BY THE COMPTROLLER GENERAL

# Report To The Congress

OF THE UNITED STATES

## Better Planning Can Reduce Size Of Wastewater Treatment Facilities, Saving Millions In Construction Costs

Well-planned wastewater treatment plants are crucial to the success of the Nation's multibillion dollar effort to clean up thousands of miles of contaminated rivers, lakes, streams, and ocean shorelines. GAO found that millions of dollars in Federal construction grant funds could be saved by applying current regulations--which restrict the size of plants and ultimately the cost to construct them--to treatment plants not yet under construction that were planned under old regulations.

GAO recommends that the Congress direct the Administrator of the Environmental Protection Agency to modify the Agency's current policy prohibiting retroactive application of program regulations to projects not yet under construction.



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COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON D.C. 20548

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To the President of the Senate and the
Speaker of the House of Representatives

Billions of dollars in Federal grants have been and are yet to be made to thousands of municipalities throughout the Nation to plan, design, and construct publicly owned wastewater treatment facilities. This report discusses ways the Environmental Protection Agency, through application of existing Federal regulations, can reduce both the size and cost of constructing treatment facilities. These reductions can potentially save millions of dollars in Federal, State, and local funds.

We made this review to evaluate the effectiveness of the facility planning process for constructing treatment plants and to determine whether changed conditions, such as increases or decreases in population projections or industrial flow for the proposed service area, were recognized and incorporated into the facility plans before the plant was designed or before construction started.

We are sending copies of this report to the Chairman, Senate Committee on Energy and Environment; the Chairman, Subcommittee on Investigations and Oversight, House Committee on Public Works and Transportation; the Director, Office of Management and Budget; the Administrator, Environmental Protection Agency; interested congressional committees; Members of Congress; and other interested parties.

Charles A. Bowsher

Comptroller General
of the United States

COMPTROLLER GENERAL'S
REPORT TO THE CONGRESS

# BETTER PLANNING CAN REDUCE SIZE OF WASTEWATER TREATMENT FACILITIES, SAVING MILLIONS IN CONSTRUCTION COSTS

## D I G E S T


Millions of dollars in Federal, State, and local construction funds can be saved by applying the Environmental Protection Agency's (EPA's) 1978 facility planning regulations to wastewater treatment plant projects developed under pre-1978 regulations but not yet under construction. (See p. 8.)

Wastewater treatment plants are considered to be the frontline of the Nation's battle to eliminate pollution and restore water quality throughout the country. Billions of Federal dollars plus several billion dollars in State and local funds have been and are yet to be spent on constructing treatment plants to meet the Nation's cleanup goals. (See p. 1.)

The facility plans on which treatment plants are designed and constructed are crucially important to the success of this multibillion dollar effort. The theory behind facility planning is straightforward--determine the sources and amount of wastewater a plant is to treat now and in the future, select the process required to treat the waste, and establish the size of plant necessary to provide the required level of treatment. But implementing the theory is complex. (See p. 20.)

In addressing one of the key components--treatment plant size--EPA issued regulations, effective October 1, 1978, limiting the size of plant eligible for Federal funding by restricting the amount of future domestic and industrial flows the planned facility would treat. However, the regulations applied only to projects for which planning grants were approved after September 30, 1978. (See p. 8.)

GAO estimates that if these regulations were applied to the 13 facility plans it reviewed, all of which had their planning grants approved before October 1, 1978, about $30 million in


Tear Sheet

Federal grant program funds could be saved when and if these projects move to the construction phase. Within the three EPA regions included in GAO's review, a total of 1,695 facility planning grant awards were made before October 1, 1978. Of these, 1,202, or 71 percent, have not yet advanced to the construction phase. (See p. 8.)

GAO made this review to evaluate the effectiveness of the facility planning process for constructing treatment plants and to determine whether changed conditions, such as increases or decreases in population projections or industrial flow for the proposed service area, were recognized and incorporated into the facility plans before the plant was designed or before construction started. (See p. 5.)

## CURRENT REGULATIONS LIMIT ENGINEERING JUDGMENT IN CALCULATING DOMESTIC AND INDUSTRIAL FLOW ALLOWANCES

Pre-1978 regulations gave the municipalities and their consulting engineers wide latitude in projecting future domestic and industrial flow. For facility planning grants approved after September 30, 1978, EPA regulations eliminated some of the subjectivity involved in calculating future flow.

For example, the amount of domestic flow to be treated by a wastewater plant is generally determined on the basis of population to be served. Before the 1978 regulations were in effect, no criteria or guidance existed to indicate which source of data--city, county, State, etc.--should be used to project population growth figures for the planning area. GAO found that consulting engineers used several sources, with widely differing yet acceptable results, to project future population. (See p. 8.)

Under the 1978 regulations, EPA stipulated that State population projections would be the sole basis for estimating future population levels to be served by the proposed treatment system. (See p. 8.)

## EFFECT OF CURRENT REGULATIONS ON PLANT SIZE AND FEDERAL GRANT FUNDS

Applying the 1978 regulations to projects not yet under construction would change the projects significantly. Eleven of the 13 proposed plants in GAO's review would be smaller--ranging from 4 to 49 percent smaller than the total plant size recommended in the facility plans. (The remaining two plants would be larger by 1 and 3 percent, respectively.) For example, applying the current regulations to a proposed treatment plant in Claremont, New Hampshire, would reduce the plant by 32 percent and could save $3 million in Federal construction grant funds. (See p. 14.)

## 1981 AMENDMENTS SIGNIFICANTLY REDUCE FEDERAL ROLE IN PLANT CONSTRUCTION

The Municipal Wastewater Treatment Construction Grant Amendments of 1981, enacted on December 29, 1981, provide that, effective October 1, 1984, no Federal grant will be made to construct that portion of any treatment works providing reserve capacity in excess of existing needs as of the date of grant approval. In addition, the amendments reduced the Federal participation level from 75 percent to 55 percent of the construction costs. (See p. 15.)

Significant Federal savings can be realized between now and October 1984 by applying the 1978 regulations to each project on a case-by-case basis. GAO believes that EPA could include, as part of its review to prevent segmenting of proposed construction projects, a quick test using the 1978 regulations' criteria for domestic and industrial flow allowances to ascertain the extent of potential savings. (See p. 16.)

## MANY FACETS OF FACILITY PLANNING ARE NOT COVERED BY GUIDANCE OR REGULATION

Many areas of facility planning that affect treatment plant size are still not covered by either guidance or regulation. As a result, engineering judgment, which GAO found to vary considerably from project to project, becomes the deciding factor in determining

plant size and ultimately total project cost. For example, in Bristol, Rhode Island, a second engineer, using the same data as the first engineer retained by the community, recommended a larger plant, resulting in an estimated net cost increase of $1.2 million. (See p. 20.)

GAO believes that additional criteria are needed not only to assist the engineers and the community in arriving at a properly sized treatment plant but also to provide EPA and State facility plan reviewers a basis on which to evaluate the adequacy of the plan and its recommended treatment system. Neither EPA nor the States typically verify key information contained in the plan; conduct their own tests on flow amounts--domestic, industrial, and infiltration/inflow--subject to treatment; or perform any of the analyses generally associated with plan development. (See p. 29.)

## AGENCY COMMENTS AND GAO EVALUATION

GAO's draft report recommended that the Administrator, EPA, amend the 1978 facility planning regulations for determining plant size to apply to all projects progressing to either the design or construction phase where, in the Administrator's judgment, applying the 1978 criteria would result in significant Federal savings.

EPA did not object to the concept of applying regulations retroactively but pointed out that the Agency was restricted from such action by a provision of the 1981 Appropriation Act. EPA further stated that if the Congress directs EPA to modify its current policy prohibiting the retroactive application of program regulations, EPA would consider the factors listed in the GAO report, including the effect of inflation on construction costs during reanalysis and redesign. (See p. 17.)

EPA also stated that it concurs with the GAO concept of developing standards for each critical factor used in establishing existing as well as future industrial and infiltration/inflow amounts to be treated by a wastewater plant. However, EPA disagrees with establishing similar standards as they relate to discharge ratios for existing and future domestic waste flows. (See p. 29.)

GAO continues to believe that specific standards to measure all critical factors are essential to ensure proper sizing of treatment plants. Without standards, the situation identified by GAO--widely varying interpretation of existing guidance without justification--will continue, resulting in potential over- or undersizing of proposed treatment facilities.

RECOMMENDATION TO THE CONGRESS

GAO recommends that the Congress direct the Administrator, EPA, to modify the Agency's current policy prohibiting retroactive application of program regulations. (See p. 18.)

