External Affairs and
International Trade Canada

**EXTERNAL AFFAIRS AND
INTERNATIONAL TRADE CANADA
OTTAWA**

THE U.S. INDUSTRIAL WASTEWATER MANAGEMENT MARKET

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Canada

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EXECUTIVE SUMMARY

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This study aims to give the Canadian environment industry an overview of the American industrial wastewater management market. More specifically, it provides up-to-date information on U.S. environmental legislation and regulations on industrial wastewater, and it identifies the main segments of industry affected as well as technological trends. Market potential and growth projections are presented, as are the principal potential private-sector partners.

LEGISLATION AND REGULATIONS ON INDUSTRIAL WASTEWATER (DOCUMENT 1)

The lynchpin of U.S. legislation affecting industrial wastewater is the Clean Water Act (CWA). Other acts, notably the Resource Conservation and Recovery Act and the Safe Drinking Water Act, may also have the effect of imposing requirements on industrial wastewater.

These acts are administered by the Environmental Protection Agency (EPA), which is also responsible for implementing environment-related national programs, regulations and policies. The individual American states play a role through laws and regulations which go beyond the national requirements in order to solve specific local problems. In addition, authority to administer some of the federal environmental programs has been delegated to the states.

The CWA seeks to re-establish and maintain the physical, chemical and biological integrity of U.S. inland surface waters. It has been amended on several occasions and is subject to re-authorization by the new administration in 1993. Originally focussed on the construction of treatment plants, the Act has expanded to deal with toxic pollutant monitoring, protection and restoration of lakes and estuaries, drainage of farmland, oil spills, stormwaters and nonpoint source pollution in general.

Amendments planned for 1993 will deal with the need to control toxic pollutants at source rather than treat them. This approach will necessitate innovative techniques which will often be specific to a particular industrial process.

NPDES LICENCES

The main mechanism for administering the Act is a licensing program -- the National Pollutant Discharge Elimination System. Companies must have an industrial wastewater licence specifying quality, quantity and restrictions on discharges. Discussions between a company and the environmental authorities are held before the licence is issued. The licence is usually renewable every five years.

STANDARDS FOR INDUSTRIAL EFFLUENTS

The EPA has developed national effluent guidelines for 51 industrial categories. Maximum concentrations for a given pollutant may vary with the category of industry. The standards are based on the degree of reduction attainable through the application of two levels of technology:

- the best practicable technology (BPT) in the case of existing facilities;
- the best available technology (BAT) for new facilities.

In September 1992, the EPA announced its plan for establishing new guidelines: 21 sets of regulations by the year 2003, including regulations for 9 industrial segments by the end of 1996 (see Table 1.3).

Table 1.3 : Industrial Effluent: Guidelines Under Development	
Segment of Industry	**Deadline**
OIL AND GAS EXTRACTION (offshore)	1993
ORGANIC CHEMICALS, PLASTICS AND SYNTHETIC FIBRES	MAY 1993
CHEMICAL PESTICIDES (manufacturing)	JULY 1993
PULP, PAPER AND PAPERBOARD	SEPT 1995
CHEMICAL PESTICIDES (formulation and packaging)	AUG 1995
WASTE TREATMENT	JAN 1996
PHARMACEUTICAL (manufacturing)	FEB 1996
METAL PRODUCTS AND MACHINERY	MAY 1996
OIL AND GAS EXTRACTION (inshore)	JULY 1996

Source: History and Background of the Effluent Guidelines Program, Janet K. Goodwin, EPA, 1992.

In these new regulations, reduction at source will be part of what is considered the Best Available Technology. The EPA will take into consideration changes in manufacturing processes, effects on air/water/soil, impact on energy use and costs.

PRETREATMENT STANDARDS

These standards apply to industrial wastewater being discharged into municipal sewer systems served by publicly owned treatment works (POTWs). According to the EPA, 35% of toxic discharged into surface waters in the Unites States come from companies connected to POTWs.

The pretreatment standards include both general and specific prohibitions applicable to all industries as well as category-based requirements for each segment of industry. These latter requirements appear in the federally developed guidelines applicable to industrial effluent.

In addition to the federal requirements, states and local authorities may require further pretreatment in order to ensure effective operation of POTWs, avoid contamination of sludges or deal with undesirable local environmental impacts.

More severe restrictions can be anticipated for toxic discharged by industry, with a view to achieving very high quality sludges and compliance with water quality criteria.

NEW SLUDGE REGULATION (National Sewage Sludge Rule)

This rule was authorized by the EPA's administrator in November 1992. It sets requirements for heavy-metal and pathogenic micro-organism concentrations, and in the case of incineration, it sets limits on total hydrocarbon concentrations in emissions. Its aim is re-use of sludges as well as their controlled disposal. This is to be achieved through:

- application on farmland, forests, gardens etc;
- disposal at identified surface sites or landfill sites reserved solely for this purpose;
- incineration at facilities set aside for sludges.

NEW NATIONAL REGULATION ON TOXIC POLLUTANTS -- WATER QUALITY CRITERIA (National Toxic Rule)

This regulation, issued in December 1992, sets national water quality standards for toxic pollutants applicable to all states. The criteria are based on risk levels and will mean even more restrictive requirements imposed on POTWs, which will in turn necessitate a higher quality for industrial effluent.

Moreover, POTWs and companies discharging their effluent into what the EPA calls toxic hot spots will have to develop control strategies on a priority basis.

STORMWATERS

Stormwaters from industrial (and municipal) sites will henceforth by subject to NPDES licensing. Stormwater management practices and technologies will be needed to limit the impact of these waters on water quality.

SAFE DRINKING WATER REGULATIONS

These regulations under the Safe Drinking Water Act (SDWA) are of interest in a study of wastewater management because the technologies and treatment methods used are sometimes similar.

No fewer than 25 contaminants will soon be regulated under the SDWA. Appendix 1.2 gives a list of contaminants regulated so far, maximum allowable concentrations, and the Best Available Technology identified by the EPA.

PRINCIPAL SEGMENTS OF INDUSTRY AFFECTED BY WASTEWATER REGULATION (DOCUMENT 2)

The main segments of industry affected by the regulations under the CWA are:

* Chemicals
* Primary metals (especially iron and steel)
* Transportation
* Oil refining
* Pulp and paper
* Metal plating and finishing
* Electronics
* Food

The 51 segments of industry affected by the EPA's effluent guidelines are listed in Appendix 2.1. Those segments subject to new or updated regulations have already been identified.

REGULATED POLLUTANTS

There are two main categories of pollutants regulated by the EPA:

- conventional pollutants such as biological oxygen demand (BOD_5), suspended solids (SS), pH, oils and greases, and micro-organisms (coliforms);

- inorganic toxic such as heavy metals, and organic toxic including dioxins, PCBs and solvents; the list of priority toxic pollutants is given in Appendix 2.3.

TYPES OF TECHNOLOGY

A thorough review of the technologies applicable to industrial wastewater would go beyond the scope of this study. Still, certain technological trends are apparent and should be pointed out:

- Reduction at source

  This includes any process or equipment designed to reduce or even eliminate pollutant formation in the first place, as opposed to recycling or recovery.

- Recovery, recycling and re-use

  With this type of technology, pollutants are recovered and recycled during the process itself, or else they are turned into marketable byproducts.

- Treatment

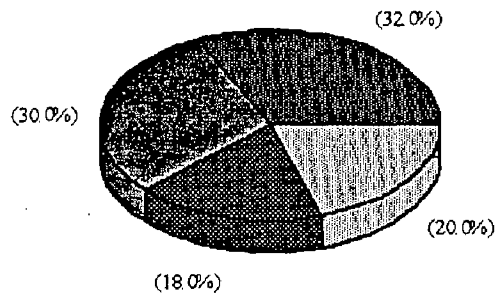
  Treatment should be as near to the source as possible. This avoids mixing of various pollutants, which makes them more difficult to treat.

Certain support technologies are increasingly in demand for environmental applications. Examples are automated process control systems, field and laboratory instrumentation and various software programs.

MARKET POTENTIAL GENERATED BY WASTEWATER REGULATION (DOCUMENT 3)

The U.S. regulations reflect public awareness and pressure, and they are having a huge influence on the demand for goods and services. The North American environment market (including Canada, the U.S. and Mexico) is estimated at $185.1 billion for 1991 (Richard K. Miller & Associates Inc.). The American market alone is estimated at between $120 and $130 billion.

Table 3.1 : Size and Segmentation of the U.S. Environmentai Market - 1991
(+/- $120 billion U.S.)



With regard to the wastewater management market more particularly, Miller & Associates estimate it at $31.4 billion in 1991, distributed as follows:

Capital expenditures	
Industry and public utilities	$ 5.5
Municipalities	$ 11.5
Operations and maintenance expenditures	
Industry	$ 5.1
Municipalities	$ 9.3

The EPA is forecasting that $110.6 billion will be spent on wastewater treatment over the next 20 years.

The lawmakers' emphasis on reduction at source (prevention), as opposed to traditional "end-of-the-line" treatment, will oblige industry and municipalities to innovate technologically and find more flexible and creative financing methods.

SPECIFIC MARKETS - WASTEWATER TREATMENT

William T. Lorenz & Co. has estimated that the capital expenditures of U.S industry on wastewater treatment were $3.6 billion in 1990. Given a 3% annual increase, this would yield a figure of $4.1 billion in 1995.

Capital investments by industry in 1990 were as follows:

Table 3.4 : Percentage Investments in Wastewater Management by Segment of Industry -- U.S. 1990

SECTORS	%
Chemicals	23
Primary metals	13
Transportation	13
Oil refining	9
Pulp and paper	8
Metal plating and finishing	6
Electronics	5
Food	4
Other	19

Source: William T. Lorenz & Co.

