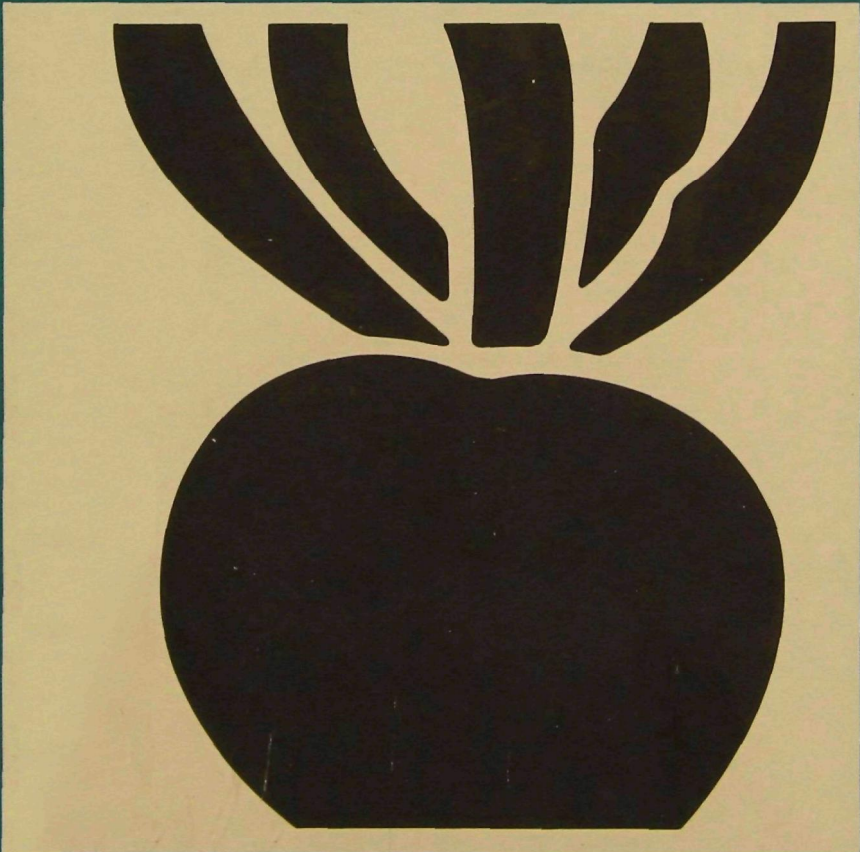


United States
Environmental Protection
Agency

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Clean Water and the Beet Sugar Processing Industry



This booklet is about the beet sugar processing industry and water pollution. It is intended to help you understand how this industry—and all other industries in the United States—are affected by a law passed by Congress to reduce and eliminate water pollution.

There are 52 beet sugar processing plants in the United States, employing approximately 13,000 men and women. In addition to beet sugar, some of these plants produce pulp and molasses for animal feeds, and Steffen filtrate for use in monosodium glutamate production.

But they also produce about 30 million pounds of wastes each day. Those wastes include 6 million pounds of oxygen-consuming decomposing organic matter, and 24 million pounds a day of suspended solids.

While 5 of these plants discharge waste waters directly to municipal treatment plants, where the pollutants are treated along with wastes from homes and other industries, and 11 are already achieving zero discharge of wastes to navigable waters, 36 others discharge directly into water bodies.


This booklet describes in non-technical language what those 36 beet sugar processing plants must do to keep their wastes from polluting the Nation's waters.

This booklet explains that:

- The technology exists to reduce water pollution from beet sugar processing plants to safe levels.
- Applying that technology costs money—but most beet sugar processing plants can afford to make the necessary investments to control pollution.
- Such pollution control investments would have only slight impact on the financial condition of the plants, and on the price consumers pay for beet sugar, and pulp and molasses by-products.

This booklet also describes why a few beet sugar processing plants may not be able to comply with pollution control standards and, unfortunately, will have to shut down with the subsequent loss of jobs.

In brief, this booklet discusses the facts of life of water pollution—how it affects all of us, why it must be controlled, and what the law requires the beet sugar processing industry to do as its part of the national program to clean up our Nation's waterways.