RECOMMENDATION TO THE ADMINISTRATOR, EPA

GAO recommends that the Administrator, EPA, with the cooperation of the engineering community, develop standards for each critical factor used in establishing existing and future domestic, industrial, and infiltration/inflow amounts to be treated by a wastewater plant. (See p. 29.)

# Contents

## ABBREVIATIONS

| | |
|---|---|
| EPA | Environmental Protection Agency |
| GAO | General Accounting Office |
| mgd | million gallons per day |
| NPDES | National Pollutant Discharge Elimination System |

# CHAPTER 1

# INTRODUCTION

Billions of dollars of Federal, State, and local funds have been spent to construct wastewater treatment plants to clean up the Nation's polluted waterways. Imperative to the success of this multibillion dollar effort are the adequacy, completeness, and accuracy of the facility plans that form the basis for designing and constructing the treatment plants. Although facility planning accounts for less than 5 percent of the $35 billion wastewater treatment construction grants program, the impact of this phase on the remaining 95 percent of program funds is enormous. As of December 31, 1981, the Environmental Protection Agency (EPA) had provided about $1 billion for over 9,000 facility planning projects about 5,000 of which are still active.

## WHAT FEDERAL PROGRAM ADDRESSES WATER POLLUTION?

The Federal program to prevent, reduce, and eliminate water pollution is carried out under the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251, et seq.). The act proclaimed two national goals. The first, commonly referred to as the "swimmable-fishable" goal, seeks to restore polluted waters, wherever possible, to a quality that allows for the protection and propagation of fish, shellfish, and wildlife and for recreation use by July 1983. The second goal seeks to eliminate all pollutant discharges into the Nation's waters by 1985.

To help meet these goals, the act requires all publicly owned wastewater treatment plants to use at least secondary treatment 1/ by July 1, 1977, and to use the best practicable waste treatment technology available by July 1, 1983. The Administrator, EPA, is authorized to extend the secondary treatment deadline to July 1, 1988, if, through no fault of the municipality, construction could not be completed in time or if Federal funds had not been available to the municipality.

## HOW WAS THE CLEAN WATER OBJECTIVE TO BE ACHIEVED?

In the early 1950's, the Congress recognized that inadequate municipal sewage treatment contributed greatly to our Nation's water pollution problems. Because of the tremendous cost to correct this problem, the Congress established a construction grants program to help local governments build or upgrade badly needed wastwater collection and treatment systems.

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1/Secondary treatment uses biological processes to accelerate sewage decomposition. The process removes about 80 to 90 percent of the biological oxygen demand from domestic sewage.

The Water Pollution Control Act Amendments of 1956 (Public Law 84-660) created the Wastewater Treatment Construction Grants Program and authorized Federal grants of up to 30 percent of the cost to construct municipal wastewater treatment plants. Subsequent amendments increased the Federal share to 55 percent. Between 1956-72 total Federal expenditures for this program amounted to $5.2 billion. The 1972 amendments to the act increased the Federal contribution to 75 percent and authorized a total of $18 billion for the program. The 1977 amendments to the act authorized an additional $25.5 billion through fiscal year 1982. Finally, the 1981 amendments to the act authorized an additional $9.6 billion through fiscal year 1985.

## HOW LARGE ARE TREATMENT PLANTS AND WHAT DO THEY COST?

Often wastewater treatment plants are the largest physical asset a community owns. The cost to construct a plant depends on both its size and the complexity of the treatment process. Plant capacities range from a few hundred thousand to several hundred million gallons of wastewater flow each day. Construction costs for a plant providing secondary treatment can range from several hundred thousand to several hundred million dollars. The following table shows 1978 average construction costs for different sized secondary treatment plants.

Average Construction Costs for Secondary Treatment Plants

| Flow (million gal. per day (mgd)) | Construction costs (note a) (millions) |
|---|---|
| 1 | $ 2.5 |
| 5 | 8.6 |
| 25 | 27.0 |
| 50 | 44.0 |
| 100 | 76.0 |

a/January 1979 dollars.

Source: "Construction Costs for Municipal Wastewater Treatment Plants: 1973-1978," performed under contract for EPA by Sage Murphy & Associates, Inc.

Due to inflation, these plants would cost more to build in 1982. For example, EPA estimates that a 5-mgd plant now would cost about $9 million and a 50-mgd plant now would cost about $50 million.

## HOW IS THE PROGRAM ENFORCED?

The National Pollutant Discharge Elimination System (NPDES) permit is the principal enforcement tool. It is a national permit program to control the pollutant discharge into waterways from all point sources, including industrial treatment plants; municipal treatment plants; certain agricultural, forestry, mining, and fishing operations; and other commercial activities. The system is administered by EPA or by an EPA-approved State program.

The permit specifies which pollutants may be discharged and sets daily average and maximum limits on such discharges. Under the act, it is illegal to discharge any pollutant into the Nation's waterways without a permit. Any violation of the permit is a violation of the law, and the violator can be fined, imprisoned, or both.

## WHAT IS THE PURPOSE OF FACILITY PLANNING?

Facility planning helps communities define wastewater treatment problems, examine all feasible solutions to those problems, and develop the best alternatives for correcting them. The potential solutions can range from building a highly sophisticated treatment plant to constructing a pond or other nonstructural alternative.

An acceptable wastewater treatment project should solve the community's wastewater problems; meet the conditions of its NPDES permit; and be appropriate to the environmental, economic, and social needs of the community it serves. More specifically, an acceptable project is one which

--the community can afford to build and maintain over the projected design life,

--is cost-effective compared with other options for achieving NPDES permit requirements, and

--provides adequate but not excessive capacity for the population to be served.

## WHO IS RESPONSIBLE FOR PREPARING, REVIEWING, AND APPROVING FACILITY PLANS?

Municipalities are responsible for preparing their facility plans. Usually the municipalities hire a consulting engineer to develop the plan as most do not have their own staff engineers. The consulting engineer agrees to prepare the plan, including identifying the various treatment methods that could be used, and prepares the cost-effectiveness analysis justifying the recommended treatment process. The plan is subject to EPA or State review and approval, depending upon whether the State has been delegated

approval authority, to determine if it complies with all applicable Federal and State regulations. According to EPA regulations, the review is not intended to evaluate the quality of the work performed. EPA assumes that the professional integrity of the consulting engineer will assure quality work.

## WHAT ARE THE KEY COMPONENTS OF A FACILITY PLAN?

A facility plan is a compilation of studies, data analyses, and evaluations which demonstrates the need for a proposed wastewater treatment plant and describes the least costly method of successfully treating a community's waste. Because the successful operation of a treatment plant depends upon identifying the amount and nature of the wastewater to be treated, the consulting engineers must gather and analyze samples of a community's wastewater to develop conclusions about the hydraulic flow (amount) and organic loadings (nature) of existing and future wastewater.

Hydraulic flow comprises three broad categories: (1) domestic or sanitary sewage, (2) industrial waste, and (3) infiltration and inflow. Organic loading expressed in terms of biochemical oxygen demand and suspended solids is a measure of the pollutants in the wastewater which must be treated to specified limits.

### Domestic sewage

Domestic sewage is defined as household-type sanitary waste discharged from residential dwellings, commercial establishments, or institutional units.

### Industrial waste

Industrial wastes are composed of solid and liquid wastes generated as a result of industrial processing. The amount and nature of industrial wastewater is directly related to the type of industry, the nature of the processes used, and the amount and type of products produced. Depending on the processes used, industrial wastes generally have much higher concentrations of biochemical oxygen demand and suspended solid loadings than domestic sewage and usually are more difficult to treat.

### Infiltration and inflow

Infiltration and inflow are generally nonpolluted flows into the wastewater treatment system resulting from weather conditions. The amount of infiltration--water seeping into the system through breaks or cracks in the sewer lines--is directly related to ground water conditions and the age and length of the sewer lines. Infiltration flows vary with the time of year--high in rainy seasons and low in dry seasons.

Unlike infiltration, inflow temporarily raises the hydraulic flows to a wastewater treatment plant. Inflow usually results

from a rainstorm entering the sewer lines through leaky manhole covers, roof drains, catch basins, or connections with the storm water disposal system.

As nonpolluted sources of flow, infiltration and inflow contribute only minimal amounts of biochemical oxygen demand and suspended solids loadings for treatment. However, the amount of infiltration and inflow can significantly affect the treatment process.

