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DRAFT

Pretreatment guidance manual for state and areawide (208) water quality management planning agencies

Volume 1

FOREWORD ON THE USE OF THIS MANUAL

The Environmental Protection Agency is currently reviewing its position on pretreatment policies, guidelines,regulations, and standards are all being reconsidered by an EPA Pretreatment Task Force. The goal of the task force is to develop a coordinated strategy for pretreatment which integrates the Federal roles of standard setting, guidelines development and enforcement with the roles of State and local governments.

This manual is being issued now in <u>draft</u> form for use by those areawide water quality management (208) planning agencies which have specified pretreatment and industrial treatment and collection systems as priorities and which must take immediate actions to include the solutions to such problems in their water quality management plans.

Several major topics presented in this manual are issues which are currently under review by the Pretreatment Task Force. These are:

- the manner in which Federal pretreatment standards should be set
- enforcement of Federal pretreatment standards
- Federal view of intergovernmental relations regarding pretreatment
- revision of the general pretreatment regulation, 40 CFR 128, to reflect EPA's new positon when it is developed

Where such topics are discussed throughout the manual they have been marked up to show that they are under review. On page 1-10, for example, there is a box containing a definition of major contributing industries taken from the current general pretreatment regulation (40 CFR Part 128). This box has been marked up to indicate that the whole concept of MCI's is being rethought. The Federal Government is considering a number of alternative approaches to developing standards such as preserving an economic equity between the direct discharger to a receiving water and an indirect discharger to a sewer or preserving water quality equity to the stream by equalizing the environmental impacts from direct and indirect dischargers.

Throughout the manual reference is made to a second volume of the manual containing appendices. The material in these appendices has been judged to be so subject to change that the second volume is not being distributed at this time.

EPA's Pretreatment Task Force is planning to have outstanding issues resolved and a coordinated pretreatment strategy developed by October, 1976. At such time this manual will be revised and issued in final form.

PREFACE

This two volume manual contains a comprehensive working review and analysis of the pretreatment issue. The manual is designed especially for State and Areawide Water Quality Management Planning (208) Agencies. As such, the information presented in the manual will enable planners and their consultants to more effectively incorporate pretreatment into their planning functions.

The manual was prepared by Process Research Division of Environmental Research and Technology, Inc. under an EPA contract (No. 68-01-3559) to the Water Planning Division. Three of the 8 membered project staff were recruited from the firms of Urban Systems Research and Engineering, Inc. of Cambridge, Massachusetts and from the law firm of Bracken, Selig and Padnos of Boston, Massachusetts.

The project staff appreciates the guidance and support provided by the Water Planning Division of EPA. The staff also thanks Gary Otakie, Municipal Construction Division, Office of Water Program Operations for his cooperation and support as well as local 208 agency staffs who contributed to the project.

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ABSTRACT

The U.S. Environmental Protection Agency recognizes the need for Federal, State and Local management programs regulating industrial point source discharges to municipal sewer systems. The ultimate purpose of these pretreatment programs is to prevent the introduction of incompatible pollutants to Publicly Owned Treatment Works (POTWs) which would result in either upset of the treatment plant's unit processes or pass-through of toxic materials to receiving bodies of water.

This manual is designed for use by State and Areawide (208) Water Quality Management Planners part of whose job it is to plan for the establishment of regulatory and enforcement programs governing the discharge of industrial wastewaters to municipal systems. The manual includes an analysis of the pretreatment issue from a Federal, State and Local viewpoint (Chapter 1) as well as descriptions of the critical management elements in pretreatment programs such as industrial waste surveys, monitoring programs, sewer use ordinances, enforcement mechanisms, legal consideration, financial considerations and possible management functions (Chapter 2). Chapter 3 provides a technical review of pollutants which can interfere with or pass-through a treatment plant and sample calculations for estimating the tolerance limits of treatment plant unit processes to various organic and inorganic compounds. The final chapter in Volume I provides three case studies on actual ongoing pretreatment programs.

Volume II is an appendix to the actual manual and includes a compilation of Federal minimum pretreatment standards, a monitoring supplement, a sample ordinance and permit from the California Water Quality Board and a copy of 40CFR128, the general pretreatment standard.

This report was submitted in fulfillment of contract No. 68-01-3559, by Process Research Divison of Environmental Research and Technology, Inc. under sponsorship of the U.S. Environmental Protection Agency. Work was completed in April of 1976.

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foul smelling rivers were evident to even an environmentally insensitive populace. To avoid treatment plant upsets and the resulting undesirable impacts on receiving waters, many cities began to specify in addition to the general prohibitions mentioned above, quantitative limitations on specific industrial wastes discharged to sewers. These limitations were legally incorporated into municipal ordinances. The employment of the ordinance as an effective device for control of sewer users developed only after the municipality clearly established its own authority over its service area. For many large metropolitan areas this has frequently taken decades as illustrated by the chronology of events shown on page iii for New York City(1).

During the 1960's, public consciousness of environmental issues increased. Previously less appreciated impacts of incompletely treated sewage began to be widely understood. For example, the role of nutrients in causing eutrophication of rivers and lakes was clearly documented and highly publicized. In response, treatment of industrial and domestic wastes began to emphasize nutrient removal processes. This trend is still under way.

As sewage treatment plants increase their effectiveness in removing traditional types of carbonaceous wastes and extend removal to nutrients, the inner workings of the treatment process become more complex and more susceptible to upset. For example, plant upset is more likely when such sensitive biological processes as nitrification and denitrification are used. More stringent pretreatment requirements are being developed by both local and federal governments to prevent plant upsets. However, even the development of a pollutant standard does not mean that a municipality can effectively use it as a means of control. This is indicated by the fact that the ordinance, the most widely used legal device for controlling sewer use is in many circumstances ineffectively enforced.(2) The reasons for this are complex. A basic factor such as public

Pretreatment:

Control measures and practices including treatment techniques, process and procedure innovations, operating methods and others for wastewaters from non-domestic point sources before introduction into the joint treatment works.

Joint Treatment Works:

Treatment works for both domestic and industrial wastewater.

INTRODUCTION

Pretreatment of industrial and commercial wastewater prior to discharge to municipal sewers has been carried out ever since sewers were first built to convey wastes away from their origin. Historically sewage treatment did not exist prior to the late 19th century; collected sewage was simply discharged directly to receiving waters. In this historic perspective pretreatment concerns were predominantly directed towards preventing explosions, physical blockage and physical or chemical disintegration of sewers. Considerably more attention was directed toward possible disruptions originating from commercial than from industrial sources due to the latter's historic tendency to locate on and directly discharge to water bodies. Similarly, when sewage treatment plants (joint treatment works) came on line in the early 1900's it was the hazards of explosion, physical blockage and chemical effects on the sewerage works itself which were the main concerns.

Later, in the mid 1950's, as the need for more efficient sewage treatment increased, the need to prevent treatment plant upsets became more critical. The effects of discharging poorly treated sewage were dramatized by resulting low oxygen levels in receiving waters: fish kills and

Chronology of New York City's Effort
To Define its Service Area Authority (1)

1898	New York City centralized control over sewer-use, jurisdiction extended over entire city.
1901	Control was decentralized - 5 borough presidents gained exclusive authority over sewers.
	Limitations on sewer use at this time primarily concerned with assuring the adequate size of plumbing to carry off domestic waste and to prohibit the discharge of butcher's offal, garbage, volatile or inflammable liquid and water at a temperature greater than 100 degrees Fahrenheit.
1938	New York Charter Revision Commission distinguished between local and citywide service functions. Local sewers were the concern of borough presidents. Intercepting sewers and treatment plants were placed under centralized control.
1962	Authority and responsibility for the operation of the entire sewer system, centralized under Department of Public Works.
1968-	Authority turned over to newly formed Department of Water Resources, a part of the Environmental Protection Administration.

attitude may be at the crux of the situation. Evidence for this view was presented by a committee of the Water Pollution Control Federation in a study which concluded that sewer collection systems were probably the most abused of all public utilities. This misuse developed in part from a common misbelief that a sewer can carry away any unwanted substance (3). From a more practical viewpoint it is the economic and political pressure exerted on the municipality by local industry which sometimes account for the lack of an effective sewer use or pretreatment program. In other situations, it may be the passive attitude on the part of a municipality which accounts for ineffective programs. This latter situation would develop naturally as a result of the municipal practice of basing user charge systems simply on water use. A necessary practice should involve basing industrial user charges on pollutant loadings as well as volume of discharged wastewater. Such a basis can be more equitable and provide a powerful incentive for a municipality to establish a monitoring and enforcement program.

A newer area of concern is directed at discharges of toxicants into sewers from commercial and industrial sources. Toxicants (such as heavy metals, cyanide and a large variety of organic compounds) can cause treatment plant upsets, and as a result, indirectly cause pollution of receiving waters through treatment plant breakdown. But many toxicants, e.g., polychlorinated biphenyls, do not affect, and are not decomposed by biological treatment plant processes. A wide variety of toxicants may therefore be discharged by treatment plants into waters that are used as drinking water sources or which support edible fish and shellfish populations. These possibilities add a new dimension to pretreatment as an issue.

The traditional understanding of the pretreatment issue, dealing exclusively with impacts on sewers and treatment plants, is irreversibly being transformed into a general public health issue. The significance of small but potentially toxic quantities of organic and inorganic chemicals passing through treatment plants or concentrating in sludges is only slowly being understood in public health terms.

The problem of disposing of treatment plant sludges containing toxics is a much more visible issue today. For example, the industrial discharge of certain chemicals, such as metals, into sewage treatment plants frequently results in elevated levels of the substances in treatment plant sludge. The disposal of such contaminated sludges in fact may pose a public health hazard, whether it is incinerated or disposed of in the ocean or on land. In the first case, metals such as mercury can pollute the air; in the second, fish and benthic organisms can accumulate high levels of metals; in the third, metals contained in land disposed sludge can contaminate groundwater or crops being grown on sludge treated soils. The pretreatment of industrial wastes containing toxicants which can contaminate municipal sludges should receive the same high pretreatment priority as the pretreatment of toxicants which can upset or pass through treatment works.

Finally, the relationship between sludge quality and pretreatment brings to the fore an important concept concerning toxic pollutant impacts. We have mentioned three such impacts: 1) the impact of toxic pollutants on plant processes and the need to prevent upsets; 2) the impact of toxic pollutants on receiving water quality as a result of pass through; and 3) the impact of toxic pollutants on sludge disposal. While the first type of impact is frequently viewed as a function of toxicant strength (or dilution), the second, and to a greater extent, the third impact of toxicants (on receiving water and sludge, respectively) are basically functions of total toxicant contributed.

The distinction between toxicant strength and total mass is particularly important to planners because standards will eventually be set in terms of strength (concentration), total mass (or both) ~~and potential hazards~~. The use of both types of standards will involve a complex set of tradeoffs with important environmental and economic implications.

As the relationship between industrial discharges into sewers and its broad reaching impacts begin to be understood, regulatory and planning agencies will be expected to respond. The nature of the response will determine to a great extent the type of pollutant removal technology and even the industrial process changes necessary to meet sewer discharge standards. Planners may have to consider to what extent the concept of joint treatment is applicable in situations where toxicants have been clearly identified.

This two volume manual is intended to serve as a guidance and resource document for Water Quality Management (WQM) Planning Agencies or simply planning agencies. The main text is contained in Volume 1 and consists of Four Chapters. Chapter 1 presents the overview of the pretreatment issue. Highlighted issues are boxed-in and appear at the top of the page. For the most part, Chapter 1 defines and attempts to clarify the pretreatment issue. In depth discussions of issues are presented in Chapters 2 and 3. Chapter 2 is prescriptive in nature and describes the main elements which constitute a pretreatment management program. This management theme is built around the industrial waste survey and the municipal ordinance. Chapter 3 presents a fairly detailed assessment of the types of pollutants which require pretreatment as well as their effects on treatment works and receiving waters. Chapter 4 presents case studies illustrating how in practice the pretreatment issue is addressed by municipalities and WQM Planning Agencies.

Volume 2 is an appendix and contains among other items an extensive compilation of published and proposed pretreatment standards.

References

1. Charles Imbelli, William B. Pressman and Harold Radiloff. The Industrial Waste Control Program in New York City. Journal WPCF 40 1981-2012, 1968.

2. M.O.P. No. 3 Regulation of Sewer Use, Journal WPCF 45, 1985-2011, 1973.

3. M.V. McIntire. Improved Procedures for Municipal Regulation of Industrial Discharges to Public Sewers. Prepared for the Office of Research and Development, USEPA, Grant No. 801372, Program Element 1 RA 030.

Chapter 1

OVERVIEW

1.1 INTRODUCTION

Chapter 1 presents an overview of the pretreatment issue. Becuase of its complexity the pretreatment issue is presented as a series of special highlighted topics. These topics address the issue from a definitional, management, planning, institutional, legal, and technical standpoint. Many of the topics discussed in Chapter 1 will be presented in greater depth in Chapters 2 and 3.

1.2 THE PRETREATMENT ISSUE

1.2.1 PERSPECTIVE ON PRETREATMENT: WHAT IS IT AND WHY IS IT NECESSARY?

The rather general term, "pretreatment", is used here to mean industrial treatment of wastes prior to discharge to sewers, which in turn convey wastes to publicly owned treatment works (POTWs). This specialized usage stems from its use in the Federal Water Pollution Control Act Amendments of 1972 Section 307(b) and (c), the latter is reproduced on the next page. One intent of this section of the Act is to protect sewage treatment plants from malfunctions resulting from the discharges of "harmful" industrial wastes. From a practical viewpoint three general types of

Sec. 307(c) Pub. Law 92-500

> "In order to insure that any source introducing pollutants into a publicly owned treatment works, which source would be a new source subject to section 306 if it were to discharge pollutants, will not cause a violation of the effluent limitations established for any such treatment works, the Administrator shall promulgate pretreatment standards for the category of such sources simultaneously with the promulgation of standards of performance under section 305 for the equivalent category of new sources. Such pretreatment standards shall prevent the discharge of any pollutant into such treatment works, which pollutant may interfere with, pass through, or otherwise be incompatible with such works."

"harmful" wastes are of concern on the municipal level:

1) Materials that damage collection systems or treatment works per se e.g. those which are explosive or tend to block, or clog up sewers and the treatment works.
2) Chemicals that are toxic to biological-type treatment plants.
3) Chemicals which interfere with sludge disposal.

A second intent of this section of the Act is to prevent the passage through the POTW of materials that are likely to result in pollution of the receiving waters. It is in this second intent of the section that the objective of the Act itself resides: that is, to "restore and maintain the chemical, physical and ~~or~~ biological integrity of the Nation's waters". While "plant upset" and "pass through" are the most frequently mentioned concerns of the pretreatment issue, other concerns such as impact of industrial wastes on sludge quality and quantity, fall easily within the meaning of the law. Note how readily the issue of industrial impacts on POTW sludge fits into the meaning of the last line of Section 307(c) of the Act (see box above).

The pretreatment issue takes on importance from a planning, as well as an operational, standpoint. Industrial discharges to public treatment plants can contribute a significant portion of the total flow or load to the treatment plant. Therefore, in order to upgrade or design a new treatment plant, the industrial contribution must be known. In many cases the extent of an industry's contribution will be influenced by federal and local pretreatment requirements. (It should be remembered that most industries historically have been located next to water bodies and therefore frequently have the choice of discharging directly or using public sewers.) The quality as well as the quantity of industrial wastes needs to be known for planning purposes, since the type of treatment process employed by the POTW may need to be designed to take into account specific types of industrial wastes. As a result, facility plans are directly influenced by the pretreatment issue.

The pretreatment issue has strong economic impacts (see Chapter 4.2.4) since certain costs are incurred by industries and POTWs in meeting federal and local pretreatment standards. In addition to the direct costs of on-site industrial pretreatment processes, which are borne solely by the industry, other costs are:

1) user charges paid to municipality for use of sewer and POTW
2) surcharges paid to municipalities by dischargers whose waste "strength" is greater than ordinary users
3) capital costs repayed by the industrial users of the treatment works, of that portion of the Federal grant which is allocable to the treatment of water from those users.

The above costs influence an industry's choice to discharge into a POTW or to utilize direct discharge. The consequences of an industry's decision "to go into sewers" can also be economically important to the municipality.

The pretreatment issue will be of particular relevance to the water quality management (WQM) plan. This plan is supposed to define ways in which the discharge of industrial pollutants can be significantly reduced or eliminated.

Pertinent Literature

Federal Guidelines	Pretreatment of Pollutants Introduced Into Publicly Owned Treatment Works October, 1973, EPA

This document represents the first effort on the part of EPA to define pretreatment as described in PL 92-500. These guidelines were published pursuant to Section 304(f) of the Federal Water Pollution Control Act Amendments of 1972. A brief discussion is presented describing the benefits of joint treatment of industrial wastewater. Similarly, all of the elements of the pretreatment issue are briefly described. Much of the material presented has been updated by new federal guidelines (presently in draft form).

Federal Guidelines (Draft)	State and Local Pretreatment Programs, August, 1975, EPA

This is a two volume report which updates the original Federal Guidelines published in 1973. The purpose of these guidelines is to assist municipalities, States, and Federal agencies in developing pretreatment requirements for the discharge of industrial wastewaters into POTWs. Volume 1 contains sections on technical, legal and management aspects of the pretreatment issue. A highly technical section is presented on pollutants which interfere with POTWs. Appendices giving detailed information on ordinance preparation, ~~published pretreatment standards~~, test procedures for analysis of pollutants and additional technical data on pollutants is presented, along with an annotated bibiiography. Volume 2 contains a detailed description of industrial processes, their SIC categories and their chemical make-up.

One of the many ways of accomplishing this is to achieve effective pretreatment requirements on the municipal level.

What responsibilities could be assumed ~~Who is responsible~~ for the pretreatment issue?

There are, in the issue of pretreatment, elements that include the entire spectrum of institutions involved in water pollution control. These responsibilities are described in Table 1-1.

(Fundamental issue which is under review)

Operationally, the Federal role in the pretreatment issue will be clearly secondary to that of the States and municipal governments. In most instances, the pretreatment issue will be expressed on an areawide, municipal and Statewide level. The Planning agency will review industrial plans, assess potential impacts and lend guidance to the municipal effort, which should constitute the mainstay of the pretreatment issue.

1.2.2 How Does Pretreatment Interact With PL 92-500 Especially With WQM Planning Under Section 208?

Goals and Objectives of PL 92-500

The basic objective of PL 92-500, the Federal Water Pollution Control Act Amendments of 1972 is stated in Section 101:

> "The objective of this Act is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters."

This objective is followed by six goal and policy statements that are meant to achieve this objective.

> "it is the national goal that the discharge of pollutants into the navigable water be eliminated by 1985;
>
> "it is the national goal that whereever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water be achieved by July 1, 1983;
>
> "it is the national policy that the discharge of toxic pollutants in toxic amounts be prohibited;
>
> "it is the national policy that Federal financial assistance be provided to construct publicly owned waste treatment works;

TABLE 1-1

INSTITUTIONAL RELATIONSHIPS

PRETREATMENT ELEMENTS	FEDERAL	STATE & AREAWIDE PLANNING/MANAGEMENT	STATE	MUNICIPAL	INDUSTRY
REGULATORY AUTHORITY	Specified by Sec 307(b) & (c) of PL 92-500. Regulations establish pretreatment standards for significant industrial users. Federal guidelines on pretreatment are specified in Sec 304 (f).	Reviews POTW Permit, and 201 plans. Creates 20 year plan. Establishes regulatory program to insure industrial pretreatment requirements are met.	May give permit to POTW and specify numerical limits. Establishes enabling law for municipal authority.	Sets local PT requirements. Defines Service Area.	None
ENFORCEMENT	Direct enforcement of Federal PT Standards	Designates agency to handle enforcement.	May have direct enforcement over POTW Permits compliance; in some cases over sewer dischargers into POTW.	Major enforcement authority over industrial users of sewers.	None
MONITORING	May carry out monitoring of POTW discharges. Reviews POTW monitoring data. Access and inspection rights.	May review POTW monitoring data; may review self-monitoring data from industrial users of POTW.	May carry out monitoring of POTW discharges. Reviews POTW monitoring data. Access and inspection rights.	May monitor: -influent to POTW -effluent -industrial users (access and inspection).	May perform self-monitoring. (most common).
FINANCIAL	Construction grants subject to review to insure that permit conditions will be met for POTW.	Reviews and Certifies Federal construction grants. May provide an assessment of economic impact of pretreatment requirements on local industry.	May provide "matching funds" for construction grants	Establishes user charges, surcharges in order that industry contributes equitably to capital and O&M costs of POTW.	Subject to user charges and fines. Cost recovery requirements. Assume cost of monitoring.
PRETREATMENT STANDARDS	Federal minimum Standard setting.	Incorporates Federal and local standards in WQM plan. Aids municipality in preparation of PT ordinance requirements.	Sets State standards in compliance with Federal minimum standards.	Sets local requirements in compliance with Federal minimum.	Subject to Federal and local requirements.
RESIDUALS	Provides guidance on sludge disposal.	Identifies both toxic components of sludge and industrial contributors. Proposes standards for sludge quality and specifies pretreatment necessary to meet sludge standard. Establishes management program for disposal of industrial pretreatment sludges.	Specifies and approves sludge disposal options.	Carries out sludge disposal in an environmentally acceptable manner. Coordinates with 208 agency in selecting sites for disposal of industrial pretreatment sludge.	Generates pretreatment sludges.

PT = Pretreatment

POTW = Publicly Owned Treatment Works

TAB[illegible]1-1 (Continued)

INSTITUTIONAL RELATIONSHIPS

PRETREATMENT ELEMENTS	FEDERAL	STATE & AREAWIDE PLANNING/MANAGEMENT	STATE	MUNICIPAL	INDUSTRY
POTW PERMITS	In some cases EPA issues POTW Permits.	Review existing draft permits--incorporate permit specifications into WQM plan. Management phase--once plan has been adopted POTW Permit and PT standards must be compatible with plan	In some cases state issues POTW Permits.	Municipal POTW must meet requirements of NPDES Permit. Local PT requirements [illegible] (listed in ordinance) should relate to NPDES permit requirements.	Compliance with PT Standards is required.
AREAWIDE PLAN	Reviews and approves Plan.	Establishes plan which may include specific: minimum pretreatment requirements; industrial waste survey procedures; ordinance types.	Certifies plan.	Contributes to WQM plan. In order to be eligible for Federal funding must be consistent with 208 plans PT requirements.	Industry participates on advisory committee.
PLAN IMPLEMENTATION	Establishes financing provisions, approves designated management agencies.	Requires a management agency to run PT program.	State designates management agency(s). Develop State legislation such as enabling laws.	May have to amend ordinance to be in compliance with PT provisions of Areawide plan.	Committee participates on technical and policy committees.
PUBLIC PARTICIPATION	Holds public hearings on Federal PT Standards.	Arranges public hearings and information transfer sessions on relevant pretreatment issues. Assists municipalities in arranging public hearings on sewer use regulations.	Comment and review on pretreatment issues as they affect water quality standards and WQM plans.	Holds or participates in public hearings on new sewer use regulations. Provide forum for all interested persons.	Participates in public hearings on sewer use regulations.
MUNICIPAL ORDINANCE	Supports efforts such as the preparation of guidance documents.	Gives direct aid to municipality in ordinance development. Reviews all municipal ordinances within planning area. May recommend regional ordinance.	Aids municipality in ordinance development. Reviews ordinance for completeness.	Creates ordinance. Will be directly involved in implementation of ordinance.	Complies with ordinance requirements.
INDUSTRY WASTE SURVEY	Supports efforts such as the preparation of guidance documents.	In many cases will carry out survey. Identify discharges of toxic wastes.	May require municipality to modify survey approach.	Frequently carries out survey.	Provides information to satisfy survey requirements.

PT = Pretreatment
POTW = Publicly Owned Treatment Works

> "it is the national policy that areawide waste treatment management planning processes be developed and implemented to assure adequate control of sources of pollutants in each State; and
>
> "it is the national policy that a major research and demonstration effort be made to develop technology necessary to eliminate the discharge of pollutants into the navigable waters, waters of the contiguous zone, and the oceans."

The policy statements on how to meet this objective focus largely on pollutant discharge. Industrial pretreatment requirements are one element of the pollutant and toxic pollutant control effort.

The NPDES System

The major tool in the Act for implementation of source control of water pollution is found in the National Pollutant Discharge Elimination System (NPDES), section 402 of the Act. NPDES permits are issued to all point sources discharging directly into "waters of the United States". These point sources include municipal treatment facilities, factories, some specific agricultural operations, service and commercial operations. The permits are designed to effect compliance with the requirements of the Act:

1) to insure effluent limitations are met on a prescribed compliance schedule;

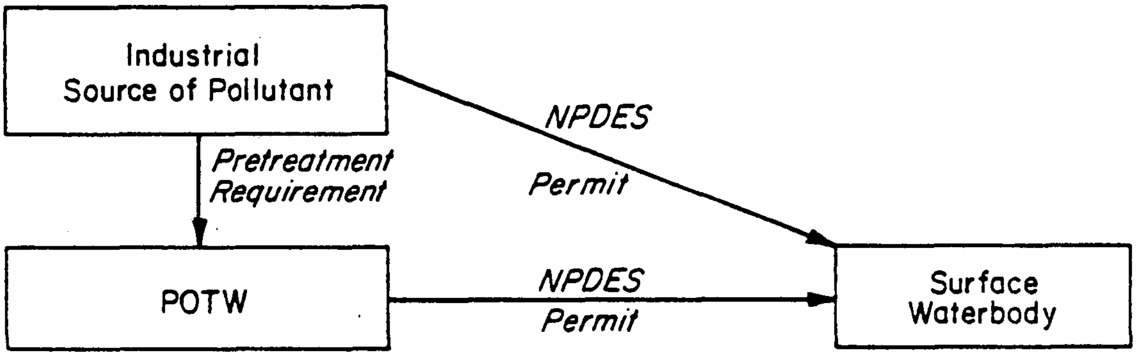
2) to insure the necessary waste treatment technology is applied; and

3) to insure water quality standards are met on a prescribed schedule.

The following figure (1-1) places pretreatment requirements on the vector between industrial point sources and the publicly owned waste treatment works. It shows that in part, pretreatment requirements are indirectly affected by the NPDES requirements of the POTW.

Figure 1-1

INDUSTRIAL POINT SOURCE CONTROL



Although the NPDES does not require issuance of permits to industries discharging to sewers*, the POTW that treats the waste is required to have a discharge permit. As part of the NPDES permit for the POTW, the municipal operating authority must submit forms identifying the discharges to the sewers from major contributing industries

The General Planning Guidelines of the Act

The major planning programs of the Act are organized under each State's Continuing Planning Process. Water Quality Management (WQM) Planning under Sections 208 and 303 is conducted in designated problem areas. This planning is the responsibility of the State in all other areas, although this responsibility may be delegated to other local, State, interstate or Federal agencies. Facilities plans are prepared by local agencies where it is determined that a POTW is needed.

1) State Continuing Planning Process - The primary goal of the continuing planning process is to ensure that the institutional arrangements and management

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* Municipalities often require sewer use permits.

(The whole concept of [illegible] is under review.)

Major Contributing Industry (from 40 CFR 128) :

A major contributing industry is one that: 1) has a flow of 50,000 gallons or more per average work day; 2) has a flow greater than five percent of the flow carried by the municipal system receiving the waste; 3) has in its waste a toxic pollutant in toxic amounts as defined in standards issued under Section 307(a) of the Act; or 4) has a significant impact, either singly or in combination with other contributing industries, on a publicly owned treatment works or on the quality of effluent from that treatment works.

programs are established to make and implement water quality decisions. Specific outputs of the CPP are the State strategy, the State-EPA agreement on timing and level of detail of planning, water quality standards, and individual State and areawide WQM plans.

2) State and areawide Water Quality Management (WQM) Planning - This planning forms the basis for implementing point and nonpoint source controls necessary to achieve the goals of the Act. It includes an assessment of municipal and industrial waste treatment system needs, and an identification of necessary regulatory programs and management agencies.

3) Facilities Plans (Section 201) - Facilities plans are the initial step in three step construction grant process. These plans must examine the cost-effectiveness of adequate construction programs to achieve necessary effluent limitations, considering different numbers, sizes, and sites for facilities. Wastewater treatment options such as land treatment and flow reduction are also examined.

The Continuing Planning Process is addressed in regulations in the Code of Federal Regulations, Chapter 40, Part 130 (40CFR130). State and areawide WQM planning is dealt with in 40CFR131 and 40CFR35, Subpart A. These regulations were published in the Federal Register on November 28, 1975.

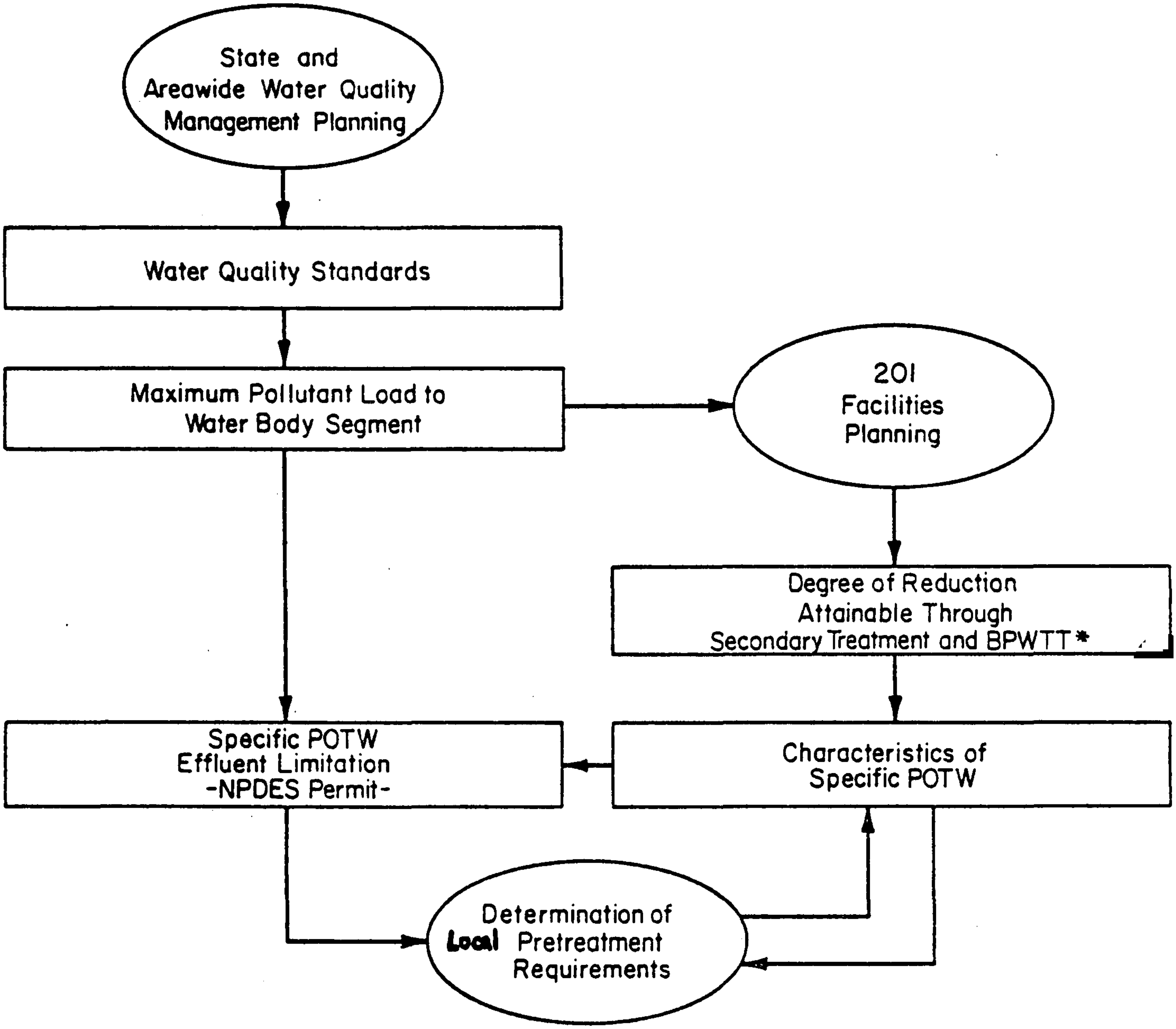
Pretreatment Within State and Areawide WQM Planning and 201 Facilities Planning

State WQM planning and 201 facilities planning will indirectly affect the development of pretreatment programs. Effluent limitations for POTWs will be set based in part on criteria developed within the WQM and 201 planning processes. Strategies to meet water quality goals, including maximum daily pollutant loads, are integral parts of the WQM plans. The 201 plan describes the process and capacities of treatment facilities. Information from WQM plans and 201 plans is critical in structuring effluent limitations of the POTW. Figure 1-2 illustrates the role of WQM and 201 planning in setting both effluent limitations for POTWs and pretreatment requirements. It can also be seen from this figure that pretreatment requirements can be used to correct a treatment plant design limitation on the one hand and be reflective of certain characteristics of POTWs on the other (e.g. if an existing POTW is a physical-chemical plant and effectively removes metals then ~~municipal~~ local pretreatment ~~standards~~ requirements may not have to be stringently set).

Pretreatment Within State and Areawide WQM Planning

Because of the multitude of problems which planning agencies must address and the limited time and resources available to them, planning agencies should prioritize their tasks. Due to varying local situations pretreatment will take on greater or lesser importance. Some planning areas may have virtually no industrial users of POTW's; other areas may have industrial users which contribute only compatible wastes to the POTW. In such cases little or no attention may be given to pretreatment. In other areas, pretreatment may be the most important element of an industrial wastewater control program.

Pretreatment may be addressed either separately as a program element under the WQM planning process or as part



* The 1977 and 1983 Technology-Based Effluent Limitations Required of POTW's by Sections 301 and 201 of the Act (BPWTT = Best Practicable Waste Treatment Technology).

Figure 1-2
PRETREATMENT AS PART OF THE PLANNING PROCESS

of an industrial waste management and planning program. Pretreatment programs have two main purposes: to insure protection of the POTW against upset and interference with sludge disposal, and to prevent industrial pollutants from passing through treatment plants and polluting receiving waters. Industrial dischargers into municipal treatment systems will be required to meet "pretreatment ~~standards~~ requirements" set up by municipalities. These ~~standards~~ requirements will be evaluated within the WQM process in order to insure that the effluent limitations for the POTW designated in its NPDES permit are not violated due to treatment plant upset caused by interference from industrial contributions. Similarly, facilities plans will be reviewed and pretreatment will be an issue in these reviews. In practice planning agencies will work closely with municipalities, giving expert advice on how to write pretreatment ~~standards~~ requirements for inclusion in the municipal ordinance. Table 1-1, Institutional Relationships, presents the management and planning functions of WQM planning (208) relative to pretreatment. The planning functions of WQM planning may:

1) Determine local pretreatment requirements based upon Federal pretreatment standards; ~~Specify minimum federal pretreatment requirements for relevant industrial categories;~~

2) Organize and update information on the type and number of industries discharging to sewers, as well as quality and quantity of their wastewater constituents;

3) Identify all industries which discharge toxic wastes to sewers connected to POTWs;

4) Identify industries whose pretreatment sludges will contain toxic substances. Incorporate such information into the areawide residuals program plan;

5) Assist municipalities in properly utilizing industrial waste survey information for inclusion into ordinances;

6) Assist municipalities in preparing enforceable ordinances;

7) Organize two-way industrial information exchanges in order to evaluate possible industrial responses to pretreatment standards;

8) Assess potential trends initiated by areawide industries in disposal options such as sewer discharges versus direct discharges to receiving waters. Determine for example, the historic annual rate at which industries connect to sewers compared to the present rate;

9) Prepare an assessment of economic impacts of pretreatment on local industries.

The prime management function of WQM planning relative to pretreatment is to establish a regulatory program to insure industrial pretreatment requirements are met.

Discharge to Publicly Owned Treatment Works (POTWs)

Under sections 301(b), 304(d) and 201(g) of the Act, municipal treatment works (POTWs) must meet "secondary treatment" requirements by July 1, 1977, BPWTT requirements by July 1, 1983, or more stringent limitations if necessary to meet water quality standards. Users of POTWs also fall within the statutory scheme set out in section 301(b). Thus industrial point sources which discharge to POTWs via sewerage systems must comply with pretreatment standards established pursuant to section 307.

Pretreatment Standards for Existing and New Sources

40 CFR 128
MAY BE REVISED

The EPA promulgated general pretreatment standards on November 8, 1973, under Title 40, Part 128 of the Code of Federal Regulations. These regulations are meant to satisfy the requirements of section 307(b) of PL 92-500.

> "Pretreatment standards...shall be established to prevent the discharge of any pollutant through treatment works (as defined in section 212 of this Act) which are publicly owned, which pollutant interferes with, passes through, or otherwise is incompatible with such works."

The general standard includes no specific numerical limitations but only definitions, general rules on prohibited wastes and pretreatment requirements for incompatible pollutants that all industries discharging to the POTW must comply with.

The regulation states that pretreatment is not required for compatible pollutants. (A more detailed description of 40 CFR 128 is provided on p. 1-17.)

Subsequent to the issuance of 40CFR128, EPA has proposed pretreatment standards for categories of point sources which will apply to existing sources. According to the regulation, the proposed standards are identical to BPT effluent limitations except the standards only apply to incompatible pollutants (see box page 1-17). [BPT or best practicable technology effluent limitations must be met by direct dischargers] ~~by 1977 pursuant to~~ section 301(b)(1)(A) of the Act.] EPA has promulgated pretreatment standards for existing sources in 15 industrial categories. These 15 categories have, however, only compatible wastes in their effluents. As a result of 40CFR128, these pretreatment standards require "no limitations" on discharge. It should be noted that no pretreatment standards have been promulgated yet for existing sources which have incompatible pollutants in their effluents.

The basis for pretreatment standards for new sources is also found within section 307. According to section 307(c), the EPA is required to establish pretreatment standards for new sources simultaneously with the standards of performance for new sources that discharge directly to waters of the United States. In many cases the regulations promulgated are identical (new source performance and pretreatment standard for new sources). The reason for this overlap of standards is very clear in the case where a particular pollutant passes through a POTW untreated or inadequately treated. The source discharging such a pollutant causes essentially the same environmental damage as a direct discharger of the same pollutant and, therefore, should meet essentially the same requirements.

For an industry to be subject to the minimum limitations, it must be classified a major contributing industry* (see p. 1-10). A compilation of the proposed and promulgated pretreatment standards these industries must comply with is provided in Appendix A of the manual.

*from 40 CFR 128

Because of numerous comments made to the EPA concerning the inadequacies of 40 CFR 128, a new regulation has been drafted (40 CFR 403) which, when promulgated, will replace 40 CFR 128. This new regulation will serve the same purpose as 40 CFR 128 but will be considerably easier to understand.