The distribution of investment by type of spending was:

- 63% for construction
- 23% for equipment
- 8% for engineering services
- 6% for instrumentation

Pollution control at source necessitates process changes, product reformulation and other changes in operating methods. New technologies for re-use, recycling and treatment of toxic pollutants will be high-growth areas.

Instrumentation, environmental software, and sludge handling and elimination techniques will see significant growth as well.

Demand will also grow for methods of reducing water consumption, recycling water, and decontaminating groundwater and sediment. The next few years will see very high growth potential for inverse osmosis, distillation, chemical extraction, ozonation, and use of ultraviolet and biotechnological methods.

POTENTIAL CANADIAN-AMERICAN PARTNERSHIPS (DOCUMENT 4)

The huge U.S. environment market is not opening up to Canadian firms all by itself. Expertise, financial resources and a willingness to innovate technologically in the face of competition (American primarily, but international as well) are the underlying determining factors.

If Canadian industry wants to be in the forefront of developments, it will have to go beyond mere trade with the U.S; it will have to resolutely and aggressively seek out partnerships and alliances. These are the key to the future.

While the U.S. environment industry certainly wants to control its own domestic market, it is not absolutely out of the question that certain large firms will be open to partnerships with Canadian firms possessing technological expertise so that they can tackle the global market together.

Since only 5% of the strategic alliances entered into by Canadian firms are with American firms, there is certainly room for more partnerships in the environmental area. As an indication of paths worth exploring, Document 4 provides a list of the major firms having contracts with the EPA as well as the main U.S. companies operating in the field of water and wastewater.

INTRODUCTION

SCOPE OF THE STUDY

This study is designed to meet the requirements of Phase I of the General Review and it leads into the other two phases:

PHASE II: Capacity of the Canadian industry to export its technology

PHASE III: U.S. market penetration strategy

Concerning the form of the study:

1- It gives a general overview of the wastewater management portion of the U.S. environmental market.

2- It is divided into four chapters dealing with:

- U.S. legislation and regulations on industrial wastewater;
- the main segments of industry affected by the regulations;
- the market potential generated by the regulations;
- potential U.S. partners.

3- The final report takes the form of four separate documents for distribution to the Canadian industry. The documents aim to raise Canadian interest in the U.S. market.

OBJECTIVES OF THE STUDY

General objectives

Provide the Canadian industry with information that will raise interest in exploring the U.S. wastewater management market and finding American partners with which to open up markets for new technologies.

Specific objectives

Provide the Canadian industry with up-to-date information on U.S. industrial wastewater regulations (Document 1), on the main segments of industry affected by these regulations (Document 2), on the market potential generated by the regulations (Document 3) and on the potential for forming partnerships with major U.S. environmental contractors (Document 4).

CONTEXT OF THE STUDY

Canada can expect to become a world leader in the technology, design and creation of services that will be increasingly in demand as the world economy comes to recognize the importance of sustainable development and adapts to it.
The time may have come to recall Michael Porter's statement that innovation in the context of stricter environmental regulations could bring about an increase in global competitiveness.

Not only have strict regulations given a fresh impetus to Canada, but the country also has the expertise needed to become a leader in numerous environment-friendly technologies.

Strong points which Canada should exploit have come to the fore at international shows such as Globe 92 in Vancouver as well as in the energetic campaign undertaken by Investment Canada in such areas as water treatment and biological mitigation measures[1].

Valued by U.S. industrial associations at $130 billion (US) in 1993, the American environmental market offers significant openings for Canadian business. To penetrate this huge and constantly changing market, companies need to be familiar with U.S. legislation and regulations affecting the areas in which they are involved. They must then join together and form strategic alliances with the main U.S. firms that have contracts with the Environmental Protection Agency -- the motor force behind environmental activities in the United States.

1 Tr.Note: The above four paragraphs are translations from «Prendre les devants» : État de la politique scientifique et technologique du Canada, Ottawa, 1991. (English not available)

DOCUMENT 1

U.S. LEGISLATION AND REGULATIONS ON INDUSTRIAL WASTEWATER

1.1 GENERAL FRAMEWORK OF U.S. ENVIRONMENTAL LEGISLATION AND REGULATIONS

1.1.1 ACCESS TO LEGISLATION

To stay on top of the American environmental market, Canadian firms need to be familiar with the main legislation and regulations affecting their particular sphere of expertise.

This part of the study provides a general overview of the U.S. legislative and regulatory framework in environmental matters. Any technologies, services, equipment or products which Canadian firms bring onto the U.S. environmental market must comply with the legislation and regulations governing it.

The market is a huge one, estimated to be worth over $130 billion (US) in 1993, with $80 billion of this representing the private sector alone. (See Appendix 1.1: U.S. Environmental Industry -- Projected Market Growth).

1.1.2 FEDERAL ENVIRONMENTAL LEGISLATION AND REGULATIONS

On 2 December 1970 President Richard Nixon signed an order stipulating that henceforth all environmental regulatory activities would come under a single new government agency to be known as the Environmental Protection Agency, commonly referred to by its acronym EPA.[2] This brought together the various activities, decisions and areas of concern previously dispersed among several government departments (Health, Education, Interior, Agriculture, etc).

Most U.S. environmental legislation and regulations were developed after 1970, as shown in the following summary history:

2 A list of acronyms and their meanings appears in the GLOSSARY at the end of the study.

Table 1.1: Brief History of U.S. Environmental Legislation*

Year		LEGISLATION*
1970	CAA	Clean Air Act
	USHA	Occupational Safety and Health Act
	NEPA	National Environmental Policy Act
1972	FIFRA	Federal Insecticide, Fungicide and Rodenticide Act
	FWPCA	Federal Water Pollution Control Act
1974	SDWA	Safe drinking Water Act
	HMTA	Hazardous Materials Transportation Act
1976	RCRA	Resource Conservation and Recovery Act
	TSCA	Toxic Substances Control Act
1977	CWA	Clean Water Act - Amendments to the FWPCA-1972
1980	CERCLA	Comprehensive Environmental Response Compensation and Liability Act
	UORA	Used Oil Recycling Act
1984	HSWA	Hazardous and Solid Waste Amendments to RCRA - 1976
1986	EPCRA	Emergency Planning and Community Right-to-Know Act
1987	WQA	Water Quality Act - Amendments to the CWA - 1977
1988	MWTA	Medical Waste Tracking Act
1990	CAAA	Clean Air Act Amendments
	PPA	Pollution Prevention Act
	OPA	Oil Pollution Act

* Acts particularly affecting the industrial wastewater management market are underlined.

Source: National Environmental Technology Applications Corporation 1992

1.1.3 THE ENVIRONMENTAL PROTECTION AGENCY (EPA)

All American environmental activity revolves around this agency. With almost 18,000 employees in 1993, and an annual budget of $7 billion, it oversees the implementation of a multitude of programs that run under the authority of the environmental laws passed by Congress and approved by the President. The Agency is responsible for general policy and for the implementation of U.S environmental legislation and regulations. It is also responsible for practical activities, including for example the preparation of the technical and chemical standards which companies must comply with. Through its 10 regional offices, where almost two-thirds of EPA employees work, the Agency works closely with the states, with local governments and with local groups to apply national legislation and regulations. The remaining third of its employees, located mainly in Washington D.C., see to the implementation of policies and programs and the development of research.

The EPA is thus the heart and the motor of the entire environmental standards framework in the United States.

1.1.4 THE REGULATORY PROCESS

The national environmental laws are supplemented by federal regulations administered by the EPA. The main laws and regulations of concern to us here, those dealing with industrial wastewater, come under the heading "Wastewater Discharges":

Table 1.2 : Wastewater Discharges		
FEDERAL LAW	**CODE**	**FEDERAL REGULATIONS**
Clean Water Act (CWA)*	40 CFR 110	Discharge of Oil
	40 CFR 116	Designation of Hazardous Substances
	40 CFR 122	National Pollutant Discharge Elimination Systems (NPDES) Regulations
	40 CFR 125	Criteria & Standards for the NPDES
	40 CFR 136	Test Procedures for the Analysis of Pollutants
	40 CFR 401	General Provisions for Effluent Guidelines & Standards
	40 CFR 403	Pretreatment Standards
	40 CFR 405	Effluent Guidelines & Standards

* includes the FWPCA of 1972, the CWA of 1977 and the WQA of 1987

Source: National Environmental Technology Apllications Corporation - 1992.

The regulation-making process includes a sequence of compulsory steps that leave room --at each stage -- for significant input by industrial and ecological lobbies and the general public:

1. legislation adopted by Congress
2. preliminary notice of proposed regulation
3. regulation proposed
4. regulation finalized
5. judicial review (from time to time)

The regulation-making process at the state and local government level will often differ from the federal practice.

1.1.5 SHARING OF JURISDICTION

While the EPA is the federal agency responsible for developing and implementing legislation and regulations at the national level, each state has its own environmental legislation and regulations and its own agencies for applying them.
State legislation and regulations must be either similar to or more stringent than federal laws and regulations. The federal legislation - which applies to all the states - has to be taken as a starting point, an incentive to go further. States may also manage federal environmental programs by delegation. An example is the Hazardous Waste Management Program.

1.1.6 REGULATIONS AND TECHNOLOGY

In the 1990s, ecological and economic concerns have become clearly interdependent. Ever since the report of the Brundtland Commission in 1987, the talk everywhere has been of sustainable development. An awareness has taken shape that economic development built on a base of deteriorating resources is no longer viable, and that the environment cannot be protected if development strategies resist taking seriously the costs of environmental destruction.

All levels of government are introducing new laws to face this new environmental challenge. In so doing, they are opening the way for technological innovation and the creation of environmental services.

