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WATER POLLUTION CONTROL LEGISLATION

Part 3

HEARINGS

BEFORE THE

SUBCOMMITTEE ON AIR AND WATER POLLUTION

OF THE

MITTEE ON PUBLIC WORKS UNITED STATES SENATE

NINETY-SECOND CONGRESS

FIRST SESSION

ON

S. 75, S. 192, S. 280, S. 281, S. 523, S. 573, S. 601, S. 679, S. 927, S. 1011, S. 1012, S. 1013, S. 1014, S. 1015, and S. 1017

BILLS AMENDING THE FEDERAL WATER POLLUTION CONTROL ACT AND OTHER PENDING LEGISLATION RELATING TO WATER POLLUTION CONTROL

GENERAL APPENDIX

SECTION I. ADDITIONAL STATEMENTS AND MATERIALS

Printed for the use of the Committee on Public Works

Serial No. 92–H9

AUTHENTICATED
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GENERAL APPENDIX

Section I. ADDITIONAL STATEMENTS AND MATERIALS

STATEMENT OF THE AMERICAN CONCRETE PIPE ASSOCIATION

By Richard E. Barnes, Managing Director

Mr. Chairman and members of the committee: the American Concrete Pipe Association welcomes this opportunity to file its views on the current water pollution control legislation pending before this Subcommittee. This statement is submitted on behalf of the members of our Association.

INTRODUCTION

The American Concrete Pipe Association was founded as a non-profit organization in 1907. The Association serves as spokesman for the concrete pipe industry in all matters affecting the welfare of the industry. It has member companies in every state except two. There are almost 500 concrete pipe plants in the United States of which our members represent 351 plants located throughout this country. The Association's membership represents 70 to 75 percent of the annual production of the entire industry. The value of our industry's total annual production is about $700 million.

The membership of our Association is deeply aware of the environmental problems confronting our great nation, especially the need for clean waters. During hearings before this Subcommittee in the 2nd Session of the 91st Congress, our Association filed a statement on May 22, 1970, presenting its position and views. This statement now appears in Volume V, pages 1705 through 1708 in said hearing record.

The control of water pollution is a major activity of the concrete pipe industry. Throughout the world, concrete pipe is the accepted conduit for irrigation, drainage, sewers, highway culverts, and pressure water supply mains. Without these systems for controlling water supply and discharge wastes, our nation could not function in a progressive and healthful manner. Attached to this statement, as Exhibit "A", is a brief report of the different types of concrete pipe available and their end uses.

ABATEMENT NEEDS

Since these hearings began, much has been said about the waste treatment grant program conducted by the Office of Water Quality of the Environmental Protection Agency. It is our opinion that to gain a complete perspective of the needs to abate water pollution, one must include the water and sewer programs of the Department of Housing and Urban Development, the Farmer's Home Administration of USDA, and the Economic Development Administration of the Department of Commerce. Attached as Exhibit "B" is a recent study prepared by the Association entitled: "A Survey of the Water Pollution Control Programs." This survey was introduced on the floor of the U.S. Senate by a member of this Subcommittee, Senator Dole of Kansas. Attached as Exhibit "C" is an update of Tables I and II of the survey.

Gentlemen, there are nearly 15,000 applications pending before EPA, HUD, EDA and FHA with a total needed grant funding of $5.9 billion. Neither the estimated fiscal outlays of less than $900 million for 1971 and about $1.4 billion for fiscal 1972 come close to the real need of $5.9 billion just to fund pending applications.

In addition to the $5.9 billion grant amount needed to cover pending applications, William D. Ruckelshaus, Administrator of EPA, testified before this Subcommittee on February 4 that the federal debt owned to the states in the form of reimbursements for their pre-paying the federal share of the EPA program has risen to $1.5 billion, of which about $300 million is immediate debt out-

standing. Thus, the current needs of applications and reimbursables to the states total $7.4 billion.

The question arises: if this represents past needed funding, what are the economic projections to just catch up with water pollution needs? A recent survey by the National League of Cities estimated that public funds needed now to control water pollution amount to from $33 to $37 billion. The Joint Economic Committee of Congress examined this same problem and estimated in 1968 that a ten year, $51.8 billion program was needed with an annual average need of $5.2 billion.

Gentlemen, the financial needs of this country to solve its water pollution problems are extremely formidable, unless new research developments discover more economical solutions. Neither the Administration's proposed increases in appropriations for EPA, nor Senator Muskie's bill, S.523, are a total financial panacea, especially in view of the economic realities of America today.

Another question that is receiving intense examination by industries and environmentally conscious citizens is the implications of the President's revenue-sharing proposal, particularly the "special revenue-sharing grants" of $11.2 billion which would be earmarked to be spent in the functional areas of transportation, education, urban and rural community development, manpower training and law enforcement. It is sincerely hoped that the water and sewer programs will not be confronted on a competitively funding basis with urban renewal and model cities programs, whereas in the past separate budgeted amounts have prevailed. In addition, the President in his environmental message excluded water districts from eligibility in the $5 billion "general revenue-sharing" plan.

FEDERAL AGENCY PROGRAMS

The following is an analysis of the four federal agency programs attempting to control water pollution:

1. *EPA.*—The specific need within the Office of Water Quality of EPA, besides the funding of 3,007 applications at grant need of $2.1 million, is to make eligible for federal grants the separation or storage of combined sewer-storm discharge systems. There are over 1,900 communities in the U.S. with combined or partially combined storm and sanitary sewer systems serving some 59 million people. To stop the raw sewage overflow at peak periods will require either the separation of combined systems or the storage of heavy combined sewer flows to be delivered for treatment to the disposal plant during periods of low flow. In 1967, the American Public Works Association Research Foundation, under study contract with the then FWPCA, estimated that the separation of our nation's combined systems would cost about $48 billion, including the necessary plumbing changes on private property. Exhibit "D" to our testimony is the result of their study. If the separation or storage of these systems is financially feasible, it is recommended that the Subcommittee consider the amendment language which appeared as Section 3 of S. 4105, which was introduced by Senator Magnuson of Washington on July 21, 1970.

2. *EDA.*—The purpose of the Public Works and Economic Development Act of 1965 was to help restore areas burdened with high unemployment and low family income. Of the total budget for programs under the jurisdiction of the Economic Development Administration of the U.S. Department of Commerce, sixty (60) to seventy (70) percent is utilized in water and sewer projects. New industry means new jobs and fuller employment where it is most needed, but, without adequate water and sewer facilities, underemployed communities can never hope to attract an influx of industrial development. As of December 31, 1970, 150 pending water and sewer projects with needed grants amounting to $100 million remained unfunded.

3. *HUD.*—HUD's Water and Sewer Facilities Grant Program helps communities stretch their limited resources to trigger local employment opportunities, promote an increased housing supply, and provide an atmosphere conducive to economic growth, thus responding to social needs as well. Presently, the program has about 4,300 pending applications unfunded at a grant amount of about $2.5 billion. The present Administration has projected an estimated $140.5 million of outlay during fiscal 1971, when Congress appropriaed $350 million for water and sewer projects and authorized an additional $1 billion in Public Law 91-431. In effect, the Office of Management and Budget appears to be willing to reduce this program for the current fiscal year by reducing more than one half of the appropriated amount. By HUD definition, "the basic parts of a water or sewer facility for which a grant may be made include all parts

of the water or sewer facility except building or household connection *and local distribution or collection laterals.*" A local collection lateral as understood by HUD is "that portion of a sewer facility which only collects flow from building or household connections and does not collect a flow from other common sewers or tributaries." If the federal government is interested in creating an incentive plan to meet the 10-year housing goal as stated in the 1968 Housing Act report, which called for 26-million units started or rehabilitated between 1968 and 1978, an amendment to the statute to make laterals eligible under the HUD Grant Program would be a suggestion. We support the testimony presented by the National Association of Counties before the House Committee on Banking and Currency on June 12, 1970, especially their statement: "We believe the Congress and the Administration should place water-sewer construction at the top of the priority list if our national housing goals are to be met over the next decade." In addition, we support the statement in the President's Advisory Commission on Intergovernmental Relations report "Metropolitan America: Challenge to Federalism" that "one of the major shortcomings in water supply and waste disposal is the continued reliance on private wells and individual septic tanks in communities where the growing density of population calls for public water and sewerage systems."

4. *FHA.*—Recent studies of applications strongly indicate that the Farmer's Home Administration is falling significantly behind with its efforts to help secure adequate public facilities for the 61,922 small towns and rural communities which desperately need water and sewer grants and loans for the construction of adequate facilities. Rural America is the home of approximately one-third of our total population. It contains most of the substandard water and sewerage systems that are used by about 19.7 million rural families. In rural areas not served with adequate central water supplies, 16 times as many people die from waterborne diseases as do in the remainder of the nation. The Surgeon General in a speech made at the Alliance for Progress 1968 Meeting stated that a Public Health study of 228 outbreaks of waterborne diseases revealed that untreated ground water used by families not connected to a public supply accounted for the majority of these diseased cases.

The Economic Research Service of USDA published a study in "Agricultural Economic Report No. 143" reporting that 44,567 communities having populations less than 5,500 do not have a sewerage system. In December 1969, FHA conducted a survey which resulted in a water and sewer system need amounting to $11.3 billion.

Of all the federal agencies, FHA has the greatest number of unfunded, pending water and sewer applications. As of December 31, 1970, 7,267 applications remained unfunded by FHA over the past three years at a grant amount of $1.176 billion. In order to adequately meet minimum water and sewer requirements, FHA has estimated the annual need for their grant program at $150 million and their loan program at $1 billion annually. This estimate falls far short of the following amounts enumerated by the President's Office of Management and Budget:

FARMER'S HOME ADMINISTRATION (USDA)

Fiscal 1971	Appropriated by Congress	To be spent
Grants	$100,000,000	$40,000,000
Direct loans	98,000,000	74,000,000
Insured loans		86,000,000

Gentlemen, if FHA is to continue with a direct action program in providing matching loans for HUD, EPA(OWQ) and EDA grants made in rural areas, it is mandatory that the insured loan fund must be substantially increased. FHA is the only federal agency among those listed that seems to have the delivery capability of making loans in rural areas in the numbers and amounts required. Because of the unavailability of monies in the Agricultural Credit Insurance Fund, it would be interesting for this Subcommittee to know what percent of the applications in all four federal agencies are pending because of the meager loan authority granted the ACI Fund. In addition, it would be interesting to know which rural areas have had development terminated or never initiated because they didn't have the funds to meet state water quality standards. Can the Congress, through the Secretary of the Interior, agree to impose state water quality standards without providing the necessary matching funds to meet those standards?

INTERAGENCY COMMITTEE

At this time the Association wishes to go on Record as supporting the original purposes and objectives of the Interagency Committee to Provide Continuing Coordination of Water and Sewer programs. This Committee provides a continuing means for interchange between federal officials responsible for administration of various water-sewer programs and the industries and associations whose members participate in such programs. The Committee serves primarily in an advisory capacity with authority to submit specific recommendations in behalf of represented industries and associations only when such recommendations have the unanimous endorsement of the participating groups. Officials of EPA (OWQ), HUD, FHA, and EDA have been responsibly responsive in implementing methods which have accelerated the processing of water and sewer grant and loan applications and have designed the application for speedy identification as to which agency has jurisdiction.

Two of the most recent actions taken by the Interagency Committee have been the unanimous adoption of guides to bidding policy and to contract award policy. Copies of both guidelines are respectively attached as Exhibits "E" and "F."

CONCLUSION

When the phrase "water pollution control" is used, most people probably register a image of a waste treatment facility in their minds. This public image is but a half truth. Before any commercial, residential, industrial or government facility is constructed, the proper pipe systems must be designed. Ideally, polluted wastes, including storm drainage, should be processed at the waste treatment plant before being discharged into our waters. The need for these proper transmission systems, or piping, is obvious to those aware of the water pollution problem, but most people have only directed their attention to land structure.

Mr. Chairman, and members of the Subcommittee, the members of the American Concrete Pipe Association thank you sincerely for the opportunity of filing this statement.

Attachments:

EXHIBIT A

Subject: A summary report on concrete pipe and their uses.

The concrete pipe industry supplies irrigation pipe, drain tile and storm sewer pipe, sanitary sewer pipe, culvert pipe, pressure water pipe, and other special use pipe.

Concrete Sanitary Sewer Pipe

In the nineteenth century the public awakened to the needs for sanitation. Modern concepts of sewerage systems were originated and concrete sanitary sewer pipe was developed. As far as is known, the first concrete sanitary sewer pipe in this country was made and installed in Mohawk, New York, in 1842 and from then on, city after city used concrete sanitary sewer pipe in the growth and development of the sewer systems. On the basis of both quality and economy, concrete sanitary sewer pipe has grown steadily in volume of production over the years. In all of its sizes, the concrete sanitary sewer pipe is a mass produced, factory-made product, meeting rigid specifications and conforming to exact tolerances in size and dimensions. It is produced using ingenious machinery and equipment operated by skilled and semi-skilled workmen turning out an exact product with the minimum of time and expense. Without sewers our cities could not exist because of the consequential enormity of pollution and the critical health and safety factors.

Concrete Pipe Culverts

Concrete highway culverts are in general use by all the State Highway Departments in the United States. Variations of concrete pipe culverts are found in general use as cattle passes, pedestrian underpasses, and passageways as protection for steam pipes, water pipes, electric light and power conduits, and conveyor belts. The major use of concrete culvert pipe is as a conduit for the free passage of surface drainage water under a highway, railroad, canal, or other embankment.

Concrete Irrigation, Drain Tile, and Storm Sewer Pipe

The concrete pipe which brings the irrigation water from the sources to the farm is an irrigation pipe made of concrete pressure pipe as distinguished from

the nonreinforced concrete farm irrigation pipe. In our western states, there are many times as many miles of concrete irrigation pipe lines as there are primary and secondary roads, and many of them have been in service for over 75 years. Concrete pipe in this function conserves the water which is lost by evaporation from open ditches; it conserves the land because the conduit is buried below the surface out of sight; and it conserves the water normally lost to non-profitable weeds. Concrete pipe is used in the larger sizes to convey the irrigation water from the storage dams in the mountains to the farm lands of our country.

In the drainage field, concrete pipe is used for the small open joint farm drains. Concrete farm drain tile increases the available farm acreage, increases the quality and quantity of farm products, decreases farm labor, decreases overhead and cost of production, and increases the value of the farmland. In the larger sizes, concrete pipe is used for all drainage problems such as diverting streams, drainage of manufacturing sites, highways, airports, ball fields, and parks.

Concrete Pressure Water Pipe

Concrete pressure pipe carries drinking water to almost every city of any size in the United States. Drinking water supply lines, irrigation water supply lines, sewer force mains, and sanitary sewer ocean outfalls all use concrete pressure pipe.

Sources: *Concrete Pipe Field Manual*, published by the American Concrete Pipe Association, 1968; *Concrete Pipe Handbook*, published by the American Concrete Pipe Association, 1967; *Design Manual*, published by the American Concrete Pipe Association, 1970.

EXHIBIT B

AMERICAN CONCRETE PIPE ASSOCIATION,
1501 WILSON BOULEVARD,
Arlington, Va.

[From the Congressional Record, 91st Cong., 2d sess., Thursday, Dec. 31, 1970]

By Senator Dole (R.-Kans.)

COST OF CLEAN WATER

Mr. DOLE. Mr. President, there have been various estimates of the cost required to provide the water and sewerage facilities necessary to restore the purity of our lakes and rivers. Soon after the convening of the 92nd Congress the Senate Public Works Committee will have to decide on the necessary level for Federal expenditures to achieve that objective. The Public Affairs Department of the American Concrete Pipe Association has submitted a report on the Federal funds that will be required. Their report will be helpful during our deliberations. I ask unanimous consent that it be printed in the RECORD at this point.

There being no objection, the report was ordered to be printed in the RECORD, as follows:

A SURVEY OF THE WATER POLLUTION CONTROL PROGRAMS

The abatement of water pollution begins with the proper funding of basic water and sewerage facilities which are under the jurisdiction of four Federal agencies—the Federal Water Quality Administration, Department of Housing and Urban Development, Economic Development Administration, and Farmer's Home Administration.

The repair of the total environment is the one issue which unites Democrats and Republicans, doves and hawks, rich and poor, and blacks and whites. A nation-wide movement has begun which is demanding results. The Federal Water Pollution Control Acts of 1956 and 1966 developed the foundation for water pollution control, but the authorized monies for environmental enhancement have yet to be matched with the needed funding.

Environmental pollution cannot be acted upon without an intelligent awareness of economic realities. It is mandatory that priorities be established, but isn't the use of water and the disposal of wastes by citizens, industry, and government as essential a priority as the basic need for clean air and adequate food supplies?

The need for adequate water and sewerage facilities remains one of the most pressing problems facing this nation's communities. Local sources of revenue continue to be severely taxed and, although many communities are making efforts to raise needed funds, the demand for Federal grants-in-aid increases. Communities cannot hope to attract new industry unless they provide ample water and sewerage facilities.

PRESENT AND FUTURE NEEDS

The Joint Economic Committee of Congress estimated in 1968 that a gross investment by all levels of government of $51.8 billion will be required to provide supporting water and sewerage facilities over a 10-year period, or an average annual level of $5.2 billion.

In appropriations hearings this session of Congress, the four Federal agencies which combine to administer the water and sewerage programs of our nation estimated that current financial needs to cover unfunded fiscal 1970 grant and loan applications amounted to about $5.3 billion. This figure represents current needs, not future forecasts. The breakdown of this amount appears in Table 1:

TABLE 1

Federal agencies	Number of pending applications	Grant amounts
FWQA	2,509	$1,739,199,948
HUD	4,308	2,496,750,000
EDA	100	90,000,000
FHA	5,935	964,088,000

CONGRESSIONAL RESPONSE

With present needs of unfunded applications amounting to $5.3 billion, and the Congressional estimate of an annual, needed amount from 1968–1977 of 5.2 billion, Congress' response in the form of fiscal 1971 appropriations appears in Table 2:

TABLE 2

Federal agencies	1971 fiscal authorizations	1971 fiscal appropriations
FWQA	$1,250,000,000	$1,000,000,000
HUD	150,000,000	350,000,000
EDA	160,000,000	160,000,000
FHA	79,000,000	[1] 100,000,000

[1] President Nixon's budget calls for an additional minimum of $50,000,000 in direct loans.

Total fiscal 1971 appropriations of $1.66 billion for water and sewage programs do not match the 1970 backlog of $5.3 billion nor come close to the annual need of $5.2 billion. Part of this imbalance is understandable when one considers the present inflation and defense expenditures.

INSIDE THE AGENCIES

Federal Water Quality Administration

The FWQA of the Environmental Protection Agency (formerly FWPCA under the U.S. Department of the Interior) distributes grant funds up to 55% of the total costs to the states for allocation to local governments to construct and expand waste treatment plant facilties. A recent survey conducted by the National League of Cities and the U.S. Conference of Mayors, at the request of Senator Muskie, estimated that public funds needed *now* to control water pollution amount to from $33 to $37 billion. In addition, the survey provided the following breakdown of certain needed funds:

(a) For primary and secondary treatment $8,701,541,974
(b) For tertiary treatment 3,904,051,553
(c) Ror interceptor and storm sewer improvement 7,361,438,149

In addition to needs and fiscal appropriations for 1971 many states which prefunded projects under the provisions of Section 8(c) of the Federal Water Pollution Control Act are due outstanding reimbursement amounting to $894 million. The total amount which FWQA is obligated to fund the states in the

forms of grants pending (2509 applications at a grant amount of $1.7 billion) and prefunded projects amounts to about $2.6 billion.

For fiscal 1971, the President signed the Public Works Appropriation Act which includes $1 billion for FWQA. The Act includes a stipulation that $200 million of the $1 billion appropriated should be used to reimburse those states which pre-funded FWQA projects.

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

HUD provides grants to local governments to finance up to 50% of the cost of basic water and sewer projects. During the first 4 years of this grant program (fiscal 1966–1969), grants amounting to $514.6 million were made for 1,151 projects (48% for water projects, 41% for sewer projects and 11% for combined water-sewer projects).

An official of HUD, in response to two letters of inquiry from Senator Goodell, stated: "The average Federal grants participation is 31.5 percent," and that the average Federal grant for water and sewer projects is only 30 percent of the total project cost. The spokesman stated that the reason the Federal grant percentage is only 31.5 percent "is in large measure attributable to the fact that our ceiling on individual grants is $1.5 so that on large projects (ranging, say, from $4–$10 million) the Federal percentage is relatively low."

HUD officials in testimony before Congress this year reported that during fiscal 1970, 4,308 water and sewer applications remained pending with grants amounting to $2.5 billion and total project costs of $5.5 billion. After the Presidential veto of the original HUD 1971 fiscal appropriations bill, Congress has passed a redrafted bill which includes $350 million for water and sewer projects, (in the vetoed bill, the amount was $500 million).

ECONOMIC DEVELOPMENT ADMINISTRATION

The EDA of the U.S. Department of Commerce provides grants of up to 50% of the total project cost in areas designated as "economic redevelopment areas." In addition, supplementary grants up to 80% are available for depressed economic areas which cannot meet the required matching share.

Since EDA originated on September 1, 1965, a total of 1,753 public works projects have been approved as of May 8, 1970. As of June 30, 1970, EDA reported that there is a backlog of about 100 sewer and water projects amounting to approximately $90 million. The 1970 fiscal adjusted appropriations amounted to $174.5 million, with an additional $90 million unfunded.

The fiscal 1971 appropriations for community development grants is $160 million with about 70 percent going to water and sewer projects.

FARMER'S HOME ADMINISTRATION

The FHA of the U.S. Department of Agriculture offers aid to rural areas which do not include part of a city or town with a population in excess of 5,500. If the rural area has less than 5,500 population, it qualifies to apply for loans to finance the development of water and sewer systems.

In December 1969, FHA conducted a survey to show the needs in its program areas. Water and sewer system needs amounted to $11.3 billion. As of December 31, 1969, FHA could not fund 5,935 applications amounting to $964 million.

In Senate testimony this year, Mr. James V. Smith, Administrator of FHA, stated that 34,763 communities do not have adequate central water systems and 44,507 communities do not have adequate sewerage facilities.

The 1971 fiscal monies available for water and sewer projects include $160 million for grants and a minimum (budgeted by the President) of $50 million for direct loans, instead of the actually appropriated $98 million.

SUMMARY

In President Nixon's State of the Union Message on January 22, 1970, he said that sewage treatment plants would be built "in every place in America where they are needed."

The range of proposals pending before the 91st Congress is from the Administration's 4-year $1 billion program for a total of $4 billion in Federal funds

to Senator Muskie's proposal in S. 3687 for a 5-year $2.5 billion program for a total of $12.5 billion in Federal funds. Last year the Senate voted to appropriate $1 billion for waste treatment facilities, but it was forced to compromise with the House at $800 million for fiscal 1970.

At the bare minimum, the credibility of the existing Federal commitment must be re-established by backing words of authorization and realized needs with monies of appropriation.

The construction of adequate water and sewerage facilities is "step one" in water pollution control priorities. Local communities and state governments cannot afford this expense without financial assistance of the Federal government. The time for Congress to react is rapidly passing.

EXHIBIT C

The following is an update as of December 31, 1970 of Table 1 of the Association's "A Survey of the Water Pollution Control Program" which appeared in the *Congressional Record* of December 31, 1970.

TABLE 1

Federal agencies	Number of pending applications	Grant amounts (millions)
OWQ (EPA)	3,007	$2.094
HUD	4,308	2.496
EDA	150	.100
FHA	7,267	1.176

The following is an update of Table 2 of the same survey prepared by the Association:

TABLE 2[1]

[In millions]

	Budget authority			Outlays		
	1970 actual	1971 actual	1972 actual	1970 actual	1971 estimate	1972 estimate
EPA (grants)	$803.3	$1,006	$2,005.1	[2]$179.0	$427.4	$1,004.5
EDA (grants)	163.2	146	146.0	134.3	139.3	144.4
EDA (loans)	11.3	14	14.0	39.9	27.9	24.0
FHA (grants)	46.0	100		21.9	38.2	61.0
HUD (grants)	135.0	350		109.0	140.5	170.0

[1] Source: Table Q-8, "Special Analyses—Budget of the United States Government."
[2] Figure purported to be $570,000,000.

In addition, the Office of Management and Budget supplied the following statistics regarding FHA:

	Million
1971:	
Direct loans	$74
Insured loans	86
1972:	
Grants	40
Insured loans	189

EXHIBIT D

TABLE I.—ESTIMATED COST OF COMBINED SEWER SEPARATION[1]

State	Complete separation of combined sewers (public)	Plumbing changes to affected buildings	Total separation
Alabama	( )	( )	( )
Alaska	$8,350,000	$3,950,000	$12,300,000
Arizona	( )	( )	( )
Arkansas	25,700,000	23,300,000	49,000,000
California	712,000,000	547,000,000	1,259,000,000
Colorado	35,400,000	17,000,000	52,400,000
Connecticut	373,000,000	146,000,000	519,000,000
Delaware	81,300,000	52,600,000	133,900,000
District of Columbia	334,000,000	119,000,000	453,000,000
Florida	3,720,000	1,490,000	5,210,000
Georgia	317,000,000	191,900,000	508,900,000
Hawaii	( )	( )	( )
Idaho	15,750,000	300,000	16,050,000
Illinois	4,270,000,000	2,420,000,000	6,690,000,000
Indiana	1,710,000,000	872,400,000	2,582,400,000
Iowa	326,000,000	188,800,000	514,800,000
Kansas	109,500,000	46,000,000	155,500,000
Kentucky	490,000,000	264,390,000	754,390,000
Louisiana	( )	( )	( )
Maine	243,000,000	116,500,000	359,500,000
Maryland	19,500,000	4,520,000	24,020,000
Massachusetts	1,425,000,000	926,330,000	2,351,330,000
Michigan	2,430,000,000	1,548,500,000	3,978,500,000
Minnesota	423,000,000	189,600,000	612,600,000
Mississippi	1,335,000	52,000	1,387,000
Missouri	972,000,000	605,000,000	1,577,000,000
Montana	20,950,000	7,450,000	28,400,000
Nebraska	263,000,000	96,700,000	359,700,000
Nevada	33,000,000	6,770,000	39,770,000
New Hampshire	196,000,000	106,450,000	302,450,000
New Jersey	990,000,000	753,500,000	1,743,500,000
New Mexico	( )	( )	( )
New York	7,100,000,000	4,366,000,000	11,466,000,000
North Carolina	6,320,000	1,360,000	7,680,000
North Dakota	64,300,000	17,400,000	81,700,000
Ohio	2,410,000,000	1,532,800,000	3,942,800,000
Oklahoma	( )	( )	( )
Oregon	372,000,000	219,000,000	591,000,000
Pennsylvania	2,300,000,000	1,396,500,000	3,696,500,000
Rhode Island	231,000,000	204,700,000	435,700,000
South Carolina	( )	( )	( )
South Dakota	16,600,000	8,240,000	24,840,000
Tennessee	173,000,000	111,700,000	284,700,000
Texas	69,000,000	42,800,000	111,800,000
Utah	( )	( )	( )
Vermont	116,500,000	28,220,000	144,720,000
Virginia	228,000,000	128,400,000	356,400,000
Washington	610,000,000	478,000,000	1,088,000,000
West Virginia	280,000,000	179,080,000	459,080,000
Wisconsin	585,000,000	408,000,000	993,000,000
Wyoming	1,420,000	557,000	1,977,000
Total	30,391,645,000	18,378,259,000	48,769,904,000

[1] From the American Public Works Association Research Foundation Report, "Problems of Combined Sewer Facilities and Overflows, 1967."

Note: (.....) indicates no evidence available that combined sewers are used in State.

EXHIBIT E

A GUIDE TO BIDDING POLICY ON WATER, SEWER AND WASTE TREATMENT PROJECTS

(Being Assisted by the Economic Development Administration, the Farmers Home Administration, the Federal Water Pollution Control Administration, the Department of Housing and Urban Development)

(Approved by the Interagency Committee to Provide Continuing Coordination of Water and Sewer Programs, May 20, 1969)

FOREWARD

It is recognized that in the public and private sector, competitive bidding on construction projects should result in economies to the owner. Some of the savings to owners from competitive bidding procedures may be realized from any or all of the following:

a. The workload of the bidder at the time and the availability of plant, equipment and key personnel.

b. As a corollary to the above, a more exhaustive study of the plans and specifications with closer estimating by those bidders in the best immediate position with the greatest desire to perform.

c. The ingenuity and interest of contractors and their suppliers, and manufacturers of plant and equipment, in divising new methods and more efficient operations.

d. Specialized experience and success in the particular field or fields of construction called for by the plans and specifications.

Full benefits from competitive bidding cannot be realized, however, unless the project has been soundly designed and lends itself to accomplishments by the most economical methods of construction. Incomplete plans and specifications, or confusion and inconsistencies between them, or outmoded construction requirements, may lead to delays, extras or claims which can nullify all potential economies from competition in bidding.

Accordingly, the owner has a right to expect when bids are tendered that the engineer has used due diligence, reasonable skill and good business judgment so that he is assured that the accepted contractor will deliver to him everything needed to complete an engineering construction project, adequate for the purpose intended, without friction or misunderstanding, for the lowest possible cost.

Similarly, the contractor has the right to expect that the information shown on the plans and specifications is sufficient to enable him to prepare a complete and accurate estimate and that he will not be penalized for a lack of care or skill in the preparation of these documents.

1. PRELIMINARY INVESTIGATION

(a) *Existing conditions.*—Existing conditions at the site of the work should be determined by appropriate exploration and investigation and the results, together with other general information, should be furnished to bidders in the plans and specifications. The extent of borings, test pits or other subsurface explorations should be based upon the nature of project. General topography should be shown and the plans should indicate existing structures, underground or overhead utilities and drainage facilities.

The extent of these investigations should be adequate to the preparation of a sound and complete engineering design. Pertinent data should be furnished to the bidders. In addition, on certain types of projects further explorations may be advantageous for the purpose of providing bidders with information helpful to construction methods.

(b) *Local Ordinances.*—The contractor is entitled to assume that the engineer has investigated local ordinances pertaining to the design and method of construction of the project and has shown on the plans or described in the specifications any unusual stipulations which would affect the cost. Familiarity with local administrative procedures and municipal, county, or state requirements with respect to traffic, the use of public highways and general construction regulations should be the responsibility of the contractor.

(c) *Royalties and Patents.*—It is advisable for the bidder to give consideration to any costs that may be involved for royalties and patents for which he would be responsible.

2. PLANS

(a) *Details of Plans.*—Plans for lump sum contracts should be complete in all details so as to define all features of the work. Plans for unit price contracts should be reasonably accurate with respect to quantities of work, and should clearly define the scope of the work and all typical details for each item of work upon which unit price payments will be used.

(b) *Entitled and Indexed.*—Plans should be entitled and contain an index of sheets. Each sheet should be numbered, dated and indicate the total number of sheets in the set. The Federal identification should also be on the plans.

(c) *Clear and Accurate.*—Plans should be clear, accurate, adequately dimensioned and drawn to sale whenever possible. Dimensions on drawings hold over scaled dimensions.

(d) *Standard Symbols.*—In indicating materials and their us, nationally accepted standard symbols should be employed, and such symbols should be indicated and defined.

(e) *Plan Nomenclature.*—Plans should use the same nomenclature as the specifications. The specifications govern in case of a discrepancy.

(f) *Sections and Details.*—Construction sections and large scale details should be drawn wherever the plan allows any doubt as to what is intended. The depths of underground construction should be clearly indicated. For grading operations, existing and final contours and the limits of grading should be accurately shown. Payment lines should be prominently shown where pertinent to the type of contract and computation of pay quantities.

(g) *Existing Conditions.*—Existing conditions and work which will be performed by others should be clearly indicated in the plans and specifications.

(h) *Changes on Plans.*—Changes on plans during the bid period should be circled, noted as revisions, dated and new prints of the revised sheets should be issued to all bidders by addendum only.

(i) *Bases of Bidding and Payments.*—There are two alternate bases of bidding and payment to the contractor: (1) lump sum and (2) unit price.

3. SPECIFICATIONS

(a) *Details of Specifications.*—The specifications should be complete, clear and concise with a statement setting forth the general scope of work and followed by an adequate description of the various classes of work segregated under the proper sections and headings.

(b) *Identification for Reference.*—Each section and heading should be identified for easy reference and indicated in a table of contents.

(c) *Standard Terms.*—Standard terms for material and processes should be used and the nomenclature must be the same as that used on the plans.

(d) *"Or Equal."*—Performance specifications and the term "or equal" may be used for equipment and certain materials. In specifying pipe, however, the acceptable material(s) should be designed into the project to assure proper installation of the material chosen and to avoid uncertainty and misunderstanding. This can be done in the following ways:

(1) By reference to nationally known materials standards such as A.S.T.M., A.A.S.H.O., U.S.A.S., A.W.W.A. and Federal specifications and standards, or the standards of similar agencies. In referring to standards, however, care must be exercised to assure that the desired type of material is selected from them since many cover two or more types.

(2) By specifying two or more materials, any one of which is acceptable to the owner.

(3) By specifying the particular material required for the project. In specifying materials the owner and his consultant will consider all materials suitable for the project. Where materials which would normally be suitable are not included for bidding, the owner and his consultant must be prepared to justify the selection of the material used.

(e) *Non-standard Materials.*—Materials for which no specific standards are available should be described as completely as possible, and standard methods of test (A.S.T.M., A.A.S.H.O., etc.), by which compliance with the specifications will be determined, must be fully stated. When results are specified, a complete description of the desired result should be given and standard methods of test for compliance, wherever applicable, should be stated.

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(f) *Time of Completion.*—A time of completion should be specified in the contract. If time is of the essence, the contract should so state and a liquidated damages clause should be included.

