that is closely related to that of balance, and is more readily defined, is that of stability. For the purposes of this guidance the terms balance and stability are considered synonomous. Stability is the characteristic or "property" that gives a population or community the ability to withstand environmental stress without undergoing significant modification in structure, function, or composition (Gerking 1950; Preston 1969). Preston (1969) properly maintained that whatever stability there is in the ecological world is not a static equilibrium, but is a fluctuating or dynamic one. If the concepts of stability and balance are indeed synonomous, as each is applied in this document, then it should be recognized that the concept of balance is not an easily measured static equilibrium, but rather involves a less easily measured dynamic equilibrium. Goodman (1975) defined stability as the persistence or constancy of numbers within a population or community. Odum's (1971) stability principle is in agreement with the constancy aspects of Goodman's (1975) definition in that self-regulating mechanisms bring about a return to constancy if a system (population or community) is caused to change from the stable or balanced state by a momentary outside influence. It is then logical to assume that if the ability of a population or community to withstand environmental stress is exceeded (i.e., self-regulating mechanisms are inhibitied or prevented from acting), a state of unbalance then exists. The magnitude of the unbalance and the length of time that it exists is probably directly proportional to the mangnitude and duration of the environmental stress. The ability of self-regulating mechanisms to compensate for an environmental stress will determine in large part the extent to which community balance or unbalance exists. The major point being made in this discussion is that there are varying degrees of environmental stress that may be exerted on a population or community which result in varying degrees of perturbation or unbalance. The resultant degree of unbalance is dependent on the population and community self-regulating mechanisms involved and the ability of these mechanisms to maintain balance.

What are some examples of self-regulating mechanisms? Hall (1972) indicated that an organism subjected to stress has three choices; 1) it can die, 2) it can adjust to the new conditions, or 3) it can migrate to a more suitable environment. These three choices could be better defined with respect to thermal effects as; 1) thermal mortality, 2) acclimation and 3) avoidance. These are three well known and widely accepted physiological and behavioral responses that have been observed numerous times in the field and laboratory. Of these three responses one, acclimation, is a self-regulating mechanism whereas thermal mortality and avoidance are the results of the inability or failure of an organism to invoke this self-regulating mechanism. To what extent population or community unbalance is caused by the exceedence of the ability of a particular species to invoke this self-regulating mechanism is again dependent on the degree and duration of the environmental stress being exerted.

Measurement of Balance

It is necessary to measure the balance of populations and communities in order to determine if it does indeed exist in a given situation. Several methods and techniques have been employed in attempts to measure community balance yet apparently no single method has gained widespread acceptance and those that once did are coming under the close scrutiny of several investigators.

One of the most popular methods of measuring community balance has been the index of diversity which was first proposed (as α) by Fisher et al. (1943). This index was developed to show the relationship between the number of species (species richness) and number of individuals within each species (eveness) in a given community. MacArthur(1955) and Margalef (1958) later proposed indices ($\bar{d}$) based on the information theory (Shannon 1948). Possibly the most widely used and accepted diversity index ($\bar{H}$) is that proposed by Shannon and Weaver (1963) which also is based on the information theory. Odum (1971) related diversity to stability, but was unsure about the extent that the relationship was a cause and effect one. Goodman (1975) explained that the vague, but widely accepted notion that more diverse communities are more stable (diversity-stability theory) is an aesthetically pleasing hypothesis. This has been influential to the extent that it was cited as more or less of a cause in much literature which discussed diversity and has been repeated as a fact in textbooks, conservation pamphlets, and environmental policy (Goodman

1975). The theory of diversity-stability has been popular most likely for the reason that the index ($\bar{H}$) which supports it is a relatively easy measurement and interpretation of a very complex arrangement. The index of diversity ($\bar{H}$) has gained widespread usage in environmental impact assessment procedures and particularly in 316(a) demonstrations. However, some potentially valid concerns about the diversity-stability theory prompt serious questions about the usefulness of $\bar{H}$ alone as a measure of community stability and reveals the need to consider other measurements as well.

Alternatives to H and similar indices have been proposed and are available. Dickman (1968) recommended that $\bar{H}$ be modified to reflect the relative productivity of each species instead of relative abundance. Hurlbert (1971) disagreed that all community tropic levels need to be considered in such an index and recommended one based on the probability of interspecific encounter. A composite index of community "well-being" (I_{WB}) has been proposed by Gammon (1976a) for use in the assessment of water quality conditions, based on the relative "well-being" or "health" of the fish community, over extended distances in freshwater rivers.

The concept of the relative abundance and numerical relationships between species serves as the quantitative basis of $\bar{H}$ and the other indices just discussed. However, in the assessment of community stability it is equally important to discuss this same concept in a qualitative sense. A knowledge of the kinds of species that are present and their numerical relationships to each other is necessary in order to assess the status or well-being of a given community. This concept was used effectively by Smith (1971) in classifying stream systems in Illinois. In all cases Smith (1971) was able to identify the chief factor responsible for the presense or absence of a particular fish species and the subsequent effect that it had on the community. As an example of this process Smith (1971) classified a stream as excellent if the expected fish species were still present in a numerical relationship to each other that is indicative of little or no modification to the aquatic environment. The absence of an expected species or the domination of the community by recognized pollution tolerant species led to a lower classification. This concept is closely alligned to the natural historical approach recommended by Goodman (1975) as an alternative to the use of diversity indices for measuring community stability or balance.

In summary the measurement of community stability or balance includes both the quantitative and qualitative aspects of community structure, function, and composition. An accurate assessment of community stability or balance should recognize the importance of community species composition and the numerical relationships between the kinds of species in the community.

Characteristics of Balanced Communities

In order to be able to recognize balanced communities it will be prerequisite to know some of their characteristics and identifying traits. Most of the measurements that have been discussed are based on the numerical abundance of individual populations and the subsequent relative abundance relationships between those populations in the community.

A community is defined as an assemblage of species populations living in a prescribed physical habitat that have a definite functional unity, trophic structure, patterns of energy flow, and a compositional unity in that there is a certain probability that certain species will occur together. Communities are typically characterized by density (numerical abundance), biomass (weight), diversity, trophic structure, and interspecific ecological processes (competition, predation). These are basic characteristics which are common to balanced and unbalanced communities alike. The definition, use, and interpretation of the term balanced, indigenous community should involve the attainment of the goal of maintaining existing balanced communities and the recovery of perturbed or unbalanced ones. Thus the characteristics of a balanced, indigenous community should reflect this goal and relate directly to the empirical measurements used to determine if balance exists. A balanced, indigenous community, as the term applies to Section 316(a), may be characterized by, but not limited to, the following:

i) all trophic levels necessary to the functioning of the community are present (includes presence of necessary food web organisms);

ii) non-domination of the community by pollution tolerant species, unless their domination is expected and cannot be directly attributed to thermal stress;

iii) expected species are present and in numerical proportions to each other that indicates that adverse thermal stress is minimal or absent;

iv) the ability of representative species to grow, survive, and reproduce in numbers sufficient to maintain levels of relative abundance, and;

v) previous normal trends (taking into account normal dynamic patterns) in community abundance, diversity, well-being, and composition are maintained.

In addition a balanced, indigenous community shall not include species whose presence or abundance is attributable to point source discharges of pollutants that will be eliminated by compliance by all sources with Section 301(b)(2) of the Clean Water Act, including alternative thermal effluent limitations pursuant to Section 316(a).

The methods and procedures for determining if a given thermal discharge provides for the protection and propagation of a balanced, indigenous community of fish, shellfish, and wildlife will be different between the Type I and Type II demonstrations. In the case of a Type I demonstration the conditions set forth in (i) through (v) above will be judged primarily on the basis of empirical information submitted in the final 316(a) demonstration and that available in any relevant reports or publications. However, predictive methods of assessment and thermal criteria may be used by either an applicant or Ohio EPA to supplement empirical information or whenever information is insufficient for making a final determination. A Type II demonstration, on the other hand, will be inherently predictive, especially in the case of proposed sources. However, this does not rule out field sampling since empirical information may be required by Ohio EPA (pursuant to 40 CFR Sec. 122.15(b)(2)(ii)(B)) for the development of the RAS list. Ohio EPA, in its determination of whether or not alternative thermal effluent limitations are appropriate, will consider information demonstrating that an applicant's thermal discharge will comply with the conditions set forth in (i) through (v) above and in any applicable water quality standards.

Appreciable Harm

The existence of community balance is dependent on the degree and duration of an adverse thermal stress and the ability of a community to withstand the stress. An exceedence of this capacity to withstand thermal stress results in community unbalance.

Appreciable harm is the result of adverse or unacceptable thermal stress which results in unacceptable damage done to a community. It is not consistent with the goal of maintaining existing balanced communities or the recovery of perturbed or unbalanced ones. The two primary factors involved with appreciable harm are, 1) the degree and duration of thermal stress, and 2) the composition of the community involved. If the ability of a population or community to withstand stress (i.e., invoke self-regulatory mechanisms) and remain balanced is exceeded, then there is evidence of appreciable harm. Short-term stress indicators such as short-term avoidance by a representative species or minor shifts in community composition possibly suggest that brief periods of thermal stress may be acceptable. Conversely, long-term stress indicators (e.g., long-term avoidance), suggest that longer periods of stress are unacceptable and that remedial measures are required to restore community balance. Such remedial measures may range from complete to partial removal of the thermal stress.

This term will be applicable to the assessment of existing sources. 316(a) demonstrations for proposed thermal discharges will rely on predictive methods of assessment.

Appreciable or unacceptable harm done to populations or communities by existing thermal discharges is suggested by, but not limited to, one or more of the following:

i) blockage of migratory routes and interference with normal movements of representative species;

ii) failure of representative species to reproduce in numbers sufficient to maintain previous levels of abundance as evidenced by a decreased abundance of formerly abundant species;

iii) poor growth or condition of representative species;

iv) increased vulnerability of a representative species to predation or disease;

v) decrease in numbers of a given species due to the competitive advantage afforded a competitor by the effects of the stress being exerted that would otherwise not have existed;

vi) failure of an unbalanced population or community to recover with the abatement of previously limiting non-thermal water quality conditions;

vii) long-term avoidance of a thermally impacted area by a representative species;

viii) simplification of a community (i.e., loss of diversity) resulting from the absence or reduced abundance of expected species;

ix) expected species not present in numerical proportions to each other because of community domination by thermally tolerant species;

x) dominance of the community by thermally tolerant species which establish themselves at the expense of endemics; and,

xi) simplification of community trophic structure resulting from the absence or reduced abundance of expected species which may be reflected by an indicator of community production (e.g., reduced assimilative capacity, total biomass, respiration).