## OBJECTIVES, SCOPE, AND METHODOLOGY

The objective of our review was to evaluate the effectiveness of the facility planning process for sizing wastewater treatment plants by addressing the following questions:

--Was the facility plan data gathering and analyses by the consulting engineer completed in accordance with Federal regulations?

--Were changed conditions, such as increases or decreases in population projections or industrial flows, recognized and incorporated into the completed facility plan?

--How do EPA and State facility plan reviewers verify key data elements of the plan that affect proposed plant size?

We selected 13 facility plans for review in three EPA regions: six in Boston's region I, four in Atlanta's region IV, and three in Denver's region VII. The regions were selected to provide a cross section of regional activity as well as broad geographical coverage. A total of nine States were visited during the review: Alabama, Colorado, Connecticut, Georgia, New Hampshire, Rhode Island, Utah, Vermont, and Wyoming.

Facility plans were randomly selected from computer printouts prepared by EPA's region I, region IV, and region VII staffs and are not considered to be statistically projectable. The printouts were of new and/or upgraded wastewater treatment plants. Excluded from the printouts were projects relating solely to pump stations and/or sewer lines--which generally do not involve expansion of existing or construction of new plants. The printouts did not indicate the type of treatment--secondary or advanced--nor did they show industrial flows, total flows, etc. We obtained this additional data from reviews of individual project files and from discussions with EPA State coordinators and other EPA construction grant officials.

The proposed facilities selected for detailed review ranged anywhere in size from 3.7 mgd up to 25.5 mgd capacity.

We conducted our review at EPA headquarters and regional offices. We interviewed State environmental officials and community officials to obtain their input. We obtained the plan

consulting engineer's input and provided all the information of selected facility plans to our consulting engineer, who analyzed the data and provided his professional comments.

At the EPA regions we reviewed the selected facility plans, environmental assessments, infiltration/inflow analyses, and sewer system evaluation surveys. We interviewed State environmental officials--principally the facility plan reviewing engineer--and reviewed State files to determine

--the basis for population estimates,

--the basis for industrial growth allowance,

--how industrial and organic makeup information was obtained, and

--infiltration/inflow time periods covered and the dates of the infiltration/inflow analyses.

We also obtained discharge monitoring reports from either the EPA regional office, the State, or the local community files for the existing facilities, industrial pretreatment permits, and the latest (1980) actual population and population projections for the facility planning areas.

We visited existing treatment facilities in the communities selected for review and interviewed the plant superintendent and operators. We met with local government officials including water and sewer officials, community engineers, local and regional planning officials, industry officials, city and town mayors and managers, chambers of commerce, and industry planning officials. We obtained water use data, sewage data, and treatment facility discharge monitoring reports for calendar years 1979 and 1980.

We contacted the facility plan consulting engineer and obtained clarification on points we raised during our review of the plans. We also obtained additional information from the consulting engineers on bases they used, such as how gallons per acre per day were arrived at in projecting future industry flows and how domestic water use and effluent levels were determined.

From all the information gathered at EPA, States, local communities, and from consulting engineers we identified alternative treatment methods considered, the reasons for the treatment method selected, and what analyses had been done to demonstrate how the recommended treatment would solve a community's wastewater problems. We also obtained reasons why land application was or was not used as a method for disposing of sewage sludge.

In computing potential cost savings, we used a study entitled "Construction Costs for Municipal Treatment Plants: 1973-1978," prepared under contract for EPA by Sage Murphy & Associates, Inc.,

Denver, Colorado. This study, using data on the cost of constructing wastewater treatment facilities in the past, attempts to establish an empirical base from which future costs can be estimated using the assumption that past costs can be adjusted for inflation, material and labor cost fluctuations, and various other influences to yield an estimate of what similar facilities will cost in the future. These estimating procedures are intended to be sufficiently simple and accurate that they could be applied to EPA's future cost estimating needs. EPA considered this study to be the best data source available on national wastewater treatment plant construction costs and used it as the source for establishing the 1980 National Needs Assessment Survey data.

The purpose of the study was to collect, categorize, and analyze construction bid data for wastewater treatment plants nationwide with the goal of providing a reference for estimating future facility costs. To accomplish this, construction bid information was obtained from the construction grant files of each of the 10 EPA regional offices. All facilities sampled were municipally owned treatment plants funded after 1973 under Public Law 92-500. The 737 treatment plant construction projects sampled included new, enlarged, and upgraded facilities. Ineligible treatment costs and the costs of facilities for collecting and transporting sewage were not considered in this report.

During data analyses, it was assumed by Sage Murphy & Associates, Inc., that the cost of a treatment plant could be viewed from three perspectives, one of which is the construction cost of the entire plant. Cost curves were developed, using linear regression analysis techniques, for total plant construction costs. Cost curves relate item cost to plant design flow. All data used in the report was updated from the bid data to fourth quarter 1978 dollars using the EPA Wastewater Treatment Plant Cost Indices.

We retained the expert and professional analysis services of a consulting engineer, Mr. Louis Guy, P.E., who was recommended to us by the Water Pollution Control Federation. From 1973 to 1981 Mr. Guy was a principal and senior vice president with Patton, Harris, Rust, and Guy, P.C., a Virginia-based firm, and has over 20 years' experience in the planning and design of publicly owned wastewater treatment plants.

Our review was performed in accordance with our current "Standards for Audit of Governmental Organizations, Programs, Activities and Functions."

## CHAPTER 2

## MILLIONS OF DOLLARS IN CONSTRUCTION GRANT FUNDS CAN BE SAVED BY APPLYING CURRENT FEDERAL GRANT REGULATIONS

The potential exists to save millions of dollars in Federal wastewater treatment construction grant funds by applying current facility planning regulations to projects which have not progressed to the construction phase. The regulations, which became effective October 1, 1978, limit the size of treatment plant eligible for Federal funding by restricting domestic and industrial flow allowances. However, the regulations apply only to projects for which grants were approved after September 30, 1978.

We estimate that applying current regulations to the 13 facility plans reviewed, all of which had their facility planning grants approved before October 1, 1978, could save about $30 million in Federal construction grant program funds. Within the three EPA regions reviewed, a total of 1,695 facility planning grant awards were made before October 1, 1978. Of these 1,695 projects, 1,202, or 71 percent, have not yet advanced to the construction phase.

### CURRENT REGULATIONS LIMIT ENGINEERING JUDGMENTS IN CALCULATING DOMESTIC AND INDUSTRIAL FLOW ALLOWANCES

Pre-1978 regulations gave municipalities and their consulting engineers wide latitude in projecting future domestic and industrial flows. (Estimated flow levels are crucial factors in determining the size of a treatment plant.) Beginning with all facility planning grants approved after September 30, 1978, EPA regulations eliminated some of the subjectivity involved in calculating future domestic and industrial flows. For example, the amount of domestic flow is generally determined on the basis of population to be served. Furthermore, before the 1978 regulations were adopted, no criteria or guidance existed on which source of data--city, county, State, etc.--could or should be used to develop growth figures. As a result, consulting engineers generally used several sources, all of which differed and yet were considered acceptable under general engineering practices, to project the future population of the planning area. Under the 1978 regulations, EPA stipulated that State population projections would be used as the sole basis for estimating future population levels to be served by the proposed treatment system.

The pre-1978 regulations were silent on how consulting engineers were to arrive at per capita flow levels; they could use either actual water records or a theoretical base, which was generally set at 100 gallons per capita per day. The 1978

regulations stipulated that per capita flow calculations are to be based on actual water use records, adjusted for consumption and losses, or on records of wastewater flow for extended dry weather periods, adjusted for dry weather infiltration, where such records exist. When water use records are not available, consulting engineers are limited to theoretical flows of 65 to 80 gallons per capita per day for communities of over 5,000 population or 60 to 70 gallons per capita per day for communities of 5,000 or less population.

According to the 1978 regulations, industrial reserve capacity can no longer be based on assumptions of significant, unspecified industrial expansion expected to occur sometime in the future. The regulations limit industrial reserves to existing industrial flow plus flow estimates based on letters of intent from industry or a small percentage growth allowance. This growth allowance cannot exceed 5 percent (or 10 percent for communities of less than 10,000 population) of the total treatment plant design flow exclusive of the industrial allowance or 25 percent of the total existing and documented industrial flow, whichever is greater.

Together, these regulation changes have reduced--in many cases, significantly--the amount of future domestic and industrial flow eligible for Federal funding. Why were the regulation changes not made applicable to all wastewater treatment projects that had not, as a minimum, progressed to the construction phase as of October 1, 1978? According to the Acting Director, Facilities Requirements Division, Office of Water Program Operations, several reasons were used to justify EPA's action. However, the principal reason cited was criticism from State and local governments, the engineering community, and many Members of Congress that EPA was continually changing the construction grants program regulations, thereby confusing all parties involved about what was required of them.