(g) *Method and Result.*—It is improper to specify both the specific method and a guaranteed result for a particular operation. If the results are specified and a method of construction is desired, the method should be in the form of a suggestion for adoption in the contractor's discretion. In such instances, however, any alternate method suggested by the contractor should be subject to the approval of the owner.

(h) *Unit Price Payments.*—Extreme care should be utilized in phrasing the payment items for unit price contracts. They must be carefully correlated with typical details for pay items shown on the plans, and should clearly indicate the method of measurement to be employed.

(i) *Performance, Payment Bond.*—Performance and payment bond in the amount of 100 percent of the contract price shall be required by the owner.

(j) *Damage to Property.*—The contractor should be responsible for damage to property consisting of structures, materials, and supplies required for the work until acceptance by the owner. The contractor should be relieved of responsibility for completed work upon acceptance by the owner. Builders Risk insurance in the name of the contractor and the owner as his interest may appear shall be furnished and paid for by the contractor or owner at the owner's option.

(1) The following forms of casualty insurance with minimum liability limits based on exposure should be carried by the general contractor and all subcontractors:

(1) Statutory Workmen's Compensation
(2) Contractor's Public Liability and Property Damage
(3) Automobile Public Liability and Property Damage.

4. BIDDING

(a) *Advertsing.*—Bids must be solicited by public advertisement in newsapers or trade publications.

(b) *Contract Documents.*—Each Prospective bidder should be furnished at least one set of the contract documents. In unusual cases where bidding time is short or the work is complicated, it may be to the owner's interest to provide one or more additional sets. If the bidder desires further additional sets for preparing his bid, the engineer should provide them to him at cost. The bidder should be allowed to retain this set or sets until the contract has been let, or until he is definitely out of the competition, whereupon the documents shall be returned to the engineer. Where local practice dictates, a deposit should be required on each set of bidding documents issued, to be refunded to him upon prompt return of the documents in good condition. The contract documents should be available for examination by prospective bidders, sub-bidders and material suppliers at the engineer's or owner's offices, or at other central locations. Documents should be issued, however, only from one office and an accurate public list of the names and addresses of those taking documents should be maintained.

(c) *Composition of Contract Documents.*—Ordinarily, a complete set of contract documents consists of at least the following:

(1) Advertising or Notice to Contractors
(2) Instructions to Bidders
(3) Form of Bid or Proposal
(4) Contract (Agreement)
(5) General and Special Conditions of Contract
(6) Specifications:
    a. General
    b. Special
(7) Plans

(d) *Notice to Contractors.*—The advertisement or Notice to Contractors should give the owner's name, location and general nature of the work, the approximate quantities of the major items, the time and place for the receipt of bids, and the availability of contract documents.

(e) *Instructions to Bidders.*—Instructions to bidders should give detailed instructions as to the method and form of bidding and award.

(f) *Proposal Forms.*—Proposal forms should be prepared by the engineer and copies furnished to each prospective bidder for submission of his bid, including one for his own records. Proposal forms should be addressed to the owner, provide for the signature by the bidder and contain a statement that the bidder proposes to undertake the work for the amount or amounts stated.

In unit price contracts, the approximate quantities, the designation of the item and the unit of measurement for each item should be indicated in a schedule of unit prices in tabular form. Space should be provided for the insertion of each unit price, a column for the extensions and one for the estimated total price. In all cases, it is preferaable that bid prices submitted by the bidder be both in figures and in writing. The written price shall govern.

(g) *Bid Rejection.*—Bids which are not submitted on the specified form of proposal should be rejected.

(h) *Alternate Methods and Quantities.*—Alternate methods of construction and quantities of work should be requested only where they are believed to be of special importance as a means of insuring a bid within a limited sum.

(i) *Time for Preparation.*—A reasonable time should be allowed for preparing bids. In general, this should be not less than three weeks. In large or complicated work a longer time may be desirable. If extension of the time for bidding becomes necessary, bidders should be notified of the new opening date at least four days prior to the original opening date.

Adequate time in which to prepare estimates is essential to sound and effective price competition. Except in cases where speed is an urgent necessity, it will be unwise to attempt to save a few days by unduly curtailing the time allowed to contractors and sub-contractors for the preparation of their bids.

It is equally important that bidders should take full advantage of the time allowed.

So far as practicable, engineers should cooperate to avoid conflict of bidding dates for important projects.

(j) *Bid Delivery.*—Bids should be delivered at a designated place and not later than a designated time, but not on a legal holiday or the day following. Bids should be opened and read in the presence of bidders and a tabulation of all bids received should be furnished to each bidder.

(k) *Award of contract should be made without delay.*—Under no circumstances should a bidder be permitted to alter his bid after the time designated for receipt of bids.

(l) *Right to Reject Bids.*—The owner should reserve the right to reject any or all bids for justifiable reasons.

(m) *Bid Guarantee.*—A bid guarantee should be required to compensate the owner for losses suffered in the event an irresponsible bidder submits the low bid. Bid guarantees may be in the form of certified checks or bid bonds, generally in an amount not in excess of 10 percent of the bid.

(n) *Identical Information.*—Extreme care should be taken that all prospective bidders base their bids on identical information.

To that end, the engineer, owner or others familiar with the work should not make interpretations of the contract documents in reply to questions from bidders except in writing in the form of addenda. Addenda should be issued where questions arise which might affect the bids. The engineer should be certain that all prospective bidders receive the addenda and they should be delivered either by hand or by registered mail. Addenda should be issued for receipt by the bidders not less than four days before the time which bids are to be received. Receipt of addenda should be acknowledged as part of the bid submitted.

5. SEPARATE CONTRACTS

(a) *Establishing Responsibility.*—When all work necessary for a complete project is included under a general contract, single responsibility for completion is secured. When portions of the work are let by the owner separately, it is important that the specifications and plans make clear the elements of the work so handled and the connection of the general contractor's work thereto.

(b) *Responsibility for Work.*—Each general contractor should be responsible for his own work and that of his subcontractors and for proper cooperation with the other contractors involved and should recognize this responsibility in preparing his bid.

A Guide to Contract Award Policy To Be Used on Water, Sewer, and Waste Treatment Projects

The four agencies involved in providing grant and loan assistance to communities for the development of water, sewer and waste treatment projects have adopted "A Guide to Bidding Policy" for use on such projects. That Guide spec-

ifies how materials will be selected and how bids on such materials will be taken.

The following guide to contract award policy, to be used in conjunction with the "Guide to Bidding Policy," provides the basis on which successful contractors will be selected and the contract awards made on projects being assisted under the water, sewer and waste treatment programs of the four agencies involved.

Whether two or more materials have been specified in the bidding documents for the project (multiple base bid) or a single material has been specified (single base bid) the award will be made to the responsible bidder submitting the lowest responsive bid.

Where alternate methods of construction or quantities of work have been used because of their special importance as a means of insuring a bid within the funds available for the project, the award will be made on the basis of the lowest responsive bid obtained by use of necessary alternates taken in the order specified to come within the available funds. The amount of funds available will be indicated prior to bid opening. The position of the bidders may be changed only in acceptance of alternates necessary to bring the bid within available funds. Selection of alternates beyond this point may not change the position of the bidders. If no bids are received within the funds available and such funds are to be augmented to allow award, the award must be made to the low bidder on the basis of the lowest responsive bid.

The option to make an award on any basis specified above must be clearly stated in the bidding documents.

Approved by the Interagency Committee to Provide Continuing Coordination of Water and Sewer Programs September 22, 1970.

AMERICAN INSTITUTE OF MERCHANT SHIPPING

AMERICAN INSTITUTE OF MERCHANT SHIPPING,
Washington, D.C., April 12, 1971.

HON. EDMUND S. MUSKIE,
U.S. Senate Committee on Commerce, Subcommittee on Air and Water Pollution, 221 Old Senate Office Building, Washington, D.C.

DEAR SENATOR MUSKIE: The American Institute of Merchant Shipping has been following with considerable interest the Senate Public Works Subcommittee hearings on S. 523. AIMS shares your concern for the need to prevent pollution, and applauds your efforts and those of your Senate colleagues to implement comprehensive water quality legislation.

It is AIMS' concern that any new legislation, in addition to being comprehensive, also should be effectual. Therefore, we are submitting for consideration and insertion in the record of Subcommittee hearings the enclosed statement in which we comment on the proposed "hazardous polluting substances" provision, in Section 8 of S. 523, and on a suggestion on your Opening Statement convening hearings on the aforesaid bill in which you propose that liability for oil pollution discharges be unlimited.

Briefly, our recent experience with state water pollution laws indicates that no insurance company will provide insurance to cover unlimited liability for either oil or hazardous polluting substance discharges. Imposition of such improbable liability actually defeats any effort to achieve maximum pollution protection. Moreover, if unlimited liability is imposed, it probably would give rise to efforts to create many single-vessel corporations whose over-all maximum liability would be limited to the value of the vessel and any freight pending on the cargo as the principal corporate assets. The present high, but insurable Federal limits of liability for oil pollution are adequate, and in addition would be equally adequate if imposed for hazardous polluting substance discharges. The imposition of "punitive" unlimited liability will not prevent accidental discharges, but probably would result in a diminution of maritime trade within and with the United States.

We also wish to comment on the recent proliferation of state water pollution laws which attempt to impose liability upon vessels in interstate and foreign commerce. These state statutes are of questionable constitutionality, directly conflict and interfere with the harmonious, uniform federal regulation of the merchant marine, and impose additional administrative and economic burdens detrimental to maritime commerce on both domestic and foreign vessels owners and operators. AIMS believes that to insure efficient, low-cost waterborne transportation, and to prevent retaliatory measures by foreign governments, states should be pre-empted from enacting and enforcing duplicative maritime pollution laws.

In addition to existing Federal liability for water pollution, voluntary programs such as TOVALOP and CRISTAL, now afford more than adequate coverage of pollution discharges. Comprehensive international schemes of liability in the form of the 1969 Brussels International Convention on Civil Liability for Oil Pollution Damage and the proposed International Compensation Fund for Oil Pollution Damage are close to realization, and if implemented, would replace the voluntary schemes.

We are grateful for your having afforded us this opportunity to comment on the legislation and proposals which your Subcommittee has under consideration.

Sincerely,

JAMES J. REYNOLDS,
President.

Attachment:

STATEMENT OF AMERICAN INSTITUTE OF MERCHANT SHIPPING

By JAMES J. REYNOLDS, President

THE FEDERAL WATER POLLUTION CONTROL ACT

Existing Oil Pollution Liabilities Adequate and Insurable.

Recommended Hazardous Polluting Substances Liability Amendment is Uninsurable.

Unlimited Financial Liability Provision Offers Illusory Maximum Protection and Actually Less Protection Than Does Existing Law and Voluntary Plans.

Adequate Pollution Protection is Now Available and Comprehensive International Plans for Protection are Close To Realization.

Pre-Emption of State Laws is Imperative.

My name is James J. Reynolds, and I am President of the American Institute of Merchant Shipping, an organization commonly referred to as AIMS. AIMS is the national trade association of the American steamship industry and is composed of 35 United States companies which own and operate about 520 U.S.-flag, ocean-going vessels of all types in the foreign and domestic trades of the United States.

On behalf of the American Institute of Merchant Shipping, I would like to thank you for this opportunity to make our views a part of the public record with regard to S. 523 and other legislative matters to be reviewed by this Committee following the hearings.

This Committee, and other concerned Committees of Congress are to be commended for their efforts in enacting responsible legislation over the past several years to control water pollution. The American Institute of Merchant Shipping shares the concern and interest of Congress in the continuing development of responsible water pollution legislation.

We wish to express our views on two proposed changes the Committee is entertaining in the Federal Water Pollution Control Act and on one change AIMS is recommending in said Act. All three proposed changes would have an important effect on ocean-going vessels in domestic and foreign waterbone trade of the United States.

The changes the Committee is entertaining would effect the limits of liability for vessel pollution discharges. With regard to oil pollution, Senator Edmund S. Muskie, in his Opening Statement, page 2, item 3, convening the hearing on S. 523, March 15, 1971, recommended that the Committee entertain the idea of removing the limits of liability for oil pollution discharges (no provision appears in the bill as introduced which would effect this change). With regard to hazardous polluting substances, Section 8 of S. 523 (pages 46 and 47), if enacted into law, would impose absolute legal liability upon the owner or operator of a vessel. Also, as now worded there exists the possibility that Section 8 might be construed so as to impose liability in an unlimited amount for acidental discharges of hazardous polluting substances from vessels.

If enacted and so construed, these legislative proposals would cause grave economic injury to vessel owners because most would be unable to assume the risk of a catastrophic discharge subjecting them to liability above and far beyond the evidence of financial responsibility they are able to provide.

AIMS is concerned also with the increasing proliferation of confusing and conflicting state maritime vessel pollution laws. This proliferation of unnecessary duplicative state law, inconsistent with federal law, only adds to the cost of waterborne transportation without providing any additional protection against pollution. In several states the laws are so harsh they are considered uninsurable by the insurance industry. Although a vessel owner has complied with the federal requirements for certification, he can be refused his right to enter and traverse United States navigable waters over which a state is attempting to assert primary jurisdiction and to require of the vessel owner additional financial certification which he may find impossible to comply with. Ocean-going vessels in interstate and foreign commerce should be subjected only to a single, uniform law, which law according to the Admiralty Clause of the Constitution, should be within the exclusive and paramount jurisdiction of the Federal Government as administrator and enforcer.

In reviewing the past lengthy deliberations of Congress, and in particular those of this Committee, with respect to the efforts which led to the enactment of the Federal Water Pollution Control Act, we have noted the care and consideration which went into fashioning the existing oil pollution liability provisions (Section 11, Control of Oil Pollution, P.L. 91–224) to make them insurable for vessel owners, and also to provide protection for cleanup to the maximum extent possible. It is our fervent hope that this carefully balanced law, with respect to liability provisions, will not be tampered with. AIMS recommends that the existing scheme of legal and financial liability for oil pollution discharges remain unchanged, except in so far as it may be amended to conform to the provisions of the 1969 Brussels International Civil Liability Convention on Oil Pollution Damage; that the same scheme of liability be imposed for hazardous polluting substances (Section 12, Control of Hazardous Polluting Substances); and that with respect to both oil and hazardous polluting substances, the law be amended to clearly indicate that states are pre-empted from passing such laws as a violation of the Constitution, and as a matter of necessity to maintain economic and administrative uniformity of law in interstate and foreign commerce.

These three matters which greatly concern vessel owners are discussed below in detail.

Existing Oil Pollution Liabilities Adequate and Insurable

Senator Muskie, in his Opening Statement, convening hearings on S. 523, suggested the Committee consider removing the legal and financial limits from existing Section 11, Oil Pollution Control of the Federal Water Pollution Control Act (hereinafter referred to as FWPCA). The bill S. 523, as introduced, contained no such provision and there was not public hearing on the important implications of taking such a drastic step. For this reason and those stated below, AIMS urges that the Committee not accept the suggestion of the ditsinguished Senator.

Vessel owners' recent experience with salt water pollution laws indicate that such laws imposing unlimited financial liability for oil pollution are uninsurable in any commercial insurance market. For example, of the 629 vessels and barges which, as of mid-March, 1971, were certificated as to financial responsibility under the recently implemented Florida Oil Spill and Pollution Prevention Act, state records reveal no vessel owner was able to obtain financial responsibility protection through the regular commercial insurance channels. (Certification under Florida law would have been impossible altogether if the State authorities had not resorted to a device of adopting certification regulations requiring a vessel owner to show only financial responsibility of $100 per gross ton, or $5 million, whichever is lesser; nevertheless, each vessel owner is liable under the state law for unlimited cleanup costs and damages.)

The reasons, as best vessel owners are able to ascertain, for the refusal of maritime insurers to underwrite unlimited financial liability for vessel discharges of oil (or other substances) are as follows:

(1) Unlimited Financial Liability for oil pollution discharges from vessels means that the party liable or the party furnishing the insurance or other evidence of financial responsibility, is not acting as an insurer covering a risk or portion thereof, but is actually acting as a guarantor to pay an unknown and unlimited sum should the occasion of a discharge require such. Insurance companies are commercial enterprises, and their officers, like any other prudent businessmen, could not contract to assume such a financial obligation of unknown proportions. Nor could they in all honesty purport to be able to do so. Only an entity having the power of taxation could take on such an obligation.

(2) Capacity of the Insurance Market—This is a rather complex subject best explained by the marine insurance underwriters and the Protection and Indemnity Clubs. Suffice it to say that as financial liability for vessel oil pollution is increased, the number of underwriters willing to insure the risks diminishes. When the limit on financial liability is removed altogether, there are no underwriters who are willing to insure vessel owners against oil pollution discharges. The underwriters will direct their efforts to insuring liabilities in markets other than the maritime oil pollution market. (We also note that recent increases in both legal liability and financial liability, as effected by law, have resulted in a

correspondingly significant increase in oil pollution insurance premiums. These costs must necessarily be included in the price of the delivered product to the consumer.)

(3) Absolute legal liability for oil pollution discharges from vessels means that all risks have been eliminated and that all discharges of oil from a vessel, regardless of cause, must be covered by the insurer. This includes not only those resulting from the negligence of the owner, operator, or crew, but also those discharges resulting from acts over which the owner or operator have no control. These include discharges caused by acts of God (hurricanes, etc.), acts of war, acts or omissions of third parties, and even negligent acts of governments. Absolute legal liability is insurable, but only if in the law it is accompanied by a reasonable limit on financial liability. Testimony before Congress on the proposed 1970 Water Quality Improvement Act (now P.L. 91–224), by a representative of the London underwriters, who write most of the world's maritime insurance, indicated that absolute legal liability for a vessel oil pollution discharge was insurable but only with a limit on financial liability not exceeding $5 million.

Presently, insurers will provide coverage for the strict and limited liability which Congress set forth in existing Section 11, Control of Oil Pollution, FWPCA. However, they will not insure unlimited financial liability as is found in some state laws and as is proposed for federal law.

Therefore, to change the federal law to impose unlimited financial liability and thereby make the law uninsurable would do inestimable damage to vessel owners and operators and great economic injury not only to United States waterborne commerce, but to foreign waterborne commerce trading with this country as well. AIMS will not comment on the possible retaliatory implications by foreign governments inherent in any United States effort to enact unlimited liability legislation, but this possibility should be kept in mind.

RECOMMENDED HAZARDOUS POLLUTING SUBSTANCES AMENDMENT IS UNINSURABLE

AIMS is concerned with Section 8 of S. 523 which establishes a scheme of liability which we believe would be injurious to maritime commerce without conferring any additional protection or increased benefits upon the public than would a more reasonable pollution liability provision. The provision which is the basis of our concern appears on pages 46 and 47 of S. 523 as Section 8 of the bill, and it would amend Section 12, the Hazardous Polluting Substances (hereinafter referred to as HPS) Section of the Federal Water Pollution Control Act as follows:

"(c) The discharge of any substance designated under this section as a hazardous substance into or upon the navigable waters of the contiguous zone is prohibited. The owner or operator of any vessel, onshore or offshore facility from which such discharge occurs is liable for damages, including costs of removal, which result directly or indirectly from such discharge without regard to negligence or wilfulness."

If enacted, this provision would impose absolute legal liability upon vessel owners or operators without any defenses whatsoever for any discharge of a HPS which might occur as a result of an act of God, war, or negligence on the part of the United States Government, or any act or omission of a third party without regard to whether it was a negligent act, all of which are defenses now included in Section 11, Oil Pollution Control, FWPCA.

In addition to imposing absolute legal liability, if Section 8 were construed to impose upon vessel owners and operators unlimited financial liability for all discharges of HPS, even those occurring without negligence or fault of vessel owner or operator, for all cleanup costs and all damages (we assume both public and private), this liability would be uninsurable to the extent that it is unlimited.

If enacted and so construed, this provision would impose additional financial and administrative burdens and complications on vessel owners and operators of vessels carrying HPS cargoes. It would especially affect those who could not self-insure, and who, for economic and business reasons, would be unable or unwilling to assume the risk of financial liability beyond any limited liability HPS insurance they might have.

Therefore, AIMS recommends that Hazardous Polluting Substance liabilities be dealt with in a separate bill to enable all parties to give adequate and carefull consideration to the problems involved.

Also, we recommend that the anticipated development of Section 12, Hazardous Polluting Substances, of the FWPCA, should conform to the existing principles

of Section 11, Oil Pollution Control, of the FWPCA, especially with regard to strict liability and with a limit placed on financial liability in absence of wilfull or negligent conduct within the privity of the owner. Since the scheme of liability implemented by Section 11 represents both a workable, insurable approach, we further recommend that the simplest method of implementing the liability provisions covering HPS, is to add the term "hazardous polluting substances" to existing Section 11 at the appropriate places.

UNLIMITED FINANCIAL LIABILITY PROVISION OFFERS ILLUSORY MAXIMUM PROTECTION AND ACTUALLY LESS PROTECTION THAN DOES EXISTING LAW AND VOLUNTARY LIABILITY PLANS

To reiterate our previous statement, vessel owners' recent experiences with state water pollution laws indicate that such laws imposing unlimited financial liability are uninsurable through the commercial insurance market. Under the recently implemented Florida Oil Spill and Pollution Prevention Act, most shipowners with large fleets trading in Florida waters could and did meet the statutory financial responsibility requirements qualifying as self-insurers but thereby subjecting the entire assets of their corporations to the risk of liability for cleanup costs and damages. Many small fleet shipowners could qualify under the Florida Act by posting a bond purchased for very high cost premiums (with coverage only up to $100 a gross ton of the vessel and not exceeding $5 million) for which their entire assets were pledged. Many vessel owners, both large and small, were reluctant to assume such a tremendous risk, and several vessel owners refused to trade in Florida waters.

It is our firm belief that the imposition of extreme and uninsurable maximum liabilities such as those found in the Florida Oil Spill and Pollution Prevention Act and in Section 8 of S. 523 afford less protection to governments and private parties than do reasonable (and insurable) liability provisions such as those found in Section 11, Oil Pollution Control, of the FWPCA.

Belief that unlimited financial liability for oil pollution will provide ultimate financial protection for damaged parties is highly illusory. Under such a scheme of liability conventional insurance is completely unavailable and the total burden of supplying financial protection falls upon each individual company.

Protection of the government and public is actually limited to the extent of the total attachable assets of each vessel company. At best this is uneven and undependable protection. This is especially true in a situation where a company with few assets may be the unfortunate victim of an unintentional but negligent discharge which otherwise could have been more than adequately covered if commercial insurance was available.

Thus, financial protection for cleanup and damages under so-called unlimited financial liability for oil pollution may be far less than the protection normally available through the commercial maritime insurance market to cover laws with strict liability and a ceiling on financial liability.

At best we can say that a law with unlimited financial liability for oil pollution makes the amount of prevailing financial protection less certain than a law with a high but insurable ceiling on financial liability. At worst, such a law can deprive a vessel owner of vital insurance coverage and the right to use his vessel in waterborne commerce.

Contrast the foregoing potential insurance and financial protection problems with the protection currently available to vessel owners and operators under Protection and Indemnity Club coverage for liabilities for oil pollution discharges. Under a P & I Club policy of insurance for oil pollution discharges from insured vessels, the indemnitor P & I Clubs, for all pollution claims, both governmental and private, arising out of any single pollution incident, provide vessel owners and operators with maximum coverage of $14,400,000.

The amount of P & I Club coverage available is not limited by vessel tonnage. For example, in the case of a 10,000 gross ton tanker, the P & I Club covering the tanker's oil pollution liability will have issued a certificate of insurance as approved by the Federal Maritime Commission for $1,000,000 ($100 x 10,000 grt) in compliance with the financial responsibility requirements of Section 11, P.L. 91–224. If the P & I Club were called upon to pay the U.S. Government the full $1,000,000 for costs of cleanup, the vessel owner would still have $13,400,000 available to cover other legitimate oil pollution claims, including any foreign governments, any states or municipalities, and any private parties.

Adequate Pollution Protection Is Now Available and Comprehensive International Plans For Protection Are Close To Realization

The public, government and industry increasingly are demanding oil and other substances in greater quantities, and they demand delivery be made on a timely basis and at the lowest possible cost. The oil product, for example, is a basic fuel for land, air and water transportation, and is a common source of heat and light, so much so that it has become a community staple as essential daily as is food and water. However, like any other commodity, the carriage and handling of oil and other substances is subject to escape through human error.

In consideration of the above factors prior to enacting the federal oil pollution law, the Congress consequently recognized that the public receives substantial benefits from waterborne commerce, and if oil and other substances are to continue to be available at the lowest possible costs, the public should share some of the responsibility and risks attendant to transporting and handling them. It is our view that under the present federal scheme of liability, vessel owners and operators shoulder the greater portion of this risk.

Currently, we believe that the Federal Public Law 91–224 and existing Protection and Indemnity Club coverage of vessels provides more than adequate protection against prohibited discharges for all States of the United States. Eventually, we hope that this will be replaced, only as far as tanker vessels are concerned, with ratification of the 1969 Brussels International Conventional Convention on Civil Liability for Oil Pollution Damage. As a supplement to the maximum $14 million protection the 1969 Brussels Convention would provide to cover cleanup costs and damages, the maritime and cargo interests are working with governments toward development of a Convention on an International Pollution Compensation Fund for Oil Pollution Damage. This fund would provide supplementary protection to the 1969 Brussels convention so that cleanup costs and damages might be covered to a maximum of $30,000,000.

Currently, two plans similar to those in the international convention schemes are operative on a voluntary basis as implemented by the oil industry. Tanker companies representing over 80 percent of the world's tanker tonnage, through a plan known by the acronym TOVALOP, have voluntarily accepted world-wide a responsibility over and above their legal liability for cleanup costs. Under this plan, a vessel owner who is a party to TOVALOP could perform reasonable cleanup activities up to $10,000,000 (assuming the vessel involved were 100,000 gross registered tons) and this would be supplementary to the financial responsibility of $14 million or $100 a gross ton, whichever is lesser, made available under United States law (P.L. 91–224). A recently implemented plan known as CRISTAL, voluntarily subscribed to by owners of more than 80 percent of the world's crude/fuel oil movements by sea, provides a supplementary fund to cover vessel pollution damage in addition to benefits offered under existing legal regimes, TOVALOP, and the 1969 Brussels Convention once it enters into force.

Pre-Emption of State Laws Imperative

Furthermore AIMS strongly recommends that existing Section 11 should be amended to pre-empt states from passing oil and hazardous polluting substance laws. This proliferation of state laws, all inconsistent with the federal law and with each other, is creating a nightmare of administrative confusion and economic chaos for vessel owners and operators.

For example, the financial responsibility rule promulgated under the Florida Act requires that a vessel owner who has complied already with the Federal Maritime Commission requirement to obtain a Federal Financial Responsibility Certificate to enter the navigable waters of the United States, must likewise comply with a duplicate Florida provision to obtain a State Certificate. In both instances, the vessel owner must pay at least $100 application fee per vessel. The Federal government itself in 1970 will collect approximately $2 million from vessel owners for such certification fees.

In the United States alone, if such laws were valid, some 30 coastal and Great Lakes States, might choose to impose dissimilar pollution laws and certificating requirements upon vessel owners. In addition, states with navigable inland waterways could also impose such laws which would have a tremendous impact on existing barge operators and on ocean-going operators who now own and are constructing more of the new, modern LASH and Seabee type vessels which can discharge barges from the mothership to travel the inland waterways to pick up and deposit cargoes. Such States, incidently, now include Oklahoma, which has a recently completed man-made waterway as far north as Tulsa.

We note that of the states which have already passed water pollution laws affecting vessels, no two states have passed identical laws. Eventually, the merchant marine could be subject in the United States alone to more than 30 different and conflicting state laws. Also we note that many of these state laws permit local governments to pass similar water pollution laws, thereby creating the potential for a legal bureaucratic nightmare of imponderable proportions.

Should all 27 or more states with navigable waterways consider imposing a financial responsibility certificating requirement which would be renewable annually, the documentation alone would impose substantial legal and administrative costs upon each vessel owner. For example, the Florida financial responsibility applications consists of some 30 pages of legal size sheets. Should all coastal states and all states with navigible waterways impose financial responsibility certificate fees upon each vessel, vessel owner's costs would tremendously escalate.

If this trend is permitted to continue, the ultimate resulting effect upon interstate and foreign waterborne commerce would be one of administrative chaos; of tremendously increased costs of transportation which would be passed on to the ultimate consumer of the transported product; of the channeling of investments into other businesses which would be decidedly more attractive than the maritime business; of the deterioration of water transportation service; of a reduction in port traffic and employment; and of a loss of tax revenues.

Vessel owners are concerned with this proliferation of state laws and regulations and constantly emphasize that shipping is an international business and all problems, except the most local, should be resolved not even on a national basis, but on an international basis. If state governments, choose to "go it alone", the result each desires and is striving for may be destroyed rather than achieved through individual action. If any achievement results from this multiplicity of laws, the slight benefit will be achieved at a disproportionate cost to each state's economy. For example, if a state requires vessels to be equipped, designed or manned in a way which no other state or country demands, then fewer ships will be able to serve it, and those that do will have greater expenses to recover. Extra costs, whether of equipment, operating expenses, or liability, are likely to be passed on through freight costs to the ultimate citizen consumer of that state or country. To warrant long-range vessel owner investment in expensive vessel pollution control equipment, vessels must be free from inconsistent local requirements and caprious changes of many different local laws which render equipment obsolete despite its efficiency. Where a vessel owner or operator's costs increase as a result of the law in one state or country alone, the resultant burden on the state's or country's trade inevitably will be much higher than when an international agreement is adopted which uniformly affects maritime nations.

Conclusion

In conclusion, it is our firm conviction that liability provisions which are unnecessarily harsh and punitive after the fact do not prevent pollution, enhance water quality, or even insure adequate cleanup funds any more than do reasonable and insurable liability provisions. Protection against pollution is no way increased, in that to call upon an old maxim "drawing and quartering a corpse does not add to hanging." Moreover, failure of the federal government to specifically pre-empt states and spell out for them the exclusive constitutional jurisdiction of the federal government over maritime matters, merely encourages these state governments to enact statutes of questionable constitutionality. Not only do these various, conflicting state laws interfere with interstate and foreign commerce, and the harmonious, uniform federal regulation of the merchant marine, but they impose additional administrative and economic burdens on vessel owners and operators which are detrimental to maritime commerce. These state laws, and regulations promulgated thereunder, increase transportation costs which are passed on to the ultimate consumer of the cargo without confering increased protection or benefit.

We believe adoption of AIMS' recommendations with regard to incorporating the provisions encompassing HPS regulation in existing Section 11 of FWPCA, maintaining the existing Section 11 scheme of liability, and the pre-emption of states from passing conflicting and confusing maritime pollution laws would insure more than adequate financial protection to cover prohibited discharges and would neither disrupt maritime transportation nor substantially add to its cost.

We thank the Committee again for affording us this opportunity to present our views.

STATEMENT OF THE AMERICAN LEGION

THE AMERICAN LEGION,
Washington, D.C., July 1, 1971.

Hon. EDMUND S. MUSKIE,
Chairman, Subcommittee on Air and Water Pollution, Senate Committee on Public Works, New Senate Office Building, Washington, D.C.

DEAR SENATOR MUSKIE: The American Legion is vitally interested in the problems of pollution and preservation of the environment. At a recent meeting of our National Executive Committee a Resolution was adopted supporting the appropriation of adequate funds for research into this complex subject. A copy of the resolution is enclosed for your information.

I would appreciate your affording representatives of The American Legion an opportunity to present testimony on this subject if hearings are held by your Subcommittee.

Sincerely yours,

HERALD E. STRINGER,
Director, National Legislative Commission.

Enclosure.

NATIONAL EXECUTIVE COMMITTEE, THE AMERICAN LEGION, MAY 5–6, 1971

Resolution No. :40.

Commission: Internal Affairs.

Subject: Funds for environmental protection research and support for Federal anti-pollution standards.

Whereas, Resolution No. 51, National Executive Committee, October 21–22, 1970, established the policy that "problems of pollution and preservation of the environment are germane to the purposese of The American Legion" and charged the Internal Affairs Commission with "the primary responsibility for coordinating the development of policies, the devising of suitable activities, and providing information to posts;" and

Whereas, the Internal Affairs Commission has considered this complex problem and finds that there are certain measures which The American Legion may properly endorse as a beginning toward the development of a comprehensive effort; Now, therefore, be it

Resolved, by the National Executive Committee of The American Legion in regular meeting assembled in Indianapolis, Indiana, May 5–6, 1971, that

1. The American Legion supports the appropriation of adequate funds public or private for research to determine more precisely the effects of any and all pollutants including pesticides and herbicides; the deevlopment of economical means of control or elimination of harmful pollutants; the discovery and use of means to control insect, rodent, and other pests and to control unwanted vegetation without harm to the environment.

2. Posts of The American Legion are urged to become informed in local problems of solid waste pollution, and to lend their support to adequate local measures, especially for the improvement of municipal sewage disposal systems.

3. The American Legion offers its full support to local campaigns to clean up our physical environment and will cooperate with other civic organizations and agencies in similar or related projects.

4. The American Legion commends the President of the United States for establishing the Environmental Protection Agency and expresses its deep interest in the work of that agency.

5. To the extent that scientific knowledge justifies, The American Legion supports the establishment and enforcement of Federal anti-pollution standards so that like industries wherever located in the United States will be required to meet like standards so that a profit advantage or disadvantage will not be created by a variation in standards or in enforcement among the fifty states.

6. Departments of The American Legion are requested to designate a commission, committee or other body to develop department policies and programs in this field compatible with National policies.

STATEMENT OF AMERICAN MINING CONGRESS

By DAVID SWAN, Vice President-Technology, Kennecott Copper Corporation

Mr. Chairman and members of the committee, I am pleased to submit this statement on behalf of the American Mining Congress, an association of U.S. companies that produce most of the nation's metals, coal and industrial and agricultural minerals. Its membership includes also more than 200 manufacturers of mining and mineral processing equipment and supplies as well as financial institutions with a business interest in the mining industry.