B. Thermal Mixing Zones - Thermal Effluent Limitations: Imposition of Final Limits

Rules 3745-1-06(B), 3745-1-11(B)(2), and 3745-1-12(M) of Chapter 3745-1 of the Ohio Administrative Code (OAC) provide the mechanism by which thermal mixing zones are defined for all surface waters of the state, including the Ohio River mainstem. This part of the 316 guidance manual is intended to explain and clarify the intent and implications of the thermal mixing zone definition and standards and general procedures by which individual thermal mixing zones will be defined. Such determinations will take into account the site-specific biological, chemical, and physical information required for 316(a) demonstrations.

It should be understood that thermal mixing zones will be defined through the establishment of effluent limitations in terms of the net facility heat rejection rate in Btu/hr. This means that thermal impact will be assessed by evaluating the effect that the size of the thermal mixing zone has on the populations and communities of the receiving water body, but each individual thermal mixing zone limitation will be defined as an effluent limitation in Btu/hr. Essentially then the terms thermal mixing zone and thermal effluent limit have become synonomous, at least for the purpose of this document and Chapter 3745-1 of the OAC. Other methods of defining thermal mixing zones were considered, but the direct thermal effluent limitation was favored because of anticipated difficulties with compliance monitoring and enforcement of some of the alternatives. The establishment of discrete three dimensional boundaries was considered impractical from the standpoint of compliance monitoring and enforcement because of the dynamic physical nature of thermal mixing zones and the effort required to monitor each. The establishment of one-dimensional downstream (rivers) or radial (lakes) boundaries would involve the installation of continuous monitoring devices in exposed areas away from the subject facility. Although their use may be necessary to determine compliance with water quality standards in certain instances, such devices may be subject to mechanical failure, damage, and loss by natural events or possibly vandalism. Thermal effluent limitations based on ΔT was discounted because such a limitation could permit an increased heat load to the receiving water body by increasing cooling water flow while maintaining ΔT. Such an event would result in a greater volume of water receiving waste heat thus expanding the thermal mixing zone to possibly unacceptable dimensions. The net facility heat rejection rate (Btu/hr) was chosen because it reflects facility cooling water flow, operational mode and capacity, and discharge temperature, information which is available in daily facility operational records. Defining thermal mixing zones with thermal effluent limitations has an added advantage in that monitoring for compliance with temperature standards is not necessary. It is automatically assumed that temperature standards are met if the thermal effluent limitation defining the thermal mixing zone is met.

The process of determining size limitations for thermal mixing zones through the establishment of final thermal effluent limitations for individual facilities will be dependent upon the following:

1) site-specific biological, chemical, and physical information provided by the applicant;

2) temperature standards or other temperature criteria applicable to receiving water body; and,

3) how well information submitted by an applicant demonstrates that a thermal mixing zone will assure the protection and propagation of a balanced, indigenous community.

Water quality standards for temperature (OAC Rules 3745-1-07(A)(26), (B)(24), and (D)(26); 3745-1-11(A)(1)(z) and (C), and 3745-1-12(C)), as previously stated, will be an important factor in the determination of final thermal effluent limitations. Since applicable temperature standards apply on and outside of a thermal mixing zone boundary they will influence the case-by-case determination of size limitations for individual thermal mixing zones. All thermal discharges are subject to the numerical limits and conditions specified by the temperature standards. The applicablility of the temperature standards is best understood by considering each standard relative to the water use designations.

Warmwater Habitat

Temperature standards for the Warmwater Habitat use designation (OAC Rule 3745-1-07(A)(26)) apply to the largest number of water bodies in the state. Nine separate sets of seasonal numerical standards were developed for the major rivers and drainage basins of the state (OAC Rule 3745-1-07(A)(26)(b) (Tables 5a-5i)). Although the numerical standards in Tables 5a through 5i are based on biological criteria (long-term survival (average), short-term survival (maximum)). there may be situations when the conditions specified in OAC Rule 3745-1-07(A)(26)(a) could supercede the numerical standards on a site specific basis. Examples of such situations may be characterized by, but not limited to, the following:

1) representative species require temperatures more stringent than applicable standards for essential ecological and physicological processes;

2) a need to protect for biological criteria more stringent than short-term and long-term survival (e.g., avoidance, growth, etc.); and,

3) observed harmful effects of a thermal mixing zone on the fish community which would require temperature limitations more stringent than applicable standards.

Exceptional Warmwater Habitat and Coldwater Habitat

The temperature standards for the Exceptional Warmwater Habitat and Coldwater Habitat (OAC Rules 3745-1-07(B)(24) and (C)(24)) use designations are essentially identical. No net change in temperature attributable to the effects of thermal discharges are allowed. Since thermal mixing zones are also prohibited this means that any thermal discharge to water bodies with these use designations must meet ambient temperature at the point of discharge.

Seasonal Warmwater Habitat

Temperature standards for the Seasonal Warmwater Habitat use designation (OAC Rule 3745-1-07(D)(26)) will not be a common 316(a) issue unless there is some disagreement over the use designation of a low-flow stream (OAC Rule 3745-1-09). Not all streams of the state that meet the flow criteria for Seasonal Warmwater Habitat will necessarily be designated as such. Designation of any low-flow stream as a Warmwater, Exceptional Warmwater, or Coldwater Habitat would require a thermal discharge to meet the applicable temperature standards at the point of discharge.

Limited Warmwater Habitat

The Limited Warmwater Habitat use designation applies to waters of the state that are presently incapable of meeting criteria necessary for the support of populations of fish and associated vertebrate and invertebrate organisms and plants either on a seasonal or year round basis. Such degraded conditions may be due to low stream flow combined with densely populated and/or industrialized areas that have inadequate sewer systems and/or waste treatment facilities. These exceptions from the Warmwater Habitat criteria will apply only to specific criteria during specified time periods and/or flow conditions. These are determined on a case-by-case basis and comply with all federal and state water quality statutes. This use designation requires significant economic or technological rationale and is to be used only as a temporary classification with upgrading of the use designation at the earliest possible time prior to July 1, 1983, where attainable (OAC Rule 3745-1-07(E). The establishment of thermal effluent limitations in water bodies with this use designation will take into account the present water quality conditions and expected recovery and consider the compliance of adjacent discharges with Section 301(b)(2), improvement in water quality, and the July 1, 1983 deadline.

Lake Erie

Lake Erie, outside of the Excepted Areas, is designated as Exceptional Warmwater Habitat, but temperature standards applicable to this use designation (OAC Rule 3745-1-07(B)(24)) will not apply. Temperature standards for Lake Erie (OAC Rules 3745-1-11(A)(34)(a) through (c) (Tables 7a-7c)) apply to all waters exclusive of the Excepted Areas. Temperature standards for the Excepted Areas (OAC Rule 3745-1-11(C)(Table 7e)) are less stringent than those applicable to the western basin (Table 7a), central basin (Table 7b), and hypolimnetic regions (Table 7c) of Lake Erie. The interpretation of the conditions specified in OAC Rule 3745-1-11(A)(34)(a) will be consistent with the interpretation of OAC Rule 3745-1-07(A)(26)(a) for the Warmwater Habitat use designation previously discussed. The Lake Erie temperature standards will not apply at depths less than three feet (OAC Rule 3745-1-11(A)(26)(b)), however, this provision will not exempt shorelines from consideration. Contact of a thermal mixing zone with a shoreline for an extended distance beyond the immediate discharge area will be a major point of consideration in establishing thermal effluent limitations for thermal discharges into Lake Erie and Excepted Areas, particularly with respect to events and conditions specified in OAC Rule 3745-1-11(A)(34)(a).

Ohio River

Temperature standards applicable to the Ohio River (OAC Rule 3745-1-12(C)) are those recommended by ORSANCO. The Ohio River temperature standards include monthly maximum limitations and a maximum rise above ambient temperature of 5F(2.8C). There are no events or conditions specified that could supercede the numerical standards. However, the previously discussed Ohio River mixing zone standard (OAC Rule 3745-1-12(M)) as well as the language of Section 316(a) itself, could supercede the numerical standards in the establishment of final thermal effluent limitations for thermal discharges into the Ohio River.

Establishment of Thermal Effluent Limitations

With respect to the preceding guidance and the applicability of water quality standards for temperature in determining final thermal effluent limitations pursuant to Chapter 3745-1 of the OAC and Section 316(a), the following scenario will be adhered to during the review of an applicant's request for alternative effluent and thermal mixing zone size limitations. Upon receiving all of the information to be submitted by the applicant Ohio EPA will initiate a review of the applicant's request. During the review and evaluation of an applicant's 316(a) submittal Ohio EPA may use any relevant data, information, methods, or publications in order to fill information gaps and arrive at a final decision. Generally the review and evaluation will focus on three major questions that pertain to the description, size, and impact of an existing or proposed thermal discharge and mixing zone. These are:

1) What are the spatial and temporal dynamics of the thermal mixing zone under current or expected facility operational modes?

2) Are the observed or predicted spatial and temporal dynamics of the thermal mixing zone acceptable to provide for and maintain the protection and propagation of a balanced, indigenous community of fish, shellfish, and wildlife in the receiving water body?

3) If the answer to the preceeding question is anything other than an affirmative one then what thermal effluent limitation is acceptable to provide for the protection and propagation of a balanced, indigenous community?

Additional questions within the scope of these questions may be raised by any person prior to, during, or after submittal of a 316(a) demonstration.

It is important that 316(a) applicants understand the intent and purpose of these questions relative to the establishment of thermal effluent limitations. Each of the four questions are discussed as follows:

1) <u>What are the spatial and temporal dynamics of the thermal mixing zone under current or expected facility operational modes?</u>

In order to understand the potential or existing environmental impacts of any thermal discharge the existing or expected configuration of the thermal mixing zone must be described under a variety of seasonal, hydrological, and meteorological conditions and facility operational modes. The description should involve actual field measurements (existing facililies) and thermal modeling (proposed and existing facilities) and will be a basic requirement of any 316(a) determination.