A black and white photograph of a beach scene. In the foreground, a white rectangular sign with rounded corners is mounted on a dark metal post. The sign has the text 'NO SWIMMING ALLOWED' in large, bold, sans-serif capital letters. Below this, the words 'WATER POLLUTED' are written in a smaller font and underlined. At the bottom of the sign, it says 'NO LIFE GUARD ON DUTY' in the same large, bold font as the top line. The sign is positioned on a grassy area next to a concrete walkway. In the background, the ocean waves are breaking onto a sandy beach. There is some driftwood and debris scattered on the shore. The overall tone of the image is somber due to the pollution warning.

NO
SWIMMING ALLOWED
WATER POLLUTED
NO LIFE GUARD ON DUTY

The Problem

You and millions of other Americans have probably seen the warning signs. They say "no swimming" or "no fishing" or "no boating" or "beach closed" or "danger, do not drink the water."

The signs are there because the water is polluted: with raw or poorly treated human wastes, with runoff from city streets, farmlands, animal feedlots, and mines; with leaks and spills from ships. And with wastes from industries—including the beet sugar processing industry.

Each year, some 402 million tons of pollutants resulting from human activities enter the Nation's waters. That's almost two tons for every man, woman, and child in the United States. The pollutants include bacteria, viruses, organic materials, animal fats, oil, acids, metals, pesticides, a myriad of other chemicals, and hot water from power plants and industrial boilers.

The pollutants make our waters unsightly. They can make the water unfit for drinking, for irrigation, and for industrial use, without expensive purification. Some pollutants rob water of the oxygen required to sustain fish and other aquatic life. Some pollutants contaminate fish and shellfish, making them unpalatable or actually unsafe to eat. Some pollutants speed the growth of algae that clog waterways, disintegrate, and give off noxious odors. Some pollutants endanger health. Some pollutants endanger reproduction; they can cause deformities and even death in various life forms.

It is impossible to put a precise pricetag on the cost of water pollution. But there is no doubt that



water pollution exacts a heavy toll. It's estimated that dirty water costs the American people at least \$13 *billion* a year—in water purification bills, in damage to fishery resources, in lost recreation.

Water pollution, in short, is a major national problem.

How did this come to pass? How did so many of our waterways become open sewers?

For many years we thought our waterways could handle the waste products of human activities. The wastes would decompose and disappear harmlessly, we thought. But we learned otherwise. We learned that we had overburdened the capacity of water to cleanse itself. We learned that our streams, rivers, and lakes could no longer assimilate the sewage discharges from increasing numbers of people and the increasing waste discharged from industry, agriculture, and mining. We learned that some pollutants can never be assimilated; they persist and accumulate in nature, posing a continuing danger to public and ecological health.

And after more than two decades of generally ineffective attempts to control water pollution, we realized that a completely new approach was needed.

To Solve the Problem

In response to widespread public concern about the sad condition of the Nation's waterways, Congress enacted the Federal Water Pollution Control Act Amendments of 1972. The 1972 Act built upon the experiences of earlier water pollution control laws. It brought

dramatic changes.

What the 1972 law says, in essence, is that nobody—no city or town, no industry, no government agency, no individual—has a right to pollute our water. What was acceptable in the past—the free use of our waterways as a dumping ground for our wastes—is no longer permitted. From now on, under the 1972 law, we must safeguard our waterways even if it means fundamental changes in the way we manufacture products, produce farm crops, and carry on the economic life of our communities.

Congress declared that the objective of the 1972 law is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters."

Congress established two goals in the 1972 law: First, wherever possible by July 1983, achieve water quality that's clean enough for swimming and other recreational use, and clean enough to protect fish, shellfish, and wildlife. Second, by 1985, no more discharges of pollutants into our waters.

How do we get from the dirty water of today to the clean water envisioned for the future? The law set in motion a new national system of uniform controls on the discharge of pollutants.

How this system applies to the beet sugar processing industry is discussed later. First, consider how the national system works, as mandated by Congress and carried out by the U.S. Environmental Protection Agency (EPA) in cooperation with State and local governments:

- The law requires EPA to establish

national “effluent limitations” for industrial plants—including beet sugar processing plants. An “effluent limitation” is simply the maximum amount of a pollutant that anyone may discharge into a water body.

- By July 1, 1977, the law requires existing industries to reduce their pollutant discharges to the level attainable by using the “best practicable” water pollution control technology (BPT). BPT is determined by averaging the pollution control effectiveness achieved by the best plants in the industry.