Before beginning my specific remarks on the proposed legislation amending the Federal Water Pollution Control Act, it might be well to point out that the member companies of the American Mining Congress have long been concerned with the quality of the environment in the areas in which they operate. The environmental effects of proposed operations are carefully considered in the planning and engineering of every mining and processing facility developed. Both through their own resources and those of manufacturing suppliers, AMC members have been active in the development of measures to protect environmental quality, including water quality, and of the technology needed to do so.

It is especially noteworthy that, although the output of the mining industry has increased substantially in recent years, the fresh water intake has increased only slightly. The reason for this is that the industry has learned how to make wash water suitable for recirculation. It has been estimated that the coal mining industry generally reuses each gallon of water 15 times prior to discharge. Thus, it is from a background of long experience and technical familiarity with the water quality problems of the mining and mineral processing industry that the following comments are offered.

Our remarks below are directed at the Administration's bills—S.1012, S.1013, S.1014—and the bill introduced by Senator Muskie and others, S.523.

GENERAL OBSERVATIONS

Under the present Federal Water Pollution Control Act, Congress recognizes the primary responsibilities and rights of the states in preventing and controlling water pollution. However, both S.1014 and S.523 would provide for direct federal responsibility and control in the field of water pollution at the expense of the states. Since approval of the first federal water pollution control act, an attempt has been made to maintain a delicate balance between the activities of the federal government and those of the state government in this field. The present proposed legislation is a drastic departure from previous policy.

Progress is being made today on the state and regional levels in controlling water pollution. It has not been demonstrated that giving the federal government additional authority is going to speed up the substantial progress being made.

Rather than giving the federal government additional enforcement authority, we believe it is more desirable to increase the authorization for sewage treatment works, increase the authorization for state and interstate programs and simplify and streamline the present operation of the Water Quality Act. In line with this basic position on proposed water pollution amendments, the American Mining Congress has the following specific comments to offer on the proposed legislation.

I. Increased authorizations for sewage treatment works and for state and interstate water pollution control program

Under the provisions of S. 1013 an appropriation of $6 billion would be authorized: $2 billion for each of the next three fiscal years to match on a 50–50 basis state and local funds, for the construction of a total of $12 billion of waste treatment works throughout the country. We endorse this proposal.

The American Mining Congress likewise endorses the proposal of the Administration in S. 1012 to increase the authorization for state and interstate programs over a period of four years on a sliding scale from $15 million in fiscal year 1972 to $30 million in fiscal year 1975. The American Mining Congress recognizes that there has been a substantial increase in the effectiveness of state water pollution control programs. However, it is also true that most state programs need additional personnel and equipment to determine adequately the problem of water pollution. The gradual increase in the amounts for state and interstate control programs should provide for orderly progress.

II. Water quality criteria

Both S. 1014 and S. 523 provide for the issuance of water quality criteria by the EPA Administrator. However, S. 1014 also requires the inclusion of analytical and test procedures; and in section 10(d)(6) that the proposed criteria be published in the *Federal Register* with interested parties being allowed 45 to 60 days to submit written comments prior to final promulgation. These are desirable features and we urge that if the subcommittee decides to include provisions on the issuance of water quality criteria, the provision in S. 1014 be followed.

III. Effluent requirements or limitations

S. 1014, in section 10(d)(4), would direct the EPA Administrator to establish "specifications for effluent limitations," while S. 523 provides that state implementation plans include "effluent requirements." We believe the approach of S. 523 is preferable.

We are strongly of the opinion that federal effluent limitations are not desirable and that such regulations should be left to regional, state or local agencies which are in a position to give recognition to local conditions. The problem we see with national effluent regulations is that such standards will be too strict for some areas, resulting in large unnecessary costs and resultant economic dislocations.

IV. Provision for the use of "latest available pollution control techniques"

S. 523, in section 10(e)(1), provides that the EPA Administrator must issue regulations requiring that those constructing new facilities install the "latest available pollution control techniques."

In the first place, the meaning of this phrase is unclear. The phrase should definitely be defined. Otherwise, when does a control technique become available and how can one be sure that it is the "latest"? Also, this section does not consider the economic or technical feasibility of the technique or the desirability of applying the latest available pollution control technique when previously existing alternatives might serve just as well.

Furthermore, we question whether a requirement of this sort is really practical. If all new construction must include the latest available control technology, tremendous pressure will be placed on the limited resources of the country. There are only so many trained individuals and firms in a position to supply the latest available pollution control techniques.

We strongly urge that before any provision of this sort is written into proposed amendments to the Federal Water Pollution Control Act, a careful review be made of the exact meaning of the phrase and how the provision is to be administered.

V. Closed-cycle system

Section 10(e)(2) of S. 523 provides that: "Whenever the Administrator finds, and publishes such finding, that closed-cycle production or treatment systems are available or can be made available, any effluent requirement applicable to a new building, structure, or facility shall provide for no discharge, except as may be required to operate such closed-cycle system."

This requirement could have the effect of imposing a zero effluent limitation on production or treatment systems since the term "closed cycle" literally means "complete retention." Analytical methods are being constantly improved so that minute amounts are being found where it was thought previously that pollutants were not present. Thus, it should be emphasized that in reality zero discharge means complete prohibition.

Furthermore, the "closed-cycle" requirement suffers from the same deficiency mentioned above concerning the requirement for the use of the 'latest available control technology" in that neither term is defined. It is not clear when the "closed-cycle" technique becomes available. Also, the "closed-cycle" technique

would be required even though the water pollution problem of a facility was insignificant. We strongly urge that this provision be deleted from any legislation approved by the subcommittee.

VI. Nondegradation Provisions

Both S. 523 and S. 1014 adopt a policy of nondegradation of the present quality of the waters to be covered by the proposed act. We believe a provision for nondegradation is quite impractical and will result in new industry being forced to locate where there is already a heavy load of waste discharges.

It is virtually impossible to engage in any industrial activity without, in some way, degrading the water. On the one hand—government policy encourages decentralization and—on the other hand—the nondegradation provision means a greater concentration of industry in already polluted areas. Apparently, the rationale of this policy is that as one waste source is cleaned up, another will be permitted to pollute in the same general area—thus resulting in no overall degradation.

It would rather be our suggestion that sources be permitted to locate on high quality waters with the provision that water quality standards be observed and enforced. Otherwise, the policy of nondegradation will lead to under-development of certain areas and increased pressure on the already heavily developed areas of the country.

VII. Permit Requirements

Under section 10(e)(1) of S. 523 there is a requirement that no person shall construct or install any building, structure or facility for commercial purposes without receiving a certification of compliance with regulations of the EPA Administrator and the State pollution control agency concerned. Today—in the vast majority of the states—a company must submit plans and specifications and secure a permit from the state control agency prior to construction of any new facility which would discharge waste water.

Futhermore, under regulations just promulgated by the Corps of Engineers, a permit must be secured under the Refuse Act of 1899. Thus, we fail to see any reason why section 10(e)(1) is needed.

Rather, we would suggest that the matter be left entirely to the states and not be duplicated on the Federal level.

VIII. Citizen suits

S. 523, in proposed section 111(i), would provide that any person may commence a civil action on his own behalf against any person alleged to be in violation of the act or against the EPA Administrator where there is alleged a failure of the Administrator to perform any act or duty under the act. We seriously question the addition of this provision to the Federal Water Pollution Control Act. Presumably, the EPA Administrator will administer the act impartially and with uniform application and interpretation without the necessity for interference by the courts. The major drawbacks we see to this propsal are: (1) a burdening of an already overcrowded court system with highly technical litigation and (2) a resultant harassment of certain industries or companies. Therefore, we strongly urge that this provision not be included in the proposed legislation.

I greatly appreciate the opportunity of submitting these comments on behalf of the American Mining Congress on proposed amendments to the Federal Water Pollution Control Act.

Members of the staff of the American Mining Congress would be pleased to discuss the points raised in this statement with members of the staff of the Subcommittee on Air and Water Pollution.

STATEMENT OF THE AMERICAN WATERWAYS OPERATORS, INC.

By MARKHAM BALL, Counsel

CONTROL OF WATER POLLUTION FROM VESSELS

The American Waterways Operators, Inc. (AWO) is the national association representing the domestic water carrier industry, principally the owners and operators of towboats, tugboats and barges on the inland and coastal waters and in the harbors of the United States. AWO welcomes the opportunity presented by the Subcommittee's review of federal water quality programs to bring to the attention of the Subcommittee some pressing problems relating to the control of water pollution from vessels.

Regulation of vessels that continually cross state lines is obviously a national question that demands a national solution. This is at least implicit in the 1970 amendments to the Federal Water Pollution Control Act, which, among other things, directed the establishment of comprehensive federal programs to control oil pollution and sewage discharges from vessels.

AWO's members are now finding, however, that a rapidly increasing mass of state laws, together with some overlaps among the federal laws regulating discharges from vessels, are subjecting vessel owners and operators to the kind of patchwork regulation that a federal system is supposed to avoid. This statement discusses three areas where overlapping and conflicting laws are causing present or imminent problems. The problems:

1. There are technical deficiencies in the provisions of federal law providing for federal preemption of the regulation of sewage discharges from vessels. These deficiencies could subject vessels to conflicting state laws for an unnecessarily long time and could make the transition from state to federal regulation unduly difficult.

2. Many states have recently enacted laws dealing specifically with the discharge of oil from vessels. These laws are undercutting, and could eventually destroy, the system of federal regulation of oil from vessels established in the 1970 Act.

3. There is a need for further coordination and unification in the administration by the Federal Government of the various federal laws relating to pollution from vessels. Vessel owners should not, for instance, be subjected to cumulative liabilities under the Water Pollution Control Act and the Refuse Act.

These problems require urgent consideration. They are severe, and they promise to become worse unless corrective action is taken. Already—as we discuss more fully below—these problems threaten to restrict seriously the ability of some vessel owners and operators to engage in commerce in certain states.

I. SEWAGE DISCHARGES: TRANSITION TO FEDERAL REGULATION

Section 13(b)(1) of the Federal Water Pollution Control Act, as added by the Water Quality Improvement Act of 1970, requires the Federal Government to promulgate standards and regulations governing the performance and use of marine sanitation devices. Section 13(c)(1) provides that the standards and regulations are to be effective for new vessels two years after promulgation, and for then-existing vessels five years after promulgation. Section 13(f) provides that, after the effective date of the standards and regulations, no state shall enforce its laws regulating marine sanitation devices with respect to any vessel subject to the federal requirements.

Obviously, it would be unreasonable to require vessels that go from state to state to maintain two or more different sanitation systems to meet differing state requirements. Congress provided for federal preemption to avoid both "potentially serious restrictions on interstate movement of commercial vessels" and "hardship to recreational boaters who move between States." S. Rep. No. 351, 91st Cong., 1st Sess. 12 (1969).

While the intention of Congress is clear, the mechanics of the transition from state to federal requirements could cause substantial practical difficulties. Take, for example, the case of an owner of a tug in existence when the federal regulations are promulgated. He has five years to equip the tug with a device meeting the federal criteria. Until the end of the five-year period, however, state law is not preempted and the tug must comply with the various regulations of the states it travels through. On the day the five-year period ends, state law no longer applies, and the tug must meet the federal criteria.

To require a vessel to comply with varying state regulations during the interim period, and then, on the day that period ends, to require compliance with federal regulations (which may or may not be compatible with the standards of the state the vessel is in at the time) would in many cases be to require the impossible. This situation should be avoided and easily can be. Vessel owners should be encouraged to comply with federal regulations as soon as possible after they are promulgated. Section 13 of the federal statute should be amended to provide that once a vessel is in compliance with federal standards and regulations for marine sanitation devices, it is no longer subject to state laws regulating these devices.

The need for this amendment becomes increasingly clear. The Environmental Protection Agency, consulting with AWO and other industry representatives, is now readying proposed standards on marine sanitation devices for promulgation. At the same time, the several states are establishing various and varying standards that are making interstate navigation increasingly difficult. A summary of state statutes and regulations prepared by EPA in 1970 showed some 33 states with laws or regulations on marine waste disposal either in effect or in preparation. A copy of this summary is atached as Exhibit A.

(Exhibit A follows:)

Exhibit A

SUMMARY OF STATE LAWS AND REGULATIONS REGARDING SEWAGE AND WASTE FROM WATERCRAFT

Alabama.—No laws relating specifically to marine waste disposal. Regulations being prepared; not yet promulgated.

Alaska.—No laws relating specifically to marine waste disposal.

Arizona.—No watercraft equipped with a marine toilet shall be operated as to discharge sewage into water. Holding tanks are permitted where adequate dockside disposal facilities are available.

Arkansas.—Any boat with sleeping accommodations or intended for overnight occupancy must be equipped with a marine toilet and sewage treating device or other approved system of sewage disposal. Treating devices must produce an effluent having a coliform count of 240 or less per 100 ml.

California.—No vessel equipped with a toilet may be operated in waters of any lake, reservoir or fresh water impoundment unless it is so designed that no sewage can be discharged into water.

Colorado.—No vessel equipped with a water closet may be operated unless water closet is incapable of discharging directly into water.

Connecticut.—No laws relating specifically to marine waste disposal.

Delaware.—No laws relating specifically to marine waste disposal.

Florida.—No laws relating specifically to marine waste disposal.

Georgia.—Law requires suitable treatment device on all watercraft equipped with marine toilets. Suitable treatment devices include chlorinator-macerators and holding tanks.

Hawaii.—Regulations prohibit discharge of sewage (a) into waters within the confines of a small boat harbor or, (b) into waters of the State from a vessel within one-half mile from its shores unless it is adequately treated to prevent pollution.

Idaho.—No laws relating specifically to marine waste disposal.

Illinois.—Law permits only the use of holding tanks, incineration devices, and other devices that will prevent pollution.

Indiana.—Law prohibits the operation of toilets on boats in Indiana waters except Lake Michigan. Department policy permits the use of holding tanks and incinerators.

Iowa.—No laws relating specifically to marine waste disposal.

Kansas.—The Department of Health provides a certification program for marine toilets located on watercraft operating on impoundments managed by the

Corps of Engineers; a chlorinator-macerator is required for certification. Considering approval of holding tanks only.

Kentucky.—State regulations require approved treatment devices on boats equipped with toilets. Only approved devices are holding tanks or incinerators.

Louisiana.—No specific regulations covering disposal of watercraft wastes. State sanitary code prohibits discharge of untreated sanitary wastes. Watercraft engaged in shellfish operations are required to have adequate sanitary treatment facilities.

Maine.—No laws relating specifically to marine waste disposal.

Maryland.—No laws relating specifically to marine waste disposal.

Massachusetts.—Existing legislation prohibits discharge of wastes from any sources which would violate the approved Water Quality Standards. Proposed act would require holding tank.

Michigan—No watercraft equipped with a marine toilet may be operated unless it is equipped with (a) a holding tank, (b) an incinerating device, or (c) self-contained marine toilet.

Minnesota.—Law permits the use of a marine toilet equipped with a suitable treatment device. Macerator/chlorinator is permited.

Mississippi.—No laws relating specifically to marine waste disposal.

Missouri.—Law provides that any boat equipped with a marine toilet must have a treatment device capable of producing an effluent meeting the following minimum standards: (a) be free of unsightly floating solids; (b) have a coliform density not exceeding 240 per 100 ml, (c) have a substantial chlorine residual present in the effluent at all times. The law does not apply to boats engaged in interstate commerce on Missouri or Mississippi Rivers.

Montana.—State standards require holding tanks.

Nebraska.—Law requires that boats equipped with toilet facilities treat wastes in manner which will prevent water pollution.

Nevada.—Law requires that every vessel equipped with a marine toilet be operated so that inadequately treated sewage is not discharged into water. Macerator/chlorinator is permitted.

New Hampshire.—Holding tank is the only approved method of collection and disposal of sewage from watercraft.

New Jersey.—Law provides that no toilet-equipped watercraft can be licensed to operate on non-tidal waters as long as any matter that might pollute the water can be discharged from its facility.

New Mexico.—Now laws relating specifically to marine waste disposal.

New York.—No watercraft equipped with a marine toilet may operate unless it is equipped with a treatment device producing an effluent meeting the following standards: (a) be free of floating solids, (b) have a BOD not more than 50 ppm, (c) have not more than 50 ppm suspended solids, (d) have a coliform count not in excess of 50/100 ml.

North Carolina.—Requires a treatment device capable of producing an effluent free of unsightly solids and having a coliform count of 100 or less/10 ml.

North Dakota.—State Health Department must approve the type of waste treatment facilities to be installed on boats.

Ohio.—State Code prohibits use of marine toilets except on main stem of Ohio River, Muskingum River, and Lake Erie. Legislation has been introduced in the Geenral Assembly that will permit the use of any device approved by the State Health Department.

Oklahoma.—State Board of Health has prohibited the use of marine toilets on lakes and reservoirs below a certain size. On waters where marine toilets are permitted, the boat must be equipped with either a holding tank or a chlorinator-macerator capable of producing an effluent containing a most probable number of coliform bacteria not in excess of 240 per 100 ml.

Oregon.—Sewage must be treated in a manner approved by the State Board of Health and the State Sanitary Authority. The Oregon State Marine Board requires that sewage from watercraft in eight lakes in Deschutes County must be rendered harmless prior to discharge.

Pennsylvania.—No laws relating specifically to marine waste disposal.

Rhode Island.—No laws relating specifically to marine waste disposal.

South Carolina.—No laws relating specifically to marine waste disposal.

South Dakota.—Requires a treatment device capable of producing an effluent free of unsightly solids and having a coliform count of 240 or less/100 ml.

Tennessee.—Regulations require that treatment devices must be used in conjunction with marine toilets. Effluent must be free of unsightly floating solids and must have a coliform count not to exceed 240 per 100 ml.

Texas.—Law requires boats equipped with a marine toilet to have a holding tank.

Utah.—Law prohibits discharge of untreated sewage from vessels. Holding tanks, incinerators or chlorinator-macerators are acceptable.

Vermont.—No specific law against pollution from vessels. However, macerator/chlorinators are not considered adequate.

Virginia.—State Water Control Board required to adopt rules and regulations for the purpose of controlling discharge of sewage from vessels.

Washington.—No laws relating specifically to marine waste disposal.

West Virginia.—No laws relating specifically to marine waste disposal.

Wisconsin.—Law requires the use of a holding tank to prevent the discharge of sewage from watercraft.

Wyoming.—No laws relating specifically to marine waste disposal.

II. Oil discharges: state laws in conflict with basic principles of federal law.

Section 11 of the Federal Water Pollution Control Act, added to the law in 1970, establishes a federal system for control of oil pollution from vessels. Despite this system of federal regulation, there were 11 states, according to information from EPA, that passed laws in the years 1968, 1969 and 1970 relating specifically to oil pollution and applying to vessels. These laws are in addition to state water quality standards adopted in conformity with section 10 of the Federal Water Pollution Control Act.

AWO has made a careful survey of these recently enacted state laws on oil discharges from vessels and has compared their provisions with those of section 11 of the federal law. A comparative analysis of the state and federal laws is attached as Exhibit B. We must point out that the survey is probably not exhaustive; there may well be states other than the 11 studied that have laws governing oil from vessels. Furthermore, we have not attempted an analysis of regulations, rulings, or recent statutory amendments in the 11 states studied. Where the meaning of a particular statutory provision was unclear on the face of the statute itself—and many such instances appeared in the course of our review—we have simply noted, but have not attempted to resolve, the question of interpretation.

Limited as it is, however, our study is sufficient to demonstrate the baffling complexities and uncertainties of the many laws that vessel owners must attempt to understand and comply with; to point out some of the areas where federal and state administrative efforts overlap; and, perhaps most significantly, to point out many areas in which the effect of state law is to defeat the purpose of the federal law.

Federal law

Section 11 of the Federal Water Pollution Control Act provides the Federal Government with a wide range of powers to limit oil discharges from vessels and to correct damage caused by such discharges. These powers are summarized on page 1 of the attached Exhibit B. They include the right to recover civil penalties for knowing discharges; various powers to board and detain vessel and to take action to abate discharges; authority to plan, coordinate and direct oil clean-up operations; authority to recover the costs of cleaning up oil spills; and a requirement that vessels maintain suitable evidence of their financial responsibility to meet the costs of cleaning up spills.

(Exhibit B follows:)

EXHIBIT B.—STATE AND FEDERAL LAWS ON OIL POLLUTION FROM VESSELS

FEDERAL WATER POLLUTION CONTROL ACT

Discharges

Prohibited

§ 11(b)(2)(3):[1] Any discharge of oil in quantities deemed "harmful" by the President, except as permitted by Federal regulation or (in contiguous zone) by International Convention.

Penalty for Discharge

§ 11(b)(5): For knowing discharges, a civil penalty of up to $10,000 per offense.

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[1] The numbers designate the applicable sections of Federal Water Pollution Control Act.

Administrative Powers

§ 11(b)(5) : Withholding Customs clearance of a vessel subject to a penalty.
§ 11(d) : Removal or destruction of spilling vessel.
§ 11(e) : Judicial action to abate discharge.
§ 11(n) : Power to board and inspect vessel, and make arrests.

Notice of Discharge

§ 11(b)(4) : Duty to notify the United States of a prohibited discharge. Failure to notify punishable by a fine up to $10,000, imprisonment up to one year, or both.

Procedures for Removal of Discharged Oil

§ 11(c)(d) : If the spilling party does not clean up properly, the United States may do so. The President is to prepare a National Contingency Plan for coordinated action to remove spilled oil.

§11(j) : The President is to issue regulations establishing methods of clean-up, criteria for local removal plans, requirements for equipment to prevent discharges from vessels, and governing inspection of vessels; violation of regulation punishable by civil penalty up to $5,000.

Liability for removal costs (and exceptions) §§ 11(f)(1) : Vessel operator liable, except if spill caused by act of God; act of war; negligence of United States; act of a third party.

Limitation of Liability for Removal Costs § 11(f)(1) : Liability limited to $100 per ton of vessel, or $14,000,000, whichever is lesser. No limitation if discharge caused by owner or operator's wilful negligence or wilful misconduct.

Liability for Damages to Third Parties § 11(o)(1) : Liability for such damages unaffected by this statute.

Liability of "Third Parties" Who Cause a Spill from Another's Vessel § 11(g) : Third parties liable for cleanup costs, subject to exceptions and limitations as in § 11(f)(1).

Evidence of Financial Responsibility § 11(p)(1) : Vessels over 300 tons, except non-oil carrying barges, must maintain evidence of financial responsibility for cleanup costs in form satisfactory to President.

MAINE

Discharges Prohibited § 11(b)(2)(3) : Discharge of oil, petroleum products, and their by-products into coastal waters, beaches, estuaries, rivers, streams and other waters. § 543.

Penalty for Discharge § 11(b)(5) : Fine of $100–$500 for each day of violation. § 550.

Administrative Powers §11(b)(5), §11(d), §11(e), §11(n) : State Environmental Improvement Commission to adopt regulations establishing operating and inspection requirements for facilities and vessels, personnel, and other matters relating to license operations. (see "other," *infra*). § 546(4)(A).

Notice of Discharge §11(b)(4) : State Commission to adopt regulations establishing procedures for reporting discharges. § 546(4)(B).

Procedures for Removal of Discharged Oil § 11(c)(d) § 11(j) : The discharging party must remove. State Environmental Improvement Commission to remove if the discharging party does not act or if his identity is unknown. § 548. State Commission to adopt requirements for procedures, equipment, methods to be used by those subject to remove discharges. § 546(4)(c),(D). State Commission to adopt requirements for safety and operation of vessels, barges, equipment, and the like for use in operation of, approach to, and departure from terminal facilities. § 546(4)(G).

Liability for Removal Costs (and Exceptions) §§ 11(f)(1) : The discharging party is liable to the state for all costs of removal unless the discharge is caused by an act of God, war, or government. § 551.

Limitation of Liability for Removal Costs § 11(f)(1) : Ordinarily, no limitation of liability for removal costs. However, if the discharging party is a terminal facility licensed under this statute and it reports the discharge to the state immediately, there is a limit, the exact nature of which is unclear on the face of the statute. § 551(b).

Liability for Damages to Third Parties § 11(o)(1) : The discharging party is liable for all third party claims unless the discharge is caused by an act of God, war, or government. There is no limitation of liability unless the discharging party is a licensed terminal facility, which reports the discharge promptly, in

which case there is a limit, the exact nature of which is unclear on the face of the statute. § 551(b)

Liability of "Third Parties" Who Cause a Spill from Another's Vessel § 11(g): No provision.

Evidence of Financial Responsibility § 11(p)(1): No provision.

Other: All oil terminal facilities within Maine must be licensed. This requirement includes all vessels used by terminal facilities to transfer oil to vessels lying offshore but within state waters. § 545.

NEW HAMPSHIRE 107: § 8–A (1969) (LAW ON PREVENTION OF COASTAL CONTAMINATION)

Discharges Prohibited § 11(b)(2)(3): No provision.

Penalty for Discharge § 11(b)(5): No provision.

Administrative Powers § 11(b)(5), § 11(d), § 11(e), § 11(n): No provision.

Notice of Discharge § 11(b)(4): No provision.

Procedures for Removal of Discharged Oil § 11(c)(d), § 11(j): State Port Authority to initiate measures to prevent the contamination of the seacoast by discharges of oil or other matter from seagoing vessels, to stockpile detergents or equipment to handle a discharge if one occurs, and to protect the coast if such a discharge occurs.

Liability for Removal Costs (and Exceptions) §§ 11(f)(1): No provision.

Limitation of Liability for Removal Costs § 11(f)(1): No provision.

Liability for Damages to Third Parties § 11(o)(1): No provision.

Liability of "Third Parties" Who Cause a Spill from Another's Vessel §11(g): No provision.

Evidence of Financial Responsibilty §11(p)(1): No provision.

Other: Committee created to study pollution problems of handling oil and petroleum products and to recommend legislation by 1/15/71.

MASSACHUSETTS, CLEAN WATER ACT (1968, 1969, 1970)

Discharges Prohibited § 11(b)(2)(3): To pump, discharge, or deposit petroleum, its products, any oils, bilge water, or water containing such substances in such manner and extent as to pollute or contaminate lakes, rivers, tidal waters, or flats or to be a nuisance or harmful to public health. C. 91 § 59.

Penalty for Discharge § 11(b)(5): Fine of not more than $1,000 per violation. C.91 § 59. Fine for violating state water quality standards of $100 per day C.21 § 42.

Administrative Powers § 11(b)(5), § 11(d), § 11(e), § 11(n): State regulations issued requiring vessels and vessel personnel and terminal facilities to follow certain procedures during oil transfer operations. Rules for the Prevention and Control of Oil Pollution in the waters of the Commonwealth § 4.0.

Notice of Discharge § 11(b)(4): The owner or operator of a vessel must notify the state Division of Water Pollution Control of any spill, seepage, or the like of oil. Failure to notify subjects the owner or operator to a fine of up to $5,000. C.21 § 27(10).

Procedures for Removal of Discharged Oil § 11(c)(d) § 11(j): Division to contain and remove any oil discharge immediately by whatever method it considers best. Statute silent on discharging party's obligation to contain and remove. Chemicals cannot be used in the clean-up operation unless their use has been approved by the division. C.21 § 27(10). Terminals handling oil must have certain equipment and a crew trained to contain oil spills. This equipment includes a boom to encircle ships discharging oil. A violator is subject to a fine of not more than $1,000 and may lose his license. C.21 § 50A.

Liability for Removal Costs (and Exceptions) §§ 11(f)(1): Division to determine who is "responsible for each spill. (Not clear whether liability may be imposed without regard to fault.) The "responsible" party or parties are jointly and severally liable for all costs of investigation and removal. The state Attorney General may bring an action in tort to recover these costs. C.21 § 27(10).

Limitation of Liability for Removal Costs § 11(f)(1): No limitation of liability. C.21 § 27(10).

Liability for Damages to Third Parties § 11(o)(1): The responsible party or parties jointly and severally liable for all damages to natural and recreational resources, including costs of restoring damaged areas to their original condition, and for all damages caused to the property of third parties resulting

from the discharge. The state Attorney General may recover these by bringing an action in tort. C.21 § 27(10). One who negligently pumps, discharges or deposits crude petroleum or any of its products so as to damage the property of another is liable in tort to that person for double the damages caused thereby. C.91 § 59A. No limitation of liability.

Liability of "Third Parties" Who Cause a Spill from Another's Vessel § 11(g): The "responsible" party or parties are jointly and severally liable for all costs of investigation and removal. Good Samaritan provision. C.21 § 27(10).

Evidence of Financial Responsibility § 11(p)(1): Any vessel using state waters to carry an oil cargo must post a bond of $25,000 or other evidence of financial responsibility for liabilities and fines incurred from oil discharges. Failure to bond or to evidence responsibility subjects the vessel owner or operator to a fine of up to $5,000. C.21 § 50B.

Other: A permit is required for the collection or disposal of waste oil. C.21 §252. Terminals handling oil must be licensed and inspected. Failure to have a license punishable by a fine of $100 per day. C.21 § 50.

CONNECTICUT, TITLE 25 § 25–54BB—25–54HH (1969)

Discharges Prohibited § 11(b)(2)(3): No direct prohibition.

Penalty for Discharge § 11(b)(5): No provision.

Administrative Powers, § 11(b)(5), § 11(d), § 11(e), § 11(n): No provision.

Notice of Discharge § 11(b)(4): Person in charge of vessel or terminal from which oil or oil products are discharged must notify the state and the U.S. Coast Guard of the discharge and its cause. Failure to notify punishable by a fine or $1,000–$5,000. § 25–54dd.

Procedures for Removal of Discharged Oil § 11(c)(d), § 11(j): State Water Resources Commission to contain and remove any discharge of oil or petroleum or chemical liquids or products. § 25–54cc(a) Statute assumes that the discharging party has the right to contain and remove. § 25–54ff. State to coordinate with federal government and other governmental agencies. § 25–54gg. Commission can establish programs and regulations necessary to carry out the intent of this statute. §25–54cc(c). State Commission to inspect all terminals that handle oil and the like and to require equipment for oil spill abatement. The statute is unclear as to whether inspection and equipment requirements apply to vessels also. § 25–54cc(b).

Liability for Removal Costs (and Exceptions) §§ 11(f)(1): One who directly or indirectly causes pollution through the discharge of "oil or any petroleum or chemical liquid or product" is liable for the costs of containing the spill and removing it. No exceptions stated. § 25–54ee.

Limitation of Liability for Removal Costs § 11(f)(1): No limitation of liability. § 25–54ee.

Liability for damages to Third Parties § 11(o)(1): No provision.

Liability of "Third Parties" Who Cause a Spill from Another's Vessel § 11(g): A third party who causes a spill, discharge, or the like is liable to the state whether or not he was negligent (§ 25–54ee) or to the discharging party if he was negligent (§ 25–54ff) for cost of containment and removal. Jointly negligent parties are liable pro rata. § 25–54ff. Good Samaritan provision. § 25–54ff(b).

Evidence of Financial Responsibility § 11(p)(1): No provision.

Other: A permit is required for any disposal or collection of waste oil or petroleum or chemical liquids or products. § 25–54hh. State Commissions to license all terminals that handle oil and the like. § 25–54cc(b).

MARYLAND, ARTICLE 96A § 29–29D (1970)

Discharges Prohibited § 11(b)(2)(3): Any discharge of oil into waters from any vessel, ship, boat, or the like except in the event of an emergency imperiling life or property or an unavoidable accident. § 29(a).

Penalty for Discharge § 11(b)(5): The discharging person is guilty of a misdemeanor to be punished by a fine of up to $10,000 and/or imprisonment for up to one year. The discharging vessel is subject to the same pecuniary liability which will constitute a lien on the vessel. § 29(b).

Administrative Powers, § 11(b)(5), § 11(d), § 11(e), § 11(n): Vessel may be detained until its penalty is paid. § 29(b). State enforcement officers have express authority to arrest any person who violates this statute and to do so without process if the offense is committed in their presence. § 29(c).

Notice of Discharge § 11(b)(4): No provision.

Procedures for Removal of Discharged Oil § 11(c)(d), § 11(j) : State Department of Natural Resources and Maryland Port Authority to develop a state emergency plan to respond to oil spillages. § 29A. No direct authority to remove oil absent such a plan. Statute assumes that the state, and not the discharging vessel, will "eliminate the residue." § 29B.

Liability for Removal Costs (and Exceptions) §§ 11(f)(1) : Person responsible for a spillage is liable for the cost of eliminating the residue of the spillage. No exceptions stated. § 29B.

Limitation of Liability for Removal Costs § 11(f)(1) : No limitation of liability. § 29B.

Liability for Damages to Third Parties §11(o)(1) : If the state Department of Natural Resource finds damage to wildlife, it can repair that damage, restore water resources, and recover costs from the party causing the damage—with no limitation of liability. §29D.

Liability of "Third Parties" Who Cause a Spill from Another's Vessel §11(g) : No provision.

Evidence of Financial Responsibility §11(p) (1) : No provision.

VIRGINIA, STATE WATER LAWS (1968, 1970)

Dicharges Prohibited § 11(b)(2)(3) : 2 separate provisions: Any discharge of oil from a vessel prohibited except in cases of emergency imperiling life or property or of unavoidable accident. State agency may regulate discharge of oil from vessels. § 62.1–195. No owner or operator of a vessel may cause or permit the discharge of any petroleum product sufficient to damage aquatic life or beaches. § 62.1–44.34.

Penalty for Discharge § 11(b(5) : Violation of § 62.1–195 is a misdemeanor punishable by a fine of $500–$2,000 and/or imprisonment for 30 days to 1 year. § 62.1–195. Violation of § 62.1–44.34 punishable by a fine of $100–$5,000. Each day of violation is a separate offense. § 62.1–44.32.