In the public sector, the development of new technologies is playing a major role. This can be seen in such varied areas as chemical processes, filtering, state-of-the-art biotechnological methods and lasers. U.S environmental legislation and regulations and their aggressive administration by the EPA should inspire Canadian firms to explore the huge American market and seek out partnership opportunities.

1.1.7 THE CLEAN WATER ACT (CWA)

1.1.71 The Act and its Requirements

Objectives

The Clean Water Act is the key American legislation governing the quality of surface inland waters. It seeks to re-establish and maintain the physical, chemical and biological integrity of all U.S. waters. Originally approved in 1956, it has undergone numerous amendments expanding its scope (1961, 65, 66, 70, 72, 77 and 87). In its early years, the Act was focussed mainly on the construction of treatment plants, but later its scope expanded to include monitoring of toxic pollutants in surface waters, protection and restoration of lakes and estuaries, drainage of farmland, oil spills, stormwaters and monitoring of nonpoint source pollutants.

The Water Quality Act (WQA) of 1987 encourages those concerned to voluntarily go beyond the national pollution control standards in order to achieve the best possible environmental results.

Programs

Programs established under the authority of the Act provide for:

- development of municipal and industrial effluent standards;
- control of toxic pollutant discharges;
- control of non-point source pollution (resulting from the erosion of cultivated land and the exploitation of urban, suburban and forest lands);
- prevention of the destruction of wetland habitats.

1.1.72 The Regulations and their Requirements

Licences

The principal regulatory mechanism under the CWA is the issuing of licences under the National Pollutant Discharge Elimination System (NPDES). Licences are required for discharging wastewater whether it be municipal, industrial, commercial or -- in some cases -- agricultural. Beginning in 1993, licences are also required for industrial and municipal stormwaters.

The licence specifies the permitted quantity and quality of discharge and sets out restrictions. It normally lasts for five years.

An NPDES licence specifies well defined criteria under which wastewaters may be discharged into surface waters (rivers, lakes, reservoirs, retention basins, oceans, estuaries, etc).

Some other types of compulsory licensing are worth mentioning even though they go beyond the subject of this report:

- for the treatment, storage and disposal of hazardous wastes;
- for the control of air pollution and the restriction of emissions of certain pollutants into the atmosphere;
- for the management of solid wastes (handling, treatment and disposal).

Effluent[3] Standards

To meet the requirements of the CWA, the EPA has developed national effluent guidelines for 51 categories of industry whose liquid wastes are deemed highly damaging to the environment.

[3] EFFLUENT: a residual liquid which is the byproduct of human activities (for example, wastewater or liquid industrial waste) and may be discharged into the environment. The wastewater may be treated or untreated; it flows out of treatment plants, sewers or industry, usually into surface waters.

The standards, which set maximum concentrations for a given pollutant that may vary with the category of industry, are based on the degree of reduction attainable through the application of two levels of technology:

- the Best Practicable Technology (BPT);
- the Best Available Technology (BAT).

Pretreatment[4] Standards

Firms which discharge their polluted waters into publicly owned treatment works (POTWs) are called indirect dischargers. NPDES licences are not required for such discharges. Under the national pretreatment program, however, industry must treat its own effluent before they go to POTWs.

This pretreatment program imposes three main types of restriction on industry, which will be examined in section 1.2.3.

4 PRETREATMENT: procedures used to reduce, eliminate or change the nature of pollutants found in industrial (not domestic) wastewaters before they enter publicly owned treatment works (POTWs).

1.2 UPDATING OF THE U.S. INDUSTRIAL WASTEWATER REGULATIONS

1.2.1 REGULATORY TRENDS

The CWA was to be reauthorized in 1992, but because of the change in the American administration, reauthorization is now expected some time during 1993.

During Senate subcommittee hearings held in 1992, proposed amendments bore mainly on the need to **reduce toxic pollutants from industry at source** rather than treat them. If these amendments are adopted and approved by the president, the provisions related to nonpoint source pollution adopted in 1990 under the Coastal Zone Management Act will apply to the entire country.

While the reauthorization has not yet been submitted to the President for approval, it is to be expected that the provisions related to prevention will be strengthened. These provisions will bring a need to develop innovative techniques for controlling specific toxic pollutants at source, in each segment of industry. The EPA has already begun the work of reviewing some of its effluent guidelines in the light of this new approach.

1.2.2 NEW GUIDELINES FOR INDUSTRY

In September 1992, the EPA announced its plan for establishing new guidelines for industrial effluent. The plan, which resulted from a legal agreement between the EPA and the Natural Resources Defence Council, foresees 21 new sets of regulations, including nine by 1996 and twelve more by 2003. The nine segments of industry to be subject to new regulations by 1996 are listed on the table below.

Table 1.3 : Industrial Effluent: Guidelines Under Development

Segment of Industry	Deadline
OIL AND GAS EXTRACTION (offshore)	1993
ORGANIC CHEMICALS, PLASTICS AND SYNTHETIC FIBRES	MAY 1993
CHEMICAL PESTICIDES (manufacturing)	JULY 1993
PULP, PAPER AND PAPERBOARD	SEPT 1995
CHEMICAL PESTICIDES (formulation and packaging)	AUG 1995
WASTE TREATMENT	JAN 1996
PHARMACEUTICAL (manufacturing)	FEB 1996
METAL PRODUCTS AND MACHINERY	MAY 1996
OIL AND GAS EXTRACTION (inshore)	JULY 1996

Source: History and Background of the Effluent Guidelines Program, Janet K. Goodwin, EPA, 1992.

As for the twelve other segments to be regulated by 2003, four have already been selected: "waste treatment" and "metals and machinery", which will receive new regulations in 1998 and 1999 respectively, and "laundries" and "transportation equipment cleaning", to be regulated by 1998.

To decide on the remaining eight segments, the EPA will carry out preliminary studies of eleven industries and make the selection on this basis. Two of the studies are already under way -- on "metal plating and finishing" and "petroleum refineries".

Some of the other industries under consideration are:

- iron and steel
- inorganic chemicals

- leather finishing and tanning
- coal mining
- oil and gas extraction (on land)
- textiles.

These industries are covered by existing guidelines, but the EPA takes the view that the toxic pollutant loads are too high (even when concentrations are low) despite use of the Best Available Technology. The preliminary studies will include updates on effluent characteristics and examination of new technologies, including source reduction, recycling and treatment techniques.

In the new regulations, reduction at source will be included in BAT. In this regard, the EPA will have to look at changes in manufacturing processes, effects on air/water/soil, impact on energy use and costs.

To assist in the identification of the potential for source reduction, the Agency has created an advisory group composed of representatives of industry, environmental groups, states and municipalities, consultants and academics. This Industrial Pollution Prevention Project Focus Group (IP3) is a subcommittee of the National Advisory Council for Environmental Policy and Technology and it will greatly influence the type of preventive measures considered when new regulatory guidelines are being established.

1.2.3 PRETREATMENT STANDARDS

The pretreatment standards have been proclaimed under the Clean Water Act -- 40 CFR 403 [Code of Federal Regulations]. They apply to industrial wastewater being discharged into municipal sewer systems served by publicly owned treatment works (POTWs). According to the EPA, 35% of toxics discharged into surface waters in the Unites States come from companies connected to POTWs.

The standards include:

At the federal level

Both general and special prohibitions applicable to all discharges:

- pollutants which are not removed at treatment stations or interfere with their operation;
- corrosive pollutants;
- pollutants which may cause fires or explosions;
- solid or viscous pollutants which may obstruct stations;
- effluent whose temperature exceeds 104°F (40°C).

Category-based standards for each segment of industry:

- restrictions on 126 pollutants deemed by the EPA to be hazardous to health and to the environment;
- restrictions on non-conventional pollutants in each sector (heavy metals, cyanides, PCBs, dioxins etc).

These category-based standards are established along with, and are part of, the guidelines for effluent discharged directly into surface waters.

At the local level

In addition to the federal requirements, local authorities may impose further restrictions in order to ensure stable operation of their POTWs, avoid undesirable environmental impacts or prevent contamination of sewage sludges.

In future, the pretreatment program will impose much more severe restrictions on toxic discharges by industry in order to achieve very high quality sludges and comply with water quality criteria. The program may also include global toxicity standards for effluent (bio-tests or bio-assays).

1.2.4. NEW SLUDGE[5] REGULATION (National Sewage Sludge Rule)

This new rule was authorized by the EPA's administrator in November 1992 and it will soon be published in the Federal Register. It is the result of fifteen years of studies and research and it aims at re-use of sludges together with their controlled disposal through:

- application on farmland, forests, gardens etc;
- disposal at identified surface sites or landfill sites reserved solely for this purpose;
- incineration at facilities set aside solely for sludges.

The Rule sets requirements for heavy-metal and pathogenic micro-organism concentrations, and in the case of incineration, it sets limits on total hydrocarbon concentrations in emissions. It also prescribes sludge management practices to limit exposure of humans and ecosystems.

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5 SLUDGE: semi-solid residues that result from many air and water treatment processes. Sludges are often seen as hazardous wastes.

The main requirements of the Rule appear in Table 1.4:

Table I.4 : Sewage Sludges -- Regulated Pollutants

Pollutants	Application	Disposal	Incineration on land at surface sites
Arsenic	X	X	X
Cadmium	X		X
Chromium	X	X	X
Copper	X		
Lead	X		
Mercury	X		
Molybdenum	X		
Nickel	X	X	X
Selenium	X		
Total hydrocarbons		X	
Zinc	X		

Since POTWs have not been designed to treat to the wide variety of pollutants present in the industrial effluents feeding into them, the sludge rule will require more thorough pretreatment in order to eliminate toxic pollutants and other harmful pollutants originating in industry.