- By July 1, 1983, the law requires existing industries to reduce their pollutant discharges still more—to the level attainable by using the “best available” pollution control technology (BAT). BAT is based on the best practicable control procedures economically achievable. If it is technologically and economically feasible to do so, industries must completely eliminate pollutant discharges by July 1, 1983.

- The law requires new industrial plants to limit pollutant discharges to the level attainable by meeting national “standards of performance” established by EPA for new plants. A new plant must meet these standards immediately, without waiting for 1977 or 1983. These new plant standards may require greater reduction of pollutant discharges than the 1977 and 1983 standards for existing plants. Where applicable, zero discharge of pollutants can be required.

- The law requires industrial facilities that send their wastes to municipal treatment plants—as some beet sugar processing plants do—to make sure the wastes can be adequately treated by the municipal plant and will not damage it. In some industries, discharges to municipal plants may thus have to be “pretreated.” That is, the portion of the industrial waste that would not be adequately treated or would damage the municipal plant must be removed from the waste before it enters the municipal system.

- The law does *not* tell any industry what technology it must use. The law only requires industries to limit pollutant discharges to levels prescribed by law.

- The law also says that if meeting the 1977 and 1983 requirements is not good enough to achieve water quality standards, even tougher controls may be imposed on dischargers.

- And while the law requires industries to meet the national discharge standards set for 1977, 1983, and for new plants, the law also allows a State or community to impose stricter requirements if it wishes. The national standards are thus *minimum* requirements that all industries must meet.

Setting limits on industrial discharges is only the first step in controlling water pollution, of course. The next step is to make sure those limits are met. And the law provides the mechanism to do that.

Permits

The key to applying the effluent limits to industries—including the beet sugar processing industry—is the national permit system created by the 1972 law. (The technical name is the “National Pollutant Discharge Elimination System,” or NPDES).

Under the 1972 law, it is illegal for any industry to discharge any pollutant into the Nation’s waters without a permit from EPA or from a State that has an EPA-approved permit program. Every industrial plant that discharges pollutants to a waterway must, therefore, apply for a permit. Essentially all have done so.

When issued, the permit regulates what may be discharged, and the amount of each identified pollutant. It sets specific limits on the effluent from each plant. It commits the discharger to comply with all applicable national effluent limits and with any State or local requirements that may be imposed. If the industrial plant cannot comply immediately, the permit contains a compliance schedule—firm target dates by which pollutant discharges will be reduced or eliminated as required. The permit also requires dischargers to monitor their wastes and to report the amount and nature of wastes put into waterways.

The permit, in essence, is a contract between a company and the government.

This combination of national effluent standards and limits, applied to specific sources of water pollution by individual permits, with substantial penalties for failure to comply, constitutes the first effective nationwide system of

water pollution control.

Now, what does all this mean to the beet sugar processing industry? That’s next.

The Beet Sugar Processing Industry’s Pollution Problems

The first step in applying the 1972 law to the beet sugar processing industry was to identify the industry’s water pollution problems and to find out what can be done to solve those problems.

To do that, the Environmental Protection Agency assembled all available information on the beet sugar processing industry. This was done through an extensive study of the industry by EPA, through published literature, with the help of a voluntary questionnaire survey of the industry conducted by the U.S. Beet Sugar Association, and by on-site visits and interviews at various beet sugar processing plants throughout the United States. In addition, a contractor’s study was prepared under EPA supervision to provide a basis for evaluating the potential economic impact of effluent limitations guidelines and standards of performance established by EPA.

Raw waste characteristics were identified and quantified, including analyses of the source and volume of water used in the process employed, and the sources of waste and waste waters in various plants. The constituents of waste waters which should be subject to the effluent limitations guidelines were identified. Existing control and treatment technologies were identified, as well as the problems, limitations, and reliability of each



treatment and control technology and the time required to implement them.