Retroactive application of new regulations, according to the various parties, was causing delays in completing the three phases of the construction program, which in turn delayed the municipality's receipt of funds for ultimate project construction. That delay increased project costs due to inflation. For these reasons, EPA opted not to apply the 1978 changes retroactively.

## APPLYING CURRENT REGULATIONS TO PRE-1978 PLAN APPROVAL WOULD SIGNIFICANTLY REDUCE TREATMENT PLANT SIZE

Applying current regulations to the 13 plans we reviewed, all of which were developed under pre-1978 regulations, showed that the domestic and/or industrial flow allowances in each plan would be reduced--in many cases, significantly. In nine plans total treatment plant flow eligible for Federal funding assistance would be reduced by at least 15 percent. The following sections discuss the individual effects on domestic and industrial flows

and the cumulative effects of applying the 1978 regulation changes to the 13 facility plans we reviewed.

## Domestic flow differences

In all but one plan (Carrollton, Ga.), applying the 1978 regulations would result in reduced domestic flow allowances. Reductions range from 5 to 60 percent, as shown below.

Effect of Applying 1978 Domestic Flow Regulations to the 13 Plans Reviewed

| | Design year domestic flow | | | |
|---|---|---|---|---|
| | Per facility plan | Per application of 1978 regulations | Differences | Percent reduced |
| | (mgd) | | | |
| Bennington, Vt. | 1.90 | 1.80 | 0.10 | 5 |
| Boaz, Ala. | 1.03 | 0.91 | 0.12 | 12 |
| Bristol, R.I. | 1.73 | 0.88 | 0.85 | 49 |
| Carrollton, Ga. | 1.61 | 1.61 | -0- | -0- |
| Claremont, N.H. | 1.50 | 0.60 | 0.90 | 60 |
| Covington, Ga. | 2.36 | 2.10 | 0.26 | 13 |
| Milford, Conn. | 4.70 | 3.21 | 1.49 | 32 |
| Portsmouth, N.H. | 2.89 | 2.00 | 0.89 | 31 |
| Sheridan, Wyo. | 3.39 | 2.86 | 0.53 | 16 |
| South Valley, Utah | 20.42 | 15.06 | 5.36 | 26 |
| Sterling, Colo. | 2.65 | 1.24 | 1.41 | 53 |
| Tullahoma, Tenn. | 2.03 | 1.68 | 0.35 | 17 |
| Wallingford, Conn. | 4.43 | 2.40 | 2.03 | 46 |

The Wallingford, Connecticut, and Tullahoma, Tennessee, facility plans demonstrate the effect of applying current regulations. As discussed below, the effect of basing domestic flow on water use records, rather than on a theoretical estimate, is significant in the Wallingford plan while the Tullahoma plan is significantly affected by using State population projections rather than population projections developed by the engineers.

### Wallingford, Connecticut

Wallingford, Connecticut, was awarded a facility planning grant for $385,805 in November 1976. At that time the city owned and operated a 5-mgd secondary treatment plant. The facility plan, approved by EPA in June 1980, recommended that the city build an 8-mgd advanced secondary treatment plant at an estimated cost of $23.8 million. The 8-mgd plant had capacity for 4.4 mgd of domestic waste, 0.5 mgd of commercial waste, 2.1 mgd of industrial waste, and 1 mgd of infiltration/ inflow.

Although actual water records available to the consulting engineers at the time of facility planning showed that domestic water use averaged about 70 gallons per capita per day, 1/ the engineers chose to develop the future domestic flow estimate by using a theoretical base of 100 gallons per capita per day. A further review of the facility plan showed that the consulting engineers had determined, during the facility planning phase, that only 83 percent of the water produced for domestic consumption was actually being discharged to the sewer system for treatment. This determination was based on an analysis of water use and wastewater flow records. Applying this rate--83 percent--to the 70-gallon-per-capita-per-day average water use, yields a domestic wastewater flow to the treatment plant of only 58 gallons per capita per day, which is 42 percent less than the 100-gallon figure used by the engineers.

The consulting engineers advised us that the 58-gallon-per capita-per-day figure was not used because (1) Wallingford is an affluent community and therefore should use more water and (2) the theoretically based figure of 100 gallons per capita per day corresponded to the 1976-77 total average daily wastewater flow to the existing plant of 3.8 mgd--100 gallons per capita per day times the estimated 1976-77 population of 38,000 equals 3.8 mgd. Subsequently, we determined that the 3.8-mgd figure included not only domestic flow but also all commercial and industrial flows to the treatment plant plus infiltration.

We estimate that applying the 1978 regulations to this project would reduce the domestic wastewater flow requirement from 4.4 mgd to 2.4 mgd--a 46-percent reduction in plant capacity for domestic flow alone. Using the Sage Murphy & Associate, Inc., cost analysis (see p. 2), adjusted for inflation, the 2.0-mgd reduction in plant size could reduce costs by $2.4 million.

As of December 31, 1981, the Wallingford plant project was in the design phase.

Tullahoma, Tennessee

The city of Tullahoma, Tennessee, received a facility planning grant on April 16, 1974, for $248,500. The planning area included the city plus a surrounding area of approximately 200 square miles. The plan, approved by EPA in April 1980, recommended building an 8.3-mgd advanced secondary treatment plant consisting of a trickling filter system and an activated sludge process with nitrification and effluent filtering. Estimated cost of the project in September 1978 was $13.3 million. This project, like the Wallingford, Connecticut, project, is in the design phase.

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1/Based on water usage information, per capita consumption averaged about 60 gallons per capita per day in 1978 and 1980.

Projected population figures for the Tullahoma project were developed by the consulting engineers using several sources of data, including city and county data and information developed by the engineers' based on their own judgment. State population projections, although available, were not required to be considered and were not used. We determined in our analysis that if the State population projections had been used, as required under current regulations, domestic flow estimates would be reduced by 17 percent.

Industrial flow differences

Our analysis demonstrates that applying the 1978 regulations would reduce industrial flow allowances in 7 of the 13 plans, increase the flow allowance in 4 plans, and have no significant impact on 1 plan. The final plan--Bristol, Rhode Island--had no change since the engineers used the 1978 regulations as the basis for projecting future industrial flows, although they were not required to. The table below shows the effect of applying current industrial flow regulations to each of the 13 plans.

Effect of Applying the 1978 Industrial Flow Regulations to the 13 Plans

| | Design Year Industrial Flow | | | |
|---|---|---|---|---|
| | Per facility plan | Per application of 1978 regulations | Difference | Percent over-/(understated) |
| | (mgd) | | | |
| Bennington, Vt. | 0.86 | 1.24 | (0.38) | (44) |
| Boaz, Ala. | 1.91 | 1.16 | 0.75 | 39 |
| Bristol, R.I. | 0.54 | 0.54 | -0- | 0 |
| Carrollton, Ga. | 2.38 | 2.18 | 0.20 | 8 |
| Claremont, N.H. | 3.75 | 2.80 | 0.95 | 25 |
| Covington, Ga. | 1.27 | 0.84 | 0.43 | 34 |
| Milford, Conn. | 2.60 | 1.00 | 1.60 | 61 |
| Portsmouth, N.H. | 1.28 | 0.48 | 0.80 | 63 |
| Sheridan, Wyo. | (a) | (a) | (a) | (a) |
| South Valley, Utah | 1.20 | 1.77 | (0.57) | (48) |
| Sterling, Colo. | 0.70 | 0.76 | (0.06) | (9) |
| Tullahoma, Tenn. | 0.58 | 1.18 | (0.60) | (105) |
| Wallingford, Conn. | 2.09 | 0.61 | 1.48 | 71 |

a/No significant industry.

The following example demonstrates the effect of applying current regulations in projecting industrial flow allowances.

## Portsmouth, New Hampshire

Portsmouth, New Hampshire, a sea coast community, was awarded a $72,863 facility planning grant on September 22, 1976. At that time, the city operated a 1.5-mgd primary treatment plant that discharged into a tidal river. The plant did not meet secondary treatment standards and was subject to a large volume of inflow due to a combined sanitary/storm sewer system in the city. The facility plan, approved by EPA in March 1977, recommended building a 5.54-mgd secondary treatment plant at an estimated cost of $6.4 million. As of December 31, 1981, the city had not yet received a design grant.

At the time of facility planning, industrial flow to the existing treatment plant amounted to 0.3 mgd. Local industries generating this waste indicated that no significant expansion to their operation was anticipated.