2) <u>Are the observed or predicted spatial and temporal dynamics of the thermal mixing zone acceptable to provide for and maintain the protection and propagation of a balanced, indigenous community of fish, shellfish, and wildlife in the receiving water body?</u>

In a more simplified form this question would read ... is the existing or proposed thermal mixing zone acceptable, i.e., what is the maximum area, section, or volume of the receiving water body that can exceed either the applicable water quality standards for temperature or other specified criteria and still provide for and maintain a balanced, indigenous community? Several site-specific biotic and abiotic factors that will be important considerations include, but are not limited to, the following:

i) physical characteristics (morphometric, hydrologic) of the receiving water body;

ii) the biological potential and richness of the habitats in contact with the thermal mixing zone (e.g., spawning areas, migratory routes, nursery areas, ciritical habitats);

iii) time exposure of drifting organisms,

iv) the availability of refuge areas to the resident aquatic organisms; and,

v) composition of the resident aquatic communities.

3) <u>If the answer to the preceeding question is anything other than an affirmative one then what thermal effluent limitation is acceptable to provide for the protection and propagation of a balanced, indigenous community?</u>

The purpose of a 316(a) demonstration is to examine the effects of the physical dynamics of an existing or proposed thermal mixing zone on the communities or populations representative of the receiving water body and to determine if it is acceptable with respect to the protection and propagation of a balanced, indigenous community or population of fish, shellfish, and wildlife. There are only two determinations possible:

i) the existing or proposed thermal mixing zone is acceptable according to the standards and criteria previously discussed in this document; and,

ii) the existing or proposed thermal mixing zones is unacceptable according to these same standards and criteria.

A finding that the existing or proposed thermal mixing zone is acceptable will generally result in the granting of the thermal effluent limitation requested with the initial submittal unless, of course, the requested thermal effluent limitation is out of line with information provided in the 316(a) demonstration. These limitations are then incorporated into the NPDES permit and all requirements under the applicable water quality standards for temperature and thermal mixing zones (OAC Chapter 3745-1) and Section 316(a) are considered met for the period of time that the permit is effective. A finding that the existing or proposed thermal mixing zone is unacceptable will usually result in the imposition of a thermal effluent limitation which will require a reduction in the amount of heat rejected into the receiving water body, or possibly a structural change (e.g., discharge relocation) which will provide for the protection and propagation of a balanced, indigenous community. This will be accomplished through the establishment of a thermal effluent limitation that will result in an acceptable thermal mixing zone. The reduction in the amount of rejected heat could range from complete to partial and will be dependent upon the degree of impact observed or expected. An acceptable thermal effluent limitation will be arrived at by considering the information requested and submitted in the 316(a) demonstration and the standards and criteria presented in this document. Once the new thermal effluent limitation is incorporated into the NPDES permit all requirements of the applicable water quality standards for temperature and thermal mixing zones (OAC Chapter 3745-1) and Section 316(a) will be considered met for the period of time that the permit is effective.

C. 316(a) Review and Evaluation Procedure

The general procedure that Ohio EPA will follow in the review of each request for the determination of alternative thermal effluent limitations pursuant to Section 316(a) and OAC Chapter 3745-1 is graphically described in Figures IV-1 and IV-2.

The step that initiates the entire process is the applicant's request for a determination of alternative thermal effluent limitations. Such a request should include the thermal effluent limitation desired by the applicant and the demonstration type that will be pursued.

<u>Type I Demonstration, "Absence of Prior Appreciable Harm"(Figure IV-1)</u>

After a request has been made for the determination of alternative thermal effluent limitations and upon considering these guidelines the applicant should submit a 316(a) study plan proposal to Ohio EPA. The study plan proposal should be submitted prior (90 days) to any field sampling and should describe as fully as possible all field and laboratory methods, analytical procedures, and sampling locations. Upon receiving the 316(a) study plan proposal Ohio EPA will review the contents and may make suggestions or comments concerning methodology, procedures, or sampling location. Field sampling should be initiated after receiving informal approval of the 316(a) study plan proposal by Ohio EPA. If the information contained in the final 316(a) demonstration is sufficient upon which to base a determination then Ohio EPA will initiate a review and evaluation of the appropriateness of the requested thermal effluent limitation. If the requested thermal effluent limitations are found to provide for the protection and propagation of a balanced, indigenous community then such effluent limitations will be granted in a proposed modification of the facility NPDES permit. If the requested thermal effluent limitation is not consistent with the protection and propagation of a balanced, indigenous community then an effluent limitation which is consistent with this goal will be incorporated into the facility NPDES permit. If there are no objections to the proposed NPDES permit limitations and conditions by an applicant or a third party then the appropriate modifications are made and the facility continues operating under the NPDES permit. If an applicant or a third party objects to the proposed NPDES permit limitations and conditions either one or both may request an adjudicatory hearing and as a result of such proceeding, or a negotiated settlement reached pursuant to such proceeding, the thermal effluent limitations may or may not be modified. All NPDES permit modifications must be approved by USEPA.

Type II Demonstration, "Protection of Representative Aquatic Species" (Figure IV-2)

A Type II 316(a)demonstration will involve the development of a representative aquatic species (RAS) list. Upon receiving notification by an applicant of the intent to pursue a Type II 316(a) demonstration Ohio EPA will promptly notify USEPA, Region V, the designee of the Secretary of Commerce, the U. S. Fish and Wildlife Service, and the Ohio Department of Natural Resources that representative aquatic species will be identified and will consider any timely (30 days) recommendations. Ohio EPA must select the RAS and advise an applicant of the selections with 60 days of receiving notification (40 CFR Sec. 122.15 (b)(2)(ii)(A)). If the information for designating RAS is inadequate then Ohio EPA may request an applicant to perform field sampling in order to furnish such information as may be necessary to select RAS. In this latter case the burden of proof will be on the applicant to demonstrate the appropriateness of the RAS selections (40 CFR Sec. 122.15 (b)(2)(ii)(B)). Upon the completion of the RAS procedure a Type II 316(a) demonstration is prepared and submitted for Ohio EPA review. The procedure from this point on is identical to that followed for the Type I demonstration.

Figure IV-1: Type I 316(a) demonstration review and evaluation flow chart for the determination of final effluent limitations for thermal discharges.

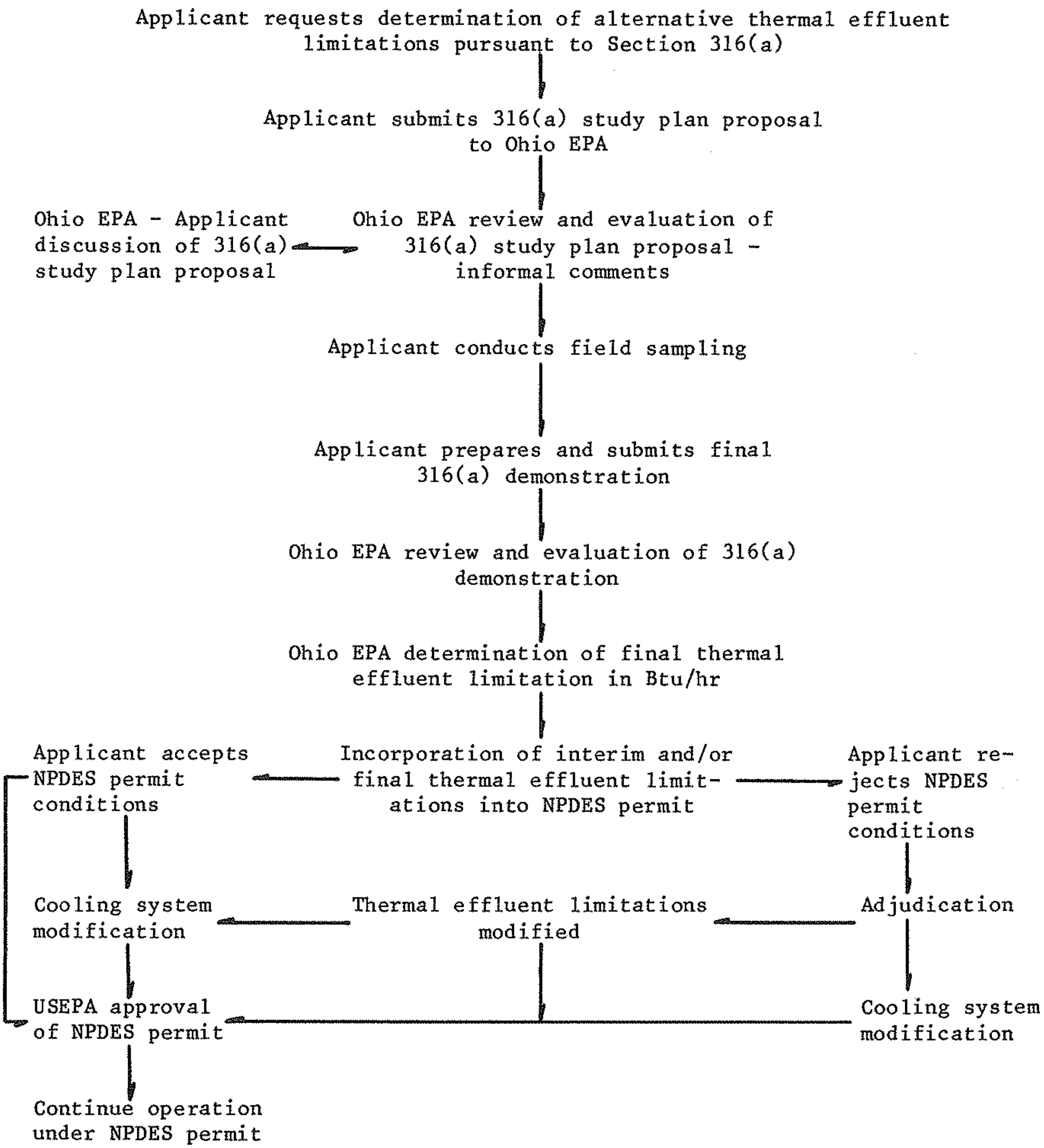
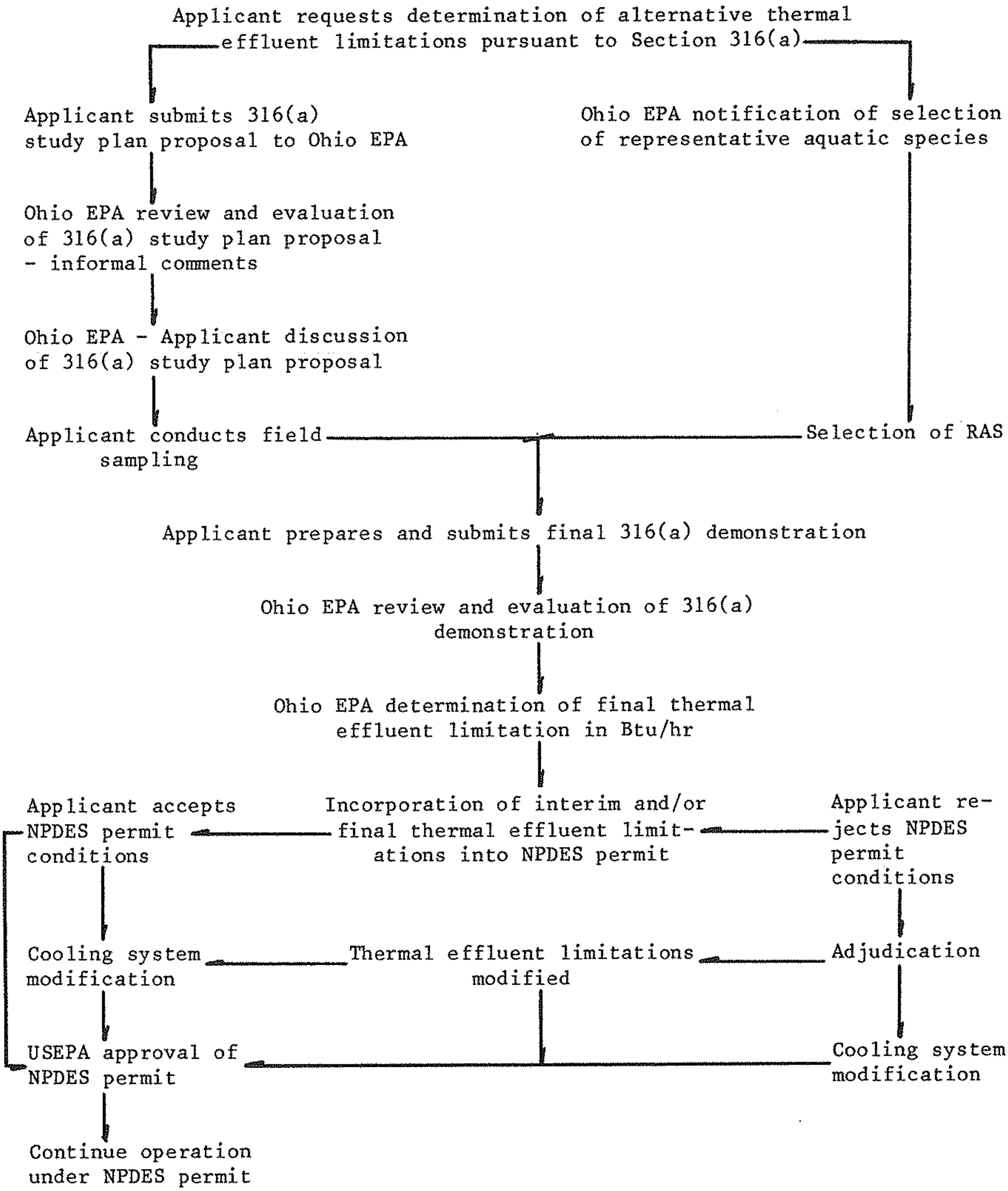