From this extensive study the following facts emerged:

- If discharged without treatment, the waste waters from a beet sugar processing plant of average size would be equivalent to the sewage load from a population of about 823,000 people in terms of organic polluting effect.
- Together, the 52 beet sugar processing plants in the United States discharge approximately 30 million pounds of wastes *each day*.
- That waste water contains about 6 million pounds of oxygen-robbing organic materials and about 24 million pounds of suspended solids *per day*.
- A major pollutant in waste discharges from beet sugar processing plants is organic material. The measurement of these oxygen-consuming pollutants in water is called "biochemical oxygen demand," or BOD. (This is usually expressed in terms of the amount of biochemical oxygen demand in five days, or BOD₅.) When dumped untreated into a stream or river, the organic material is decomposed by micro-organisms, which consume oxygen in the water. This depletion of the oxygen content can have a catastrophic impact on life in the water body, since fish and other aquatic animals and plants must have dissolved oxygen to survive. A total lack of dissolved oxygen due to high BOD can produce a "dead"

water body in which aquatic survival is impossible. Also, even when all the oxygen in a body of water has been used, the decay of organic matter continues, which produces noxious gases, such as hydrogen sulfide and methane.

- Another major pollutant from beet sugar processing plants is suspended solids, both organic and inorganic. Among the inorganic are silt, sand, and clay. The organic components include such things as beet tops, grass, and boiler ash. These pollutants are collectively called "total suspended solids," or TSS. Suspended solids discolor and cloud water, impairing photosynthesis in aquatic plants. If pollutants containing organic matter settle on the bottom, they become sludge beds that further deplete the water's oxygen content, as well as creating gases toxic to aquatic life. In addition to their esthetic and ecological considerations, suspended solids in water from streams used by industry can interfere with many industrial processes. They can cause foaming in boilers, damage equipment, and impose high purification costs on industries that need water to make their products.

There are two key points to remember: *Raw wastes from beet sugar processing plants contain unacceptable amounts of organic materials and suspended solids. The wastes thus have to be treated before they can be discharged into a water body... and... These two major beet sugar processing industry water pollutants can be treated successfully.*

- Other identified pollutants in beet sugar processing plants include coliform bacteria and heat.

- Another consideration is the acid or alkali content of liquid wastes. This is called the "pH" of the mixture. (Pure distilled water has a pH of about 7, a strong acid solution has a pH of 1, and a strong alkali solution has a pH of 14.) Extremes of pH or rapid pH changes can exert stress conditions on aquatic life, or kill it outright. Dead fish, associated algae blooms, and foul stench are esthetic liabilities in any waterway. Even moderate changes from "acceptable" criteria limits of pH are deleterious to some species. In general, however, the pH of wastes from sugar beet processing plants can be easily adjusted where necessary.

- The proper handling of sugar beets before reaching the plant, the design of beet flume systems to facilitate dry-handling techniques, dry methods for handling lime mud cake, conversion of Steffen filtrate to usable end-products, process water reuse, and the reuse and recovery of various flows in the processing plant—all in-plant control measures—are extremely important in efforts to control pollution from beet sugar processing.

- Finally, the EPA study revealed that the process waste waters from the beet sugar processing industry also contain pollutants that will not interfere with publicly owned treatment works.

In sum, the beet sugar processing industry's water pollution problems were identified, and it was

determined that water pollution from the industry can be controlled by use of machinery and methods already in use. In other words, the technology to do the job already exists.

The Law and the Industry

Having assembled these facts, EPA's next step was to prepare standards for beet sugar processing plants under the 1972 law. Many factors were considered: Differences in raw material used, the product produced, the manufacturing process employed, raw waste characteristics, existing control and treatment technologies with their attendant problems, limitations and reliability of each, and environmental impact of such technologies on other pollution problems such as air, solid waste, noise, and radiation. The energy requirements and costs of each control and treatment technology were also identified.

The proposed regulations were issued July 19, 1973. They were sent to the industry and other interested organizations for review and comment. Comments were received from sugar processing companies, beet sugar processing organizations, and by Federal and State agencies. EPA then carefully analyzed the comments and made appropriate changes in the standards.

On January 31, 1974, EPA issued the final standards for the beet sugar processing industry to follow in order to meet the requirements of the 1972 law.

The standards are contained in an official government regulation

published in the "Federal Register." This regulation is supported by a detailed technical document called the "Development Document for Effluent Limitations Guidelines and Standards of Performance for New Sources for the Beet Sugar Processing Subcategory of the Sugar Processing Point Source Category."