TITLE 40 CODE OF FEDERAL REGULATIONS PART 128

This general regulation defines pollutants in two categories: compatible and incompatible. Compatible pollutants are biochemical oxygen demand, suspended solids, pH, fecal coliform plus "...additional pollutants identified in the NPDES permit if the publicly owned treatment works was designed to treat such pollutants...". Examples of such pollutants are given as chemical oxygen demand, total organic carbon, phosphorus-nitrogen and related compounds, fats, oils and grease. Incompatible pollutants are any that are not compatible pollutants. The standards set forth for these two categories apply only to major contributing industries which are defined on page 1-10 of this chapter. The only specific regulations established by 40 CFR 128 are those for prohibited waste. These can be found in Appendix D of this handbook.

The key section of this regulation is Section 128.133 which defines the pretreatment standards for incompatible pollutants. This paragraph sets the pretreatment standard for existing sources as the BPT requirements which are described on p. 1-15. This standard is modified somewhat by two additional statements. First of all, if the related POTW is committed in its NPDES permit to remove a specified percentage of any incompatible pollutant the pretreatment standard will be correspondingly reduced. In addition, when the BPT regulation for direct dischargers is promulgated for a specific industry a pretreatment standard will be proposed for indirect dischargers in that industry.

It is important to note that this regulation covers existing sources only. Pretreatment standards for new sources are proposed and promulgated simultaneously with the new source performance standards according to 307(c). For new sources there are no general pretreatment ~~standards~~ regulations which correspond to 40 CFR 128.

1.3 The Design and Administration of Pretreatment Programs

ith respect pretreatment, the federal government is involved in industrial waste management through its planning efforts, funding programs, and effluent regulations, but much of its contact with industry is indirect. A heavy [redacted] burden of industrial waste management--and, therefore, of pretreatment--falls on State and municipal governments.

About half of the States currently have responsibility for granting NPDES permits which regulate direct discharge of wastes into navigable waters.[1] Although NPDES States assume responsibility to insure that industrial users of POTWs comply with pretreatment standards, large numbers of industrial users have not yet been addressed by finalized

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[1] In non-permit States, EPA regional offices are responsible for NPDES permits, either alone or in cooperation with the State.

pretreatment standards.[2] As a result, States have not yet been forced to assume major pretreatment responsibilities. Nevertheless several States have instituted effective pretreatment programs on their own.

Municipalities have the responsibility of designing and administering pretreatment programs (see chapter 4.3), their authority coming from the general police powers, and from State enabling legislation. They must enforce whatever pretreatment ~~standards~~ requirements are necessary to meet Federal standards, prevent violations of their NPDES permits due to plant upsets caused by interference from industrial contributions, minimize their sludge disposal costs, and protect their systems from damage or upset due to industrial wastes. The basic issues and problems they face in discharging their responsibility are discussed in the remainder of this chapter.

Industrial wastewater management on the municipal level breaks down into two basic elements: a survey and analysis of industrial wastes discharged into the local sewer system, and an administrative and regulatory program to control and monitor these wastes. One objective of industrial waste management at the municipal level is usually the creation of an industrial cost recovery system (see chapter 4.3.3) and the establishment of appropriate user charges. But whenever industry is a major contributor (see p. 1-10) to POTW influent, pretreatment may be an issue of equal ~~as~~ or greater importance, particularly from the environmental point of view.

Survey and Analysis of Industrial Wastes

A data base of the types and quantities of industrial wastes discharged to sewers is obtained by an industrial waste survey (IWS). While it usually is conducted as part

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[2] The only promulgated pretreatment standards for existing sources are for categories which have compatible wastewaters. The standards call for "no limitations" on discharge.

of a pretreatment program, an IWS can be used in several ways:

1) To forecast annual O/M costs in order to allow a user and surcharge system to be created;

2) To update the industrial cost recovery system;

3) To aid in forecasting industrial discharge levels for planning POTW expansions or new facilities for which 201 facilities plans will be done;

4) To identify industrial wastes subject to local and federal pretreatment ~~standards~~ requirements;

5) To gauge the impact of industrial wastes on the quantity and quality of POTW sludge;

6) To help planning agencies evaluate total toxicant pollution in a region; and

7) To set local pretreatment ~~standards~~ requirements.

While there are a number of cheaper ways to fulfill all these functions of an IWS, they are less reliable in their results, potentially less equitable in their economic impacts on industries, and ultimately less effective in serving water quality goals. Procedures for conducting IWSs are discussed in length in Chapter 2, Section 2.1.

The Administrative and Regulatory Program

Conducting an industrial waste survey is relatively straightforward in principle and execution; designing and administering pretreatment ~~standards~~ requirements, on the other hand, ~~are~~ is likely to be a complex and difficult process, with many economic, legal, political, and technical issues to resolve. Since the pretreatment issue is still new, the following discussion of the dynamics of standard setting and enforcement must be to some extent speculative.

Setting Pretreatment ~~Standards~~ Requirements

[redacted]

Such a program consists of legally binding arrangements with local industries, usually in the form of a Pretreatment Ordinance, which establishes exact conditions for discharges. Federal pretreatment standards, as discussed in the previous section, are binding on major contributors to the system. Smaller contributors, however, may also be regulated by the municipal ordinance, and municipal ~~standards~~ requirements for all contributors may be more strict, if necessary, than federal standards.

It is important to remember that POTWs have three different, often separable, objectives in setting up pretreatment (programs): 1) to improve plant efficiency to prevent upsets; 2) to maximize sludge quality (and, therefore, minimize disposal costs); and 3) to prevent pass-through of dangerous pollutants. Plant upsets cost money and cause permit violations; avoiding them is perhaps the highest priority of pretreatment from the POTW's standpoint. Present sludge disposal practices are not always the most environmentally adequate methods available. When pollution control procedures are better defined, costs for sludge management may be considerably higher. Thus POTWs are currently not experiencing the real costs of sludge disposal. Pass-through, especially where plant efficiency is completely unaffected by a particular pollutant, entails no direct dollar costs, but possibly very heavy environmental costs; giving this issue the top priority it deserves may be economically and politically difficult, but every effort must be made to do so.

Industries' Response to Pretreatment ~~Standards~~ Requirements: Once ~~a~~ pretreatment ~~standard has~~ requirements have been set, industries must bear the often substantial costs of meeting them. They have three major alternatives: 1) to pretreat wastes; 2) to change manufacturing processes to lower pollutants in their waste stream; or 3) to disconnect from the system (go out of business, move, or seek their own NPDES permit). Different ~~standards~~ requirements may provoke different responses as shown above.

If industries select the first response--setting up

Trends in Sewer Use

Industries converting from direct discharge (into navigable waters) to sewer discharge may represent a trend in some areas. Although this trend has not been precisely documented there appears to be at least two incentives for it:

1) Some permitting authorization may encourage industries to relinquish their permits for direct discharge and utilize POTWs instead. This rationale appears to be based on the "desirable" goal of reducing the number of pollution point sources in receiving waters.

2) Industries may find it less expensive to discharge into sewers due to:
   a) the implicit and explicit subsidies mentioned in Chapter 2.5.6.

   b) less stringent regulations as a result of poor municipal regulation of its industrial dischargers.

treatment processes to reduce concentrations of controlled pollutants to acceptable levels--the results will be predictable. But if they approach compliance in other ways, the results are less certain. Process changes may involve introducing new pollutants into an industry's waste stream, or raising the levels of minor pollutants above effluent requirements. Disconnection from the system reduces total flow to the POTW (with possible economic and technological effects), but also reduces contaminant loadings. In both cases, standards might have to be reviewed in order to define pretreatment requirements as equitably as possible for all contributing industries.

[redacted] Planners will probably wish to set tentative requirements on the basis of the IWS results, approach industries, environmental groups, and other interested parties, with the results, and ask for their responses. A second and final set of requirements might then be necessary. Industries severely affected by the requirements should be given particular attention and all help possible to prevent their going out of business (see below). The final set of ~~standards~~ requirements should be so well understood by industry and the POTW that their implementation will cause no surprises, and will meet all pretreatment goals.

Other Considerations: Setting pretreatment ~~standards~~ requirements is further complicated by a variety of issues (discussed in more detail in Chapter 2). One of these is allowance for industrial growth: if ~~standards~~ requirements are calibrated just tightly enough to meet immediate pretreatment needs, they would have to be recalculated and changed if new industries were to connect to the system. Aside from the administrative costs this would incur for the municipality, it could well pose far heavier costs to existing industries, which might be forced to change their entire pretreatment strategies. Other issues include safety margins within the ~~standards~~ requirements, criteria for setting variances and allocating their costs among participating industries, and the impacts of pretreatment on industrial location and on environmental protection programs such as the Clean Air Act.

Relief to Endangered Firms

The high cost of pretreatment unit processes may endanger the existence of some marginally profitable firms, and will be a significant burden on most others. The only options open for the relief of economically endangered firms are to give them financial and technical advice on how to meet requirements, or to grant them variances (from local requirements). Variances should only be granted as a last resort, for if pretreatment goals are not to be compromised, all concessions granted to one industry must be paid for through stricter requirements on other industries. Financial and technical advice, on the other hand, can be highly useful in helping industries find ways of complying with pretreatment at minimum cost. (These are discussed at greater length in Chapter 2.)

There are several forms of Federal financial assistance available for recouping the cost of pretreatment, including various investment tax credits, tax-exemptions on construction bonds, loan subsidies, and rapid amortization procedures for pollution control equipment. These should be brought to the attention of all industries.

Technical advice can take a number of forms. Site visits by engineers familiar with pretreatment problems can reveal good housekeeping processes that would reduce pollution emissions. They could also recommend process changes that would permit compliance with pretreatment standards at lower cost than pretreatment. Directories of available pretreatment equipment can also be compiled, giving industries information on vendors, local prices, and technical specifications.

All possible relief measures should be made available to local industries as soon as possible, preferably before requirements ~~standards~~ are set. In this way firms can anticipate what their response to pretreatment requirements ~~standards~~ will be, and can inform the requirement ~~standard~~ setting agency.

Conclusions

Because of the heavy economic impacts that pretreatment requirements may have in many areas, economic issues may obscure the real objective of pretreatment--environmental protection. Industries will exert pressure on POTWs to relax requirements wherever possible, especially on pollutants that impose no direct costs on the design and operation of municipal treatment plants. Because pass-through, and to a lesser extent sludge disposal, pose few such costs, economic pressure for compromise will be felt exactly where environmental damage is least understood and potentially of the greatest long-term significance.

While the economic impacts of pretreatment on industries cannot be ignored, and while aid toward compliance must be proffered wherever needed, planners must always place the water quality objectives of pretreatment first.

Chapter 2

MANAGEMENT PROGRAMS

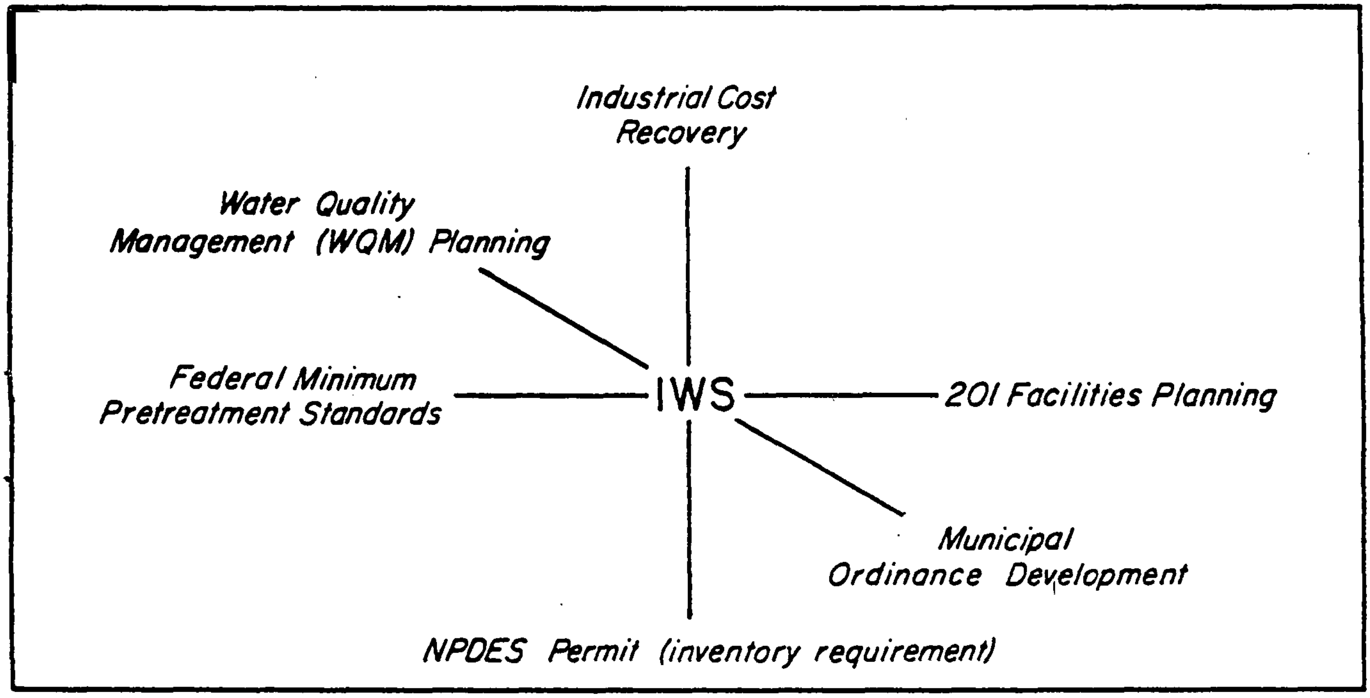
2.1 INTRODUCTION

This chapter describes the elements required for the development and administration of an industrial pretreatment program. The technical, legal and economic considerations for the management of industrial wastes are brought into focus by a description of two key activities: the industrial waste survey (IWS) and the development of a local sewer use ordinance. The IWS will serve to define the quantity and quality of industrial wastes in a locality and will lay the groundwork for planning a control program. The information obtained from an IWS will be an integral part of all the water quality management efforts for an area including facilities (201) plans, updating State program plans, WQM (208) planning, NPDES permit and cost recovery requirements, and, especially pertinent to industrial waste control, the development of a sewer use ordinance (Figure 2-1). As the IWS is to definition and planning, the sewer use ordinance is the core of enforcement and management of industrial wastes. It is the legal basis for establishing industrial pretreatment limitations and assigning of financial responsibility (Figure 2-1). The ordinance traditionally has been a document defining general sewer-use regulations. Historically, there were provisions against discharging wastes that would either damage the sewerage system or obstruct flow within the pipes. Enforcement proceedings were often detailed but mostly ignored by administrators of the ordinance (13). Subsection 2.3.5 presents planning guidance on how municipalities can develop more readily enforceable ordinances to control industrial wastes in the sewerage system. An alternative to the traditional approach of controlling sewer discharges would be to enact a general enabling ordinance providing for negotiation of individual contracts with each industry. This is also discussed in subsections 2.3.5 and 2.4.5.

2.2 OUTLINE OF MANAGEMENT PROGRAM ELEMENTS

Several activities will proceed in either chronological or parallel succession in planning an industrial pretreatment program. The capacity and capabilities of the sewerage facilities must be determined. An assessment of the industries and their wastes will be assembled mainly from the IWS and supported by information from Federal, regional and State planning activities (Figure 2-2). A comprehensive review of the existing ordinances will identify what controls are already in use and how effective these have been in regulating industrial discharges.

Because of water quality considerations, some municipal NPDES permits will specify limitations on pollutants that originate essentially from industrial discharges. In such cases, these specific limitations will probably only be controllable by establishing local pretreatment requirements, Definition and Planning



Management

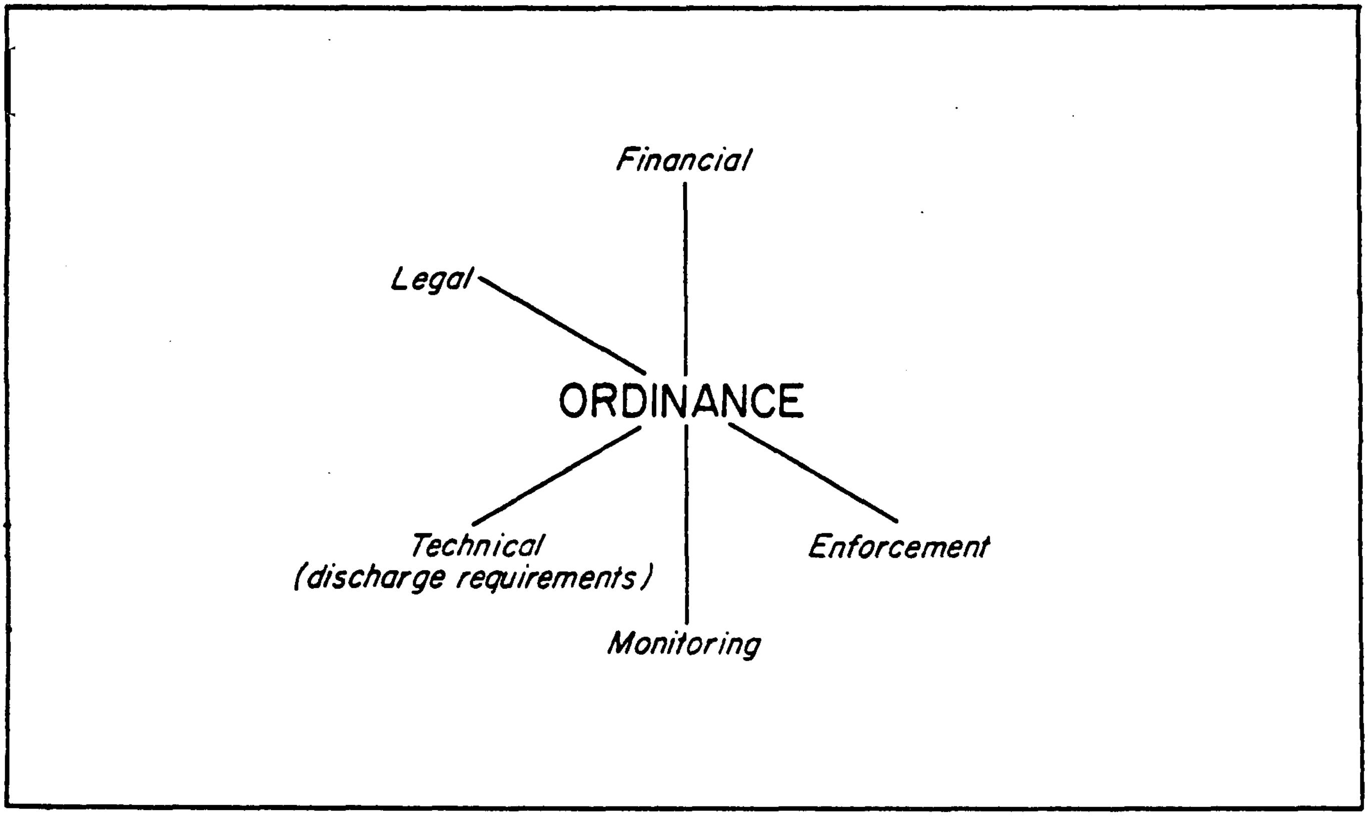


Figure 2-1

INDUSTRIAL WASTE MANAGEMENT

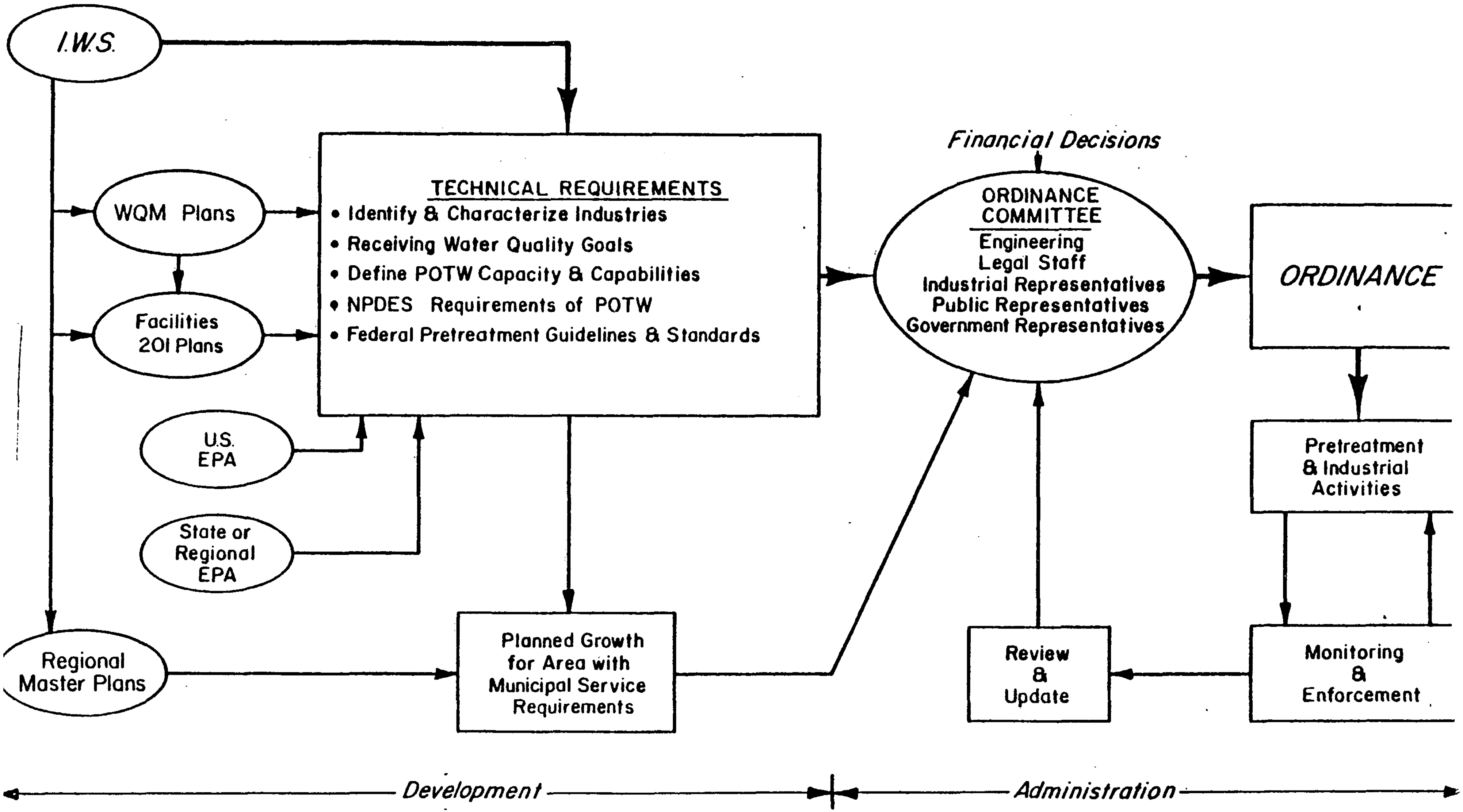


Figure 2-2

DEVELOPMENT AND ADMINISTRATION OF [illegible]N INDUSTRIAL PRETREATMENT PROGRAM e.g., a municipal ordinance. These elements (IWS, Ordinance Review, POTW Study) are listed and described in Table 2-1. Several additional elements of a mangement program such as impacts on industry, sludge disposal and toxic substances are also described in this table.

2.3 TECHNICAL CONTROL ELEMENTS FOR INDUSTRIAL POLLUTANTS DISCHARGED TO SEWERS

2.3.1 Introduction

The function of a monitoring program will be to determine compliance with pretreatment requirements, to supplement data for computation of user charges and surcharges, and to evaluate any important changes in the system. The intial stages of a monitoring program will involve a survey of the existing non-residential discharges to a sewerage system. This information will provide a technical data base for the development of a local pretreatment ordinance, of treatment strategies and of any subsequent monitoring program that is needed. A well structured monitoring program will reveal any changes in the quantity, quality, or number of industrial discharges, and will aide in the planning of future treatment plants or the expansion or upgrading of present systems. Moreover, by supplying immediate notice of the presence of interfering materials in unacceptable quantities, monitoring could serve as a warning device, initiating precautionary measures to avoid treatment plant upsets or decreased operating efficiencies.

The responsibility of monitoring industry can rest upon either the industries themselves or upon sewerage works personnel. Federal authority to require self-monitoring by industries is described in section 308 of PL 92-500. According to this section, the owner or operator of any waste discharge can be required by the Administrator of EPA to:

1) install, use and maintain monitoring equipment;
2) sample effluents at appropriate locations and frequencies;

Table 2-1

PRETREATMENT MANAGEMENT PROGRAM ELEMENTS

1. INDUSTRIAL WASTE SURVEY

Data Compilation

- Identify all industrial contributors.
- Establish quality and quantity of pollutants.

Data Analysis

- Assign S.I.C. categories. • Identify toxic dischargers. • Identify significant contributors.

2. MUNICIPAL SEWER ORDINANCES

Survey

- Examine ordinances for completeness and enforceability.

Review and Analysis

- Determine what ordinances require updating and change. • Advise and aid individual municipalities in drafting (or changing) sewer use ordinance.

3. ENFORCEMENT PROGRAM

Scope

- Determine if an effective enforcement program exists and recommend improvements.

Monitoring Program

- Identify monitoring program possibilities. Select best suited for circumstances.

4. PRETREATMENT FINANCIAL PROGRAM

Cost Breakdown

- Breakdown the costs of pretreatment program into survey, monitoring, analysis, legal and treatment.

Cost Assignment

- Develop system for equitably assigning cost recovery and user charges to industry.

5. POTW STUDY

POTW Pretreatment Characteristics

- Relate the type of POTW, its capacity, and type of industrial user to the specific pretreatment needs, e.g., physical-chemical versus biological, trickling filter versus activated sludge.
- Include historical review of POTW upsets and negative water quality impacts.

POTW Discharge Permit (NPDES) Permit Survey

- Ascertain the technical degree to which the standards in the sewer use ordinance are reflected in the municipal NPDES permit.

Impacts on Sludge Disposal

- Relate sludge treatment options and disposal costs to industrial users of POTW.

6. PUBLIC PARTICIPATION

Awareness of Pretreatment

- Initiate efforts to increase citizen understanding of important issues. • Conduct public information meetings with public and industrial representatives.

Industrial Participation

- Form advisory committees with significant industrial representation.

7. SECONDARY ISSUES

Impacts on Industry

- Determine what impacts program has on industrial costs. • Advise industries on available incentives.

Toxic Substances Legislation

- Ascertain to what degree pretreatment program must respond to 307(a) standards.

3) establish and maintain records as deemed necessary;

4) prepare and submit reports; and

5) provide other information that may be reasonably required.

The extent to which this authority is enforced will depend on existing discharges and water quality standards, the resources of the industry, and the resources of the sewage system organization. It is likely that self-monitoring by industries would be an efficient approach in many cases, but it must be determined to what extent POTW support and surveillance will be needed to double check such a program. If Federal authority to require monitoring appears to be inadequate or inappropriate for local conditions, it can be augmented or defined more specifically in the local ordinance or user regulations.

Monitoring is a cornerstone of a pretreatment program and its enforcement; care should be taken to avoid its becoming a hinderance. Monitoring activities will not always involve costly sampling and measurement. In situations where resources are limited, monitoring activities should be used selectively. For example, there may be enough published literature on industrial wastes to roughly characterize the local industrial discharge. More frequently available information may permit a decision to be made whether to monitor an industrial contributor. Thus, monitoring could merely involve assembling and updating information such as the list of industries and their production characteristics without having to sample effluents. The published literature will also be instrumental for identifying special items of concern, such as toxic substances, for a given industry. However, actual sampling will at times be required to measure compliance with pretreatment requirements or when an industry challenges the characterization given to its wastes.

The purpose of this section is to describe the options available for a monitoring program and provide guidance for performing such activities. Because local conditions will vary, instruction on which option is best suited to a given situation would be quite complex and is thus deliberately avoided. Rather, criteria for an agency to use in making such decisions are posed. Requirements for personnel, costs, technical equipment and data are considered herein.

Monitoring has several purposes. Compliance monitoring measures an industry's progress towards, or adherence to, pretreatment requirements. User charge monitoring will provide initial data or update existing data used in computing an industry's share of the costs involved with public treatment of wastes. Emergency (or Demand) monitoring will be conducted during unusual conditions, including plant upsets.

Development of a monitoring program may be the task of the local authority, with the planning agency serving as consultant arbiter, or it may primarily be the task of the planning agency itself. In either case, it is important that the planner take responsibility to tailor a well organized, simple monitoring program that will effectively report on the status of the industrial waste pretreatment program by obtaining maximum cooperation of the industries involved without feelings of undue harrassment.

2.3.2 The Industrial Waste Survey

The extent of industrialization will vary considerably between regions, and thus the quantity and quality of industrial wastes should be systematically identified. Metropolitan areas (such as New York City, with 44,000 non-residential sources) will have widely diversified industries which are sometimes difficult to identify or analyze. Rural or suburban areas may have few industrial discharges or none at all, but even one discharge, such as a large paper mill, could significantly affect sewerage works operations. A

An Industrial Survey May:

1) Identify all non-residential sources;
2) Categorize the industries (e.g., Sewer ~~of~~ or direct discharge; products manufactured; size of plant)
3) Classify and sample each waste discharge.

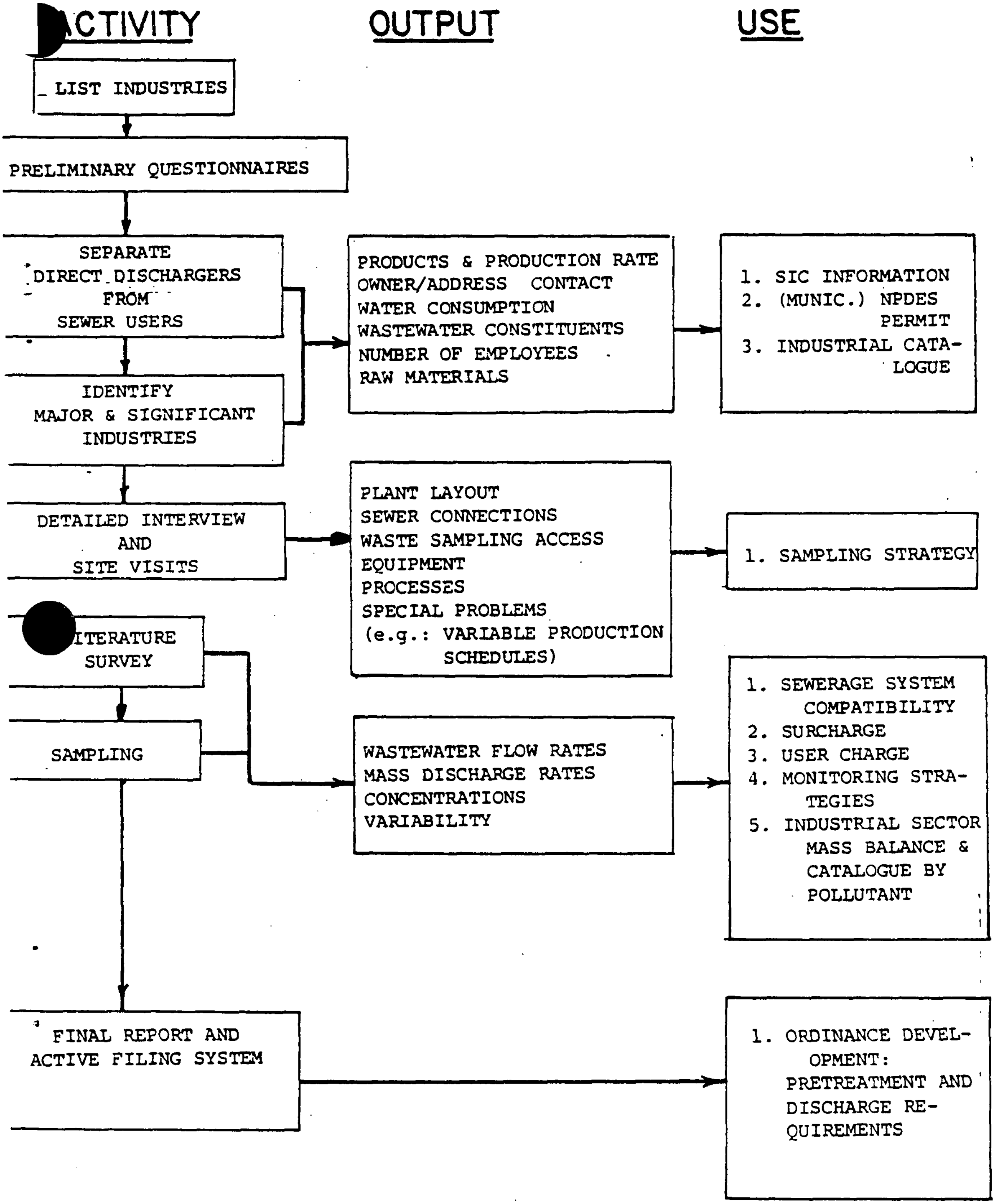
thorough industrial survey may be required to provide baseline data for NPDES permits, but it will also aid in the development of a pretreatment ordinance as well as in the planning of sewerage system improvements or additions. Moreover, such a data base could be of value for areawide toxic substance surveys and economic and land-use planning. Sewer user charges and surcharges will also be based on the results of the industrial survey and analysis.

Description of Tasks for the Industrial Waste Survey

The text entitled: "The Treatment of Industrial Wastes", by E. B. Besselievre (9) presents a detailed guidance for the development of.an industrial waste management program beginning with obtaining the baseline data to be acquired from an industrial waste survey. From a complete list of firms in the area and with some basic information on their activities, the significant contributors of industrial waste should be sorted from the insignificant and non-manufacturing firms. The wastes from this former grouping can then be characterized by survey and analysis and control or pretreatment strategies can then be developed. Figure 2-3 summarizes the activities and intended outputs of an Industrial Waste Survey (IWS).

List of Firms. In smaller areas, there may be a group or an individual already familiar with all of the non-residential discharges. Where such familiarity does not exist, there are various sources from which a complete list of firms can be compiled. Some of these are:

INDUSTRIAL WASTE SURVEY



1) Census records
2) Tax records
3) Chamber of Commerce or other business organizations
4) State liquor authorities (or breweries, wineries, etc.)
5) Other licensing agencies (e.g., Fire Department)
6) State directory of manufacturers
7) Board of Health
8) Public Utilities
    a) Gas and electric suppliers often bill commercial and industrial accounts separately.
    b) Water utilities can often identify large consumers.
9) Insurance company statistics
10) Telephone directory yellow pages

Industry Classification. A preliminary questionnaire will help identify the industries that will require more detailed study. This initial survey should be limited to simple questions like:

1) What is your product(s)?
2) What is your production capacity?
3) How many people do you employ?

It can be conducted by mail, telephone, or in person. Most likely some amount of personal interviewing will be necessary. The information obtained should be sufficient to separate the manufacturing from the non-manufacturing and dry production firms. These latter two can then be stored in an inactive file.

The remaining manufacturing industries should then be surveyed in more detail in order to ascertain which firms produce wastes that are:

1) below surchargeable concentrations;
2) above surchargeable concentrations (portion to be taxed);
3) hazardous, prohibited, or toxic;
4) resistant to treatment and likely to pass through to receiving waters.

Tasks involved with this detailed survey will include personal site visits and interviews with plant personnel; determination of water usage and effluent flow rates, description of unit processes, including heating and air conditioning systems; listing of raw materials and (if possible) preparation of material balances for the operations; and sampling of effluents. A flow chart, showing major equipment and piping should be prepared.

Once the products, processes, and size of an industry have been defined the wastewater discharges must be identified and characterized according to:

1) flow rates;
2) waste constituents;
3) pollutant quantities (concentration and mass discharge rates); and
4) variability of each of the above.

The literature, much of it quite recent, contains wastewater effluent characteristics for many industrial classifications and subcategories. The wastewater constituents to be expected from an industry, their concentrations or mass discharge rates per production rate, and treatment ~~of~~ or pretreatment strategies can most likely be identified without having to sample and measure actual effluents (Table 2-2). A list of significant wastewater parameters for selected industrial classification (4) is included in Appendix B. If actual sampling of waste is required, more detail on the procedures that are involved is given in the following section which describes monitoring options.

It is important that the variability of discharge be determined for an industry or for a waste constituent. Some industries' operations vary seasonally while others vary even daily because of their use of batch or semi-continuous processes. The variability of industrial discharges could affect the designation of monitoring intervals, pretreatment process design and treatment plant operations.

Table 2-2

PARTIAL LIST OF REFERENCES FOR THE CHARACTERIZATION OF INDUSTRIAL WASTES

TITLE, AUTHOR, REFERENCE NUMBER	REVELANT TOPICS
Handbook for Monitoring Industrial Wastewater, U.S. EPA, 1973 (4)	Program planning. Waste constituents by industry. Parameters to be measured, sampling schedule, sample volumes. Sampling techniques. Data analysis. Personnel training.
Cost of Implementation and Capabilities of Available Technology to Comply with PL 92-500, Battelle, Inc., 1975 (18).	Description of 38 industrial categories. Effluent characteristics (constituents and concentrations). Residuals after treatment. Available treatment technology.
Capabilities and Costs of Technology for the Organic Chemicals Industry to Achieve the Effluent Limitations of PL 92-500, 1975, Catalytic, Inc. (19).	Description of the industry. Plant process analysis for 37 product/processes. Extensive BOD/COD wastewater characterization. Descriptions of 29 "Generalized Plants" with concentrations and mass discharge rates for various important parameters.
Capabilities and Cost Technology for the Inorganic Chemicals Industry to Achieve the Requirements and Goals of the Federal Water Pollution Control Act, Catalytic Inc., 1975 (20).	Similar to above but for Inorganic Chemicals industry.
Innovative Technology Study, Water Purification Associates and Process Research, Inc., 1975 (21).	Wastewater characteristics for 9 major industrial categories. Advanced treatment technologies
Theories and Practices of Industrial Waste Treatment, Nemerow, 1963, (22).	Origin and quantitative characteristics of major industrial wastes from 32 industries under: apparel, food processing materials, chemicals, energy. Treatment theory and basic practices.
Industrial Wastes: Their Disposal and Treatment, Rudolfs, 1953 (23).	Emphasizes treatment. Describes (quality/quantity) wastes from unit processes of 14 industrial categories.

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Nancy, K.H., Weber, W.J., Jr., Analysis of Industrial Wastewaters, Wiley Interscience, New York, 1971.

Lund, H.F. Industrial Pollution Control Handbook, McGraw-Hill, 1971

A comprehensive industrial waste survey was conducted in Long Island City, New York (1). It found that of 2,000 firms identified, 82 percent did not discharge any industrial waste, 9.5 percent contributed insignificant amounts, 5.7 percent discharged toxic or prohibited wastes, and only 3 percent discharged wastes in amounts that were surchargeable. The reference given above for this survey describes in detail each of the activities that were performed and is recommended as an example of IWS procedures. The study noted that an average of 172 man hours was required per firm to complete all the tasks involved with the IWS. Surcharge formulas, ordinances, program organization, waste problems, and sampling techniques are explained in the reference.