Figure IV-2: Type II 316(a) demonstration review and evaluation flow chart for the determination of final effluent limitations for thermal discharges.



V. SECTION 316(b) PROCEDURES AND GUIDELINES

A. Introduction

This section of the Ohio EPA 316 guidance manual describes and discusses minimum information considerations, impact assessment procedures, and determination of best technology available (BAT) for the location, design, construction, and capacity of cooling water intake structures pursuant to Section 316(b) of the Clean Water Act. Some of the problems associated with cooling water intake structures are the entrainment of aquatic organisms (phytoplankton, zooplankton, macrobenthos, fish eggs and larvae) through cooling water systems and the impingement of adult and juvenile fish against intake screens. Both entrainment and impingement may result in considerable damage to individual organisms (all life stages), species populations, and communities alike. It is recommended that all intake studies emphasize fish.

The general overall goal of any 316(b) demonstration should be to:

1) establish reliable loss projections of all life history stages of representative aquatic species; and

2) evaluate the significance of the projected losses (magnitude of adverse impact) to the impacted species populations and communities.

Recommended intake monitoring frequencies for existing facilities are based on "risk assessment", i.e., the probability of organism involvement with a cooling water intake. Minimum sampling frequencies for individual intakes will be dependent on the magnitude of risk involved at each. Risk assessment at existing intakes is highly dependent on the capacity (flow) and location (siting) characteristics of each intake. Minimum sampling frequencies for proposed facilities will deal primarily with the location (siting) of new intake structures.

Impact assessment and determination of BAT will focus on the design, location (siting), construction, and capacity (flow) characteristics of each existing or proposed cooling water intake structure relative to the minimization of adverse environmental impact, as defined. BAT determinations will be made on a case-by-case basis, but intake impact assessments must consider the acceptability of intake damage from the perspective of adverse environmental impact. Some assessments may involve an examination of the cumulative impact of several cooling water intakes located on the same water body (e.g., western and central basins of Lake Erie, Ohio River).

The approach of Ohio EPA to the interpretation and determination of adverse environmental impact will be based on the acceptability of intake damage. Adverse environmental impact is defined as damage that occurs whenever there is entrainment or impingement of aquatic organisms as a result of the operation of a cooling water intake structure. The acceptability of this damage is dependent upon the following:

1) the number of organisms entrained and impinged;

2) the percentage of each representative species population lost due to entrainment and impingement damage (when applicable to certain high risk intakes);

3) magnitude of damage to endangered species;

4) magnitude of damage to commercial and sport species;

5) magnitude of damage to ecologically valuable species; and,

6) whether the observed entrainment and impingement damage contributes to community unbalance.

Entrainment and/or impingement effects will be considered unacceptable if the maintenance of existing balanced communities or the recovery of perturbed or unbalanced communities are impaired or prohibited, or the magnitude of damage to endangered, commercial, sport, and/or ecologically valuable species interferes with an existing or planned use of the source water body.

B. Assessment of Risk

Risk assessment will usually involve existing intakes, but can apply to the assignment of post-operational sampling frequencies for newly constructed intakes. The extent of the risk to an impacted population or community can only be known for certain by actually measuring rates of entrainment and impingement at the intake. The accuracy of this type of assessment is dependent on sampling methods, location, duration, and frequency. How then is risk assessed without first spending at least one year monitoring a given intake? The most practical way appears to be that of examining the design, location, and capacity of the intake in question. Construction effects are not likely to be a major aspect of risk assessment at existing intakes and is usually a temporary concern with proposed structures. Of the three important risk factors capacity (flow) is of primary importance, particularly in rivers. A comparison of facility cooling water demand with the flow record of the source water body is one criterion for determining the magnitude of risk. As the ratio of cooling water flow to source water body flow increases the potential for risk also increases. Generally the median flow (i.e., the flow exceeded 50 percent of the time) of the source water body will be compared to the maximum facility cooling water demand in order to determine the ratio. Minimum recorded monthly flows during biologically critical periods such as spawning, egg and larval drift, migration, etc., will also be considered in developing these ratios. The design of a cooling water intake will also be considered with respect to the probability of involvement of resident aquatic organisms and the potential for damage to these organisms. Risk may also be highly dependent on the distribution and mobility of representative species, spawning habits (broadcasters, nest builders), egg type (pelagic, demersal, adhesive), parental care, and dispersal of larvae and juveniles. These considerations will be especially important in determining risk with respect to the biological richness of the area adjacent to an intake structure. Together these criteria determine if an intake should be classified as high or low risk. A certain amount of discretion will need to be exercised by Ohio EPA in determining risk, particularly with intakes that occupy a position intermediate between high and low risk.

<u>Classification of Intake Structures - High or Low Risk</u>

A high risk cooling water intake is one with which resident aquatic organisms have a high probability of involvement (i.e., being entrained or impinged). Required minimum sampling frequencies will be based on risk and will be greater at facilities with high risk intakes. Facilities with an intake that meets the following design, capacity, and location criteria will be considered high risk:

1) facilities, located on rivers or streams, with a maximum cooling water demand greater than or equal to 25 percent of the median flow and/or greater than or equal to 50 percent of the minimum recorded monthly flow during the months when fish egg and larval drift is significant for the period of record (based on at least 10 years of flow data);

2) facilities, located on Lake Erie, with shoreline intakes and a maximum cooling water demand of greater than or equal to 1000 cfs (646 MGD);

3) existing facilities, located on Lake Erie embayments or excepted areas, with a maximum cooling water demand of greater than or equal to 500 cfs (323 MGD);

4) facilities located on Lake Erie estuaries regardless of cooling water demand; and,

5) facilities with a maximum cooling water demand of greater than or equal to 1500 cfs (970 MGD) regardless of location.

Facilities with an intake that meets the following design, capacity, and location criteria will be considered low risk:

1) facilities, located on rivers or streams, with a maximum cooling water demand less than or equal to 10 percent of the median flow and/or less than or equal to 25 percent of the minimum recorded monthly flow during the months when fish egg and larval drift is significant for the period of record (based on at least 10 years of flow data); and,

2) facilities, located on Lake Erie, with shoreline intakes and a maximum cooling water demand of less than or equal to 500 cfs (323 MGD).

The criteria for determining risk leave intermediate situations in which the cooling water flow or intake design and location may fall between high and low risk as follows:

1) facilities, located on rivers or streams, with a maximum cooling water demand greater than 10 percent, but less than 25 percent of the median flow and/or greater than 25 percent, but less than 50 percent of the minimum recorded monthly flow during the months when fish egg and larval drift is significant for the period of record (based on at least 10 years of flow data);

2) facilities, located on Lake Erie, with shoreline intakes and a maximum cooling water demand greater than 500 cfs (323 MGD), but less than 1000 cfs (646 MGD);

3) existing facilities, located on Lake Erie embayments or excepted areas, with a maximum cooling water demand of less than 500 cfs (323 MGD); and,

4) facilities, located on Lake Erie, with submerged offshore intakes.