According to the EPA, about 30% of the sludges at POTWs do not meet the requirements of the new rule. The remaining 70% are considered to be of very good quality and can be used like any other fertilizer or soil conditioner. However only a third of these useable sludges are in fact being used. The rule also imposes odour controls, and this calls for various techniques that can also eliminate pathogenic micro-organisms.

1.2.5 STORMWATERS

Stormwaters from industrial and municipal sites are subject to NPDES licensing now that the EPA has acted on a recent court judgment rejecting further delays. Technologies specifically for controlling stormwaters are needed, as well as methods for assessing and for limiting their impact on water quality.

Administrative procedures in this area have yet to be specified. Discussions involving companies, the states and the EPA are under way.

1.2.6. NEW NATIONAL REGULATION ON TOXIC POLLUTANTS -- WATER QUALITY CRITERIA (National Toxic Rule)

This regulation, issued in December 1992, sets national water quality standards for toxic pollutants applicable to all states except those which have adopted more restrictive criteria. The criteria are based on the degree of risk to human health. However there is no consensus on the proposed risk level or on the exposure assumptions used by the EPA; these could therefore be challenged.

The criteria will nevertheless have the effect of imposing very severe concentration limits on POTWs. Again there will have to be extensive pretreatment by firms discharging wastewater into municipal sewers.

The specific limits applicable to a given company are to be set when the NPDES licence is issued or renewed, either directly by the EPA or by those states which have received delegated authority.

POTWs and companies discharging their effluents into what the EPA calls toxic hot spots will have to develop control strategies on a priority basis. Hot spots are areas where the quality of water, sediments and aquatic life is particularly affected by toxic substances.

1.2.7. REGULATIONS UNDER THE SAFE DRINKING WATER ACT (SDWA)

Even though the regulations under the SDWA do not pertain to industrial wastewater, treatment methods and technologies for drinking water may be similar. These regulations are therefore indirectly relevant to our study.

The SDWA was amended in June 1986 to strengthen the regulations affecting both surface waters and groundwater.

Under the Act, the EPA sets objectives and concentration limits for contaminants in drinking water in order to protect human health. The Agency issues primary and secondary regulations in this area.

The National Primary Drinking Water Regulations (NPDWR) specify the maximum allowable contaminant concentrations. A Drinking Water Priority List (DWPL) setting out the priority contaminants has been published and is revised every three years. The 1991 revision includes 77 contaminants and groups of contaminants, 25 of which will soon come under regulations.

A list of contaminants regulated so far, maximum allowable concentrations, and the Best Available Technology identified by the EPA is given in Appendix 1.2 (USEPA Drinking Water Standards and BAT for Regulated Contaminants).

For the reader's guidance, we list below the main technologies required by the drinking water regulations:

AA :	activated alumina
AD :	alternative disinfectants (i.e. other than chlorine)
AX :	anion exchange
CC :	corrosion control
CF :	coagulation - filtration
Cl_2 :	chlorination
D :	disinfection
DEF :	diatomaceous earth filtration
DF :	direct filtration
GAC :	granular activated carbon
IX :	ion exchange
LS :	lime softening
O X :	oxidation
PTA :	packed-tower aeration
RO :	reverse osmosis

The EPA is in the process of preparing new regulations and it will be reviewing existing regulations including the ones for:

Radon	(October 1993)
Arsenic	(1994)
Sulfate	(1994)
Disinfection of groundwater	(August 1994)
Disinfectants and their byproducts	(1993/1994)

Other contaminants are under study with a view to producing regulations in 1994, including:

acrylonitrile
acifluorfen
boron
bromomethane
cyanazine
2.4 / 2.6 dinitrotoluene
hexachlorobutadiene
manganese
molybdenum
dichloropropane
tetrachloroethylene
zinc

APPENDICES

DOCUMENT 1

U.S. ENVIRONMENTAL INDUSTRY - PROJECTED MARKET GROWTH

INDUSTRY SEGMENT	Annual Growth	Projected Revenue ($ Billions)					
		1991	1992	1993	1994	1995	1996
1. Analytical Services	6%	1.7	1.8	2.0	2.1	2.2	2.3
2. Solid Waste Mgmt	5%	27.4	28.5	30.8	32.6	33.9	35.3
3. Haz Waste Mgmt	6%	13.7	14.3	15.6	16.7	17.5	18.4
4. Asbestos Abatement	1%	3.0	3.1	3.2	3.2	3.2	3.1
5. Water Infrastructure	4%	12.5	13.1	13.8	14.5	15.0	15.5
6. Water Utilities	2%	11.8	12.0	12.3	12.5	12.7	13.0
7. Env Consulting/Eng	9%	13.4	14.3	16.4	18.0	19.4	20.6
8. Resource Recovery	10%	15.8	16.7	18.7	20.8	23.0	25.3
9. Instrument Mfg	6%	1.8	1.9	2.1	2.3	2.4	2.5
10. Air Pollution Control	13%	5.3	5.8	6.7	7.7	8.8	9.9
11. Waste Mgmt Equip	7%	11.0	11.6	12.7	13.7	14.6	15.1
12. Env Energy Sources	7%	2.0	2.1	2.2	2.4	2.6	2.8
Total	7%	119	125	136	147	156	164
Composite Annual Growth Rate			4.8%	8.9%	7.4%	6.2%	5.4%

Source: Environmental Business Journal - April 1992

APPENDIX 1.1

USEPA drinking water standards and BAT for regulated contaminants

APPENDIX 1.2

Contaminant	Standards: Regulation	Standards: Status	Standards: MCLG *mg/L*	Standards: MCL *mg/L*	Best Available Technology: Conventional Processes	Best Available Technology: Specialized Processes	Reference
Organics							
Acrylamide	Phase II	Final	zero	TT	Polymer addition practices		34
Alachlor	Phase II	Final	zero	0.002		GAC	34
Aldicarb	Phase II	Delayed	0.001	0.003		GAC	36
Aldicarb sulfone	Phase II	Delayed	0.001	0.002		GAC	36
Aldicarb sulfoxide	Phase II	Delayed	0.001	0.004		GAC	36
Atrazine	Phase II	Final	0.003	0.003		GAC	34
Benzene	Phase I	Final	zero	0.005		GAC; PTA	10
Benzo (a) pyrene	Phase V	Final	zero	0.0002		GAC	40
Carbofuran	Phase II	Final	0.04	0.04		GAC	34
Carbon tetrachloride	Phase I	Final	zero	0.005		GAC; PTA	10
Chlordane	Phase II	Final	zero	0.002		GAC	34
2,4-D	Phase II	Final	0.07	0.07		GAC	34
Dalapon	Phase V	Final	0.2	0.2		GAC	40
Di (2-ethylhexyl) adipate	Phase V	Final	0.5	0.5		GAC; PTA	40
Di (2-ethylhexyl) phthalate	Phase V	Final	zero	0.006		GAC	40
Dibromochloropropane (DBCP)	Phase II	Final	zero	0.0002		GAC; PTA	34
p-Dichlorobenzene	Phase I	Final	0.075	0.075		GAC; PTA	10
o-Dichlorobenzene	Phase II	Final	0.6	0.6		GAC; PTA	34
1,2-Dichloroethane	Phase I	Final	zero	0.005		GAC; PTA	10
1,1-Dichloroethylene	Phase I	Final	0.007	0.007		GAC; PTA	10
cis-1,2-Dichloroethylene	Phase II	Final	0.07	0.07		GAC; PTA	34
trans-1,2-Dichloroethylene	Phase II	Final	0.1	0.1		GAC; PTA	34
Dichloromethane (methylene chloride)	Phase V	Final	zero	0.005		PTA	40
1,2-Dichloropropane	Phase II	Final	zero	0.005		GAC; PTA	34
Dinoseb	Phase V	Final	0.007	0.007		GAC	40
Diquat	Phase V	Final	0.02	0.02		GAC	40
Endothall	Phase V	Final	0.1	0.1		GAC	40
Endrin	Phase V	Final	0.002	0.002		GAC	40
Epichlorohydrin	Phase II	Final	zero	TT	Polymer addition practices		34
Ethylbenzene	Phase II	Final	0.7	0.7		GAC; PTA	34
Ethylene dibromide (EDB)	Phase II	Final	zero	0.00005		GAC; PTA	34
Glyphosate	Phase V	Final	0.7	0.7		OX	40
Heptachlor	Phase II	Final	zero	0.0004		GAC	34
Heptachlor epoxide	Phase II	Final	zero	0.0002		GAC	34
Hexachlorobenzene	Phase V	Final	zero	0.001		GAC	40
Hexachlorocyclopentadiene	Phase V	Final	0.05	0.05		GAC; PTA	40
Lindane	Phase II	Final	0.0002	0.0002		GAC	34
Methoxychlor	Phase II	Final	0.04	0.04		GAC	34
Monochlorobenzene	Phase II	Final	0.1	0.1		GAC; PTA	34
Oxamyl (vydate)	Phase V	Final	0.2	0.2		GAC	40
Pentachlorophenol	Phase II	Final	zero	0.001		GAC	35
Picloram	Phase V	Final	0.5	0.5		GAC	40
Polychlorinated byphenyls (PCBs)	Phase II	Final	zero	0.0005		GAC	34
Simazine	Phase V	Final	0.004	0.004		GAC	40
Styrene	Phase II	Final	0.1	0.1		GAC; PTA	34
2,3,7,8-TCDD (dioxin)	Phase V	Final	zero	5E-08		GAC	40
Tetrachloroethylene	Phase II	Final	zero	0.005		GAC; PTA	34
Toluene	Phase II	Final	1	1		GAC; PTA	34
Toxaphene	Phase II	Final	zero	0.003		GAC	34
2,4,5-TP (silvex)	Phase II	Final	0.05	0.05		GAC	34
1,2,4-Trichlorobenzene	Phase V	Final	0.07	0.07		GAC; PTA	40
1,1,1-Trichloroethane	Phase I	Final	0.2	0.2		GAC; PTA	10
1,1,2-Trichloroethane	Phase V	Final	0.003	0.005		GAC; PTA	40
Trichloroethylene	Phase I	Final	zero	0.005		GAC; PTA	10
Total trihalomethanes†	Interim	Final		0.1	AO; PR; discontinue pre-Cl_2		1
Vinyl chloride	Phase I	Final	zero	0.002		PTA	10
Xylenes (total)	Phase II	Final	10	10		GAC; PTA	34
Inorganics							
Antimony	Phase V	Final	0.006	0.006	C–F‡	RO	40
Arsenic	Interim			0.05			1
Asbestos (fibers/1 >10 μm)	Phase II	Final	7 MFL	7 MFL	C–F‡ DF; DEF; CC		34
Barium	Phase II	Final	2	2	LS‡	IX; RO	34
Beryllium	Phase V	Final	zero	0.001	C–F‡; LS‡	AA; IX; RO	40
Cadmium	Phase II	Final	0.005	0.005	C–F‡ LS‡	IX; RO	34
Chromium (total)	Phase II	Final	0.1	0.1	C–F‡ LS (Cr III)‡	IX; RO	34
Copper	Lead and copper	Final	1.3	TT	CC; SWT		27
Cyanide	Phase V	Final	0.2	0.2	Cl_2	IX; RO	40
Fluoride	Fluoride	Final	4	4		AA; RO	11
Lead	Lead and copper	Final	zero	TT	CC; PE; SWT; LSLR		27
Mercury	Phase II	Final	0.002	0.002	C–F (influent <10 μg/L);‡ LS‡	GAC; RO (influent ≤10 μg/L)	34
Nickel	Phase V	Final	0.1	0.1	LS‡	IX; RO	40
Nitrate (as N)	Phase II	Final	10	10		IX; RO	34
Nitrite (as N)	Phase II	Final	1	1		IX; RO	34