Administrative Powers § 11(b)(5), § 11(d), § 11(e), § 11(n) : State may order one permitting or causing pollution of state waters to cease and desist, which order may be enforced by the state courts. §§ 62.1–44.15(8), 62.1–44.29, 62.1–44.34.

Notice of Discharge § 11(b)(4) : No provision.

Procedures for Removal of Discharged Oil § 11(c)(d), § 11(j) : State Water Control Board may order the person responsible for a spill illegal under § 62.1–44.34 to take necessary action to abate any pollution caused thereby. If the Board cannot determine immediately who is responsible for the discharge, it may take necessary action to abate any pollution with the consent of the Governor. § 62.1–44.34.

Liability for Removal Costs (and Exceptions) §§ 11(f)(1) : The cost of abatement undertaken by the state is recoverable from the person causing or permitting the discharge. No exceptions stated. § 62.1–44.34.

Limited of Liability for Removal Costs § 11(f)(1) : No limitation of liability in § 62.1–44.34. See, however, description in next block, *infra*.

Liability for Damages to Third Parties § 11(o)(1) : One who discharges oil in violation of § 62.1–195 is liable to the city or county in which the oil is discharged for $1 per gallon spilled in liquidated damages, such amount collectible by an action in admiralty. This liability is limited to $15,000. The statute is unclear as to whether this limit applies to removal liability under § 62.1–44.34 or whether the liquidated damages are to compensate for costs of removal or for third party damages or both. § 62.1–195.

Liability of "Third Parties" Who Cause a Spill from Another's Vessel § 11(g) : No provision.

Evidence of Financial Responsibility § 11(p)(1) : No provision.

FLORIDA, OIL SPILL PREVENTION AND POLLUTION CONTROL ACT OF 1970, CHAPTER 70–244.

Discharges Prohibited § 11(b)(2)(3) : Any discharge of oil, petroleum product, petroleum by-products, or other pollutants (including non-oil matter) into or upon coastal waters, estuaries, tidal flats, beaches and lands adjoining the seacoast. § 4.

Penalty for Discharge § 11(b)(5) : Civil penalty for *any* violation of statute of up to $50,000, with each day of violation a separate offense. If the discharge is reported to the state immediately, there is no penalty. §§ 10, 16.

Administrative Powers § 11(b)(5), § 11(d), § 11(e), § 11(n): Port manager may board a vessel prior to its entry into port to ascertain its seaworthiness and the presence of required containment gear. § 7(c). State Department of Natural Resources to establish rules that would deny a vessel entry into port under less than minimum weather and sea conditions. § 7(g). Prior to being granted entry to a port, the master of a vessel must report any discharges since he left his last port, any mechanical problem which creates the possibility of a spill, or any denial of entry to port during the current cruise of the vessel. Statute unclear as to port manager's authority to refuse entry on the basis of this information. § 7(h).

Notice of Discharge § 11(b)(4): Pilot and master of a vessel to report a discharge immediately to port manager and U.S. Coast Guard. § 7(b). Failure to give this notice is a felony punishable by a fine up to $10,000 or imprisonment for up to 2 years. § 12.

Procedures for Removal of Discharged Oil § 11(c)(d), § 11(j): The discharging party must remove the discharge to the satisfaction of the state Department of Natural Resources. The Department itself may also undertake the removal. § 8(i). The Department will establish regulations for removal and the port manager can order the discharging vessel to take removal measures deemed necessary. § 7(c), (d). The Department is to require containment gear on vessels. § 7(a). Governor has special powers to respond to an emergency. § 13. State to cooperate with U.S. under § 11 of 1970 federal act. § 8(2). Containment gear required for facilities. § 6.

Liability for Removal Costs (and Exceptions) §§ 11(f)(1): Discharging party liable without regard to fault for all costs of abatement and clean-up performed by a state or local agency. State (apparently in its discretion) "may" waive liability if the discharge was caused by an act of God, war, government, or third party. § 11.

Limitation of Liability for Removal Costs § 11(f)(1): No limitation on liability. § 11.

Liability for Damages to Third Parties § 11(o)(1): Discharging party liable without regard to fault for all costs of rehabilitation of wildlife performed by the state. State (apparently in its discretion) "may" waive liability if the discharge was caused by an act of God, war, government, or third party. No limitation on this liability. § 11.

Liability of "Third Parties" Who Cause a Spill from Another's Vessel § 11(g): The right of the discharging party to proceed against responsible third parties is preserved. § 8(5). Good Samaritan provision. § 8(4).

Evidence of Financial Responsibility § 11(p)(1): Vessels and terminal facilities must provide evidence of financial responsibility based on capacity, cargo carried, and other factors established by regulation. Any claims may be brought against the person providing evidence of financial responsibility. The amount for which evidence of responsibility is required is not specified. § 14.

Other: Terminal facilities must be licensed. This requirement includes vessels of the facilities used to transfer oil to vessels lying offshore. § 6.

MICHIGAN, WATERCRAFT POLLUTION CONTROL ACT OF 1970, ACT 167, 1970

Discharges Prohibited § 11(b)(2)(3): Discharge or causing the discharge of any oil, litter or the like which "render the water unsightly, noxious or otherwise unwholesome so as to be detrimental to the public health or welfare or to the enjoyment of the water for recreational purpose." § 3–533(203)(1). Discharge of garbage, sewage, litter, or oil from watercraft. § 3–533(203)(2). Discharge of oil or oily wastes from watercraft that threaten to pollute waters or beaches § 3–533(211).

Penalty for Discharge § 11(b)(5): Violation of the statute is a misdemeanor punishable by a fine of up to $500. One who maintains maritime safety requirements and complies with federal marine and navigation laws and regulations is not subject to this fine. § 3–533(211).

Administrative Powers, § 11(b)(5), § 11(d), § 11(e), § 11(n): No provision.

Notice of Discharge § 11(b)(4): No provision.

Procedures for Removal of Discharged Oil § 11(c)(d), § 11(j): The owner or operator of any watercraft which discharges or causes or contributes to a discharge must remove that discharge immediately from waters and shoreline. By implication, the state may remove the discharge. § 3–533(207)(2). General power to promulgate rules. Statute unclear whether this would permit rules on

matters not specifically mentioned therein such as requirements of containment gear or the like or authority to board and inspect vessels. § 3–533(209), (210).

Liability for Removal Costs (and Exceptions) §§ 11(f)(1): If the state removes the discharge, the watercraft and its owner or operator are liable for all costs of removal. No exceptions stated. § 3–533(207)(2).

Limitation of Liability for Removal Costs § 11(f)(1): No limitation of liability. § 3–533(207)(2).

Liability for Damages to Third Parties § 11(o)(1): No provision.

Liability of "Third Parties" Who Cause a Spill from Another's Vessel § 11(g): No provision.

Evidence of Financial Responsibility § 11(p)(1): No provision.

CALIFORNIA (1968, 1970)

Discharges Prohibited § 11(b)(2)(3): Any intentional or negligent discharge of oil except for discharges of sewage and industrial waste permitted by Water Code Chapter 4, Division 7, Harbors and Navigation Code § 151.

Penalty for Discharge § 11(b)(5): Civil penalty up to $6,000. Harbors and Navigation Code § 151.

Administrative Powers, § 11(b)(5), §11(d), § 11(e), §11(n): No provision.

Notice of Discharge § 11(b)(4): No provision.

Procedures for Removal of Discharged Oil § 11(c)(d), § 11(j): State Fish and Game Department authorized to clean up the effects of a discharge of petroleum or petroleum products. Fish and Game Code § 5655.

Liability for Removal Costs (and Exceptions) §§ 11(f)(1): Fish and Game Department to recover reasonable costs of clean-up or abatement from one who has discharged oil intentionally or negligently. Fish and Game Code § 5655; Harbors and Navigation Code § 151.

Limitation of Liability for Removal Costs § 11(f)(1): No limitation of liability. Harbors and Navigation Code § 151.

Liability for Damages to Third Parties § 11(o)(1): In addition to liability for costs of clean-up or abatement, one who discharges oil intentionally or negligently is liable to the Fish and Game Department, for all "actual damages," without limit. "Actual damages" is not defined and the statute is unclear whether this applies damages to private parties. Harbors and Navigation Code § 151.

Liability of "Third Parties" Who Cause a Spill from Another's Vessel § 11(g): No provision.

Evidence of Financial Responsibility § 11(p)(1): No provision.

WASHINGTON, RCW 90.48.315 ET SEQ. (1969, 1970)

Discharges Prohibited § 11(b)(2)(3): Any discharge of oil not otherwise permitted by state law except discharges caused by an act of God or war or by a negligent act of the state or the United States. § 90.48.320.

Penalty for Discharge § 11(b)(5): If the discharge is intentional or negligent, the discharging party is liable for a penalty of up to $20,000 per violation. § 90.48.350.

Administrative Powers, § 11(b)(5), § 11(d), § 11(e), § 11(n): State Water Pollution Control Commission may board vessels to investigate violations of the statute. § 90.48.355.

Notice of Discharge § 11(b)(4): The person discharging must notify the state Water Pollution Control Commission immediately. § 90.48.360.

Procedures for Removal of Discharged Oil § 11(c)(d), § 11(j): The discharging party must remove the oil. If removal is not possible, he must contain, treat, or dispose of it. The state can prohibit or restrict the use of chemical or other dispersants if it appears that their use would be detrimental to the public interest. § 90.48.325. The state is given express authority to investigate a discharge and to remove and contain it. § 90.48.330.

Liability for Removal Costs (and Exceptions) §§ 11(f)(1): If the Water Pollution Control Commission removes a prohibited discharge because the "responsible" party failed to do so, that party is liable for the State's expenses in removal or containment. § 90.48.335, 340.

Limitation of Liability for Removal Costs § 11(f)(1): No limitation of liability. § 90.48.335, 340.

Liability for Damages to Third Parties § 11(o)(1): Liability without regard to fault for damages to public or private persons or property resulting from

any discharge not caused by an act of God or war or a negligent act of the state or United States. No limitation of liability. § 90.48—(§ 6 of 1970 Act).

Liability of "Third Parties" Who Cause a Spill from Another's Vessel § 11(g): Any person not an owner or operator responsible for a prohibited discharge is liable for clean-up expenses undertaken by the state or any other party. No limitation of liability. § 90.48—(§ 7 of 1970 Act).

Evidence of Financial Responsibility § 11(p)(1): No provision.

Other: Permits required prior to any discharge of oil. § 90.48—(§ 8 of 1970 Act).

ALASKA, STATUTES TITLE 46, CHAPTER 05 (1968, 1970)

Discharges Prohibited § 11(b)(2)(3): Any discharge of petroleum or its residuary products, coal tar, asphalt, and the like, which violates state water standards is expressly prohibited, unless caused by an act of God or by circumstances beyond the control of the discharging party. § 46.05.170(b). Any discharge of ballast water, tank-cleaning waste water, or other waste containing oil in excess of 100 parts per million of oily residue by vessels over 300 tons. § 46.05.173(a).

Penalty for Discharge § 11(b)(5): Fine of up to $25,000 and/or imprisonment for 30 days to 1 year. § 46.05.210(a).

Administrative Powers, § 11(b)(5), § 11(d), §11(e), §11(n): State Attorney General may bring injunctive action to prevent a violation of these statutes. § 46.05.200. Vessel may be detained as security for damages for non-ballast discharges. § 46.05.215. A vessel having discharged ballast at sea in violation of § 46.05.173 may not take on oil, petroleum products, or their by-products as cargo in Alaska. § 46.05.173(b). State Department of Health and Welfare may order the immediate discontinuance of pollution of waters if it finds that an emergency exists. § 46.05.190.

Notice of Discharge § 11(b)(4): Person in charge of vessel to notify State Department of Health and Welfare of any ballast discharge. § 46.05.173(d).

Procedures for Removal of Discharged Oil § 11(c)(d), § 11(j): No explicit provision. However, damage provision § 46.05.210(c), *infra*, assumes that state may have removed a discharge and restored the environment to its former state.

Liability for Removal Costs (and Exceptions) § 11(f)(1): One who violates either § 46.05.170 or § 46.05.173 is liable to the state for "liquidated damages," which term is not defined, at $5,000–$100,000. § 46.05.210(b).

Limitation of Liability for Removal Costs § 11(f)(1): One who violates § 46.05.173 (discharge of ballast) is also liable for damages of $100 per ton of vessel or per $500 evaluation of facility or $14 million, whichever is less. If the violation was the result of willful negligence or willful misconduct, "damages" means cost of abatement, containment, and removal and of reasonable restoration of the environment to its former state. When violation not willful, "damages" is not defined. No limitation of liability if violation the result of willful negligence or willful misconduct. § 46.05.210(c).

Liability for Damages to Third Parties § 11(o)(1): See immediately above.

Liability of "Third Parties" Who Cause a Spill from Another's Vessel § 11(g): No provision.

Evidence of Financial Responsibility § 11(p)(1): No provision.

The scheme of regulation of section 11 is comprehensive in scope. It is also a carefully balanced scheme. Liability for the costs of oil clean-up is not absolute: a vessel owner is excused if a discharge from his vessel is caused, not by his act, but by an act of God, an act of war, negligence of the United States, or the act of a third party—and if a third party is the cause, that third party must pay clean-up costs. Congress carefully considered alternative standards of liability, including a standard that recognized no exception from liability in the case of an oil spill caused entirely by a third party. See S. 7 as reported to the Senate Public Works Committee by the Air and Water Pollution Subcommittee, 91st Cong., 1st Sess., Comm. Print No. 3, pp. 28–29, July 2, 1969. It rejected these alternatives, and decided that a vessel owner should not be liable if a discharge was wholly the result of factors he could not control.

Similarly, unless a discharge is caused by a vessel owner's or operator's wilfulness or negligence, liability for oil clean-up costs is limited to $100 per ton of the vessel, up to $14 million. Congress considered imposing unlimited liability (see H.R. 14000, 90th Cong., 1st Sess., p. 7, as introduced on November 14, 1967), and decided against it. Evidence received in hearings on the 1970 Act indicated that insurance could not be purchased at levels substantially above $100 per ton,

or for overall maximum liability much above the $10–12 million range, if oil clean-up liability were based on negligence (a standard often the same in effect as the standard finally adopted). If liability were made absolute, without regard to fault, insurance would be available only up to much lower levels, probably about $67 per ton/$5 million overall. See *e.g.*, Hearings on S. 7 before the Subcommittee on Air and Water Pollution, Senate Public Works Committee, 91st Cong., 1st Sess., ser. 91–2, pt. 4, at 1308–10 (1969). Congress weighed this evidence and adopted the principles of limited liability and liability that is not absolute. Liability was intended to be high enough to protect the public interest, "while at the same time not placing an unreasonable insurance burden on vessel owners." S. Rep. No. 351, 91st Cong., 1st Sess. 17 (1969). So long as there were exceptions to absolute liability for clean-up costs,

> "the figure of $100 per ton . . . should be insurable. . . . The figure [as a measure of required financial responsibility for cleanup costs] reflects an attempt by the committee to assure maximum protection to the U.S. Government while not requiring uninsurable evidence of financial responsibility." *Id.*, p. 18.

Unlimited absolute liability

Exhibit B shows that in at least nine states (eight coastal states and Michigan) recently enacted oil pollution laws obliterate entirely the limits that Congress so carefully established. The states, and the relevant provisions of their laws on liability for oil clean-up costs, are the following:

Maine.—*No limitation* on liability. No exception to liability for discharge caused by third party.

Massachusetts.—*No limitation* on liability. Law unclear whether liability based on fault.

Connecticut.—*No limitation* on liability. Apparently absolute liability.

Maryland.—*No limitation* on liability. Possibly absolute liability.

Virginia.—Possibly *no limitation* on liability. Apparently absolute liability.

Florida.—*No limitation* of liability. Apparently no exceptions to liability, except at the discretion of the state.

Michigan.—*No limitation* of liability. Apparently absolute liability.

California.—*No limitation* on liability.

Washington.—*No limitation* on liability. No exception to liability for discharge caused by third party.

Current enforcement

Not all of these states have yet established the administrative machinery to put their laws into effect. The present situation in Florida, however, is a clear example of the serious limitations these laws may impose on the ability of vessels to go from state to state.

Florida's regulations were scheduled to go into effect on March 1, 1971. It became clear, however, that many companies would have to forego oil carrying operations in that state once the regulations took effect. Companies cannot buy insurance policies for the unlimited clean-up liability that exists under Florida law, and they are understandably reluctant to subject themselves to liabilities they cannot insure against. Many companies, furthermore, fear that they cannot provide the evidence of financial responsibility required by the regulations as a condition of entry into the ports of Florida. (Florida requires insurance or other evidence of financial responsibility up to only $100 per ton, but apparently requires evidence of absolute responsibility, without any exceptions and with defenses allowed to the insurance companies only at the discretion of the state. Insurance is not generally available on these conditions.) Faced with the likelihood that its regulations will have the effect of excluding many vessels from its ports, Florida has postponed full enforcement of its regulations until March 15. It is, however, at the present time issuing warnings to vessels in its waters that do not meet the requirements of the Florida law and regulations. There is no predicting what will happen after March 15.

No public interest is served by laws that establish total liabilities with respect to oil spills that are greater than vessel owners can pay or can insure against. Although the law may provide that liability is unlimited, once a vessel owner's insurance and assets are exhausted, further loss must fall on the last claimant in line—the state, the United States or an injured private property owner. An equitable and effective scheme of liability would recognize that the ability of a vessel owner to pay, out of insurance or out of his own assets, is limited.

Criminal and civil penalties.

Added to these liabilities for oil clean-up costs are various provisions for criminal penalties under the laws of six states, civil penalties in three (including one of $50,000 per day in Florida—another factor deterring entry into Florida waters), and miscellaneous provisions for "liquidated" or punitive damages (including in Massachusetts potential liability for double the damages caused to third parties).

These penalties add still more potential financial liabilities on top of clean-up liabilities that are already so high as to be uninsurable. Furthermore, state penal provisions may produce the added consequence of real, if unintended, harassment of vessel owners. It is fundamentally unfair to put a vessel owner twice in jeopardy for a single act—to make him defend separate penal actions in state and federal courts for one oil spill. There may indeed be Constitutional questions with respect to state penalties for oil spills, not only the question of double jeopardy, but also the question of compelled self-incrimination. Both the federal law and the laws of six states require persons who discharge oil to report the discharges. The discharges may be criminal acts under the Federal Refuse Act, under the laws of three of the states that require notice, and under the laws of three additional states.

Administration.

Finally, there is the problem of overlapping state and federal administration of oil pollution control efforts. In the 1970 Act, Congress directed the establishment of a comprehensive federal plan to provide "efficient, coordinated, and effective action" to deal with oil discharges in the navigable waters of the United States, adjoining shorelines and the contiguous zone. Section 11(c)(2). This system has now been put into effect under a National Contingency Plan. 35 F.R. 8508 (June 2, 1970). The President was also directed to promulgate regulations (which have not yet been issued) establishing methods to prevent and remove oil discharges and establishing criteria for local and regional oil removal plans. What the Congress clearly intended is a unified system under the ultimate control of the Federal Government, a system that provides "some uniformity in dealing with oil spills." S. Rep. No. 351, 91st Cong., 1st Sess. 16 (1969).

Not many state laws recognize this pre-eminent federal role. Maryland, for instance, duplicates the federal power to detain vessels for the payment of penalties. Virginia and Alaska duplicate the federal power to bring an action to abate a discharge. Florida, Washington and perhaps Maine duplicate the federal power to board and inspect vessels. Florida, Maine and perhaps Connecticut duplicate the federal authority to prescribe oil clean-up methods and equipment, and Florida seems to claim the right to exclude from its waters vessels that do not have oil-containment gear on board that meets Florida's specifications. It is not clear what happens if the various states and the Federal Government require different kinds of containment gear.

The laws of at least 10 states appear to give state officials essentially the same powers that federal officials have under the federal law to clean up oil that the discharger does not clean up. If the Federal Government cleans up, federal law provides that the Federal Government is to recover from the vessel owner (unless one of the statutory exclusions applies), or, if the act of a third party was the sole cause of the discharge, from the third party. If the states clean up, many state laws provide that the states are to recover these costs from the vessel owner, no matter what was the cause of the spill. Again, there is no apparent mechanism now in existence for resolving the inconsistencies. There is no way of knowing whether state or federal officials or both are to clean up an oil spill, and, if the vessel owner was not at fault, whether the vessel owner, a third party or nobody is liable for the costs of clean-up.

There is even an overlap in the requirement of certificates of financial responsibility for oil clean-up costs. As of April 3, a federal certificate will be required for most oil carrying vessels using the ports or waters of the United States. Nevertheless, Massachusetts has its own certification requirement and may or may not be satisfied with the federal certificate. At this point, AWO is not certain how Massachusetts will apply this aspect of its law. Florida requires a certificate, will not accept the federal certificate, and apparently intends after March 15 to bar from its ports any vessel that does not have a Florida certificate.

We recognize, of course, that Congress provided in section 11(o)(2) of the Water Pollution Control Act that

"Nothing in this section shall be construed as preempting any State or political subdivision thereof from imposing any requirement or liability with respect to the discharge of oil into any waters within such State."

But it also provided in section 11(o)(3) that

"Nothing in this section shall be construed . . . to affect any State or local law *not in conflict with* this section." (Emphasis added.)

We now have a situation in which the laws of many states *are* in conflict, and in the most fundamental ways, with the federal law. The basic concepts of liability that is not absolute and liability limited to insurable amounts are undermined completely. Administration becomes a harassing federal-state competition. And the ability of vessels to engage in commerce between the states, which after all is one of the essential things the Federal Government was created to insure, is put in serious jeopardy.

Needed: A uniform system

To remedy this situation, we recommend a combination of Congressional action and action by the Executive under existing authority.

1. The Federal Government, presumably through the Environmental Protection Agency, should exercise the authority granted in section 11(j) of the Water Pollution Control Act to establish methods for preventing and cleaning up oil discharges and to establish criteria for local oil removal plans. States and localities should be permitted and encouraged to make and enforce rules for the prevention and clean-up of oil spills from vessels, but only to the extent that their rules and procedures are approved in advance by the EPA as consistent with federal law and regulations. In order to prevent overlapping and conflicting state and federal activities, EPA must exercise its overall power to direct and coordinate these activities.

2. The costs of cleaning up oil spills from vessels should be recoverable only by the Federal Government, with the following exception: if a state or locality incurs costs in cleaning up an oil spill pursuant to procedures approved by EPA, the party responsible for the spill should be liable to the state or locality for these costs to the same extent as it would have been liable to the United States if the United States had cleaned up the spill. The liability to all governments of the party responsible should not exceed the federally established limitation of liability for clean-up costs of $100 per ton/$14 million.

3. Except in the case of state regulations approved in advance by EPA as consistent with federal law, federal law should pre-empt state provisions for detention or removal of vessels, abatement proceedings, boarding and inspection, evidence of financial responsibility requirements and other enforcement provisions.

4. State laws permitting recovery of actual damages to the property of third parties should remain in force and not be pre-empted. State laws that provide criminal penalties, punitive damages, liquidated damages or double damages, in addition to recovery of actual damages, should be pre-empted by the federal provisions for penal liability.

III. OVERLAP OF FEDERAL LAWS ON CONTROL OF POLLUTION FROM VESSELS

Vessel owners and operators are now subject to both civil and criminal penalties for water pollution under a number of federal laws. These include the Federal Water Pollution Control Act, which imposes a civil penalty up to $10,000 per offense in the case of oil discharges, section 11(b)(5), and which requires one in charge of a vessel to give notice of a discharge or face criminal penalties, section 11(b)(4). In addition, the Refuge Act imposes a criminal penalty of up to one year in prison, a fine up to $2500 or both for refuse discharges, 33 U.S.C. §§ 407, 411, and a civil penalty (which applies in the case of vessels only) up to $2500, 33 U.S.C. § § 407, 411, 412. Statutes specifically relating to the harbors of Chicago, New York, Baltimore and Hampton Roads make it criminal to discharge refuse into any of those harbors. 33 U.S.C. §§ 421, 441, 451a. These statutes, like the Refuse Act, apply to the discharge of any polluting material, not just oil.

Two problems arise from this overlap of federal law, one of which may be dealt with administratively, the other of which requires correction by legislation.

The first problem is a lack of clarity as to the jurisdiction of various federal agencies to administer these federal laws. One federal agency should control all federal activities under these statutes—proceedings to assess pen-

alties, to abate or enjoin violations, to clean up discharges or to recover the costs of federal clean-up. That agency, it would appear, should be EPA. Already EPA and the Department of the Army have made excellent progress in this direction with regard to enforcement of the Refuse Act. Their recent memorandum of understanding, 36 Fed. Reg. 3074 (Feb. 17, 1971), recognizes EPA's leading role with regard to Refuse Act violations affecting water quality. There also appears to be a need to bring the Coast Guard into this cooperative arrangement. In at least some districts the Coast Guard not only supervises clean-up of oil discharges under the Water Pollution Control Act, but also, by delegation of authority from the Corps of Engineers, enforces the Refuse Act, sometimes taking the lead in asserting the Government's rights to civil penalties under that Act. All of these activities should be brought under one federal roof so that vessel owners need deal with only one agency, and so that duplicative penal proceedings are avoided.

The second problem arisse from the inherent conflict that exists between provisions for civil penalties under the Water Pollution Control Act and Refuse Act, on the one hand, and, on the other hand, the provisions of the Water Pollution Control Act that requires or encourage the reporting and clean-up of oil spills. It is not fair, when a vessel operator reports a spill and then cleans it up, for the Government then to use his words and conspicuous conduct as the basis for assessing penalties. It also undermines the policy of the Water Pollution Control Act to encourage the prompt reporting and clean-up of spills, so as to minimize their damage. Section 11(b)(4) of the Water Pollution Control Act deals with part of this problem by providing that notification of a discharge in compliance with that Act shall not be used in a criminal case against the person giving the notice. Nevertheless, it is now standard practice in some districts for the Coast Guard to assert Refuse Act civil penalties for all discharges from vessels, whether or not a vessel operator was at fault in causing the discharge and whether or not he acted promptly to report the spill and clean it up.

Civil and criminal penalties for discharges do not play particularly important roles in the federal program to control water pollution from vessels. The requirements that spills be reported and cleaned up, the provision of liability in rem for clean-up costs, and the federal requirements regarding financial responsibility are far more useful tools. We would suggest that, in order to encourage prompt reporting and clean-up of spills, Congress should provide immunity from actions for civil or criminal penalties under the Refuse Act or Water Pollution Control Act (not including liability for actual damages or clean-up costs) to anyone who takes prompt action to report an oil spill of which he is aware and who makes all reasonable efforts to contain and clean up a spill for which he is responsible.

THE AMERICAN WATERWAYS OPERATORS, INC.,
Washington, D.C., March 30, 1971.

HON. EDMUND S. MUSKIE,
Chairman, Subcommittee on Air and Water Pollution, Senate Public Works Committee, Washington, D.C.

DEAR SENATOR MUSKIE: This letter and enclosure are in reference to discharge of hazardous substances from vessels which your Committee is considering.

The American Waterways Operators, Inc. (AWO) is the national association representing the domestic water carrier industry, principally the owners and operators of towboats, tugboats and barges on the inland and coastal waters and in the harbors of the United States. AWO's members include the owners and operators of vessels that carry materials commonly considered hazardous substances, as well as the owners and operators of certain terminal facilities that handle these substances.

We regret that the schedule of the Subcommittee's current hearings on proposed water pollution bills did not afford time for an oral statement on behalf of AWO. In lieu of such a presentation, we are transmitting herewith a written statement on one subject covered by bills before the Subcommittee that is of particular importance to the domestic water carrier industry: the subject of hazardous substances, other than oil, and the discharge of these substances from vessels.

We shall appreciate the inclusion of this statement in the record of the Subcommittee's hearings.

Sincerely yours,

BRAXTON B. CARR, *President.*

Attachment:

ADDITIONAL STATEMENT OF THE AMERICAN WATERWAYS OPERATORS, INC.

By Braxton B. Carr, President

Our comments are directed principally to S. 523. That bill, in section 8, would impose liabilities for the discharge of substances that have been designated as hazardous substances by the President pursuant to section 12(a) and (b) of the Federal Water Pollution Control Act.

The liabilities imposed would be absolute and unlimited. The second sentence of section 8 provides:

> "The owner or operator of any vessel, onshore or offshore facility from which such discharge occurs is liable for *any* damages, including costs of removal, which result directly or indirectly from such discharge, *without regard to negligence* or willfulness." (Emphasis added.)

WEAKNESSES IN S. 523

We can see several very serious flaws in this proposal:

(1) *Uninsurable risks.*—To the best of our knowledge, it would not be possible to buy insurance against the unlimited and absolute liabilities that the bill would impose. Such insurance appears to be no more available for cleanup liability for hazardous substances than for oil—and, as this Subcommittee is aware, insurance for unlimited and absolute liability is not available for oil spills.

On questions of vailability of insurance, AWO and its members must, of course, rely on information provided by their insurance companies and insurance brokers. We have not made a complete survey of the insurance industry. We have, however, begun consultations with industry representatives, and thus far we have heard, without exception, that the proposed absolute and unlimited liability is uninsurable. Mr. Paul Kreuzkamp, vice president of the international insurance brokerage firm of Alexander and Alexander, has authorized us to report that, given the limited capacity of the world's insurance market, absolute and unlimited liability for damages resulting from spills of hazardous substances is uninsurable. Messrs. Nicholas J. Healy and Gordon W. Paulsen, representing the London Group of Protection and Indemnity Associations (which handles approximately 70% of the marine liability insurance of the world) advise that they are unable to predict the amount of liability that may be insurable, but they are firmly of the view that the full liability that would be established under S. 523 is not insurable. They have authorized us to report this to the Subcommittee.

The problem, apparently, is not merely that higher risks would mean higher insurance costs (and ultimately higher costs to shippers and consumers.) The problem is that insurance will simply not be available against risks that the bill would create.

Passage of the proposed section would, therefore, present the owners and operators of vessels in the waters of the United States with an intolerable choice. Without insurance against all potential liability, they must either put the entire assets of their companies at risk in every carriage of a hazardous substance, or they must refrain from carrying these substances. We cannot predict the actions of individual companies with certainty. It seems clear, however, that many carriers, as a matter of prudent business judgment, would choose not to undertake the unlimited risks that carriage of hazardous substances would entail.

(2) *Liability regardless of fault.*—S. 523 would make a vessel owner or operator liable for any discharge of a hazardous substance from his vessel, whether or not he caused it and whether or not he could have done anything to prevent it. This is fundamentally unfair. Surely if a vessel owner or operator uses all due care to prevent hazardous spills from his vessel, he should not be liable if a spill is caused by forces beyond his control. There should be exceptions from liability in the case of acts of God, acts of war, Governmental acts, and acts of third parties. With regard to acts of third parties, if a vessel containing a hazardous substance is being properly navigated, or is properly anchored, and if a third party's vessel negligently collides with it causing a discharge, it should be the negligent party, not the innocent party, that should be held responsible.

(3) *Conflicting state and federal laws.*—The laws and regulations that govern

vessels moving in interstate commerce must comprise a uniform, nationwide system. This is not to say that state laws on hazardous substances must be totally preempted or that state administrative officers should play no role in the cleanup of discharges of these substances. State plans for the prevention and cleanup of such discharges should, however, not go into effect without prior approval by the President or his delegate to insure that the laws of individual states are compatible with the national system of regulation. Nothing in any state's law should be permitted to conflict with the Coast Guard's regulations on the transportation of hazardous substances or with the President's powers under section 12 of the Federal Act to establish cleanup procedures and to conduct cleanup operations.

To the extent that state laws impose liabilities in excess of amounts that the Congress finds to be insurable, the state laws should, we think, be preempted. Otherwise the risk of liability under state law would stand as a harsh deterrent to the movement of vessels from state to state. State laws that impose civil or criminal penalties in addition to any provided under federal law should also be preempted.

There is also a need to avoid overlap between federal laws. If the Water Pollution Control Act is amended to provide for the payment of damages for discharges of hazardous substances, there should be no penalties assessable under the Refuse Act for the same kinds of discharges.

In a statement submitted to this Subcommittee on March 5, 1971, in connection with the Subcommittee's review of federal water quality programs, AWO called the Subcommittee's attention to the fact that a multitude of newly enacted state laws are undermining the federal program to regulate oil pollution from vessels that was created by the 1970 amendments to the Federal Act. We urged that Congress act promptly to bring order out of what is becoming a chaotic situation by providing a unified federal-state system regulating oil discharges. We urge, in the case of other hazardous substances, that the Congress provide at the outset for the development of a unified system of regulation.

NEED FOR DATA AS BASIS FOR LEGISLATION

Discharges of hazardous polluting substances and their prevention and cleanup present questions far more complex than those involving oil discharges, a subject with which this Subcommittee has dealt in detail for some years. Some of the essential questions that must be addressed in order to lay a realistic groundwork for legislation are the following:

(1) *What substances are to be regulated?*—As yet no substances have been finally designated as hazardous pursuant to the mandate of section 12 of the Federal Water Pollution Control Act. Until the substances are known, it is not possible to know the risks involved and the remedies required. We support the provisions of S. 1014 that require the Administrator of EPA to identify hazardous substances and to report on existing evidence of the effects of their discharge. This seems a necessary first step in devising regulations limiting or prohibiting discharges.

(2) *What steps to clean up or mitigate discharges are to be required?*—Regulations establishing recommended methods of removal have not yet been promulgated under section 12 of the Federal Act. It is difficult even to estimate the amount of potential liabilities for cleanup costs that may be involved, if cleanup methods are unknown. Again, the procedures contemplated by S. 1014 will help illuminate these questions.

(3) *What insurance is available against liability for discharges?*—It may not be possible to answer this question with any certainty until the answers to the first two questions are known. Nevertheless, the Subcommittee will need to hear directly from the insurance industry on this essential issue.