Another IWS has been described in a report by the New Castle County (Delaware) 208 Planning Agency (2). The planning agency itself conducted this survey which compiled, categorized, and where necessary sampled industries discharging to sewers in the area. In its conclusions about the IWS, the agency suggested that a permit system, similar to the NPDES, be initiated for dischargers into the public wastewater collection system. In another study for the City of Buffalo (New York), consulting engineers were hired by the sewer authority to survey the local industries, develop a monitoring program, and develop an equitable cost recovery system in compliance with U.S. EPA regulations. Detailed description of the sampling and analysis of industries is given in the engineering report (3).

2.3.3 Monitoring Program Options

The results of an industrial survey will provide a basis for development of a simple and effective monitoring program. As a first step, a working map should be drawn up to illustrate the list of industrial discharges that will require monitoring. This map should display the relevant sewer lines, streets and addresses to enable personnel to quickly locate the sources and routes of pollutants during any routine surveillance or emergency situations. Next, each discharge should be considered in terms of the following:

1) the reason for monitoring (e.g., surcharge or pretreatment compliance);
2) the need for actual sampling;
3) the wastewater constituents to be measured;
4) appropriate sampling stations and their accessibility;
5) frequency and duration requirements for sampling;
6) sampling methodology; and
7) projected sampling and reported costs for that discharge per annum.

From this information (some of which will have been obtained from the IWS) an overall monitoring program can be developed.

If actual sampling and measurement is required, the options available for monitoring range from analysis of simple grab samples at the treatment plant influent to continuous, automatic analysis of each discharge and telemetering the information to a central location. The degree of sophistication of a program will depend on several factors, including the size of the system, the types of industries, and the available resources. For example, a chemical industry would probably already have the facilities to monitor its own effluent and it would thus be most efficient to require it to do so. Large sewerage systems will often have analytical facilities at their disposal, but such systems are also likely to have many industries to monitor and might require a substantial expansion of existing facilities and personnel. If the costs of such expansion are to be passed on to the industries, self-monitoring by the industries may be more efficient. Small sewerage systems may find it best to contract with consultants or another agency to perform monitoring functions, but again, the industries themselves should be considered as part of the available resources. Below is a list of possible monitoring programs:

MONITORING CAN BE PERFORMED PRIMARILY BY:

1) Industry
2) Sewerage Authority personnel
3) Automatic equipment

AT:

1) Industrial sites
2) Sewer junctions
3) Sewage treatment plant

1) continuous and intermittent monitoring of toxic wastes at the source;
2) continuous and intermittent at key junction points in the sewer system;
3) continuous (and intermittent) monitoring of the treatment plant influent;
4) industrial self-monitoring;
5) sewerage personnel monitoring;
6) private contractor monitoring.

The following briefly describes some of the options for monitoring. In choosing the optimal arrangement for a locality, the planning agency may possess objective information and thus be a valuable participant in the decision-making process.

Industrial Self-Monitoring

Similar to the NPDES approach to measuring compliance, the self-reporting of discharge data will place responsibility on the industries using publicly owned treatment works and requiring pretreatment regulation. Self-monitoring could possibly prove to be the most efficient approach because it will be performed by those closest to and presumably most familiar with the processes that are involved. Better maintenance and optimization of pretreatment and sampling processes is likely to occur from direct participation by industry rather than by regulatory procedures. A minimum amount of expansion of sewerage system personnel and facilities would be required. The success of such a program would of course depend on the integrity and accuracy of the discharger's reports. Periodic on-site compliance checks by the regulator [redacted] will be necessary to assure industrial diligence.

Effluent samples collected by the industry could be analyzed in-house if laboratory facilities are available. Duplicate samples could be sent to an independent laboratory or to sewerage authority facilities to corroborate the results obtained by the industries' laboratories. Alternatively, these samples collected by industries could simply be sent to outside laboratories. The frequency, number, and volume of samples will depend on numerous factors discussed in section 2.3.4.

A standard reporting procedure should be established by the planning agency or by the agency that will subsequently administer the program. United States EPA regulations (40 CFR 128) state that when pretreatment standards are promulgated, a contributor would be required to be in compliance with such standards within 3 years from the date of promulgation.* Thus, reports showing compliance progress should be devised. Besides flow data and discharge rates of specific water quality factors, these reports should state any changes in production capacity, raw materials, process design, and wastewater pretreatment operations.

Sewerage Authority Monitoring of Industrial Discharges

The formation of a monitoring unit within the sewerage authority will require field equipment, laboratory facilities and skilled personnel. The size of the monitoring unit or the number of monitoring teams will be determined by both the

* Note: Compliance dates are under review along with a number of issues contained in 40 CFR 128. See Foreword on the use of this manual for greater detail.

number of industrial contributions and the frequency at which they must be sampled. Each field team will have the responsibility to: 1) take on-site measurements (e.g.: flow, temperature, dissolved oxygen); and 2) collect samples and return them to the laboratory for analysis. Procedures for data and sample gathering should be adequately defined and adhered to so that the results are acceptable as official documentation. Duplicate samples should be offered to the industry for parallel analysis. Most often the sampling site will be on the industry's property and satisfactory procedures should be established for entry and use of the premises. During the monitoring task, a member of the team should interview a representative of the industry to discuss any pertinent aspects of the waste discharge and to review any required records.

It must be insured that the results of the monitoring visit represent the complete range of conditions that are possible for the waste discharge. For example, a complex industry with integrated batch and continuous processes may require several weeks to monitor wastes from one cycle of products and intermediates. If equalization is not practiced at the plant, a highly variable waste discharge should be expected (e.g., see Nemerow, (22)) and one day of sampling will not be representative. A lengthy stay or repeated visits by the monitoring team would be required.

A typical monitoring team might consist of one engineer and two technicians, visiting an average of 200 industries per year. The team would be supported by a laboratory chemist and technician dedicated at about half time. The engineer would interface with the industry while giving support to the technicians. With sufficient equipment, two sites could be sampled simultaneously. Each monitoring visit would thus average 2 to 3 days. The engineer in charge would be responsible for the entire operation, including the final disposition of information. Based on common pay scales, the personnel cost of such a program would roughly amount to about $300 per site. Materials, maintenance, laboratory expenses, and overhead will increase this figure. Multiples of these monitoring groups could be formed as required.

Automatic Monitoring

Automatic water sampling devices can be installed at many industrial sites. A list of some currently available units is given in Appendix B. These units either take discrete, timed samples of a designated volume or a composite sample collected over a period of time. Composite samplers collect at a rate either proportional to time, for sampling waste streams that are essentially constant, or proportional to flow rate, for waste streams that are variable. Discrete samplers collect a sample volume (often 1 liter) at controllable intervals that usually range from once every 15 minutes to once every 3 hours. With either type, samples must be transported to a laboratory and then analyzed.

Several water quality factors can be automatically analyzed on site by mechanical or electronic devices. These devices consist of a sensor, usually immersed in the waste stream; a signal conditioner, which receives the measurement and usually converts it to a voltage analogue (digital machine language may also be used); and an output device, most often a recording volt meter calibrated to measure the signal in pertinent units (e.g., mg/l). Additionally, the signal can be transmitted to a remote output device: this is commonly done across rented telephone lines. The capital expense for this type of equipment is often high and frequent maintenance is often required. It has been estimated (3) that capital costs for automatic monitoring will run about $4,000 for each parameter measured, while telemetering and recording equipment could cost up to $12,000 per total system. Protective enclosures could cost up to $15,000. Below are some of the water quality parameters that can be monitored automatically.

FLOW
CURRENT
DEPTH
PRESSURE
TEMPERATURE
TURBIDITY
CONDUCTIVITY
DISSOLVED OXYGEN
TOTAL ORGANIC CARBON
OIL
CYANIDE
AMMONIUM
pH
FLUORIDE
OTHER SPECIFIC ITEMS

Interference by other water quality components and fouling effects can be a problem with such equipment. Nevertheless, there will be situations where automatic monitoring will be the most effective approach. Detection of a toxic or hazardous material is one likely application. Automatic equipment can be connected to an alarm at a given industry or at the treatment plant.

Sewerage System Monitoring

Besides the issue of who (or what) will perform the monitoring, the most suitable monitoring sites must also be determined. In some cases, extensive monitoring on a regular basis at each industrial site may not be necessary. Monitoring key intersections or selected locations in the sewerage system itself may be adequate. From the industrial discharge map, these key locations could be identified. Sampling stations consisting of automatic, semi-automatic or manual equipment could be established in manholes and sewerage system personnel would visit each station periodically. Upon detection of excessive amounts of some component, the treatment plant would be notified and the violator located by tracking the pollutant upstream. In other cases monitoring the municipal treatment plant influent may be adequate.

Treatment Plant Influent Monitoring

By continuously monitoring the sewage treatment plant influent, it may be possible to avoid a disruption of plant functions caused by unacceptable amounts of toxic compounds. Upon detection of such material that would interfere with treatment operations, a predetermined influent bypass procedure to a holding pond could be initiated and a field crew dispatched to locate the source of this material. Telephone interviews could possibly identify an overt upset at a particular industry. Given a familiarity with the types of upsets that are likely to occur at each industry, and guided by the industrial discharge-sewer map, a mobile unit should be able to backtrack to the source and advise on remedial measures. Ideally, the bypass detention capacity would be equivalent to the maximum time required to locate and eliminate the toxic material in the system, although such conditions may not be feasible.

It is improbable that a total plant failure will occur due to the presence of a toxic compound. Instead, reduced removal efficiencies are likely. This is particularly true in biological plants where the microorganisms will somewhat adapt to the sublethal conditions caused by various compounds. Thus, upset conditions will often be somewhat obscure and the remedial response will be less drastic than bypass and detention.

Industrial Operations Records

Presumably if an accurate materials balance is known for a given industrial process, the composition and amount of a waste discharge could be computed from raw material consumption records or production data. Fluctuations in efficiencies and the often disorganized status of such data for many industries would preclude employing such a technique to detect small changes in effluent quality. However, significant shifts in production could be detected which might call for a re-evaluation of the monitoring of that particular industry.

Combination of Options

Described above were some of the individual options that are available for a monitoring program. Most likely, local conditions will exist which resist a straightforward application of any one approach. The needs of both industry and the publicly owned treatment works should be realized. Economics, reliability, simplicity, and ultimate impact upon water quality are factors for a planning agency to consider.

2.3.4 Monitoring Techniques

Where sampling will be required, a permanent sampling station, or control manhole, should be established. This station should be safely and easily accessible; it should be large enough to contain any equipment required for sampling, measurement, or automatic monitoring; and it should be located so as to sample the actual discharge to the sewer.

The required frequency of sampling will depend on the variability of the quantity and quality of the wastewater and the reliability of any pretreatment system in use. There are two intervals to consider: the sample intervals for a given monitoring event; and the monitoring event interval. Initially, more frequent monitoring and sampling may be required until the range of variability of the discharge is determined. Monitoring intervals may vary from one to twelve months or more. Criteria for choosing the interval will be based on: available personnel and financing the potential impact of the constituents being monitored, the relative significance of the plant to the sewerage system operations, and any particular requirements to measure compliance with effluent limitations (for the POTW) or pretreatment (requirements for the industrial user) ~~regulations~~. The potential for the periodic discharge of slugs of pollutants should be evaluated and measured if applicable. Sample intervals during a monitoring event will usually range from 1 to 24 hours (Table 2-3). The terms "high- and low-variability" are indeed subject to interpretation (4).

MONITORING REFERENCES

1) Improved Procedures for Municipal Regulation of Industrial Discharges to Public Sewers - McIntire (13)
2) Handbook for Monitoring Industrial Wastewater - EPA (4)
3) Sampling of Wastewater - Shelley (5)
4) Wastewater Sampling Methodologies and Flow Measurement Techniques - EPA (6)
5) Standard Methods for the Examination of Water and Wastewater - APHA (7)
6) Estimating Laboratory Needs for Municipal Wastewater Treatment Facilities - EPA (8)

Table 2-3

SUGGESTED SAMPLING OR COMPOSITING SCHEDULE

Source: U.S. EPA Handbook on Monitoring Industrial Wastes (4)

CHARACTERISTIC	HIGH VARIABILITY	LOW VARIABILITY
BOD[a]	4 hr	12 hr
COD or TOC[a]	2 hr	8 hr
Suspended Solids	8 hr	24 hr
Alkalinity or Acidity	1 hr grab	8 hr grab
pH	Continuous	4 hr grab
Nitrogen and Phosphorus[b]	24 hr	24 hr
Heavy Metals	4 hr	24 hr

Notes:

[a] The compositing schedule where continuous samplers are not used depends on variability, i.e., 15 min for high variability to 1 hr for low variability.

[b] Does not apply to nitrogen or phosphorus wastes (e.g., fertilizer).

The water quality factors to be measured will depend on the industry and the purpose of monitoring. Measurements may be limited to BOD and suspended solids for surchage information, or they may be aimed at heavy metals or specific ions to prevent plant upsets or pass-through of these materials to the environment.

The sampling procedure used must ensure that a truly representative sample of the wastewater is collected. The difference between discrete-timed samples, flow proportional samples, and time-composite samples was mentioned in the section on automatic monitoring. Where suspended solids or immiscible fluids are present, mixing and sampling inlet velocity considerations will be of importance for either manual or automatic sampling. It is critical for both sampling and for measurement that the technique used does not interfere with the accuracy of the data. The reader is referred to the following documents on sampling:

1) Sampling of Wastewater, by P.E.D Shelley (EPA Technology Transfer) (5)
2) Wastewater Sampling Methodologies and Flow Measurement Techniques (U.S. EPA Report 907/9/-74-005) (6)

The volume of sample to be collected will depend on the physical or chemical analysis requirements for the parameter(s) of concern and their range of concentration. Generally, each constituent will require 100 to 1000 ml for analysis (Table 2-4). Specific detail on each water quality parameter is given in the U.S. EPA handbook mentioned previously and in "Standard Methods for the Examination of Water and Wastewater" (published by the American Public Health Association) (7). Upon collection of a sample it should be minimally labelled with the date, time, location, and parameters to be analyzed. For some parameters, the sample must be preserved after collection. Typical commerical prices for laboratory analyses are listed by constituent in Table 2-5.

Flow data is essential for computing the total mass rate of discharge of any material to the sewerage system. There are a variety of measurement techniques for the two types of flow systems: open channel flow, such as in sewers; and presurized flow, such as from the many industrial process units that use pumps and pressurized reactions. For pressurized flow, some measuring devices are:

Venturi meter
Flow nozzle
Orifice meter
Pitot tube
Magnetic flow-meter
Rotameter

For open channel flow:

Current meter
Depth measurements
Depth & Surface velocity measurement
Pitot tubes
Wiers
Flumes

Additionally, tracer dilution methods are useful where equipment cannot be installed. Water meters and tank depths may also provide adequate flow data. Timed collection in a calibrated vessel (bucket and stopwatch) is also a common flow measuring technique.

In addition to flow measurement and sampling devices, analytical equipment will be required. A discussion on equipping an analytical laboratory is beyond the scope of this manual, but the reader is referred to the document "Estimating Laboratory Needs for Municipal Wastewater Treatment Facilities" published by the Operation and Maintenance Program of the U.S. EPA Office of Water Program Operations (8). This publication includes specific requirements for laboratory facilities for various sized systems as well as requirements for laboratories handling samples from non-residential sources.

Where applicable, mobile field equipment and on-site apparatus will also be required. Generally there are three techniques utilized for analysis: wet chemical, electro-chemical, and bioassay. There are various portable and automatic wet- and electro-chemical instruments on the market. A list of these, the parameters that they measure, and the manufacturers is given in Appendix B. When selecting field equipment, the following should be considered:

1) Special environmental enclosures or carrying apparatus;
2) Chemical interferences present in the wastewater;
3) Physical interferences (floating debris, grit, and grease);
4) Microorganism fouling;

Table 2-4

VOLUME OF SAMPLE REQUIRED FOR DETERMINATION OF THE VARIOUS CONSTITUENTS OF INDUSTRIAL WATER

	Volume of Sample,^{a} ml
PHYSICAL TESTS	
*Color and Odor	100 to 500
*Corrosivity	flowing sample
*Electrical conductivity	100
*pH, electrometric	100
Radioactivity	100 to 1000
*Specific gravity	100
*Temperature	flowing sample
*Toxicity	1000 to 20 000
*Turbidity	100 to 1000
CHEMICAL TESTS	
Dissolved Gases:	
†Ammonia, NH_3	500
†Carbon dioxide, free CO_2	200
†Chlorine, free Cl_2	200
†Hydrogen, H_2	1000
†Hydrogen sulfide, H_2S	500
†Oxygen, O_2	500 to 1000
†Sulfur dioxide, free SO_2	100
Miscellaneous:	
Acidity and alkalinity	100
Bacteria, iron	500
Bacteria, sulfate-reducing	100
Biochemical oxygen demand	100 to 500
Carbon dioxide, total CO_2 (including CO_3^{-}, HCO_3^{-}, and free)	200
Chemical oxygen demand (dichromate)	50 to 100
Chlorine requirement	2000 to 4000
Chlorine, total residual Cl_2 (including OCl^-, HOCl, NH_2Cl, $NHCl_2$, and free)	200
Chloroform - extractable matter	1000
Detergents	100 to 200

	Volume of Sample,^{a} ml
Miscellaneous:	
Hardness	50 to 100
Hydrazine	50 to 100
Microorganisms	100 to 200
Volatile and filming amines	500 to 1000
Oily matter	3000 to 5000
Organic nitrogen	500 to 1000
Phenolic compounds	800 to 4000
pH, colorimetric	10 to 20
Polyphosphates	100 to 200
Silica	50 to 1000
Solids, dissolved	100 to 20 000
Solids, suspended	50 to 1000
Tannin and lignin	100 to 200
Cations:	
Aluminum, Al^{+++}	100 to 1000
†Ammonium, NH_4^+	500
Antimony, Sb^{+++} to Sb^{+++++}	100 to 1000
Arsenic, As^{+++} to As^{+++++}	100 to 1000
Barium, Ba^{++}	100 to 1000
Cadmium, Cd^{++}	100 to 1000
Calcium, Ca^{++}	100 to 1000
Chromium, Cr^{+++} to Cr^{++++++}	100 to 1000
Copper, Cu^{++}	200 to 4000
†Iron, Fe^{++} and Fe^{+++}	100 to 1000
Lead, Pb^{++}	100 to 4000
Magnesium, Mg^{++}	100 to 1000
Manganese, Mn^{++} to $Mn^{+++++++}$	100 to 1000
Mercury, Hg^{+} and Hg^{++}	100 to 1000
Potassium, K^{+}	100 to 1000
Nickel, Ni^{++}	100 to 1000
Silver, Ag^{+}	100 to 1000
Sodium, Na^{+}	100 to 1000
Strontium, Sr^{++}	100 to 1000
Tin, Sn^{++} and Sn^{++++}	100 to 1000
Zinc, Zn^{++}	100 to 1000

Table 2-4 (Continued)

VOLUME OF SAMPLE REQUIRED FOR DETERMINATION OF THE VARIOUS CONSTITUENTS OF INDUSTRIAL WATER

	Volume of Sample,[a] ml
Anions:	
Bicarbonate, HCO_3	100 to 200
Bromide, Br^-	100
Carbonate, $CO_3^{=}$	100 to 200
Chloride, Cl^-	25 to 100
Cyanide, Cn^-	25 to 100
Fluoride, Fl^-	200
Hydroxide, OH^-	50 to 100
Iodide, I^-	100
Nitrate, NO_3^-	10 to 100
Nitrite, NO_2	50 to 100
Phosphate, ortho, $PO_4^{=}$, $HPO_4^{=}$, $H_2PO_4^-$	50 to 100
Sulfate, $SO_4^{=}$, HSO_4^-	100 to 1000
Sulfide, $S^{=}$, HS^-	100 to 500
Sulfite, $SO_3^{=}$, HSO_3^-	50 to 100

[a] Volumes specified in this table should be considered as a guide for the approximate quantity of sample necessary for the particular analysis. The exact quantity used should be consistent with the volume prescribed in the standard method of analysis, whenever the volume is specified.

* Aliquot may be used for other determinations.

† Samples for unstable constituents must be obtained in separate containers, preserved as prescribed, completely filled and sealed against all exposure.

Table 2-5

SCHEDULE OF FEES - WATER ANALYSIS

TEST	5 FIRST SAMPLES
Acidity or Alkalinity	$ 5.00
Aluminum	10.00
BOD	25.00
Calcium	5.00
Carbonate	10.00
Chloride	5.00
Chlorine, Free	5.00
Chromium,	
Hexavalent	8.00
Total	10.00
Coliform, Membrane Filter Technique	
Total	10.00
Fecal	10.00
Color	
Apparent	3.00
True	5.00
Conductivity	2.00
Copper	8.00
Cyanide	
Free	10.00
Total	15.00
Detergents (L.A.S.)	10.00
Fluoride	10.00
Grease & Oil	15.00
Hardness, Total	5.00
Iron	8.00
Magnesium	5.00

Table 2-5 (Continued)

SCHEDULE OF FEES - WATER ANALYSIS

TEST	5 FIRST SAMPLES
Nitrogen	
Ammonia - Direct Nesslerization	8.00
Ammonia - Distillation	10.00
Kjeldahl	15.00
Nitrate	10.00
Nitrite	10.00
Oxygen Demand, COD	12.00
pH	2.00
Phenol	20.00
Phosphorus, Total	10.00
Phosphate	
Total	10.00
Ortho	8.00
Metals by Atomic Absorption Spectrophotometry	10.00
Solids	
Dissolved	5.00
Settleable	5.00
Suspended	5.00
Total	5.00
Volatile	5.00
Sulfate	8.00
Sulfide	
Direct Determination	8.00
Distillation	12.00
Silica	8.00
Turbidity	2.00

5) Calibration and reagent stocking requirements;

6) Cost: automatic or kit-form equipment costs are high, but the use of such equipment may save time and thus personnel costs;

7) Simplicity and dependability: available personnel should be capable of performing routine and repair maintenance;

8) Data: the analytical technique must be accepted by regulating authorities.

In cases where sewerage system personnel are performing a substantial amount of the monitoring, a well-equipped mobile laboratory would be a worthwhile investment. The cost of such a unit would be about $20,000. This unit could also aid in emergency detection of hazardous and toxic discharges.

Personnel Requirements

The technical personnel and their classification will vary according to the organizational structure of the sewerage authority. Preferably, the manager of an industrial survey and monitoring program will be an engineer who is familiar with industrial processes, their wastes, and wastewater treatment. Depending on the size of the program, direct subordinates may be field technicians and laboratory personnel; other engineers may be required to direct the field operations and laboratory group(s). Technicians must be able to operate and maintain all of the equipment as well as understand the basic concepts of chemistry and wastewater treatment. The educational background for technicians could be a recent B.S., or engineering degree with no experience, an associate degree, or a high school degree with directly applicable experience. As previously mentioned, a field team of one engineer and two technicians may be able to monitor about 200 industries per year.

Results of a Monitoring Program

The information acquired from monitoring must satisfy the stated objectives of the program. It must be easily accessible and in usable form, and it must be of acceptable precision and origin to satisfy any requirements of regulatory or legal authorities. Besides serving as potential evidence in legal enforcement proceedings, the data may be useful in designing future wastewater treatment procedures for each particular industrial category. A general description of the data according to monitoring objectives is described below.

Hazardous and Toxic Materials. It is imperative that this information be transferred quickly to the treatment plant operator so that he may take precautionary measures if such action is required. The most expedient method would be an alarm panel at the treatment plant. If a material is being measured at the treatment plant, influent data will most likely be either in concentration units or presence/absence notation. In the event of an alarm for any material, any available data should be carefully logged for future documentation. For industrial site monitoring of these materials an alarm procedure must be established. When a predetermined upper limit for a given compound is exceeded, notice must be given to the treatment plant. A log should be kept of the measurements. This could consist of strip charts from a recording instrument. Periodic reports should be submitted to the regulating authority.

Surcharges and User Charges. User charges are imposed upon an industry according to the fraction of the total sewerage system that it uses. Wastewater flow data will most often suffice for user charge evaluation. Surcharges are often required of industries that discharge wastes in excessive amounts over an "average" concentration for that locality. Most often surcharges are imposed for BOD and suspended solids, which are the two primary water quality components that most treatment plants are designed to remove. A surcharge formula will require flow and concentration data (e.g., mg/l, lb/million cu ft) for each parameter of concern.

Compliance. Whether or not an industry pretreats wastes, regulations will exist for the quantity and quality of wastewater allowable from each industry. These regulations will range from "no limitation" to "zero discharge" with various concentration or mass discharge limits in between. For an industry to report on compliance, their data will be in the form (e.g., mg/l) identical to the regulation for each parameter. Strip charts or signed log sheets should be submitted with any reports.

Sample forms for recording monitoring data are given in Appendix B. A "Data Summary Form", "Compliance Monitoring Log", "Toxic or Hazardous Compounds Monitoring Log", and a "Sample Bottle Label" are included in the appendix. These forms may require modification to suit individual local requirements, but generally they will be appropriate for most needs.

2.3.5 Development of the Sewer-Use Ordinance for an Industrial Pollutant Control Program

Traditional municipal sewer use ordinances* define programs and limitations for controlling the quality of industrial dischargers to sewers. These ordinances should be responsive to individual characteristics of the municipality. For example, the waste treatment needs of a community with diverse industries, but centrally located, may be very different from areas with scattered or with only one predominant industry. This section defines the nature of an ordinance and discusses its development. Administration and enforcement of ordinances is discussed in the next section entitled, Legal Control Elements.

Information required for Ordinance Development. For an ordinance to be effective in preventing sewerage system upsets and pass-through of undesirable materials to receiving waters, information from many sources should be analyzed and integrated before preparing the ordiance. The most likely data sources include the IWS, Regional Master Plans, EPA, 201 Facilities Plans, and Water Quality Management (WQM) Plans; these will yield information on water quality goals, POTW capabilities, and growth projections (Table 2-6).

The procedures for developing an ordinance are highlighted in Figure 2-2 (page 2-4). The arrows suggest the sequence of information acquisition and thus the logic guiding ordinance development. For example, the industrial waste survey (IWS)

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* and other regulatory devices.

necessarily precedes the development of the ordinance. It identifies the industries and their effluents that will be subject to pretreatment regulation. In cases where ordinances have already been developed prior to the development of various water pollution control plans or before the IWS has been completed, review and update of the ordinance will be necessary.

The Ordinance Development Committee. The ordinance is not only a legal document but a technical and managerial reference. The committee that develops it should include individuals with expertise in the fields of environmental engineering, law, management, planning and health. There should be representatives from all the government jurisdictions as well as industrial representatives, private individuals (environmentalists) and attorneys. The following list of individuals constitutes an ordinance committe.

1) Representative of 208 areawide planning agency;
2) The top supervisory official, who will have responsibility for the administration and execution of the requirements of the final document;
3) The municipal attorney;
4) The municipal or city engineer;
5) The head of the local sewerage system or public works department;
6) The superintendent of sewers or sewage treatment;
7) The chief operator of the local sewerage-treatment plant;
8) The chief chemist ~~of~~ or chief laboratory technician of the local city or sewage or water-treatment plant;
9) A representative, or several, of the important local industries;
10) A local private sanitary engineer with experience in industrial-waste treatment, or a representative of the regular consultants of the city;
11) A representative of the local health department;
12) A representative of the state health department or pollution control agency;
13) The city planning engineer, if there is one.

Elements of an Ordinance. The Journal of Water Pollution Control Federation published guidelines for drafting a sewer use ordinance and a model ordinance, "Manual of Practice 3: Regulation of Sewer Use" (10). The model includes many of the necessary elements for a general ordinance. The information presented below discusses those elements relevant to industrial dischargers to municipal sewer systems. ~~A model~~ [redacted]. Unmodified application of this model is not likely because individual municipal ordinances should reflect local needs, statutes, regulations, and policies. Below is a list of the elements of an ordinance:

I. Introduction of the Ordinance - The first section of the ordinance should state the purpose, jurisdiction and scope of the document.

II. Definition of Terms - The ordinance, a technical as well as legal document, will employ specific language. Specialized terms should be defined. A suggested reference is: "Glossary-Water and Wastewater Control Engineering", published by the Water Pollution Control Federation (11).

III. Prohibited Wastes - The ordinance should clearly identify categories of wastes that may not be discharged into public sewers. These prohibited wastes [redacted] may include the following categories: [redacted]

1) wastewaters with pollutants that create a fire or explosion hazard in the POTW;
2) wastewaters which will cause corrosive damage;
3) wastewaters which contain solid or viscous wastes in amounts which would cause obstruction to flow or interference in the POTW;
4) wastewaters containing heat in amounts which would inhibit biological activity in a POTW resulting in treatment process upset and subsequent loss of treatment efficiency;

(and/or an amount of oxygen demanding pollutants (BOD))

3) a volume of wastewater released in a slug discharge* as to cause treatment plant upset.

IV. Toxic Wastes - the discharge of wastewater containing toxic pollutants should be limited. Although Federal standards for toxicants have not been promulgated to date, State and local health and water resource boards may very well give guidance on toxic limitations.

V. Industries Subject to Indirect Discharge Limitations - The industries to which the municipal ordinance is to apply should be clearly stated.

VI. Indirect Discharge Limitations - Industrial indirect discharge limitations should be presented and should reflect minimally [redacted] Federal pretreatment standards. [redacted] The limitations are described in terms of both pollutant concentration and quantity of discharge (mass discharge rate).

VII. Sampling and Analysis - Legal provisions for monitoring should be included in the ordinance. Reporting procedures and stipulation for inspection by local authorities or their designated agents should be defined. General and minimum requirements for flow measurement, sample collection, and laboratory analysis should be presented.

(One way in which a slug discharge may be defined is)

*Slug Discharge: the release of wastewater such that the average hourly discharge over any period of two-hour duration is more than twice the daily average hourly discharge. i.e., a slug discharge is: $\frac{\text{Hourly average over 2 hours}}{\text{Hourly average over 1 day}} > 2$

Furthermore, procedures for setting, approving and subsequently requiring specific monitoring activities should appear in this part of the ordinance.

VIII. Enforcement and Penalties - Administrative enforcement proceedings prior to court actions should be delineated. Violators of the ordinance may be assessed fines and other penalties. The ordinance should clearly define the penalties and the prosecution procedure. Schedules of compliance should be stated.

IX. Financial Information* -

Section 204(b)(1)(B) of the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500) requires that industrial users of the treatment works make payments for that portion of the cost of construction of such treatment works (as determined by the Administrator) which is allocable to the treatment of such industrial wastes.

For greater detail see 40 CFR 35.935-13, Regulations on industrial cost recovery and user charges and 40 CFR 35 Appendix B Federal Guidelines on user-charges.

X. Sewer Use Permit - An industrial permit, similar to those issued for direct discharges, may be prescribed within the ordinance. Review and renewal schedules should be included to insure that all changes in industrial discharges would be subject to the provision of the ordinance (see Chapters 4.3 and 4.4).

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*See Section 2.5.

XI. Regulation for Building New Sewer Connections - The ordinance may include regulations for new sources and their sewer connections. This could, however, require a separate permit and ordinance.

XII. Legal Requirements - The ordinance must be enacted in accordance with State and local laws. The last section of the ordinance should include:

- A validity clause to insure there are no conflicts with other regulations;
- An enacting clause with the date the law is to be legally enforceable; and
- Proper signatures and attests of appropriate officials.

An Alternative to the Traditional Ordinance

An alternative approach to development of the sewer use ordinance is to draft a general enabling ordinance to provide authorization and regulations for specific industrial wastewater treatment contracts (with individual users) (13). The general enabling ordinance would include policy statements, methods for the negotiation and development of the individual contract, and the general provisions of the contracts. Specifically, each contract would:

1) establish the relationship between the units of product and the character and quantity of waste;
2) require installation of a control manhole, continuous flow measuring device and sewer shut-off mechanism;
3) establish an industrial self-reporting system; and
4) delineate specific control remedies for non-compliance.

An example of the general ordinance has been included in Appendix C. Individual contracts are discussed further in Section 2.4.5 under "Agreements".

2.4 Legal Management Elements

2.4.1 Introduction

The purpose of this section is to identify and examine some of the most important legal issues which should be considered in developing and implementing an industrial pretreatment program. The roles of the Federal, State and local water pollution control and planning agencies and the POTW operators in carrying out such a program will be discussed. Control measures which may be implemented at each level of governmental organization will be considered. Finally, this section will address the types of enforcement actions which may be taken by the various governmental entities as well as private citizens to insure compliance with the industrial pretreatment program.

The legal problems inherent in the implementation of an effective industrial pretreatment program become particularly complex when the POTW is under the jurisdiction of a regional authority which does not have legal control over the industrial users of the system. Indeed, some regional authorities do not even have the ability to effectively control the discharges from the municipal users. For example, in the Boston area, the Metropolitan District Commission (MDC) acts essentially as a waste treatment wholesaler serving some forty municipalities. It is not clear whether the MDC has the legal authority, under any circumstances, to refuse wastes from any member municipality.

2.4.2 Federal Role

The Federal Water Pollution Control Act Amendments of 1972 (the "Act") requires the operator of a POTW to be able to exercise control, either directly or indirectly, over industrial users. Section 301(a) of the Act prohibits the discharge of any pollutant into waters of the United States by any person (including municipalities and sewerage districts), except in compliance with a permit containing certain effluent limitations applicable to such person, incremental dates for compliance and other requirements of the Act. The permit is issued either by EPA or the state pursuant to the National Pollutant Discharge Elimination System (NPDES) as set forth in Sec. 402. In order to enable the POTW to meet the effluent limitation requirements, one of the principal premises of the Act is that industrial users of a POTW will pretreat their wastes to the extent necessary to remove all substances incompatible with the process for treatment of domestic wastes. To implement this objective, Sec. 307(b) requires the Administrator of EPA to establish pretreatment standards for incompatible pollutants discharged by industries into POTWs that (a) are not susceptible to treatment (pass through the POTW and into the receiving waters) or (b) may interfere with the operation of the POTW.

In addition to the EPA pretreatment standards, it may be necessary for municipalities to impose supplemental controls on industrial users in order for the POTW to meet its NPDES requirements. The extent to which such additional controls may be necessary will depend on the strength and quantity of the industrial pollutants, the quantity of domestic waste, the size and length of connecting and intercepting sewers and other factors. Some of the EPA regional offices (principally those on the east coast) have attempted to deal with this issue directly by including in the NPDES permits for POTWs a requirement for adoption and implementation of sewer use ordinances and other legal controls to regulate the entry of industrial pollutants into the POTW.

2.4.3 Federal Means of Control

The principal means of Federal control over industrial pretreatment is through the promulgation and direct enforcement of pretreatment standards pursuant to section 307 of P.L. 92-500. Additional legal possibilities include prohibitions on new sewer connections, imposition of industrial self-monitoring and reporting requirements through section 308 of the Act, and financial incentives through 208 planning grants, [redacted] and the EPA construction grants program.

Table 2-7

POTENTIAL ENFORCEMENT MATRIX OF PRETREATMENT REGULATIONS

	ADMINISTRATIVE and WQM	JUDICIAL
Federal	Review of Section 201 (208)* [redacted] [redacted] plans Grants and financial incentives -Construction grants and loans - 208 Grants -Government procurement of goods Orders of compliance -Schedules -Fines	Civil Actions for noncompliance -Permanent or temporary injunctions -Compliance schedules Judicial Review
State	Issuance of NPDES permits Enabling Legislation Aid to POTW (Capital Costs (N.H.) O.M. Costs (N.Y.))	Civil Actions based on State Statutes, NPDES permits if issued.
Regional	Areawide planning agencies -Grant approval -NPDES review	
Municipal	POTW** operating authority -Requirement of industry reporting -Regulation of input to sewers - tie-ins -Imposition of surcharge	Hearings Civil actions based on ordinance, agreements -Injunctions -Damages award for non-compliance with local authorities
Individual		Civil actions against violators for non-compliance with effluent standards Civil actions against EPA for failure to meet requirements of PL 92-500

*Section 201 and 208 [redacted] refer to sections of PL92-500, the Federal Water Pollution Control Act Amendments of 1972.

**Publicly Owned Treatement Works.

Federal Enforcement

The industrial pretreatment requirements may be contained in standards set by EPA under Section 307, and they may also be contained in control measures adopted by the States or the local operator of the POTW. EPA could enforce the POTW for violation of an effluent limitation contained in the NPDES permit issued to the POTW (caused by high concentration of industrial pollutants (or by interference from industrial pollutants)) or for violation of a procedural requirement of the permit, such as failure to conduct an industrial waste survey, etc. If an industrial user is violating a pretreatment standard established under Section 307, EPA could take action against the POTW if the NPDES permit requirements were not being met, or it could take action directly against the contributing industry.

The administrative and judicial actions which EPA may take and the sanctions which may be imposed are contained in Section 309 of the Act. As provided in Section 309(a), EPA may issue an administrative order requiring compliance, within a specified period, but not more than 30 days. The Administrator is authorized under Section 309(b) to bring civil action for permanent or temporary injunction. A person who violates Section 307, a condition in an NPDES permit or an order issued by the Administrator shall be subject to a civil penalty not to exceed $10,000 per day of violation (309(d)). Any person who "willfully or negligently" violates a pretreatment standard or condition in an NPDES permit shall be punished in a criminal action by a fine of not less than $2,500 nor more than $25,000 per day of violation, or by imprisonment for not more than one year, or both (Section 309(c)).

New Sewer Bans

EPA has authority under the Act to prohibit any new users from discharging to the POTW if the POTW is not in compliance with all the conditions of its NPDES permit. One common cause of non-compliance could be that an industrial user is not meeting its pretreatment requirements. The authority for this control is contained in Section 402(h) which allows EPA to obtain a court order prohibiting the discharge of pollutants into a POTW by any source not utilizing the POTW prior to the EPA finding of an NPDES permit violation.

Industrial Self-monitoring

EPA also has authority to require industrial users of POTW's to monitor their effluents and keep records of that monitoring under section 308 of the Act. If EPA followed up by spot-checking of monitoring and record-keeping performed by industry, industrial self-monitoring could become an effective mechanism for insuring compliance with Federal pretreatment standards. The authority for EPA to enter the premises of industrial users of POTW's, sample effluents, and inspect records is also contained in section 308.

Grants and Financial Incentives

Section 204(a) of the Act provides that before approving grants for POTWs, the Administrator of EPA shall make certain determinations. One such determination is "that such works are included in any applicable areawide waste treatment management plan developed under Section 208". (Section 204(a)(1)). Section 208(b)(1) provides that the WQM (208) planning agency shall, within one year after its designation, have in operation "a continuing areawide waste treatment management process." An initial plan prepared in accordance with the continuing process is to be certified by the Governor and submitted to the Administrator not later than two years after the planning process is in operation. The plan prepared under such process must include various specified items, including a regulatory program to assure that "any industrial or commercial wastes discharged into any treatment works in such area meet applicable pretreatment requirements". (Section 208(b)(2)(C)(iii)). The phrase "applicable pretreatment requirements" is not limited to those established under Section 307, and therefore presumably would include any standards set by the State, regional authority, or political subdivision. Thus, the Act requires that a WQM plan be in effect within three years after designation of the 208 planning agency and that thereafter no construction grants for a POTW be made by EPA unless the proposed POTW is included in the 208 plan.