In brief, the regulation:

- Establishes the limits to be met by July 1, 1977 through the best practicable control technology currently available.
- States the limits to be met by July 1, 1983, using the best available technology economically achievable.
- Establishes the requirement of zero discharge of process waste water pollutants to navigable waters for all new plants.
- Identifies the major beet sugar processing industry pollutants and establishes maximum limitations for BOD5, TSS, fecal coliform, and temperature that beet sugar processing plants can discharge during any one day, and on an average over a 30 day period.
- Requires that the pH (acidity or alkalinity) of beet sugar processing plant discharges be within the range of 6.0 to 9.0.
- States there is nothing to preclude the discharge of process waters from beet sugar processing to municipal treatment plants.
- Allows flexibility in applying

pollution controls to meet the 1977 standard in special cases.

- Does *not* tell beet sugar processing plants what technology to use to meet regulations. The standards require beet sugar processing companies to limit pollutant discharges to levels found attainable by using best practicable control technology.

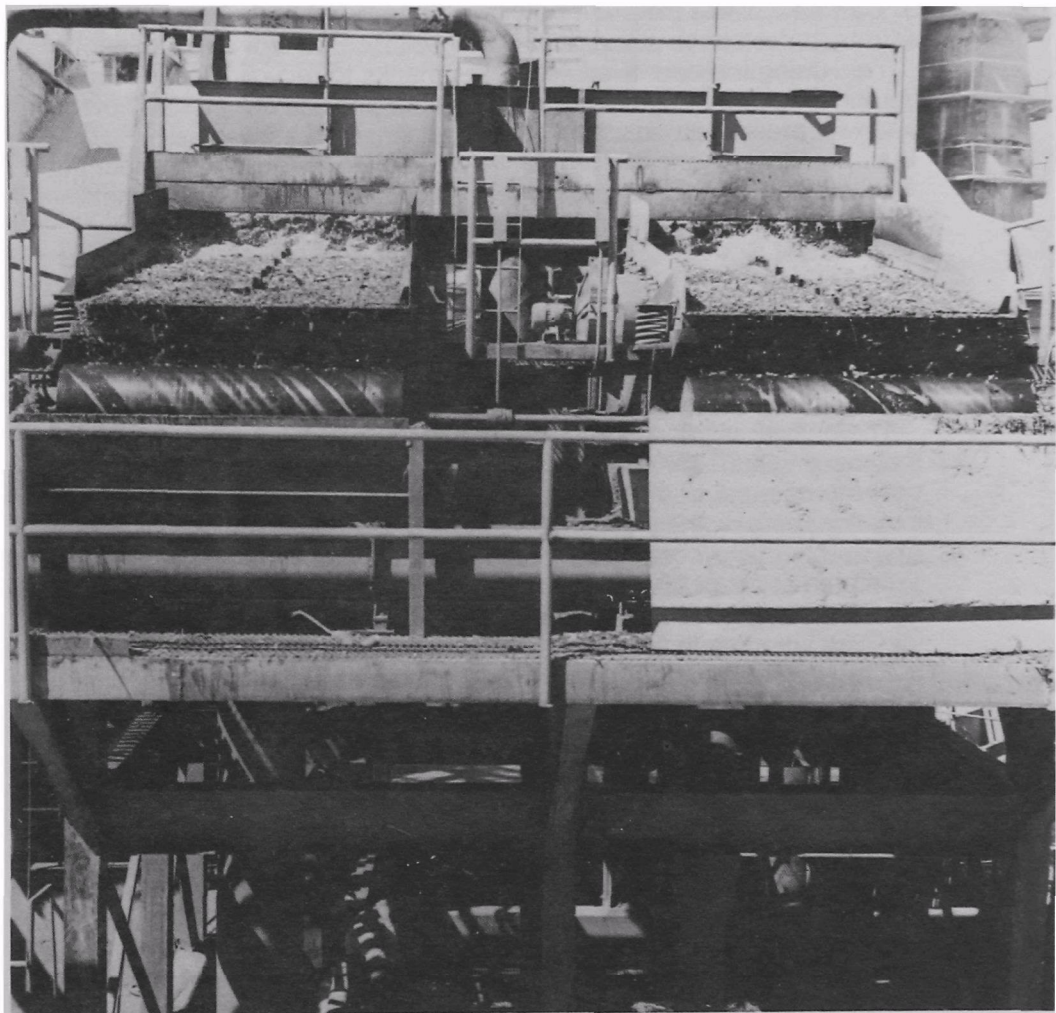
What does all this mean—to beet sugar processing companies, to those who work in beet sugar processing plants, and to the public?