(4) *Should the Federal Government bear risks that cannot be commercially insured?*—This question will be squarely before the Congress if, as seems inevitable, unlimited and absolute liabilities are found to be uninsurable. AWO has previously suggested the creation of a federal insurance program to cover losses that are not commercially insurable and cannot be covered in any other way.

(5) *What information is currently available to Congress on the prevention of hazardous discharges and on cleanup methods and cost?*—Representatives of the manufacturers and carriers of hazardous products have worked with the Coast Guard for over five years to identify the hazards of liquid cargoes and to design vessel equipment, tanks and handling systems to transport these substances safe-

ly. Coast Guard regulations on transporting these substances are in existence and are constantly being revised in consultation with industry. New regulations covering barges came into effect on June 1, 1970. The chemical industry is now implementing a national emergency reporting system to provide prompt action and technical advice in the event of chemical spills. These various measures are having effect. It may never be possible to eliminate entirely the risk that certain cargoes may cause very damaging spills, but such spills are now quite rare. Congress will need information on all of these subjects from manufacturers, carriers and the Federal Government.

It is not possible within the compass of this statement to discuss in detail the questions outlined above. These are important questions, however, and they deserve further careful consideration by the Subcommittee. We would urge that, before this Subcommittee acts on the subject of hazardous substances, it hold further hearings to develop facts on which realistic legislation may be based.

STATEMENT OF THE AMWAY CORPORATION

By JAY VAN ANDEL, Chairman of the Board

PHOSPHATES—THE CURE WORSE THAN THE DISEASE?

The Great-Phosphate-in-Detergents-Debate of 1970 has been characterized by a confusing mixture of truths, half-truths, and confusion in much of what has been written and spoken. Separating fact from fiction, and emotion from reason, has not been easy. The goal of clean water is universally accepted, but the proposed means of achieving it are conflicting and often misunderstood.

Hasty action to remove some or all phosphates from detergents and to market huge quantities of non-phosphate laundry products in their place will result in playing a game of chemical Russian Roulette with our lakes and streams.

Laundry detergents, soaps and other cleaning products are mixtures of a variety of chemicals. Some of these chemicals are organic and more or less biodegradable—that is, they can be consumed by bacteria and converted into simpler and presumably less harmful substances. Many of the chemicals used are inorganic, soluble in water, and cannot be degraded or consumed by bacteria. Some of these chemicals, such as phosphorus, are natural elements and act as nutrients to plants in the water, such as algae.

Very little is actually known today about the total effect on the environment of pouring billions of pounds of any such chemical—organic or inorganic—into our streams and lakes.

Public and governmental concern and pressure has brought about a premature substitution of certain new untested ingredients such as NTA for part of the phosphate in some detergents. Manufacturers with considerable reluctance have begun to use small quantities of NTA in place of some phosphate to try to meet the public clamor for immediate action. But recently the use of NTA as a substitute for phosphate has been the subject of widespread concern; yet only a few months ago some ecologists were proclaiming its attributes in the most glowing and unquestioned terms. The effects on the environment of draining huge quantities of this chemical into streams are simply too complex and unknown at this time for anyone to be able to make a sound judgment.

Public clamor for action has also spawned the introduction into the market of a number of "non-phosphate" detergents. These products use mixtures of various chemicals that have been used as part of the formulas in various detergents for many years—chemicals such as washing soda, borax, sodium metasilicate, surfactants, and even table salt.

One of these new "non-phosphate" products recently introduced to the market contains 45% table salt (sodium chloride) as one of its principal constituents. Now the detergent industry has long known that sodium chloride can be used as a detergent ingredient, although it has no known detergent action; it is merely an inert additive or a bulk filler. But the environmentally concerned consumer who uses such a product is only trading "phosphate down the drain" for "table salt down the drain", thereby possibly trading fresh water for salt lakes.

Other "non-phosphate" detergents use large quantities (as much as 60%) of washing soda. This compound, chemically known as sodium carbonate, is not only being utilized in detergents but also in combination with soap as a water softening ingredient. In vast quantities, it might increase the alkalinity of streams and lakes, upsettng the ecological balance by killing microorganisms upon which higher forms of life depend for food. As a result, the entire biological food chain, ending with fish, could be seriously impaired.

Table salt can only be removed from waste water at sewage plants through extremely costly distillation plants (such as are used to convert sea water into fresh water). There is no presently known inexpensive way to remove washing soda from waste water during sewage treatment. In order for these chemicals to completely replace the more efficient phosphate, they will have to be used in vast quantities—billions of pounds—if the soap and detergent industry moves entirely away from phosphate formulas to these new mixtures. Non-phosphate, non-

NTA detergents as presently available perform poorly on wash-and-wear, permanent-press type fabrics which often compose over half of the modern laundry mix. They also perform poorly in hard water, and for heavily soiled laundry. Since performance is considerably lowered with such products, the consumer will be tempted to use mort of the substitute compounds in hope of achieving the excellent results formerly obtained from phosphate compounds.

The effects of pouring billions of pounds of table salt, washing soda, or similar chemicals into our lakes and streams may well be a much greater threat to our environment than continued use of phosphates. Trading the better known effects of a chemical that could be easily removed from sewage, such as phosphate, for the unknown effects of hard-to-remove chemicals may be a bad bargain, ecologilogically and economically.

The problem to be solved then is how can we provide consumers with effective, low-cost laundry compounds which either we can be certain do not need to be removed from waste water, or can be economically removed at sewage treatment plants.

Several solutions present themselves. First, based upon present environmental knowledge, the only way we can be *certain* that laundry products would not further contribute to water pollution or fertilization would be to stop using *all* detergents, including soaps, water softeners, "non-phosphate" products, bleaches—everything.

If we were to stop pouring *any* chemical mixture down our drains and were to use *only clear water* for washing and cleaning, we would obviously make an improvement.

If, however, we used only clear water for washing and cleaning, America would still not have clean lakes and streams. Soaps and detergents are estimated to contribute less than 17% of the total phosphate which enters our waters. A large amount is also contributed by crop fertilizer, animal manure, dirt, bacteria and other nutrient run off from farmlands, feed lots, and gardens. Also, industrial and human wastes which are not properly removed by sewage treatment because most sewage plants are inadequate, contribute not only phosphate but many other undesirable chemicals and bacteria. And of course washing clothes in clear water would still result in millions of pounds of dirt and bacteria from the clothes going into the drain and ultimately to streams and likes, if not removed at a treatment plant. Clear water would of course only do a very poor job of washing, and such a solution would be neither workable nor acceptable.

Secondly, we can re-formulate laundry products, eliminating the phosphates. This method is being strongly promoted by public pressure today. However, it is highly questionable whether reformulation will even partially solve problems of nutrient-rich waters. As long as any chemicals continue to enter streams and lakes in such great quantity, there is a strong possibility that the new phosphate-substitute formulas may be even more ecologically difficult to control than the old phosphate products, which at least we *know* we can remove at sewage plants.

We must also consider that such new formulas create many new and complex problems such as increased corrosion of washing machines, and inefficient performance on synthetic, and wash-and-wear fabrics. We will also have to contend with lower performance in hard water (even when the new formulas are used in considerably greater quantities than present phosphate detergents), higher consumer costs, plus limited use in automatic machines, etc. In view of these facts it then becomes apparent that the value of substitute chemicals is serisously limited as a real solution to "the phosphate problem" (or more correctly, "the total eutrophication problem").

But we already have available to us a for more comprehensive and effective and economical solution to the problem of detergent chemicals entering streams and lakes. Although we know *very little* about lake eutrophication and the effect of complex mixtures of various chemicals drained into our waterways, we do know a *great deal*, right now, about how to *remove* various chemicals in water solution from sewage water. The technology for removing chemicals from water is well developed and very advanced, although the use of this technology with regard to sewage treatment unfortunately has been limited by the taxpayers' indifference and reluctance to pay for proper sewage treatment.

Therefore, a logical solution, both reasonable and workable, is to have a Federal agency specify which chemicals may be used not only in detergents and soaps but in *any* product that may find its way into sewage drains, and allow the use of *only those chemicals that can be easily removed from waste water.* It should be also mandatory for municipal and industrial sewage treatment plants

to *install equipment capable of removing these chemicals*. In this way the Federal and municipal governments together with the industrial and public sector will be coordinated on a total plan to restore the quality of our waters.

Not all chemicals can be removed easily and economically or with the same type of equipment. But processes *are* available today that are reliable and economical for removing a number of commonly used detergent chemicals from sewage water at municipal sewage plants. For instance, phosphates can be removed by an inexpensive process with an operational cost of less than $2. per person per year at a municipal plant, (even in primary stage plants) and the process will not only remove detergent phosphates but sewage phosphates as well, for about the same cost. Since at least half of the phosphate entering streams and lakes comes from sewage, it would make eminently more sense to *remove phosphate from all* sources at the city sewage plant than to eliminate only *part* of it from detergents at the point of manufacture. And since detergent re-formulation with phosphate substitutes might introduce chemicals much more difficult to remove than phosphate, and potentially more harmful to the environment, it would make good sense to go no further down the re-formulation path until we are sure of all the results.

Laundry detergent manufacturers do not use phosphates because they have no regard for the environment. They have been accused of resisting change; of being able to produce products without phosphate, but unwilling to change because it would hurt their profits, and of being environmentally unconcerned. Such accusations are not based on fact. If the expense of phosphate substitutes necessitated increased costs to the manufacturer, the cost would be passed on to the consumer as is true in any manufactured product. Profit structure would not be affected. Detergent manufacturers buy phosphates from chemical suppliers as they do other chemicals, and they have no vested interest in promoting phosphates.

Laundry detergent manufacturers, however, know a great deal more about the chemistry of soaps and detergents and other cleaning products than do most of their critics, no matter how sincerely motivated such critics may be. They are aware that a hasty change in direction at this time may literally, and ecologically, be "jumping from the frying pan into the fire." Therefore, although the detergent industry can produce phosphate substitute products immediately if public pressure demands (although such products are markedly inferior in performance), conscientious manufacturers are very aware that until a great deal more is known about the entire situation, it may be far wiser not to take any premature action or make any radical changes which could expose our environment to the possibility of what are presently unknown hazards. Phosphate is well known and understood and is economically manageable. New directions—new chemicals—new chemical mixtures—are unknowns.

Another possible danger of great magnitude could be legislation at local levels which has not been coordinated with a Federal master plan structured upon knowledge and assessment of all of the options. Some state and local governments have been bowing to public pressure and threatening to pass hasty laws requiring detergents to be formulated without phosphates or with lower phosphate content. Such *local* legislation, if it should proliferate, will only add to confusion. It may bring greater ecological damage as well as result in higher costs to the consumer.

A far more sensible approach is to set a reasonable top limit on phosphate usage in products at the *Federal* level now. The 20% P_2O_5 (8.7% P) level used in Canada is practical. This would buy some time for scientists to engage in relevant research. A Federal law, as previously mentioned, should require *certification* of all chemicals to be used in detergents to the effect that they are considered removable at sewage plants, or considered not harmful to streams or lakes even if not removed. Following these guidelines, the manufacturers would be able to formulate from this certified list of chemicals the different products needed for various purposes—heavy duty laundry—hard water laundry—soft water laundry—bleaching—stain removal—with full consideration for environmental concerns. Such a scientific and logical approach, properly coordinated at the Federal level only, would provide the greatest possibility of bringing all of us to the ultimate goal of clean water.

The emotional tactics of hurling invective, printing outdated, confusing and inaccurate phosphate percentage lists, and trying to reformulate detergents in local legislative halls are not effective methods. In fact it is quite possible that a certified list of government approved chemicals, evaluated under conditions of

cool scientific testing instead of hot emotional hearsay would list controllable phosphate as one of the safest of all the chemicals we could use.

With due consideration for alternative solutions, it appears at this time that use of such certified, approved chemicals, coupled with adequate sewage treatment plants, would eliminate the threat of salted streams or soda lakes or algae blooms and bring us instead to our goal—the re-establishment of clean, pure water supplies to serve the needs of North America!

RESEARCH PUBLICATIONS

Chemical and Engineering News, 1155 Sixteenth St., N.W., Washington, D.C. 20036.
Chemical Engineering, 330 W. 42nd St., New York, N.Y. 10036.
Chemical Processing, 111 E. Delaware Pl., Chicago, Ill. 60611.
Detergent Age, 41 E. 42nd St., New York, N.Y. 10017.
Modern Packaging, 1301 Ave. of the Americas, New York, New York 10019
Plastics World, 221 Columbus Ave., Boston, Mass. 02116.
Soap & Chem. Specialties, 254 W. 31st St., New York, N.Y. 10001.
Chemical Week, 330 W. 42nd St., New York, N.Y. 10036.
Aerosol News, P.O. Box 31, Caldwell, N.J. 07006.
Analytical Chemistry, 1155 16th Street N.W., Washington, D.C. 20036
American Perfumer and Cosmetics, 1031 South Blvd., Oak Park, Ill. 60302

STATEMENT OF HON. JAMES M. BEGGS, UNDER SECRETARY OF THE DEPARTMENT OF TRANSPORTATION

[BEFORE THE SENATE COMMITTEE ON COMMERCE, SUBCOMMITTEE ON OCEANS AND ATMOSPHERE, REGARDING S. 1238 AND RELATED BILLS, WEDNESDAY, APRIL 21, 1971]

Mr. chairman and members of the committee, I appreciate the opportunity to testify today on S. 1238 and related bills, all of which are directed at the serious problem of the contamination of our oceans. I would like to introduce Rear Admiral Robert E. Hammond, Chief of the Office of Operations of the Coast Guard, who is on my right.

Secretary Volpe has said often that at the Department of Transportation environmental quality is a goal, not a constraint. I am pleased to be here today to explore with the Subcommittee how the Department, through the Coast Guard, can play a positive and effective role in regulating ocean dumping.

I graduated from the Naval Academy in 1947. At that time, no one questioned the capacity of the oceans to absorb our waste. We now realize, however, the peril of ocean dumping on a major scale. We now understand that we cannot continue to poison our oceans merely because they seem large enough to dilute the poison.

Administrator Ruckelhaus of the Environmental Protection Agency and Chairman Train of the Council on Environmental Quality will testify during this hearing. Both of these gentlemen will address themselves to the environmental concerns involved. I need not reiterate their statement of the problem or their commitment to solving it. I would like, however, to assure this Subcommittee that my Department, through the Coast Guard, stands ready to cooperate immediately with the Environmental Protection Agency to carry out those portions of the program which they choose to delegate to us. I can also assure the Subcommittee that the Coast Guard can today fulfill its responsibilities for enforcement under section 8(c) of S. 1238.

In this regard, let me review for you the capabilities of the Coast Guard to carry out this proposed legislation. I have attached to my statement, as Appendix A, a more thorough analysis of what is available in the way of support personnel, materials, and technical expertise to fulfill this mission.

The Coast Guard is already active in the area of ocean dumping as an adjunct to its Marine Environmental Protection Program. On a day-to-day basis, they receive information on planned dumping and record the location, identity of materials, and persons involved in all observed ocean dumping activities. This information is furnished to interested agencies such as the Council on Environmental Quality and the Environmental Protection Agency. They have also monitored many dumping operations upon request.

Based on our experience, we believe effective regulation of ocean waste disposal requires three elements: a permit issuing authority, an available surveillance and enforcement capability, and effective monitoring activity. Clearly, the agency vested with the responsibility for enforcement should have some involvement at each stage of the regulation scheme, particularly the issuance of permits. S. 1238 makes provision for this in section 8(b), and we have already begun to discuss with the Environmental Protection Agency how we can be most useful to them and to the program. It is self-evident that effective surveillance and enforcement calls for knowledge of any permits issued and the terms of those permits.

The Coast Guard engages in a variety of mission areas which would support the role of the Environmental Protection Agency in the regulation of ocean dumping. They have long been established as the Federal maritime law enforcement agency. Their officers and men are trained and experienced in matters of law enforcement just as they are trained and experienced in seamanship. The Coast Guard provides a substantial Federal maritime force for enforcement of the maritime aspects of the Refuse Act and the various other oil

pollution laws. They also have a long history of involvement with the marine community in such areas as the handling of dangerous cargo and the issuance of permits for various regulated marine activities.

In addition, the Coast Guard has the facilities to carry out these functions, and with little augmentation, can utilize these same facilities to participate actively in a program of ocean dumping regulation. Appendix A outlines in detail the Coast Guard units available for ocean dumping regulatory activity. As you will note, they cover all waters over which the United States has jurisdiction.

The Coast Guard can easily aid the Environmental Protection Agency in the issuance of permits, and I have listed in Appendix A the locations of the already-established Coast Guard Captains of the Port and Marine Inspection Offices. I wish to emphasize that these offices are well known to all members of the marine industry, both national and foreign, and are presently involved in many tasks closely related to ocean waste disposal regulation. Captains of the Port are responsible for the inspection of port structures housing hazardous materials and for the supervision of explosives loading. Marine Inspectors are responsible for the inspection and certification of merchant vessels. These two types of facilities represent an already available administrative force. We believe these offices would be able to absorb a permit issuing function with a modest personnel increase. The FY 1972 budget already contains 26 additional staff members for the Captain of the Port Offices to help handle the increased work loads caused by expanding pollution control and port security duties. Based on a projection of three to six thousand permits a year, we would estimate that an additional $285,000 for additional personnel would be needed for this function during the first year.

In addition, the Coast Guard's experience and the data they have collected, in the regulation of hazardous material transport, would be readily available to assist the Environmental Protection Agency in making the necessary determinations as to whether or not particular substance should be disposed of at sea. The Coast Guard also collects oceanographic data in support of other missions which, while presently limited in scope, could be utilized in baseline determination.

Captains of the Port have small boats, ranging from 31 to 44 feet, at their disposal for a variety of tasks including the supervision of loading of material to be dumped at sea and other calm water surveillance and monitoring. Eighty-two and 95 foot patrol boats are also available for the same tasks. Medium and high endurance cutters can be utilized too, and these vessels are capable of long-range operations of extended duration. Finally, Coast Guard helicopters and fixed-wing aircraft can respond in less than one hour for surveillance and other duties.

We are currently assuming that surveillance will be required in each instance when toxic or radioactive dumping takes place. In other cases, spot checks will be made in approximately 5 to 10 percent of the dumpings. To specifically carry out the surveillance function, we would initially utilize the six HU 16 aircraft which the FY 1972 budget reactivates for the Marine Environmental Protection program. The Coast Guard estimates that this places an additional burden of 600 aircraft hours or $315,000 on its resources.

The availability of surface vessels is somewhat more critical. The Coast Guard has estimated that surface surveillance activities will require 350 ship days at a cost of one million dollars. If the Committee would like, I would be pleased to submit for the record how we arrived at this figure.

We would point out that our present fleet is fast approaching its limit of use, even based on multi-purpose missions. Exact requirements cannot be determined, but we believe additions to the fleet in the smaller cutter range will be necessary in the future in order to fully perform our surveillance function.

Further personnel expenses to maintain liaison with the Environmental Protection Agency will be necessary.

If requested, we could also aid the Environmental Protection Agency in oceanographic monitoring of dump sites and adjacent waters. The Coast Guard has, for several years, been a major participant in the United States oceanography program. This participation takes the form of daily observations from lightships and offshore light stations as well as from a variety of ships. Seasonal oceanographic cruises are also carried out in specially equipped vessels. Craft are therefore already available for this function and the only additional cost would be for specialized equipment. In this regard, the Coast Guard Office of Research and Development and the Office of Engineering are developing monitoring technology and instrumentation to support our present operational programs. Of particular importance will be the development of sensors specifically for pollution control

purposes. Finally, our Oceanographic Unit and our marine scientists are skilled and experienced in the evaluation of environmental data as a result of our efforts in oceanography survery work including the International Ice Patrol.

In short, the Department of Transportation stands ready and able to aid the Environmental Protection Agency in administering this program. We believe we have the ongoing facilities to carry out not only the surveillance and enforcement aspects of the program already assigned to us in S. 1238, but also, if delegated by EPA, the permit issuing and ocean monitoring functions.

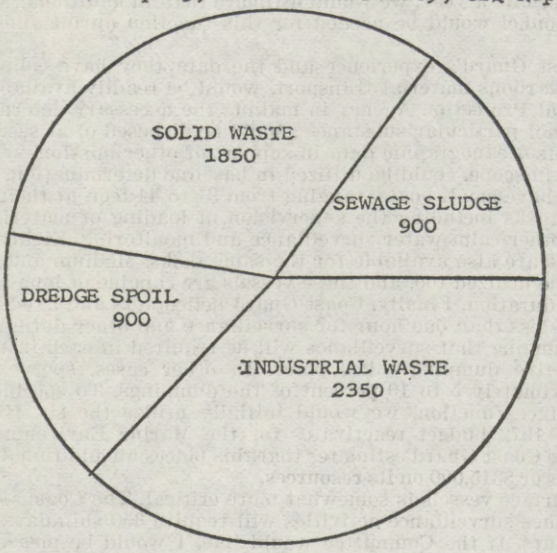
This concludes my prepared statement, Gentlemen. I would now be willing to answer any questions you might have.

APPENDIX A

OCEAN DUMPING

Projected Permit Applications
(Estimated first year)

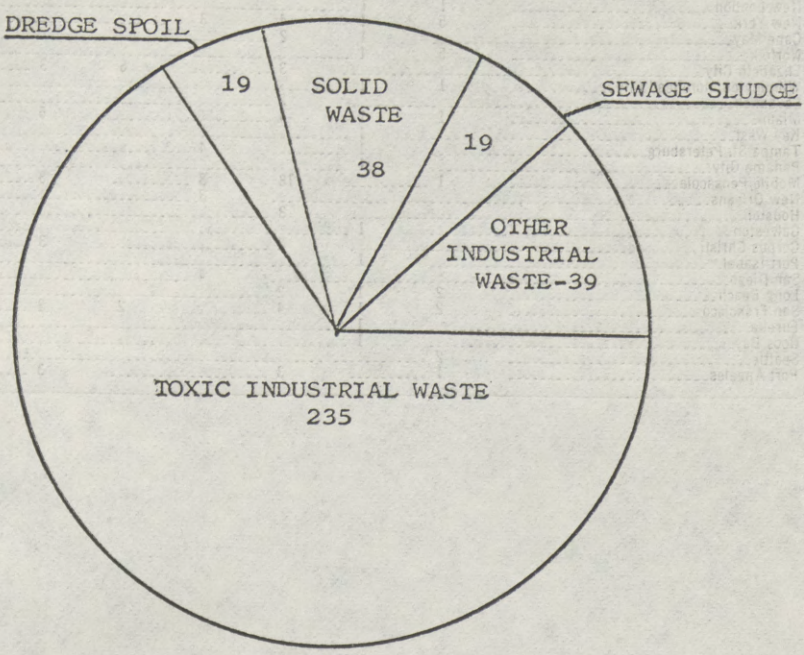
Source: Ocean Dumping, A National Policy; CEQ Report to the President



Total: 6,000

OCEAN DUMPING

Surveillance and Enforcement
(Estimated ship-days in first year)



Total: 350 Ship-days

Personnel requirements for dumping/permit issuing/supervision

Enlisted in COTP's to issue permits	18
Officers (one in each District office) to coordinate patrol schedules, supervise local operations	12
One officer, one enlisted, and one civilian at headquarters for overall supervision, liaison with EPA and CEQ, handling congressional correspondence	3

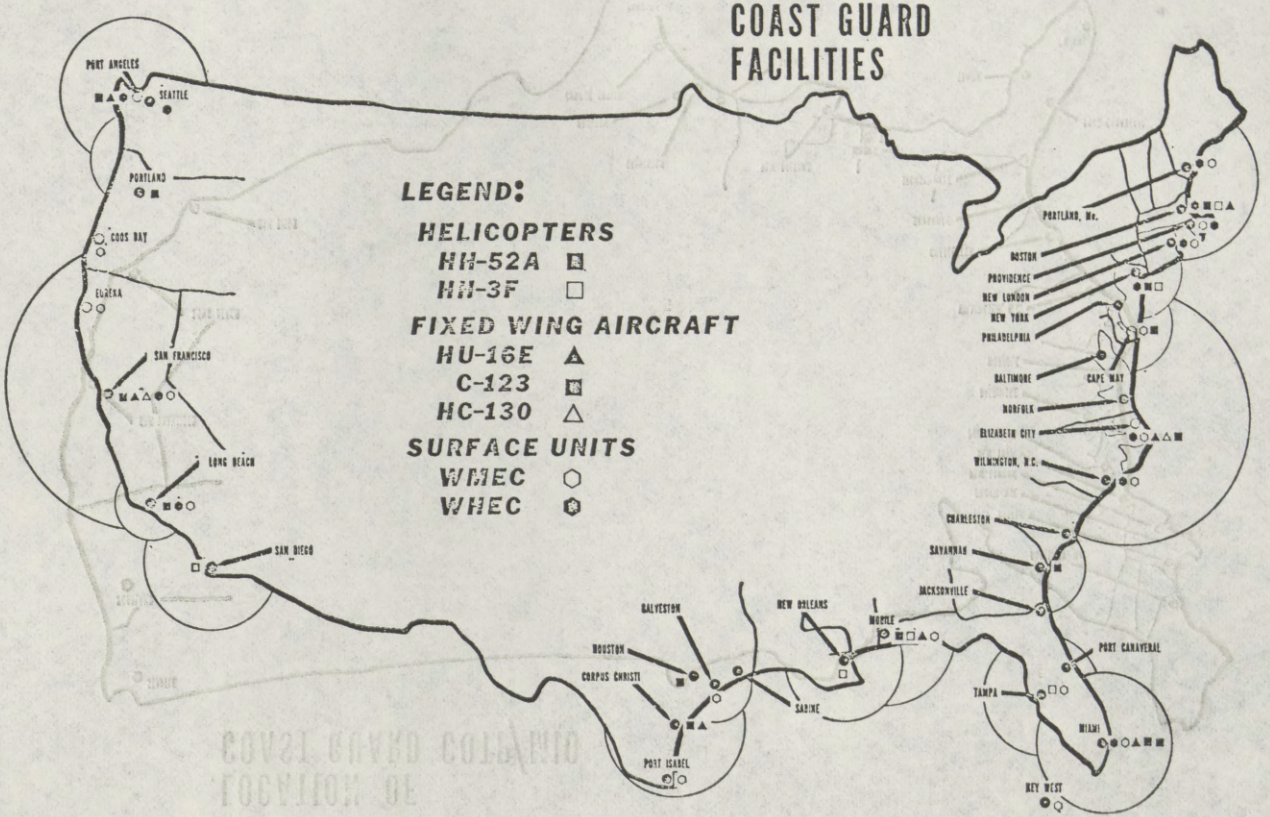
LOCATIONS OF COAST GUARD CAPTAIN OF THE PORT (COTP) AND MARINE INSPECTION OFFICES (MIO)

	COTP	MIO		COTP	MIO
Portland, Maine	X	X	Key West	X	
Boston	X	X	Tampa	X	X
Providence	X	X	Mobile	X	X
New London	X		New Orleans	X	X
New York	X	X	Sabine	X	X
Delaware			Houston	X	X
Philadelphia	X	X	Galveston	X	X
Baltimore	X	X	Corpus Christi	X	X
Norfolk	X	X	Port Isabel	X	X
Wilmington, N.C.	X	X	San Diego	X	X
Charleston	X	X	Long Beach	X	X
Savannah	X	X	San Francisco	X	X
Jacksonville	X	X	Portland	X	X
Port Canaveral	X		Seattle	X	X
Miami	X	X			

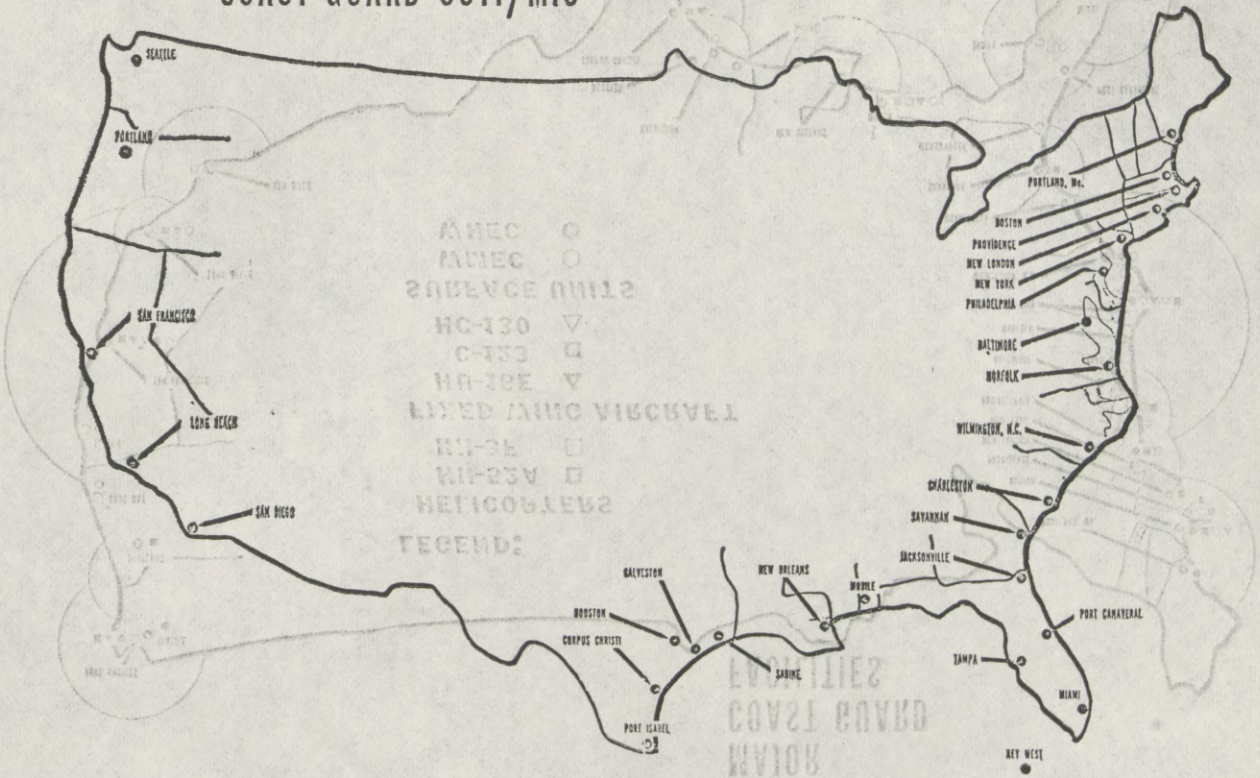
LOCATION OF MAJOR COAST GUARD FACILITIES

	HEC	MEC	HH52	H3	C130	HU16	C123
Portland, Maine	1						
Newcastle		2					
Boston	6		3	3		1	
New Bedford	1	1					
New London	1	1					
New York	5	1	4	3			
Cape May		1	2				
Norfolk	5	1					
Elizabeth City			3		6	3	
Wilmington/Morehead City	1	1					
Savannah			2				
Miami	1	1	4			5	1
Key West		1					
Tampa/St. Petersburg		1		4			
Panama City		1					
Mobile/Pensacola	1		18	3		3	
New Orleans				3			
Houston			3				
Galveston		1					
Corpus Christi			2			3	
Port Isabel		1					
San Diego				4			
Long Beach	2	1	2				
San Francisco	2	1	4		2	3	
Eureka		1					
Coos Bay		1					
Seattle	2						
Port Angeles	1		3			3	

MAJOR COAST GUARD FACILITIES



LOCATION OF COAST GUARD COTP/MIO



CHAMBER OF COMMERCE OF THE UNITED STATES OF AMERICA

By JOHN J. COFFEY*

VIEWS ON SENATE BILLS 523, 1012, 1013, 1014, AND 1015

The Chamber of Commerce of the United States takes this opportunity to present its views on several water pollution control proposals to the entire Senate Public Works Committee membership. Our original intention had been to present these comments to the Subcommittee on Air and Water Pollution in formal testimony, permitting adequate discussion of the key issues in this important proposed legislation. The Subcommittee staff, however, thwarted our efforts to be heard through initial failure to invite our views and through subsequent rejection of our request to testify at the hearings.

The water pollution control issue is of vital concern to the National Chamber's membership—a federation of 3800 chambers of commerce and trade and professional associations, and over 39,000 business firms. Our members have the right to be heard—the right to participate in the formulation of national policy on a serious national problem. And they shall be heard, despite the Subcommittee staff's efforts. As the first phase in providing business community input to your deliberations on water pollution legislation, the National Chamber is submitting this statement to *all* members of the Senate Public Works Committee. We urge you to consider not only the merits of the viewpoint presented in this statement, but also the operation of the Subcommittee on Air and Water Pollution which precluded more beneficial discussion of this viewpoint in direct testimony. Because this opportunity for questioning was not provided, the National Chamber stands ready to respond to any individual requests for further clarification and comment.

As the National Chamber stated to this Committee last May, several significant changes are required in the Federal program if water pollution problems are to be abated and prevented. Specifically, the level of Federal funding for the municipal grant-in-aid program needs to be substantially increased, deadlines for administrative action by the Environmental Protection Agency must be detailed, and periodic review of water quality standards must be scheduled. These legislative actions, together with prompt use of existing authorities can bring us to our water quality goals. However, several provisions of the major bills (S. 523 and S. 1014) under consideration must rejected because of the dangers which they present to water quality standards programs, to state water rights, to state control over economic development, and to our *total environment.*

BACKGROUND ON LEGISLATION

The Water Quality Act of 1965, developed by this Committee and its counterpart in the House of Representatives following extensive hearings and deliberations, constituted landmark environmental legislation. Many of the principles contained in that Act have been subsequently reflected in legislation affecting other fields.

The National Chamber followed closely the development of the Water Quality Act and advocated several constructive changes in the bill as originally introduced. When the Conference Committee Report was filed on September 17, 1965, we fully endorsed the reported bill (S. 4) and worked hard for its enactment. In 1966, and again in 1969, the National Chamber supported several amendments—later enacted—designed to improve the effectiveness of the Water Quality Act, the latest of these amendments having been signed into law on April 3, 1970.