Another determination which the Administrator must make before approving a construction grant is "that the applicant...has made adequate provisions for assuring proper and efficient operation..." (Sec. 204(a)(4)). EPA IS EVALUATING THIS REQUIREMENT AMONG OTHERS IN DEVELOPING ITS PRETREATMENT POLICY.

Another possible incentive for future State and local involvement in pretreatment programs may be provided by EPA's conditioning of future 208 grants on the development and implementation of State and areawide pretreatment programs. EPA may "earmark" a certain fraction of a planning grant to be spent on pretreatment for future 208 grants.

A further means to assure compliance with pretreatment requirements is Section 208(c)(1) which requires that the Governor designate one or more waste treatment management agency for each designated 208 area at the time a plan is submitted to EPA for approval. This agency will be responsible for the operation of the POTW in the 208 area. Section 208(c)(2) provides that the designated management agency shall have adequate authority --

(A) to carry out the WQM (208) plan,

(H) to refuse to receive any wastes from any municipality which does not comply with any provisions of an approved plan,

(I) to accept for treatment industrial wastes.

The WQM plan must provide that each municipality enact and enforce measures of control (such as a sewer ordinance), as discussed in Section 2.3.5, to ensure compliance by the industrial users with necessary pretreatment requirements. The management agency must have the authority to refuse to accept the wastes from a municipality if it does not enact such controls or does not enforce them effectively against an industrial user under its jurisdiction.

Section 208(d) provides that after a waste treatment management agency has been designated and a plan for the area has been approved, EPA shall not make any grants for construction of a POTW except to such designated agency and for works in conformity with such plan. At this point, it is not clear what entities will be designated at the management agencies since no designations have been made.

Another means of using Federal financial assistance to encourage POTWs to comply with clean water standards, including pretreatment requirements, is making a POTW in noncompliance with applicable standards ineligible for any federal contracts, grants or loans. The authority for this control is found in Section 508(c) of the Act which requires the President to issue an order requiring each Federal agency to adopt regulations and procedures to ensure that no person, including States and local units of government, found by EPA to be in violation of requirements of the Act will receive any Federal contracts, grant or loan. EPA has issued regulations to implement the order issued by the President under Section 508(c) (see 40 CFR Sec. 15.1). Under these regulations, EPA will maintain a list of violating facilities which EPA determines are in noncompliance with a requirement of the Act, including specifically conditions contained in an NPDES permit. The EPA regulations provide an exemption for any grant or loan for the purpose of assisting a facility to comply with an environmental pollution regulation (Sec. 15.5). Therefore, although a listed POTW would remain eligible for construction grants from EPA for improvement or expansion of the POTW, the listed POTW would not be eligible for loans or grants from other Federal agencies for purposes unrelated to abatement of environmental pollution.

2.4.4 State Role

The statutes of many States require the water pollution control agency to establish pretreatment standards for industries discharging into a POTW. However, in some States, the agencies are not exercising this responsibility. For example, the water pollution statutes of Massachusetts and New Hampshire require their respective water pollution control agencies to establish pretreatment standards for industries discharging into a POTW. Under these statutes, the municipalities are prohibited from accepting industrial wastes into their facilities which do not comply with the State established standards. However, despite these requirements, neither State agency has established pretreatment standards for existing users, or taken any other action with respect to pretreatment. Instead, the State agencies are looking to the municipalities to handle the entire pretreatment program. However, the water pollution control agency in Massachusetts does require proper pretreatment for new industrial tie-ins, and enforces this requirement through its authority to issue permits for new sewer connections. The agency has used this authority to deny permits to new users, if overloading would result. It has not exercised the authority to prevent incompatible pollutants from entering the system. However, a recent Federal court case involving a regional sewerage system indicates that such authority could be validly used for this purpose. In Smoke Rise v. Washington Suburban Sanitary Commission, 8 ERC 1350 (D. Md. 1975)(a), the court upheld a moratorium declared by the State department of water pollution control on additional hook-ups to the regional public sewer system as a reasonable exercise of the State's police powers and denied the plaintiff's claim that it was a "taking" requiring compensation under the U.S. Constitution. The moratorium was declared because the POTW was providing inadequate treatment which caused "discharges of raw and inadequately treated sewage into the waters of the state, which waters are being, or are likely to become polluted in a way dangerous to health, thereby constituting a menace and nuisance prejudicial to the health, safety and comfort of the public". Moreover, a State with an approved NPDES permit program under Section 402(b) of the Act can prohibit new tie-ins to the POTW of the State which has found a violation of any of the conditions in the NPDES permit applicable to the POTW (see Section 402(h) of the Act).

Grant and Financial Incentives

Under the Act, the Federal share of the capital cost of a POTW is 75 percent (Sec. 202(a)), and the applicant (POTW) must agree to pay the non-Federal share. There is no requirement in the Act that the States pay any portion of the capital costs. However, most States do participate in the non-Federal share of the capital costs. Thus, the State may use its grants assistance as leverage to insure proper operational maintenance of the POTW, including a requirement for an effective industrial pretreatment program. Moreover, the States may utilize this assistance in a manner better designed to effect compliance with the pretreatment program than the Federal assistance. For example, under the law of New Hampshire, the State share of the construction costs is payable over the period of the bond issue, usually 20 years. This procedure allows the State to stop payment at any time during the 20 year payout period if the municipality is not meeting the State requirements. The State has exercised this authority and is using it now by withholding payments from Nashua. The State considers this withholding authority to be a very effective device for improving plant performance.

In addition to providing grants for construction of POTWs, some states (New York and Pennsylvania, for example) have programs to provide financial assistance for the operation and maintenance of the POTW. Such programs contain controls to insure that the operator of the POTW will take necessary measures to prevent incompatible pollutants from entering the system and interfering with the proper operation of the plant. For example, the enabling act which creates this program in New York requires, as a condition for the grant, that the POTW operator must submit evidence that "the applicant municipality has enacted and is enforcing appropriate ordinances or regulations to maintain such controls as are necessary to regulate the use of the sewer collection systems and sewage treatment works to insure that the sewerage systems will not be adversely affected". This requirement compels the municipality to enforce pretreatment standards against its industrial users. The New York law provides for an annual inspection of the POTW by a State representative whose certification of compliance with the applicable standard is necessary for the POTW to remain eligible for State assistance. One of the standards is that the POTW is being operated in accordance with the discharge permit, which, as discussed above, will contain industrial pretreatment requirements.

State Enforcement

If a State has not been delegated the NPDES permit program, the State nevertheless may take an enforcement action against a discharger where the State permit program parallels the NPDES program or where the State law authorizes State officials to enforce a Federal NPDES permit. In addition, a State may commence an enforcement action against an industrial user for violating a pretreatment standard ~~requirement~~ established under Section 307 of the Act. The State may also commence an enforcement action against a municipality for violating an effluent limitation of its NPDES permit under the "Citizen Suits" provision contained in Section 505 of the Act. The latter enforcement action may occur under two circumstances:

1) when an industrial discharge causes a POTW upset and this in turn causes the POTW to violate an effluent limitation for a pollutant such as BOD5.
2) When a POTW NPDES permit contains a ~~unique~~ Special limitation (such as metals) and where an industrial discharge causes a POTW to violate its permit due to "pass thru" as a result of a POTW design limitation for this pollutant.

Section 505 allows "any citizen" to commence a civil action for certain violations and the term "citizen" defined in Section 505(g) as a "person", which term is defined in Section 502(5) to include a "State". See Section 2.4.6 below for a discussion of actions which may be taken under the "Citizen Suits" section of the Act.

If a State has an approved NPDES permit program under Section 402(b), it can bring an action against the POTW for the violation of any conditions of the permit. It should be noted that under the Citizens Suit section, a suit can be brought against the POTW only for violations of an effluent standard or limitation. Indeed, the State NPDES program will not be approved unless the State has the authority to abate violation of a permit, including levying civil and criminal penalties (Sec. 402(b)(7)). Moreover, in order to qualify for the NPDES program, a State must also have the authority to insure that an industrial user of the POTW will comply with the pretreatment standards set under Section 307 (see Sec. 402(b)(9)).

2.4.5 Local Role (Municipalities, sewage districts, etc.) Responsibility Under NPDES Permits

No POTW may discharge treated wastes into waters of the United States except in accordance with the terms of an NPDES permit. Generally, such permits require the POTW to:

1) meet certain discharge limitations for specified pollutants based on a monthly and weekly average and daily maximum, (these limitations may not be met unless the industrial users of the POTW perform pretreatment, which may be more extensive than required by the EPA issued standards under Section 307),

2) undertake a survey of industrial users to determine the volume, constituents and strength of their wastes and establish a schedule for each user for the installation and operation of the necessary pollution control equipment.

As noted in Section 2.4.2, some EPA regions also require the operator of the POTW to have in effect a sewer use ordinance or some other legal measure to control industrial discharges into the POTW.

Instead of requiring each industrial user to pretreat its own wastes, the POTW could install and operate the pretreatment equipment at the POTW. The costs for this equipment, however would not be eligible for construction grants. If it is technologically feasible, the latter procedure might be more cost-effective than requiring each industrial user to install and operate its own equipment. In this case, the industrial user would be required to pay its share of the capital costs of such pretreatment facility through the industrial cost recovery program under Sec. 204(b)(1)(B) and an increased share of operation and maintenance under the user charge requirement of Section 204(b)(1)(A). In either situation, the POTW must have the authority to either require the industrial user to install and operate pretreatment equipment or to pay its share of the capital costs of constructing such equipment at the POTW.

Legal Authority

The entity which owns the POTW, and the management agency designated under Section 208(d), if different from the owner, must have sufficient legal authority to effectively control the wastewaters of the industrial users.

If the area serviced by the POTW is confined to the boundaries of a political subdivision of a State (such as a city or county), the legal authority is relatively clear.

Such political subdivisions can control the wastes discharged into the public sewers by industrial users located within their jurisdiction under their inherent police powers. On the other hand, more complex problems arise in the case of a regional authority created to handle the sewage of several political subdivisions. If the regional agency is established by the political subdivisions themselves, such agency will have only those powers as are specifically delegated to it in the compact or agreement creating it. Municipalities may be reluctant, for political reasons, to surrender to a regional agency the authority to regulate the wastes contributed by their industries as well as the power to set sewage treatment rates charged to those industries. If the regional agency is created by the State legislature, such agency will have those powers specifically granted in the enabling act. This act may include controls over individual users located within the political subdivisions.

However, many existing regional sewerage authorities or districts are not able to legally interface with industries in the system. This is because the enabling acts have not given the authorities the power to control the discharges into municipal sewers which in turn connect to the sewers controlled by the regional agency. In such instances, the development and enforcement of ordinances controlling the input of industrial wastewaters is legally the responsibility of the individual municipalities in the system. They may look toward the regional agency for guidance in developing effective controls, but nevertheless the municipalities in these cases retain the legal authority and the responsibility of controlling these industrial users.

It should be remembered that whether the regional agency is created by compact or by special act of the legislature, the agency does not have any inherent police powers to control the discharges of the users.

Although the enabling act creating the regional agency may give it the legal authority to control only discharges by the municipalities, and no direct authority over the individual users, a method of operation may be informally agreed upon between the agency and the municipalities (apart from a formal compact) which in effect gives the agency control over the users. For example, the enabling act creating the Greater Lawrence Sanitary District in Massachusetts authorizes the Commission to establish rules and regulations covering the discharge of wastwater into sewers under its control. However, the District only actually controls the interceptor; it does not control the industrial tie-ins. Despite this legal limitation, the municipalities included in the District want the Commission to be able to effecfively control all wastes entering the District's interceptors. This is because the District owns the treatment plant facilities and has funds to employ professional personnel to operate the plant and to obtain and maintain laboratory and metering and sampling equipment. The municipalities, however, do not have sufficient funds to perform those tasks. Accordingly, with the consent of the municipalities the District requires each industrial user (those already tied-in as well as new users joining the system) to make written application to the District for a discharge permit. The application must set forth the volume and strength of all the pollutant constituents in the applicant's effluent. The permit will contain the necessary treatment requirements for effluent beyond the tolerances of the treatment plant. The District also is preparing regulations which will include pretreatment requirements ~~standards~~. It is expected that each municipality in the District will adopt a sewer ordinance consistent with the District's regulations.

The Lawrence District requires each industrial user to provide access through a manhole to its wastes and to allow the District's inspectors to enter the manhole and use portable meters and monitors to determine the flow and pollutant constituents of the effluent. The District sends bills directly to the industrial users for treatment services and payment is made to the District through the municipalities.

Although the District has no direct enforcement authority over the industrial users, pressure can be and is applied through the municipalities with the ultimate recourse of cutting off a municipality in which an industrial user who refuses to meet the District's requirements is located. Of course, such action is rather extreme and might, as a practical matter, never be used because of the tremendous health problems it would cause to the municipality involved.

Local Means of Control: Introduction

The principal means for local entities to control the pollutants discharged into the POTW by industrial users of the system are the sewer ordinance, rules and regulations, municipally issued sewer discharge permits, and agreements between the discharger and the manager of the POTW. The most commonly used means of control is the sewer ordinance. However, rules and regulations issued by an administrative agency sometimes are utilized to add greater specificity to the ordinance. In addition to the ordinance and the rules and regulations, permits may be issued to the industrial users to set forth the specific quantity and quality of each user's discharge and to place the user on a schedule leading to final compliance with the pretreatment and effluent limitation requirements. Finally, an agreement between the industrial user and the POTW's operator may be appropriate in situations where there is one principal industrial user of the POTW.

Sewer Ordinance

A municipality has the authority to enact a sewer use ordinance under its police powers, which include the power to act to protect the public health, safety and general welfare. The NPDES permits covering POTW discharges issued by some EPA regions require the permittee to have in effect by a specified data a sewer use ordinance or some other similar legally enforceable device to control the discharges

An Alternative to the Traditional Municipal Ordinance

Municipalities may choose to enact sewer-use ordinances with general enabling provisions: The statute would allow for specific contracts negotiated with individual industrial dischargers. The enforcement mechanisms would be established by mutual agreement of industry and municipality and would emphasize these three civil proceedings:

1) Surcharges for wastes in excess of the amounts contracted for;
2) Payment of costs incurred by government as a result of damage caused by industrial discharges not contracted for, and
3) Termination of treatment service (for very serious infractions).

Citizen suits based on industries not meeting their contractual obligations stipulated in the agreement would be adequately provided for in the ordinance. Industries would monitor their own discharges according to the contract. This alternative stresses the active involvement of industry in setting enforcement procedures (13).

of users. For example, General Condition 20 of the NPDES permits issued to the operators of POTWs in Massachusetts requires the permittee to have in effect a sewer use ordinance and/or Rules and Regualtions, acceptable to the Regional Administrator which at a minimum:

1) prohibits a major contributing industry from discharging any incompatible pollutants in an amount in excess of that allowed under the EPA pretreatment standards, and
2) requires all major industrial dischargers to perform such monitoring of its discharges as the permittee may reasonably require.

Rules and Regulations

Apart from the general authority of municipalities to enact sewer ordinances under the general police powers, a State enabling act may authorize municipalities and sewer districts to adopt rules and regulations governing the use of sewers. For example, Chapter 83, Section 10 of the Massachusetts General Laws authorizes a city, town or sewer district to prescribe rules and regulations regarding the use of public sewers to prevent the entrance of any substance which may tend to interfere with the flow of sewage or the proper operation of the sewage system and the treatment and disposal works. This section also allows for penalties of up to twenty dollars for each violation of any such rules or regulation. Rules and regulations may also be utilized in conjunction with a sewer ordinance. The ordinance may set forth the general provisions and authorize a specified agency to issue rules and regulations from time to time interpreting and further implementing the ordinance. The rules and regulations can provide quite specific limitations on the contributions of whole industrial categories or each individual user and can be revised as necessary by the implementing agency. The ordinance, on the other hand, can only be changed by action of the City Council or the Town Meeting.

Permits

In addition to the sewer ordinances and rules and regulations, the operator of the POTW also may want to develop a permit system under which permits are issued to each industrial user. The permits set forth the specific allowable rate of flow and pollutant constituents of the wastes for each permittee. This device may be particularly useful if the municipality can identify possible problems with the users complying with the ordinance. The permit, may contain a time schedule for performance of certain acts toward final compliance, such as ordering, installing and operation of the pretreatment equipment. Violation of any provision of the permit, including the compliance schedule, would warrant an enforcement action against the permittee. A permit system is being used in the Greater Lawrence Sanitary District as discussed above.

Agreements

In areas where there are a limited number of major industrial users of the POTW, separate written agreements between the municipality and the industrial users may be an effective method of control. For example, in the Town of Merrimack, N.H., the POTW was specially designed to handle the brewery wastes of the Anheuser-Busch Company. Therefore, the Town and the Company entered into an agreement whereby the Town agreed to accept the Company's wastes for treatment and the Company agreed to pay a specified charge based on certain effluent limitations for BOD, suspended solids and chlorine, with the charge to be renegotiated in the event the limitations were exceeded. Unlike a sewer ordinance or rules and regulations, an agreement between the operator of the POTW and the major industrial discharger gives the discharger specific rights in and to the POTW which can only be terminated if it breaches certain terms of the agreement. Industries regulated by local ordinances or rules and regulations do not have such contractual rights in the POTW.

Specifically, in the Agreement between Merrimack and Anheuser-Busch, the Town agreed to construct a POTW what would adequately treat the company's wastes in the approximate quantity and of the approximate characteristics as described in the Agreement and the Company agreed not to discharge any wastes which:

1) contain inflammable solvents,
2) has PH lower than 5.0 or higher than 10.0,
3) contains oils and fats greater than 25 ppm,
4) contains toxic materials
5) would impair the strength, durability, hydraulic biological capability of the POTW.

The agreement further provided that the Town would enact a sewer ordinance consistent with the terms of the Agreement and that in the event of any conflict, the terms of the Agreement shall prevail.

Enforcement of Pretreatment Standards

Enforcement of the measures contained in the control instruments (sewer ordinances, permits, rules and regulations and agreements) is an important part of the pretreatment program. Effective enforcement requires a combination of administrative and judicial procedures and sufficiently stringent sanctions to compel compliance with the control measures. Moreover, the implementation of the enforcement program requires teamwork between administrators, engineers and lawyers and cooperation between the administering agency and the legal enforcement agency (such as the office of the city solicitor).

Monitoring

Under the terms of the NPDES permits issued for the POTW, the permittee is required to monitor its discharges and submit monthly reports to EPA (or the State agency) on the pollutant constituents of the treated effluent. The NPDES permit issued for the POTW does not require monitoring by the industrial users of the system. However, the POTW will have to monitor the industrial discharges that enter the POTW at some point in the system (the initial point of discharge, at the connection with the interceptors; at the POTW, etc.) in order to enable it to take measures to meet the effluent limitations of the permit. Such monitoring can be done in several ways. The POTW can require each industrial user to do its own monitoring at the point of discharge or the POTW can perform the monitoring at the treatment plant or at some point in the collection system. Such a decision will depend on the number of industrial tie-ins and the methods of connection. If the waste is not monitored until it reaches the treatment plant or the main interceptor, the dilution effect may make it difficult to determine the actual flow and the strength of the wastes of any one industrial user. However, many municipalities are reluctant to require monitoring by each user because of the expense this imposes on local industry.

If the industrial users perform self monitoring, the POTW, through one of the means of control discussed above, should establish monitoring guidelines, such as type of equipment, calibration, frequency of monitoring, reporting procedures, training of personnel required to operate the monitors (and the pretreatment equipment itself), and establish inspection procedures (See also Section 2.3).

Procedure

The most effective procedure for enforcement of the control measures is a combination of administrative and judicial measures. Generally these measures would be set out in the following steps. The first step is a determination by the agency on the basis of monitoring and inspections, that a particular user of the system is in violation of a control measure applicable to it. The second step, if the violation does not appear to be clearly willful and does not involve an emergency which could endanger the public health, could be for informal discussion between officials of the agency and the user to determine whether the matter can be resolved without formal enforcement proceedings.

If not, the third step would be formal written notification by the agency to the user of the violation with a specified time for compliance. A next step involving a conference would be a possibility. If compliance does not result in the specified time period, the next step would be the issuance of a show cause order by the agency or the enforcement authority of the legal entity (i.e. the city solicitor of the municipality). The show cause order would specifiy the date for a hearing before the agency at which the user would have the opportunity to show why an order should not be issued. Thereafter, an order may issue which could require the immediate discontinuance of the discharge to the sewer or such discontinuance to take place at some future time, the payment of a civil fine, with a minimum and maximum penalty ususally specified for each offense. Each day's continuance of the violation may be considered a separate offense. If the violator fails to comply with the agency's order, depending on State law and any special legislation creating the management agency, violations of an administrative order may be directly enforceable by the agency or it may be necessary for the agency to bring a separate court action to enforce the order, with the possibility of ciminal sanctions.

2.4.6 Legal Aspects of Citizen Participation in a Pretreatment Program

Section 505 provides that any citizen may commence a civil action on his own behalf--

1) against any person (including the United States Government and its agencies) alleged to be in violation of (a) an effluent standard or limitation or (b) an order issued by EPA or the State regarding such standard or limitations, or
2) against the Administrator for his alleged failure to perform any non-discretionary act or duty under the Act.

An "effluent standard or limitation" is defined to include pretreatment standards under Section 307 (See Sec. 505(f)).

In such an action the Federal district courts may enforce the standard or limitation or order, or order the Administrator to perform a certain act or duty, and apply any appropriate civil penalties as provided under Section 309(d). The latter referenced section provides, *inter alia*, that any person who violates Section 307 shall be subject to a civil penalty not to exceed $10,000 per day of violation.

Section 505 allows "any citizen" to bring an action without regard to whether or not the citizen is actually harmed by the alleged violation. It does not allow the citizen to recover any damages caused by the polluter. The court does have the discretion to award plaintiffs the costs of litigation (including reasonable attorney and expert witness fees). However, the proof of a violation of a pretreatment standard in a suit under Section 505 would be evidence of negligence by the discharger in an independent cause action for damages, such as that discussed below.

Independently of Section 505 of the Act, a citizen could bring suit against an industrial user for violation of the provisions of a local sewer ordinance. Such an action would be based on negligence, nuisance, or the common law rights of a riparian owner. The relief sought would be an injunction and/or damages actually suffered by the plaintiffs as a result of the actions of the discharger. A case which is instructive on this point is Springer v. Schlitz Brewing Company, 7 ERC 1516 (4th Cir. 1975) where the plaintiff (downstream riparian owners) alleged that they were damaged by the wastes discharged from the defendant's brewery and that such discharges to the POTW violated the provisions of the local sewer ordinance. The brewery claimed that any damage to plaintiffs resulted from the failure of the POTW to provide adequate treatment, for which the brewery could not be held liable. The POTW was not joined as a party and there was no allegation that the POTW was in violation of any Federal or State permits or other requirements. The Court found that under the law of North Carolina industrial users are immune from liability only when their discharges of wastes are as prescribed by law. Accordingly, the Court held that the violation of a municipal sewage ordinance which is intended to protect downstream riparian owners can subject an industrial user of the POTW to private civil liability. Moreover, independently of the sewage ordinance, the Court held that the plaintiffs could recover damages if they could prove that the brewery knew, or in the exercise of reasonable care should have ascertained, that the POTW could not adequately treat the brewery waste. The Court further pointed out that in order to recover damages the plaintiffs would have to prove that the wastes from the brewery actually caused harm to the plaintiffs.

2.5 Economic and Financial Elements

2.5.1 Basic Benefits and Costs of Joint Treatment for Industries

Industries choosing to discharge their wastes to municipal sewer systems receive several economic benefits. Although they must repay at least their portion of the Federal share of POTW construction costs (without interest, however) as well as a proportional share of the operations and maintenance costs, they can take advantage of any economies of scale of the POTW and avoid the extra costs incurred in obtaining their own NPDES permit for direct discharge. Not having to go to the capital market to borrow funds to purchase pollution control equipment, they may also favorably affect their debt/equity ratio. EPA has estimated[1] that the implicit subsidy to industry on the Federal share of plant costs is 69 percent or even higher if the local share is not recovered or if supplementary interest-free State grants are available. In some cases the implicit subsidy to industry may exceed the 75 percent subsidy to municipalities.

Aside from pretreatment, an industry discharging to a municipal system may face two basic charges.

Industrial Cost Recovery (ICR) Charges

Section 204(b)(1)(B) of the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500) requires that industrial users of the treatment works make payments for that portion of the cost of construction of such treatment works (as determined by the Administrator) which is allocable to the treatment of such industrial wastes.

The congressional intent of this provision is that "it is inappropriate in a large Federal grant program providing a high percentage of construction funds to subsidize industrial users from funds provided by taxpayers at large" (legislative history).

This provision was implemented in the Code of Federal Regulations at 40 CFR Part 35, Subpart E, promulgated by the Environmental Protection Agency on February 11, 1974. Specifically, 40 CFR 35.928 and 35.935-13 state the industrial cost recovery system shall be prepared by the grantee, approved by the Regional Administrator, and implemented and maintained by the grantee in accordance with those regulations.

Additional guidance on this subject is available in Federal Guidelines - Industrial Cost Recovery Systems. Copies may be obtained by requesting publication # MCD-45 from:

General Services Administration (8FFS)
Centralized Mailing List Services
Bldg. 41, Denver Federal Center
Denver, Colorado 80225

User Charges

In addition to ICR charges, industry must pay a proportional share of the operational, maintenance, and replacement costs of the POTW. User charges information is contained in Federal regulations, 40 CFR 35.935-13 and Federal Guidelines, 40 CFR 35 Appendix B.

2.5.2 Economic Impacts of Pretreatment Standards

Certain industrial wastes pose additional system costs. Most important to the operation of the POTW, some pollutants are imcompatible with biological treatment processes. They may lower the efficiency of the processes, causing increased pass-through of pollutants and possible violation of the municipal NPDES permit; they may even cause a complete plant breakdown. Industrial pollutants may also lower the quality of sludge, making it unsuitable for certain disposal methods such as soil conditioning, thereby increasing disposal costs.[3] Lastly, some industrial pollutants may pass through a plant with no effect on plant processes. This may also cause the POTW to violate its NPDES permit if specific effluent limitations appear in the permit due to water quality considerations. Pass-through entails no direct O/M[1] costs to the treatment plant.

Pretreatment standards established to reduce the concentration of incompatible wastes in the POTW influents can dramatically increase the industrial plants share of the cost of joint treatment. The economics of compliance with these standards is complex and planners should anticipate the dynamics of industry response. Basically, an industrial plant has five options through which to comply with a given set of pretreatment standards:

1) Drop out of the POTW system (go out of business, move out of the area, seek own discharge permit);
2) adopt process changes that alter its waste stream;
3) build individual pretreatment facilities;
4) build joint pretreatment facilities with other local industries; or
5) finance, with other industries, a central pretreatment facility or other special process at the POTW itself.

An Industry will seek to select that option, or combination of options, that maximizes its profits after complying with pretreatment standards. Let us examine the economic consequences of each option in general terms:

<u>Drop out of system</u>: If an industry drops out of the system, its entire volume of effluent disappears from the POTW influent. On the one hand this may decrease the total flows so much that dilution of pollutants contributed by other industries drops significantly, raising net concentrations (unlikely). In such a situation, pretreatment requirements ~~standards~~ would have to be raised. On the other hand, the total mass of imcompatible pollutants would decrease, as well as the proportion of incompatible wastes with respect to compatible base flows, thereby reducing O/M costs to

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[1] Operation and maintenance

the plant, improving sludge quality, and reducing pass-through. Pretreatment ~~standards~~ requirements for pollutants contributed by the industry in question could then be lowered. In some cases, the POTW may be left with unanticipated reserve capacity formerly allocated to the industry that dropped out. This may pose [redacted] financial problems for the municipality.

Process changes: A variety of options are available to the industry in the way of process changes. On one extreme, simple good housekeeping practices can reduce pollutant discharges, often saving the industry money directly. On the other hand, pretreatment might provide the incentive to construct a whole new manufacturing plant using a low pollution technology; in this case the industry might also decide to drop out of the system and relocate. Between the two extremes are incremental on-site process changes that change the effluent profile of the user, and these may pose difficulties to standard setters.

Where municipal pretreatment ~~standards~~ requirements for small contributors are more lenient than Federal standards, industries might lower the water content of their effluent to drop below the Federal standards threshold of 50,000 gpd. Though this may force them to pay a surcharge on the increased concentration, expensive pretreatment processes might be avoided. The resulting increase in O/M unit costs to the POTW would probably be recovered through the surcharge formulae, but there would be no improvement in sludge quality or reduction in upset risk, decreased plant efficiency, and increased pass-through. Process changes could also involve a change in the mix of pollutants emitted: an industry might shift to a process that allows one pollutant to drop to ~~the~~ pretreatment require~~d~~ment ~~standard~~ but another to rise up to the ~~standard~~ requirement, increasing the total amount of the second pollutant in the POTW influent and possibly requiring a recalculation of the ~~standard~~ requirement for the second pollutant. The best outcome of a process change might be that a major contributing industry would change to such a markedly less polluting process that pretreatment

~~standards~~ requirements for other industries could be relaxed (though no farther than the levels at which the first industry would elect to make the process shift.)

Individual pretreatment: The construction by an industry of pretreatment facilities on-site would simply lower its contribution of controlled pollutants to the POTW. This option would have few, if any, dynamic effects on ~~standard~~ requirement setting. It would predictably lower POTW costs, reduce upset risk, predictably lower pass-through, and predictably raise sludge quality. Unfortunately, this option may be the most expensive one for industry, as estimates put such pretreatment costs at the level of conventional secondary treatment (see Section 2.5.5). Despite certain financial subsidies available under this option, industry may seek alternate means of complying with standards.

Joint pretreatment: Similar to individual pretreatment by a number of cooperating industries (for instance, in an industrial park), joint pretreatment of wastes could realize economies of scale for participants with particular benefits for smaller and less efficient ones. Joint pretreatment could be one route by which to avoid having to grant variances to marginally profitable older industries, and therefore it could conceivably allow certain standards to be relaxed.

Pretreatment at POTW: An extreme version of joint pretreatment, the construction of a facility or a process modification at the POTW itself may be the least costly option through which to meet certain standards. It would have to be planned and constructed entirely by industry, and with private funds, and it raises complicated administrative, legal, and technical problems.

2.5.3 Economic Efficiency

Faced with this range of possible responses to pretreatment ~~standards~~ requirements, the ~~standard setting~~ agency responsible for specifying pretreatment requirements will seek to make administrative decisions that simplify industries' options and make their response to pretreatment more predictable. This probably means ruling out the last compliance option, pretreatment at the POTW, despite its possible economies. Modifying the plant itself to take over pretreatment functions would reduce system flexibility: it might be difficult for new industries to utilize such a system, and it would also be disruptive if any participating industries disconnected from the system, for other industries would be unwilling to make up the deficit of options maintenance, and replacement costs (OMR costs) specified in 40CFR 35.905-17.

Economic efficiency, in the economist's sense of minimization of total costs, will be difficult to achieve with pretreatment. One reason is that economically efficient approaches such as pretreatment at the POTW may be so administratively awkward that they are not practical. More important, optimum efficiency could well require that different pretreatment requirements ~~standards~~ be set for every industrial contributor, based soley on the costs to each user of reducing its contribution of incompatible wastes. This could be approached through the wholesale use of variances (both more lenient and more strict than the uniform standards) or through individual contractual agreements in place of a municipal ordinance or perhaps most easily through an effluent fee. However, all these approaches are inconsistent with the philospy expressed by the Federal pretreatment standards for significant contributing industries, and seem opposite to the mandate of P.L. 92-500. Disproportionate allocation of pretreatment responsibilities to those industries able to meet them at lowest cost would also run into resistance from industries themselves--those asked to do more than their minimum share would resist except under a fee system.

Most POTWs, particularly those with a large number of industrial contributors, will probably set uniform requirements ~~standards~~ and seek to help heavily affected firms after the fact.

2.5.4 Other Considerations

Growth: ~~Standards~~ Pretreatment requirements should be set to allow for industrial growth; otherwise these would have to be revised constantly. Inevitably, this means more stringent ~~standards~~ requirements for pretreatment than are strictly necessary considering the flows documented by the Industrial Waste Survey (IWS). Industries will object to these higher ~~standards~~ requirements (except, perhaps, if they themselves plan to extend operations) and they may force the available growth margin down. Thus, long term economic growth of an area may be mildly constrained by pretreatment ~~standards~~ requirements. Deliberate economic trade-offs may have to be made by the ~~standard~~ requirement setting agency between immediate economic impacts on local industry and long-term costs of developing industrial growth.*

Safety Margins: ~~Standard~~ Requirement setting will also have to allow some margin for safety, increasing the costs to industry of compliance. For instance, manufacturing processes usually give off different quantities and qualities of wastes at different stages of their cycles. Processes from two or more industries may go in and out of phase, producing intermittent peak loadings of pollutants that must be accounted for in the ~~standards~~ requirements. The possibility of manufacturing processes breakdowns may also have to be considered. Safety margins could be reduced if industries cooperated with each other in reducing phasing problems and improving safeguards against process breakdowns. This could lead to reductions in pretreatment costs to all involved industries.

Variances: [redacted] Influents of pollutants must be kept below certain absolute levels to meet the three basic objectives of pretreatment--maintenance of plant stability, maintenance of sludge quality, and achievement of water quality goals. Local variances are therefore granted at the expense of other participating industries, a fact that will

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* An effluent fee system could overcome some of the problems associated with allocating industrial capacity with a POTW. For a more thorough discussion see Reference 25.

not escape their observation: every variance carries with it implications of more stringent general ~~standards~~ requirements. Industrial pressure may be exerted to deny variances to marginal industries, making it the more imperative that economic remedies be available to such industries to allow them to achieve compliance with pretreatment ~~standards~~ requirements. Variances should be granted only as a last resort.

Industrial Location: Planning areas encompass a number of separate sewerage systems. Different plants, having different industries and different populations connecting to them, may set up different pretreatment ~~standards~~ requirements. While it would be impossible for most existing industries to make a connection choice between more than one POTW--though industries on the border between two service areas may have this option--industries moving to a 208 region are likely to consider pretreatment ~~standards~~ requirements when they make their location decisions. While the POTWs have the power to deny connections to new industries if they would become overloaded, or if excessive amounts of incompatible waste were to be contributed, there may be pressure on them not to do so; most municipalities are anxious for employment growth. Pretreatment ~~standards~~ requirements might then become an element of competition as municipalities relax pretreatment ~~standards~~ requirements to attract employment and taxable properties. Industry might decentralize through a region, disrupting regional industrial siting plans such as those promulgated by Air Quality Maintenance Areas. Uniform pretreatment ~~standards~~ requirements may have to be applied regionwide to remove this incentive, despite the greater total pretreatment costs and economic inefficiency implied.

2.5.5 The Identification of Affected Firms

From the previous discussion it is evident that pretreatment requirements may increase the costs of joint treatment in POTWs--at least for the participating industries. These costs are not insignificant: according to the draft report of the National Commission on Water Quality,

> "Establishment of Federal pretreatment standards for industry may have a more dramatic effect than the cost recovery and proportionate charge provisions."[1]

For example, for the metal finishing industry and for textiles, pretreatment represents 80 percent of total treatment costs necessary for meeting EPA's 1977 BPT standards.[2] Facing substantial pretreatment costs, some firms will elect to treat their own wastes and obtain their own discharge permit, others simply will not be able, or will choose not to bear, the costs of complying with the requirements of P.L. 92-500, either through self or joint treatment; they will relocate, or go out of business. Such effects must be considered by areawide planners. Treatment plant design and the ~~selection~~ specification of pretreatment ~~standards~~ requirements depend on the volume and composition of the industrial wastes received by the POTW. Regional economic goals--such as employment and income growth--dictate concern with impacts on industries.

To identify the industries which may be seriously affected by pretreatment requirements, planners should examine industrial trends in their area. A number of studies[3] have found that pollution control requirements hasten existing tendencies, affecting the older "marginal" firms most severely: industries in the process of relocating are the least able to absorb the necessary costs. The smaller pulp and paper mills and textile mills of the Northeast represent a case in point. Usually newer, more prosperous, firms are better able to raise the necessary capital, temporarily absorb increased costs, and in the longer term recover their increased costs in the form of higher prices. The first step in identifying the industries likely to be severely affected by pretreatment requirements should then involve a

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[1] National Commission on Water Quality, Staff Draft Report, Washington, D.C., Nov. 1975.

[2] idem.

[3] Sharon M. Oster, The Incidence of Local Water Pollution Abatement Expenditures: A Case Study of the Merrimack River Basin, Ph.D. Thesis, Department of Economics, Harvard University, June 1974.

review of regional economic trends. Most planning agencies have the necessary information: their examination of the area's economic base normally includes historical considerations. Published sources, such as County Business Patterns and the Census of Manufacturing (for larger areas) may also be useful. In addition, State and local employment offices and local chambers of commerce may be helpful in identifying marginal industries.

The second step involves a review of the studies of the costs of treatment for particular industries: a number of studies have been conducted for the Environmental Protection Agency, and for the National Commission on Water Quality. These studies identify the industries which are heavy users of municipal treatment facilities. Their findings are presented in Table 2.8. According to this table, the metal finishing industry is particularly dependent on municipal facilities: 70 percent of all establishments, or some 49,000 plants discharge to POTWs. Textile mills, pulp and paper mills, and canneries for fruits and vegetables are other sectors dependent on municipal facilities. Heavy users with incompatible wastes--the metal finishing industry--may be expected to be sensitive to pretreatment costs.

The Commission studies go on to examine plant closings due to water pollution control requirements. They conclude that "A majority of plant closures are for plants which are users of municipal systems and are defined by EPA as having incompatible pollutants," i.e., industries subject to pretreatment regulations. Further, they conclude that....

> "Plant closures are significant in Pulp and Paper Metal Finishing, Textiles, Fruit and Vegetables, Feedlots (including dairies), and Meet Packing. They are concentrated in a small high-cost segment of the industry (usually 5-10 percent of capacity). Generally they are the old, small, single-plant firms, that in many cases could not remain economically viable over the next decade regardless of water pollution control requirements."

Table 2.8

Industrial Usage of POTWs

Industrial Categories	Total No. of Plants	By Number of Plants	By Production Capacity
Canned & Preserved Fruits and Vegetables	2,123	40%	(50%)
Inorganic Chemicals	3,700	negligible	negligible
Organic Chemicals		10%	10%
Plastics & Synthetics		(40%)	(20%)
Iron & Steel	416	unknown	negligible
Metal Finishing	70,000	70%	unknown
Pulp and Paper	598	30%	10%
Steam Electric Power	1,037	negligible	negligible
Textiles	1,926	76%	unknown

Source: National Commission on Water Quality, op.cit.