Impact of the Guidelines

Let's consider some questions at this point about the impact of pollution control on the beet sugar processing industry.

1. Can beet sugar processing plants meet the 1977 limitations? That is, *technologically* can they reduce their discharges of pollutants to the levels required by 1977?

The answer is yes. Most existing beet sugar processing plants *can* meet the 1977 standards. In fact, 60 percent of the plants are already meeting the 1977 standards. While there is no one treatment process (biological, chemical, or physical) which is universally applicable in achieving zero discharge of pollutant waste waters, the technologies already exist which can be applied to any one single plant in meeting the guidelines limitations. In addition, five plants discharge their waste waters to municipal treatment



plants, another alternative available to other beet sugar processing plants.

2. Can beet sugar processing plants meet the 1983 limitations? That is, *technologically*, can they reduce their pollutant discharges to the levels required by 1983?

Again, the answer is yes, with a few exceptions. Presently, there are 11 plants already achieving zero discharge of pollutants to navigable

waters. Approximately 11 to 19 plants in various areas of the country are anticipated to have difficulty meeting the zero discharge standards, 9 due to excessive land requirements and attendant high economic costs, and the rest due to intrinsic economic difficulties. If municipal systems become available to the nine plants without sufficient land, these plants would no longer have difficulty meeting the 1983 requirements.

3. Can new plants meet the new source performance standards?

Yes. Using the best available demonstrated control technology, and with proper site selection to assure sufficient land availability, any new beet sugar processing plant can meet the zero discharge requirement.

4. Can the beet sugar processing industry *afford* to meet the 1977 water pollution control requirements?

The answer is *yes*. It's estimated that meeting the 1977 standards will cost the beet sugar processing industry approximately \$7 million. Annual operating costs are estimated at about \$0.7 million. The new investment in pollution control facilities amounts to 0.5 to 0.8 percent of the industry's present investment in plant and equipment, the exact amount varying depending on the size of the plant, and whether it uses the straight or Steffen system.

5. Can the beet sugar processing industry *afford* to meet the 1983 water pollution control requirements?

Yes, most of the companies can afford to do so. It's estimated that for the entire industry the incremental investment and annual cost to meet the 1983 standards will be \$5–13 million and \$430,000–1.1 million respectively.

Moreover, much of the additional investment can be returned in the form of valuable materials recovered by using better in-plant controls. In fact, some beet sugar processing plants may find that their new cost to control water pollution may be small. And a few plants may

actually realize a net profit on their pollution control investments, thanks to recycling—the recapture, sale, and use of materials now being discharged as wastes.

So far, we've talked about beet sugar processing plants that can—technologically and financially—meet the 1977 and 1983 standards. Now a tougher question:

6. What about beet sugar processing plants that *cannot* financially meet the 1977 standards? What will happen to them?

The economic analysis for this industry indicated that from three to five plants might have financial difficulty in meeting the final 1977 guidelines. However, three of these plants have indicated through permit applications that they in fact would be able to meet the 1977 limitations. This reduces the potential closures for 1977 to one to two plants, representing about 50 to 100 full-time employees.

For the men and women affected, the loss will be very real. It will mean relocating to another job in the beet sugar processing industry involving a move to another community, perhaps entering a new career, or perhaps an early retirement. EPA is very much aware of this problem. As originally proposed, the 1977 standards could have affected four to 10 plants under the guideline. By revising the regulation (but maintaining its integrity and purpose), this potential economic impact was substantially reduced. Any further lowering of the 1977 standard would have meant the continuing discharge of raw wastes—or business as usual,

regardless of water pollution. And business as usual with water pollution is simply no longer environmentally tolerable and therefore is not allowed under the 1972 law. It should be noted that the regulation will create new jobs in construction and maintenance of new pollution control facilities.

In sum, the price of restoring and maintaining the quality of our waterways for the benefit of all may indeed be costly to those who can only stay in business by continuing to pollute.

7. What about the 1983 standards? Will any more beet sugar processing plants have to close because of those standards?

An EPA economic analysis indicates, unfortunately, that one to two additional plants *could* have financial difficulty in meeting the 1983 guidelines. These plants are larger than 2300 tons of beets sliced/day and thus are not exempt from the zero discharge requirement. The average plant will employ 50 people on a full-time, year-round basis, and approximately 200 full-time people on a seasonal basis. Both seasonal workers and full-time workers would lose their jobs if the plants close. For the seasonal workers, work in the beet sugar processing plant is not their primary source of income. The full-time workers, because of their skills, are in a pretty good position to move into other jobs in the same industry.