The one criterion that will be of primary importance in determining the risk involved with the intermediate situations is the location of the intake relative to the biological richness of the source water body in close proximity to the intake. Naturally the greater the biological richness the greater is the risk factor. Thus in the first three intermediate examples intakes meeting the indicated design and capacity criteria will be considered high risk if they are located in an area of high biological richness. However, such intakes located in areas of low biological richness will be considered low risk. In the fourth intermediate example submerged offshore intakes will usually be considered low risk, but distance offshore, depth, and the interrelated factor of biological richness will influence risk assessment. As a general rule for submerged offshore intakes, the greater the distance offshore the lower the risk factor will be. Capacity of these intakes is also important and will influence the risk factor accordingly.

C. General Information Considerations

Information describing the biological, hydrological, and physical characteristics of the source water body and certain engineering aspects of the facility cooling water intake system and structure should be considered in each 316(b) demonstration. The hydrological, physical, and engineering information described below is standard in all 316(b) submittals, but the extent of the biological information generated should be dependent on risk.

Location of Important Site Characteristics

Information about the location of the facility, cooling water intake, and relevant site-specific characteristics should include, but is not limited to, the following:

1) maps showing the regional location of the facility, adjacent point source discharges and water intakes, adjacent tributaries, and major population centers;

2) location and extent of the study area according to each field method and technique used (sampling locations); and,

3) a description of the morphometry, substrate and shoreline, and artificial structures in and on the receiving water body.

Hydrological Information

Information regarding the hydrological characteristics of the receiving water body should include, but is not limited to, the following:

1) Rivers and Streams - monthly flow (cfs) duration analysis including at least ten years of data, lowest monthly flows for the ten year period, the seven-day, once-in-ten-year low-flow, the flows exeeded 90, 75, and 50 percent of the time, and the average flow;

2) Lake Erie Estuaries and Embayments - the mean high lake level and highest lake level on record, a description of the seasonal exchange of water between the estuary or embayment and Lake Erie including flow patterns, episodes of stagnation, wind effects, and flushing rates (up to ten years of data when available);

3) Reservoirs - spatial and temporal trends in flow-through time, release schedules, and water level; and,

4) Lake Erie - the mean high lake level and highest level on record, spatial and temporal variations in prevailing offshore and nearshore currents, and wind direction and effects.

This information should be provided for both existing and proposed facilities.

Facility Operating Information

Information about observed and expected facility operating modes should include, but is not limited to, the following:

1) monthly cooling water intake flow (cfs) in increments not to exceed 10 percent of the maximum cooling water demand or 100 cfs, whichever is less vs. river flow (cfs) in increments not to exceed 10 percent of the seven-day, once-in-ten-year low-flow of the receiving water body or 50 cfs, whichever is less;

2) monthly mean and maximum facility cooling water flow (cfs) demand;

3) facility cooling water flow duration analysis for the period of facility operation; and,

4) duration and frequency of the recirculation of condenser cooling water for de-icing purposes.

Facility Cooling Water Intake and System Design

The following information about the facility cooling water system and design should be provided as a minimum:

1) a complete description of the facility cooling water intake structure and system configuration;

2) description of the screen system design and operation;

3) mean and maximum approach and "through screen" intake velocities;

4) description of fish handling and by-pass facilities (if any);

5) description of de-icing capabilities;

6) location of chlorination and/or addition of biocides;

7) maximum rated capacity and number of circulating water pumps;

8) mean and maximum temperature rise across the condensers;

9) description of resultant time-temperature experience of organisms subjected to entrainment (for demonstrations in which 100 percent mortality is not assumed); and,

10) description of pressure regimes, turbulence of flow, and velocity shear stress within the cooling water system (for demonstrations in which 100 percent mortality is not assumed).

D. Biological Information Considerations

Biological information adequate to provide quantitative estimates of annual losses of adult, juvenile, egg, and larval stages of fish at existing and proposed intakes, and relative densities of at least eggs and larvae in source water bodies should be provided by all 316(b) applicants. The extent of the information should be dependent on the risk involved at existing intakes and the proposed location of new intakes. All 316(b) studies should focus primarily on fish. The development of an RAS list will focus on key species that are frequently encountered at the intake or in the source water body.

Existing Intakes

Two objectives that should be met by any 316(b) sampling program an demonstration for an existing intake are:

1) to project and establish reliable loss projections within the limitations of the sampling program, of representative aquatic species; and,

2) to evaluate the significance of the projected losses (magnitude of adverse impact) to the impacted community and individual species populations.

In order to fulfill these objectives certain minimum information for sampling frequency, duration, location, and methods should be provided. Guidelines for sampling fish eggs and larvae (entrainment) and adult and juvenile fishes (impingement) have been established and are presented in this section. All such aspects of an applicant's 316(b) monitoring program should be described in detail in the 316(b) study plan proposal.

1. Entrainment

Important aspects of entrainment sampling at existing intakes are the frequency, duration, location, and methods used to measure losses of fish eggs and larvae at existing intakes. Ranges of sampling frequencies, diel subsampling, and seasonal duration for high and low risk intakes are summarized in Table V-1.

Recommended sampling frequencies range from once/2 days to once/7 days for high risk intakes and once/7 days to once/10 days for low risk intakes. Sampling frequencies for intakes occupying a position intermediate between high and low risk should fall somewhere between high and low risk frequencies. Stratification of sampling frequencies (i.e., seasonally varied sampling frequencies) within the suggested sampling dates (April 1 - August 31 or October 1) may be appropriate and will be recommended on a case-by-case basis. For example, a frequency of once/2 days may be desirable at a high risk intake during the periods of peak egg and larval drift, but may be reduced to once/7 days preceeding and following this period. This type of arrangement may be most appropriate in rivers where larval drift peaks are of a relatively brief duration. Previous studies on the Missouri River (Omaha Public Power 1975), Mississippi River (Latvaitis 1977), and Wabash River (Gammon 1976b) revealed that the peak larval drift period lasted for a period of time ranging from 17 to 42 days, the 42 day period being twice that observed during the previous year (Latvaitis 1977). If a 30 day period of peak larval drift is assumed then a sampling frequency of once/2 days would result in 15 total samples and a once/7 days frequency only 4 or 5 samples. Such peak periods naturally do not occur between the same two dates year after year, but should generally occur sometime during spring and summer in Ohio waters.

A review of larval drift and fish egg abundance data from the nearshore waters of the central basin of Lake Erie by Herdendorf (1978, personal communication) revealed that both eggs and larvae first appeared on April 15 and lasted through August 1 and August 23 respectively. Peak larval densities at several sites throughout the central basin occurred between May 2 and July 23, an 82 day period. Peak egg densities at the same locations occurred between May 13 and June 20, a 38 day period. The 82 day range of peak larval density is much longer than that observed in rivers, however this range represents a combination of data from different years and was probably of a shorter duration during any one given year. It is also apparent that new populations of larvae emerge an average of once every 7 to 10 days (Herdendorf 1978, personal communication) which confirms the need to sample at least once/7 days. More frequent sampling will be recommended for high risk intakes. The results of studies in the western basin indicate similar trends (Herdendorf 1978, personal communications). Sampling for fish eggs and larvae in Lake Erie need not begin earlier than April 15, but should begin no later than May 1, and should continue at least through August 31. Stratified sampling schemes are acceptable and should take into account peak periods of egg and larval abundance.

The number of subsamples per 24 hours is an important consideration of entrainment sampling, especially when diel variations in egg and larval abundance are apparent or suspected. If diel variations are not of concern then the duration of sampling need not be more than six or twelve hours/day. However, these six or twelve hour periods should be rotated through a 24 hour period on consecutive sampling dates. For example, at a duration of six hours/day and a frequency of once/2 days, the first day of sampling would run from 0000-0600 hours, the second day from 0600-1200 hours, the third day from 1200-1800 hours, and so on. If diel variations are of concern then the sampling duration should be for 24 hours with 6, 8, or 12 hour subsamples.

Daily frequency should be maintained regardless of the number and duration of diel subsamples.

The location of sampling at facilities with cooling water intakes is an aspect of entrainment that has received less attention than it deserves. The usual or most common sampling point for eggs and larvae has been at the intake structure in the vicinity of the traveling screens, but discharge sampling has been used in some studies. More recently taps installed in the main circulating water lines after the main circulating water pumps have been used. A comparative study of the various sampling methods (e.g., pumps, nets, taps) and locations (i.e., intake vs. discharge) at one intake would be of great value in determining the best or most representative location for measuring entrainment. Until such is determined Ohio EPA will recommend that taps be installed in the main circulating water lines for measuring entrainment. Taps need not be installed in each line, but should be positioned at two or three representative locations taking into account egg and larval distribution across the intake. If the installation of taps is not feasible then sampling with pumps or nets will be an acceptable alternative. Concerns about discharge sampling have not been completely satisfied and, until resolved, will not be recommended over the intake location.

One hundred percent mortality of all entrained fish eggs and larvae will automatically be assumed unless on-site live-dead studies are performed or other acceptable survival information can be offered.

Source water sampling will be recommended for all high risk intakes and should characterize spatial and temporal variations in the distribution and abundance of fish eggs and larvae susceptible to entrainment. For intakes located in rivers this will usually involve sampling a transect located just upstream from the intake along a line perpendicular to the direction of flow. Three or four sampling locations along this transect should suffice and vertical (surface, mid-depth, bottom, etc.) locations should be established if water depth exeeds 3-4m. Source water sampling locations in Lake Erie should consider the area in the immediate vicinity of the intake and adjacent near-shore and offshore locations. Based on recent findings and recommendations by Herdendorf (1978, personal communication) in the western basin of Lake Erie all source water sampling for fish eggs and larvae should take place at night. The sampling locations should be arranged in a way that will permit the construction of density profiles from nearshore to offshore waters. 316(b) applicants should include a map of the proposed source water sampling locations in the 316(b) plan of study submittal.

2. Impingement

Important aspects of impingement sampling at existing intakes are frequency and duration. Sampling efforts should account for all fish impinged on the intake screens during each sampling period. Ranges of recommended impingement sampling frequencies, diel subsampling, and seasonal duration for high and low risk intakes are summarized in Table V-2. Recommended sampling frequencies range from once/2 days to once/5 days at high risk intakes and are based on the recommendations of Murarka and Bodeau (1977). Seasonally stratified sampling schemes are recommended to ease the cost constraints of a combined entrainment-impingement sampling program. Murarka and Bodeau (1977) discussed cost related constraints in developing an adequate sampling frequency and provided a formula for determining cost or frequency based upon accuracy (usually $\pm$ 50%) and cost limitations. When there is a conflict between accuracy and cost, either the cost constraint or accuracy constraint must be sacrificed, or both constraints modified. Ohio EPA recognizes the importance of a cost effective intake monitoring program, but the need for accuracy may be of overriding importance, especially at high risk intakes.