In developing the industrial flow allowance for the proposed facility, however, the consulting engineers projected that 1.28 mgd of industrial waste would require treatment by the year 2000. The 1.28-mgd figure was established using a theoretical base of 2,000 gallons per acre per day and applying the 2,000-gallon figure to one-half of the land zoned by the city of Portsmouth for industrial development.

By applying the 1978 regulations, industrial flow allowances eligible for Federal funding would be reduced from 1.28 mgd to 0.48 mgd. The reduced flow is based on the 0.3 mgd industrial flow existing at the time of facility planning plus a growth allowance of 5 percent of the new treatment plant's total design flow. This is the largest growth allowance permitted by the 1978 regulations.

## Combined effect of current regulations to the 13 facility plans

In total, 11 of the 13 plans would reduce treatment plant size if the 1978 regulations were applied. Reductions range from 4 to 49 percent of the total plant size recommended in the facility plans. Potential dollar savings associated with the reductions in plant size ranged from $200,000 to $7.2 million.

## Effect of Applying 1978 Regulations on Total Treatment Plant Size for the 13 Plans

| | Total design year flow (note a) | | | |
|---|---|---|---|---|
| | Per facility plan | Per application of 1978 regulations | Differences | Percent over-/(understated) |
| | (mgd) | | | |
| Bennington, Vt. | 5.06 | 5.11 | (0.05) | (1) |
| Boaz, Ala. | 4.56 | 3.75 | 0.81 | 18 |
| Bristol, R.I. | 3.79 | 2.94 | 0.85 | 22 |
| Carrollton, Ga. | 5.39 | 5.19 | 0.20 | 4 |
| Claremont, N.H. | 6.20 | 4.22 | 1.98 | 32 |
| Covington, Ga. | 4.58 | 3.89 | 0.69 | 15 |
| Milford, Conn. | 11.00 | 7.93 | 3.09 | 28 |
| Portsmouth, N.H. | 4.63 | 2.94 | 1.69 | 37 |
| Sheridan, Wyo. | 4.40 | 4.12 | 1.28 | 6 |
| South Valley, Utah | 25.50 | 20.72 | 4.78 | 19 |
| Sterling, Colo. | 3.66 | 2.32 | 1.34 | 37 |
| Tullahoma, Tenn. | 8.14 | 8.40 | (0.26) | (3) |
| Wallingford, Conn. | 7.79 | 4.09 | 3.88 | 49 |

a/Includes domestic, commercial, institutional, and infiltration/inflow.

The following example demonstrates the impact of applying current regulations to both the domestic and industrial flow allowances.

### Claremont, New Hampshire

Claremont, a community of approximately 16,000 in the White Mountains of New Hampshire, operates a 1.1-mgd primary treatment plant which treats only domestic wastes. Approximately 1.7 mgd of industrial wastewater is discharged directly into the nearby Sugar River. In June 1975 Claremont received a $91,800 facility planning grant to upgrade its existing plant to provide secondary treatment. The plan, approved by EPA on December 15, 1977, recommends constructing 7.9 miles of sanitary sewer lines and building a 6.2-mgd activated sludge plant which will treat both domestic and industrial wastewater. In 1977 the engineers estimated that the project would cost $16 million.

Both the domestic and industrial flow allowances in the Claremont plan would be reduced under the 1978 regulations. The planning engineers estimated that 1.5 mgd of domestic flow would

require treatment by the year 2000 based on a 100-gallon-per-capita-per-day discharge. At the time they prepared the plan, the engineers analyzed water use records and determined the domestic flow to be 50 gallons per capita per day. Had they used this rate, as would be required under the 1978 regulations, the future domestic flow allowance would be reduced by half to 0.75 mgd.

In addition, changes in projected population resulted in a net decrease of 2,300 people, further reducing projected domestic flow to 600,000 gallons per day.

The engineers estimated future industrial flow to be 3.75 mgd, consisting of 2.25 mgd of existing industrial flow and 1.5 mgd of future flow from an undeveloped, 750-acre industrial/commercial park area. At the time the engineers were preparing the plan, there were no sewer lines to the park area and the community had no plans to sewer this area, which is approximately 2 miles from the nearest lateral line. The 1.5 mgd for the park area is based on a theoretical flow of 2,000 gallons per acre per day multiplied by the number of zoned acres (750). Had the engineers followed the 1978 regulations, future industrial flow would be limited to 2.8 mgd, or 950,000 gallons per day less than shown in the facility plan.

The net effect of applying the 1978 regulations to the Claremont facility plan would be to reduce (1) the domestic and industrial flow allowances by 2 mgd and (2) Federal construction grant funds by approximately $3 million.

## IMPACT OF 1981 AMENDMENTS ON SIZING OF WASTEWATER TREATMENT PLANTS

Significant changes have been made by the Congress to further reduce both the size of wastewater treatment plants and the amount of Federal funds for plant construction. On December 29, 1981, the Municipal Wastewater Treatment Construction Grant Amendments of 1981 were enacted. The amendments provide that, effective October 1, 1984, no Federal grant will be made to construct that portion of any treatment works providing reserve capacity in excess of existing needs as of the date of grant approval. In addition, the amendments reduce the Federal participation level from 75 percent to 55 percent of the construction costs.

These amendments will have considerable impact on Federal dollar outlays. For example, the facility plan for South Valley, Utah, approved by EPA in March, 1981, recommends constructing a 25.5-mgd advanced secondary treatment plant at an estimated cost of $94.4 million. Based on 75-percent funding, the Federal share would amount to approximately $71 million. To arrive at plant capacity, the consulting engineers used a theoretical flow figure of 100 gallons per capita per day times a projected population

of 255,000 to be served by the system in the year 1993. The 100-gallon-per-capita-per-day figure was broken down by allocating 80 gallons to domestic waste and 20 gallons to commercial and industrial waste and infiltration/inflow. The 1980 census of the South Valley service area showed an existing population of 106,800.

Using the 1981 amendment criteria, the proposed treatment plant would be significantly reduced in size from 25.5 mgd (255,000 population times 100 gallons per capita per day--80 domestic and 20 commercial, industrial, and infiltration/inflow) to 10.7 mgd (106,800 population times 100 gallons per capita per day--80 domestic and 20 commercial, industrial, and infiltration/inflow). Total projected cost of the plant, using the Sage Murphy & Associates, Inc., cost figures, adjusted for inflation, would be reduced from $94.4 million to $18 million with the Federal share dropping from $71 million to $10 million.

EPA, recognizing the impact of the 1981 amendments, took action to prevent municipalities from segmenting 1/ as a means of obtaining 75-percent Federal funding for projects that otherwise would not have been started until after the October 1, 1984, switch to 55-percent Federal funding. Under draft criteria, segmenting would be allowed only for existing construction projects, for projects so costly that the State would never have enough money in a single year to provide financing for the entire project, and for projects built to comply with a court order which sets phased pollution control requirements.

In addition, to avoid grandfathering of projects into a higher Federal funding level, EPA has developed draft grant rules that would bar increases in funding of facility planning and design grants if the additional funds would expand the scope of a proposed project. EPA headquarters has advised the regions informally that both policies--covering segmenting and increasing a project scope--are in effect immediately.

## CONCLUSIONS

Billions of tax dollars will be needed to construct and operate municipal waste treatment facilities to clean up the Nation's waterways. Therefore, the most cost-effective use of Federal funds is essential, especially in view of the Nation's budgeting constraints. Applying current facility planning regulations to treatment projects that were developed under pre-1978 criteria but have not yet progressed to either the design or construction phase could save Federal, State, and local governments millions of dollars in construction funds.

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1/Constructing a treatment system in phases--one phase involving the interceptor lines, another phase the pumping stations, another phase the plant itself, etc.

While we recognize that the Federal Government is striving to reduce the effects of Federal regulations on State and local governments, we believe that the potential savings available through application of the 1978 regulations to previously approved facility plans must be weighed against the adverse effects--delays in projects and increased costs due to inflation--of such actions. We also recognize that the current regulations would not be applicable to all proposed projects. Whether or not they should be applied will depend upon such factors as

--the size and cost of the project;

--whether the project has proceeded to design and, if so, how much of the design work is completed;

--when construction on the project is to begin;

--the effects of inflation on construction costs due to any delays caused by retroactive application of the 1978 regulations.