There is no denying that closures of plants would seriously affect beet growers. Each plant processes the entire crop of about 300 growers who would suffer loss of sales through shutdowns of

plants. However, if the capacity and processing of a plant that had to close down is picked up by another nearby plant, the loss of income to beet growers would probably be negligible. In most cases, too, growers have the option of growing crops other than beets.

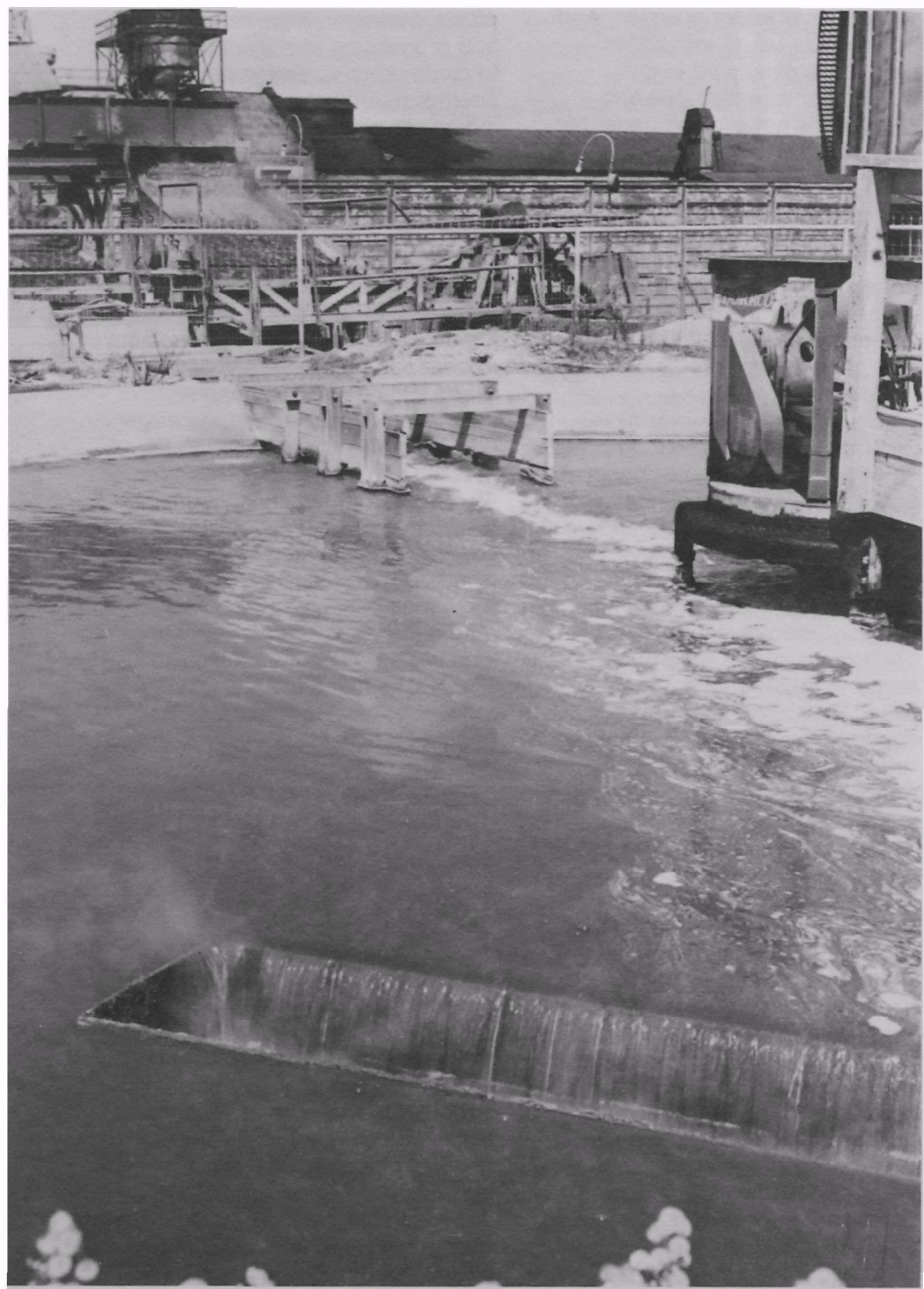
8. How will the 1977 and 1983 standards affect consumers? What impact will they have on the price of beet sugar?