USEPA drinking water standards and BAT for regulated contaminants

Contaminant	Standards: Regulation	Standards: Status	Standards: MCLG mg/L	Standards: MCL mg/L	Best Available Technology: Conventional Processes	Best Available Technology: Specialized Processes	Reference
Nitrate - nitrite (both as N)	Phase II	Final	10	10		IX; RO	34
Selenium	Phase II	Final	0.05	0.05	C-F (Se IV);‡ LS‡	AA; RO	34
Sulfate	Sulfate	Proposed	400/500	400/500	C-F	IX; RO	40
Thallium	Phase V	Final	0.0005	0.002		AA; IX	40
Radionuclides							
Beta-particle and	Interim			4 mrem	C-F		1
photon emitters	Rad	Proposed	zero	4 mrem	C-F	IX;RO	42
Alpha emitters	Interim			15 pCi/L	C-F		1
	Rad	Proposed	zero	15 pCi/L	C-F	RO	42
Radium-226 + 228	Interim			5 pCi/L	C-F		1
Radium-226	Rad	Proposed	zero	20 pCi/L	LS‡	IX; RO	42
Radium-228	Rad	Proposed	zero	20 pCi/L	LS‡	IX; RO	42
Radon	Rad	Proposed	zero	300 pCi/L		Aeration	42
Uranium	Rad	Proposed	zero	20 µg/L	C-F;‡ LS‡	AX; LS	42
Microbials							
Giardia lamblia	SWTR	Final	zero	TT	C-F; SSF; DEF; DF; D		15
Legionella	SWTR	Final§	zero	TT	C-F; SSF; DEF; DF; D		15
Standard plate count	SWTR	Final§	NA	TT	C-F; SSF; DEF; DF; D		15
Total coliforms	TCR	Final	zero	**	D		17
Turbidity	SWTR	Final	NA	PS	C-F; SSF; DEF; DF; D		15
Viruses	SWTR	Final§	zero	TT	C-F; SSF; DEF; DF; D		15

*Abbreviations used in this table: AA—activated alumina; AD—alternative disinfectants; AX—anion exchange; CC—corrosion control; C-F—coagulation-filtration; Cl_2—chlorination; D—disinfection; DEF—diatomaceous earth filtration; DF—direct filtration; GAC—granular activated carbon; IX—ion exchange; LS—lime softening; LSLR—lead service line removal; OX—oxidation; PE—public education; PR—precursor removal; PS—performance standard 0.5-1.0 ntu; PTA—packed-tower aeration; RO—reverse osmosis; SWT—source water treatment; TT—treatment technique

†The sum of the concentrations of bromodichloromethane, dibromochloromethane, tribromomethane, and trichloromethane

‡Coagulation-filtration and lime softening are not BAT for small systems for variances unless treatment is already installed.

§Final for systems using surface water; also being considered for groundwater systems

**No more than 5 percent of the samples per month may be positive. (For systems collecting fewer than 40 samples per month, no more than 1 sample per month may be positive.)

DOCUMENT 2

PRINCIPAL SEGMENTS OF INDUSTRY AFFECTED BY WASTEWATER REGULATIONS

Between 1974 and 1987, the Environmental Protection Agency (EPA) issued regulations for 51 segments of industry, on the basis of the Best Practicable Technology (BPT) for existing factories, and the Best Available Technology (BAT) for new factories built after the regulations went into effect.

The industry segments thus regulated are listed in Appendix 2.1 (Environmental Protection Agency, Parts 400 to 699).

New industries which will be subject to regulation in the future are identified in Document 1 (U.S. Legislation and Regulations on Industrial Wastewater, section 1.2.2.: New Guidelines for Industry). See also Appendix 2.2 of this Document.

2.1 REGULATED POLLUTANTS

There are two main categories of pollutants regulated by the EPA:

- conventional pollutants;
- inorganic toxics.

Conventional pollutants defined under the Clean Water Act (CWA) include:

- biological oxygen demand (BOD_5)
- suspended solids (SS)
- pH (a measure of acidity/alkalinity)
- oils and greases
- pathogenic micro-organisms (coliforms)

Toxic pollutants may be organic or inorganic. They are hazardous to aquatic animal and plant life in very low concentrations. The list of 126 priority toxic pollutants appears in Appendix 2.3. Included are dioxins, PCBs, solvents and heavy metals. Only pollutants specific to a given segment of industry are included in the effluent guidelines.

2.2 TYPES OF TECHNOLOGY

It is not possible in a general overview to give a complete review of all the technologies applicable to each segment of industry. Still, certain technological trends are apparent and should be pointed out:

2.2.1 REDUCTION AT SOURCE[6]

This includes any process designed to reduce or eliminate pollutant formation in the first place, as opposed to recycling or recovery.

Information obtained from the EPA, together with reports from the Senate and House subcommittee hearings in connection with re-authorization of the CWA, testify to the importance accorded by U.S. legislative and regulatory bodies to reduction at source, as opposed to maintaining the traditional approach of pretreatment (before the pollutants enter the treatment plant).

6 Reduction at source includes any modification to equipment, technologies, processes or operational procedures; the reformulation or design of a product; the substitution of raw materials, and improvements in the maintenance of facilities, training of personnel and inventory control.

2.2.2 RECOVERY, RECYCLING AND RE-USE

When it is not possible to reduce at source and thus prevent the formation of a pollutant, the next best thing is technologies to recover, recycle and re-use. With this type of technology, pollutants are recycled during the process itself, or else they are turned into marketable byproducts or byproducts which are useable in other industrial operations.

2.2.3 TREATMENT

While the emphasis is henceforth to be on preventive reduction, treatment methods are still needed. Treatment should be as near to the source as possible in order to avoid mixing of various pollutants, which can produce synergistic effects and make them more difficult to treat.

This category includes disinfecting techniques that generate no harmful byproducts.

2.3 SUPPORT TECHNOLOGIES

The new technologies require control, measurement and decision support systems if they are to operate properly from the point of view of both environmental quality and productivity.

2.3.1 AUTOMATED CONTROL SYSTEMS

Automated process control systems increasingly incorporate environmental parameters. Environmental protection is incorporated into the operating parameters of processes and the formation of undesirable pollutants is thus prevented.

2.3.2 INSTRUMENTATION

Measuring instruments are increasingly needed for ongoing monitoring of operating parameters or for analyzing undesirable emissions. These detectors or analyzers are often connected to the automated control system.

Ever more sophisticated laboratory instruments such as gas chromatographs and plasma spectrometers are needed to rapidly analyze organic and inorganic compounds.

2.3.3 MANAGEMENT TOOLS

These are software packages which incorporate all the air/water/soil parameters, allowing more effective environmental management.

APPENDICES

DOCUMENT 2

Environmental Protection Agency
(EPA) Parts 400 to 699

CHAPTER I—ENVIRONMENTAL PROTECTION AGENCY—(Continued)

SUBCHAPTER N—EFFLUENT GUIDELINES AND STANDARDS

Industrial Effluents: Guidelines Under Development

Segment of Industry	Deadline
OIL AND GAS EXTRACTION (offshore)	1993
ORGANIC CHEMCIALS, PLASTICS AND SYNTHETIC FIBRES	MAY 1993
CHEMICAL PESTICIDES (manufacturing)	JULY 1993
PULP, PAPER AND PAPERBOARD	SEPT 1995
CHEMICAL PESTICIDES (formulation and packaging)	AUG 1995
WASTE TREATMENT	JAN 1996
PHARMACEUTICALS (manufacturing)	FEB 1996
METAL PRODUCTS AND MACHINERY	MAY 1996
OIL AND GAS EXTRACTION (inshore)	JULY 1996

Source: History and Background of the Effluent Guidelines Program, Janet K. Goodwin, EPA, 1992.