We also recognize that the entire controversy regarding reserve capacity of publicly owned wastewater treatment systems will become a moot point with implementation of the 1981 amendments to the Clean Water Act. However, during the interim to October 1984 significant Federal savings can be realized by applying the 1978 regulations on a case-by-case basis. As part of its review to prevent segmenting of proposed construction projects, EPA could make a quick test using the 1978 criteria for domestic and industrial flow allowances to estimate the potential savings. If, in EPA's judgment, the potential savings warrant revision of the proposed project, then we believe EPA should revise the project accordingly.

## AGENCY COMMENTS AND OUR EVALUATION

In our draft report, we recommended that the Administrator, EPA, amend the 1978 facility planning regulations for determining plant size to apply to all projects progressing to either the design or construction phase where, in the Administrator's judgment, applying the 1978 criteria would result in significant Federal savings.

In a letter dated June 1, 1982 (see app. I), commenting on our draft report, EPA stated that in the 1981 Appropriation Act, the Congress specifically prohibited the agency from using fiscal year 1981 construction grant funds for the retroactive application of program regulations. The Administrator of EPA also issued a directive prohibiting the Agency from retroactively enforcing project requirements or conditions not in effect at the time of grant award, except as expressly required by law or executive order.

If the Congress directs EPA to modify its current policy prohibiting the retroactive application of program regulations, the Agency would consider factors such as provisions of superceded policy and the factors listed in this report, including the effect of inflation on costs during reanalysis and redesign.

In its response, EPA did not object to the concept of retroactive application of regulations but merely pointed out that the 1981 Appropriation Act restricted it from using fiscal year 1981 construction grant funds for such purposes. Congressional debate supporting the restriction pointed out that the retroactive application of regulations across the board was causing delays in project completion and that such delays were increasing project costs through inflation. Although this restriction applied only to 1981 appropriations, EPA extended the provision to cover all program funds regardless of the year appropriated.

We believe that the conditions which existed when the 1981 Appropriation Act was passed do not necessarily exist today; for example, high inflation rates versus significantly reduced inflation, $3.4 billion appropriation versus a proposed appropriation of $2.4 billion, 75 percent Federal funding of a project versus 55 percent Federal funding effective October 1, 1984, etc. Therefore, in light of these changing conditions, we believe that the Congress, as well as the general public, may be more amenable to the concept of retroactive application of regulations when such action can result in significant cost savings.

While we recognize that this problem of retroactive application is one of limited duration (the 1981 amendments to the act provide that effective October 1, 1984, no Federal grant will be made to construct that portion of any treatment works providing reserve capacity in excess of existing needs), the fact remains that during the interim to October 1, 1984, significant savings in Federal, State, and local funds can be realized by applying the 1978 regulations to treatment projects on a case-by-case basis.

## RECOMMENDATION TO THE CONGRESS

We recommend that the Congress direct the Administrator, EPA, to modify the agency's current policy prohibiting the retroactive application of program regulations. This can be accomplished by including in the appropriation of funds for this program for fiscal years 1982 and 1983 language such as the following:

> "Provided, That any funds appropriated in this act used for grants to construct wastewater treatment facilities shall fund excess capacity only to the extent that such capacity is consistent with the criteria set forth in the EPA regulations at 40 CFR §35.900 *et seq.*"

## BUDGETARY IMPACT OF OUR RECOMMENDATION

We believe that substantial savings could result if the Congress directs that those projects developed under pre-1978 criteria, which have not progressed to the design and/or construction phase, be required to apply the 1978 facility planning regulations. For example, if these plants were constructed in 1982, approximately $30 million in Federal funds could be saved. Construction of waste treatment facilities is funded from the EPA account for Construction Grants (20-00) 68-0103 in the Pollution Control and Abatement (304) budget subfunction. The House Committee on Public Works and Transportation and Senate Committee on Environment and Public Works have authorizing jurisdiction.

# CHAPTER 3

# CHANGES ARE NEEDED IN THE CURRENT SYSTEM OF FACILITY PLANNING TO ACHIEVE GREATER EFFICIENCY IN USE OF GRANT FUNDS

Each year Federal, State, and local governments spend billions of dollars to construct treatment plants that may or may not be the right size to meet a community's wastewater treatment needs. While the 1978 regulation changes provided some criteria to follow, many areas of facility planning are still left to the engineer's discretion and judgment.

Our review of 13 facility plans showed that not only did engineering judgment vary considerably from project to project but that engineers used a myriad of ways, all considered to be within acceptable engineering practices, to establish the treatment plant size for each of the proposed systems. EPA and/or the States review each plan to verify that it addresses all the required elements, but they do not have definitive criteria to measure the plan against nor do they independently verify key information and assumptions used by the engineer.

Changes are needed in the facility planning process if EPA and the States are to have a basis for determining if a proposed treatment plant is the right size, at the right cost, to treat the community's existing and future wastewater needs and if it will effectively contribute to meeting the Nation's clean water goals.

## EPA PLANNING REGULATIONS DO NOT CLEARLY DEFINE HOW TREATMENT PLANT SIZE SHOULD BE DETERMINED

The theory behind facility planning and calculating treatment plant size is straightforward: determine the sources and amount of wastewater a plant is to treat now and in the future and then establish the size of plant necessary to provide the required level of treatment. While the theory is simple, implementing it is complex. EPA regulations describe the elements each plan must cover, but they are very general about how engineers are to develop and analyze information to support the plan.

### Many important areas not covered by planning regulations

While the 1978 EPA regulations and guidance are more restrictive than those in the past, many areas of facility planning affecting treatment plant size still are not covered by either guidance or regulation. Engineers are depended upon to answer each of the following questions without guidance from EPA:

--How much domestic flow exists today and how much can be expected in the future?

--What is the amount of existing and projected industrial flow from the service area?

--How much of the current flow to the system can be attributed to infiltration/inflow and what levels can be expected in the future?

Obtaining the answers to these basic questions, however, requires answering a number of subsidiary questions. Examples of questions that must be answered in determining existing domestic flow include:

--Are water use or treatment plant flow records available, accurate, and reliable? What basis is used to make this determination?

--If domestic flow rates are based on water use records, how much of the water used is actually returned to the sewer system?

--If domestic flow rates are based on treatment plant flow records, how many people are currently served by the sewer system and how much wastewater does each person discharge?

In estimating future domestic flow, a similar set of questions must be answered, including:

--Will projected growth areas in a community be served by the sewer system or by individual disposal systems?

--Will residences currently served by individual disposal systems connect to the sewer system if it is made available?

--In total, how many people will be served by the sewer system in the future?

How engineers answer each of these questions significantly affects the size of the treatment plant recommended in the facility plan. Engineers are allowed to make many assumptions about future conditions and are constrained only by broad engineering practices, judgment, and experience.

## JUDGMENT PLAYS A SIGNIFICANT ROLE IN THE WAY ENGINEERS DEVELOP A FACILITY PLAN AND DETERMINE PLANT SIZE

Each of the 13 plans we reviewed addressed the three types of wastewater flow that a facility is required to treat--domestic, industrial, and infiltration/inflow--however, the basis and support

for the figures varied considerably. Engineers used a variety of techniques and made a number of assumptions to determine existing flow and to project future flows from domestic and industrial sources as well as infiltration/inflow. The techniques and assumptions used reflect the engineers' interpretation of available information and their experience and judgment. Because judgment differs from engineer to engineer, no assurance exists that the treatment plant recommended in the facility plan is the right size for a particular community. In two facility plans, a second engineer hired by the community to design the plant recommended a larger treatment plant because that engineer's interpretation of available information differed from the planning engineer's.

Basis for determining existing flows

Our review showed that engineers used a number of methods to determine existing domestic and industrial flows and the amount of infiltration/inflow entering the sewer system. Although the methods differed, each was acceptable to EPA. The charts below identify several of the different methods used to arrive at existing flows.

Methods Used by Engineers To Determine Existing Flows in the 13 Facility Plans Reviewed

Domestic:

Water use records adjusted for consumption.

Water use records not adjusted for consumption.

Wastewater treatment plant flow records.

Theoretical estimates of per capita flow.

No specific identification of method for existing domestic flow.

Industrial:

Water use records maintained by the industry.

Water use records maintained by the water company.

Engineers' metering of industrial flow

Responses to questionnaires sent by engineers to industries.

No specific identification of method for existing industrial flow.

Infiltration/Inflow:

Theoretical estimate based on comparison of water sales information and recorded treatment plant flows during wet and dry seasons.

Theoretical estimate based on recorded treatment plant flows during wet and dry seasons.

Engineers' metering and testing of the sewer lines.

Infiltration estimates based on:

average plant flow for 5 months during the wet season,

wettest month of the year, and

dry season flows adjusted for wet seasons flows.