Estimates of expected plant closures by sector and region are presented in Table 2-9. It should be noted that not all of these closings are caused by pretreatment requirements; the list, however, is indicative of the sectors in each region which may be expected to have difficulties in meeting pretreatment costs.

A consideration of regional economic trends, together with pretreatment cost estimates should aid regional planners in identifying the severely impacted industries.

2.5.6 Assistance to Industries

Although a pretreatment program is legally required for all POTWs, areawide planners have a number of alternatives for assisting severely affected industries. These include financial advice, technical advice, and the granting of variances.

As described above, the firms most likely to be severely affected by pretreatment requirements are the smaller, older industries. They are also the least likely to have the resources for investigating the financial assistance available to them. The forms of federal assistance available for meeting pretreatment costs are summarized in Table 2-10. Planners should investigate whether firms have considered these forms of assistance, and others which may be available in their particular planning region.

Secondly, areawide planners may offer technical assistance to affected firms, as the small, older firms may not have the resources to investigate technical alternatives--potentially of low cost--for meeting their pretreatment requirements. First, planners may commission their engineers to develop a directory of pretreatment equipment, including types of equipment, vendors of the equipment, local prices, and technical evaluations. Such a directory would facilitate the investment program undertaken by industries.

Table 2-9

Distribution of Industrial Impacts - Plant Closures, Subcategories, Products, and Region--for Selected Industries

Industry	Number of Plant Closures, BPT/1977	Percentage of Capacity, BPT/1977	Most Impacted Subcategory	Most Impacted Products	Most Impacted Region
Pulp and Paper	Max. 80	4.5%	Dissolved Sulfite Non-integrated Paper	Bleached Paper	Northeast North Central
Iron and Steel	N.A.	1.7%	Independent Forming and Finishing	Hot and Cold Finished Products	North Central
Petroleum Refining	10	1.0%	Topping Lube	High sulfur fuel Lubricating Oils	Mid-Atlantic Gulf Coast
Textiles	479	4.8%	Wool Dyeing Fabric Finishing	Wool	New England Mid-Atlantic
Metal Finishing	uncertain	7.3%	Small job and Captive Shops		California, Illinois Ohio, Michigan New England
Steam Electric	N.A.	Negligible	Construction Retrofits		Northeast North Central
Chemicals	13	Negligible	Small volume Producers		New Jersey, Ohio, West Virginia, Delaware
Canned & Preserved Fruits & Vegetables	104	4.0%	Dehydrators & Freezers	Citrus, Potatoes Processing	Florida, Northwest
Beef Feedlots	7,200-15,700	1-3%	Less than 500 head		Moisture Excess, South
Dairy Feedlots	15,700-33,500	3-7%	Less than 100 head		Equal National
Hog Feedlots	13,700-45,400	2-5%	Less than 1000 head		Southeast
Dairy Products	149	0.75%	Small Butter & Evaporative Milk		
Fertilizer	20	1.5%	Phosphates	Urea, Di-ammonia, Phosphate	Florida

SOURCE: National Commission on Water Quality, Draft Final Report, op.cit., P.III-72

Table 2-10

Forms of Financial Assistance Available for Pretreatment Expenditures

-- Rapid Amortization (over sixty months) for state certified pollution control equipment as introduced into the Internal Revenue Code as part of the Tax Reform Measure, 1969 (15).

-- If Rapid Amortization is not applicable,

- The investment tax credit allows commercial enterprices to deduce 7% of the cost of new equipment from corporate taxes due the same year the equipment was purchased. Investment tax credit may be used if the investment does not qualify for rapid amortization (12).
- The industrial portion for construction of pollution control facilities may be financed by tax-exempt bonds. The facilities are then owned by the public and leased to the industry until interest and principal is paid off *(12).
- Low interest, long-term loans are available to small businesses for construction of pollution control equipment including pretreatment facilities and interceptor sewers if industry would suffer "economic injury," Section 8 of the Small Business Act (12).

*This may require legal changes in some states, although it is permissible under Section 103(c) of the Internal Revenue Code.

In addition, the engineering firms retained by the areawide planners are likely to have some experience with pollution control techniques, including process modifications and good housekeeping practices. They may visit plants claiming severe impacts to offer suggestions on the best methods of pretreatment; programs of capital investments, process changes, and good housekeeping practices. A brief study of the firms claiming severe economic impacts would not only provide technical advice, it would enable the planning agency to validate such claims.

The final method of assistance involves granting variances to firms--relaxing their pretreatment requirements. Besides water quality ocnsiderations, this should depend on the magnitude of the cost elements involved. Pretreatment standards normally involve a number of pollutants. The sensitivity of treatment plant costs and pretreatment costs should be established for each pollutant category.

2.6 PUBLIC PARTICIPATION

EPA has published guidelines for the minimal amount of public participation needed to comply with the law (40 CFR 105). Additional guidance to planning agencies on how to effectively involve the public in the planning process is detailed in the EPA documents entitled: "The Public Participation Handbook for Water Quality Management" (Draft) (16) and chapter ten of the "Guidelines for Areawide Waste Treatment Management Planning" (17). The planning agency should strive to obtain the maximum amount of public participation that is efficiently possible for areawide planning.

2.6.1 Legal Requirements

Title One section 101(e) of the Federal Water Pollution Control Act (PL 92-500) requires that the public participate in water pollution control activities.

> "Public participation in the development, revision, and enforcement of any regulation, standard, effluent limitation, plan or program established by the Administrator (of EPA) or any State under this Act shall be provided for, encouraged, and assisted by the Administrator and the States."

In meeting this requirement, planning agencies must include a mechanism in their areawide planning process for eliciting input from the public.

2.6.2 Public Participation with Pretreatment Planning

Part of the Water Quality Management (WQM) planning process is to serve as a forum for involving the public in water resource planning (see Chapter 4.2.4). The public should have a role in formulation of the control plan for industrial discharges to sewers. The regulation of industrial discharges to sewers will affect sectors of the public including industry itself, consumers, individual taxpayers, environmentalists, and local government agencies. For successful implementation of the industrial control plan, these sectors should be a part of all phases of the WQM process for pretreatment including definition of goals, priorities setting, implementation schedules and management strategies.

2.6.3 Advisory Committees

The most effective way to insure that a pretreatment plan will be well received and be complied with by industry is to intimately involve industrial representatives in preparation of the plan. The industrial subcommittee of the general advisory committee should have frequent opportunities to suggest means to control industrial pollutants to sewers. The 208 planners may also request alternative solutions directly from industry on an individual basis. One person in all WQM planning agencies should be designated a liaison with the industrial sector of the area.

Other members of the general advisory committee may include municipal officials (or their designated representatives), municipal engineers, local scientists and engineers, state health officials, independent environmentalists and regional/local planners. Incorporating the goals of this cross-sectional committee into the WQM plan, the continuing advisory committee may become advocates for the plan and may function in educating the rest of the community.

The advisory committees will take part in both the industrial waste survey and the development of the sewer use ordinance (subsections 2.3.2 and 2.3.5). The industrial subcommittee should be able to assist the industrial waste survey. The list of the ordinance committee in subsection 2.3.2 presents a suggested group of individuals from public and private sectors of the community who would either draft a sewer use ordinance or advise the municipality on how to draft its sewer use ordinance. This ordinance committee is representative of a temporary committee set up within a WQM planning agency as required to fulfill specific tasks.

Some Issues Requiring Public Participation

As discussed above, the regulation of industrial discharges to sewers will impact on facets of the general community such as its economy, political institutions, and water resources. Some of the more significant issues requiring public input are:

1) Direct Discharge or Sewer Discharge. The planning agency, as an open forum for communication, will have a major role in educating industries as to the requirements of PL 92-500. Industries may be quite uninformed on the technical and financial requirements of pretreatment and cost recovery. Similarly, the requirements for direct discharge, including legal liabilities, should be explained to industry. The planning agency will disseminate accurate information. Whether industries choose direct discharge or joint treatment must be considered in the overall WQM plan and also may affect the economy of the community. The importance of these decisions which will have impact on the WQM areawide plan, 201 facilities plan and State program plan, demands that they be based on accurate information.

2) Control of Industrial Wastes and the General Economy of the Community. Industrial waste treatment or pretreatment costs (capital and operating), sewerage system user charges, surcharges, and monitoring costs will to some degree increase manufacturing costs. These increases are likely to be passed on to the consumer. Offsetting these small increases of prices for consumer goods should be a decrease in an individual resident's share of waste treatment if the costs of such services are equitably distributed. To some extent, the quality and intended uses of receiving waters in a community is a public decision. The aesthetic or recreational desire for high quality water and the stringent control requirements for industry should be weighed against possible corresponding plant closures or relocations with the loss of jobs resulting. Conversely, there are economic benefits associated with improved water quality and new industries, based on recreation for example, could arise. High quality process water sources could attract new industry to an area. Proper land-use planning such as industrial park locations resulting in optimal waste management could yield economic benefits. These issues must be identified for each community and will require decisions by its members.

3) Control of Industrial Wastes and Community Public Health. Industrial wastes are a primary source of toxicants to the environment. As our understanding of these materials increases as well as our capabilities to control their fate, this issue gains in significance. During the treatment of industrial wastes a given compound will either be altered chemically or simply removed to a different phase. In the latter case the compound which may be toxic and often resides in a sludge, will be disposed of via land, water, or air. Besides recycling, there is no alternative. Land application of these materials can affect crops and groundwater supplies which can then be consumed by residents. Incineration can volatilize compounds to the surrounding atmosphere in the community posing physiological threats upon inhalation or skin contact. Discharge to receiving waters can affect organisms consumed by man, recreational participants, and water supplies. Considering that some estimates indicate that 40 percent of the U.S. population is supplied with water that has been used at least once before for domestic or industrial purposes the public should be aware of their local situation. Control and avoidance of harmful materials is

somewhat a public choice; the conventional economic analysis which compares costs to benefits will have to be modified to weigh the more complex cost-benefit-risk tradeoffs involved with both obtaining a living from and living with industry in the community.

2.7 PROBABLE MANAGEMENT FUNCTIONS IN A PRETREATMENT CONTROL PROGRAM

The initial WQM (208) plan will identify an agency or agencies which will be responsible for managing the pretreatment program in the planning area. Such a management agency would be empowered to refuse municipal wastes which do not comply with the plan, i.e., those wastes requiring pretreatment to comply with the plan. The management agency would also be empowered to refuse or accept industrial wastes for treatment. These authorities enable the management agency to function in controlling industrial discharges to sewers. This section highlights some of the probable management functions of the agency in pretreatment. The management role may be expanded from this list.

2.7.1 NPDES Permits

The (208) management agency(s) may have six direct functions within the NPDES to insure control over industrial discharges to sewers. The management agency could:

1) review any industrial and municipal monitoring reports of industrial discharges to sewers, POTW influent and POTW effluent;

2) arrange for spot monitoring checks of industrial discharges to sewers;

[redacted]

3) review new POTW applications for compliance with pretreatment program for the area;

4) review all renewal POTW applications for compliance with area pretreatment requirements; and

5) advise the NPDES issuing authority (if different) on results of review.

2.7.2 Industrial Waste Surveys

The management agency(s) should implement a system to periodically update the information from the initial IWS for the area. Changes in industrial discharges to sewers (including new dischargers) should be integrated with the areawide industrial pollution control program. The updating activities such as sampling and interviewing may be conducted by individual municipalities but the integration into the areawide waste management program should be the task of the 208 agency. To insure that municipalities adequately update their IWS, the 208 management agency may require annual reports.

2.7.3 Enforcement of Pretreatment

Enforcement of the control program for industrial dischargers to municipal sewers can be predominantly a function of local and State government (see section 2.4, Legal Management Elements). Because it will possess a comprehensive familiarity with the area, the 208 management agency(s) could have a significant supporting role in enforcement. This responsibility will include:

1) writing new municipal sewer ordinances and/or updating existing ordinances;
2) reviewing enforcement and penalty clauses of existing ordinances for insurance of pretreatment compliance;
3) advising EPA of industries not complying with pretreatment to make them ineligible for Federal contracts, grants, loans; and
4) advising regional EPA on POTW grant applications based on pretreatment compliance.

2.7.4 Public Participation

The management agency(s) is a likely forum for continuing information exchange between industry, environmentalists, municipal governments and the local community. A substantial input from the public is required in formulation of the plan; so a continuing exchange during plan implementation will naturally follow. Both citizen advisors and industrial liaison people will be included in the management structure.

2.7.5 Variance

The (208) management agency(s) would review the criteria used in setting pretreatment requirements to determine if all information relevant to the particular industry was not included into the process of setting regulations for the industry. The agency might function directly by proposing to the regional EPA a variance, setting more lenient or more stringent requirements or it may act as arbiter during negotiations between an industry and a municipality.

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NOTE: Portions of this chapter dealing with POTW interference and pass through are developed in greater detail in Federal Guidelines - State and Local Pretreatment Programs which are prepared pursuant to section 304(f) of P.L. 92-500. These guidelines will be published shortly.

Chapter 3

POLLUTANTS WHICH PASS THROUGH OR INTERFERE WITH POTWs

3.1 INTRODUCTION

It is an accepted practice for some industries to discharge their wastewater into POTWs and have it treated and disposed of jointly with domestic wastewater by a common treatment facility. Such an arrangement may or may not be detrimental to the objectives of water pollution control at the POTW, depending on the type of industrial waste and level of industrial waste management. However, because of the diverse nature of industrial wastes, it is very likely that certain constituents of industrial wastes may not be compatible with the POTW and may cause interference with various components of the POTW. In general, such interference may affect:

1. Wastewater Collection Works;
2. Biological Treatment Processes;
3. Receiving Water of POTW;
4. Sludge Disposal.

Significant wastewater parameters for 21 selected industrial classifications may be found in Table 4-1 of the Handbook for Monitoring Industrial Wastewater, U.S. Environmental Protection Agency, August, 1973.

In the following sections, the pollutants which affect these components will be examined, their threshold concentrations available in the literature will be summarized as general guidelines, some useful techniques to reduce excessive fluctuations of hydraulic and/or pollutant discharge will also be discussed. In addition, the general approach to determine pretreatment requirements as well as some illustrative sample calculations will be presented in Section 3.6. For information which is site-specific or unavailable from the literature, general considerations and approaches are also suggested. It is hoped that the information assembled in this Chapter will be helpful to 208 areawide planning agencies and their consultants in coping with the technological and scientific aspects of industrial pretreatment programs.

3.2. POLLUTANTS WHICH AFFECT WASTEWATER COLLECTION WORKS

The first category of industrial pollutants which should be excluded from the POTWs are those which may damage the wastewater collection works, e.g., sewers, pumping stations, etc. In general, the following wastewaters shall not be introduced into a POTW:

1) wastewaters with pollutants that create a fire or explosion hazard in the POTW;
2) wastewaters which will cause corrosive damage;
3) wastewaters which contain solid or viscous wastes in amounts which would cause obstruction to flow or interference in the POTW;
4) wastewaters containing heat in amounts which would inhibit biological activity in a POTW resulting in treatment process upset and subsequent loss of treatment efficiency;
5) a volume of wastewater and/or an amount of BOD released in a slug discharge so as to cause treatment plant upset.

treatment facilities. These wastewaters are generally considered as prohibited wastes, to be completely excluded from POTWs.

Since industrial wastes vary greatly in constituents and character, the actual identification of the above prohibited wastewaters may have to be achieved by industrial waste surveys and perhaps testing. Nevertheless, the general constituents of these wastewaters can be briefly described in the following subsections.

3.2.1. Explosive and Flammable Materials

Certain constituents of industrial wastes may cause explosion and fire hazards to sewer lines, manholes, and pumping facilities if they are not strictly controlled. In general, these hazardous materials fall under two major categories:

(1) Organic materials, such as hydrocarbons, ethers, alcohols, ketones, aldehydes, and organic peroxides, etc.;

(2) Powerful oxidizing agents such as peroxides, chlorates, perchlorates, bromates, and substances which can liberate flammable or explosive gases.

The sources of these hazardous materials are most likely those industries manufacturing or using them in their normal operations.

The production of sewer gas, methane, as a result of anaerobic conditions in a sewer system also presents a well-known potential fire and explosion hazard. Although this hazard may not be directly attributed to any industrial waste constituents, an indirect cause-effect relationship might exist. Certain conditions of industrial wastes could be highly conducive to the creation of anaerobic conditions in the sewers, such as high BOD loads and/or high temperature of industrial discharges.

3.2.2. Corrosive Materials

Corrosive materials contained in industrial waste may deteriorate sewers and pumping equipment, cause structural damages and failures, and ultimately lead to economic losses to POTWs. Those commonly regarded as corrosive to POTWs include:

(1) Sulfate and sulfide, and substances which may lead to their production in the sewer system. The resultant corrosion usually occurs at the crown of concrete sewers.

(2) Low pH (acidic) wastes. The acidic nature of industrial wastes may attack and disintegrate metal and concrete pipes and structures. Unless the works is specifically designed to accommodate such wastes, the pH of wastewaters is usually required to be not lower than 5.0.

(3) Strong oxidizing agents which tend to react chemically with the pipes and structures, and render them structurally unsound.

3.2.3. Materials which Cause Flow Obstruction

Certain constituents of industrial wastes may settle to form deposits, adhere to surfaces to form slime or scale, or float and accumulate to form scum. The overall effect of all these mechanisms is a change in the sewer's hydraulic characteristics and consequently an obstruction of wastewater flow.

Experience in New York City*

The flammable substances in the industrial laundry wastes may cause explosion and fire hazards, and this potential may be determined by using a standard explosimeter.

The acidic wastes discharged by a pigment manufacturer seriously corroded a large concrete sewer and caused a cave-in under a commercial pier and deterioration of other sewer pipes further up the line.

A paint manufacturer discharging untreated caustic washwater caused a sewer blockage and created a continuous fire hazard. This problem was solved by requiring pretreatment to remove paint solids and solvents from the washwater.

Sewer clogging due to fats and greases is a major maintenance problem for sewers receiving industrial discharges from meat processing plants. However, the pretreatment of the wastes by a process or device, such as a grease trap or interceptor, may remove fats and greases effectively.

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* "The Industrial Wastes Control Program in New York City," by Charles Imbelli, et al, JWPCF 40 (1), 1981-2012 (December, 1968).

These materials should be excluded from any industrial discharges into POTWs, and they generally include the following categories:

(1) High levels of suspended solids which tend to settle by gravity in the sewer system;

(2) Oil and grease which tend to solidify in the sewer system;

(3) Colloidal materials which tend to agglomerate and then settle in the sewer system.

3.3 POLLUTANTS WHICH INTERFERE WITH BIOLOGICAL TREATMENT PROCESSES

Wastewater treatment facilities represent a combination of physical, chemical, and biological treatment processes which are designed to remove, concentrate, and stabilize the deleterious water pollutants, convert them into harmless or even useful form, and ultimately dispose of them in an ecologically sound fashion. Normal and efficient operation of these processes constitutes a significant fraction of the effort towards a successful program of water pollution control. Conversely, any interference or upset of these processes due to the presence of industrial toxicants may render the treatment facility partially or completely inoperative, degrade the water quality which was desired to be protected, and incur losses, tangible as well as intangible, to the public good.

The goal of wastewater treatment, such as secondary or higher treatment, can frequently be achieved by various combinations of treatment processes, most broadly classified as biological and physical-chemical treatment. For POTWs, biological treatment processes are by far the dominant choice mainly on the basis of domestic wastewater characteristics. In view of the mechanism of operation, land treatment systems may be considered a form of biological treatment, and will be included in this section.

In terms of probable process upsets due to industrial wastes, biological treatment is generally more susceptible than physical-chemical treatment. This section will be directed to pollutants which interfere with normal type biological treatment processes. Should the POTW utilize physical-chemical rather than biological treatment, it is conceivable that the pretreatment guidelines and requirements will be established with considerations which are rather different from those discussed in this section.

The factors and pollutants considered in this section include excessive fluctuations of hydraulic and/or pollutant discharge, i.e. slug discharges, heat, inorganic and organic pollutants. These factors will be considered in view of their effects on three biological treatment processes: aerobic oxidation by activated sludge or trickling filter, nitrification, and anaerobic digestion. Those pollutants which interfere with land treatment primarily consist of chemicals which may have undesirable impact on the soil and crops systems.

The technical information presented in this section should be considered as general guidelines. Local wastewater characteristics and the operation of treatment facilities may play an important role in determining the treatment performance(1). In using the threshold concentrations of pollutants which are toxic to certain treatment processes, the different degrees of acclimation possible with different biological treatment processes and the sequence of these vulnerable processes in a normal type biological treatment plant should also be taken into consideration.

3.3.1. Excessive Fluctuations of Hydraulic and/or Pollutant Discharge

The design of municipal wastewater treatment plants is usually based on certain prescribed ranges of fluctuation in wastewater flow and compatible pollutants mass loading. Design treatment performance may be achieved when the fluctuations in flow and/or pollutants fall within the prescribed range. In general, the treatment performance will deteriorate or collapse as the fluctuation exceeds the prescribed design level.

The wastewater originating from residential areas usually exhibits diurnal fluctuation in flow and concentration of common pollutants such as BOD, and the fluctuations of this kind are usually considered and accommodated in the design of treatment plants. For a POTW receiving industrial discharges, the situation might become more complex, since the industrial discharges might cause excessive fluctuations in flow and/or concentrations of pollutants, the key considerations being the pollutant mass flux and its discharge schedule. Since those pollutants which are usually not designed to be removed by secondary biological treatment plants will be discussed in other sections, only common pollutants such as BOD, suspended solids, etc. will be considered here.

If a large flow rate of industrial waste or a large quantity of pollutants are introduced into a POTW within a relatively short time period, these are commonly referred to as slug discharges. Although the wastewater flow and pollutants like BOD may be well received at the design levels of loading, the slug discharges may cause a treatment process upset and subsequent loss of treatment efficiency. Under these conditions, slug discharges may be considered as prohibited wastes.

The rigorous definition of slug discharges will be related to the design and capacity of the specific treatment plant receiving the industrial wastewater, and are consequently site-specific. Although generalized statements on site-specific issues like slug discharges are difficult to establish, it should be obvious that any remedial measure which can reduce the fluctuations in flow and pollutants will be highly beneficial in reducing the impact of slug discharges on a POTW.

One important means of coping with slug discharges is the use of a flow equalization process, especially in the consideration of industrial pretreatment. Essentially, equalization means the provision of a storage facility for industrial wastewater so that the wastewater can be discharged to the POTW more uniformly and continuously rather than in the fluctuating and intermittent fashion in which it is actually produced at the industrial facility. The result is a relatively more uniform discharge in both flow and pollutant loading into the treatment works, and many treatment processes, especially those of biochemical nature, will benefit significantly from flow smoothing and concentration dampening.

For those industries contributing significant fractions of the total flow and pollutants into the POTW, equalization as an industrial pretreatment may be particularly useful because it represents a rather flexible technique to manipulate the flow and pollutant loading at their sources rather than at the treatment plant. Ideally, equalization as industrial pretreatment may even be utilized to augment the low points in the diurnal cycle of domestic wastewater flow, and thus to reduce the magnitude of fluctuations, if the industrial wastewater has characteristics comparable to the domestic wastewater.

Useful information on the design, costing, and case studies of flow equalization has been made available (2) although it is not discussed specifically for industrial pretreatment.

A modification of the equalization technique, proportioning, may be useful under certain conditions. Proportioning refers to the discharge of industrial wastewater from a holding tank in proportion to the flow of domestic wastewater in the sewers. The industrial wastewater is usually metered into the sewer according to a predetermined schedule based on the flow pattern of domestic wastewater. The objective of proportioning is to keep constant the ratio of industrial to domestic wastewater flow entering the treatment works. The relatively constant dilution achieved by such proportioning can be designed to insure that any incompatible industrial pollutants will be diluted to an acceptable level at the treatment works.

3.3.2 Heat

Heat will interfere with a POTW when its level is high enough to inhibit the normal biological activity of treatment processes at a POTW. This critical level of heat is generally considered to be 40° C (104°F) at the treatment facility.

In many cases, substantial quantities of heat can be discharged into a municipal sewage system along with wastewater without causing an upset to treatment processes. In fact, some heat, particularly in cold weather, may actually improve the effectiveness of biological treatment processes.

In addition to the thermal effect on treatment processes, the thermal impact on the wastewater collection system warrants additional considerations. Anaerobic decomposition of organics within the wastewater collection system is usually unavoidable, and the generation and accumulation of methane within the sewer system would be a natural consequence. As discussed in section 3.2, excessive accumulation of methane may present a potential fire and explosion hazard, which should be strictly regulated and avoided. Since most biochemical processes will be accelerated as temperature rises up to a certain critical level, it is conceivable that methane production and accumulation will increase as a result of the industrial thermal discharge into public sewer systems. Therefore, it is possible that thermal discharges may cause adverse effects on the sewer system even though the wastewater temperature at the treatment plant might be still lower than 40°C. The delineation of such thermal impact on sewer systems depends on the type and design of sewer systems involved. Local monitoring and analysis for the methane and waste temperature might be the best solution to such site-specific questions.

3.3.3 Inorganic Pollutants

Wastewater usually contains a large number of inorganic substances, many of which are not detrimental to biological treatment processes. Those of concern are primarily dissolved, present in molecular or ionic form. Since the concentrations of dissolved substances are dictated by various chemical equilibria, the presence of some substances, not harmful themselves, may still have significant effects on the toxicity to biological treatment processes. The toxicity of certain cations, for example, may be enhanced or reduced by the presence of certain anions or other chemical forms which may combine with the cations to form complexes.

Table 3-1 (3) summarizes those major inorganic pollutants that are likely to be toxic to biological treatment processes. The majority of cations of concern are metals, which mostly originate from the metal processing and plating industry. Much metal plating is carried out in numerous small independent shops located in metropolitan areas; this tends to make the control of these troublesome metals more difficult. Although the threshold concentrations tabulated are the total concentration of each metal, it should be recognized that the effects of metals are dependent on the amounts of EDTA, hydroxide, sulfide, carbonate, and phosphate (4), etc., present, which determine the available concentration of free metal ions in solution through certain chemical reactions such as complexation and precipitation. The fact that some metals are amphoteric (3), i.e. they may exist in solution as a cation or anion under different conditions, also indicates that the toxic effects of these metals may vary with other parameters such as pH.

In addition to the chemical considerations discussed above, certain biological factors may be highly significant in establishing the threshold concentrations that are toxic to biological treatment processes. For certain toxic pollutants it has been long recognized that a population of microorganisms may be developed through appropriate acclimation, which can function effectively for the treatment purposes and show low or no sensitivity to the presence of the toxic pollutants. For inorganic metals, the acclimated population may show high levels of tolerance while certain toxic organic pollutants can even be degraded by the acclimated

Table 3-1

THRESHOLD CONCENTRATIONS OF INORGANIC POLLUTANTS THAT ARE INHIBITORY TO BIOLOGICAL TREATMENT PROCESSES (3)

	CONCENTRATION (mg/l)		
POLLUTANT	ACTIVATED SLUDGE PROCESSES	ANAEROBIC DIGESTION PROCESSES	NITRIFICATION PROCESS
Ammonia	480	1500	
Arsenic	0.1	1.6	
Borate(Boron)	0.05-100	2	
Cadmium	10-100	0.02	
Calcium	2500		
Chromium (Hexavalent)	1-10	50	0.25
Chromium (Trivalent)	50	50-500	
Copper	1.0	1.0-10	0.005-0.5
Cyanide	0.1-5	4	0.34
Iron	1000	5	
Lead	0.1		0.5
Manganese	10		
Magnesium		1000	50
Mercury	0.1-5.0	1365	
Nickel	1.0-2.5		0.25
Silver	5		
Sodium		3500	
Sulfate			500
Sulfide		50	
Zinc	0.08-10	5-20	0.08-0.5

Note: Concentrations shown represent influent to the unit processes. Blanks represent lack of data.

Anaerobic Digester Upset by Metals

"In the Long Island City area, in 1960, the discharge of toxic metal from more than 40 metal platers was held responsible for the upset of the sludge digestion process at the Bowery Bay pollution control plant. An educational campaign as a preliminary step to enforcing compliance was resorted to because of the difficulties encountered by the many small firms in meeting the prescribed limits. Housekeeping procedures, instituted by the platers, were highly effective in reducing the toxic metals reaching the treatment plant."*

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*"The Industrial Wastes Control Program in New York City," by Charles Imbelli, et al, JWPCF 40 (1), 1981-2012 (December, 1968).

population. It is conceivable that the performance of the acclimated population may depend on a relatively narrow range of the flow and pollutant composition in the actual operation.

Since different microbial populations are utilized in different biological treatment processes, those processes will exhibit different degrees of adaptability. Activated sludge processes have been known to be more adaptable to toxic pollutants than either anaerobic digestion or nitrification processes. This difference in adaptation may be attributed to different degrees of biological diversity among the processes. Both anaerobic digestion and nitrification processes require rather specific microorganisms to achieve the treatment purposes while the activated sludge processes involve a great variety of organisms.

In view of these complicating factors discussed above, the threshold concentrations in Table 3-1 should be considered as general guidelines to be adopted with caution. Preferably, a pilot testing program should be conducted to determine the feasibility of biological treatment on a specific mix of industrial and domestic wastewaters.

3.3.4 Organic Pollutants

Organic chemicals may be defined as those compounds made up of carbon in combination with one or more other elements such as hydrogen, oxygen, nitrogen, sulfur or phosphorus. In general, organic compounds may be derived from biological species such as animals and plants, or may be produced through chemical synthesis. Some of the synthesized organic compounds are rarely, if ever, found in the natural environment, and consequently may not be readily biodegradable by the microorganisms utilized in biological treatment processes. At certain levels of concentration, some organic chemicals are toxic to the microorganisms which are the active agents of biological treatment processes. Under such conditions, interference with the biological treatment process usually results in significant reductions in treatment efficiency, which might or might not be recovered within reasomable periods of time, depending on the treatment process involved and the degree of process upset.

Although many of the organic chemicals of concern can be identified, and their concentrations may be determined by using modern analytical techniques, the process of delineating the problem may be complicated by several factors. Some toxic organic compounds, such as phenol and formaldehyde, may be effectively removed from wastewaters by biological treatment if the biological population has been allowed to acclimate gradually (4). Therefore, the threshold concentrations of organic pollutants that are inhibitory to biological treatment processes become flexible and will vary with the operating conditions, such as type of biological process and even the design of the process. Many organic pollutants may become susceptible to biological degradation after acclimation. However, it should be pointed out that the performance of the acclimated population may depend on a relatively narrow range of the flow and pollutant composition in the actual operation.

In addition to removal by degradation after acclimation, toxic organic chemicals can also be removed by other mechanisms. Volatile compounds may be lost to the atmosphere during aerobic biological treatment. Other substances, such as some chlorinated

Anaerobic Digester Upset by Kepone

An industrial wastewater containing Kepone, a chlorinated ketone insecticide in the same category as DDT, was allowed to be discharged into the POTW of Hopewell, Va., in March, 1974, without adequate consideration of its toxic impacts*. Early in April, 1974, the anaerobic digesters of the Hopewell sewage treatment plant failed completely**. The Kepone discharger was closed in July, 1975*, and the digesters were not back in service until January, 1976**.

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* Washington Post, January 1-4, 1976.

** Personal communication with William R. Havens, superintendent of Hopewell sewage treatment plant.

organic coumpounds, may be adsorbed on suspended particules or precipitated and thus removed to different extents.

Anaerobic digestion of sludges is the biological treatment process which is most susceptible to interference by toxic pollutants, especially phenols, chlorinated organic compounds and metals. The effect of chlorinated organic compounds even at very low concentrations is remarkable (4), and therefore, particular attention must be focused on the treatment of industrial wastwaters containing such compounds, which might be used as insecticides or solvents for various purposes.

Among aerobic biological treatment processes, nitrification seems to be most sensitive to toxic substances. The specific autotrophic bacteria which are responsible for nitrification are much more easily inhibited than are the heterotrophic bacteria which are responsible for the oxidation of organic carbon compounds. Organic sulfur compounds, expecially those with sulfur-carbon-nitrogen linkages are well known (4) inhibitors of nitrification. However, acclimation is possible to some extent with nitrification processes.

Among the aerobic processes for the oxidation of organic carbon, activated sludge and trickling filters are the most common. Acclimation of biological populations to toxic organic substances is possible with both these processes. However, trickling filters seem to be more resistant to shock loads and toxic wastes than do activated sludge processes. Those using specially-designed plastic sheets as filter medium are even more adapted to industrial wastewater treatment because of many advantages in the surface characteristics which are made available in such designs.

In general the organic compounds of most concern in terms of interference with biological treatment processes include phenols, chlorinated organic compounds, aromatic nitrogenous compounds, and surfactants. Table 3-2 lists threshold concentrations of various organic pollutants to three biolocical treatment processes (3). Many of these data are derived from laboratory experiments under certain operating conditions. Extrapolation of these data to other applications therefore, will require careful consideration of pertinent factors. The information contained in Table 3-2 is far from complete; it is presented here to serve as a guideline where no other pertinent and detailed information is available for specific applications.

3.3.5 Pollutants Which Interfere with Land Treatment

Land treatment of municipal wastewater effluents utilizes the soil-crops system for the removal of certain water pollutants. In addition to waste treatment, the reuse of water for agricultural irrigation can also be achieved simultaneously. Since this combination of waste treatment and water reuse may be highly beneficial and cost effective in certain localities, especially in water-short regions, land treatment of wastewater will probably be more widely practiced in the future. This trend will be particularly true for the treatment of municipal wastewaters, including those receiving industrial discharges in a POTW. Therefore, it becomes essential to consider any possible impact an industrial discharge may have upon land treatment systems.

Table 3-2

THRESHOLD CONCENTRATIONS OF ORGANIC POLLUTANTS THAT ARE INHIBITORY TO BIOLOGICAL TREATMENT PROCESSES (3)

	CONCENTRATION (mg/l)		
POLLUTANT	ACTIVATED SLUDGE PROCESSES	ANAEROBIC DIGESTION PROCESSES	NITRIFICATION PROCESSES
Alcohols			
Allyl		100	19.5
Crotonyl		500	
Heptyl		500	
Hexyl		1000	
Octyl		200	
Propargyl		500	
Phenols			
Phenol	200		4-10
Creosol			4-16
2-4 Dinitrophenol			150
Chlorinated Hydrocarbons			
Chloroform		10-16	
Carbon Tetrachloride		10-20	
Methylene Chloride		100-500	
1-2 Dichloroethane		1	
Dichlorophen*		1	
Hexachlorocyclohexane		48	
Pentachlorophenol*		0.4	
Tetrachloroethylene		20	
1,1,1,-Trichloroethane		1	
Trichloroethylene		20	
Trichlorofluoromethane*		0.7	
Trichlorotriflouroethane (Freon)		5	
Allyl Chloride			180
Dichlorophen			50
Organic Nitrogen Compounds			
Acrylonitrile		5	

Table 3-2 (Continued)

POLLUTANT	CONCENTRATION (mg/1) ACTIVATED SLUDGE PROCESSES	ANAEROBIC DIGESTION PROCESSES	NITRIFICATION PROCESSES
Organic Nitrogen Compounds (Continued)			
Thiourea			0.075
Thioacetamid			0.14
Analine			0.65
Trinitrotoluene (TNT)	20-25		
EDTA	25		300
Pyridine			100
Surfactants			
Nacconol	200		
Ceepryn	100		
Miscellaneous Organic Compounds			
Benzidine	500	5	
Thiosemicarbazide			0.18
Methyl isothiocyanate			0.8
Allyl isothiocyanate			1.9
Dithio-oxamide			1.1
Potassium thiocyanate			300
Sodium methyl dithiocarbamate			0.9
Sodium dimethyl dithiocarbamate			13.6
Dimethyl ammonium dimethyl dithiocarbamate			19.3
Sodium cyclopentamethylene dithiocarbamate			23
Piperidinium cyclopentamethylene dithiocarbamate			57
Methyl thiuronium sulphate			6.5
Benzyl thiuronium chloride			49

Table 3-2 (Continued)

	CONCENTRATION (mg/l)		
POLLUTANT	ACTIVATED SLUDGE PROCESSES	ANAEROBIC DIGESTION PROCESSES	NITRIFICATION PROCESSES
Miscellaneous Organic Compounds (Contd.)			
Tetramethyl thiuram monosulphide			50
Tetramethyl thiuram disulphide			30
Diallyl Ether			100
Dimethyl-paranitrosoaniline			7.7
Guanidine carbonate			19
Skatole			16.5 7.0
Strychnine hydrochloride			175
2 chloro-6 trichloro-methyl-pyridine			100
Ethyl urethane			250
Hydrazine			58
Methylene blue			100
Carbon disulphide			35
Acetone			840
8-hydroxyquinoline			73
Streptomycin			400

Note: Concentrations shown represent influent to the unit process. Where indicated with a *, the concentration represents total plant influent. Blanks represent lack of data.

Three basic methods of land application can be defined for the treatment of wastewaters: irrigation, infiltration-percolation, and overland flow. These different methods are designed to achieve different overall objectives, to be adapted to different site conditions, and to produce renovated water of different qualities. Generally, various levels of wastewater pretreatment prior to its application to land may be necessary for their successful operation. The discussion of these aspects of land treatment has been detailed in recent publications on land treatment (5,6).

Land application systems may be subject to interference of various wastewater constituents. However, some pollutants such as BOD and suspended solids can usually be controlled by appropriate POTW pretreatment and do not interfere with the subsequent process of land application. In general, BOD and suspended solids at the level of secondary effluent or lower will not cause difficulties in subsequent land applications.

Nevertheless other wastewater constituents could interfere with land application in different ways. The possible interferences include those with the soil system, crops involved (if irrigation is used), and quality of renovated water. For example, relatively high concentrations of sodium in comparison with calcium and magnesium (the sodium adsorption ratio) may cause deflocculation of the soil structure, decreasing soil permeability, and perhaps eventual sealing of the soil. Excessively high levels of salinity or total dissolved solids may present a hazard in irrigating certain crops. A number of trace elements, including heavy metals, are also major concerns because of their toxic effects on plants or their excessive accumulation in soils. The nitrogen content of the renovated water may become a major consideration if the water becomes the source of a drinking water supply. The nitrate nitrogen in drinking water is limited to 10 mg/l because of the possibilities for methemoglobinemia in children.

Nitrogen mass balance computations can determine whether this constraint will be limiting.

Some quantitative guidelines on those chemical constituents in irrigation water which may interfere with soil-crops system are available in the literature (5,6). Shown in Table 3-3 are some major inorganic constituents to be regulated in the irrigation water (5), mainly on the basis of their effects on soil structure and their toxicity towards crops. As to trace elements in the irrigation water, key factors to be considered are concentration levels toxic to crops as well as the absorptive capacity of the soil. Table 3-4 shows recommended maximum concentrations of trace elements in irrigation water (6,11) for various types of soil and application rates of irrigation.