Following passage of the Water Quality Act, the National Chamber conducted a series of regional conferences with state and local chambers of commerce and public officials explaining in detail the responsibilities of states under this Act.

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Many of our state and local chamber members also participated in the public hearings required by the Act prior to the adoption of water quality standards by the states. The vast majority of our members recognized that the Water Quality Act, if implemented fully and properly, could provide the necessary thrust to solve our nation's water pollution problems. The support of the business community was in part responsible for all fifty states developing water quality standards and implementation plans for their interstate waters. Each of the states now has some form of water pollution control program for all waters under its jurisdiction.

Much progress has been made in the fight against water pollution under the Water Quality Act. Much additional progress could have been made if the Act had been implemented fully and properly. Such additional progress can still be made if this Committee will insist upon full and proper implementation of the Act which it worked so hard to develop—and if the Administration works hard to carry out the intent of Congress.

It must be emphasized that continuing substantive state and local action is required to complement the Federal action detailed in the Water Quality Act. To encourage local action in managing environmental quality, the National Chamber has recently published, and distributed to local chambers of commerce, *Improving Environmental Quality—Business-Led Action to Improve Water and Air Quality.* This booklet, available upon request, has been designed to assist local chambers and other community groups to organize and implement effective air and water pollution control programs.

PROBLEMS—BUDGETARY

Failure of appropriations to match the authorization levels of the Act has resulted in a lag in the construction of municipal waste treatment facilities. In recent years, high interest rates and poor bond market conditions have prevented some communities from proceeding on their own without Federal assistance. In a statement to this Committee last year, the National Chamber supported authorization of grant agreements totaling $4 billion to implement the municipal grant-in-aid program.

Increasing demand for additional waste treatment facilities and rising construction costs continue to escalate the estimated cost for the municipal program. The total cost of needed facilities is difficult to pinpoint, likewise the Federal share.

S. 1013 proposes $2 billion per year for the municipal grant program; S. 523 recommends $2½ billion per year. It's impossible to determine if either accurately reflects the true need. Both figures do represent substantial increases in the Federal commitment when compared with Federal appropriation over the past years, and this is the important factor. A higher level of Federal funding should break the backlog of unbuilt municipal facilities. However, success of the municipal grant program depends heavily upon confidence that appropriations will match authorizations. The "broken promises" of the past years have caused much of the delay in municipal construction.

If it is shown that increased Federal funding of municipal facilities does not significantly ease the construction backlog, the National Chamber will examine other avenues of Federal participation, such as the Environmental Financing Authority detailed under S. 1015. However, assuming favorable action on an increased level of Federal funding of the grant program, an assessment should first be made of the effects of this increased funding prior to consideration of rather novel and far-reaching proposals, such as detailed in S. 1015.

PROBLEMS—ADMINISTRATIVE

Significant improvement in water quality could result if the states were allowed to implement their responsibilities under the 1965 Act without unjustified Federal interference. The Water Quality Act authorizes Federal oversight of the water quality programs on interstate waters, and provides ample authority for strong action should state efforts not measure up to the requirements of the law.

As early as three years ago I pointed out in testimony to the House Public Works Committee that the continued failure by Federal authorities to unconditionally approve any of the water quality standards submitted by the states was resulting in delay in the implementation of those standards. If there are reservations concerning a state's standards, and these reservations cannot be satisfied, then the standards should be disapproved and Federal action initiated

as detailed in the Water Quality Act. Without firm approval of standards and plans, state authorities, municipalities and industries are reluctant to act to meet standards which can be changed at any time. Firm "ground rules"—water quality standards and implementation schedules—must be established in order to justify the substantial investments of time and money required to meet the standards.

Senator Muskie, in S. 523, has proposed periodic state review of water quality standards, a review we support. A five-year period would seem appropriate in view of the current five-year amortization for industrial capital expenditures on pollution control.

However, this review must be complemented by prompt Federal action, either fully approving or disapproving the proposed standards. Such Federal action on the water quality standards submitted by the states in 1967 should be taken immediately. The elimination of "moving targets" as standards will greatly accelerate effective water pollution control programs. If the Administrator of the Environmental Protection Agency disapproves these standards, the Water Quality Act provides for sufficient Federal authority to act in the absence of responsible state action. However, the Administrator must first take a firm position on the state water quality standards submitted in 1967 if abatement of water pollution is to proceed. Unconditional approval of state standards—or disapproval precipitating Federal action—is a necessary next step toward meaningful water quality improvement.

The 1970 Clean Air Act amendments incorporate deadlines for administrative action by the Environmental Protection Agency. This principle should apply also to the water quality program. I hope that such deadlines will be added to the Federal responsibilities under the Water Quality Act.

Legislative Dangers

The major proposals (S. 523 and S. 1014) now before your Committee contain substantial dangers. Your chief task may well prove to be the elimination of these dangers from the final bill approved by the Committee.

Danger to the principle of water quality standards, and to all the state programs based on this principle

All states now have water quality programs for the waters under their jurisdiction. Water quality standards have been used as an effective means of providing for public participation in the choice of water quality goals—in effect, the use of the water resource. Such standards are effective in protecting water from thoughtless abuse, judging costs and benefits, and weighing the effectiveness of pollution control actions.

Specific effluent limitations, designed to achieve water quality standards, are necessary items in any implementation plan. Both bills, but in particular S. 1014, place too much emphasis on rigid establishment of these effluent limitations. S. 1014 discusses Federal effluent standards for "minimum acceptable levels of treatment."

The chief argument against these Federal effluent standards is that they will be so unresponsive to regional problems that they could, in fact, impede real progress. For each water basin, state and/or regional authorities must set discharge limitations on individual waste sources in order to achieve the adopted water quality standards. Many states utilize a yearly permit system to enforce these discharge limitations. Due to changing conditions (increasng population, shifts in land use, flow variations, etc.) in each basin, these discharge limitations must be flexible in order to effectively achieve the quality standards without undue hardship. The time-consuming process of Federal approval will largely destroy this flexibility.

Both bills contemplate some form of control by the Administrator of EPA over discharge limitations. By vesting approval and/or enforcement powers over discharge limitations with EPA, regional and state authorities will be unable to respond swiftly to changing conditions in the water basin because of the required Federal action. In addition, the need to simplify Federal administration will probably lead to great pressures for uniform national discharge limitations, thus seriously imperiling the status of water quality standards. At the Federal level, the administrative ease associated with enforcement of uniform discharge limitations will overshadow the need for adequate water quality. This would present serious obstacles to the prevention of pollution.

DANGER TO STATE WATER RIGHTS AND STATE ECONOMIC DEVELOPMENT

Both bills extend Federal participation in water pollution control efforts substantially beyond the interstate waters now covered by Federal law. While recognizing that there is a Federal role in the establishment of quality standards for interstate waters, beginning in 1963 this Committee, together with the House Public Works Committee, carefully studied Federal authority over intrastate waters. Because of the acute interrelationship between water quality (hence water use) and the development of river basins, the principle of Federal intervention into strictly intrastate situations was rejected.

Both S. 523 and S. 1014, by delegating final approval authority over intrastate water quality and over point source waste discharges to the Environmental Protection Agency, will concentrate considerable economic planning powers in the office of the Administrator. This authority could give the Administrator substantial power over the use of intrastate waters and over the location of new sources of discharge—both municipal and industrial. Each state would then be dependent upon the Administrator for its economic future. For example, Federal regulation would be extended to intrastate waters used for irrigation (regulating salt content) and to "contiguous" waters where coastal states now lease mineral rights.

Since water quality standards are the true measure of our success in protecting our environment and in providing for adequate water usage. Federal enforcement action should be directed against violations of the established water quality standards. The actions are detailed in the Water Quality Act. Federal efforts to enforce quality standards, coupled with rapid, unconditional approval of appropriate state standards are essential to prevent and control pollution.

DANGER TO OUR TOTAL ENVIRONMENT

Related to the preceeding discussion on uniform effluent standards is the problem of language similar to "latest available technology."

Given finite resources, as a society we must balance our desire for a high quality physical environment with our demands for adequate housing, proper nutrition, sufficient energy, mobility, jobs—in short, our standard of living. Water quality standards provide one of the key interfaces between the physical environment and our social and economic needs. The proper allocation of our limited resources to provide the best total environment for man is the function of these quality standards. Undermining this balancing process through requiring "latest available technology" on all new sources will mean that resources which should be used to satisfy man's other needs will be diverted. While this diversion may improve the physical environment, it must degrade the quality of life—our total environment.

The need for the proper establishment and strong enforcement of water quality standards cannot be overemphasized. Concern over the physical environment must not lead to an overreaction which would neglect the fact that man, unlike flowers and trees, requires not only a suitable physical environment for life, but also those social and economic factors which make life worth living.

Lack of Federal authority over intrastate water quality and point source discharges does not suggest that pollution of intrastate water will result, just as the past few years have shown that Federal authority (poorly administered) has not been a panacea for interstate water pollution problems. Under the Water Quality Act, states were encouraged to adopt water quality programs for their waters, and each state now has an agency to handle water pollution control. Most states have ongoing programs, several of which have been significantly more effective than the joint Federal-State programs for interstate waters. States have been able to develop new concepts for dealing with water basins entirely within their jurisdiction.

Another form which this danger to state economic development assumes is the "non-degradation" provision contained in both bills. The issue of non-degradation has concerned the National Chamber for several years. In essence, non-degradation stipulates that, regardless of water quality standards adopted after public hearings, no water body will be allowed to decline from its present level of water quality, even if that level is well above the approved quality standards. While non-degradation is absolutely necessary to improve the condition of presently low quality waters, its application to high quality waters presents major difficulties.

A national policy of non-degradation will tend to concentrate population and industry in areas already under substantial environmental pressure. Since 100% treatment (complete recycling) is not now within the scope of our technology, a non-degradation policy will force new waste sources—municipal, industrial, and agricultural—to locate in areas where existing sources are reducing their waste discharges rather than in areas where there are presently no waste discharges. If these sources were to locate on high quality waters, some degradation would necessarily occur, but as long as the adopted water quality standards were enforced, no pollution would result. This principle of non-degradation will lead to continued underdevelopment of our non-populous areas and increased environmental strain on the heavily populated and heavily developed sections of the country.

Rivers and Harbors Act of 1899

Many of the dangers outlined in the proposed legislation apply also to the Administration's planned implementation of the Rivers and Harbors Act of 1899. Much of the Administration's bill, S. 1014, is designed to give legislative sanction to the permit system for industrial discharges which would proceed under the 1899 Act. This permit system, and the proposed regulations to implement the system, flies in the face of much of the fine work on water quality standards accomplished by this Committee over the years. Firm direction from Congress must be given to Federal efforts in water pollution control. I urge that you use the present legislative opportunity to bring the Administration's proposal back into line with water quality standard programs.

Summary Recommendation

Because of the proven effectiveness of the Water Quality Act in encouraging state water quality programs, and because the full potential of this Act has not been realized due to failure to implement the Act fully and properly, the National Chamber urges the members of this Committee to insist that the Water Quality Act of 1965 be given a chance to perform as effectively as this Committee envisioned when it drafted the legislation in 1965. This failure in the implementation efforts, which must rest with those officials who in the past have been responsible for the Federal program, has adversely affected not only the interstate water quality programs, but also the intrastate efforts designed to complement the joint state-federal program. Improvements in the implementation of the Water Quality Act are necessary to continue water quality efforts. To this end the National Chamber urges this Committee to adopt measures which would:

1. increase the level of Federal funding;
2. force prompt unconditional decisions by the Administrator on state water quality standards submitted for review;
3. require periodic review of state water quality standards (as in S. 523).

By taking this action, and by rejecting proposals which would undermine the thrust of the Water Quality Act or impose Federal control on the development of the states and their waters, the members of this Committee will accelerate and improve the national effort to abate water pollution.

59-068 O—71—pt. 3——5

FLOOD AND POLLUTION CONTROL IN METROPOLITAN CHICAGO

Prepared by the City of Chicago Department of Public Works,
MILTON PIKARSKY, Commissioner

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I GENERAL ASPECTS OF URBAN RUNOFF AND WATER POLLUTION BY COMBINED SEWER OVERFLOW

The fall of rain and snow through the atmosphere cleans the air by dissolving out contaminants and physically washing out particulate matters. The flow of waters over the land in the form of runoff to watercourses adds further soluble and insoluble natural contaminants to the water cycle. Even the percolation of waters into the soil and their eventual flow into watercourses and lakes adds soluble and insoluble substances which may or may not be of a pollutional nature. Thus even without the effect of man's urban existence, nature creates pollutional conditions.

The urban environment magnifies these pollution producing conditions. The air washing of the urban atmosphere contributes more and more diverse pollutional substances to precipitation. The drainage of the urban area adds contaminants that far exceed those nature-induced pollutants added to runoff by solution and erosion in open non-urban areas. The conversion of pervious open land to impervious urban surfaces, such as roads, walks, streets, roofed structures, parking areas, shopping centers, and airports, produces greater faster runoff along with scour pollution. The use of water for public and industrial services produces waste waters containing the waste products of human life and living as well as industrial processing.

The discharge of these waters into receiving waters constitutes the major water pollution problem. The ever-increasing amounts of such pollutants and the growing complexity of these water-borne wastes have created a deepened concern for the safety and usefulness of the nation's water resources.

There is a direct relationship between the cleanliness of the urban environment and the cleanliness of storm-water runoff—or, conversely, between poor urban housekeeping and the pollutional effect of runoff waters which come in contact with urban-created street and land debris and aerial pollutants. Regardless of the sources of urban pollution of this nature, the connecting link is the street inlet structure to the separate storm sewer or the combined sewer. The relationship between urban cleanliness and water pollution appears obvious; what is not so obvious is the extent of this relationship and what can be done to eliminate or reduce it. So little has been done in the past to correlate the influence of street debris and air pollutants with the delivery of these contaminants to separate storm or combined sewers, precipitation, and runoff, that the problem must be approached as a relatively unexplored area of urban operations.

Separate storm sewers, as well as combined sewers, are potential recipients of the type of urban pollution. In addition these separate storm conduits are utilized as discharge points for other wastes not classified as "out-of-doors" pollutants that are the result of urban environment conditions. These other waste waters include: so-called clean waters discharged from cooling and refrigeration systems, contaminated waters from stack-washing operation in commercial and industrial establishments, and surreptitious or illegal discharges of actual waste waters from commercial and industrial operations into separate storm sewers. Indeed, it is not unknown for municipalities to provide relief for surcharged sanitary sewers by diverting their excess flow into storm sewer systems. In

some cases, illegal discharges of individual septic tank systems have been made into convenient separate storm sewer lines. In combined sewers, waste discharges can be considered, more or less, as indigenous components of the combined sanitary storm-water flows. In the case of separate storm sewers, these pollutants are not treated and they add a burden to receiving waters. Thus, combined sewer overflows constitute a significant part of the nation's total water pollution problem. It is important to recognize, however, that the overflow problem must be evaluated in terms of the total effects on water and land resources from all overflows, discharges and spills of waste waters, not as an isolated and unrelated source of water pollution.

Despite current concern over the problems of combined sewers and their overflows, U.S. communities continue to build combined sewers to replace and extend sewer systems. Active programs to eliminate or minimize the volume and strength of overflow wastes are impeded by the high cost of such projects and the inconvenience to urban life and activities.

In the case of multiple community regional operations, some of the communities which utilize joint facilities are sewered as separate systems but they discharge separate sanitary flows into combined collection sewers of older central cities. This separate sanitary sewage thus becomes combined wastes and contributes to the overflow problem "by association." This general problem also occurs frequently in communities which have both separate and combined sewers. The flow from the separate sanitary sewers enters the combined sewers, thus contributing to overflows.

Executive infiltration into combined sewers usurps valuable sewer capacities and increases the frequency and duration of overflows. Infiltration frequently exceeds design and code limits. Correction of excessive infiltration could reduce the overflow problem by providing increased in-system capacity for the storage of more combined sewage flows.

While sewer separation has been advocated as a positive method for eliminating combined sewer overflows, and separation projects are reported to be the most commonly used corrective measure, most separation work has been carried out on only portions of sewer systems, seldom involving the entire system.

Sewer separation is not the panacea of all combined sewer problems. Other overflow corrective measures have merit, not only in terms of comparative cost to separation, but also in terms of cost and convenience to property owners and the general public. Other than sewer separation, surface control, storage and off-system treatment are considered to be promising methods of reducing or eliminating the pollutional effects of overflows.

II—FLOOD AND POLLUTION PROBLEMS IN METROPOLITAN CHICAGO

A. The flood control problem

Since the end of the Second World War, Metropolitan Chicago has undergone a period of extensive urban development. This development has caused a tremendous increase in the impervious area and larger surface runoff during storm periods. To alleviate local flooding of basements and underpasses throughout Chicagoland, hundreds of millions of dollars have been expended in the construction of new sewerage. While greatly reducing the undesirable storage of water in basements and underpasses, a new and increasing problem of flood control in the rivers and canals is becoming apparent.

During the heavy storm period of October 9–11, 1954, the Union Station and other downtown buildings were flooded. To reduce the flood stage in the river, the locks at the mouth of the Chicago River were opened allowing polluted water to enter Lake Michigan. This was the first time since the locks were constructed in 1938 that they were opened to permit river water to flow into the lake.

Since that time the locks have been opened during storms of July 12–13, 1957, September, 1961 and August, 1968. The frequency of requiring lock openings to the Lake for river flood control is greatly increasing, and will continue to increase as new outlet sewer capacity is added.

The normal and desirable outlet for all storm water is to the southwest along the Sanitary and Ship Canal to Lockport, the DesPlaines River through Joliet to the confluence of the Kankakee River and through the Illinois River Waterway System to the Mississippi River.

The Sanitary and Ship Canal designed for a capacity of 10,000 cubic feet per second was completed in 1900. Because of drawdown of the water surface at Lockport during heavy storms, the Canal has been able to handle a peak discharge, for short periods of time, of up to 24,000 cfs.

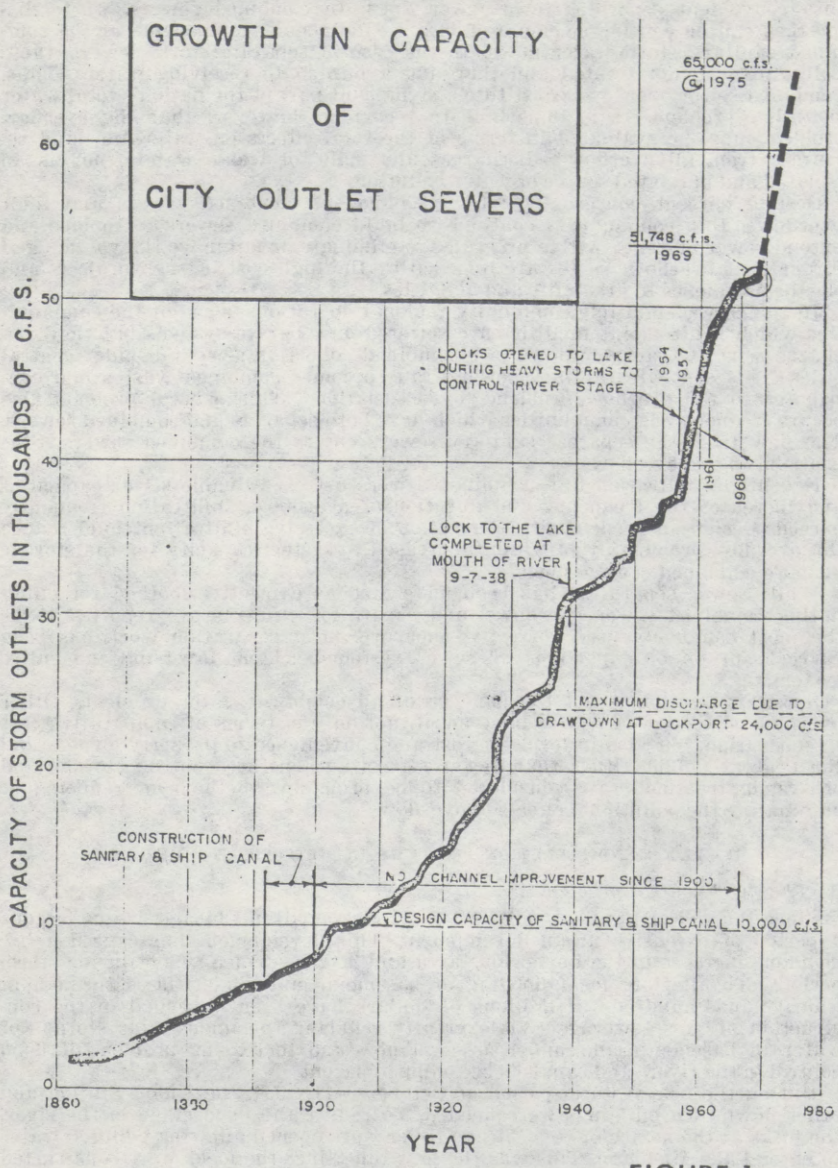


FIGURE 1

Figure 1, shows the accumulated growth of outlet capacity of sewers in the City of Chicago. The total projected outlet capacity of 65,000 cfs will be reached in 1975. This, of course, is not the required capacity of the waterway system because of channel storage and offsetting of the sewer discharge peaks; however, it is a good indicator of the future flood control problems that lie ahead.

The DesPlaines River North of Hofmann Dam in Riverside has inadequate capacity to drain its fastly urbanizing tributary area. Large storage reservoirs and/or increased conveyance capacity must be provided to handle the increasing runoff.

In the Calumet Area, large acreage is only a few feet above normal water level of the Calumet River and waterway systems. In many places this provides only small graduates for the tributary streams and sewer. During large storms, the O'Brien Locks must be opened permitting river water to flow through the Calumet River to Lake Michigan. But even this will not keep the stage sufficiently low in the largest storm periods.

B. The waterway pollution problem

The pollution of the waterway system is another vital problem confronting the Chicago Metropolitan Area. This same problem exists for nearly every other large metropolitan area in the Country. Most of these urban concentrations are drained by systems of combined sewers which spill to the open water courses when the sanitary intercepting sewers or treatment plants are overloaded.

Combined sewers have been estimated to carry approximately 3 percent of the annual sewage volume to the waterways during storm overflow periods, thus 97 percent of the annual sewage volume is delivered to the treatment plants. The actual annual pollution load which is discharged from combined sewers to the waterways is somewhat greater. This is due to the cleansing of the sewer inverts during periods of high storm runoff.

In addition to the pollution of the river caused by the combined sewer systems, other major contributors are the sewage treatment plants. Three major treatment plants handle the household and industrial wastes for the City of Chicago and much of the suburban area within the Metropolitan Sanitary District. These plants are the North Side Treatment Works, the West-Southwest Treatment Works and the Calumet Treatment Works.

The U.S. Public Health Service study, "Great Lakes, Illinois River Basin Project" (1) (GLIRBP) in two separate periods of study in 1961 found the combined effluent of the three plants was 1238 and 1682 MGD; at a population equivalent (PE) of 969,000 and 793,000; which is equal to 78.2 and 66.2 tons of 5 day B.O.D. per day, respectively. The average overall efficiency for these two periods was 88.3 percent. The reduction in the effluent PE during the second period was attributed to the heavy rainfalls occurring during that period, resulting in the direct overflow of pollutants to the watercourses by combined sewers and therefore not measured at the plants.

Extensive sludge deposits are formed in the waterways downstream of the treatment plants and the many large outfall sewers. These sludge deposits have a significant oxygen demand and thereby use up a large part of the natural oxygen content in the waterways. At many places where these large sluge deposits occur, gaseous bubbles are released to dot the water surface and result in extensive odors along the river channel.

Other sources of pollution of the rivers are the discharges from industries, and leakage from boats and barges. Industries also use river water for cooling purposes increasing the temperature by several degrees; this reduces the amount of dissolved oxygen the water can hold.

The dissolved oxygen (DO) is one of the most important constitutents of the waterway system. All of the above sources of pollution tend to deplete the dissolved oxygen.

The low dissolved oxygen throughout much of the length of the waterway system indicates the poor condition, especially in the summer season. Insufficient DO is available to support desirable fish and aquatic life in the stream.

The GLIRBP study has shown that the Waterway System through Chicago and downstream to the Kankakee River is in an extremely polluted condition and can be considered as a hazard to human health.

III PROPOSED PROJECTS FOR CONTROLLING FLOODING AND POLLUTION

A number of alternatives have been studied for solving the problems of waterway pollution caused by the spillages from combined sewers. Also for solving the problems of flood control of the waterways during severe storm periods. Among those advanced are the following:

Separation of sewers

A complete study of the separation of sewers has been made for the 300 square mile area of Chicago and vicinity, and would require nearly ten thousand miles of sanitary sewers, many lift stations and interceptors. It has been estimated that the cost of this separation would be in the range of 3½ to 4 billion dollars.

Even if separation were to be accomplished at this tremendous cost and with its concomitant disruption of traffic in almost every street, the inconvenience to all of the people, the reworking of house and building plumbing, and the adjustment and relocation of public and private utilities, it is questionable as to whether it would solve the problems associated with delivering all wastes to the treatment plants. Accidental or illegal connections to the wrong sewer and the possible leakage between sanitary and storm sewers, would make policing of the six to eight mile long sewer systems impractical. In addition, it has been shown that storm water itself carries considerable pollution to the waterways.

The separation of sewers would not provide any flood benefit to the waterway system.

Storage in existing sewers

Consideration was given to storing the runoff of the smaller storms in the existing sewer systems by the use of inflatable dams. Such storage, if entirely used, would amount to approximately 3,200 acre-feet or 0.2 inches over the 192,000 acres of the combined sewered area. The entrapment of combined flow for storms having a runoff of this magnitude would result in a reduction of spillage of approximately 65 percent. This storage would reduce the frequency of combined sewer spillages from an average of 60 per year to about 15 per year.

However, because of the flat slope of the sewers in the Chicago Metropolitan area, this method of reducing the spillages was not further considered. The velocity generated in the sewers in the post storm period would not be sufficient to scour the sediment deposited during the storage period, and would result in extensive maintenance problems. Also, this method would not contribute anything toward the solution of the flood control problem.

Underflow-storage plan

This plan proposes the construction of a pattern of large tunnels in the dense Niagaran limestone rock formation, 200 to 300 feet below the surface waterway system. These tunnels would be sized to provide a linear distribution of storage volume and conveyance capacity in a pattern which would intercept all of the approximately 400 outfalls of the existing combined sewers. The tunnels would be sloped down to low points, and pumping facilities, opposite the existing sewage treatment plants. Overflow from the combined sewers, during storm periods, would drop through shafts to the large storage tunnels. In the post storm period, the tunnels would be dewatered by pumping directly to the existing treatment works.

The Underflow-Storage Plan takes advantage of the lower water level to be established in the Illinois Waterway at Lockport, Illinois, for improvement of navigation and flood control of the waterway system. The new water level, 70 feet or more below the level of Lake Michigan, will allow the construction of tunnels with large underflow conveyance capacity to Lockport and provide flood protection for the largest storm of record.

Storage of 18,000 acre-feet or 1.12 inches of runoff in the tunnel system will provide 98.5% reduction of pollutants entering the waterway from combined sewer spillages.

Subsequent paragraphs will provide the details of this plan.

Deep tunnel plan (Harza and Bauer, consulting engineers)

This plan is a multi-purpose plan, including hydro-electric power development, with a "pumped-storage" scheme, now widely used throughout the world as adjuncts to hydropower developments on surface streams or to thermal power plants. In the Deep Tunnel Plan, storage for hydropower would be provided in rock caverns, 600 feet or more below the surface and in surface reservoirs above ground in the vicinity of the underground caverns. Reversible pump-generator units would be used intermittently to move water upward and to develop power during downflow. Power would be generated and sold to the Commonwealth Edison Company daily during the hours of peak demand for electricity. Power would be purchased for pumping, daily, during the periods of low demand for other uses in the Metropolitan area. Based on an estimated net revenue, in excess of cost of operation, revenue bonds would be sold by the Metropolitan Sanitary District to provide capital for a portion of the multi-purpose project.

The underground caverns and the surface reservoir would be oversized beyond the needs for power development to provide for entrapment and storage of excess spillage from the combined sewer outlets. Primary sedimentation would be pro-

vided underground at the entrance to the caverns, and the sediment pumped to the existing treatment works. Controlled outflow from the surface storage would also be directed to the existing major treatment works.

The total volumes of the proposed multi-purpose storage is 35,000 acre-feet below ground and 45,000 acre-feet above ground, or a total in the system of 80,000 acre-feet, of which 20,000 acre-feet was considered to be normally needed for power development, leaving 60,000 acre feet normally available for pollution and flood control.

The tunnel system to deliver the combined sewer spillage to the storage and power development site or sites would be generally of the same pattern as for the Underflow Plan, with an interconnecting tunnel through Chicago's southside connecting the Mainstream and DesPlaines Tunnel System to the Calument Tunnel System.

Two locations for storage and power development are presented: one near the Calumet Treatment Works, and one near the West-Southwest Treatment Works.

Chicago drainage plan (Illinois Division of Waterways)

This plan presented in a preliminary report in November, 1968, combines navigation, flood control and pollution control in the areas tributary to the Illinois Waterway upstream from Brandon Dam.

For flood control in the Lockport-Joliet Area, as well as for improved navigation, it is proposed to remove the Brandon Road Dam and Locks, and the existing Lockport Dam, Lock, and Controlling Works; to build new twin locks, dam and controlling works about two miles upstream from the existing Lockport Dam; and to deepen and widen the channel from Brandon Road to the new Lockport Locks, so as to lower water levels in this reach, about 34 feet below present water levels.

Upstream from the new Lockport Dam, the Sanitary and Ship Canal would be widened to 325 feet, with 150 feet of this width to be deepened 10 feet. The Lockport Dam would be designed to maintain dry weather water levels above Lockport, 10 feet lower than at present.

The widening would extend to Willow Springs Road and the 10-foot lowering of the surface water levels would extend along the Calumet-Sag Channel and Little Calumet River to the O'Brien Lock and Dam and along the Sanitary and Ship Canal to Throop Street. A new dam and lock would be built at Throop Street with a 10-foot differential head, and the O'Brien Lock and Control Works rebuilt to accommodate the lowered water surface.

For pollution control, the Division of Waterways proposed the installation of storm water detention and sedimentation tanks at combined sewer outlets. These would be of the flow-through type and would discharge all flows in excess of tank volumes as partially settled combined sewage into the surface waterways. Solids which settled in the tanks, together with the liquid retained at the end of each stormwater runoff period would be drained or pumped into the intercepting sewers of the Metropolitan Sanitary District. Screening and chlorination at the tank locations as well as mobile aeration of the waterways might be added to improve the pollution control.

Proposed plans

Because of the urgency of meeting the water quality standards, SWB–15, (2) established by the Illinois State Sanitary Water Board and approved by the Federal Government, studies were continued on the various solutions to the flooding and pollution problems.

In February 1968, a Technical Advisory Committee of prominent engineers in the field of sanitation and drainage was established to review the several plans advanced for solving the pollution and flood control problems of the Chicago Metropolitan Area. The Technical Advisory Committee was charged with establishing criteria by which each plan would be evaluated, and finally to make recommendations to the Flood Control Coordinating Committee on the plan or composite plan which would be suited to economically solve these problems.

Such a plan would be primarily aimed at solving the pollution of the waterway system caused by the overflow from combined sewers during rainfall periods and eliminating flooding of the waterway in time of heavy storms. The plan must provide for meeting the criteria established by the State Sanitary Water Board for each water course not only as to the quality of water but as to time of implementation. The recommended plan must be adequate to handle a recurrence of the greatest storm of record without requiring the discharge of river or canal water to Lake Michigan.

The final plan selected, although meeting the criteria established for pollution abatement and flood control, should be as broad and as multiple-purpose as possible. Such other areas as recreation, esthetics, navigation and power generation should be considered if economically justified.

Storage entrapment studies

Since there was considerable difference of opinion as to the effect of storage on entrapment of pollutants, a subcommittee with members selected to represent the three principal local agencies of the Technical Advisory Committee made some detailed computer studies involving the relationship between the volumes of underground storage (acre-feet) and trap efficiency (percent of total B.O.D. spillage that would be trapped in underground storage).

From this study, it appeared that the percent of entrapment varies greatly with the amount of storage until reaching between 15,000 and 20,000 acre-feet when applied to the 300 square mile combined sewer area. Above 20,000 acre-feet, the increase in entrapment is at a far slower rate per increment of volume. If capital cost per acre-foot were constant for all volumes, then to achieve a trap efficiency greater than 98 percent might appear uneconomically unwarranted. However, many other compensating factors in the cost of providing such storage volume must be carefully evaluated.

Present status of plan for pollution and flood control

The authors have generally agreed that the First Phase Construction, to be outlined in the subsequent paragraphs of this report, is compatible with the Metropolitan Sanitary District's, the City of Chicago's and the State Division of Waterways' proposed plans. This is with the complete understanding that as detailed design progresses on this First Phase, conveyance tunnel configuration, size elevation, storage volume, treatment of the overflows and locations may require some modifications to provide the most economical system. The extension of the underflow tunnel to the Des Plaines River at Lockport, lowering of the waterways for navigation and flood control, or generating hydro-electric power to offset a part of the capital cost under the Second Phase work, require further evaluation.

The elected officials of the various agencies, however, have not adopted the First Phase Construction, nor any of the three plans as of this writing. Implementation of the projects will depend on policies established and commitments made by these agencies.

In the following paragraphs, the complete Underflow-Storage Plan is presented only to provide the reader with the relationship of the First Phase to the overall plan.

Combined underflow-storage plan

A modified form of the initial Underflow Plan proposed in the 1966 report has been developed and is referred to as the Combined Underflow-Storage Plan.