Table V-1: Recommended daily frequency, diel subsampling, and seasonal duration for entraiment sampling at high and low risk cooling water intakes.

Risk	Frequency	Diel	Seasonal Duration
High	once/2 days to once/7 days	one 6, 8, or 12 hr. sampling period/24 hrs. up to four 6 hr. sampling periods/24 hrs., three 8 hr. sampling periods/24 hrs., or two 12 hr. sampling periods/24 hrs.	April 1 - October 1 (rivers and streams); April 15 - August 31 (Lake Erie, embayments and estuaries included);
Low	once/7 days to once/10 days	one 6, 8, or 12 hr. sampling period/24 hrs. up to four 6 hr. sampling periods/24 hrs., three 8 hr. sampling periods/24 hrs., or two 12 hr. sampling periods/24 hrs.	April 1 - October 1 (rivers and streams); April 15 - August 31) (Lake Erie, embayments and estuaries included).

Murarka and Bodeau (1977) recommended that the total sampling effort for measuring impingement losses need not exceed 180 days/year (once/2 days), but should not be less than 75 days/year (once/5 days). These are the recommended frequencies for high risk intakes. Recommended frequencies for low risk intakes range from once/5 days to once/10 days.

As with entrainment, diel subsampling for impingement will be required if diel variations in impingement rates are of concern. Subsampling periods are the same as those recommended for entraiment.

Impingement sampling should continue year round and may be seasonally stratified in a manner similar to that described for entrainment.

One hundred percent mortality of all impinged fish will be assumed unless on-site live-dead studies are performed or other acceptable survival data can be offered.

Extensive source water sampling for impingeable organisms is not required, but some knowledge about the relative abundance and distribution of representative species should be known. Such information may be most readily available through commercial fishery landing records or recent literature. Population modeling may be appropriate in the case of certain high risk intakes and has been used in the western basin of Lake Erie and is planned for use in the central basin.

Proposed Intakes

Proposed cooling water intakes must meet BAT for location, design, construction, and capacity prior to construction and operation. Such BAT requirements may be determined through the results of pre-construction studies performed to satisfy environmental assessment (i.e., EIS) obligations. Of the four BAT requirements three (location, design, and capacity) are the most important relative to the results of pre-construction studies. Construction effects are usually short-term in effect, but every effort should be taken to minimize both long-term and short-term impacts. Design and capacity may be known prior to pre-construction studies, but may be dependent on the type of fauna and species encountered and the location of the intake. The location or siting of any proposed cooling water intake is the most important aspect and should be dependent on the results of the pre-construction studies. An intake location should not be chosen without first having some knowledge of fish egg, larval, juvenile, and adult distribution and abundance at several locations in the source water body.

1. Ichthyoplankton

Source water body sampling for entrainable organisms, mostly fish eggs and larvae, involves frequency, diel, and sampling location considerations. Sampling for fish eggs and larvae should begin just prior to the first appearance of eggs or larvae and continue through to the end of the drift period. Generally sampling should begin around April 1 in rivers and streams and April 15 in Lake Erie, as conditions permit, and extend through October 1 and August 31 respectively. The rationale for these dates was previously discussed.

A sampling frequency of once/7 days to once/10 days may be adequate to characterize the mean concentration (number of eggs or larvae/100 m^3) of eggs and larvae in the source water body for the purposes of intake siting and making entrainment estimates (number of eggs and larvae entrained/year). This is based on information from Lake Erie (Herdendorf 1978, personal communication) where it is believed a new population emerges every 7 to 10 days during the spawning season. To date such information has not been made available for inland rivers and streams. It is possible that more frequent sampling could be justified in these water bodies and will be dealt with on a case-by-case approach.

With respect to diel variations the time of day when samples are taken is of importance. In some water bodies, particularly those with persistently turbid conditions, diel considerations may not need to be made and sampling could be performed at any time of day. However, in water bodies where turbid conditions are not persistent diel variations in catch rates may be quite important. Recent findings in the western basin of Lake Erie showed a range of day/night ratios of larval densities from 1:3.9 to 1:28.4 with a mean ratio of 1:13.1. These results were attributed to net avoidance by larvae during the day and the movement of interface species to a higher position in the water column at night (Herdendorf 1978, personal communication). Based upon these findings source water sampling for fish eggs and larvae in Lake Erie should be conducted at night.

The selection of sampling locations should be reflective of an effort by the applicant to select a location for the proposed intake based on the results of a pre-construction sampling program. This will involve the establishment of sampling transects. Such transects should be established perpendicular to the permanent flow in rivers and streams and from nearshore to offshore waters in lakes, reservoirs, and Lake Erie. If water depth is greater than 3-4m then surface, mid-depth, and bottom samples should be taken. Oblique tows are generally acceptable in Lake Erie nearshore waters, but surface-bottom sampling may be requested in certain cases. Care should be taken to extend sampling transects far enough offshore in Lake Erie to the point where fish eggs and larval densities significantly decline.

2. Adults and Juveniles

Sampling for adult and juvenile fishes will generally involve establishing trends in relative abundance, temporal and spatial distribution, and spawning, feeding, and nursery areas in the vicinity of the proposed intake structure. Much of this information may be readily available from commercial fishery records and the literature. A stratified sampling design may be appropriate in some instances. Sampling locations should consider all available habitats (i.e., pools, riffles, backwaters, nearshore, offshore, shoals, beaches, surface, bottom, etc.) of the source water body in the vicinity of the proposed intake structure. Methods used could range from electrofishing to echo sounding to seines and should be reflective of an effort to inventory and establish the relative abundance all fish species in the study area. Sampling frequency and effort should be commensurate to the potential risk posed by a proposed intake to adult and juvenile fishes.

E. Selection of RAS for 316(b) Demonstrations

RAS selections should be based on "target" species, i.e., those species most commonly encountered in entrainment, impingement, and source water body sampling. Historical data should be reviewed in the selection of RAS at existing intakes in order to reduce the possibility of overlooking species populations that have previously been adversely affected by an existing intake and would otherwise not have been considered as RAS based on current data.

It is expected that the number of species designated as RAS will vary and be dependent on the number of species commonly encountered at the intake and in the source water body. Extensive population modeling need only include the most economically and ecologically valuable RAS at certain high risk intakes.

F. Impact Assessment and Determination of Best Technology Available

The primary objective of any 316(b) evaluation should be to determine if an existing or proposed cooling water intake structure minimizes adverse environmental impact.

Table V-2: Recommended daily frequency, diel subsampling, and seasonal duration of impingement sampling at high and low risk cooling water intakes.

High	once/2 days to once/5 days	one 6,8, or 12 hr. sampling period/24 yrs. up to four 6 hr. sampling periods/24 hrs., three 8 hr. sampling periods/ 24 hrs., or two 12 hr. sampling periods/24 hrs.	year round
Low	once/5 days to once/10 days	one 6, 8, or 12 hr. sampling period/24 hrs. up to four 6 hr. sampling periods/24 hrs., three 8 hr. sampling periods/ 24 hrs., or two 12 hr. sampling periods/24 hrs.	year round

All 316(b) evaluations should consider the location, design, construction, and capacity aspects of each cooling water intake examined and attempt to focus on specific problems (i.e., entrainment or impingement). Evaluation of low risk intakes will likely be made with a minimum of data and impact assessment as long as all parties involved agree that the adverse environmental impact is minimized. Intermediate and high risk intakes will require a more careful impact assessment and more precise data. The requirements for preciseness of data and sophistication of impact assessment techniques will increase with risk. In situations where several intakes are located on a common source water body (e.g., western and central basins of Lake Erie, Ohio River) the impact assessment procedure used by Ohio EPA may focus on the cumulative impact of the intakes involved. The detailed use and application of population models will generally be confined to basin and system wide assessments and more difficult 316(b) cases where intake damage and the subsequent environmental and socio-economic impacts are potentially unacceptable. Such efforts will focus on key representative fish species.

Existing Intakes

An assessment of intake damage at an existing cooling water intake should consider adverse environmental impact and fulfill the following objectives:

1) estimate the numbers (with accompanying confidence limits) of fishes impinged and eggs and larvae entrained (by species) during each year of sampling;

2) estimate the percent of each representative fish species population lost due to entrainment and impingement mortality (when applicable to certain high risk intakes); and,

3) evaluate the significance of the estimated losses (magnitude of adverse environmental impact) to the representative fish species populations and existing fisheries in the source water body.

As stated these are general objectives on which an assessment of intake effects should focus. All 316(b) demonstrations for existing intakes should address the first and third objectives regardless of the risk involved. However, the precision with which such estimates and evaluations are made should increase proportionally with risk. It will be required that the second objective be addressed for some high risk intakes. This will involve population modeling of key representative fish species. Modeling of species populations in the western basin of Lake Erie have recently focused on yellow perch (*Perca flavescens*) (Patterson 1976a, 1976b, 1976c, 1976d; Paul and Patterson 1977ms) and is planned for additional representative species in both the western and central basins of Lake Erie.

Factors affecting the rates of entrainment and impingement should be addressed in the 316(b) demonstration. Providing such information will enable Ohio EPA to isolate potential or existing problems and if necessary, recommend modifications to intake design or operation. The availability of entrainable and impingeable organisms and facility operational variations appear to be the two major factors that determine entrainment and impingement rates and fish survival of each. Observed variations in fish impingement and entrainment rates may be accounted for statistically by comparing these rates with several variables through the use of a stepwise analysis. Variables that may influence fish availability and facility operation include, but are not limited to, the following:

1) fish availability - water quality, temperature, hydrological conditions (e.g., flow, current velocity, water level), and season.

2) facility operation - cooling water flow volume intake velocity, screen operation, chlorination, ΔT across condenser, recirculation, cribhouse designation, and unit operation.