The EPA economic analysis concluded that any price increase due to pollution control would be minimal. Plants representing 40 to 45 percent of the industry's annual production are already in compliance with the zero discharge level, and plants representing another 30 percent require only a 0.2 percent price increase (to maintain profitability). The rest of the industry might require, at most, a 0.8 percent price increase. Competition with the cane sugar industry may further limit any price increase that may be required.

9. What about the productive capacity that will be lost if some beet sugar processing plants do indeed shut down?

Based on consideration of excess capacity in various plants, the likely advent of new plants in some regions, and the availability of imported sugar and substitute sweeteners, the overall supply of sugar would probably not be affected in the event of actual plant closings.

Thus, water pollution control requirements for the beet sugar processing industry will have no



long-range repercussions in terms of supplies of beet sugar and related by-products, or industry growth. The standards will not affect the Nation's balance of trade with other countries or exports of beet sugar.

In summary, with the possible exception of, at most, 17 plants the beet sugar processing industry can meet the water pollution control requirements mandated by the 1972 law. The result will be cleaner water for all of us to enjoy and less waste for the beet sugar processing industry.

The Cleanup Program

The control of industrial pollution is not the only aim of the Federal Water Pollution Control Act. The law also required municipal treatment plants to meet certain discharge standards by 1977 and 1983. The law increased Federal aid to local governments to help build sewage treatment facilities, and established planning procedures for State and local governments to control water pollution from all sources more effectively, in cooperation with the Federal Government. It also streamlined and strengthened the enforcement provisions of the water pollution control program.

Some water quality control problems are so complex that they cannot be solved by using technology alone. For this reason the Act included an areawide waste treatment management planning process under Section 208. This areawide planning brings together several aspects of water

pollution control, including treatment of municipal and industrial wastes, the issuing of discharge permits to industry, and the ways of dealing with "nonpoint" sources of pollution such as stormwater runoff, in a comprehensive approach. Emphasis is placed upon planning by local governments.

In sum, the 1972 law provides formidable new tools "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters."

With the cooperation, hard work, and investment of considerable amounts of money from industries and all levels of government, progress has already been made toward reducing—and eventually eliminating—pollution in our rivers, streams, lakes, and harbors. But much still remains to be done. Still more money and effort will have to be invested if the clean water program is to be successful—if we are to have water that is safe and healthful for drinking, for use by industry and agriculture, for swimming and boating, for fish and wildlife.

To help pay for this cleanup, Congress set up a construction grants program in which the Federal Government will pay up to 75 percent of construction costs for treatment plants. The funding for this program is expected to rival the Federal highway program in magnitude. In fact, costs of treatment plants, interceptor services, and combined sewer overflow control facilities from the beginning of the program through 1982 are expected to total approximately \$50 billion. That's an average of around \$5 billion per

year, compared to the \$13 billion a year that water pollution now costs the American people. Congress felt that expenditures under the construction grants program were essential to deal with a significant and pressing environmental problem.

Some Suggestions on How to Improve Pollution Control in Plants

There are several in-plant control measures which individual plants can use to reduce pollutants in beet sugar processing waste waters.

While not strictly part of in-plant operations, the method of handling beets in the fields can make a big difference in the amount of solid wastes and tare which enter the flume system. Care should be taken to remove leaves, trash, and as much soil as possible at the time the beets are harvested.

Deterioration of stored beets can be minimized by proper storage conditions and the shortest storage time possible. Improvements in sys-

tem design can reduce the amount of wastes introduced into the beet flume system.

One plant in California has solved the lime mud slurry problem by recovering the lime mud cake from the holding pond, and recalcining it for reuse.

There are several ways in which waste waters from barometric condensers may be reused. Waste waters can be used in the raw water supply, in lime mud slurring, gas washing, in the flume recirculation system, and for diffuser makeup water.

Not only will improved in-plant methods reduce pollution, but experience has shown that such improvements in design, construction, operation, and plant management are important contributors to overall efficiency and economics of plant operation.

For additional copies of this booklet, write: Public Information Center (PM-215), EPA, Washington, D.C. 20460.