In September 1992, the EPA announced its plan for establishing new guidelines for industrial effluents. The plan, which resulted from a legal agreement between the EPA and the Natural Resources Defence Council, foresees 21 new sets of regulations, including nine by 1996 and twelve more by 2003.

Toxic Pollutants Regulated Under Categorical Standards

1. acenaphthene
2. acrolein
3. acrylonitrile
4. benzene
5. benzidine
6. carbon tetrachloride
7. chlorobenzene
8. 1,2,4 trichlorobenzene
9. hexachlorobenzene
10. 1,2-dichloroethane
11. 1,1,1 trichloroethane
12. hexachloroethane
13. 1,1-dichloroethane
14. 1,1,2-trichloroethane
15. 1,1,2,2-tetrachloroethane
16. chloroethane
17. bis(2-chloroethyl) ether
18. 2 chloroethyl vinyl ether (mixed)
19. 2 chloronaphthalene
20. 2,4,6-trichlorophenol
21. parachlorometa cresol
22. chloroform (trichloromethane)
23. 2-chlorophenol
24. 1,2-dichlorobenzene
25. 1,3-dichlorobenzene
26. 1,4-dichlorobenzene
27. 3,3 dichlorobenzidine
28. 1,1 dichloroethylene
29. 1,2-trans dichloroethylene
30. 2,4 dichlorophenol
31. 1,2-dichloropropane
32. 1,2-dichloropropylene (1,3 dichloropropene)
33. 2,4-dimethylphenol
34. 2,4-dinitrotoluene
35. 2,6-dinitrotoluene
36. 1,2 diphenylhydrazine
37. ethylbenzene
38. fluoranthene
39. 4 chlorophenyl phenyl ether
40. 4 bromophenyl phenyl ether
41. bis(2-chloroisopropyl) ether
42. bis(2-chloroethoxy) methane
43. methylene chloride (dichloromethane)
44. methyl chloride (chloromethane)
45. methyl bromide (bromomethane)
46. bromoform (tribromomethane)
47. dichlorobromomethane
48. chlorodibromomethane
49. hexachlorobutadiene
50. hexachlorocyclopentadiene
51. isophorone
52. naphthalene
53. nitrobenzene
54. 2-nitrophenol
55. 4-nitrophenol
56. 2,4-dinitrophenol
57. 4,6-dinitro-o-cresol
58. N-nitrosodimethylamine
59. N-nitrosodiphenylamine
60. N-nitrosodi-n propylamine
61. pentachlorophenol
62. phenol
63. bis(2-ethylhexyl) phthalate
64. butyl benzyl phthalate
65. di-n-butyl phthalate
66. di-n-octyl phthalate
67. diethyl phthalate
68. dimethyl phthalate
69. benzo(a)anthracene (1,2-benzanthracene)
70. benzo(a)pyrene (3,4-benzo-pyrene)
71. 3,4-benzofluoranthene (benzo(b)fluoranthene)
72. benzo(k)fluoranthene (11,12-benzofluoranthene)
73. chrysene
74. acenaphthylene
75. anthracene
76. benzo(ghi)perylene (1,12-benzoperylene)
77. fluorene
78. phenanthrene
79. dibenzo(a,h)anthracene (1,2,5,6-dibenzanthracene)
80. indeno (1,2,3-cd)pyrene (2,3-o-phenylenepyrene)
81. pyrene
82. tetrachloroethylene
83. toluene
84. trichloroethylene
85. vinyl chloride (chloroethylene)
86. aldrin
87. dieldrin
88. chlordane (technical mixture & metabolites)
89. 4,4-DDT
90. 4,4-DDE (p,p-DDX)
91. 4,4-DDD (p,p-TDE)
92. Alpha Endosulfan
93. Beta Endosulfan
94. endosulfan sulfate
95. endrin
96. endrin aldehyde
97. heptachlor
98. heptachlor epoxide (BHC-hexachlorocyclohexane)
99. Alpha BHC
100. Beta-BHC
101. Gamma BHC (lindane)
102. Delta BHC (PCB-polychlorinated biphenyl)
103. PCB-1242 (Arochlor 1242)
104. PCB-1254 (Arochlor 1254)
105. PCB-1221 (Arochlor 1221)
106. PCB-1232 (Arochlor 1232)
107. PCB-1248 (Arochlor 1248)
108. PCB-1260 (Arochlor 1260)
109. PCB-1016 (Arochlor 1016)
110. toxaphene
111. antimony (total)
112. arsenic (total)
113. asbestos (total)
114. beryllium (total)
115. cadmium (total)
116. chromium (total)
117. copper (total)
118. cyanide (total)
119. lead (total)
120. mercury (total)
121. nickel (total)
122. selenium (total)
123. silver (total)
124. thallium (total)
125. zinc (total)
126. 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)

DOCUMENT 3

THE MARKET POTENTIAL GENERATED BY WASTEWATER REGULATION

GENERAL COMMENTS

Several evaluations exist of the U.S. environmental market. However it is difficult to compare them because of their differing definitions and differing coverage of recent trends. Caution is therefore called for when interpreting them.

Our study of the main components of this market is based principally on the estimates of Richard K. Miller & Associates Inc. (Environmental Markets 1992 - 1995). In addition, it draws on publications of the Environmental Business Journal (San Diego, CA), studies by NETAC (National Environmental Technology Applications Corporation - Pittsburgh) and estimates by William T. Lorenz & Co (Concord, NH).

3.1 GENERAL OVERVIEW OF THE U.S. ENVIRONMENTAL MARKET

The regulations are affecting the demand for environmental goods and services. The number and diversity of regulations, especially since the EPA was established in 1970, are obliging industry to continuously expand its knowledge of the regulations in order to serve customers effectively.

The legislation and regulations, often reflecting public pressure and awareness, are the market's motor force. The market is changing rapidly, which makes it difficult to give a precise assessment of its size and targets.

Alongside significant university/business partnerships, government/industry partnerships are developing rapidly.

This collaborative effort manifests itself as confidence invested by legislators and political strategists in the suggestions, initiatives and technologies of industry. In addition, many business people are taking an interest in the trend toward privatization of infrastructures.

Now that the environmental authorities have decided to emphasize prevention, we will be seeing improvements in processes that permit reduction at source, as opposed to traditional "end-of-the-line" treatments. This legislative initiative is opening the way to environmental engineering and the creation of new technologies.

3.1.1 THE NORTH-AMERICAN AND U.S. ENVIRONMENTAL MARKETS

The North-American Market (United States - Canada - Mexico)

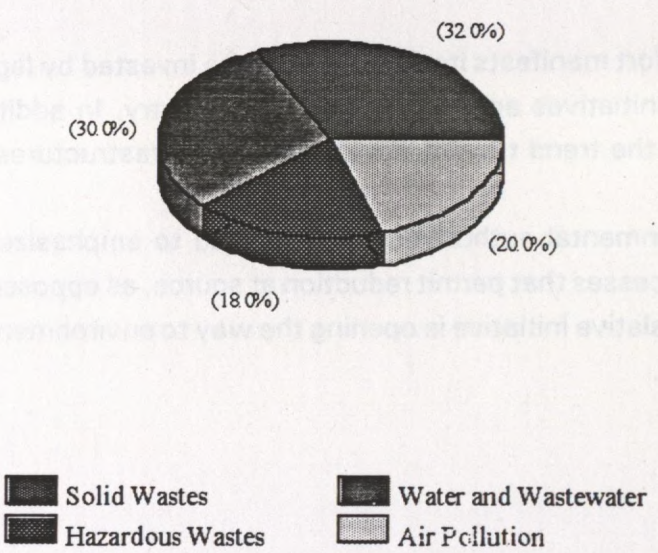
In the summary of his study of environmental markets, Richard K. Miller estimates the North-American environmental market at $185.1 billion for 1991. Note that this figure includes all levels of government as well as the private sector. Water and wastewater management represents $31.4 billion of the total.

The U.S. Market

The U.S. environmental market has been described since 1988 in the Environmental Business Journal published by EnviroQuest Inc. (San Diego CA). It is divided into 12 segments and its value is estimated at about $120 billion for 1991, of which $41 billion represents the public sector and a little more than $78 billion the private sector. (See in Appendix 3.1 the two tables "U.S. Environmental Industry Segments - 1991" and "U.S. Environmental Industry - Projected Market Growth.)

Based mainly on these data, NETAC has estimated the U.S. market for 1991 in terms of four segments (see Table 3.1).

Table 3.1 : Size and Segmentation of the U.S. Environmental Market - 1991
(+/- $120 billion U.S.)



Another approach, by William T. Lorenz and Co., estimates the U.S. environmental market at $130 billion for 1991, of which $78 billion represents the private sector (industrial and commercial businesses). Lorenz describes the market by segments and by sector (see Table 3.2).

Table 3.2 : The U.S. Environmental Market - 1991

	US $billion	%
BY SEGMENT		
Air	33	25
Wastewater	52	40
Solid and toxic wastes	45	35
Total:	130	100%
BY SECTOR		
Industrial and commercial enterprises	78	60
Municipal governments	29	22
Federal government	19	15
State governments	4	3
Total:	130	100%

Source: William T. Lorenz & Co.

3.1.2 THE WASTEWATER MANAGEMENT MARKET

According to Miller, the $ 31.4 billion spent by the North-American public and private sectors in 1991 on water and wastewater management (services, products, treatment facilities and equipment) was distributed as follows:

Table 3.3 : The North-American Water and Wastewater Management Market - 1991

	(millions of US$)
Capital expenditures - private industry and public utilities	$ 5.5
Capital expenditures of municipalities (water treatment and sewers)	11.5
Operating and maintenance expenditures - industry	5.1
Operating and maintenance expenditures - municipalities	9.3

Note: The above amounts do not include engineering consultation services, laboratory analysis services, monitoring costs or research and development.