The recommended maximum concentrations for continuous use on all soils are set for those sandy soils that have low capacities to react with the element in question. The criteria for short-term use are suggested for soils that have high capacities to remove from the irrigation water the elements being considered (11).

Table 3-3

SUGGESTED VALUES FOR MAJOR INORGANIC CONSTITUENTS IN WATER APPLIED TO THE LAND (5)

Problem and related constituent	No problem	Increasing problems	Severe
Salinity[a]			
EC of irrigation water, in millimhos/cm	<0.75	0.75-3.0	>3.0
Permeability			
EC of irrigation water, in mmho/cm	>0.5	<0.5	<0.2
SAR (Sodium adsorption ratio)[b]	<6.0	6.0-9.0	>9.0
Specific ion toxicity[c]			
From root absorption			
Sodium (evaluate by SAR)	<3	3.0-9.0	>9.0
Chloride, me/l	<4	4.0-10	>10
Chloride, mg/l	<142	142-355	>355
From foliar absorption[d] (sprinklers)			
Sodium, me/l	<3.0	>3.0	--
Sodium, mg/l	<69	>69	--
Chloride, me/l	<3.0	>3.0	--
Chloride, mg/l	<106	>106	--
Miscellaneous[e]			
NH_4-N NO_3-N]- mg/l for sensitive crops	<5	5-30	>30
HCO_3, me/l [only with overhead sprinklers]	<1.5	1.5-8.5	>8.5
HCO_3, mg/l [only with overhead sprinklers]	<90	90-520	>520
pH	Normal range =	6.5-8.4	--

a. Assumes water for crop plus needed water for leaching requirement (LR) will be applied. Crops vary in tolerance to salinity. mmho/cm x 640 = approximate total dissolved solids (TDS) in mg/l or ppm; mmho x 1,000 = micromhos.

b. $\mathrm{SAR} = \dfrac{\mathrm{Na}}{\sqrt{\dfrac{\mathrm{Ca} + \mathrm{Mg}}{2}}}$ where Na = sodium, me/l, Ca = calcium, Mg = magnesium.

c. Most tree crops and woody ornamentals are sensitive to sodium and chloride (use values shown). Most annual crops are not sensitive.

d. Leaf areas wet by sprinklers (rotating heads) may show a leaf burn due to sodium or chloride absorption under low-humidity, high-evaporation conditions. (Evaporation increases ion concentration in water films on leaves between rotations of sprinkler heads.)

e. Excess N may affect production or quality of certain crops, e.g., sugar beets, citrus, grapes, avocados, apricots, etc. (1 mg/l NO_3-N = 2.72 lb N/acre-ft of applied water.) HCO_3 with overhead sprinkler irrigation may cause a white carbonate deposit to form on fruit and leaves.

Note: Interpretations are based on possible effects of constituents on crops and/or soils. Suggested values are flexible and should be modified when warranted by local experience or special conditions of crop, soil, and method of irrigation.

ble 4-9

SEWER AUTHORITY
INDUSTRIAL WASTE SURVEY
SUMMARY OF INDUSTRIAL SURCHARGES*

Industry	SIC Cat.	New Surcharges to be Assessed Under Present System		Surcharges to be Levied Under Secondary Treatment			Previous Surcharges To be Updated	
		T.S.S.	Cl_2	B.O.D.	T.S.S.	PO_4	T.S.S.	Cl_2
ABC Co.	3322	X			X	X		
D&E, Inc.	2865			X			X	X
Company F	7218	X		X	X	X		
Company G	3443	X			X			
Company H	2021	X		X				
I&J Co.	2011						X	X
Company K	2649				X		X	X
L-M-N, Inc.	2026	X	X	X	X	X		
Company O	3471	X				X		
Company P	3269	X			X			
Company Q	8062		X					
Company R	7395		X					
Company S	7218			X	X	X	X	X

X = new surcharge or updated surcharge required for that parameter

* Names are Fictitious.

Table 4-10

SEWER AUTHORITY
INDUSTRIAL WASTE SURVEY
SUMMARY OF INDUSTRIES FOUND IN VIOLATION OF SEWER ORDINANCES*

Industry	SIC Cat.	Violation of Existing Ordinance			Anticipated Violation of Proposed Ordinanc		
		G & O	Toxics	Misc.	G & O	Toxics	Misc.
Company A	2011	X		Solids	X		Solids
Company B	2011			Solids			Solids
C&D, Inc.	2013			Solids			Solids
Company D	2013	X			X		
E,F, &G Co.	2013	X			X		
H Products, Inc.	2013	X		Solids, pH	X		pH, Solids
Company I	2013			pH			pH
J&K Brothers	2021	X			X		
Company L	2022	X			X		
Company M	2024	X			X		
N-Z, Inc.	2026			Prohibited solids & debris			Prohibited solids & debris

*Names are fictitious.

TABLE 3-5

DISTRIBUTION OF SURVEYED TREATMENT PLANTS BY PLANT PROCESS

Source: Burns & Roe, 1975 (7)

PROCESS	NO. OF PLANTS	PERCENT OF TOTAL
Primary	79	29
Trickling Filter	81	30
Activated Sludge	83	31
Biological with Chemical Addition	8	3
Tertiary	11	4
Other	7	3

Of the 61 water quality components originally considered, a detailed study was made of 17 selected materials. The criteria for choosing these 17 materials was based on the availability and validity of the data and the assumed significance of the material. When using data for generalizations about plant performance, it is important to realize the potential limitations of that data. For the plant performance data to be presented later in this section, there are three such considerations:

Table 4-12

SEWER AUTHORITY INDUSTRIAL WASTE SURVEY
HEAVY METAL LOADING FROM MAJOR CONTRIBUTING INDUSTRIES
SAMPLED DURING PHASE II PROGRAM*

		Ace Wallpaper Co.	C-D-E, Inc.	Hometown Press	F&C Co.	Smith Laboratories	Company Z	Q-R Chemical Co.	Company X	Company Y	James Steel Co.	J-K, Inc.	Company W	Company V	M-N Foundry
SIC CATEGORY		2649	2653	2751	2761	2834	2851	2865	3231	3269	3312	3312	3315	3316	3321
AVG. DAILY FLOW MGD		0.057	0.068	0.014	0.1715	0.073	0.036	1.784	0.093	0.103	0.376	0.066	0.178	0.220	0.099
	Cr TOTAL			0.1918 0.0231					0.053 0.041				411.648 611.200		
	Cr HEX												295.583 438.800		
- AVERAGE POINT SOURCE LOAD - ppm/#/day	NI							0.333 5.510	0.074 0.575			.0500 .0275	5.524 8.200	.0190 .0359	0.041 0.034
	CU	0.642 0.305				0.0890 0.0541		2.333 38.600					86.156 127.900		
	As														
	HCN				0.0496 0.0710			0.375 6.200					3.637 5.400		
	CD		0.0240 0.0138										0.243 0.360		
	Pb				0.0576 0.0824					10.675 9.170	0.101 0.314	0.020 0.011	6.332 9.400		0.098 0.081
	Hg		.000399	.000400 .000048	.0048 .0069				.000386						
	Zn			.2764 .0334		0.404 0.246	.227 .068	0.683 11.30			0.081 0.251		11.317 16.800		0.119 0.098
	Fe	43.374 20.630	4.906 2.800	5.370 0.627	1.622 2.320		21.331 6.39	0.279 4.620	9.762 7.580	0.731 0.628	1.456 4.530	0.2440 0.1345	2375.178 3526.000	0.241 0.443	6.782 5.600
	MN						.040 .012						60.221 89.400		0.121 0.100

* Names are fictitious.

TABLE 3-6

CHARACTERIZATION OF PRIMARY AND BIOLOGICAL PLANT PERFORMANCE

	Primary Plants		Biological Plants	
Parameter*	Percent Removal (median)/(mean)	Effluent Concentration (median)/(mean)	Percent Removal (median)/(mean)	Effluent Concentration (median)/(mean)
Cd (μg/l)	7/8	11/14	9/19	10/30
Cr "	16/26	90/188	41/42	50/218
Pb "	20/24	110/156	41/38	60/92
Hg "	22/27	0.6/1.0	38/35	0.6/3.5
Cu "	18/26	110/191	56/56	50/113
Ni "	6/6	75/165	16/21	65/182
Zn "	26/31	300/550	52/52	160/277
Fe "	35/40	1300/1518	59/57	600/1827
Mn "	8/15	160/176	28/35	90/140
P-TOT (mg/l)	ID/13	10/13	32/34	6/7
TKN "	ID/22	ID/24	40/42	17/18
NH_3 "	17/20	13/20	37/45	12/14
PHEN (μg/l)	ID/38	ID/16	68/60	2.5/175
TOC (mg/l)	20/24	125/142	71/69	45/25
COD "	18/26	340/346	75/73	100/110
SS "	50/51	78/93	80/75	30/40
BOD "	28/30	140/167	85/81	28/39

Notes:

* Metal concentrations are for combined particulate and dissolved fractions

1. ID = Insufficient data reported.

Source: Burns & Roe, 1975 (7)

Statistical information on effluent concentrations and removal efficiencies for the 17 selected parameters is given in Tables 3-7 and 3-8, respectively for primary, trickling filter, and activated sludge plants. It was determined that a significant correlation exists between influent and effluent concentrations of 9 metals (Table 3-9).

Median and mean removal efficiencies have also been determined for a few modified biological and tertiary plants (Table 3-10). The tertiary plants consisted of conventional or modified activated sludge processes with polishing lagoons or filters as the final process unit. Chemical addition with biological treatment most often consisted of lime or polymer addition to the primary clarifiers followed by conventional activated sludge. For Cr, Pb, Hg, Ni, Zn, Total-phosphorus and TOC, better removal efficiencies were obtained with modified biological treatment than with tertiary treatment.

For the limited number of primary plants sampled for cyanide and hexavalent chromium, total pass-through was noted while for biological plants removals of 29% and 18%, respectively, were noted (Table 3-11). Better removal of oil and grease was noted in biological plants (68%) than in primary plants (48%).

Specific Studies of Pollutant Removals

The discharge of heavy metals was recently studied (8) at the Hyperion treatment plant, Los Angeles. This plant discharged a total of 350 mgd, about 235 mgd of which was primary effluent and 100 mgd was secondary (activated sludge) effluent. It was thus possible to compare the metal concentrations in primary and biological treatment effluents for the same influent. Unfortunately, influent concentrations of the materials were not presented so that actual pass-through percentages could not be evaluated. The results of this study indicated that in primary effluents, most of the Cd, Cr, Cu, Hg and Zn were associated with a particulate fraction, while in secondary treatment, which removed about 90 percent of

TABLE 3-7

EFFLUENT DATA SUMMARY FOR PRIMARY, TRICKLING FILTER AND ACTIVATED SLUDGE PLANTS (SELECTED PARAMETERS)

Parameter	Primary Plants				Trickling Filter Plants				Activated Sludge Plants			
	Mean	Standard Deviation	Max/ Min.	No. of Plants	Mean	Standard Deviation	Max/ Min.	No. of Plants	Mean	Standard Deviation	Max/ Min.	No. of Plants
Cd (µg/l)	14	9	40/3	35	11	10	66/1	41	50	277	1970/1	48
Cr "	188	406	2600/6	40	235	563	3200/3	52	202	515	2520/5	60
Pb "	156	272	1700/10	37	116	276	1800/5	45	67	68	350/3	51
Hg "	1.0	1.3	5.0/0.1	23	1.0	2.0	10.0/0.1	22	6.0	32	200/0.1	37
Cu "	191	278	1700/10	48	133	283	1800/3	54	92	195	1600/8	68
Ni "	165	387	1700/6	33	198	336	1533/7	38	165	387	1700/6	56
Zn "	550	658	3600/30	49	316	464	2800/40	57	238	257	1400/10	66
Fe "	1520	1020	5000/400	30	2910	11000	65600/100	34	747	1170	6800/100	37
Mn "	176	112	390/30	22	136	130	580/20	28	144	200	940/10	23
P-TOTAL (mg/l)	12.9	22	77/1.3	10	9.02	3.8	18.3/3.3	27	5.2	2.7	10.4/1.0	40
TKN "	24.4	11.6	47/8.5	-	16.8	11.9	47.8/1.2	21	19.0	9.6	34/1.5	12
NH_3 "	20.2	34.6	256/2.1	63	16.6	17.2	115/0.03	65	11.1	7.6	27.5/0.07	63
PHENOL (µg/l)	16	23	53/0.1	-	209	772	3000/0.03	13	135	473	2000/0.02	16
TOC (mg/l)	142	84.2	539/52	35	54.3	26.3	129/23	23	35.3	22.4	95.0/10	14
COD "	346	-	768/58	19	133	-	361/18	38	86	-	275/14	42
SS "	93	62	314/15	54	43	37	228/5	66	37	39	185/2	64
BOD "	167	111	650/20	58	48.6	47.3	245/4.0	61	28.3	40.7	230/2.0	65

Source: Burns & Roe, 1975 (7)

TABLE 3-8

REMOVAL DATA SUMMARY* FOR PRIMARY, TRICKLING FILTER AND ACTIVATED SLUDGE PLANTS (SELECTED PARAMETERS)

Parameter	Primary Plants				Trickling Filter Plants				Activated Sludge Plants			
	Mean	Standard Deviation	Max/ Min.	No. of Plants	Mean	Standard Deviation	Max/ Min.	No. of Plants	Mean	Standard Deviation	Max/ Min.	No. of Plants
Cd	8	17	76/0	31	20	25	75/0	35	17	27	88/0	44
Cr	26	26	80/0	36	37	30	99/0	48	46	34	98/0	54
Pb	24	26	88/0	34	37	31	93/0	41	39	32	95/0	49
Hg	27	29	75/0	21	30	23	67/0	20	39	32	99/0	34
Cu	26	24	77/0	44	54	24	95/0	49	57	24	95/0	63
Ni	6	18	92/0	28	21	23	86/0	32	20	21	80/0	44
Zn	31	22	88/0	38	46	22	89/0	52	58	25	99/0	58
Fe	40	22	89/0	27	50	26	90/0	30	63	27	98/8	35
Mn	15	20	81/0	16	31	23	72/0	21	38	32	93/0	19
P-TOTAL	13	8	24/0	7	26	22	99/0	24	42	25	92/0	36
TKN	22	20	60/0	7	50	27	94/7	20	34	26	92/5	11
NH_3	20	16	64/0	42	41	30	99/0	48	49	31	99/4	47
PHENOL	38	-	50/25	2	50	28	85/0	12	69	31	98/0	16
TOC	24	19	56/0	30	64	18	84/8	23	73	12	89/42	13
COD	26	-	82/0	18	71	-	95/34	36	75	-	94/24	40
SS	51	18	92/17	47	75	19	97/20	66	75	22	99/9	62
BOD	30	22	89/0	52	77	18	96/5	60	84	15	99/18	65

Notes:

* All numbers except the number of plants are in percentage

Source: Burns & Roe, 1975 (7)

*In a study to evaluate the effect of treatment plant variables upon the removal of metals from sewage, the investigator found that the effluent concentration was most dependent on the influent concentration. The actual correlation coeficients for this influent-effluent concentration relationship are presented in Table 3-9 for the 9 metals studied under 3 different types of sewage treatment.

TABLE 3-9

CORRELATION COEFFICIENTS: INFLUENT VS EFFLUENT CONCENTRATIONS

	CORRELATION COEFFICIENTS*			NO. OF
COMPONENT	Primary	Trickling Filter	Activated Sludge	PLANTS P/TF/AS
Cadmium	0.97	0.83	1.00	31/35/44
Chromium	0.98	0.81	0.84	36/48/54
Lead	0.58	0.67	0.77	34/41/49
Mercury	0.89	1.00	0.76	21/20/34
Copper	0.97	0.87	0.67	44/49/63
Nickel	0.94	0.69	1.00	28/32/49
Zinc	0.96	0.93	0.61	38/52/58
Iron	0.67	0.99	0.57	27/30/35
Manganese	0.92	0.85	0.95	16/21/19

Source: Burns & Roe, 1975 (7)

TABLE 3-10

REMOVAL IN BIOLOGICAL PLANTS WITH CHEMICAL ADDITION, AND TERTIARY PLANTS

	Biological w/Chem Addition		Tertiary	
	Median/ Mean	No. of Plants	Median/ Mean	No. of Plants
CD	0/0	4	0/6	5
CR	67/70	6	14/32	7
PB	38/39	6	31/44	10
HG	33/34	5	17/22	4
CU	80/75	5	79/73	9
NI	75/62	7	13/18	5
ZN	79/72	8	77/63	7
FE	84/84	3	94/82	8
MN	39/39	2	47/53	5
P-TOTAL	80/78	6	41/43	6
TKN	51/57	6	88/88	2
NH_3	45/56	5	89/80	9
PHENOL	82/82	2	85/65	4
TOC	79/79	3	75/74	3
COD	87/78	5	88/84	10
SS	83/78	8	93/90	11
BOD	93/86	6	95/90	11

Source: Burns & Roe, 1975 (7)

Table 3-11

REMOVAL AND EFFLUENT DATA SUMMARY FOR OIL AND GREASE, CYANIDE AND HEXAVALENT CHROMIUM

	Primary Plant (PP)				Biological Treatment Plants (BP)			
	Percent Removal		Effluent Concentration		Percent Removal		Effluent Concentration	
	Median/Mean	N	Median/Mean	N	Median/Mean	N	Median/Mean	N
O&G (mg/l)	52/48	6	25.0/27.8	6	83/68	13	9.0/21.0	25
CYN (mg/l)	0/0	1	0.055/0.075	4	3/29	14	0.010/3.672	28
HEX. CR. (μg/l)	0/0	3	20/17	3	0/18	19	10/15	20

Source: Burns & Roe, 1975 (7)

the particulates, the effluent contained mainly dissolved metals (Table 3-12). However, the remaining particulates in the secondary effluent were of small diameter in the range of 0.2 to 0.8μ and could thus bear higher fractions of trace metals per unit mass of particulate than could the larger primary effluent solids in the range of 44μ. In general, the total amount of each metal component constituted from 0.3 to 0.9 percent of the total dry weight of wastewater particulate matter and the trace metal composition of the particulates (primary and secondary effluents) generated from the Hyperion plant consisted as follows (in milligrams per kilogram, dry weight):

Hg	3
Mn	50 - 160
Cd	90 - 200
Pb	200 - 800
Ni	300 - 800
Cu	800 - 1,500
Cr	1,700 - 2,500
Zn	2,000 - 3,000
Fe	3,000 - 5,000

For primary or secondary treatment, the differences in the removal of particulates containing adsorbed metals will be reflected in the metal content of the sludge generated from either process.

<u>Polychlorinated Biphenyls (PCB's)</u>. These compounds, used mainly for electrical insulation, contain from 12 to 68 percent chlorine and are extremely stable and flame resistant. The refractory properties of these materials and the relatively high concentrations found in several aquatic environments suggest that sewerage systems may convey some amount of PCB's

TABLE 3-12

TRACE METAL REMOVAL EFFICIENCIES OF THE SECONDARY TREATMENT PROCESS AT HYPERION WASTEWATER TREATMENT PLANT, FROM CHEN ET AL (8)

	Sample	Total Concentrations			Dissolved Fractions*		
		Primary Effluent (µg/l)	Secondary Effluent (µg/l)	Reduction[±] (%)	Primary Effluent (µg/l)	Secondary Effluent (µg/l)	Reduction (%)
Suspended particulates	05	75[†]	5[†]	93			
	06	118[†]	7[†]	94			
Cd	05	10.4	7	30	3.0	5.7	-90
	06	28	10	64	2.7	9.0	-230
Cr	05	315	50	84	147	30	80
	06	300	60	80	100	47	53
Cu	05	102	15	85	25.5	10.7	58
	06	130	40	69	20	27	-35
Hg	05	0.5	0.16	68	0.13	0.07	46
	06	0.5	0.12	76	0.13	0.10	23
Ni	05	191	82	57	169	78	54
	06	200	150	25	153	140	10
Pb	05	98	56	43	69	49	29
	06	110	41	63	95	40	58
Zn	05	182	102	44	41	94	-130
	06	430	105	75	53	87	-64
Mn	05	38	26	31	23	25	-9
	06	32	24	25	27	23	15
Fe	05	457	58	87	196	40.6	80
	06	700	85	88	120	53	56

*Dissolved fractions are those remaining in filtrate after it is filtered through 0.2 µ membrane filters.

[†] Suspended particulate concentrations are in milligrams per liter.

[±] Reduction from primary effluent to secondary effluent.

to receiving waters. The U.S. EPA has issued waste disposal restrictions aimed at keeping PCB concentrations in aquatic environments below 0.001 μ g/l while FDA limits for edible fish is 5 ppm which may possibly be lowered to 2 ppm. Concentrations of 5 to 20 mg/l of PCB's have been measured in salmon and striped bass from Lake Ontario and the Hudson River (9). Of the 18 million kilograms of pcb's produced annually, it is estimated that 4.5 million kilograms are lost to the environment. The sources have been partly identified as being the sole U.S. manufacturer and various users of PCB's discharging directly to receiving waters or through the sewage systems of municipalities.

A study (10) of treatment plants in Wisconsin with flows ranging from 0.14 mgd showed effluent concentrations of PCB's to range from less than 0.05 μg/l to 42 μg/l with 6 of the 11 plants' effluents in the range of 0.1 to 0.5 μ g/l. At a 1 mgd trickling filter plant serving an industrialized area, about 70 percent removal of PCB's into sludge was noted with effluent concentrations ranging from 0.28 to 1.1 μ g/l. The industries in this municipality manufactured cement, metal work abrasives, paint, fiberglass, and electrical equipment. Average PCB effluent concentrations from a primary plant and an activated sludge plant of similar size (about 1 mgd) were 0.17 and 0.14 μ g/l, respectively, but no influent data was available to calculate removal percentages. A small, 0.14 mgd, trickling filter plant that received no industrial wastes discharged from 0.17 to 0.38 μ g/l of PCB's. Cleaning compounds, waxes, detergents and packaging material were cited as possible residential sources of PCB. The study concluded that secondary treatment could remove up to 70 percent of the influent PCB's.

3.4.2 Impact of Pollutants on Receiving Waters

A material introduced to an aquatic environment may have a singular effect on the physical, chemical, or biological components of a system, it may cause a succession of events, or it may have multiple effects on these components. For example, the discharge of suspended solids to a receiving water will decrease its clarity--a physical effect. By excluding a certain amount of light energy, the decreased clarity will affect the phototrophic community and such a shift in species distribution could alter the grazing habits of higher trophic levels--multiple biological effects. Furthermore, the suspended solids could provide surfaces for the adsorption of dissolved materials, such as heavy metals, and aid in their deposition to the sediments--a physical-chemical effect. The impact of a material will be a function of the receiving water's characteristics, as well as the general characteristics of that material. Initially, upon discharge of any substance to a receiving water, it will be subject to dilution and possibly volatilization, sedimentation, adsorption, precipitation, solubilization, chemical reaction and biological utilization.

The intended uses of waters that receive treated wastes must be defined in order to appropriately consider the impact of pollutants. Waters to be reused for drinking water supplies are of vital concern because of the obvious or suspected health-related consequences of ingesting even minute quantities of many compounds. As a result, much effort has been invested in developing criteria and recommending limits for a wide range of compounds in drinking water supplies. Waters used for fishing and shellfishing with the catch intended for human consumption pose a special problem. Numerous compounds, such as metals, pesticides, and pathogens, are known to magnify in some organisms to many times the dilute concentrations existent in their aquatic habitat. The mechanism can be either biomagnification--one organism such as a clam acting as a filter and retaining pollutants, or trophic accumulation--concentrating a material up the food chain as each higher trophic organism grazes its prey. The impact of pollutants on waters to be used for recreation,e.g., swimming and boating, is very often the most difficult to assess. In addition to the possibility of ingestion, a bather will be exposed to the effects of a given material due to skin contact and absorption through other bodily orifices. To date, most epidemiological studies of the recreational use of water have been inconclusive.

Presented herein are the impacts of materials that are likely to be present in industrial wastes. The physical and biological effects which have been observed for these materials are briefly described. Where possible, recommended concentration limits are given for receiving waters as proposed by the National Academy of Sciences, the U.S. EPA, or other regulatory agencies. Several of the more complex water quality components are discussed in the text while the remainder are tabulated for simple reference. An extensive review on the effects of contaminants on aquatic environments and man was conducted by the National Academy of Sciences (NAS). The resultant document, "Water Quality Criteria 1972," is a comprehensive reference on pollutants and their impact on all types of waters and intended uses (11).

Organic Material. Sewage treatment plants are designed specifically to remove some fraction of the influent organic materials. Organic, or carbonaceous, wastes consist of a variety of compounds, however, ranging from metabolic products such as carbohydrates, proteins, and fats to synthetic or refined chemicals such as pesticides and benzene derivatives. After their discharge to receiving waters, many of these compounds are susceptible to further decomposition and oxidation, thus imposing a demand on the oxygen resources of the water. As dissolved oxygen is consumed by biological or chemical reactions, numerous secondary effects may result in the aquatic environment. Conversely, some of the organic compounds resist decomposition and persist in toxic forms which may upset the biota of an aquatic environment and may even pose a threat to human health. There are several tests that are popularly performed to help quantify the above types of organic material. The results of these tests are commonly accepted as water quality parameters. These are the 5-day Biochemical Oxygen Demand

(BOD), Chemical Oxygen Demand (COD), Total Organic Carbon (TOC), and Carbon Adsorbable Organics (CCE and CAE; see page 3-40).

The BOD of a waste ideally measures the amount of oxygen consumed by heterotrophic organisms during the decomposition of an organic portion of this waste over a 5-day test period. For a domestic wastewater, about 1.5 pounds of oxygen are required per pound of organic matter metabolized, but this could vary considerably for many industrial carbonaceous wastes. Historically, the BOD test has been used to estimate acceptable loadings on a receiving water by consideration of assimilative (or recovery) mechanisms of the receiving water and prescribed limits of the minimum acceptable dissolved oxygen concentrations for intended uses of the water. The test can be deceptive, however, because the BOD resulting from a laboratory test will not necessarily represent natural conditions in a receiving water.

The COD of a waste measures all of the material that is subject to oxidation by both biological or chemical mechanisms. For many industrial wastes which may contain exotic and possibly toxic (to heterotrophs) organic compounds, the COD test will better represent the potential oxygen demand on receiving waters. The COD of a waste will be larger than the BOD and the additional oxygen demand reflected by this difference will be exercised at a slower rate in natural waters. Both BOD and COD are used to relate waste discharge to oxygen depletion in receiving waters, but universal limitations for these parameters cannot be stated because of the large variability of assimilative mechanisms in receiving waters.

The TOC of a waste measures the complete set of organic carbon compounds. Although the test is relatively simple and automated devices to perform it are marketed, it does not identify any specific organic fractions nor does it quantify an oxygen demand potential of a waste. However, it is possible that for some industrial wastes, correlations between TOC and more specific parameters can be developed and the test will thus have useful applications. The carbon adsorbable organics tests are slightly more descriptive. The Carbon Chloroform Extract test (CCE) measures those compounds that are adsorbed onto activated carbon and then are extracted by a chloroform washing. Many of the compounds measured by this test are potentially toxic or carcinogenic. The presence of substituted benzene compounds, kerosene, polycyclic hydrocarbons, phenylether, acrylonitrile and insecticides have been noted in CCE tests. A limit of 0.3 mg/l CCE in water supplies has been recommended by NAS and 0.7 mg/l by the U.S. EPA. The Carbon Alcohol Extract (CAE) test uses ethyl alcohol to desorb materials subsequent to the chloroform desorption procedure. Alkyl benzene sulfonate (ABS) among other compounds, has been noted to be present in CAE material. The NAS has recommended a limit of 1.5 mg CAE/l. Both the CAE and CCE may be particularly pertinent to many industrial wastes. Unless attempts are made to correlate CCE and CAE with specific compounds, the test should be considered a general measure of aesthetically or biologically undesirable compounds of unidentified organic structure.

Pesticides. It is likely that industries producing pesticides and herbicides will discharge some amount of these materials in waste streams. Among such materials are chlorinated hydrocarbons, organophosphorus compounds, and chlorophenoxy herbicides. Many of these compounds, particularly the insecticides, are extremely persistent in the environment and highly toxic to mammals. Furthermore, they are magnified in other organisms consumed by man. The herbicides are also toxic but generally at higher concentrations. Herbicides, if inadvertantly discharged to a receiving water, could kill the aquatic vegetation which upon decomposition could deplete the dissolved oxygen and upset other organisms

James River Closed to Fishing Because of Kepone Pass-Through at Sewage Treatment Plant of Hopewell, Va.

In addition to the digester upset described on page 3-15 the kepone-containing industrial waste caused the kepone to pass through the Hopewell sewage treatment plant for 16 months and contaminate the receiving waters--the best shad and oyster waters of Virginia's James River from Richmond to Tidewater, and perhaps other Chesapeake Bay tributaries as well.

Kepone, a toxic substance in all mammalian species and a suspect carcinogen, tends to persist for years in the environment and accumulate along the aquatic food chain. James River was closed to fishing in December, 1975, denying thousands of fishermen their only livelihood. The lost catch already runs into the millions of dollars, and the James River fishermen are suing for $27 million.*

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* New York Times, January 28, 1976.

in the water. Recommended safe limits on the concentration of pesticides in water have been derived from animal and a few limited human toxicity studies with safety factors of from 0.002 to 0.1 applied (Table 3-13).

Other Compounds. Table 3-14 gives the possible effects of 23 other compounds or elements that are likely to be discharged by industrial operations.

Table 3-13

RECOMMENDED (U.S. EPA) SAFE LIMITS FOR PESTICIDES IN DRINKING WATER SUPPLIES*

CHLORINATED HYDROCARBON INSECTICIDES	
Aldrin	0.001 mg/l
Chlordane	0.003
DDT	0.05
Dieldrin	0.001
Endrin	0.0005
Heptachlor	0.0001
Heptachlor Epoxide	0.0001
Lindane	0.005
Methoxychlor	1.0
Toxaphene	0.005
ORGANOPHOSPHATE AND CARBAMATE INSECTICIDES	
As Parathion	0.1 mg/l
CHLOROPHENOXY HERBICIDES	
2, 4-D	0.02 mg/l
2, 4, 5-TP (Silvex)	0.03
2, 4, 5-T	0.002

*National Academy of Sciences (1972) Water Quality Criteria

TABLE 3-14

POSSIBLE EFFECTS AND RECOMMENDED LIMITS FOR INDUSTRIAL WASTE COMPONENTS

COMPOUND	EFFECTS	RECOMMENDED LIMITS (mg/l) Drinking	Wildlife Support
Ammonia NH_3	1.Biological nutrient. Used by algae, vascular plants & microorganisms for growth. 2.Exerts an oxygen demand on receiving waters by reacting to form nitrate. 3.Interferes with Chlorination by the formation of chloramines. 4.Sometimes corrosive to copper. 5.Toxic in high concentrations.	0.5 (NAS)[1]	
Arsenic As	1.Toxic. Causes fatigue, gastrointestinal catarrh, kidney degeneration, tendency to edema, polyneuritis, liver cirrhosis, bone marrow injury, exfoliate dermatitis and possibly cancer.	0.05	
Cadmium Cd	1.Toxic. Accumulates in liver and kidney tissue. Causes the skeletal deforming Itai-itai disease. 2.Toxic to aquatic organisms, especially in soft water.	0.01	0.003[1]* 0.0004
Chromium Cr	1.Hexavalent chromium is toxic to humans. Can cause tumors, skin sensitization, and possibly intestinal disorders. 2.Toxic to aquatic organisms, causing inhibition of growth and death.	0.05	0.05[1]

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[1] National Academy of Sciences, 1972. Where reference notations are absent, limitations are from U.S. EPA, (40CFR51 March 14, 1975, p. 11994 Fed.Reg.)

*Higher value is for soft water.

TABLE 3-14 (Cont.)

COMPOUND	EFFECTS	RECOMMENDED LIMITS (mg/l)	
		Drinking	Wildlife Support
Copper Cu	1.Large doses can cause emesis and liver damage. 2.Imparts taste to drinking water. 3.Enhances corrosion of aluminum. 4.Toxic to aquatic life, especially algae and mollusks. Atlantic salmon will avoid a concentration of 0.004 mg/l. Tests suggest a concentration of 0.033 mg/l would be safe for flathead minnows.	1.0[1]	
Cyanide HCN	1.Toxic to fish and to humans in large (50-60 mg/l) doses.	0.2	0.005[1]
Iron Fe	1.Imparts taste to drinking water.	0.3[1]	
Lead Pb	1.Toxic to man, causing burning in the mouth, severe thirst, vomiting, diarrhea, anorexia, nausea, severe abdominal pain, paralysis, mental confusion, visual disturbances, anemia, and convulsions. Especially toxic to young children. 2.Toxic to fish, especially in soft water. The 96 hour LC50 often ranges from 1 to 7 mg/l. Possible chronic effects include reproductive and growth interference.	0.05	0.03[1]
Nickel Ni	1.Toxic to fish. Estimated safe concentration (for flathead minnows) is 0.1 mg/l.		

TABLE 3-14 (Cont.)

COMPOUND	EFFECTS	RECOMMENDED LIMITS (mg/l) Drinking	Wildlife Support
Nitrate NO_3 Nitrite NO_2	1.Biological nutrient. Can be especially significant in estuaries where nitrate has been estimated to be limiting. 2.Responsible for methemoglobinemia (hemoglobin alteration producing suffocation) in infants. 3.Possibly responsible for reactions occurring in the body to form carcinogens.	$10(NO_3)$ $1(NO_2)^1$	
Manganese Mn	1.Imparts taste to drinking water, stains laundered clothes, and forms deposits in distribution systems.	0.05^1	
Mercury	1.Toxic, especially as methyl mercury. Symptoms of acute toxicity are vomiting, abdominal pain, bloody diarrhea, kidney damage and death usually within 10 days. Chronic exposure causes inflamation of mouth and gums, swelling of salivary glands, excessive salivation, loosening of teeth, kidney damage, muscle tremors, spasms of extremities, personality changes, depression, irritability, and nervousness. 2.Can be biologically magnified by aquatic organisms thus increasing the toxic potential by human consumption. Magnification of 10,000 times have been measured in experiments with brook trout.	0.002	0.00005^{1*} 0.5 mg/kg

*Recommended concentration to avoid accumulation in an organism beyond the limit of 0.5 mg/kg which is the allowable total body burden in an organism intended for human consumption.

TABLE 3-14 (Cont.)

COMPOUND	EFFECTS	RECOMMENDED LIMITS (mg/l) Drinking	Wildlife Support
Oil and Grease	1.Cause taste, odor, and appearance problems. 2.Floating oil affects waterfowl by decreasing buoyancy, accelerating heat loss, and inhibiting egg hatching. 3.Can cause changes in benthic and shoreline communities. 4.Toxic to aquatic organisms. The 96 hour LC50 for various refined components of oil (e.g.: benzene, gasoline, bunker oil) ranges from 5.6 to 14,500 mg/l.	0^1	0^1
pH	1.Affects corrosion of metals 2.Affects biological processes, by direct toxicity or enhancing the effects of other compounds.		
PCB	1.Toxic to fish. The higher the percentage of chlorine, the lower the toxicity. LC50 values range from 10 to 300 mg/l. 2.Toxic to humans, causing skin lesions, increased liver enzyme activity, and Yusho disease. Suspected carcinogen.	0.001 μg/l*	
Phenolics	1.Imparts taste and odor to drinking water. 2.Affect the taste of fish consumed by humans.	0.001^1	0.1^1
Phosphate PO_4^{--}	1.Associated with eutrophication of waters. Can stimulate noxious plant growths. 2.Concentrations above 0.1 mg/l can affect coagulation of drinking waters.	**	**

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*Possibly a safe concentration.

**No universal limits can be determined.

TABLE 3-14 (Cont.)

COMPOUND	EFFECTS	RECOMMENDED LIMITS (mg/l) Drinking	Wildlife Support
Silver Ag	1.Causes a grey discoloration of the skin and eyes, and mucous membranes of humans.	0.05	
Sulfate SO_4^{--}	1.Laxative effect on humans. 2.Can impart taste.	250[1]	
Sulfide H_2S	1.Toxic, especially at low pH and low dissolved oxygen levels.		0.002[1]
Surfactants ABS,LAS	1.Produce unsightly masses of foam in streams or along shores of lakes. 2.Helps to disperse normally insoluble or sorbed substances, thus interferes with sedimentation. 3.High concentrations are toxic to humans (LAS at 700 mg/l). 4.Lethal to fish at concentrations of 0.2 to 10 mg/l (as LAS).	0.5[1]	0.2[1]
Zinc Zn	1.Imparts taste to drinking water. 2.Toxic to aquatic life. Toxicity is enhanced in soft water and in waters with low dissolved oxygen con. For flathead minnows, the 96-hour LC50 was 0.87 mg/l in soft water and 33 mg/l in hard water.	5[1]	

Note: The following discussion on sludge disposal is limited, for the scope of pretreatment, to the contamination of sludge by toxic pollutants. Consideration of the potential benefits of land utilization of sludge are not discussed.

3.5 POLLUTANTS WHICH AFFECT SLUDGE DISPOSAL

3.5.1 Introduction

The type and quantity of industrial discharges and the degree to which industrial pretreatment is practiced will directly influence the characteristics of POTW sludges. On the basis of POTW sludge character, two extreme sludge types are likely. The first type results when an industry discharges mostly compatible type wastes to a municipal sewage treatment plant. In this case the resulting POTW sludge resembles a typical domestic sludge. There is within this domestic type sludge a range of sludge compositions extending from those with low to those with high industrial character. A second type of POTW sludge, predominantly an industrial-like sludge, results when an industrial waste constitutes either the major portion of the total POTW waste, e.g., pulp industry waste, or contributes a high portion of a specific chemical category, e.g., metals. In addition, industrial sludges are also generated directly by industries that extensively pretreat their wastewater before discharge to POTWs. The route of formation of these two extreme sludge types are depicted in Figure 3-1.