Since the Illinois Division of Waterways has solidified their recommendations regarding waterways improvements and requested action by the U.S. Corps of Engineers to reconstruct that portion of the Illinois Waterway through Joliet. As already stated, their recommendations include the removal of the Brandon Road Dam and Lock and the existing Lockport Lock and Controlling Works, and the construction of a new dual lock and control gates in the waterway about 2 miles upstream from the existing Lockport Lock. This will extend the water levels of the Dresden Pool upstream to the new Lockport Lock, where the low-water differential water surface will become about 74 feet. The corresponding differential, during maximum flows, has not been accurately determined but will probably be about 70 feet.

The completion of the above described work will move the possible point of low-level discharge for an underflow tunnel, or tunnels, about 10 miles upstream

from that shown in the 1966 Chicago Underflow Report. The utilization of this low-level point of discharge for peak flows becomes more attractive.

A project, already approved by Congress and awaiting funding, provides for the widening of the channel to 225 feet.

The Chicago Drainage Plan now proposed by the Illinois Division of Waterways recommends the widening of this reach to 325 feet to accommodate barge tows which currently operate on the Illinois Waterway as far upstream as Brandon Road Pool and to increase flood conveyance capacity.

The Division of Waterways Plan also recommends a 10-foot deepening of the Canal for a width of 150 feet to further increase conveyance capacity.

The combined Underflow-Storage Plan herein recommended assumes a widening to 325 feet, without any deepening.

Combining storage with conveyance

The City of Chicago presented, in September, 1968, the Composite Drainage Plan, which considered the possibility of providing mined storage areas at four locations along the main tunnel, plus one in the Calumet Area and one along the DesPlaines River Tunnel. This was proposed in order to provide temporary detention storage closer to the various origins of spillage water and thereby reduce conveyance distances, and consequently the cost of conveyance tunnels. This concept of geographical spreading of the underground storage volume is further extended in the Underflow-Storage Plan.

It is now suggested that the main tunnels be re-sized so as to serve both as conveyance tunnels and as continuous storage reservoirs. The total length of underflow-storage tunnels is about 106 miles.

It is proposed that the principal tunnels be 26 feet wide and 50 feet high and have paved inverts plus sidewall lining (in their lower portions only). The principal or mainstream tunnels from Lockport to Lake Street would be Twin Tunnels.

It is also proposed that the inverts slope to low points opposite each of the three major existing treatment works. Pumping stations are proposed at these points having a combined pumping capacity of about 2,000 cfs, which is about equal to ¾ of the total ultimate dry weather average flow through the three major treatment works.

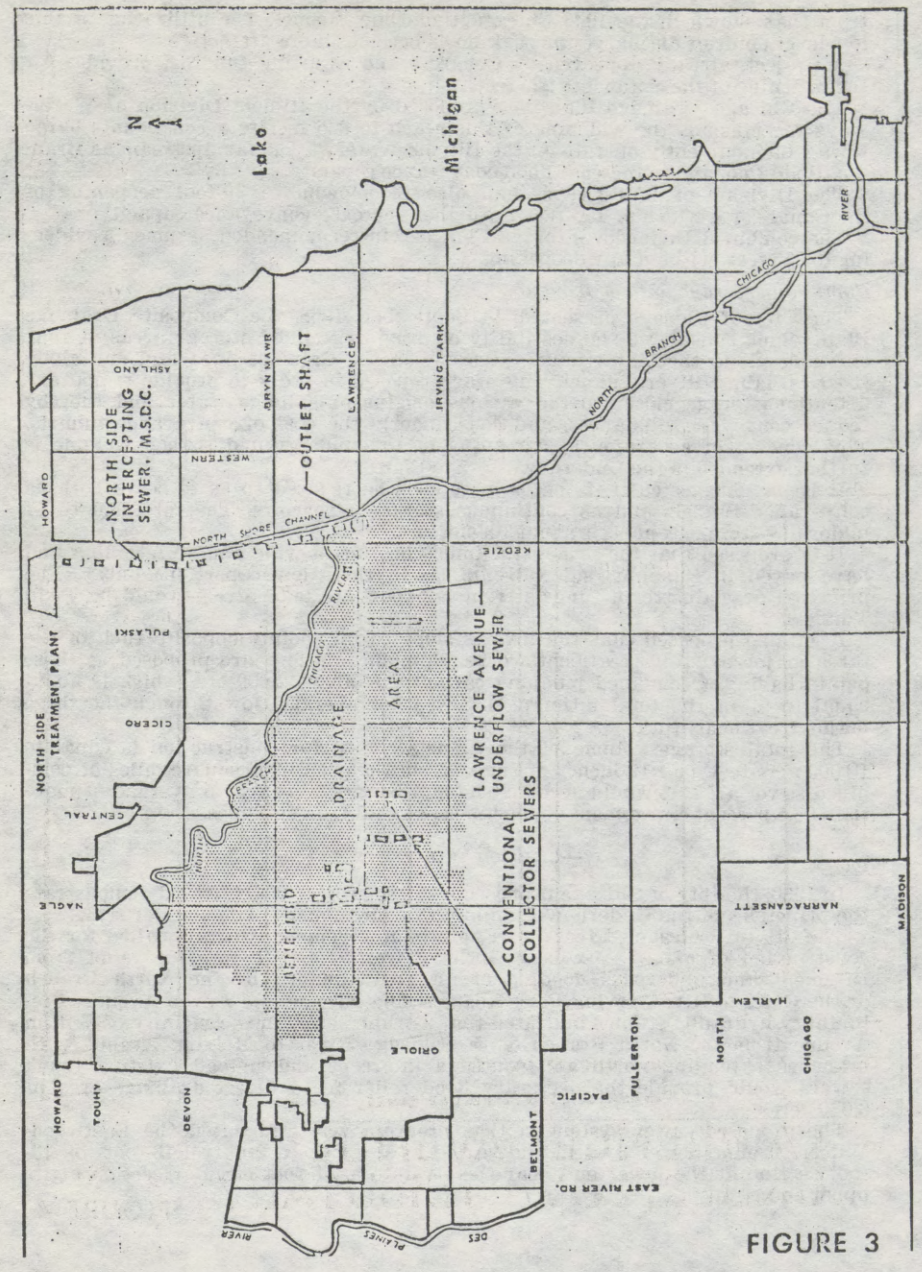
The total storage volume of the tunnels shown for construction is equal to 18,000 acre-feet, or 1.12 inches of runoff from the entire 300 square miles of combined sewer area. It would accomplish, on a long term basis, an average of more than 98.5 percent entrapment of combined sewer B.O.D. spillages.

IV—CHICAGO UNDERFLOW PLAN

In 1966, the City of Chicago proposed a sewer project which would demonstrate the principles of the Underflow Plan but, of course, on a much smaller scale.

The City of Chicago's Five Year Capital Improvement Program called for the construction of a new Auxiliary Outlet Sewer System to provide relief from basement and underpass flooding of an area bounded by the North Branch of the Chicago River, Irving Park Road, Oriole Avenue and Devon Avenue. Preliminary hydraulic studies indicated that a trunk sewer in the vicinity of Wilson Avenue from the North Branch of the Chicago River to Melvina Avenue with branches extending north and south to intercept and unload existing trunk sewers would provide the necessary flood relief for a direct drainage area of 3,620 acres.

The proposed sewer system in that program was designated the Eastwood-Wilson Avenue Sewer System and varied in size from a 2 barrel 13-foot by 13-foot section at the lower end near the river to a 7.5-foot circular section at its upper end.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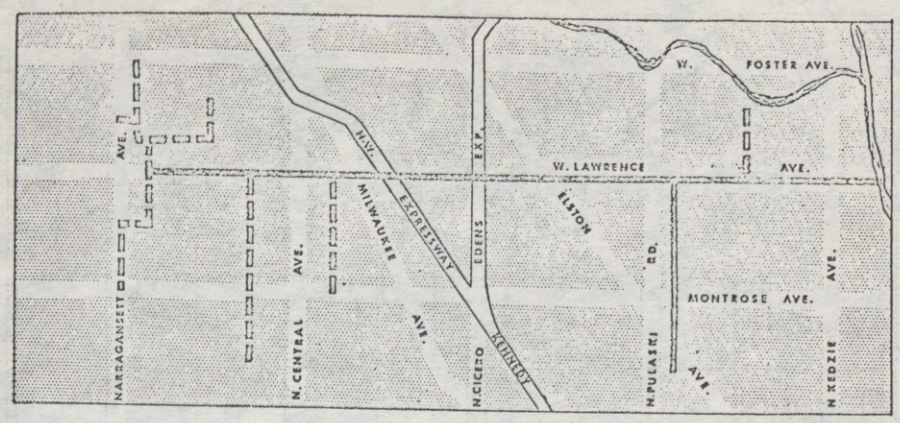
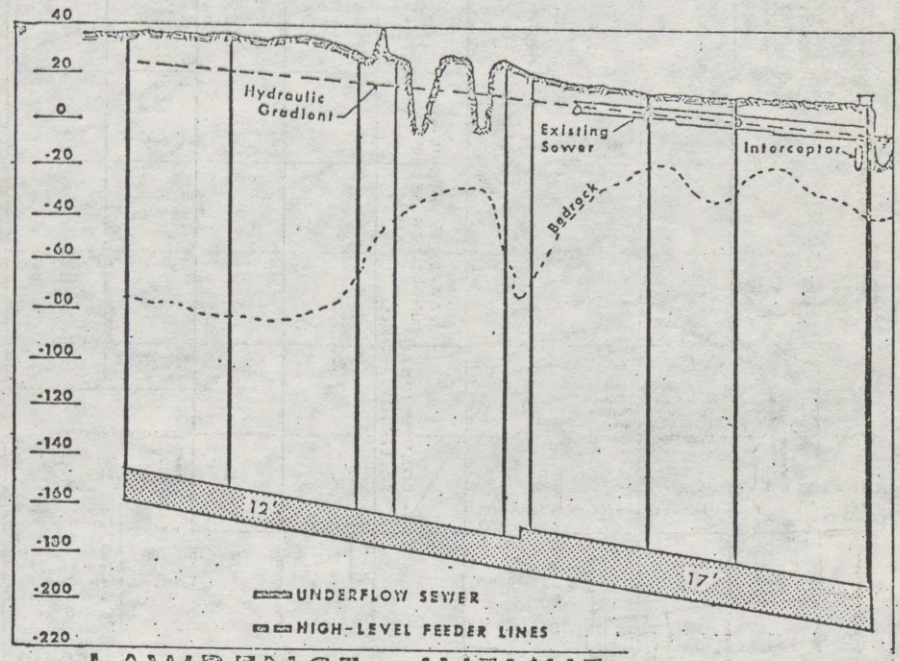
Lake
Michigan
NORTH SIDE INTERCEPTING SEWER, M.S.D.C.
OUTLET SHAFT
NORTH SHORE CHANNEL
NORTH BRANCH CHICAGO RIVER
NORTH SIDE TREATMENT PLANT
CHICAGO RIVER
DRAINAGE AREA
LAWRENCE AVENUE UNDERFLOW SEWER
CONVENTIONAL COLLECTOR SEWERS
HOWARD
WESTERN
ASHLAND
BRYN MAWR
LAWRENCE
IRVING PARK
KEDZIE
PULASKI
CICERO
CENTRAL
NAGLE
HARLEM
NARRAGANSETT
MADISON
NORTH CHICAGO
FULLERTON
PACIFIC
BELMONT
EAST RIVER RD.
ORIOLE
DEVON
TOUHY
HOWARD

FIGURE 3

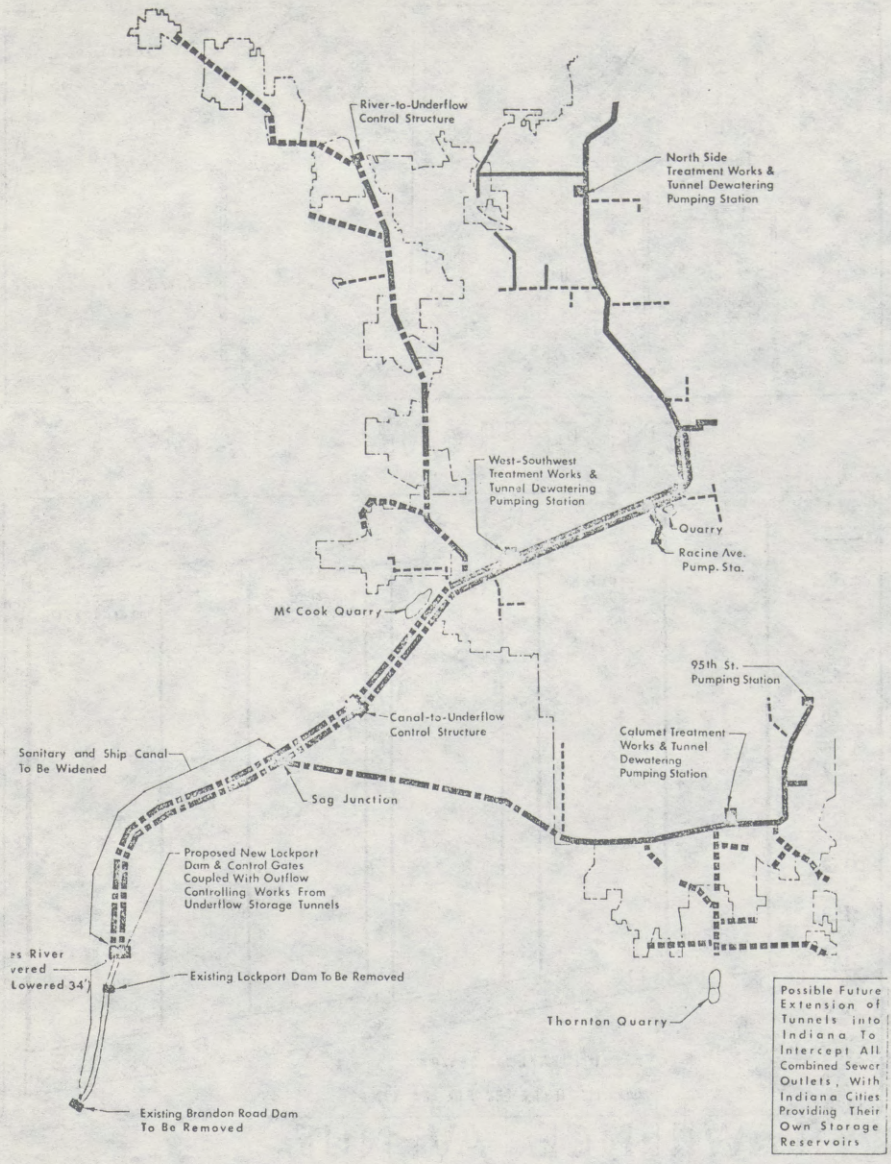


UNDERFLOW PLAN



LAWRENCE AVENUE UNDERFLOW TRIBUTARY

FIGURE 4


River-to-Underflow Control Structure
North Side Treatment Works & Tunnel Dewatering Pumping Station
West-Southwest Treatment Works & Tunnel Dewatering Pumping Station
Quarry
Racine Ave. Pump. Sta.
Mc Cook Quarry
95th St. Pumping Station
Canal-to-Underflow Control Structure
Calumet Treatment Works & Tunnel Dewatering Pumping Station
Sanitary and Ship Canal To Be Widened
Sag Junction
Proposed New Lockport Dam & Control Gates Coupled With Outflow Controlling Works From Underflow Storage Tunnels
Existing Lockport Dam To Be Removed
Thornton Quarry
Existing Brandon Road Dam To Be Removed
Possible Future Extension of Tunnels into Indiana To Intercept All Combined Sewer Outlets, With Indiana Cities Providing Their Own Storage Reservoirs

Consideration was given to lowering the profile of this sewer to increase the storage available during small storm periods and to cause it to flow full before discharging to the river. The storage thus generated would reduce the frequency of spillages from this combined sewer to the river. Lowering the profile would necessitate pumping of sewage to the existing sanitary intercepting sewer, increasing the overall cost. It would also require that more of the construction be performed by earth tunnel method. Recent development of earth mining machines has resulted in lower bid prices in earth tunnel contracts. However, preliminary soil investigations indicate that heavy primary steel lining and occasional rock sections would negate the savings from the use of such machines. Costs would greatly exceed that of the conventional open cut construction method.

Recent improvements of the rock mining machines (Moles) have reduced the cost of tunneling in various kinds of rock materials for large irrigation and hydroelectric projects throughout the world. Preliminary cost estimates revealed that mining in rock may be competitive with open cut methods.

Lowering the profile of the Eastwood-Wilson sewer over one hundred feet into bed rock and constructing it as an "Underflow Sewer" looked promising. Sanitary flow would not normally, in dry weather period, enter the tunnel and therefore would not be pumped on a continuous basis. Pumping would be required, however, for dewatering of the tunnel to the existing sanitary intercepting sewer in the post rainfall period.

The Department of Public Works retained the Harza Engineering Company to study alternate methods of constructing the proposed Eastwood-Wilson Auxiliary Outlet Sewer System. The studies were to include a comparison of costs of constructing the sewer by open cut and tunnels, the maintenance and operating costs, and their recommendations on the best method to fit the City's needs.

It was decided to construct a lined tunnel sewer in the Niagaran limestone formation approximately 250 feet under the surface of Lawrence Avenue and demonstrate the feasibility of the "Underflow" concept. The rock tunnel would be excavated by a tunnel boring machine. Lawrence Avenue, an arterial street, was selected as the route of the sewer because of the requirement of the mole to travel in nearly a straight line. Because the tunneling would be so far below the surface, traffic in that arterial street and commercial activities would not be interrupted, as would be the case with the conventional open cut construction.

The tunnel would be 12,800 feet long at 12 feet in diameter and 9,300 feet long at 17 feet in diameter. A branch tunnel in Harding Avenue extending south from Lawrence Avenue to Berteau Avenue, a distance of 4,000 feet would also be 12 feet in diameter. Approximately 18,000 feet of new conventional branch sewers would relieve the overloaded existing sewers and convey the flow to the tunnel inlet shafts. Ten inlet shafts would be constructed to supply the tunnel and one 25-foot diameter outlet shaft for the discharge drainage.

The total storage in the tunnels and shafts will be about 4,000,000 cubic feet or about 0.30 of an inch over the 3,620 acre drainage area. This storage would provide space for the runoff from rainfall accumulation up to about 0.9 inches without overflowing to the river.

The construction of these Underflow Sewer Systems will demonstrate the feasibility of constructing, economically, a detention reservoir to greatly reduce the pollution caused by overflows from combined sewers, far below the surface in public right-of-way, while providing the conveyance capacity to reduce basement and underpass flooding. It will also demonstrate the practicability of constructing a much enlarged Underflow System beneath the waterways to serve the entire 300 square mile combined sewer area in the City of Chicago and the surrounding Metropolitan Area. When the enlarged Underflow System is completed, the Lawrence Avenue Underflow Sewer and the two being constructed by the Metropolitan Sanitary District will become branches to the trunk lines under the waterways. At that time the pumping stations serving these three initial Underflow Sewers will be abandoned.

Project cost

The largest single item of cost of the proposed project is the excavation, hauling and disposal of rock.

To arrive at a conservative estimate for the rock excavation (including hauling and disposal) conferences have been continued with manufacturers of rock drilling, blasting and hauling equipment. These companies have had wide ex-

perience in working with contractors engaged in rock tunneling throughout the United States and elsewhere.

These conferences and studies were a continuation of similar conferences and inspection trips, participated in by the Bureau of Engineering, as well as the Metropolitan Sanitary District and their consultants.

Unit cost of rock excavation varied with the size of the tunnels and the number of simultaneously worked tunnel headings. Prices per cubic yard vary from $60.00 for a 10-foot diameter single tunnel with two headings to $5.65 per cubic yard for cavern (room and pillar) excavation with multiple headings. The principal governing factor appears to be the size or face area of the headings. For the combined Underflow-Storage tunnels, with 26-foot wide by 50-foot high tunnel faces, the estimates are $8.81 per cubic yard for single tunnels and $8.03 per cubic yard for twin tunnels.

Table 7 shows the quantities of rock excavation required for the various tunnel sizes and locations.

Table 8 shows the overall contract cost of the tunnels required, classified as to size, location and construction phase.

Table 9 is a summary of Total Project Cost, including contingencies, and engineering and supervision.

TABLE 7.—QUANTITIES OF ROCK EXCAVATION (MAIN TUNNELS ONLY) (ROCK "IN SITU", OR SOLID ROCK)

Location	Size	Length (miles)	Rock excavation (thousand cubic yards)			
			Per mile	Phase 1	Phase 2	Total
Mainstream	Twin 26 feet x 50 feet	11.99	502.0	6,030		
Do	Twin 26 feet × 50 feet	20.38	502.0		10,250	
Do	Single 26 feet x 50 feet	13.53	251.0	3,406		
Do	17 feet ϕ	3.00	51.6	155		
DD	12 feet ϕ	12.80	26.9	344		
Total		61.70		9,935	10,250	20,185
Calumet Branch	Single 26 feet x 50 feet	8.27	251.0	2,090		
Do	Single 26 feet × 50 feet	12.45	251.0		3,120	
Do	14 feet ϕ	2.00	36.0	72		
Do	10 feet ϕ	2.29	19.8	45		
Total		25.01		2,207	3,120	5,327
Des Plaines Branch	Single 26 feet x 50 feet	19.50	251.0		4,880	4,880
Grand total		106.21		12,142	18,250	30,392

Note: Loose rock to be handled is estimated at 140 percent of volume shown of approximately 42 million cubic yards.

TABLE 8.—ESTIMATED CONTRACT COST OF TUNNELS, PHASES 1 AND 2

Location	Size	Length (miles)	Cost (In thousands of dollars)			
			Per mile	Phase 1	Phase 2	Total
Mainstream	Twin 26 feet x 50 feet	11.99	5,500	65,945		
Do	do	20.38	5,500		112,000	
Do	Single 26 feet x 50 feet	13.53	3,000	40,590		
Do	17 feet π	3.00	2,700	8,100		
Do	12 feet π	12.80	2,000	25,600		
Total		61.70		140,235	112,000	252,235
Calumet Branch	Single 26 feet x 50 feet	8.27	3,000	24,810		
Do	do	12.45	3,000		37,350	
Do	14 feet π	2.00	2,300	4,600		
Do	10 feet π	2.29	1,700	3,893		
Total		25.01		33,303	37,350	70,653
Des Plaines Branch	Single 26 feet x 50 feet	19.50	3,000		58,500	58,500
Grand total		106.21		173,538	207,850	381,388
Cost of branches—Phase 3:						
Tributary to Calumet Bracnh						36,650
Tributary to Des Plaines Branch						35,000
Total, phase 3						71,650
Total, phases 1, 2 and 3						453,038

Table 9.—Summary of project cost

Tunnels (see table 8)	$453,038.00
Pumping stations	50,000.00
Pump discharge conduits	3,000.00
Drop shafts from combined sewer outlets to tunnels	65,000.00
Drop shafts from river to tunnels	6,000.00
Tunnel outflow controlling works at Lockport	5,000.00
Subsurface exploration	5,000.00
Total contract cost	$587,038.00
Miscellaneous work (use 5 percent)	29,352.00
	$616,390.00
Engineering & Supervision, 10 percent	58,610.00
Total project cost	$675,000.00
Cost as of May, 1970, E.N.R. construction cost index	$1,417.41

V—SUMMARY AND CONCLUSIONS

Having outlined some of the major problems associated with flooding of basements and underpasses and the inadequancy of present rivers and canals to carry off flood flows, it becomes apparent that major flood control facilities, at great expenditures of monies, are required. The polluted condition of these open watercourses must also be eliminated to meet the standards established by the State and Federal pollution control agencies. A primary source of pollution, namely, the spillages of polluted water from combined sewers in time of storms, has been the subject of this study and report.

Three separate schemes have been described for solving these flooding and pollution problems in the Chicago Metropolitan Area. These are the Underflow Storage Plan, the Deep Tunnel Plan and the Chicago Drainage Plan.

A large relief sewer system proposed in the City's Capital Improvement Program has been redesigned as an Underflow Sewer along the conceptual plan of the metropolitan areawide Underflow-Storage Plan. This Underflow Sewer in Lawrence Avenue is now being constructed with the aid of a FWQA demonstration grant for $1,500,000. Since the time this project was started, two other Underflow Sewers were placed under construction by the Metropolitan Sanitary District.

The contruction of these sewers has already demonstrated the anticipated quality of the dense dolomitic limestone rock which is prevalent throughout the Chicagoland area, and the structural ability of such rock to adequately support the propsed large tunnels.

A complete description of the Underflow-Storage Plan has been presented which will reduce the spillage of pollutants to the surface waterways by over 98.5 percent and provide the necessary flood control to handle the 100-year frequency storm. Preliminary runs with a mathematical computer water quality model indicate that the Underflow-Storage Plan, together with improved sewage treatment plants, will clean up the waterways so that they will be in compliance with the State and Federal Standards.

It is recommended that the First Phase of the Underflow-Storage Plan, which would include the construction of tunnels along the North Shore Channel, Chicago River System and Sanitary and Ship Canal between Wilmette Controlling Works and Harlem Avenue be started immediately. Also, the First Phase should include tunnels along the Sag Channel, Little Calumet and Calumet Rivers between Crawford Avenue and the 95th Street Pumping Station. Drop shaft connections and pumping facilities would be constructed along the route of the tunnels under the First Phase work.

It is estimated that the First Phase would cost approximately $322,000,000 and would provide a direct benefit to a 240 square mile tributary combined sewer area. Pollution quantities which now overflow to the waterways in time of storm form that area, would be reduced by 95 percent.

The First Phase work can be expanded in the Second Phase along the lines of either the Underflow-Storage Plan, the Deep Tunnel Plan, or the Chicago Drainage Plan. It is further recommended that a complete conceptual study of the Second Phase work be done concurrently with design and construction of the First Phase.

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CONFERENCE OF STATE SANITARY ENGINEERS

BY WESLEY E. GILBERTSON, Chairman-elect

I am pleased to submit this statement on behalf of the Conference of State Sanitary Engineers, an organization of the chief environmental program officials of the fifty States.

We, at the state level, share your concern about the effectiveness of present water pollution control efforts and the need for a more effective attack on the nation's pollution problems. We believe that every American is entitled to an adequate supply of good quality water for his daily use, whether it be residential, industrial or agricultural, and for recreation and general enjoyment. Effective water pollution control and water quality management are necessary to meet this goal.

The comments are primarily concerned with Senate Bill 523 and five administration bills to implement the President's February 8, 1971 environmental message. Three of the five administration bills would amend the Federal Water Pollution Control Act, one would create an Environmental Financing Authority and the other bill is the Marine Protection Act of 1971. Our comments on these bills are grouped under three major elements of an effective water quality management program-planning, financing and enforcement.

PLANNING

One of the ways in which man learns is by experience. State water pollution control agencies have utilized various approaches and techniques in programs to prevent and abate water pollution over the years. Some approaches and techniques have been found to be more effective than others. The effectiveness of many legislatively sound programs has been hampered by a lack of funds and people to fully implement the programs.

Speaking from rather extensive Pennsylvania water pollution control experience, we have found that effective water pollution control cannot be achieved by tackling the sources solely on an individual case-by-case basis. What is needed now both at the state and federal level is an effective water quality management effort in which adequate and effective planning, as well as the implementation of planning is utilized. Along with these elements, a strong regulatory program supported by an adequate governmental financial commitment to meet the priorities and goals of the nation is needed.

The lack of effective planning and positive pollution prevention has been one of the most serious weaknesses in pollution control efforts thus far. Steps have been taken to improve the planning aspects of the Federal program. Changes have been made in sewage treatment plant construction grant regulations to require regional, metropolitan and basin planning. A water quality standards program has been implemented for interstate waters. An anti-degradation concept has been initiated. There is an urgent need to do more in the planning area to prevent pollution.

In the legislation that is being considered, there are provisions to allow the Administrator of the Environmental Protection Agency to ban the discharge of toxic materials. There are provisions to regulate and in some instances ban the dumping of wastes into the ocean environment. These regulatory provisions are undoubtedly needed but in themselves are not the total solution to the problem. We have found that regulations to ban a discharge without effective planning to provide an environmentally safe alternate means of disposal can create other environmental problems. Again using a Pennsylvania example—our state like many others has had relatively stringent pollution control laws for a number of years. Pennsylvania law, as written in 1937, banned the discharge of pollutional materials to the state's waters. Many industries had materials that, if discharged to state waters, would cause pollution and many of these materials were difficult to treat or to dispose of. To comply with State requirements some industries, instead of treating and directly discharging wastes, stored wastes, treated or

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untreated, in impoundments or "lagoons." These walls of these impoundments have failed in some instances causing serious pollution incidents. Some leach pollution to underground waters. The use of such impoundments was not forbidden because technically they did not discharge. Our most recent amendments to our legislation in Pennsylvania make it clear that potential pollution as well as activities that might cause pollution are to be regulated. This concept is important. It prevents situations in which the implementation of one phase of a pollution control program results in the creation of another pollution problem—namely waste impoundments. The proposed Marine Dumping Act of 1971 could create problems in many parts of the nation. Bans on discharging harmful substances will call for some other means of disposal of complex materials. Planning must be conducted to provide some sort of state operated waste acceptance service for difficult-to-treat wastes so that they can be disposed without creating environmental hazards. Such an acceptance and treatment service could provide the facilities and technology needed to do the job. Individual waste producers do not seem to be able to do this. Private efforts to solve this problem have largely failed.

The legislation should be amended to provide grant funds for the development of regional or state waste acceptance agencies to accept and treat difficult-to-handle wastes so that dumping bans do not create another problem at another location. The costs of treating wastes at these installations should be borne by the waste producer.

Further, we believe that the legislation should clearly delegate to the Administrator of EPA the responsibility for designating acceptable ocean dumping sites for noninjurious wastes.

In addition to implementing a waste acceptance service which would be geared to handling existing problems, there should be a clearly defined policy to require evaluation of new waste products before commercial production begins. Using this approach, which is one kind of planning, some of the serious pollution and waste disposal problems that the nation faces today could be prevented.

The Administration bill and Senate Bill 523 both include an anti-degradation provision to insure that high quality waters are protected. The anti-degradation concept is one which is noble in concept, but difficult in administration. We believe that the anti-degradation concept can be effectively implemented only if it is a part of the definitive plan for a region, state or the nation. The anti-degradation concept cannot be truly implemented in isolation from effective land use control. Unless carefully and thoughtfully administered, the anti-degradation principle will force population and industrial concentrations into urban areas where existing water quality levels are lower, thus compounding all environmental problems in these areas.

ENFORCEMENT

Water Quality standards incorporate both planning and enforcement elements because they represent an effective planning device and serve as the basis for enforcement of effluent control requirements. Both the Administration bill and Senate Bill 523 extend coverage of water quality standards beyond interstate waters. Because of the national concern with the environment, it seems to be a logical step to extend the federal standards for water quality to all waters of the nation. We believe that ground waters are a very significant resource and should be subject to effective water quality standards and favor the administration proposal to applying water quality standards to both surface and ground waters.

We have found that in establishing effective water quality standards that it is relatively easy to propose water quality criteria or goals for surface water. The task of designing an effective and meaningful implementation plan, taking into account future growth and the specific waste discharges on a watershed and their effect on water quality, requires substantial staff time by state agencies. We can understand the urgency of setting specific time limits by which water quality standards ought to be established. However, we have found that waters are not effectively managed and pollution not abated in many instances when standards are established and some sort of minimum blanket treatment requirements are set as the implementation mechanism. This type of standard setting procedure is like attempting to paint a masterpiece with a wall brush. We tried this blanket requirement approach to managing water quality almost 25 years ago and found that we have very frequently underestimated the treatment needs. It is far better to use mathematical modeling and simulation techniques to predict the effects of

waste discharges on receiving waters. Using this approach, we have found that many waters, especially the smaller intrastate waters, require a minimum of tertiary treatment to assure that water quality criteria are met. With the present staff that most state agencies have available, it would be impractical and almost impossible to establish effective and meaningful water quality standards in the time frames proposed in both bills.

A consideration in scheduling the completion of the development of water quality standards is the relation of the standards to the planning regulations that are a part of the federal construction grant program. Without the information that is to be deevloped in the basin, metropolitan and regional plans, it is almost impossible to do an effective job of developing a meaningful implementation plan for water quality standards. The target date for completion of these plans is made 1973 and they must be taken into account in developing water quality standards.

The time required for water quality standards development, varies with the nature of the state and its population. I believe a nine month or one year time limit for all states to adopt meaningful water quality standards is not practical and would not enhance the nation's water pollution control effort. I suggest that the water quality standards portion of the bill be amended to require that within 30 days of the passage of the act, states be required to submit to the Environmental Protection Agency Administrator a schedule for the establishment of water quality standards. Those areas that have the most serious water pollution problems should be given highest priority in establishing water quality standards.

Both the Administration bill and Senate Bill 523 would direct the Administrator of EPA to establish minimum levels of treatment for various types of waste. It appears that minimum effluent requirements would be based on a determination of treatment methods that are deemed "practical". We are concerned that such a declaration, if not properly qualified could result in a license to pollute. We have found that not only availability of treatment methods and technology but also that the size and uses of a stream must be taken into consideration in determining minimum effluent requirements. The act should clearly state that a state water pollution control agency can require more stringent effluent requirements than those published by the Administrator.