Source: Richard K. Miller & Associés inc.

The municipal wastewater treatment market has stabilized but the market for treatment of industrial wastewater containing hazardous wastes is in a state of ongoing expansion.

Stricter regulations on discharges combined with the need to think in terms of prevention and reduction at source are forcing the municipal and industrial wastewater treatment sectors to consider more effective technologies and more flexible and creative methods of funding for the coming years.

In its 1992 Needs Survey concerning wastewater treatment, the EPA points out that federal, state and municipal governments need to plan for expenditures in the order of $80.4 billion over the next twenty years for the construction and improvement of public treatment works. Adding to this an estimated $ 30.2 billion for the actual treatments, the EPA estimates the total national need at $110.6 billion.

At the risk of repetition, we can assert that all estimates of the environmental market suggest numerous business opportunities opening up in the 1990s. Systems, equipment and services connected with waste management and pollution control will see an expanding market over the next decade.

The EPA predicts that by the year 2000, environmental expenditures will reach a level at least 50% higher than at present, precisely because of the enforcement of existing legislation.

3.2 SPECIFIC MARKETS

According to William T. Lorenz & Co., in 1990 U.S. industry made capital investments of $3.6 billion in wastewater treatment. Given a 3% annual increase, this would yield a figure of $4.1 billion in 1995. Table 3.4 shows how the investments are distributed:

Table 3.4 : Percentage Investments in Wastewater Management by Segment of Industry -- U.S. 1990

SECTORS	%
Chemicals	23
Primary metals	13
Transportation	13
Oil refining	9
Pulp and paper	8
Metal plating and finishing	6
Electronics	5
Food	4
Other	19

Source: William T. Lorenz & Co.

NOTE : Public utilities invested an additional $1.1 billion in 1990 but no growth is predicted for the coming years.

In 1990, 63% of investments were for construction, 23% for equipment, 8% for engineering and 6% for instrumentation.

3.2.1 CONTROL AT SOURCE

Control of pollution at source, in other words prevention, is the approach favoured by the legislation and by the industry. Specific technologies will be needed for each application, sometimes with quite sophisticated computerization and instrumentation.

These technologies will not only help solve the problems of earth, air and water pollution but will often save industry money because they encourage better utilization of resources and reduce treatment and disposal costs. The programs undertaken by companies such as 3M, Dow Chemical, Polaroid, Monsanto and Allied Signal are concrete examples of this trend. Thus 3M's «Pollution Prevention Pays» program and Dow Chemical's «Waste Reduction Always Pays» program have saved many hundreds of millions of dollars.

All these programs have involved a critical examination of processes, operating methods and raw materials by internal working groups supported where necessary by outside consultants, as well as a firm commitment by senior management.

3.2.2 NEW TECHNOLOGIES

New technologies to control organic and inorganic toxics and to recover, recycle and re-use "waste" materials in industrial wastewater represent an area of enormous opportunity in the coming years.

3.2.3 CHEMICALS

The industrial wastewater management market is highly fragmented and contains numerous suppliers offering a variety of technologies and services, specialized chemicals and ever more sophisticated equipment.

According to Kline and Co (Fairfield, NJ), the market in chemicals to treat industrial wastewater grew 10% in 1990, with sales reaching $465.0 million -- about 20% of the total market for water treatment chemicals.

The growing demand for specialized chemicals and automated systems to measure them are giving rise to a rapidly developing service industry.

3.2.4 PRETREATMENT

With the growing need for pretreatment, some U.S. industries are having recourse to pre-assembled treatment systems that can be installed with a minimum of connection work. These systems are sometimes operated on a subcontracting basis.

3.2.5 HANDLING AND DISPOSAL OF SLUDGE

This is a significant market because of the need to purchase filter presses, centrifuges and vacuum filters.

3.2.6 ENVIRONMENTAL INSTRUMENTATION

This is an area with significant growth potential estimated at 15% annually. According to Richard K. Miller and Associates Inc., the North-American market in 1991 was $1.4 billion, 58% of which was related to water. Instrumentation for immunoassays, continuous monitoring, remote sensing and gas chromatography are clear examples.

3.2.7 ENVIRONMENTAL SOFTWARE

These information management tools are in high demand. Growth in this market is estimated at 20% annually for the next five years. Richard K. Miller and Associates Inc. estimate that the market in 1991 was $ 600 million. However there is no figure for the proportion of software specific to industrial wastewater.

Geographical information systems (GISs) are expanding rapidly. Development of interactive decision support systems (IDSSs) and expert systems for the environment are growth areas because of the huge amount of data and the vast number of factors that are now needed to make a decision.

3.2.8 DRINKING WATER

New, sophisticated technologies will also be needed for drinking water, and this should be of interest to suppliers of water purification equipment.

Inverse osmosis, distillation, ozonation, ultraviolet, chemical extraction and biotechnological methods will have very high growth potential over the next few years not only in the area of drinking water but also as methods for decontaminating industrial wastewater. There is a growing demand for processes to help recycle water and reduce its consumption as well as processes for decontaminating groundwater and sediment.

CONCLUSION

The environmental market is changing rapidly and it increasingly involves co-operation among universities, industry and government. The North-American market (United States - Canada - Mexico) is estimated at $185 billion and the U.S. market at between $120 and $130 billion in 1991, with the private sector alone representing $78 billion of this.

In the area of industrial wastwater, 1990 and 1991 saw capital investments of some $5 billion by private-sector industry and public utilities:

according to Miller:	industry + utilities	=	$ 5.5 billion (1991)
according to Lorenz:	ind. $ 3.6 + utilities $ 1.1	=	$ 4.7 billion (1990)

Development of new technologies for industry is being strongly affected by environmental regulations. The EPA is stressing reduction at source rather than "end-of-the-line" treatment, and the most recent technological trends are reflecting this. (See Appendix 3.2: Summary of Investment by U.S. Private-Sector Firms in the Industrial Wastewater Management Market and Summary of Technological Trends).

APPENDICES

DOCUMENT 3

U.S. ENVIRONMENTAL INDUSTRY SEGMENTS - 1991

INDUSTRY SEGMENT	PUBLIC COMPANIES			PRIVATE COMPANIES			Estimated Total Revenue ($ Bil)
	# Cos.	Total Ann. Rev. ($ Mil)	Average Rev./Co. ($Mil)	Approx. # Cos.	Total Ann. Rev. ($ Mil)	Average Rev./Co. ($ Mil)	
1. Analytical Services	5	47	9	1500	1700	1.1	1.7
2. Solid Waste Mgmt	16	14409	901	5200	13000	2.5	27.4
3. Haz Waste Mgmt	35	4172	119	2800	9500	3.4	13.7
4. Asbestos Abatement	12	966	81	2500	2000	0.8	3.0
5. Water Infrastructure	25	6488	260	2500	6000	2.4	12.5
6. Water Utilities	13	1695	130	24000	10100	0.4	11.8
7. Env Consulting/Eng	24	4318	180	6800	9100	1.3	13.4
8. Resource Recovery	23	4534	197	5100	11200	2.2	15.8
9. Instrument Mfg	13	777	60	300	1100	3.5	1.8
10. Air Pol Control	16	1246	78	1200	4100	3.4	5.3
11. Waste Mgmt Equip	16	2015	126	6000	9000	1.5	11.0
12. Env Energy Sources	9	373	42	800	1600	2.0	2.0
Total:	207	41040	198.3	58700	78400	1.3	119.4

Source: Environmental Business Journal - April 1992

APPENDIX 3.1

U.S. ENVIRONMENTAL INDUSTRY - PROJECTED MARKET GROWTH

INDUSTRY SEGMENT	Annual Growth	Projected Revenue ($ Billions)					
		1991	1992	1993	1994	1995	1996
1. Analytical Services	6%	1.7	1.8	2.0	2.1	2.2	2.3
2. Solid Waste Mgmt	5%	27.4	28.5	30.8	32.6	33.9	35.3
3. Haz Waste Mgmt	6%	13.7	14.3	15.6	16.7	17.5	18.4
4. Asbestos Abatement	1%	3.0	3.1	3.2	3.2	3.2	3.1
5. Water Infrastructure	4%	12.5	13.1	13.8	14.5	15.0	15.5
6. Water Utilities	2%	11.8	12.0	12.3	12.5	12.7	13.0
7. Env Consulting/Eng	9%	13.4	14.3	16.4	18.0	19.4	20.6
8. Resource Recovery	10%	15.8	16.7	18.7	20.8	23.0	25.3
9. Instrument Mfg	6%	1.8	1.9	2.1	2.3	2.4	2.5
10. Air Pollution Control	13%	5.3	5.8	6.7	7.7	8.8	9.9
11. Waste Mgmt Equip	7%	11.0	11.6	12.7	13.7	14.6	15.1
12. Env Energy Sources	7%	2.0	2.1	2.2	2.4	2.6	2.8
Total	7%	119	125	136	147	156	164
Composite Annual Growth Rate			4.8%	8.9%	7.4%	6.2%	5.4%

Source: Environmental Business Journal - April 1992

Summary of Investment by U.S. Private-Sector Firms in the Industrial Wastewater Management Market and Summary of Technological Trends

The 1990 market : $ 3.6 billion (capital expenditures - private sector)

Segment	% of market	Activities	% of market
Chemicals	23	Construction	63
Primary metals	13	Equipment	23
Transportation	13	Engineering	8
Oil refining	9	Instrumentation	6
Pulp and paper	8		
Metal plating and finishing	6		
Electronics	5		
Food	4		
Other	19		

Technological trends:

Control at source

- new production processes
- new equipment
- improved operating procedures
- product reformulation
- new raw materials
- training
- inventory control

Recovery, recycling and re-use

- recycling during the production process
- reduction of volumes and quantities
- turning wastes into useful byproducts

Source : William Lorenz & Co.