3.5.2 Sludge Composition

The composition of two Type 1 POTW sludges, one with low and one with high industrial character is shown in Table 3-15. It is the metal content of sludges that frequently can be used to distinguish its industrial nature. The sludge (Blue Plains) with low metal character originates from Washington, D.C., a city known to be predominantly residential in composition. The sludge (Lawndale) with high metal content originates in Chicago, a city with much higher industrial character. The Blue Plains sludge, for example, contains only 1/5th the amount of zinc and nickel and 1/30th the cadmium content of the Chicago sludge. It is important to recognize, however, that even in the case of a municipality where sewers service predominantly domestic users, the

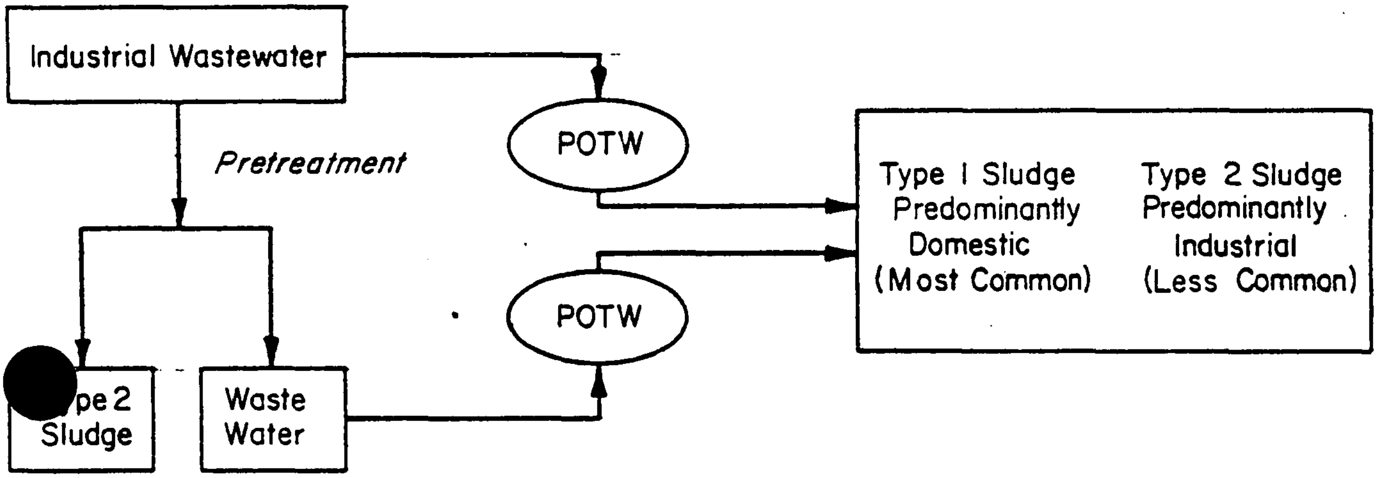

Figure 3-1

ROUTES OF FORMATION OF TWO DIFFERENT SLUDGE TYPES

TABLE 3-15

CHEMICAL COMPOSITION OF LOW AND HIGH METAL SLUDGE (12)

	CONCENTRATION, ppm	
ELEMENT	BLUE PLAINS, WASHINGTON, DC	LAWNDALE, CHICAGO
N	25,000	18,250
P	10,000	35,300
K	5,000	1,855
Ca	15,000	51,000
Mg	10,000	12,550
S	9,000	7,600
Zn	2,000	10,325
Cu	1,100	2,915
Mn	180	340
Ni	100	500
Cd	20	655
Cr	NA[a]	4,980
Mo	8	NA
Fe	NA	39,950
B	23	NA
Hg	NA	3.5

a. NA = Not Available

presence of combined storm and sanitary sewers may permit the entry of significant quantities of certain metals into the sewage system and ultimately into the sludge. The much higher metal content of the Chicago sludge is most likely due to industrial discharges.

Two general types of industrial chemicals can contaminate POTW sludges. These are inorganic chemicals, such as the heavy metals, and organics which do not biodegrade during the treatment process.

Metals. A large fraction of heavy metals in wastewater effluents and surface runoff is known to be associated with suspended solids (13). Because a higher efficiency of suspended solids removal is a characteristic of secondary treatment processes (compared to primary treatment processes) differences in metal content of respective sludges can be expected. Chen et al (13), reported that when secondary treatment removed 90 to 95% of the suspended solids, from 70 to 85% of the chromium, copper and mercury and from 30 to 60% of the total cadmium, nickel, lead and zinc were also removed and incorporated into the POTW sludge. Thus metals removed from wastewater appear to be strongly coupled to the suspended solids removal capability of the treatment plant.

Organic Chemicals. Organic chemicals which are non or slowly biodegradable may be concentrated in treatment plant sludges. Specific information as to type of organic chemicals and the degree to which they concentrate in sludges is sparse. The most likely mechanism for concentration into sludge is a result of a specific organic compound's capacity to adsorb onto wastewater solids (14).

The concept that removal efficiency of organics by wastewater treatment sludges is related to the suspended solids removal capability of the POTW was clearly demonstrated by the work of Ganz et al (14). The removal by wastewater treatment of fluorescent whitening agents (FWAs) (used in household detergents to improve the visual appearance of laundered fabrics) was studied and found to be directly related to the POTW's suspended solids removal capability.

Industrial contribution of dyes, inks, paint pigments, polychlorinated biphenyls (PCBs) and pesticides are likely to be found in sludge. This also results from their dual properties of adsorptivity as well as resistance to biological degradation.

Industrial sludges generated as a result of pretreatment will be highly industry specific. Generally these sludges will not contain significant quantities of pathogens, and will consist predominantly of either inorganic or exotic organic chemical sludges. Lime sludges containing heavy metal hydroxides are a very common industrial type of inorganic sludge.

3.5.3 Sludge Disposal Options

Municipal wastewater sludges are presently disposed of by the following methods. The frequency of use of each disposal option is listed in parentheses: (15)

1) Land spreading of liquid and dewatered sludges	(20%)
2) Lagooning and landfilling	(40%)
3) Incineration and landfill of ash	(25%)
4) Ocean dumping	(15%)
5) Fertilizer by-product recovery	(1%)

The popularity of landfilling is due to several factors which include cost-effectiveness, availability of land and lack of strong environmental requirements governing the practice. However, the trends in sludge disposal practices are subject to rapid change and appear to be influenced by a very complex set of economic, environmental, and institutional factors. For example, the United States EPA has

Problem of Kepone-Containing Sludge at Hopewell, Virginia

The admittance of Kepone-containing industrial waste into the POTW of Hopewell, Virginia, described on page 3-15 also created a sludge disposal problem. The lagooned sludge was found to contain 200 to 600 ppm of Kepone with 3 to 5% solids*, and was deemed unsuitable for land disposal as practiced before the Kepone contamination**. Solution to this problem might involve chemical fixation of lagoon sludge followed by burial or incineration*.

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*EPA fact sheet on Kepone, 1-9-76 (Office of Water Planning and Standards, Washington, D.C.)

**Personal communication with William R. Havens, Superintendent of Hopewell sewage treatment plant.

Stated its intention to completely phase out ocean dumping of sewage sludge by 1981 provided that acceptable land based disposal methods can be substituted.

[redacted]

The incineration option on the other hand has come under strong local disapproval as a result of escalating costs of fuel and the concern for effects of air pollution. Land spreading practices are dependent on local attitudes concerning land use as well as concern about dissemination of toxic metals and pathogens. Landfilling appears, for the moment at least, to have escaped careful environmental scrutiny. However, substantial adverse environmental impacts are likely in all but the most rare of landfills and this disposal option will probably become less available.

3.5.4 Impacts of Industrial Waste Discharges on Sludge Disposal Options*

Table 3-16 presents an overview of available sludge disposal options and qualitatively describe the environmental problems associated with each. A more detailed discussion of how specific industrial chemicals affect each disposal option is presented in the following section.

Land Spreading

One criterion (which has been used) for determining sludge loading rates was based on an early recommendation of the Agricultural Research

* Note: The following discussion is also relevant for non-industrial sources of pollutants (e.g. urban runoff in a combined sewer system) however this is beyond the scope of pretreatment.

Table 3-16

IMPACT OF INDUSTRIAL CHEMICALS ON POTW SLUDGE DISPOSAL OPTIONS

Municipal Sludge Disposal Option	Major Environmental Concerns	Specific Abatement Procedures	Longrange Planning and Regulatory Response
Landspreading	Metal content of sludge may injure or contaminate crops Toxicants may enter the agricultural food chain.	Adjust sludge loading rates to provide safe limits.	Establish acceptable sludge metal levels. Enforce industrial pretreatment for selected problem metals. Establish a program for maintenance of records on sludge compositions, loadings rates, etc.
Lagooning and Landfill	Metals and organics in leachates may contaminate ground and surface waters.	Protect groundwater at landfill site from contamination, e.g. Use of liners cover materials underdrainage system chemical fixation	Establish selection procedures for landfill sites. Establish Landfill Management Program.
Incineration and Landfill	Air emissions may cause pollution, e.g. metals such as mercury; Leachate generation from disposal of ash may cause water pollution.	Install Air pollution emission controls. Protect ground water as described under Landfill.	Plan to use incineration for distraction of toxic or nonbiodegradable organics if locally a problem. Upgrade air pollution control.
Ocean Dumping	Metals and organics in sludges may destroy biological productivity. Toxicants such as metals and pesticides may enter food chain.	[redacted] Regulations and Criteria 40 CFR 220-227.	Possible future phase out of this disposal option.
Resource Recovery Composts and Fertilizers	Metals and toxic organisms may contaminate product.	None	Reduce toxic components by pretreatment.

Service, U.S. Department of Agriculture and is shown below. This formula illustrates how the metal content of sludge functions as a limit to the amount of sludge that may be applied:*

$$\text{Total sludge (dry weight tons/acre)} = \frac{32{,}700 \times \text{CEC}}{\text{ppm Zn} + 2(\text{ppm Cu}) + 4(\text{ppm Ni}) - 200}, \text{ where}$$

CEC = Cation exchange capacity of the unsludged soil in meq./100 g.

ppm = mg/kg dry weight of sludge

This equation limits the heavy metal additions calculated as zinc equivalents to 10 percent of the CEC. The zinc equivalent takes into account the greater plant toxicity of copper and nickel.

It has been generally recommended that sludges having a cadmium content greater than 1 percent of its zinc content should not be applied to cropland except under the following conditions:

1. There is an abatement program to reduce the quantities of cadmium in the sludge to an acceptable level
2. The project is reviewed by the U.S. Department of Agriculture and the Food & Drug administration

Chaney (16) has <u>conservatively</u> proposed a metal content of a sludge appropriate for land application;*

Element	Content
Zn	2000 ppm
Cu	800 ppm
Ni	100 ppm
Cd	0.5% of Zn
B	100 ppm
Pb	1000 ppm
Hg	15 ppm

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* Note: Each of these formulations is based upon protection of plants from toxic effects. Human health effects from eating crops to which sludge has been applied have not been taken into account. From this point of view Cheney's criteria are conservative in protecting crops; the criteria may not be conservative enough to protect humans. —

Cheney's formulation is presented here to serve primarily as a point of reference for later calculations (See Table 3-19). These proposed limits have been developed to protect plants and reduce uptake of metals. It is not known what margins, if any, exist between current levels of heavy metals in the diet and those which may result in adverse human health effects. It must be insured that not only are cropland resources protected but also that harmful contaminants are not accumulated in the food chain.

Landfill

In order to contribute to leachate, heavy metals must be soluble. Soluble forms may exist as cations, soluble inorganic complexes, organic chelates and anions. The decomposition of sludge in soil can create two conditions in which metals are solubilized. Solubilization results from both the formation of organic chelates and from reducing conditions in the soil environment. Quantitative estimations of the degree of movement of metals in soil are dependent on a large number of complex factors. When soils are highly aerobic and have even a low clay content, metals will precipitate or bind to soil as a function of the soils cation exchange ability.

Leachate containing materials can contaminate surface waters as well as aquifers. If landfills are located in recharge areas, contamination of aquifers is possible. Data on the reactivity of individual metals is seen in Table 3-17.

Incineration

Volatile Organics

Such volatile organics as pesticides and polychlorinated biphenyls are known to accumulate in human and aquatic organisms. The concentrations of these substances in emissions from sludge incinerators will depend on the efficiency of operation. During "normal" operations, pesticides and PCBs will be destroyed in multiple - hearth and fluidized bed incinerators. New source performance standards for sludge incinerators ~~is~~ are contained in 40 CFR 60.

TABLE 3-17

REACTION OF METALS IN AQUIFERS (17)

Vanadium - occurs in cationic and anionic form. In the cationic form, with the usual prevailing groundwater conditions, the minimum solubility is about 1 ug/l. The anionic form is slightly more soluble.

Chromium - the trivalent and hexavalent cations can exist in groundwater at pH values of 8.0 to 9.5. The solubility of the cationic species in uncontaminated water is about 0.5 g/l. At pH values of less than 8, the complex cation $CrOH^{+2}$ predominates. Anionic forms of chromium are stable in groundwater, but occur as a result of contamination, not naturally, and may reach higher concentrations.

Manganese - is present in most soils and rocks and thus finds its way into groundwater. Although manganese is not usually a major heavy metal in sewage sludge (it could be in an industrial sludge), leachate and plant uptake data indicate that application of sludge releases manganese into percolating water and soil solution (Braids 1975, Hinesly 1974). The concentration of manganese is usually less than iron. In the pH range of most groundwater, manganese occurs as the Mn^{+2} ion at a concentration of as much as 1 mg/l.

Iron - is an ubiquitous component of soils, sediments, and rocks. Its most common form in groundwater is ferrous ion Fe^{+2}. Iron solubility is sensitive to the Eh/pH conditions and it can dissolve or precipitate rapidly. Iron contained in recharge water will quickly react to the conditions encountered in the groundwater. The occurrence of up to 10 mg/l in groundwater is common.

Cobalt - occurs in low concentrations in soils, but in most places is taken up by plants in sufficient quantity to meet the requirements for animal nutrition. In groundwater, it probably occurs as the Co^{+2} cation. Cobalt easily forms complexes with organic compounds, and also forms a number of complex ions. The natural concentration amounts to a few micrograms per liter.

Nickel - behaves much like cobalt, and occurs naturally as the Ni^{+2} species. Generally nickel species are more soluble than cobalt, therefore slightly more nickel may be expected in groundwater.

Copper - solubility is limited by cupric oxide or hydroxy-carbonate minerals to about 64 ug/l. Copper may

TABLE 3-17

REACTION OF METALS IN AQUIFERS (17)...CONTINUED

occur in higher concentrations in acid mine drainage areas or in highly mineralized areas.

Zinc - is seldom present in natural waters at concentrations which would be in equilibrium with hydroxide or carbonate minerals. Waters have been found with concentrations of several hundred mg/l. It is among the most concentrated of heavy metals in sludge, and is a primary candidate for a basis for limiting sludge application to land. It could remain in solution after percolating to groundwater to the extent of several hundred micrograms per liter.

Molybdenum - can exist in several valence states and as polymeric hydroxide anion species. It is relatively rare in nature and in sludges and probably seldom exceeds a few micrograms per liter in natural groundwater.

Silver - oxide and chloride salts have low solubility. Furthermore, metallic silver is stable at the usual Eh ranges in groundwater. As a result, silver ion in solution generally amounts to less than 1 ug/l. It is unlikely to reach groundwater from land application of sludge.

Cadmium - occurs in trace amounts naturally. It is toxic and could be a problem if sludge source contained a large quantity. It should be a primary candidate for a basis for limiting sludge application to land.

Mercury - is usually not detectable in groundwater. It is of most concern in surface waters where methylation of mercury in sediments renders it soluble and available for adsorption by fish.

Lead - in natural groundwater is rarely above trace concentrations. Dissolution from plumbing and dissemination by alkyl leads added to gasoline contribute to sewage sludge. Soils retain lead quite strongly, reducing its probability of reaching groundwater.

Boron - occurs naturally as the anion H_2BO^{-3}. Because borate salts are soluble, after mixing with groundwater, boron is likely to remain in solution.

Arsenic - occurs naturally as the arsenate species H_2AsO^{-4} and $HAsO_4^{-2}$ in the pH range of most groundwater. Most heavy metal arsenates are only slightly soluble and would control the solubility to a few tenths of a milligram

TABLE 3-17

REACTION OF METALS IN AQUIFERS (17)...CONTINUED

per liter. Arsenates also form complexes with hydrous iron oxides which have very low solubilities.

Selenium - chemically resembles sulfur, but is much less common in nature. Some soils are high in selenium and drainage water from irrigated seleniferous soil contains as much as 1 mg/l. It occurs in the anionic selenate SO_3^{-2} form. Selenium is a common contaminant in landfill leachate where paper and inks are source materials. Certain industrial sludges may also have relatively high selenium concentrations.

Metals

EPA has published proposed Amendments to National Emission Standards which would limit mercury emission from incinerators to a maximum of 3200 grams per day (40 CFR 61).

Ocean Dumping

Criteria which restrict the concentrations of certain constituents in materials to be dumped in the ocean were promulgated by the U.S. EPA on October 15, 1973. (See Table 3-18) These criteria were based on the assumption that proper mixing of sludge dumped into sea water will result in concentrations (in the mixing zone) which will not be higher than background levels. (In general, municipal sludge cannot meet these criteria.)

3.5.5 Determination of Metal Content of Sludges and Estimation of the Impact of an Industrial Metal Discharger on Sludge Quality

For existing systems a direct chemical analysis of POTW sludges will establish their metal composition. This end of the line approach generally does not permit sewer dischargers to be qualitatively or quantitatively identified.

It is, however, possible to make better than an order of magnitude approximation of an industry's contribution of metals to sludge by knowing the industrial flow rate and metal concentration and by assuming a specific metal removal efficiency of the POTW as reported by Chen, et al (13).

This approach is illustrated by Table 3-19. This sample calculation shows that a single discharger's impact on sludge quality decreases as the size of the POTW increases. Conversely, as the industrial discharge increases, the metal content of the sludge increases.

Using such calculation it should be possible to determine the percentage of the total POTW sludge metals contributed by individual industries. Pretreatment or a surcharge could be employed by a municipality to remedy a situation in which an individual contributor is significantly contaminat-

TABLE 3-18

MATERIALS PROHIBITED FROM OCEAN DUMPING IN OTHER THAN ALLOWABLE QUANTITIES (18)

Constituent	Allowable level of concentration
Material which may float or remain in suspension	None allowed
Mercury	Solid phase less than 0.75 mg/kg - Liquid phase less than 1.5 mg/kg
Cadmium	Solid phase less than 0.6 mg/kg - Liquid phase less than 3.0 mg/kg
Organohalogens (or compounds which may form organohalogens in the marine environment)	Must not exceed: (a) (After mixing) 0.01 of a concentration shown to be toxic to appropriate sensitive marine organisms as determined by an EPA approved bioassay. (b) 0.01 of a concentration otherwise shown to be detrimental to the marine environment.
Living organisms	Must not: (a) Extend range of biological pests, viruses, pathogens or other agents capable of infesting, infecting or altering the normal populations of organisms. (b) Degrade uninfected areas. (c) Introduce viable species indigenous to the area.

TABLE 3-19

SAMPLE CALCULATIONS SHOWING THE RELATIONSHIP BETWEEN POTW SIZE, INDUSTRIAL METAL DISCHARGES AND THE RESULTING METAL CONTENT OF SLUDGE

Secondary Treatment Plant Size (mgd)	0.5	5.0	20
Sludge Generated (dry tons/day)	0.25	2.5	10
(lb/day)	500	5000	20,000

Industrial Discharges
(assume a metal concentration of 10 mg/l md 50% removal by POTW sludge)

Industrial Flow (gal/day)	PPM (metal in sludge)		
10,000	837	84	21
50,000	4185	419	105
100,000	8770	840	210

MUNICIPAL AND INDUSTRIAL DISCHARGES

MUST COMPLY WITH THE OCEAN DUMPING CRITERIA 40 CFR 227 ing the POTW sludge.

3.5.6 Planning Implications for Sludge Disposal

The pollutional impact of industrial wastes on municipal sludge disposal has been discussed. Associated with pollutional impacts are economic impacts which arise as a result of several factors. First, industrial discharges may increase the quantity of POTW sludge generated in a manner which is not reflected in the industry as flow, BOD or suspended solids contribution; e.g., a nonbiodegradable, dissolved solid. In such situations the industrial dischargers are not contributing equitably to POTW sludge disposal costs. Second, an industrial discharger may contaminate municipal sludges to a degree where certain disposal options are eliminated and only more costly options are available.

Areawide management planning agencies should be cognizant of such potential economic disparities and could aid municipalities to achieve an equitable solution. Another planning function that would be particularly critical to areawide sludge management has to do with the quantity and quality of industrial sludges generated as a result of pretreatment. Because of the potential toxic nature of these sludges, disposal sites and methods will have to be carefully evaluated. Such techniques as secure landfill in which liners, cover materials or chemical fixation are employed to minimize leachate generation may have to be adopted. Possible management procedures are listed in Table 3-20.

Table 3-20

WQM(208) AREAWIDE PLANNING - PRETREATMENT AND MUNICIPAL SLUDGE MANAGEMENT

	Pretreatment Sludge Issue	(208)Planning and Management
1.	Increased POTW sludge generation as a result of industrial discharges.	Insure that industries are paying their fair share to municipalities for sludge disposal.
2.	Contamination of POTW sludge with toxicants, e.g. metals, due to a lack of pretreatment on the part of industry.	Aid municipality in setting acceptable levels of toxicants in sludge. Amend sewer use ordinances to contain appropriate ~~standards~~ requirements.
3.	Generation of Industrial sludges as a result of pretreatment.	Management of industrial sludge disposal practices is necessary in order to avoid surface and ground water pollution. An areawide secure landfill site should be evaluated to minimize multiple sludge dumping sites. Additional management practices may include sludge segregation for future resource recovery or supplementary pollution control efforts.

3.6 DETERMINATION OF PRETREATMENT REQUIREMENTS

3.6.1 Federal Pretreatment Standards

The Federal pretreatment standards have been described and discussed in Section 1.2.4, and those already promulgated or proposed have been summarized in Appendix A. These standards have been established on an industry-by-industry basis.

At present, most of the numerical limitations in these standards are in terms of mass, e.g., pounds per unit weight of product or unit area of operation, rather than concentration limitations. In view of the difficulties involved in the application of mass limitations, it is ~~likely~~ possible that EITHER mass OR concentration limitations OR BOTH might be used in the future.

3.6.2 Local Pretreatment Requirements

Industrial water pollution problems are generally site-specific, and industrial waste pretreatment programs usually require a high degree of familiarity with the specific POTW system, its contributing industries, and the particular problems caused by their wastes. Therefore, effective pretreatment programs will best be developed and administered at the local level, and the primary responsibilities will be borne by either areawide or Statewide planning agencies. In designated areas in which pretreatment problems exist, areawide planning agencies will be responsibile for the establishment of local pretreatment requirements and the overall design of industrial user control programs. In non-designated areas, where the State acts as 208 planning agency, municipalities may play a greater role in establishing local pretreatment requirements and the overall industrial user control programs.

Technically speaking, the basis for establishing local pretreatment requirements consists of the following considerations:

1) Elimination of industrial pollutants which damage wastewater collection works;

2) Control of industrial pollutants which interfere with biological treatment processes;

3) Control of industrial pollutants which pass through treatment works and adversely affect receiving waters;

4) Control of industrial pollutants which affect sludge disposal.

The general guidelines and technical information have been presented in Sections 3.2, 3.3, 3.4, and 3.5 for these considerations. If these considerations cannot be fulfilled by applying Federal pretreatment standards to the industrial sewer users, then more stringent local pretreatment requirements may be needed to achieve the goals of industrial wastes management. For a specific industrial pollutant, it is conceivable that the more stringent local pretreatment requirement may be dictated by one of the above considerations, and sample calcualtions will be shown in the next section to illustrate the determination of limiting concentrations.

3.6.3 Sample Calculations

As indicated in Section 3.6.2, the more stringent local pretreatment requirements may be dictated by different considerations. In general, those industrial pollutants which affect wastewater collection works are classified as prohibited wastes, and are not allowed to be discharged into the POTW. Therefore, the permissible concentration of a specific pollutant in the treatment plant influent will primarily depend on its impact upon:

1) treatment process upset;

2) pollutant pass through;

3) sludge disposal;

Different permissible influent concentrations may be calculated for each specific pollutant of concern, and the lowest concentration thus calculated will become the basis for the determination of industrial pretreatment for each industrial discharger.

This general approach is illustrated in the following paragraphs by conducting calculations on a specific industrial pollutant, copper. The treatment plant is assumed to employ activated sludge and anaerobic digestion processes, and the digested sludge will be disposed by land spreading. Technical data compiled in Sections 3.2, 3.3, 3.4 and 3.5 are used in these calculations, and appropriate assumptions are also made as needed.

Treatment Process Upsets

1. Activated Sludge Process

According to Table 3-1, the threshold concentration of copper for activated sludge is 1 mg/l. If 26% of the incoming copper is removed by primary treatment, then the permissible copper concentration in the influent to the treatment plant is:

$$\frac{1 \text{ mg/l Cu}}{(1-0.26)} = 1.35 \text{ mg/l Cu} = W$$

2. Anaerobic Digestion Process

According to Table 3-1, the threshold concentration of copper for anaerobic digestion is 1.0 to 10 mg/l, suppose 5 mg/l Cu is used for this illustrative calculation. Assume that 6,900 gallons of primary and secondary sludges are generated per million gallons of wastewater(19), and 57% of copper is removed by activated sludge plants in the sludges, then the permissible copper concentration in the influent to the treatment plant is:

$$5 \frac{\text{mg Cu}}{\text{l sludge}} \times \frac{6,900}{1,000,000} \times \frac{1}{0.57} = 0.06 \text{ mg/l} \quad \text{Cu} = X$$

Pollutant Pass Through

If NPDES permit of the treatment plant requires a copper concentration of 1 mg/l not to be exceeded in the POTW effluent, and 43% of incoming copper will pass through activated sludge plants (i.e., 57% removed), then the permissible copper concentration in the influent to the treatment plant is equal to:

$$\frac{1 \text{ mg/l}}{0.43} = 2.33 \text{ mg/l} \quad \text{Cu} = Y$$

Sludge Disposal

According to Section 3.5, the copper content of sludge has been suggested not to exceed 800 ppm for satisfactory land spreading. Assume that the digested sludge is generated at a rate of 1,400 pounds of dry solids per million gallons of wastewater(19) and 57% of copper in the wastewater is removed by the activated sludge plant in the form of sludge, then the amount of Cu in sludge is:

$$1400 \frac{\text{lbs dry solids}}{\text{MG wastewater}} \times \frac{800 \text{ lbs Cu}}{1{,}000{,}000 \text{ lbs dry solids}} = 1.12 \frac{\text{lbs Cu}}{\text{MG}}$$

The permissible copper concentration in the influent to the treatment plant is equal to:

$$1.12 \frac{\text{lbs Cu}}{\text{MG}} \div 0.57 \times \frac{1 \text{ mg/l}}{8.34 \text{ lb/MG}} = 0.24 \text{ mg/l} \quad \text{Cu} = Z$$

As shown above, the permissible copper concentration in the influent to the treatment plant have been calculated and designated as W, X, Y and Z. These numerical values may be summarized as follows:

Treatment Process Upsets:

1. Activated Sludge Process W = 1.35 mg/l Cu
2. Anaerobic Digestion Process X = 0.06 mg/l Cu

Pollutant Pass Through Y = 2.33 mg/l Cu

Sludge Disposal Z = 0.24 mg/l Cu

A comparison of these results shows that the lowest and thus limiting concentration of copper permissible in the influent to the treatment plant is X, 0.06 mg/l, which is based upon the toxic effect of copper to the anaerobic digestion process. Any further consideration of pretreatment requirement on copper-containing industrial wastes will have to be controlled by a permissible influent copper concentration of 0.06 mg/l.

Following the establishment of the permissible influent concentration, the next logical question leads to the determination of the maximum concentration allowable in an industrial discharge. In general, many factors to be considered in such a determination are site-specific, including most importantly:

1) The ratio of total wastewater discharge to the industrial wastewater discharge containing the specific pollutant;
2) The ratio of maximum to average concentration in industrial wastewater containing the specific pollutant;
3) The fraction of the influent concentration discharged by non-industrial sources, i.e., the fraction which cannot be controlled by industrial pretreatment.

The information on these key factors should be obtained through industrial waste surveys and an understanding of the specific sewerage system receiving the industrial wastes discharge.

3.6.4 Pilot Testing

Although substantial technical data have been presented in previous sections as a result of literature searches for the purpose of determining pretreatment requirements, it should be pointed out that pilot testing, if possible, may frequently prove to be necessary and/or beneficial under certain circumstances. Primarily, the purpose of pilot testing is to remedy the inadequacy of the technical information available in literature, a situation which is not uncommon in the field of industrial waste management.

Many factors contribute to the complex nature of industrial wastes. A large number of industries exist, and even within the same industry different processes may be selected for manufacturing the same product and producing distinctly different wastes. Many constitutents of industrial wastes may have never been found in nature, and thus may be toxic to organisms or resistant to biochemical decomposition. Furthermore, because of technological development, a large number of new compounds of ever-changing variety are and will be added to the industrial waste stream yearly. On the other hand, the sensitivity of biological treatment processes to the effects of various toxic waste constituents may be quite flexible, depending on various operational conditions. For instance, some toxic organic substances such as phenol and formaldehyde can be almost completely removed from wastewaters by biological treatment if the biological population responsible for the treatment process have been given time to acclimate properly. For practical purposes, the limits of biological treatment are not predictable on general grounds, but must be determined experimentally.

Much of the quantitative information in sections 3.3.3 and 3.3.4 ~~have~~ has been derived from laboratory experiments with batch and/or continuous-flow reactors, designed to study the effects of the specific compounds or elements of concern. While this is a convenient scheme for experimentation and the most common source of information on toxic pollutants, extreme care has to be undertaken in extrapolating the experimental results from the laboratory to full-scale treatment plants. Outlined below are some key considerations:

1) Effect of acclimation;
2) Presence or absence of other waste constituents which may have synergistic or antagonistic effects;
3) Accuracy of the simulation of full-scale facilities by laboratory experiments;
4) Changes in environmental conditions such as effect of temperature on treatment performance, laboratory experiments are frequently conducted at the convenient room temperature.

Actual monitoring and testing at existing treatment facilities would provide the most reliable information but, unfortunately, such information is rare for the toxic effects of industrial wastes. Furthermore, considering the complicating factors discussed above, much caution should be used in extrapolating data from one treatment plant to another. In determining industrial pretreatment requirements, each POTW should be studied by pilot testing on a case-by-case basis. This preferred approach, however, will usually be infeasible because of technical and/or economic constraints, so the information contained in this section can be used as general guidelines.

As to the technical manpower needed, such pilot testing, ideally, should be carried out by the treatment plant operators or other technical personnel of the regulatory authority for the POTW. The pilot testing may also be conducted in conjunction with industrial waste survey by qualified consultants.

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Chapter 4

CASE STUDIES

4.1 INTRODUCTION

To enhance the use of this manual, three examples of actual ongoing industrial wastes programs are presented here. The purpose of these case studies is to provide guidance for establishing pretreatment programs and to highlight particular problems and issues which may be encountered. They are chosen on the basis of geography, demography, types of industries and types of treatment facilities within the area. The actual manual (chapters 1, 2, 3) and the case studies are designed to be used together to provide both specific and general guidelines for planning and managing an industrial pretreatment program.

4.2 CASE STUDY I

4.2.1 Introduction

This case study emphasizes some of the major issues involved in developing industrial waste programs. Although the planning agency discussed here has not completed an industrial waste survey, it has encountered several issues relating to pretreatment while developing its project control plan. The descriptive sections of this study concern the agency's overall industrial program and some completed work. The second half is an analysis of the issues facing this agency.

4.2.2 Overview

The WQM (208) planning area is located along the eastern seaboard of the Continental United States. The area includes four urban centers and 26 smaller towns. Geographically the region is a coastal plain underlain by several moderate to high yield aquifers which supply much of the area's water supply. Situated between an area with a highly industrial economy and one with a tourism-recreation based economy, the district has an economic base made up predominantly of small industries involved with textiles, metal finishing and food processing. Agricultural industries include fishing, dairy products and fruit products.

Approximately half the population of the area is served by sewers which discharge to three primary treatment plants and ten secondary plants. All three primary plants are scheduled for upgrade or are in the process of new plant construction. Many of the secondary plants are undergoing upgrade or regionalization. Data on the industrial contributions to these treatment plants are at this time, limited. Information that does exist includes partial industrial flow inventories for two of the major cities along with guidelines which provide expected pollutant loadings from various industrial categories and sub-categories. Industrial waste surveys for the remainder of the area are either in progress or in the planning stage.

4.2.3 Presentation of WQM Pretreatment Program

Description of Overall Industrial Plan

The thrust of the planning agency's industrial wastes program, for direct discharge as well as pretreatment, is clearly indicated in the introduction to their plan for the control of industrial discharge.

> "By focusing on the relationship between pollution control and economic development from the start, alternative methods of meeting the standards which can be more cost effective than traditional end of the pipe technologies can be formulated."

The three objectives of the program are stated as (1) meeting [redacted] water quality standards without transfer of toxic pollutants to unprotected land and air, (2) keeping as many waste materials as possible in the economic rather than the disposal sphere through encouragement of reuse and recycle, and (3) the recognition of the relationship between pollution control and economic growth. At this stage of development the program is designed to emphasize three issues: water quality, residuals management and economic development. The issue of pretreatment although not stated as one of these three key elements will certainly become an important consideration in each of the program tasks listed in Table 4-1.

To facilitate public participation in this program, the WQM Areawide Planning Agency is organizing an Industrial Task Force which will include representatives from industry, government and planning agencies. The purpose of such a group is to serve as an information source for both industry and government as well as a forum for collecting data and for discussing the various problems faced by its members. One issue which the task force is designed to address is sewer use ordinances. By involving both those individuals responsible for ordinances and those subject to ordinances, it is believed that the task force will be more able to effectively deal with this critical element in the pretreatment issue. At this time the desired output of the industrial wastes program is alternative, cost effective, industrial pollution control practices emphasizing ideas such as joint treatment, reuse/recycle and economic incentives.

Description of Key Elements

Industrial Waste Survey

The first task in the industrial program involves the

Table 4-1

WQM (208) INDUSTRIAL WASTES PROGRAM
CONTROL OF POLLUTION FROM INDUSTRIAL SOURCES

Source of Data Base		Scope of Work
Permits, plans and Interviews	1	Review of Present Status and Anticipated Plans for Industrial Wastes
Municipal Plans Technologies Reuse/Sink Alternatives	2	Analysis of Anticipated Plans and Alternative Waste Handling Procedures
Industrial Survey Analysis	3	Development of Alternative Programs for Liquid Wastes and Residuals
Facilities Planning	4	Evaluation of Use and Consequences of Programs on Economic Growth, Anti-Degradation Policy and Water Quality

collection of the industrial data necessary for the remainder of the program to be generated. The objectives of this task are as follows:

1. Determination of present industry practices and proposed plans for meeting water quality standards in the region.
2. Initial training of staff on data sources and industry practice.
3. Establishment of potential problem areas.
4. Explanation of WQM Planning Goals to industry and requests for cooperation.
5. Collection of data on two levels: One on general industry and the other on specific sites in the district.
6. Determination of additional data requirements.

Industrial data is being collected using three levels of effort. Level One data is an inventory of industry types and employment for each city and town within the district utilizing the SIC code and description system. Level Two data employs general EPA guidelines for estimating waste loads by parameter for specific types of industries. Level Three data includes specific company data collected for purposes of sewage treatment plant design.

In the initial stages of this task (Level One data collection) it became evident that five major industrial areas existed within the district as shown in Table 4-2.

Table 4-2

SUMMARY OF LEVEL ONE DATA

	Total No. of Companies	Total Employment
25 "non-industrial" towns	192	16,479
5 Major industrial communities	763	69,826

On the basis of this data and the fact that the treatment plants serving these five areas would receive a larger portion of industrial inputs, the five major industrial communities were chosen for more in-depth study. This basically involved the generation of Level Two data for these communities. This data includes sub-categorization of the industries listed in the Level One, wastewater characteristics (general guidelines), treatment alternatives, in some cases BPT* effluent limitations and an assessment of whether a particular category generates a significant waste load. In addition, Level Two includes a listing of those industries under NPDES permits for direct discharge. Finally, in progress is the collection of water consumption data for the industries in the five industrial areas.

The expected result of this study is a Pollutant Profile which will prove useful as a display mechanism to show general areas where particular concentrations of industrial pollutants are generated. This will in turn aid the planners in developing the remainder of the program.

From the currently completed Level Two data, several decisions concerning the generation of Level Three data have been made. First, four communities have been initially chosen for the Level Three effort. Secondly, only those categories which generate significant waste streams will be surveyed. At this time, Level Three data has been collected, in part, only for two cities and is summarized in Table 4-3 and Table 4-4.

As the data collection process for this task proceeds, additional data requirements are being determined. Conversely, certain areas have been chosen for a more limited effort (Level Two as opposed to Level Three). Thus the outline for the industrial waste survey is extremely flexible and undergoes continual change although the overall goals remain.

Treatment Plant Inventory

One of the major outputs of an industrial pretreatment program is the assessment of potential treatment plant

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* BPT = Best Practicable Control Technology Currently Available

Table 4-3

SUMMARY OF INDUSTRIAL SURVEY: CITY A

SIC	Description	Number of Companies	Total Waste Flow Gallons/Day (g/d)
22.	Textile Mill Products	2	1,153,500
28.	Chemical and Allied Products	2	145,177
30.	Rubber and Miscellaneous Plastic Products	1	4,500
31.	Leather and Leather Products	1	7,120
34-39.	Miscellaneous Metal Products	16	197,700
			1,508,000

Table 4-4

SUMMARY OF INDUSTRIAL SURVEY: CITY B

SIC	Description	Companies	Million Gallons/ Year (MG/yr)
20.	Food and Kindred Products	2	95.3
22.	Textile Mill Products	16	632.4
28.	Chemical and Allied Products	1	43.8
30.	Rubber and Miscellaneous Plastic Products	3	23.8
34-39.	Miscellaneous Metal Products	11	99.6
	Total Manufacturing		894.7
72.	Laundries	14	48.9
	Car Washes	7	7.6
	Total Service		56.5
	Total Manufacturing and Service		951.2
	(or at 275 days/yr: 3.5MGD)		

upsets caused by industrial discharges. For that purpose part of the required data base is obviously an inventory of treatment facilities. In fact, the 208 Project Control Plan indicates the treatment plant inventory as part of the required data based for the completion of the industrial wastes program.

The district includes ten secondary treatment plants and three primary plants. As shown in Table 4-5, the larger facilities are operating at capacity or above design flow. There are two new plants under construction, five plants proposed for upgrade or new facilities and one upgrade under design. Most of the secondary plants utilize extended aeration or trickling filters as their treatment process with one plant utilizing biological stabilization ponds. Sludge disposal runs the gamut of possible disposal practices from incineration to land treatment on farm land.

Several insufficiencies in treatment plant operation and maintenance have been indicated in the report. First of all, although all municipalities involved have adopted sewer use ordinances, few if any are enforced. In addition, many of the treatment plants do not have adequate monitoring facilities compounding this enforcement problem.

4.2.4 Pretreatment Issues - Analysis of Specific Issues and Program Elements

Economic Impact of Pretreatment

Even before the inception of PL 92-500 the high cost of environmental protection was generally recognized. The law itself addresses this fact by placing part of the public sector economic burden on the Federal Government. The law does clearly place the economic burden of industrial waste treatment on the industries themselves (PL 92-500 Sec. 204).