Inflow estimates based on worst storm experienced in a 1-, 2-, 5-, or 10-year period.

Basis for determining future flows

In projecting future flows, the engineers again used a number of methods. These methods are shown below.

Methods Used by Engineers To Estimate Future Flows in the 13 Facility Plans Reviewed

Domestic:

Same per capita discharge rate as determined from existing water use records.

A theoretical rate assuming an increase in the existing per capita rate determined from water use records.

Same theoretical per capita rate used to calculate existing domestic flows.

Population projections developed by either the State, other government agencies, or the engineers.

Industrial:

Same industrial flow identified during facility planning.

Increased industrial flow based on allowances provided for under the 1978 EPA regulations.

Increased industrial flow based on the estimated number of acres to be occupied by industry and a theoretical flow per acre.

Increased industrial flow based on actual industrial flow per acre at time of facility planning.

Letters of intent from major industries.

Infiltration/Inflow:

Reduced infiltration rates ranging from 10 to 82 percent of existing infiltration.

Reduced inflow rates ranging from 5 to 99 percent of existing inflow.

Allowance made for additional infiltration due to installation of new sewer lines.

No allowance made for increased infiltration due to installation of new sewer lines.

Examples of different engineering judgment

Engineers' professional judgment can be a decisive factor in determining the size and makeup of a wastewater treatment plant. Since judgment differs from engineer to engineer, many solutions to a community's treatment needs may be supportable. The range of solutions is constrained only by broad engineering practices and the consulting engineer's judgment. The wide range of engineering judgment is clearly illustrated by what occurred in the planning and design stages of the Bristol, Rhode Island, and Sheridan, Wyoming, wastewater treatment projects.

Bristol, Rhode Island

Bristol, Rhode Island, a community with a 1980 population of 20,128, is upgrading its 3-mgd primary plant to provide secondary treatment. In 1976 the town received an EPA facility planning grant for $197,574 and hired one consultant engineer to develop the facility plan and a second consultant engineer to design the plant. The facility planning engineer completed the plan in August 1979 and recommended building a 2.9-mgd secondary treatment plant at an estimated cost of $15.9 million. The plant was to be financed from an EPA grant of $7.1 million, a State grant of $1.4 million, and $7.4 million from Bristol. The project is now in the design phase and, based on the design engineer's recommendations, is to treat 3.8 mgd, or 31 percent more flow than the planning engineer recommended. The size increase resulted from the design engineer's different analysis and assumptions concerning the size of the population to be served by the sewer system as well as the domestic flow rate. The differences are shown below:

Design Parameters for Bristol, Rhode Island, Wastewater Treatment Project

| Flow sources | Facility plan parameters Flow (mgd) | Basis | Design parameters Flow (mgd) | Basis |
|---|---|---|---|---|
| Domestic | 0.83 | 19,700 people X 42 gal. per day | 1.73 | 21,670 people X 80 gal. per day |
| Industrial | 0.54 | Existing flow plus 25-percent increase | 0.54 | From facility plan |
| Infiltration/ inflow | a/ 1.52 | | b/ 1.52 | |
| Total | 2.89 | | 3.79 | |

a/Does not include storm-related inflow of 350,000 gal. per day.

b/Does not include storm-related inflow of 561,000 gal. per day.

The planning engineers used the preferred EPA method of calculating domestic flow, although they were not required to do so because the grant for the project was approved before the 1978 regulations were in effect. They analyzed water use records and assumed that 75 percent of the water used would be returned to the sewer system; this assumption resulted in a 42-gallon-per-capita-per-day domestic flow rate. In calculating inflow to the new plant, the planning engineers assumed that 70 percent of existing inflow could be eliminated, leaving 350,000 gallons per day of inflow to be treated from a major rainstorm.

The design engineers, however, had problems with the 42-gallon-per-capita-per-day domestic flow rate, the estimated population to be served by the sewer system, and the amount of inflow that could be effectively removed from the sewer lines. They believed that the 42-gallon-per-capita-per-day figure was too low and that improvements to the town's water supply system would result in increased water use. Therefore, they decided to use the optional EPA method of calculating domestic flow and assumed that a theoretical 80-gallon-per-capita-per-day flow would be more realistic for Bristol and would be consistent with good engineering practice. However, they did not show that the water records used by the planning engineer were inaccurate or that the planning engineer's analysis was faulty.

We discussed the possibility of improvements being made to the city's water system with officials of the Bristol County Water Company and were told that:

--The company is looking into the possibility of buying additional water from the city of Providence. However, the cost of laying pipes to transport the water would be about $25 million.

--The company has known for about 40 years that the demand for water was reaching the company's capacity.

--The company cannot make the $25 million investment, and the communities served by the system are not willing to pay the increased costs associated with the project.

As of June 1982, no action had been taken or contemplated to initiate construction of the water improvement project.

The design engineer also assumed that a greater population would be served by the sewer system than did the facility planning engineer. The facility planning engineer had divided the city of Bristol into 33 subzones. While the design engineer agreed with the subzone breakdown, he believed that several of the subzones the facility planning engineer had excluded would be served by the system in the design year. This change resulted in an estimated 2,000 more people to be served by the sewer system in the future.

The design engineer also disagreed with the planning engineer's estimate that 70 percent of the identified inflow could be effectively eliminated from the sewer system. The design engineer assumed a 50-percent removal rate because of the uncertainties associated with the community's inflow removal program. This left 561,700 gallons of storm-related inflow to be treated rather than the 350,000 gallons estimated by the planning engineer.

The Rhode Island Department of Environmental Management and EPA approved the facility plan even though they too had reservations about the seemingly low gallon-per-capita-per-day domestic flow rate used by the facility planning engineer. EPA approved the plan on the condition that domestic flows be analyzed further during the design phase. EPA engineers told us that a 60-gallon-per-capita-per-day flow was more realistic for a town of Bristol's size than the 42-gallon-per-capita-per-day rate calculated from water records. Yet, following our discussion, EPA accepted the design engineer's estimated 80-gallon-per-capita-per-day flow rate because it appeared to be in good engineering practice. The net effect of these design changes, using the Sage Murphy & Accociates, Inc., cost data resulted in a $1.2 million increase in project cost.

Sheridan, Wyoming

Engineering judgment can affect other areas of the recommended treatment plant in addition to plant size, as illustrated by the Sheridan, Wyoming, wastewater treatment plant. Separate

planning and design engineers were involved in this project. The design engineer modified the treatment plant process, increased the plant size, and extended the plant's design life by 10 years.

Sheridan, Wyoming, received a $56,250 facility planning grant in 1974 to upgrade and enlarge its existing 2.1-mgd plant. The plant did not provide secondary treatment, emitted an offensive odor within a quarter-mile radius, experienced grit removal and sludge handling problems, and was subject to hydraulic overloading at times of peak infiltration/inflow. The facility plan, approved by EPA in 1979, recommended building a 4.1-mgd average daily flow plant consisting of (1) trickling filters in series within an activated sludge aeration basin, (2) both aerobic and anaerobic digestion, (3) land application of sludge, and (4) an equalization basin to hold and control flow during periods of high infiltration/inflow.

The community hired a second engineering firm to design the treatment plant. Based on the design engineers' judgment, the following changes to the facility plan were made and approved by EPA:

--The plant's design life changed from the year 1990 to the year 2000. The design engineers believed that the plant should have adequate treatment capacity for about 20 years from the date the plant was to become operational rather than 20 years from the date the facility planning grant was awarded.

--Treatment plant average daily flow increased from 4.1 mgd to 4.4 mgd. Extending the design life of the plant by 10 years would increase the population size that could be served in the future and thus would increase flow to the treatment plant.

--The design engineers eliminated the treatment plant process recommended by the planning engineer and approved by EPA and substituted an alternate treatment process. Based on their professional background, the design engineers believed that the alternate process would better serve Sheridan's treatment needs.

Both the Bristol, Rhode Island, and Sheridan, Wyoming, wastewater treatment projects clearly demonstrate the subjective nature of facility planning. The differing assumptions and backgrounds of the design engineers working on each project resulted in significant changes to both facility plans. Although the changes in both projects were substantial, neither the Bristol nor the Sheridan projects experienced any significant delay as a result of obtaining EPA approval of the changes.

## FACILITY PLAN REVIEWS DO NOT DETERMINE THE ADEQUACY OF TREATMENT PLANT SIZE

EPA and State facility plan reviews do not ensure that the recommended treatment plant is the right size because no criteria exist against which reviewers can measure their decisions. Reviewers judge the reasonableness of a plan based on their background and on general engineering practice. Traditionally, EPA officials do not verify key information, conduct their own tests, or perform their own analysis. Thus, the effectiveness of the reviews depends on information contained in the plan and on the reviewers' judgment.