Such an analysis should include as many variables as possible in order to provide a ranking of the relative importance of each variable within the two major categories of variation. The degree of the correlation between these variables within and between the two categories should reveal which factor, or combination of factors, was the most important relative to entrainment and impingement rates. The most important result of a stepwise analysis will be the isolation of facility operational variations or procedures that contribute the most to the observed entrainment and impingement rates. The survival of entrainment or impingement by fishes under various facility operational modes will also be an important consideration in determining what remedial measures should be taken, if any. Analagous situation survival estimates appear to be appropriate for most intakes although certain high risk intakes may require more detailed on-site evaluation. This information will be useful in determining if operational and/or structural modifications to a cooling water intake is necessary and if so how extensive it should be. In situations where intake damage is acceptable and agreed to be low non-penalty operational modifications (e.g., cooling water flow manipulation, screen washing, recirculation, chlorination, etc.) may be appropriate to minimize adverse environmental impact. As intake damage becomes more and more unacceptable the possibility of incurring operational penalties (e.g., load management, reduced pumpage) and/or structural modifications (e.g., intake relocation, volume reduction, fish handling facilities) increases.

Entrainment and impingement damage should be minimized at all intakes as much as it warranted by the acceptability or unacceptability of observed losses. As the magnitude or unacceptability of the adverse environmental impact increases the more substantial will be the requirements for reduction of intake damage.

Proposed Intakes

Much of the concern that has been expressed about fish losses at existing cooling water intakes can be eliminated at new intakes if proper construction, design, and siting (location) procedures are followed. Although the majority of facilities using closed-cycle cooling require make-up water the problem of capacity (i.e., volume) is substantially reduced. However, some large volume intakes (e.g., once-through cooling systems) have been proposed in other states and are likely in Ohio. Ohio EPA does not totally preclude the acceptance of large volume intakes as BAT for proposed facilities, but there are locations on many source water bodies in which the impact (both intake and thermal effects) of such facilities may not be acceptable. Pre-construction study requirements and regulatory review of proposed large volume intakes will be substantial.

The structural and operational design of new intakes is also important in reducing intake damage. Low velocity screening systems, fish handling and by-pass systems, and velocity caps are just three examples of several designs that are being developed to reduce intake damage. Steps should be taken to minimize the potentially severe, but usually short-term effects of intake construction.

Of the four BAT requirements for cooling water intakes the most important one relative to proposed sources is that of location (siting). Pre-construction siting of an intake in many cases may be the most important part of meeting BAT for proposed intakes. The siting procedure should rely substantially upon the results of pre-construction monitoring. The probable impact of a proposed intake may be determined for several locations in the source water body (at least for entrainment). Entrainment rates could be estimated by multiplying mean fish egg and larval densities (number/100 m^3) at each location by the expected cooling water flow rate (m^3/sec). The location with the lowest concentration of eggs and larvae should be chosen. Impingement impacts will be much more difficult, if not impossible to predict.However, impingement damage may be reduced through proper siting as well as intake design (i.e., low approach and through-screen velocities) and capacity. Fish entrainment and impingement losses at new intakes should be minimized as much as is reasonably possible, even if the predicted losses alone are not significant. Such losses must be viewed as being added to the cumulative impact of both existing and proposed cooling water intakes within the same source water body. The siting procedure for most proposed intakes should not be difficult, but will require increased precision and sophistication as the potential for new entrainment and/or impingement damage increases.

G. Review and Evaluation Procedures

The procedure for the review, evaluation and submittal of study plans and final demonstrations is outlined for existing and proposed cooling water intakes (Figs. V-1 and V-2).

Existing Intakes (Fig. V-1

A request by an applicant for the determination of best technology available for an existing cooling water intake structure should be accompanied by a 316(b) study plan proposal. Such a study plan proposal should be submitted at least 90 days prior to the initiation of field sampling. Upon receiving the study plan Ohio EPA will review and evaluate the proposal noting primarily the conclusions of the applicant's risk assessment, intake and source water sampling frequency and methods, and sampling locations. Ohio EPA may at this time advise the applicant as to the acceptability of the proposal and may recommend changes to any part of the study plan submittal. Opportunities for Ohio EPA - applicant discussion of any aspect of the study plan proposal will also be available at this time. Upon the completion of at least one year of sampling an applicant should then prepare and submit a final 316(b) demonstration to Ohio EPA. Further study or analysis may be necessary and if so will be specified at this time. After completing a review and evaluation of the final 316(b) demonstration Ohio EPA will make a determination of whether or not an applicant's existing cooling water intake meets BAT for minimizing adverse environmental impact. The specified BAT conditions will then be incorporated via modification into the NPDES permit. If an applicant accepts the BAT conditions, there are no third party objections, and USEPA gives approval, the intake is modified accordingly and/or operation continues under the NPDES permit. If an applicant rejects the BAT conditions a request for an adjudicatory hearing may be made and as a result of such proceeding, or a negotiated settlement reached pursuant to such proceeding, the BAT conditions may or may not be modified. All NPDES permit condition modifications must be approved by USEPA.

Proposed Intakes (Fig. V-2)

The determination of best technology available for proposed cooling water intakes will take place prior to the issuance of a Permit to Install (PTI) (OAC Chapter 3745-31). All BAT conditions will be specified in the PTI. The initial step is for an applicant to request the determination of best

Figure V-1: 316(b) review and evaluation flow chart for the determination of best technology available for existing cooling water intakes.

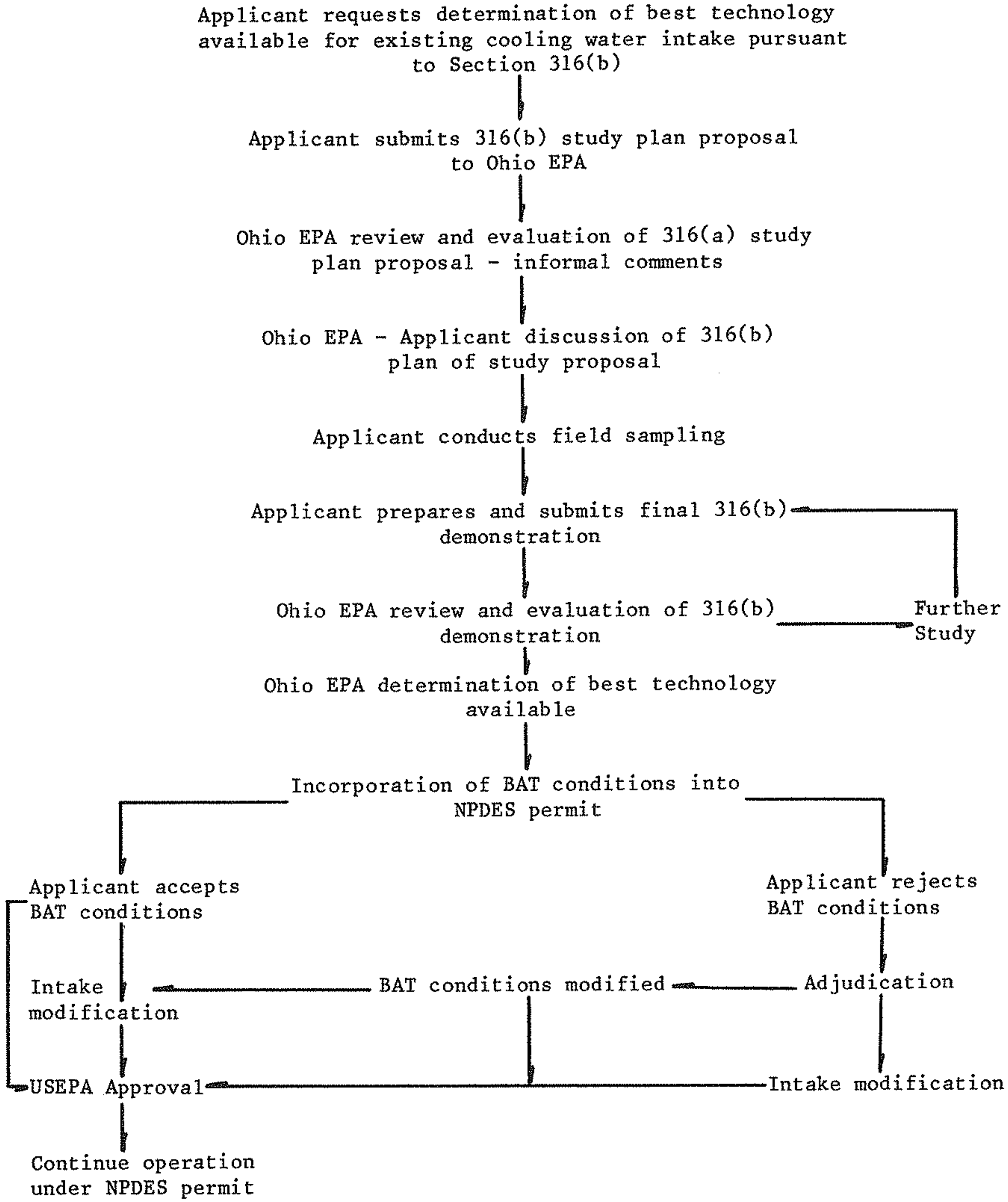
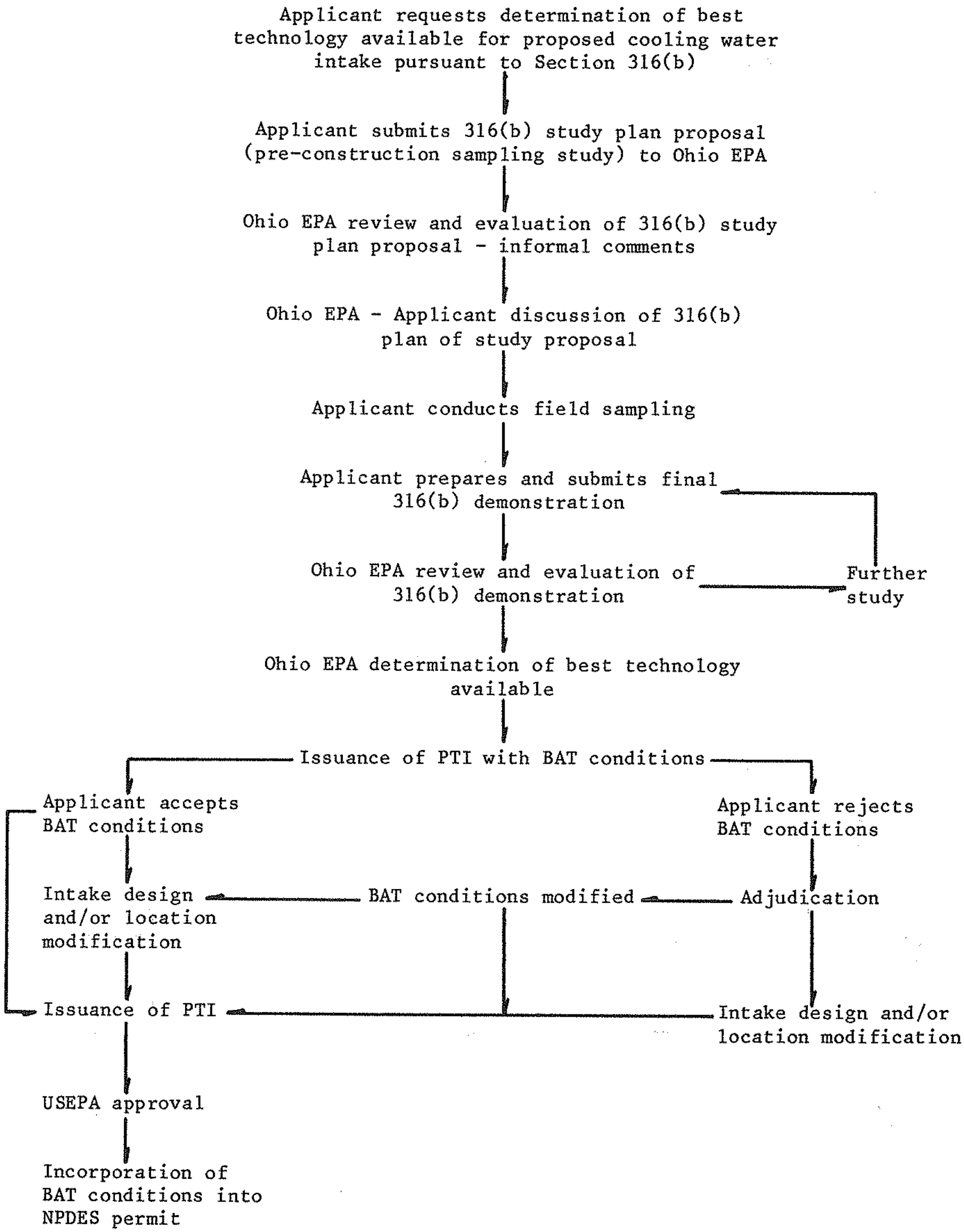