Table 4-5

SUMMARY OF AREA TREATMENT FACILITIES

		Design Cap. MGD	Average Flow MGD	Future Considerations
1.	S	2.8	4.0	New plant proposed
2.	S	1.4	2.4	Upgrade proposed
3.	S	1.0	1.2	Regional plant proposed
4.	S	.75	.80	New plant under const.
5.	P	4.7	5.6	New plant under const.
6.	P	16.0	22.0	Upgrade under design
7.	S	1.8	.6	
8.	S	2.0	.7	
9.	S	2.1	.9	Regionalization proposed
10.	S	.58	.33	
11.	P	30.0	30.0	Upgrade proposed
12.	S	1.75	1.6	
13.	S	1.7	.26	
TOTALS		66.6	70.4	

S = Secondary Plant

P = Primary Plant

The planning area in question is not a heavily industrialized area.* Neither does it base its economy on tourism and recreation. Lying between these two extremes its economy is based on small industries centralized in five "industrial" areas. The major industries are textiles, metal finishing and food processing, which includes seafood, dairy products and fruit products. Relatively smaller financial benefits are gained from the fresh fish industry, dairy farming and fruit farming. Except for a small percentage of large industrial plants which are direct dischargers (113 permits) most units are small plants discharging to sewers.

With respect to the minimum pretreatment standards promulgated by the Federal Government, the food processing industries (dairy products, canned and preserved seafood) do not face stringent limitations for existing sources. New sources under the Dairy Products category face no limitations on compatible pollutants while those sources under the canned and preserved seafood category will be subject only to general regulations. Standards for existing textile sources are only proposed at this time and indicate limitations on COD, Chromium, Phenol, Sulfides and pH depending on the industrial subcategory. For the metal finishing industries (electroplating) existing pretreatment source standards are only proposed while new source standards are in effect, both indicating stringent limitations on a variety of metal discharges. The point of this information is that the economic impact of pretreatment is relative to the industry being considered. Metal finishers and platers in this case appear to face a high cost of pretreatment while food processors, especially existing sources, face little economic burden. The cost to the textile industry lies between the other two categories.

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Because the area has not been economically stable in recent years, the planning agency recognizes the importance

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* in relation to a nearby major metropolitan center (pop. >2,000[illegible]0)

of economic considerations in dealing with pretreatment by placing great importance on economic impacts, incentives and alternatives. In fact, one program task is an assessment of the impact of their total industrial program, including pretreatment, on economic growth in the area. However, compounding the problem of the economic impact of pretreatment are the added problems of increasing costs of energy and labor. In its program the agency is attempting not only to minimize the negative impacts of pretreatment but also to develop alternatives that create incentives to industries.

In light of this point of view, the agency is assessing ideas such as joint treatment and reuse/recycle as well as developing a high degree of industrial participation. Other programs such as industries combining to treat and remove prohibited wastes will be economically and environmentally assessed. Additional programs (see Section 2.5) can be added to aid in this task. First of all, those industries most severely affected by pretreatment regulations should be identified. This task should be followed by actual site visits. Guidance should be provided to these industries on pollution control techniques, capital investments and process changes. In this way the Agency can not only provide technical assistance but also validate claims of severe economic impacts.

This particular planning agency is under pressure to adopt a policy which will not inhibit economic growth in its district. This fact is reflected in its non-aggressive attitude toward ordinances and enforcement. However, by not enforcing ordinances and user charges, the municipalities in the area are allowing the public sector to pay for the treatment of industrial wastes. The planning agency, being cognizant of this inequity, should develop a program that provides equitable payment schedules under the law.

In assessing the economic impact of pretreatment care must be taken to insure that the priorities of a 208 agency be kept in focus. According to Section 101(a)(5) of PL 92-500:

> "It is the national policy that areawide waste treatment management planning processes be developed and, implemented to assure adequate control of sources of pollutants in each State."

The mandate is clearly one of environmental protection. A WQM (208) planner must certainly consider economic issues but not at the expense of required environmental quality. It is the job of a planner to balance properly these sometimes opposing issues.

Planning for Residuals Management

The recent emphasis on "environmentally safe" residuals disposal practices has evolved from a developing understanding of the short and long term impacts of hazardous waste materials. The problem becomes an element in the pretreatment issue when considering the possibility that the enforcement of industrial pretreatment standards will result in increased generation of industrial sludges and expand the options for disposal of POTW sludge. In the case where pretreatment standards are not enforced the problem is transferred to the generation and disposal of POTW sludges.

The major contributors of toxic materials in this 208 planning area are the metal plating and finishing industries. Of particular importance are jewelry manufacturers (precious metal finishers) many of which are direct dischargers. However, may of the smaller electroplating, aluminum finishing and general metal finishing companies are sewer dischargers. The current sludge disposal method involves long distance transport to hazardous waste landfills. Table 4-6 provides a listing of the most important hazardous wastes and pollutants associated with metal finishing industries.

The residual problem has been recently highlighted at several industrial meetings held in conjunction with the industrial wastes program. The major issues discussed include quantities generated, disposal practices and recovery

Table 4-6

WASTE MATERIALS FROM METAL PLATING AND FINISHING INDUSTRIES WHICH CAN CONTAMINATE SLUDGES

Mineral Acids	Chromate
Alkali	Heavy Metals
Chlorinated Solvents	Cyanide
Hydrocarbon Solvents	Grease

opportunities. The Project Control Plan deals with the problem of industrial residuals in several tasks. First, information concerning residual production and disposal will be collected as part of the necessary data to evaluate current industry plans and possible alternatives. A second program addresses several aspects of the issue in terms of alternative solutions to the disposal problem by identifying general opportunities for recycling, evaluating the feasibility of joint treatment and examining the option of creating a hazardous waste landfill.

An additional aspect of the residuals issue which must be addressed is the impact of pretreatment on the quality and quantity of sludge generation at the POTW. There are two distinct situations which can be encountered.

i - limited or no industrial pretreatment

Since many industrial toxics are known to be associated with suspended solids, the settling processes involved in primary and secondary treatment will separate much of the hazardous material from the liquid portion of sewage (see Section 3.5). This will result in a sludge with some industrial characteristics (see Figure 3-1). The degree to which the POTW sludge is "industrial" will depend on the level of input of industrial process wastewater and the degree to which industrial pollutants pass through the plant. This is dependent on the type of material and the relative efficiency of a particular POTW.

Because of the addition of these toxics to domestic sludge, disposal by ocean dumping, land filling and land-spreading may no longer be options for consideration. The possibility of incineration will be limited depending on the level of metal emissions (such as mercury) expected. In cases where the "industrial" characteristics of the sludge are dominant a hazardous waste landfill may become the only disposal option.

ii - substantial industrial pretreatment

The biological treatment systems utilized in most secondary treatment plants are susceptible to upset by many organic and inorganic compounds (see Chapter 3). Both Federal and local pretreatment requirements are developed to protect treatment plants from this type of industry-related upset.

A secondary impact of enforced pretreatment requirements is the protection of POTW sludge from contamination by industrial wastes. In this case POTW sludge has primarily domestic (compatible) characteristics. In terms of the environmental impacts of toxic substances many options for disposal are available.

In the case where limited or no pretreatment exists, the direct impact is to limit the disposal options to one of the most expensive choices: a hazardous waste landfill.

Other residuals options, such as resource recovery, should be assessed from a cost-benefit point of view. This analysis can include consideration of a program in which several industries combine their waste streams for treatment and materials recovery.

It should be clear that the issue of residuals generation and disposal is not unique to this area. There are many industries besides metal plating and finishing that generate considerable quantities of hazardous materials. In effect, most agencies will face this issue to some degree. Therefore, the possible alternatives, summarized in Table 4-7 could be considered by many different agencies.

Table 4-7

ALTERNATIVE PRACTICES AND MAJOR CONSIDERATIONS IN RESIDUALS MANAGEMENT

Major Considerations
- Environmental Impact
- Cost vs. Benefit
- Quality and Quantity of Residuals Generated

Disposal Options
- Ocean Disposal
- Landspreading
- Sanitary Landfill
- Hazardous Waste Landfill
- Incineration

Alternate Management Options
- Materials Recovery

As with other issues, the 208 role in planning for residuals management must be aggressive. One reason is to insure that industry contributes its fair share to the cost of POTW sludge disposal (i). Also, by maintaining the domestic characteristics of POTW sludge the possible disposal options can include the more useful alternatives such as landspreading, land reclamation and direct recycling of sludge.

Ordinance Development, Enforcement and Monitoring

One of the most critical elements in any pretreatment program is the development and enforcement of an effective sewer use ordinance. The ordinance provides the means, on a municipal level, for the protection of sewers, POTWs and local water quality and for the control of waste inputs into the local sewage system (see Section 2.4.5). The role of an areawide planner in this issue is dictated by the status of other areawide plans, the level of responsibility accepted by State and local governments and the Agency's own view of its responsibility.

For this WQM (208) (planning) agency the ordinance issue has not fully developed, although several aspects have been encountered. All thirteen municipalities with treatment plants have adopted ordinances based upon the model suggested by the State although enforcement of these ordinances is almost non-existent. Compounding the issue is the fact that many of the area's (section) 201 plans are complete and include suggested ordinances within their respective POTW discharge permits. The (planning) agency [illegible] views its role as one of review and coordination of existing municipal ordinances and suggested 201 ordinances. This somewhat passive attitude toward ordinances has resulted from the assumptions that: 1) development of ordinances is a 201 responsibility, and 2) development of enforcement practices is solely a municipal responsibility. To resolve these problems several sections of the manual provide guidance. The above mentioned Section 2.4.5 is a review of important control elements in ordinances, Section 2.3.5 suggests ideas for the development of an ordinance and Appendix C provides a sample ordinance compiled by the California Water Pollution Control Association.

An adopted ordinance can only be effective if it is backed by an operative enforcement and monitoring program. The area's problem relating to this issue is twofold. At a recent meeting with the 208 staff it was indicated that the local municipalities did not take an active attitude toward enforcement of ordinances. This fact is due in part to the lack of adequate laboratory facilities in the area and the added expense of an extensive monitoring program.

For its industrial pretreatment program to become fully developed a 208 Agency must take an active role in the ordinance issue. This role should consist of providing guidance to municipalities on developing effective ordinances, coordinating with 201 planners on review of suggested ordinances, suggesting strong enforcement procedures (see Section 2.4) and advising other agencies on monitoring or implementing a monitoring program themselves.

Coordination of WQM Plans and 201 Plans

In the above discussion an overlap is indicated between 201 facilities plans and Areawide WQM plans concerning the development of ordinances. This particular problem arose because several 201 plans containing ordinaces preceeded the WQM plan. The WQM Agency's minimum responsibility in this case is to review the ordinance and if it is found to be deficient to conduct a joint review between 201 and WQM staff members. The arbitrator in such a review is normally the Regional EPA Administrator.

This is but one case in which a possible conflict could arise between the major ongoing EPA planning programs: WQM and 201. For this reason the responsibilities of each must be clearly understood by the Areawide WQM planner. State Water Quality Management plans constitute the overall water quality framework within which Areawide Water Quality Management plans are developed for particular portions of water bodies, specifically in industrialized areas. A further discussion of these plans is found in Chapter 1.2.2.

Generation and Use of IWS

The industrial waste survey is the core of the data base utilized in developing a pretreatment program (see Section 2.3.2). To generate their IWS this Agency has chosen a three step procedure (see Section 4.2.3) identifying those areas where, in their judgement, major emphasis should be placed. For these chosen areas or municipalities an on-site industrial waste survey is performed. To a large degree the agency is utilizing literature surveys, general guidelines and water consumption data to estimate waste loadings from particular industries and plants. In quantifying waste loads for the purpose of developing ordinances and user charges the highest loading values provided in the estimates should be used, if for no other reason than to provide for adequate margin of safety for POTW operation. In this way industries will have an incentive to self-monitor. The data generated by industrial self-monitoring would be used to present their case for the reduction of pretreatment requirements ~~standards~~.

This approach certainly reduces costs and time necessary for generating a data base for an industrial wastes program. In the final analysis this data should be adequate to develop the following pretreatment program elements:

1) Quantity and quality of industrial waste inputs;
2) Locations of maximum industrial inputs;
3) Ordinances;
4) User charges;
5) Impact on POTW sludge quantity and quality.

Public Participation

This case study provides a good example of how a 208 planning agency can generate industrial participation in their pretreatment program. As part of their industrial wastes program several meetings were organized between the 208 staff, consultants and local industrialists. These meetings resulted in worthwhile two-way exchanges of ideas, problems and potential solutions. In addition, it allowed the 208 (planning) agency to carefully explain their position to industry. However, more participation from municipal officials is needed to understand all points of view. Continuation of this program with added municipal participation, will greatly enhance the development of the Industrial Waste Program.

4.3 CASE STUDY II

4.3.1 Introduction

This case study provides two examples of the development of the more technically based aspects of an industrial pretreatment program on a local level. The major program elements delineated include the generation and use of an Industrial Waste Survey, development of a comprehensive and enforceable sewer use ordinance and the establishment of equitable cost recovery. Unlike Case Study I, which provided only insights into some of the major pretreatment issues, Case Study II provides methodologies and techniques for developing the above mentioned elements. Background information on this particular area and its industrial program is also provided for reference.

4.3.2 Overview

The 208 area is located in the northern United States and includes one of the major urban-industrial cities contiguous to the Great Lakes. Population is centralized in the one major urban area and four smaller urban and suburban centers. The region's economy is greatly dependent on manufacturing with lesser importance on wholesale trade and services. Minor economic benefits are gained from contract construction, transportation, public utilities and finance. Agricultural and mining activities are very limited, as shown in Table 4-8.

Table 4-8

EMPLOYMENT CHARACTERISTICS OF 208 AREA

Industry	% of Total Employment
agricultural	<1
mining	<1
contract construction	4
manufacturing	42
transportation and public utilities	6
wholesale trade	18
finance, insurance etc.	5
services	16

Many of the area's major industries are currently direct dischargers; however, the number of water quality limited segments in the region may severely limit future direct dischargers as well as provide an incentive for industries to discharge to sewers. In view of these facts pretreatment must eventually become an important consideration for WQM (208) planners.

4.3.3 Description of Major Program Elements, City A

The first example is the industrial program currently under consideration for the major urban center in the area. Industrial contributions to the treatment system amount to 14% of the average daily flow. The new treatment facility will consist of secondary biological treatment.

Industrial Waste Survey

The first step needed to comply with the requirements mentioned in Section 4.3.2 is an industrial waste survey. The simplest and least expensive method of accomplishing this task is to utilize water consumption data, literature reviews on industrial wastes and sewage to water ratios (in-product retention percentages) to develop estimates on expected industrial waste loads to a particular sewarage system. Conversely, the most intensive method involves actual site visits and on-site sampling and flow measurements. The choice of one or the other should be based on economics and the extent of industrial contributions to the system. The municipality in question has chosen to conduct its survey using the more intensive method.

The first step was to compile an initial list of 1600 industries. Questionnaires were sent to 564 of these which resulted in 350 industries being chosen for the sampling program. These were chosen on the basis of their being a major contributing industry (see p. 1-10) or their expected discharges of incompatible pollutants. Next, a four phase sampling program was instituted which included:

- in-plant investigations
- scheduling of industries for sampling
- sampling and analysis of the waste
- reporting

Where access was available, flow measurements were made using standard apparatus such as weirs, flumes and stage-flow recorders. Water consumption data was used where direct flow measurements were not feasible. Water meter readings provided the raw data to which allowances were made for in-product retention of water and sanitary discharge. When actual flow data was obtained, water meter readings were used to estimate actual in-product retention and losses.

First stage sampling involved daily collection from 85 industries. Analyses were performed immediately except BOD's which were prepared twice a week. To eliminate errors as to the origin of each sample and the analyses required, each sample was labeled with a code number and date which provided cross reference to a field data sheet, preliminary analysis sheet and industrial waste map atlas. All samples were analyzed for BOD, TSS, PO_4 and chlorine demand. Based on the results of the initial surveys and the type of industrial process, forty-five industries were chosen for heavy metals analysis.

The results of the data collection effort were submitted monthly in a three-phase format over the two-year project period. First, a section was provided that described general information concerning plant operations and sampling procedures. The second section discussed whether or not the results of that month's analysis indicated the need for additional or updated surcharges. Three possible surcharge situations were considered. Existing surcharges on TSS and chlorine demand were reviewed as to the necessity for update or the establishment of new surcharges using the current formula. Also, industries that would require new surcharges on the basis of TSS, BOD and PO_4 under secondary treatment were indicated. Table 4-9 is a partial listing of the industries sampled and the results of the surcharge review.

The final section of the monthly reports indicated those industries which either were in violation of the existing ordinance or would be in violation of the proposed ordinance. Violations were based on discharges of grease and oil, toxics and miscellaneous materials such as solids, pH, phenol, cyanide, and prohibited debris as shown in Table 4-10.

At this time the second stage collection effort is continuing with an additional 79 industries scheduled for sampling. However, even at the initial stage the survey data was utilized for the development of both ordinances and cost recovery formulae.

The local municipality's consultants have provided two additional data listings that are important for developing a comprehensive pretreatment program. The first listing, shown on Table 4-11, is a summary, by industry, of the sampling procedures used. The second is the partial results of the heavy metal analyses performed on 45 specified industries. The listing shown in Table 4-12 provides heavy metals quantification in concentration and loading terms.

Sewer Use Ordinance

Since the existing primary treatment facility is proposed to be upgraded to secondary treatment, the current sewer use ordinance required updating to prevent damage to the more complex systems. In general, the suggested ordinance is similar to the California Model Ordinance provided in Appendix C. The key sections of the ordinance considered here include an expanded prohibited waste list, a separate article covering industrial discharges, an enforcement program

Table 4-9

SEWER AUTHORITY
INDUSTRIAL WASTE SURVEY
SUMMARY OF INDUSTRIAL SURCHARGES*

Industry	SIC Cat.	New Surcharges to be Assessed Under Present System		Surcharges to be Levied Under Secondary Treatment			Previous Surcharg To be Updated	
		T.S.S.	Cl_2	B.O.D.	T.S.S.	PO_4	T.S.S.	Cl_2
ABC Co.	3322	X			X	X		
D&E, Inc.	2865			X			X	X
Company F	7218	X		X	X	X		
Company G	3443	X			X			
Company H	2021	X		X				
I&J Co.	2011						X	X
Company K	2649				X		X	X
L-M-N, Inc.	2026	X	X	X	X	X		
Company O	3471	X				X		
Company P	3269	X			X			
Company Q	8062		X					
Company R	7395		X					
Company S	7218			X	X	X	X	X

X = new surcharge or updated surcharge required for that parameter

* Names are Fictitious.

Table 4-10

SEWER AUTHORITY
INDUSTRIAL WASTE SURVEY
SUMMARY OF INDUSTRIES FOUND IN VIOLATION OF SEWER ORDINANCES*

Industry	SIC Cat.	Violation of Existing Ordinance			Anticipated Violation of Proposed Ordinance		
		G & O	Toxics	Misc.	G & O	Toxics	Misc.
Company A	2011	X		Solids	X		Solids
Company B	2011			Solids			Solids
C&D, Inc.	2013			Solids			Solids
Company D	2013	X			X		
E, F, &G Co.	2013	X			X		
H Products, Inc.	2013	X		Solids, pH	X		pH, Solids
Company I	2013			pH			pH
J&K Brothers	2021	X			X		
Company L	2022	X			X		
Company M	2024	X			X		
N-Z, Inc.	2026			Prohibited solids & debris			Prohibited solids & debris

[redacted]ames are fictitious.

Table 4-11

SEWER AUTHORITY
INDUSTRIAL WASTE SURVEY
SAMPLING SUMMARY*

Industry	Sample Point #	Number of Sample Days	Compositing Time/Hours	Normal Work Day/Hours	Type of Flow Measurement	Type of Sample Collected	Point of Access
ABC Co.	1	2	8	8	Water Meter	AC Comp. Sampler	Vent
	2	2	8	8	Water Meter	AC Comp. Sampler	Clean-out
D&E, Inc.	1	8	24	24	Flow Meter at Pretreatment Plant	AC Comp. Sampler	Effluent Chamber
	2	5	24	24	Flouride Injector	AC Comp. Sampler	City M.H.
	3	5	24/8	24/8	Water Meter	AC Comp. Sampler	Plant Sewer
	4	3	8	8	Water Meter	Hand Composite	City M.H.
	5	4	24	24	Water Meter	AC Comp. Sampler	Plant Sewer
Company F	1	3	8	8	Water Meter	AC Comp. Sampler	Settling Sump
Company G	1	3	24	24	Water Meter	DC Comp. Sampler	Plant Sewer
	2	3	24	24	Water Meter	DC Comp. Sampler	Plant Sewer
	3	3	24	24	Water Meter	DC Comp. Sampler	Plant Sewer
	4	3	24	24	Water Meter	AC Comp. Sampler	Vent
	5	3	24	24	90° V-notch Weir	DC Prop. Sampler	City Sewer
Company H	1	3	24	24	90° V-notch Weir	DC Comp. Sampler	City Sewer
	2	4	24	24	Water Meter	DC Comp. Sampler	Plant Sewer
	3	3	24	24	Water Meter	DC Comp. Sampler	Plant Sewer
	4	3	24	24	Water Meter	DC Comp. Sampler	Plant Sewer
	5	3	24	24	Water Meter	DC Comp. Sampler	Plant Sewer
I&J Co.	1	3	8	8	Water Meter	AC Comp. Sampler	Clean-out
Company K	1	3	8	8	Water Meter	AC Comp. Sampler	Grease Trap
L-M-N, Inc.	1	2	8	8	Water Meter	AC Comp. Sampler	Vent
	2	2	8	8	Water Meter	AC Comp. Sampler	Vent

* Names are fictitious.

SEWER AUTHORITY INDUSTRIAL WASTE SURVEY
HEAVY METAL LOADING FROM MAJOR CONTRIBUTING INDUSTRIES
SAMPLED DURING PHASE II PROGRAM*

		Ace Wallpaper Co.	C-D-E, Inc.	Hometown Press	F&C Co.	Smith Laboratories	Company Z	Q-R Chemical Co.	Company X	Company Y	Jones Steel Co.	J-K, Inc.	Company W	Company V	M-N Foundry
	SIC CATEGORY	2649	2653	2751	2761	2834	2851	2865	3231	3269	3312	3312	3315	3316	3321
	AVG. DAILY FLOW MGD	0.057	0.068	0.014	0.1715	0.073	0.036	1.784	0.093	0.103	0.376	0.066	0.178	0.220	0.099
	Cr TOTAL			0.1918 0.0231					0.053 0.041				411.648 611.200		
	Cr HEX												295.583 438.800		
- AVERAGE POINT SOURCE LOAD - $\frac{\text{ppm}}{\text{\#/day}}$	NI							0.333 5.510	0.074 0.575			.0500 .0275	5.524 8.200	.0190 .0359	0.041 0.034
	CU	0.642 0.305				0.0890 0.0541		2.333 38.600					86.156 127.900		
	As														
	HCN				0.0496 0.0710			0.375 6.200					3.637 5.400		
	CD		0.0240 0.0138										0.243 0.360		
	Pb				0.0576 0.0824					10.675 9.170	0.101 0.314	0.020 0.011	6.332 9.400		0.098 0.081
	Hg		 .000399	.000400 .000048	.0048 .0069				 .000386						
	Zn			.2764 .0334		0.404 0.246	.227 .068	0.683 11.30			0.081 0.251		11.317 16.800		0.119 0.098
	Fe	43.374 20.630	4.906 2.800	5.370 0.627	1.622 2.320		21.331 6.39	0.279 4.620	9.762 7.580	0.731 0.628	1.456 4.530	0.2440 0.1345	2375.178 3526.000	0.241 0.443	6.782 5.600
	MN						.040 .012						60.221 89.400		0.121 0.100

Names are fictitious:

utilizing industrial permits and concentration limits on toxic substances. These limits were based on the prevention of both upset to the secondary plant and pass-through of toxics.

The prohibited wastes list contains several interesting elements. One is an "anti-dilution" clause which states that there shall be no discharge of . . .

> "Any waters added for the purpose of diluting wastes which would otherwise exceed applicable maximum concentration limits."

The limited discharge list not only includes heavy metals such as lead, chromium and copper but also a 50mg/ℓ limit on grease and oil, a .05mg/ℓ limit on phenol and a 1mg/ℓ limit on cyanide. The reader should realize that the values listed in Table 4-13 were derived for this particular system and cannot be arbitrarily used in any area.

Table 4-13

METALS DISCHARGE CONCENTRATION LIMITS

	Discharge Limit, mg/ℓ
Chromium (Total)	3.0
Chromium (Trivalent)	1.0
Chromium (Hexavalent)	1.0
Copper	1.0
Zinc	5.0
Nickel	1.0
Cadmium	1.0
Arsenic	0.5
Barium	1.0
Lead	0.1
Manganese	1.0
Silver	0.05
Boron	1.0
Mercury	0.01
Selenium	0.05

A method for estimating these limits is described in Chapter 3.6.3 of this manual.

The surcharge limits are also set in the ordinance as follows:

BODs - 250 ppm
TSS - 250 ppm
Phosphorus - 5.0 ppm

These are based on the estimated quality of local domestic sewage.

This particular ordinance sets up its own enforcement mechanism in the form of a Permit for Industrial Wastewater Discharge (see pp. 2-50 and 2-53 of this manual). The permit may specify pretreatment requirements, flow restrictions, points of discharge, time restrictions and payment schedules. It is required by all non-domestic users and specifies that incompatible pollutant pretreatment requirements for major contributing industries shall be the Federal pretreatment ~~regulations~~ standards. For compatible pollutants, surcharges are to be instituted based on the aforementioned limits. This method allows each industry to make the financial decision whether to reduce their discharge of "compatible" pollutants or pay a surcharge fee.

The final section of the ordinance deals with sampling and monitoring. The responsibility for monitoring is clearly placed on the discharger either directly or financially if the local municipality performs the task.

LOCAL REIMBURSEMENT SYSTEM*

The basis of an equitable ~~cost recovery~~ REIMBURSEMENT system is the fact that each user of the treatment works pays ~~their~~ its share of both the capital and operations and maintenance costs. Users of the system are categorized as (1) domestic and (2) commercial and industrial. Charges to ~~these~~ domestic users are made on the basis of flow. Industrial users present a special problem in that charges must be made on the basis of not only flow but also surcharges for compatible pollutant discharges greater than a standard domestic loading. In some cases, charges can also be levied for incompatible pollutants.

For the purposes of this manual only local industrial ~~cost recovery~~ REIMBURSEMENT (for capital and O + M costs) is to be considered here. The basic industrial cost recovery charge includes

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* (THIS IS A SUMMARY DISCUSSION OF AN EXAMPLE LOCAL PROGRAM. FOR ADDITIONAL GUIDANCE SEE 40 CFR 35.928 AND 35.935-13 AND FEDERAL GUIDELINES - INDUSTRIAL COST RECOVERY SYSTEMS.)

three components as shown in the following formula:

INDUSTRIAL SEWAGE TREATMENT CHARGE = DOMESTIC RATE +
PROPERTY RATE + SURCHARGE

When considering pretreatment the important component in the above formula is the surcharge which makes the formula generally applicable to all industries. If an industry discharges only domestic strength waste, this term drops out and the treatment charge becomes that of an ordinary domestic user.

For the municipality in question here surcharges are to be based on three design parameters of the new treatment facility: BOD, Suspended Solids and PO_4. The domestic limits were set on the basis of normal domestic strength wastewater. Thus the surcharge requires industry to pay for any discharges above these limits.

4.3.4 Description of Major Program Elements, City B

Overview

The second largest municipality in this particular planning area is somewhat unique in that industrial sources contribute 50% of the average wastewater flow. This is reflected in the fact that the population equivalent based on the flow of wastewater is over 250,000 while the actual city population is 86,000. In addition, the city's wastewater stream contains high concentrations of toxic materials and metals discharged by local chemical manufacturers. These factors led to an initial conclusion that the operation of a biological treatment system would not be feasible.

Industrial Waste Survey

During the preliminary phases of this program it became clear that its successful completion would depend on the cooperation of all groups involved, especially industries. For this reason, after preliminary site visits and the collection of data from industry questionnaires, the municipality's consultant allowed each industry to sample its own waste stream. The industries subsequently paid for analyses performed under the supervision of the consultant. A summary of the results of that survey are shown in Table 4-14.

Table 4-14

INDUSTRIAL DISCHARGE (1970), CITY B

Contaminated Industrial Discharge	Flow (MGD)	Suspended Solids (LB/Day)	Chemical Oxygen Demand (COD) (LB/Day)
To municipal sewers	62.5	190,000	136,000
To diversion sewers	30	17,000	2,000
To river	71	67,000	104,000
TOTALS	163.5	274,000	242,000

Several important conclusions were drawn from the results of this initial survey. The fact that a biological system would not be feasible for the treatment of the quantity of industrial waste being discharged was confirmed. The municipality and its consultant concluded that a physico-chemical facility would be the most reasonable alternative. The industries involved agreed to substantially reduce their volume of wastewater discharged to sewers by process adjustments and the separation of non-contact cooling waters. The preliminary design values for flow, suspended solids and COD were derived based on the industrial waste survey and are shown in Table 4-15.

It is interesting to note that for the purpose of designing this particular facility contributions from commercial and industrial dischargers were separated. In effect, this indicates the compatible nature of commercial discharges with respect to physico-chemical treatment.

The choice to utilize physico-chemical treatment has two interesting effects on the pretreatment issue. First of all, the Federal pretreatment standards (40CFR128, 40CFR403-

432), promulgated on the basis of secondary biological treatment cannot directly apply. Secondly, the local sewer use ordinance must be somewhat different than those previously described in this manual.

Table 4-15

AVERAGE DAILY FLOW AND LOADINGS USED FOR THE DESIGN OF CITY B TREATMENT PLANT (1990)

	Flow (MGD)	Suspended Solids (LB/Day)	Chemical Oxygen Demand (COD) (LB/Day)
Domestic & Commercial	11.2	35,340	70,760
Infiltration	10.6	--	--
Industrial	26.0	59,750	64,560
TOTALS	47.8	95,090	135,320

Sewer Use Ordinance

The operation and maintenance of a physico-chemical treatment plant required a sewer use ordinance substantially different in content than the standard ordinance covering biological treatment facilities. Of critical importance in this ordinance is the definition of compatible pollutants. The following list defines those pollutants which are to be considered compatible for the physico-chemical facility.

Table 4-16

COMPATIBLE POLLUTANTS FOR CITY B TREATMENT FACILITY AS DEFINED IN THE SEWER USE ORDINANCE

1. Chemical Oxygen Demand
2. Total Suspended Solids
3. Acids and Alkalies within acceptable pH limits
4. Phenols
5. Phosphates - all forms
6. Nickel
7. Copper
8. Cadmium
9. Zinc
10. Lead
11. Fecal Coliform
12. Total Nitrogen
13. Settleable Solids (Grit, Screenings and Particulates)
14. Oil and Grease (in non-excessive amounts)

As in the Federal regulations, the ordinance defines incompatible pollutants as any pollutant which is not compatible. The ordinance also states that the above pollutants cannot be discharged in amounts that are not amenable to treatment by the facility.

The ordinance's enforcement mechanism contains two major elements. First, each industrial contributor is required to enter into industrial discharge agreements with the local municipality. These agreements define the industry's waste stream in terms of flow, suspended solids loading and COD loadings. Non-compliance with its agreement requires the industry to pretreat. The second element involves monitoring. Each industrial contributor is required to construct, operate and maintain its own sampling and monitoring system. The financial burden for these activities is placed directly on the discharger.

4.4 CASE STUDY III

4.4.1 Introduction

The broad spectrum of responsibilities that the WQM planning process is designed to consider dictates the need for planners to decide which issues are to receive major emphasis. For this reason, few agencies are beyond the initial stages in developing pretreatment programs. The purpose of this case study is to describe one particular agency's program in terms of completed tasks and their projected outline for the final pretreatment plan.

The WQM (208) planning area, located along the mid-Atlantic coast, is a semi-industrialized area with population and industrial centers distributed mainly in its northern half. Some farming occurs within the area, but major economic benefits are derived through light manufacturing and services.

Although the area includes seven wastewater treatment facilities only one receives appreciable quantities of industrial wastes. This facility, located in the area's largest city (pop. 80,000), is a 90 MGD secondary activated sludge plant with anaerobic digestion. The major industrial contributors are Food and Kindred Products (SIC #20), Paper and Allied Products (SIC #26), Chemicals and Allied Products (SIC #28), Leather and Leather Products (SIC #31) and Primary Metals Industry (SIC #32).

4.4.2 Inventory of Non-Domestic Dischargers

This agency's industrial waste survey began with the compilation of a list of non-domestic dischargers that would be considered for sampling. The list was derived from local industrial studies, directories and sewer billing records. To determine which industries were sewer dischargers NPDES permit records were investigated and questionable firms were contacted by telephone. This procedure resulted in a listing of 800 potential non-domestic dischargers. The final step in this procedure was to conduct preliminary site visits to determine if a particular industry was indeed discharging industrial quality waste.

Although on-site sampling was performed, the Agency was not able to obtain direct flow measurements. Instead, water consumption data was utilized with corrections made using a mean sewage to water ratio (S/W). Table 4-17 is a summary of the S/W ratios used by the Agency.

Table 4-17

MEAN SEWAGE TO WATER RATIOS

Industry	Ratio
Power Generation	.591 ± .344
Chemical and Allied Products	.616 ± .271
Petroleum Refining	.508 ± .210
Natural Gas Products	.238 ± .110
Primary Metals	.653 ± .317
Food and Kindred Products	.747 ± .237
Sand and Gravel Products	.903 ± .212
Stone, Clay and Glass Products	.733 ± .378
Cement, Hydraulic	.387 ± .387
Pulp and Paper Mills	.876 ± .064
Other Non-Durable Goods	.665 ± .371

Water Quality analyses were performed by planning agency personnel using procedures prescribed in Standard Methods. The following parameters were included in their analyses.

- BOD_5
- COD
- pH
- Suspended Solids
- Settleable Solids
- Chromium
- Lead
- Zinc
- Copper
- Nickel

One conclusion that was drawn from the data was that industries involved in similar operations do not necessarily discharge similar wastes. One example of this is two beverage bottling plants listed under SIC #20. Although some heavy metals concentrations are similar there was substantial differences in the values for pH, BOD_5, COD, Settleable Solids and Zinc. The reason for this, whether pretreatment or process differences, is not known at this time.

The most significant conclusion drawn from this initial survey was the need for a system of industrial discharge permits comparable to the NPDES system for direct dischargers.

The initiation of this permit scheme would provide the agency with much of the data needed to plan additional surveys. Specific information that would be obtained from permit applications include water consumption, process operations and wastewater flow. A more detailed description of this enforcement mechanism is found in the following section.

4.4.3 Ordinance Development

This planning agency has recently helped the local county authority in developing amendments to its existing sewer ordinance. These amendments are specifically concerned with industrial discharges and are entitled "Regulation of Non-Domestic Wastewater Discharges in the Public Sewer System". The ordinance is similar in most respects to the model ordinances provided in Appendix C of this manual. Enforcement is provided by means of a Wastewater Discharge Permit System, which states that pretreatment may be required as one of the permit conditions.

The enforcement program is designed to develop in a stepwise procedure, as follows:

(1) Notify existing and potential violators,
(2) Prepare draft permit applications and permits,
(3) Standardize procedures for processing permit applications,
(4) Standardize procedures for delineation of compliance and abatement schedules,
(5) Develop interim surcharge formula,
(6) Develop policy statement on responsibility for resampling for dischargers seeking variances or claiming incorrect sampling,
(7) Issue waste discharge permits, and
(8) Establish abatement schedules either in conjunction with those dischargers who wish to participate or draw up involuntary abatement schedule.

The agency believes it can complete the first six steps listed above as part of its planning process. The remaining tasks will be handled by the continuing management agency.

The permit applications (step (3)) not only provide an enforcement mechanism for the ordinance but also a refinement of the data collected in the agency's Inventory of Non-Domestic Dischargers. In this way the agency can collect data on industrial discharges without sampling the industries themselves.

4.4.4 Outline of Projected Pretreatment Plan

A completed WQM pretreatment plan must first and foremost comply with the requirements of PL 92-500 Section 208. The initial requirement stated in Section 208(D)(1) is that the waste management planning process must be "consistent with Section 201 of (the) Act". Further, the plan must "contain alternatives for waste treatment management, and be applicable to all wastes generated within the area involved". The plan must also include:

> 208(b)(2)(A) The identification of treatment works necessary to meet the anticipated municipal and industrial waste treatment needs . . .
>
> (C) The establishment of a regulatory program to . . .
>
> (iii) assure that any industrial or commercial wastes discharged into any treatment works in such area meet applicable pretreatment requirements . . .

The final paragraph above is the key mandate as far as pretreatment is concerned.

The regulatory program must establish pretreatment requirements for those pollutants which will either pass-through or interfere with a publicly owned treatment works.

The planning agency views their pretreatment program as not only a method of instituting regulations to protect treatment facilities, but also an important element in the evaluation of their residuals management plan. This viewpoint developed through the understanding that the level of pretreatment required will have a direct impact on the quality of municipal sludge and, therefore, a direct impact on reuse and disposal options. The following discussion describes the three elements in their overall plan.

Treatment Facility Evaluation

The first step is to identify those treatment facilities receiving industrial contributions. These facilities will subsequently be characterized according to the quality and quantity of their effluent and sludge. By examining treatment process characteristics the agency's industrial staff will be able to identify compatible and incompatible pollutants. This final step provides the initial correlation between this task and the evaluation of pretreatment requirements.

Pretreatment Evaluation

The compilation of data on industrial discharges to sewers is the first step necessary for the evaluation of pretreatment requirements. Work on the agency's Industrial Waste Survey has begun (see Inventory of Non-Domestic Dischargers) and will be completed in conjunction with the Industrial Permits Program. Using the industrial data collected and information from the facilities inventory the present and projected load of incompatible pollutants can be determined. After possible reduction alternatives are assessed according to their technical and economic feasibility, final pretreatment requirements will be determined and used to evaluate industrial impacts on the residuals management system.

Residual Waste Management Plan

Industrial pretreatment requirements are necessary information for determining municipal sludge quality. This in turn allows the agency to evaluate the possible disposal or reuse options available. A more detailed discussion of this issue is found in Case Study I.

By outlining their final pretreatment plan, the planning agency has effectively separated their planning functions from the continuing management process which will succeed them. The evaluation of technical pretreatment alternatives, economic impacts or industrial growth policies and the selection of pretreatment requirements are viewed as planning functions. The evaluation and selection of a final residuals management program will also be included. However, finalization of the industrial permits program will not be completed during the planning phase. Thus, the establishment of ordinance enforcement procedures is viewed as a management function.

In many cases the separation of planning and management functions will be defined by time and economic constraints. Pilot testing of industrial wastes, which might be considered a planning function, can only be conducted if the planning agency has the time and funds remaining after the prerequisites for this task are complete. The WQM agency being considered here views pilot testing as a management function. The critical fact is that due to the limited time frame alloted them, Areawide WQM planning agencies must decide which planning functions are to recieve the highest priority.