Facility plans are reviewed by EPA and/or States, depending upon whether the State has been delegated approval authority. If it has been delegated authority, a State can review and approve the plan without an EPA review. If a State has not been delegated authority, it reviews the plan to verify that it conforms with both Federal and State regulations and any applicable areawide waste treatment management planning requirements and then submits the plan to EPA. EPA then reviews the plan to determine whether the recommended plant is properly sized, cost effective, and environmentally sound.

EPA regional officials stated that they rely on the engineers to perform a thorough analysis of the community's wastewater conditions, to evaluate alternatives for treating a community's waste, and to select the alternative that will provide the right size and type treatment plant to best meet the community's wastewater treatment needs. EPA does not independently verify key information such as the number of people currently served by the sewer system or the per capita wastewater discharge. EPA officials also do not conduct their own monitoring at the plant, test for the amount of infiltration/inflow entering the sewer system, or measure and analyze industrial effluent discharged to the system.

The Acting Director, Facility Requirements Division, EPA, stated that reviewing facility plans requires considerable engineering judgment and expertise. Reviewers must weigh the reasonableness of the plan; that is, does it make sense in relation to the community's pollution problem. However, "reasonableness" is a subjective term open to interpretation. As previously discussed, many important areas of the planning process are not covered by criteria or regulations. Thus, the effectiveness of facility plan reviews depends heavily upon the background and judgments of the EPA and/or State reviewing officials.

## CONCLUSIONS

Federal, State, and local governments spend billions of dollars to construct wastewater treatment plants that may or may not be the right size to effectively meet a community's wastewater treatment needs. While current regulations are more restrictive than those in the past, many areas of facility planning that

affect treatment plant size are still not covered by either guidance or regulation. As a result, engineering judgment, which we found to vary considerably from project to project, becomes the deciding factor in determining plant size and ultimately total project cost.

We believe that additional criteria are needed not only to assist the engineers and the community in arriving at a properly sized treatment plant, but also to provide EPA and State reviewers a basis on which to evaluate the adequacy of the facility plan and its recommended treatment process. Neither EPA nor the States typically verify key information contained in the flow projections. Nor do they conduct their own tests on the amount of flow--domestic, industrial, and infiltration/inflow--subject to treatment, nor perform any of the analysis generally associated with plan development. Therefore, we believe that specific criteria to measure these factors are essential to ensure proper sizing of a treatment plant and to aid in an equitable distribution of the limited dollars available to meet the Nation's clean water objective.

## RECOMMENDATION TO THE ADMINISTRATOR, EPA

We recommend that the Administrator, EPA, with the cooperation of the engineering community, develop standards for each critical factor used in establishing existing as well as future domestic, industrial, and infiltration/inflow amounts to be treated by a wastewater plant. We recognize that local conditions may warrant deviation from any established standard. However, deviations should require additional justification by the consulting engineer to provide EPA with a basis for evaluating the proposed change. These standards should, as a minimum, establish

- --a discharge ratio to be applied to actual water use records when determining existing and future domestic flow to the plant for treatment;
- --a method to be used in measuring industrial flow (for example, meter industrial discharge rates);
- --inflow estimates based on a worst storm event experienced in a specified time period (for example, 1 year, 2 years, 5 years, etc.).

## AGENCY COMMENTS AND OUR EVALUATION

In commenting on our draft report, the Agency stated that:

Item 1--The range of discharge ratios (80-90 percent) provided in EPA guidance (MCD-19) reflects practical experience that should not be supplanted by inflexible regulation.

Item 2--EPA will consider incorporating a method for measuring industrial flows to municipal, publicly owned treatment works in program regulations.

Item 3--EPA is not currently carrying out studies to identify an appropriate storm frequency for estimating flow. A proposal now under consideration for implementation would identify current infiltration/inflow detection techniques and, when completed, would identify requirements for future development of infiltration/inflow prediction techniques. Such techniques would most likely include those related to storm events.

While we agree that the discharge ratios (80-90 percent) provided in EPA guidance (MCD-19) reflect practical experience, it is nonetheless merely a guide and not a standard. Therefore, the engineering community is neither required to abide by the ranges established in the guide nor required to justify deviations from the range. As a result, wide percentages in discharge ratio applications have occurred. For example, in the 13 plans reviewed, domestic discharge ratios used by the engineers ranged from a low of 66 percent to a high of 100 percent with no consistency in these applications between existing domestic flow and projected future domestic flow. We further believe that establishing a standard would provide sufficient flexibility to meet the 80- to 90-percent discharge rates recommended in EPA guidance and would perclude the use of wide-ranging ratios identified in our report.

With regard to items 2 and 3, the agency generally concurs with the concept and the need for such standards. EPA further stated that it will consider establishing criteria to measure these elements.

We, however, continue to believe that specific criteria to measure all critical factors are essential to ensure proper sizing of treatment plants and to aid in an equitable distribution of limited dollars available to the program.

APPENDIX I

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

JUN 1 1982

OFFICE OF
POLICY AND RESOURCE MANAGEMENT

Mr. Henry Eschwege
Director
Community and Economic Development Division
U. S. General Accounting Office
Washington, D. C. 20548

Dear Mr. Eschwege:

The Environmental Protection Agency (EPA) has reviewed the General Accounting Office (GAO) draft report, "Better Planning Can Reduce Size of Wastewater Treatment Facilities, Saving Millions." Public Law 96-223 requires that the Agency submit comments on the report, so that GAO may consider our views prior to publishing the final report. Below are the Agency's responses to the report's recommendations and enclosed is a list of detailed comments which we feel should be incorporated in the final report.

The construction grants program regulations have been revised in response to the 1981 amendments to the Clean Water Act and the President's regulatory reform initiative. On May 12, 1982, the revisions (40 CFR Subpart I) were published as interim final regulations in the Federal Register. The report's recommendations and revisions to guidance documents will be considered during the regulatory comment period.

GAO Recommendation

GAO recommends that the Administrator, EPA, amend the 1978 facility planning regulation for determining plant size to apply to all projects progressing to either the design or construction phase where, in the judgment of the Administrator, the application of the 1978 criteria would result in significant savings of Federal monies.

EPA Response

In the 1981 Appropriations Act (copy enclosed), Congress specifically prohibited EPA from using Fiscal Year 1981 Construction Grant funds for the retroactive application of program regulations. The Administrator of EPA has also issued a directive prohibiting the Agency from retroactively enforcing project requirements or conditions not in effect at the time of grant award, except as expressly required by law or executive order (copy enclosed).

If Congress directs EPA to modify its current policy prohibiting the retroactive application of program regulations, we would consider factors such as provisions of superceded policy, such as those identified in PRM 80-6, and the factors listed on page 17 of this draft report, including the effect of inflation on costs during reanalysis and redesign.

GAO Recommendation

GAO recommends that the Administrator, EPA, with the cooperation of the engineering community, develop standards for each critical factor used in establishing existing, as well as future domestic, industrial, and infiltration/inflow amounts to be treated by a wastewater plant. GAO recognizes that local conditions may warrant deviation from any established standard. Such deviations, however, would require additional justification by the consulting engineer and would provide EPA with a basis for evaluating the proposed change. These standards should, as a minimum, establish:

1. a discharge ratio [potable inflow/waste outflow] to be applied to actual water use records when determining existing and future domestic flow to the plant for treatment.

2. a method to be used in measuring industrial flow (e.g., meter industrial discharge rates).

3. inflow estimates based on a worst storm event experienced in a specified time period (e.g., one year, two years, five years, etc.).

EPA Response

In response to the proposed standards:

Item 1 - The range of discharge ratios (80-90%) provided in EPA guidance (MCD-19) reflects practical experience that should not be supplanted by inflexible regulation.

Item 2 - EPA will consider incorporating a method for measuring industrial flows to municipal publicly owned treatment works in program regulations.

Item 3 - EPA is not currently carrying out studies to identify an appropriate storm frequency for estimating flow. A proposal now under consideration for implementation would identify current infiltration/inflow detection techniques, and when completed, would identify requirements for future development of infiltration/inflow prediction techniques. Such techniques would most likely include those related to storm events.

We appreciate the opportunity to state our views on this draft report, so that GAO may consider and incorporate the Agency's comments in the final report.

Sincerely yours,

Joseph A. Cannon
Acting Associate Administrator
for Policy and Resource Mangement

Enclosures

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