Figure V-2: 316(b) review and evaluation flow chart for the determination of best technology available for proposed cooling water intakes.



technology available for design, location, construction, and capacity of a proposed cooling water intake structure. A study plan proposal should accompany this request and be submitted to Ohio EPA at least 90 days prior to the initiation of field sampling. Ohio EPA will review the study plan noting primarily the location of sampling stations or transects, methods, and sampling frequency. It will be important for an applicant to demonstrate that the proposed intake design and location selections will be substantially dependent on the results of the pre-construction sampling program. Ohio EPA may at this time advise an applicant as to the acceptability of the proposal and may recommend changes to any part of the study plan proposal at this time. Opportunities for Ohio EPA - applicant discussion of any aspect of the study plan proposal will also be available at this time. BAT determinations will be made on a case-by-case basis as specified in this document and will rely on information presented in the final 316(b) demonstration, supporting documents, and other relevant reports and publications. Proper siting (location) and design of the intake with respect to the results of the pre-construction sampling program will be of prime importance in these considerations. BAT conditions will be incorporated into the PTI as a proposed action of the Director of Ohio EPA. If an applicant accepts the BAT conditions, there are no third party objections, and USEPA gives approval, the final PTI is issued. Eventually the BAT conditions will be incorporated into the NPDES permit which will satisfy all obligations under section 316(b). If an applicant rejects the BAT conditions in the PTI a request for an adjudicatory hearing and as a result of such proceeding, or a negotiated settlement reached pursuant to such proceeding, the BAT conditions may or may not be modified. All NPDES permit conditions must be approved by USEPA.

VI. LITERATURE CITED

Dickman, M. 1968. Some indices of diversity. Ecology, 49(6):1191-1193.

Fisher, R.A., A.S. Corbet, and C.B. Williams. 1943. The relation between the number of individuals and the number of species in a random sample of an animal population. J. Animal Ecol., 12:42-58.

Gammon, J.R. 1976a. The fish populations of the middle 340 km of the Wabash River. Purdue Univ. Water Res. Research Cen., Tech. Rep. No. 86. 73pp.

____.1976b. Measurement of entrainment and predictions of impact on the Wabash and Ohio Rivers, pp. 159-176. In L.D. Jensen (ed.), Third National Workshop on Entrainment and Impingement. Ecological Analysts, Inc., Melville, N.Y.

Gerking, S.D. 1950. Stability of a stream fish population. J. Wildl. Mgmt., 14(2): 193-202.

Goodman, D. 1975. The theory of diversity-stability relationships in ecology. Quart. Rev. Biol., 50(3): 238-266.

Hall, C.A.S. 1972. Migration and metabolism in a temperate stream ecosystem. Ecology, 53: 585-604.

Herdendorf, C.E. 1978. personal communication.

Hurlbert, S.H. 1971. The nonconcept of species diversity: a critique and alternative parameters. Ecology, 52(4): 577-586.

Latvaitis, B.P. 1977. Fish eggs and larvae, pp. 435-488. In R.M. Gerhold (ed.), Operational Environmental Monitoring in the Mississippi River near Quad Cities Station, Feb. 1976-Jan. 1977. Ann. Rept. to Commonwealth Edison Co., Chicago, Illinois.

MacArthur, R.H. 1955. Fluctuations of animal populations, and a measure of community stability. Ecology, 36:533-536.

Margalef, D.R. 1958. Information theory in ecology. Gen. Syst., 3:36-71.

Milburn, G.S. and G.C. Ginsberg. 1977. Regulatory developments in section 316(b), pp. 11-20. In L.D. Jensen (ed.), Fourth National Workshop on Entrainment and Impingement. EA Communications, Melville, New York.

Murarka, I.P. and D.J. Bodeau. 1977. Sampling designs and methods for estimating fish-impingement losses at cooling water intakes. Argonne National Laboratory. ANL/ES-60. 277pp.

Ohio Environmental Protection Agency. 1974. Guidelines for owners and operators of facilities with thermal discharges for submittal of demonstrations pursuant to sections 316(a) and 316(b) of PL 92-500. Division of Surveillance (Draft) 64pp.

Omaha Public Power District. 1975. Nebraska City power station unit No. 1 section 316(a) and (b) demonstration-FWPCA. Omaha Publ. Power, Omaha, Nebraska. 99pp.

Odum, E.P. 1971. Fundamentals of ecology. W.B. Saunders Co., Philadelphia. 574pp.

Patterson, R.L. 1976a. An outline of quantitative procedures for analyzing larval fish abundance data from western Lake Erie. School Natural Resources, Univ. Michigan, Ann Arbor. 34pp.

____.1976b. Methodology for estimating mortality and production rates of larval fishes using data on estimated abundance. School of Natural Resources, Univ. Michigan, Ann Arbor. 14pp.

____.1976c. Analysis of the dynamics of yellow perch populations under stress by point sources and area-wide sources of mortality (with reference to the western basin of Lake Erie). School of Natural Resources, Univ. Michigan, Ann Arbor. 16pp.

____.1976d. Production, mortality, and condenser cooling water entrainment of larval perch in Michigan-Ohio waters of the western basin of Lake Erie in 1975. School of Natural Resources, Univ. Michigan, Ann Arbor. 51pp.

Paul, J.F. and R.L. Patterson. 1977(ms). Hydrodynamic simulation of movement of larval fishes in western Lake Erie and their vulnerability to power plant entrainment. Paper presented at 1977 Winter Simulation Conference, National Bureau of Standards, Gaitherburg, Md., 5-7 Dec. 1977. 12pp.

Preston, F.W. 1969. Diversity and stability in the biological world. Brookhaven Symposia Biol. 1-12.

Shannon, C.E. 1948. A mathematical theory of communication. Bell Sys. Tech J., 27: 379-423/

____.and W. Weaver. 1963. The mathematical theory of communication. Univ. Illinois Press, Urbana. 117pp.

Smith, P.W. 1971. Illinois streams: a classification based on their fishes and an analysis of factors responsible for the disappearance of native species. Ill. Nat. Hist. Surv. Biol. Notes No. 76. 16pp.

United States Environmental Protection Agency. 1974. 316(a) technical guidance-thermal discharges. Water Planning Division, Office of Water and Hazardous Materials, U.S. EPA (Draft). 188pp.

____.1976a. Development document for best technology available for the location, design, construction, and capacity of cooling water intake structures for minimizing adverse environmental impact. Effluent Guidelines Division, Office of Water and Hazardous Materials, U.S. EPA, Washington, D.C. EPA-440/1-76/015-a. 263pp.

____.1976b. Guidance for determining best technology available for the location, design, construction, and capacity of cooling water intake structures for minimizing adverse environmental impact-section 316(b) PL 92-500 (Draft 2). 50pp.

____.1977a. Interagency 316(a) technical guidance manual and guide for thermal effects sections of nuclear facilities environmental impact statements. Office of Water Enforcement, Permits Division, Industrial Permits Branch, Washington, D.C. (Draft). 79pp.

____.1977b. Guidance for evaluating the adverse impact of cooling water intake structures on the aquatic environment:section 316(b) PL92-500. Office of Water Enforcement, Permits Division, Industrial Permits Branch, Washington, D.C. (Draft). 59pp.

Utility Water Act Group - Edison Electric Institute. 1976a. Comments on EPA's proposed 316(a) regulations and draft guidance manual. UWAG-EEI ad Hoc Water Quality Group. 133pp.

____.1976b. Comments of Edison Electric Institute and Utility Water Act Group on the Environmental Protection Agency section 316(b) guidance manual (second draft-April 1976). 51pp.

____.1977a. Comments on "draft interagency 316(a) technical guidance manual and guide for thermal effects sections of nuclear facilities environmental impact statements May 1, 1977." UWAG-EEI. 69pp.

____.1977b. Comments on "draft guidance for evaluating the adverse impact of cooling water intake structures on the aquatic environment: section 316(b) PL92-500 May 1, 1977." UWAG-EEI. 30pp.