APPENDIX 3.2
(Continued)

	Treatment - as close to source as possible - no generation of harmful byproducts - inverse osmosis, ozonation, ultraviolet, distillation, chemical extraction, biotechnological methods - decontamination of groundwater and sediment - decontamination and handling of sludges
Support technologies	. automated process control systems . field instrumentation (detectors, analyzers etc) and lab instruments (chromatography etc) . software and decision support systems (GIS etc.)

DOCUMENT 4

POTENTIAL CANADIAN-AMERICAN PARTNERSHIPS

POTENTIAL CANADIAN-AMERICAN PARTNERSHIPS

Environmental services markets often appear when a law is passed, expand for a few years and then drop back to a subsistence level. This short cycle means that few companies are in a position to devote themselves entirely to environment-related activities or to make long-term plans in this field.[1]

"The environmental market will not automatically belong to Canadian companies. Canadian firms can expect competition from foreign companies, particularly U.S., Japanese and European firms, in most market segments. These foreign firms, especially the U.S. based firms, represent a significant threat to Canadian environment companies because of their financial resources, skills and experience."[2]

"The key element for Canadian...firms is to ride their own niche areas of expertise into the U.S. market using the broadest possible network of contacts, information, and alliances."[3]

There are countless examples of Canadian inventions which have not been used, either because methods of industrial production at a competitive price were lacking or because no marketing effort was made.

A product is the result of the meeting of technical discoveries with needs expressed by a market, indicating that a certain problem needs to be solved or a certain need satisfied. This encounter of technological potential with the market is one of the most important features of modern society.

In this respect, the United States has already spent considerable sums on large environmental programs and consequently they enjoy a certain advantage over Canadian firms. However certain Canadian companies have developed expertise in water and wastewater and they should work to develop niches on the huge U.S. market. For this purpose, a key tool must be partnerships and strategic alliances with big American companies. It is necessary to go beyond mere trade and move resolutely toward alliances. This will allow aggressive Canadian firms to place themselves advantageously on the U.S. environmental market without necessarily having to make enormous investments. The result will be savings in time and money, as well as a focus on what each partner

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1 Les alliances stratégiques ; passeport pour l'Europe, Canada-Europe 1992, External Affairs and International Trade Canada, p. 62. [original English not available]

2 Human Resources in the Environment Industry (Summary Report), Employment and Immigration Canada, November 1992, p. 10.

3 Penetrating the U.S. Environmental Market : Prospects and Strategies for Canadian Consulting Engineers, U.S. Eastern Seaboard Focus, External Affairs and International Trade Canada, February 1992, p. iii.

One of the main ways for Canadian industry to penetrate the U.S. market would be partnerships with the main firms that have EPA contracts and with the main American companies that have recognized expertise in this or that aspect of the environment.

4.1 THE ENVIRONMENTAL PROTECTION AGENCY (EPA)

All American environmental activity revolves around this agency, which was set up in 1970. With almost 18,000 employees in 1993, and an annual budget of $7 billion, it oversees the implementation of a multitude of programs that run under the authority of the environmental laws passed by Congress and approved by the President.

The Agency is responsible for general policy and for the implementation of U.S environmental legislation and regulations. It is also responsible for practical activities, including for example the preparation of the technical and chemical standards which companies must comply with.

Through its 10 regional offices, where almost two-thirds of EPA employees work, the Agency works closely with the states, with local governments and with local groups to apply national legislation and regulations. The remaining third of its employees, located mainly in Washington D.C., see to the implementation of policies and programs and the development of research.

The EPA is thus the heart and the motor of the entire environmental standards framework in the United States. It is the agency targeted by the well-known lobbies, and it is also the agency which awards huge environmental contracts to a few prime contractors.

Available data show that 70% of alliances made by Canadian companies are with other Canadian firms, 15% are with Europeans, 10% with Japanese (and the Pacific region) and only 5% with Americans. There is room here for partnership efforts.

4.2 MAJOR EPA CONTRACTORS[10]

ABB Environmental Services, Inc.
261 Commercial Street
Portland, ME 04101
207/775-5401

Bechtel Corporation
50 Beale Street
P.O.Box 2965
San Franciso, CA 94119

Black & Veatch Consulting Engineers
1500 Meadow Lake Parkway
Kansas City, MO 64114

Camp Dresser McKee, Inc.
One Cambridge Center
Cambridge, MA 02142
617/621-8181

CH2M Hill
6060 South Willow Drive
Englewood, CO 80111
303/771-0900

Donohue & Associates
4738 N. 40th Street
Sheboygan, WI 53083
414/458-8711

Ebasco Services, Inc.
160 Chubb Avenue
Lyndhurst, NJ 07071
201/460-6075

Ecology & Environment, Inc.
Buffalo Corporate Center
368 Pleasantview Drive
Lancaster, NY 14086
716/684-8060

Halliburton NUS Environmental Corp.
910 Clopper Road
Gaithersburg, MD 20877
301/258-6000

ICF Kaiser Engineers
1800 Harrison Street
Oakland, CA 94912
415%268-6000

Jacobs Engineering Co.
521 S. Lake Avenue
Pasadena, CA 91109

Malcolm Pirnie, Inc.
2 Corporate Park Drive
White Plains, NY 10602
914/694-2100

Metcalf & Eddy Companies, Inc.
P.O.Box 4043
Wakefield, MA 01880
617/246-5200

OHM Corporation
16406 U.S. Route 224E
P.O.Box 551
Findlay, OH 45839
419/423-3526

PRC Environmental Management, Inc.
303 E. Wacker Drive, suite 500
Chicago, IL 60601
312/856-8700

Roy F. Weston, Inc.
1 Weston Way
West Chester, PA 19380-1499
215/692-3030

10 Source: NETAC - National Environmental Technology Applications Corporation (Pittsburgh)

4.3 MAJOR U.S. ENVIRONMENTAL COMPANIES - WATER AND WASTEWATER

Private Companies

AMERICAN PACIFIC CORPORATION
One Quality Way
Trevose, PA 19053
215/355-3300

BETZ INDUSTRIAL
4045 S. Spencer Street Suite B-28
Las Vegas, NV 89119
702/735-2200

CALGON CARBON CORPORATION
P.O. Box 717
Pittsburgh, PA 15230
412/787-6700

CAMP, DRESSER & McKEE INC.
Cambridge Center
Cambridge, MA 02142
617/621-8181

DAVIS WATER & WASTE INDUSTRIES
2650 Tallevast Road
Tallevast, FL 34270
813/355-2971

DUPONT SAFETY & ENVIRONMENTAL
RESOURCES DIV.
1007 Market Street
Wilmington, DE 19898
302/992-3666

LANCY ENVIRONMENTAL SERVICES CO.
181 Thorn Hill Road
Warrendale, PA 15086
412/772-1257

METCALF & EDDY CO. INC.
P.O. Box 4043
Wakefield, MA 01880
617/246-5200

NALCO CHEMICALS CO.
One Nalco Center
Naperville, IL 60563 708/304-1000

Public Utilities

AMERICAN WATER WORKS CO., INC.
1025 Laurel Oak Road
Voorhees, NJ 08043
609/346-8200

AQUA CORPORATION
P.O. Box 546
Lexington, KY 40585
606/278-5412

CALIFORNIA WATER SERVICE CO.
1720 N. 1st Street
San Jose, CA 95112
408/298-1414

GWC CORPORATION
P.O. Box 6508
Wilmington, DE 19804
302/663-5918

UNITED WATER RESOURCES
200 Old Hook Road
Harrington Park, NJ 07640
201/784-9434

USEFUL ADDRESSES

ENVIRONMENTAL BUSINESS JOURNAL
P.O. Box 371769
San Diego, CA 92137-1769
619/295-7685

NATIONAL ENVIRONMENTAL
TECHNOLOGY APPLICATIONS CORP.
615 William Pitt Way
Pittsburgh, PA 15238
412/826-5511

RICHARD K. MILLER & ASSOCIATES INC.
5880 Live Oak Parkway Suite 270
Norcross, GA 30093

WATER ENVIRONMENTAL FEDERATION
(40,000 members)
601 Wythe Street
Alexandria, VA 22314
703/684-2470

WILLIAM T. LORENZ & CO.
85 Warren Street
Concord, NH 03301
603/228-3373

U.S. ENVIRONMENTAL
PROTECTION AGENCY
Office of Water Resource Center (WH-556)
401 M Street, S.W.
Washington, DC 20460
202/260-7786

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GLOSSARY OF ACRONYMS

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AWWA	-	American Water Works Association
BAT	-	Best Available Technology
BPT	-	Best Practicable Technology
CAA	-	Clean Air Act
CERCLA	-	Comprehensive Environmental Response, Compensation and Liability Act
CFR	-	Code of Federal Regulations
CWA	-	Clean Water Act
BOD_5	-	Biological Oxygen Demand (over 5 days)
EPA / USEPA	-	U.S. Environmental Protection Agency
EBJ	-	Environmental Business Journal
FWPCA	-	Federal Water Pollution Control Act
NETAC	-	National Environmental Technology Applications Corporation
NPDES	-	National Pollutant Discharge Elimination System
POTWs	-	Publicly Owned Treatment Works
RCRA	-	Resource Conservation and Recovery Act
SDWA	-	Safe Drinking Water Act
TSCA	-	Toxic Substances Control Act
WEF	-	Water Environmental Federation
WQA	-	Water Quality Act