One concern that all state pollution control administrators share is the increasing tendency towards duplication of program effort. According to the policy declaration of the act, state water pollution control programs are to be utilized wherever possible to abate pollution. Yet, the thrust of the legislation as proposed, is to increase the potential of overlap and duplication, by failing to provide for specific mechanisms for Federal discretion to delegate and exempt where state programs meet required performance levels. There is need to avoid such major duplications as exist at the present time relating to the permitting procedures under the 1899 Refuse Act. We believe that federal activities relating to water pollution control should be centered in one agency, namely the Environmental Protection Agency. If a federal permit system is deemed necessary, it should be implemented under the direction of the Environmental Protection Agency. Such a permit system, however, must not duplicate effective state permit systems. In such states, the procedures and systems should be audited periodically to insure meeting Federal legislative goals. A duplicate permit should not be required. We recommend strongly that the committee eliminate duplication of permit requirements also for the reasons that suspension and revocation actions in overlapping state-federal systems will cause administrative confusion and legal conflicts. We believe that the language in Senate Bill 523 which provides for delegation of plant inspections and surveillance should apply throughout the enforcement section of the act.

In Pennsylvania we have found that economic sanctions against polluters are an effective pollution abatement and enforcement tool. We have removed firms causing pollution problems from Commonwealth bidding and purchasing lists and this has resulted in prompt pollution abatement. This concept is included in Subsection (1) of Section II of Senate Bill 523 and we endorse its implication at the National level.

FINANCING

Federal legislative policy provides for financial incentives to encourage state pollution control programs and to aid municipalities in constructing sewage treatment facilities. It has often been said that the action is where the money

is. Under the present funding levels in the federal water pollution control effort, approximately 36 percent of the federal funds are directed to federal programs and research. About 62 percent of the funds go to municipalities for construction grants and about 2 percent of the funds go to state water pollution control agencies to aid in enforcing water pollution control laws. The pending proposals would not improve this situation significantly. This distribution of funds does not seem to match the policy declaration of the Federal Act which assigns the primary pollution control responsibilities to the States. I recognize that both the Administration bill and Senate Bill 523 would increase somewhat the authorizations for grants for state water pollution control programs, but I believe that it is timely to initiate more aid in the area of planning. Planning grants should be made available for basin planning, land use planning, metropolitan and regional planning, information systems, planning reviews and plan maintenance.

As I mentioned previously, without effective planning, we are not going to have effective pollution control. Planning regulations for the construction grants program have been established but funds are not readily available to do the planning. The anti-degradation concept has been proposed but needs land use planning. New regulations have required the states to review environmental impact statements and permit applications but no funds have been provided for these tasks. There is a widening gap between the mandates of both State and Federal legislation and regulations and the funds to do the job. In order to make water pollution control and water quality management more effective in the nation, I propose the following programs grants to be authorized to state water pollution control agencies:

Type of grant	Fiscal year			
	1972	1973	1974	1975
Program grants	$40,000,000	$50,000,000	$60,000,000	$60,000,000
Enforcement.				
Monitoring.				
Surveillance.				
Planning grants	100,000,000	100,000,000	100,000,000	80,000,000
Drainage basin.				
Land use.				
Metropolitan and regional.				
Information systems.				
Planning reviews.				
Plan maintenance.				

Under the program grant regulations as proposed in the Administration bill, the concept of awarding grants for "improved programs" is included as an incentive to state programs. We agree with this proposal, however, it is not clear whether grants could be awarded to states that have initiated efforts in the elements that are defined as an "improved program". It should be made clear that states would not be excluded if they have begun some activities in these areas but need improvement and that these funds would be used to supplement and improve existing programs. There is an urgent need to make a significant commitment in the form of the funding of the water pollution control staff effort to carry out the mandates of the increasingly stringent legislation that is being enacted. Without the people to do the job, legislation means little.

Both the Administration bill and Senate Bill 523 suggest that the construction grants program amounts be changed and that the authorization for grants be increased. The Administration bill includes the concept of a federal "pulling out" of the financial picture in the construction grants program. We believe that it is too early for the federal government to begin to cut back its commitment in pollution control grants. The pollution control effort is really beginning to move. The time for a cut back in effort is when the goals are met not when a program is beginning to move. We, therefore, urge that the "pull out" concepts in the Administration bill be removed including the provision which would require that the proportionate federal share of industrial contributions to a project be placed into a reserve for future expansion of treatment facilities. We believe this provision would have the effect of discouraging industrial participation in regional projects and would be contrary to desirable regionalization of waste collection and treatment. We believe that the law should only require that industry pay its fair share in a joint treatment program.

With regard to the time constraints on construction grants while Senate Bill 523 reinstates the provision that funds must be obligated within six months after the end of the fiscal year in which funds were allotted, the Administration bill continues the present requirement that the funds be obligated by the end of the fiscal year. Since funds are not generally appropriated at the start of the fiscal year, we find the provision for obligation of funds in the Administration bill to be restricting and difficult to meet. The additional six months as originally provided allows adequate flexibility for obligation of funds to needed projects.

In addition, Senate Bill 523 requires the obligation of reallotted funds by the end of the fiscal year following that in which the funds were originally appropriated. Because of the time lag in determining the amount of funds to be reallotted, and the additional time needed for the actual reallottment, there is little time left for obligation of these additional funds under this provision. We recommended that the time limit for obligation of reallotted funds be eliminated.

Under Section 8 of the Senate Bill 523, grants can be made to a state for the construction of necessary treatment works to provide for the effective treatment of "sewage and other wastes of any kind or description". As you are probably aware, a number of other states have serious water pollution problems resulting from past mining of coal. The problem of abating mine drainage pollution from abandoned mining operations has fallen on the states and it would appear to us that construction grant funds under this legislation could be utilized to supplement state funds in the abatement of abandoned mine drainage pollution. We urge that such language be included.

It would appear that pollution control construction funding requirements will necessitate the $2½ billion level included in Senate Bill 523.

We believe that the Environmental Financing Authority suggested by the administration would be a beneficial factor in the financing of pollution control facilities.

My comments have not covered all sections of the bills but I hope they have pointed out to you some of the state views resulting from administering water pollution control programs. We hope that this experience can be used in developing federal legislation.

Together the states and the federal government can do the job protecting and enhancing water quality. This job can only be done if (1) competent staff and funds are provided to do the job, (2) the job isn't hindered by duplication and (3) that the program is designed to prevent pollution on a planned basis rather than on a "brush fire" basis.

Sincerely yours,

WESLEY E. GILBERTSON,
Chairman-Elect.

STATEMENT OF THE EDISON ELECTRIC INSTITUTE

The Edison Electric Institute, national trade association of investor-owned electric light and power companies, welcomes the opportunity to comment on some of the legislative proposals which this subcommittee is presently considering. The member companies of EEI serve approximately 77 percent of the nation's electric customers.

The following comments focus principally on aspects of S. 523 and S. 1014 which appear to affect the electric utility industry most directly. Before making the specific comments, however, it should be noted that electric utility companies are primarily non-consumptive users of water. They take water from a lake, river, estuary, or ocean; use it to cool the steam required to generate electricity in thermal power plants; and then return it. Over 80 percent of the electricity in this country is generated in thermal power plants cooled in this manner. The bulk of the remainder is generated in hydroelectric plants which also make use of the nation's waters in a non-consumptive way.

The Edison Electric Institute has appeared before this Subcommittee on previous occasions to discuss proposed water quality legislation. The most recent instance was on May 1, 1970, when William S. Lee, Vice President, Engineering of Duke Power Company presented testimony. Mr. Lee described the quantitative requirements of electric generating stations for cooling water, and discussed the techniques available to the industry for moderating the thermal discharges which are a necessary part of the process of electricity generation.

As Mr. Lee pointed out, we have a good understanding of the rate and mechanisms of waste heat dissipation from cooling water. This heat can be transferred to the atmosphere in only two ways: either by means of a cooling tower or through natural heat dissipation mechanisms from a water body. A number of techniques are available to make use of natural heat dissipation, making use of natural water bodies, artificial water bodies such as cooling ponds, or with the help of sprays or other mechanical devices. He noted that a cooling tower causes a more substantial consumptive loss of water than the same heat dissipation from a water body. While cooling towers can be helpful in heat dissipation in some locations, they are not a panacea and alternate means of cooling should always be considered.

The electric utility industry has been conducting extensive research into the effects of warm water discharges. One EEI research project, carried on under the direction of the Johns Hopkins University, has been underway for about eight years and is continuing at increasing levels of support. Reports of this work have previously been provided the Committee. Recently an additional report has been issued entitled "An Optimal Siting Model for Thermal Plants With Temperature Constraints," and a copy is enclosed for the Committee's files. The report describes the development of a new computer technique for choosing from a given set of possible sites, the most economically desirable combination of plant alternatives that maintains the coolant receiving waters below their maximum permissible temperatures. EEI has also recently published a summary of environmental water studies made by electric utility companies. The survey included the work of 121 companies and provides descriptions of some 400 studies which are completed or underway. A copy of this summary is also enclosed. An independent consulting organization was asked to review the completed studies and has found that none of the plants at the sites surveyed has damaging effects on the local eco-systems.

Reference to Mr. Lee's testimony is pertinent because the principles he discussed and the technical information he provided are as applicable today as when he appeared before this Committee less than 12 months ago. The proposals this year are somewhat different, emphasizing the fact that water quality regulation is at present in an almost continuous state of flux. The resulting uncertainties make designing and operating electric power facilities difficult in the extreme.

The Administration's recently announced permit program under the 1899 Refuse Act has served to aggravate the situation, and we are concerned that

the proposed bills would confuse matters further. For instance, S. 523 and S. 1014 would extend the Federal water quality standards to all waters including intrastate waters. Depending upon the implementation, they could establish effluent limitations and criteria under which Federal Refuse Act permits would be issued, or they could operate entirely independently. President Nixon's order implementing the 1899 Act speaks of "effluent requirement" while S. 1014 could establish different "effluent limitations." Would there be two sets of rules? Would it be correct to infer that if one had a permit under the 1899 Act one would not be subject to the penalties proposed in S. 523 or S. 1014?

As proposed, the Federal permit program would allow the Environmental Protection Agency to overrule a state certificate issued pursuant to Section 21(b) of the Federal Water Pollution Control Act. Moreover, a Federal permit might be denied even though no certificate was required. The effect of such actions would be counter to the Federal-state cooperation which has been developing over recent years. In fact, as proposed the procedures under the permit program appear to fail to accept the competence of State Water Quality Review Boards.

The Edison Electric Institute has submitted detailed comments on the permit program to the Office of the Chief of Engineers, Department of the Army. A copy of these comments is enclosed.

There is a critical need to consolidate the number of certifying agencies in the environment field, not to proliferate them. Sound regulation is not achieved by shifting standards and overlapping regulatory bodies. We agree with EPA Administrator Ruckelshaus that solution of the problems of water pollution requires vigorous and constant implementation of regulatory authority. However, we suggest that more is achieved by firm regulation than by erratic and sometimes unreasonable and conflicting actions.

Under either S. 523 or S. 1014, it appears that responsibility for setting standards, and particularly for enforcing them, would be shifted to a significant degree from the states to the Administrator of the Environmental Protection Agency. The exact and complete impact of the proposed shift in emphasis from state to Federal cannot be ascertained, because it depends significantly on the Administrator's implementations and procedures under this legislation. This, in itself, is a matter of concern to us.

The process of setting water quality standards by the states has been progressing well and our industry has generally found state agencies to be competent and knowledgeable about local situations. Utilities have made a good start toward working closely with these state agencies by doing environmental homework in advance of site decisions and before committing to specific cooling water facilities. Since each site must be considered on the basis of its own indigenous ecology along with other water quality parameters, jurisdiction at the state level promises to be more effective and more sensitive to the full spectrum of local conditions. To remove jurisdiction of thermal discharges to the higher federal level offers no evident benefits in the public interest, and, on the contrary, our experience has shown that it will lead to decision making on the basis of arbitrary formulas without giving proper weight to the local conditions that do affect public interest.

The proposed legislation—either S. 523 or S. 1014—would amend section 10 of the Federal Water Pollution Control Act to establish, implement, and enforce water quality standards. The general approach is clearly recognized as being similar to that of the Clean Air Amendments of 1970. Although there is no mention of thermal discharges, and heat is not specifically designated as an effluent, application of the Act to thermal discharges from electric power plants would be of great concern to us.

The bills apparently provide no latitude for the Administrator to take into account the fact that heat discharges are diluted as distances from the point of discharge increase. This "mixing zone" concept is essential if we are to be able to make use of natural water bodies for cooling. Closing off this option could have a seriously detrimental effect on the ability of the industry to construct power plants unless there is extensive use of cooling towers. However, the use of cooling towers can also cause difficulties.

A cooling tower performs its cooling almost entirely by a single mechanism—evaporation. In addition to this consumptive loss of water, fine droplets of unevaporated cooling water are carried away by the airstream in cooling towers, and this is known as drift loss. On the other hand, a natural water body dissipates temperature in three ways—evaporation, conduction, and back-radiation.

Under average climatic and mixing conditions, the evaporative process dissipates about one-half the extra heat from a water body with the remaining half dissipated by the other two ways which create no consumptive loss of water. A cooling tower causes a consumptive loss of water about 2½ times as great as the same heat dissipation from a water body.

The only way to use a water body for heat dissipation is to permit direct discharge of warmed effluents with a reasonable and adequate allowance for mixing and initial heat dissipation in a "mixing zone." To eliminate the mixing zone altogether would force the arbitrary application of cooling towers to existing and future thermal power plants. For water conservation purposes alone, it is essential that the natural heat dissipation mechanisms be employed wherever they can be made reasonably compatible with the ecology—and this, in turn, dictates that the concept of "mixing zones" be retained for thermal discharges. In addition, cooling towers may require a wasteful use of scarce land resources or impair air quality to an unacceptable degree.

In order to strike the best overall balance among *all* resources, it may be desirable in some cases to use natural water bodies for cooling. This would be particularly true if no adverse effect on any other beneficial use of water is demonstrated. It is our experience that a major defect of many proposals for environmental protection is a single-minded attention to particular parts of a broad problem. The present proposals for water quality regulation, for example, focus entirely on one aspect of the environment to the exclusion of environmental problems related to land, air, or esthetics. They do nothing to promote the protection of *total* environmental quality which establishment of a unified environmental agency was intended to achieve.

The Edison Electric Institute, therefore, urges that the subcommittee provide in any legislation favorably reported a clear and unequivocal statement permitting continued use of mixing zones for heat dissipation of thermal discharges. It is in the public interest to allow continued use of the mixing zone as an alternative to the use of cooling towers when the circumstances require.

Section 10(e) (2) of S. 523 provides that effluent requirements for new buildings or facilities shall permit no discharges when Administrator finds that closed-cycle production or treatment systems are available or can be made available. This provision is unclear as to the intended application. It is assumed that the "closed-cycle production or treatment system" relates to waste treatment rather than closed-cycle cooling towers for heat dissipation. If this provision is approved by the Subcommittee, it should be changed to make it clear that closed-cycle cooling towers are not included in its coverage.

The bills propose that water quality criteria should reflect the latest scientific knowledge, and that effluent limitations be based on the availability of practicable treatment or control measures which shall be generally applicable to industrial facilities under construction on the date of enactment or on which construction is commenced after date of enactment. We applaud the concept that effluent limitation be based on the availability of practicable control measures. Limitations set in any other manner would have little meaning. However, under the language in the bills it would seem that a plant under construction, even though it had received preconstruction clearances, might have to meet effluent limitations promulgated months after the date of enactment. This could cause construction to be halted, depending on the attitude of the Administrator. We would hope this point could be clarified.

Both S. 523 and S. 1014 also provide that in cases where water quality on the effective date of the legislation is higher than the water quality criteria, no standard shall permit degradation or "such high quality shall be maintained in accordance with regulations." This apparently would bar industries from using certain waters, and we do not believe this is sound. While the overall objective, which we presume to be that water quality be improved in the future, is one we endorse, we do not believe that precluding the use of certain bodies of water is the proper way to achieve it. In the future, we may find that in order to improve the quality of some water bodies it would be desirable to move a production facility to an area now unused. The proposal in the bills ignores the question of how much development a particular water body can absorb without harm, and makes an arbitrary rule that applies generally. As a society we will need to have our water resources available for sound development.

The bills provide that the Administrator publish recommended control techniques to achieve water quality standards. This information will be helpful in public discussions of water quality control, and we would hope that the pub-

lications would be descriptive rather than judgmental. Presentation of the effectiveness, cost, economic feasibility, and environmental consequences of various control techniques should speak for themselves—and should be open to public scrutiny and discussion before final publication. It may be that the public would be aided in its understanding of these matters if several expert opinions were included in such a publication, rather than just those of the regulatory agency.

There are several other specific provisions as proposed in S. 523 and/or S. 1014 which are of interest to electric companies. Brief thoughts on these points may be useful to the Subcommittee in its consideration of this legislation.

S. 523 does not define the terms used in the bill. The meaning of "Water Quality Standards" and the contents of a "plan" do not appear to be consistent throughout the bill. S. 1014 does provide definitions, and this appears preferable.

S. 523 establishes shorter deadlines for required actions than does S. 1014. For example, it requires initial regulations to be promulgated in 90 days as compared to 6 months in S. 1014. Subsequent state standards must be adopted in 9 months after promulgation of initial regulations, in contrast to one year in S. 1014. The longer time periods in S. 1014 are still within reasonable limits and would provide for a more orderly accomplishment of the purposes of this legislation.

S. 523 requires achievement of standards within 3 years. S. 1014 has no comparable provisions but does require states to adopt a plan of implementation and enforcement as expeditiously as practicable. The approach contained in the latter bill is preferable to establishing an arbitrary timetable.

S. 523 requires state and EPA certification of compliance with regulations governing the latest pollution control techniques for new commercial facilities. Since existing law will require state certification of compliance with prescribed standards and a Federal permit for all discharges effective July 1, 1971, this dual certification is not only unnecessary, but can result in delays of vital facilities. Both bills provide for citizen suits in the manner of the 1970 Clean Air Act. However, S. 1014 contains some additional beneficial safeguards with respect to these suits which would tend to preclude a proliferation of costly, unnecessary, or harassing actions.

S. 1014 prohibits the Administrator from approving water use designations if they specify the assimilation of waste as a primary use. This might be interpreted as precluding the use of cooling lakes built by a utility specifically to assimilate waste heat from a generating plant. This point should be clarified to the extent that such lakes or ponds are not included in the meaning of the section.

In conclusion, we would remind the Subcommittee that an adequate and reliable supply of electric energy is one of the essential elements to the solution of many of the environmental problems facing our nation. We believe in sound regulation, but we believe equally that every attempt should be made to reduce licensing and construction delays affecting electric power supply. Imposition of new permit or certification requirements in addition to regulations which now exist and which should be given an opportunity to work will clearly make it more difficult for regulatory agencies to reach timely decisions concerning electric power plant construction. Further, provision for legal actions by individuals at every level of the already complex administrative process would simply serve to increase the frustrations and delays facing the agencies charged with the responsibility for regulating environmental quality.

The Edison Electric Institute commends the Subcommittee for its interest in clarifying some of the problems which have developed in water quality control. Companies in the electric utility industry are attempting to operate under water regulations which are in a chaotic state. Uncertainties abound, as regulators come and go and as new regulations are imposed. We hope the Subcommittee will find a way to bring better definition and clearer responsibility into the process of water quality regulation, for sound regulation of water quality is surely needed throughout the country.

Attachments follow:

Enclosure I

Cooling Water Discharge Project Report No. 6

AN OPTIMAL SITING MODEL FOR THERMAL PLANTS WITH TEMPERATURE CONSTRAINTS

Prepared for

Edison Electric Institute Research Project No. 49

by

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Edison Electric Institute
Cooling Water Discharge Project (RP-49)

LIST OF PREVIOUS PUBLICATIONS

RP-49 Rpt. #	EEI Publ. #	Title	Date of Publication
1	65-901	"Water Temperatures and Aquatic Life"	June, 1965
2	65-902	"Heat Exchange in the Environment"	June, 1965
3	68-901	"Field Sites and Survey Methods"	June, 1968
4	69-900	"The Effects of Elevated Temperature upon Aquatic Invertebrates"	September, 1969
5	69-901	"Surface Heat Exchange at Power Plant Cooling Lakes"	November, 1969

Edison Electric Institute

Cooling Water Discharge Project (RP-49)

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An Optimal Siting Model for Thermal Plants
with Temperature Constraints

ACKNOWLEDGMENTS

The analytical research work for the Cooling Water Discharge Research Project (RP-49) is being carried out by the Department of Geography and Environmental Engineering under contract between the Edison Electric Institute (EEI) and The Johns Hopkins University. EEI is the trade association of the nation's investor-owned electric power companies.

Coordination of the research between the university project staff and EEI is maintained through a Steering Committee of the Cooling Water Task Force, under the EEI Prime Movers Committee.

The authors are indebted to Professor Steve Hanke, of The Hopkins Faculty, for his review and contributed foreword, also to Willard L. Graves, Jr., for assistance with computer programming, and to Derek K. Brady for assistance with preparation of the material for publication.

An Optimal Siting Model for Thermal Plants
with Temperature Constraints

ABSTRACT

Three models are presented for the optimal siting of thermal-electric generating stations as a trade-off between the costs of power production and the costs of transmission to the load centers subject to the constraints of compliance with temperature standards. The models are intended to be used as aids in making location decisions, particularly by showing the sensitivity of the models' optimal solutions to changes in input parameters, and also by permitting the evaluation of costs associated with different siting policies and different temperature standards.

The three models presented are a zero-one integer programming model, a mixed integer programming model and a model with probabilistic temperature constraints. A working solution technique for the zero-one integer programming model with a maximum capacity of 90 variables and 34 constraints is discussed. The type and format of input information needed for this model are described in detail. A sample problem is formulated, its solution is presented, and the results of various sensitivity analyses are discussed. Plans for solving more comprehensive problems based on the mixed integer and probabilistic model formulations are included in Appendix C.

A general discussion of the economic aspects of an integrated power generating system and of questions relating to efficient utilization and growth of such a system appears in a foreword.

An Optimal Siting Model for Thermal Plants
with Temperature Constraints

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SOME ECONOMIC ASPECTS OF POWER SYSTEM PLANNING

A FOREWORD TO REPORT NO. 6

by

Steve H. Hanke
Assistant Professor of Resource Economics

During the past five years there has been an increasing awareness by the public, governmental agencies and industry that the use of the "environment" is not free, and lacking appropriate tenure protection in one form or another it is subject to overuse. The public's anxiety over the use of "environmental resources" has reached an apparent climax within the past few months with an increasing number of conflicts arising over the siting of large private, as well as public, investments that spill external costs upon various segments of society. The electric power industry has been enveloped in these conflicts.

Three fundamental factors lie at the heart of the most recent siting controversies. The first concerns the necessity of providing the public with increasing quantities of electricity and, therefore, an increasing number of sites for generating plants. At conflict with this objective is a second factor, the rising sensitivity of the public to the effects on the environment that may result from large installations such as those projected for the future. There is generally little in the private vocabularies of the conflicting parties that facilitates reconciliation between these two points of view. Hence, the solution inevitably calls for public action. Unfortunately, however, a third factor impedes the process, since public

agencies have not yet developed adequate guidelines and appropriate institutional arrangements for comprehensive planning and prompt decisions.

The following report, by utilizing the example of temperature standards, illustrates a model and framework which shows how siting decisions could incorporate various external costs and/or standards. Therefore, it can be viewed as the crude forerunner of a siting approach which attempts to reconcile conflicting objectives and claims upon the use of the environment and which could be utilized by both the power industry and public bodies that are interested in providing electric power at the lowest "social cost." Moreover, further development of the approach presented here towards incorporating environmental effects could help to bring planning and construction back on schedule and, therefore, be of value in avoiding future power interruptions, higher prices or higher taxes.

It should be emphasized that the model has several limitations. Even though it is designed to incorporate non-market benefits and costs, it does not account for complications that arise when the proposed investment will, upon completion, form part of an existing system. When a new project will affect the operation of the rest of the system of which it becomes a part, the full consequences of the investment are not revealed by the data which relate to that project alone. A full evaluation of the benefits and costs, therefore, requires data about the whole system when either the scale or time-pattern of output differs between two or more alternatives being considered. Thus, the system costs may be very different from the present value of an individual plant's private costs.

Since the model presented in the report is not developed in the context of a system, the nature of the complications introduced by system interdependence are not considered. This particular feature of the report should be viewed with some caution, since the implications generated by not incorporating this interdependence are indeed fundamental.

Accompanying this foreword is a Power System Planning Chart (Figure 1) depicting a general scheme by which the choice can be made of a plant program which minimizes the entire system cost subject to constraints such as meeting specified future demand loads and simultaneously satisfying effluent quality requirements. Cost is defined here as the present worth of all net future expenditures on the construction, maintenance and operation of the generating, transmission and distribution system. The general investment (not strictly location) model in the context of the system is strategic rather than tactical; it relates to the decisions that must be made when choosing what types of plants to install and where they should be installed in a given future period. As a result, different types of plant mixes may be examined to determine the most efficient use of the system as a whole.

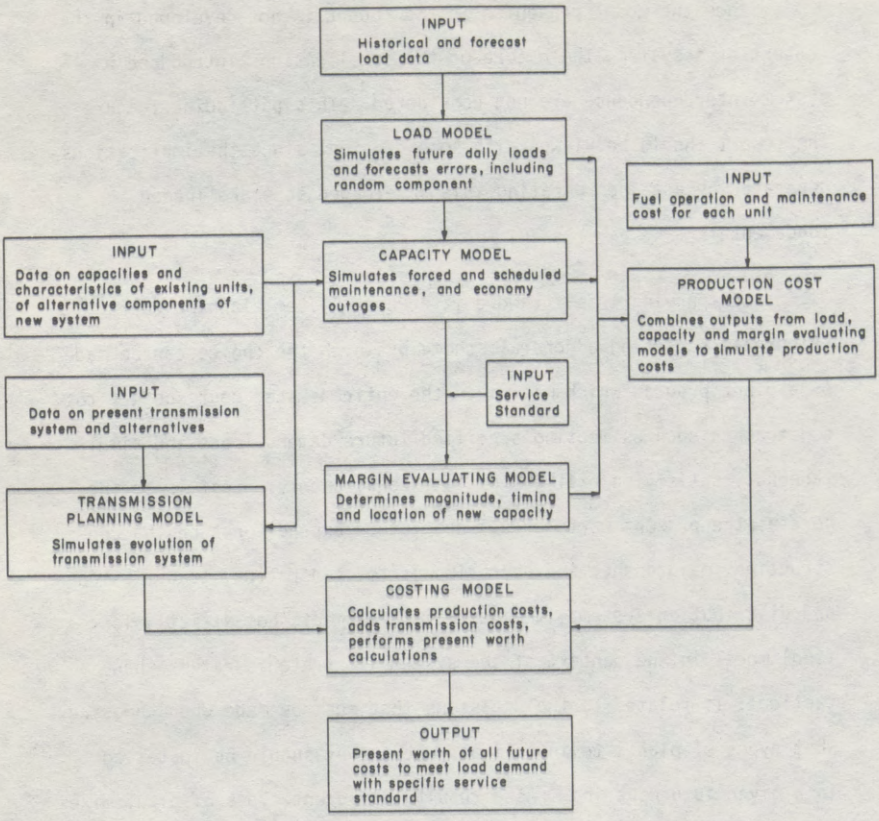

FIGURE 1. Power System Planning Chart
(Adapted from Westinghouse Eng., Sept. 1960, p. 130)

AN OPTIMAL SITING MODEL FOR THERMAL PLANTS WITH TEMPERATURE CONSTRAINTS

1. INTRODUCTION

The choice of location for a power generating station is a function of many complex and interrelated factors, including the locations and types of demand loads to be met, the types of generating facilities available and their capacities, the supply of raw fuel, the transmission of energy produced, the disposal of wastes and various political and aesthetic constraints. For water-cooled thermal plants, it is important that the generating stations be located near water bodies that have adequate cooling capacity.

On a small stream, or in areas of high thermal waste loads, the heat discharged may have environmental effects which make the receiving water less serviceable to some of its other users. To protect against this possibility, governmental agencies are establishing temperature standards for many receiving waters. Plant siting policy with regard to water temperature standards may take several forms: (a) alternative cooling facilities may be incorporated at each plant site in order to reduce the heat load reaching the water body; (b) smaller plants in greater number may be dispersed along the water body in order to lessen the heat impact at any particular point; or (c) some combination of these two alternatives may be selected.

The type of temperature standard* may affect the location decision. For example, a particular set of alternatives might be chosen if the standard specified a maximum permissible absolute temperature for the receiving water, whereas if the standard was expressed in terms of a maximum permissible excess above its normal ambient temperature, then a different set of alternatives may prove to be optimal. Both of these optimal solutions might be dependent on regulatory policies concerning compliance with maximum temperature standards during statistically extreme weather conditions. The type of temperature standard may also influence the type of abatement equipment used, as well as the location selected, depending on the cost trade-offs involved.

The task is to search among the many combinations of feasible alternatives to find that set which, for the least overall cost, satisfies both the demand loads and the temperature standards. This report presents an approach by which the environmental aspects of this task may be taken into account.

Before describing the optimal siting models in detail, it is important to appreciate the nature of their capabilities. The staffs of both utilities and regulatory agencies involved in plant siting decisions need a great deal of information in order to decide upon an appropriate course of action at any time. Answers to many questions must be sought,

*The uniform application of standards, as used in this report, is for purposes of illustrations only, and is not necessarily considered optimal from an economic standpoint. For efficient management of water resources, the costs of extra treatment should be balanced against the downstream benefits derived from higher quality effluents. It is evident that different kinds and levels of treatment might be justified depending upon other uses of the water. These could vary from region to region and from time to time, so that the application of fixed standards might result in undesirable inefficiencies, i.e., too much or too little treatment in light of the benefits and costs perceived in a region.

such as (a) How sensitive is the decision criterion to errors in estimating such items as property values, fuel prices, transmission costs and future demand loads?, (b) Which type of stream temperature standard affects the optimal location pattern most?, and (c) How much does compliance with temperature standards cost? The optimal siting models presented in this report may be used to examine all of these questions, particularly by manipulating the input data and constraints in such a way as to show how environmental quality standards affect the optimal location pattern and consequently the cost of satisfying the demand loads. Thus, the role of the models is to provide additional information to assist the decision-maker faced with a major investment in plants which can affect the environment.

Three siting models are presented in this report. The first, which is described in the main body of the report, is a zero-one integer model. Although this model is somewhat restrictive in its assumptions (see Section 2.2), it has the advantage of a readily available solution technique. The other two less restrictive models, a mixed integer model and a probabilistic model, are formulated and discussed in Appendix C, although working solutions for these less restrictive models are not yet available.

2. DEVELOPMENT OF THE ZERO-ONE INTEGER MODEL

2.1 General Description of the Siting Problem

The siting problem is developed in the following manner. Suppose there are many possible plant sites in or near a region for which estimates of future power demands at load centers within the region have been made. At each of these potential sites, there are several alternative sizes and types of generating facilities that might be built. The costs of providing power for the region involve both the capital costs of constructing generating facilities, transmission lines and distribution systems, and the operating costs involved in fuel supply, equipment maintenance, insurance and taxes, etc. It is evident, therefore, that the total enumeration of all possible combinations of sites, plants and cooling facilities may be an enormous task, perhaps an insurmountable one.

The problem is to find the optimum number, size and location of facilities required to satisfy the given demand loads, in such a manner as to minimize the total cost (i.e., capital costs plus lifetime operating costs) while complying with the following constraints:

(a) the predicted power demands of the region must be satisfied, and

(b) the temperature standards for the coolant receiving waters must not be exceeded.

It is recognized that this may appear to be a somewhat idealized concept of the problem, in that its relationship with an existing power system is not defined, and that it approaches the satisfaction of est-

imated future demand loads in a "static mode" rather than in the context of a dynamically growing system. It should be remembered, however, that the siting model is not intended to solve a problem by a single, one-run application, but is useful only when the optimality of its solution is tested under various conditions of costs and constraints. When considered in this multiple-run context, with the possibility of testing various time horizons for costs and demand loads, the applicability of the model becomes more apparent.

2.2 Assumptions Required to Formulate the Model

Two assumptions which are implicit in all three of the models presented in this report are:

(a) For each site location and plant alternative, the total production cost (capital plus operating cost) is a linear function of the generating capacity of the power plant. (The linear function is assumed, in this case, to be a sum of two components, i.e., an "intercept cost" which is independent of the plant's generating capacity, and a "slope cost" which is proportional to the generating capacity. See Figure 8 in Appendix B.)

(b) The surplus heat to be dissipated from each thermal power plant is proportional to its generating capacity.

In addition, for the zero-one integer model only, it is assumed that: (c) Each demand load center must receive its entire power requirements from a single generating plant.

Although the first two assumptions may be considered fairly realistic, the third assumption is somewhat more restrictive, in that it necessitates the breakdown of large demand areas into individual load centers having demands no larger than the generating capacity of the smallest plant alternative. This tends to increase the complexity and therefore the computation time of the problem.

2.3 Mathematical Formulation of the Model

The objective of the model is to minimize the total cost, which, using the notation summarized in Appendix A, is expressed:

$$\text{Minimize} \quad \sum_i [X_i F_i + \sum_j Y_{ij} L_j (P_i + T_{ij} + D_j)] \tag{2.1}$$

In this expression, the first term represents the sum of the intercept costs, F_i (see Sections 2.2(a) and 2.5(a)) for all plant alternatives selected. Note that the plant selection coefficients, X_i, are zero for all plants not in the selected set (see Equations 2.2 and 2.4). The second term represents the sum of the selected load-dependent costs (i.e., those for which the load assignment coefficients, Y_{ij}, are non-zero) obtained by multiplying each demand load, L_j, by the appropriate cost rates for production, P_i, transmission, T_{ij}, and distribution, D_j. Note that, except where stated otherwise in this formulation, the index i for plant alternatives runs from 1 through NP, while the load centers run from 1 through NL with the index j.

The plant selection and load assignment coefficients, X_i and Y_{ij}, are constrained to conform to the following requirements:

(a) At most one plant alternative may be selected at each site:

$$\sum_{i \in S_m} X_i \leq 1 \qquad \text{(for all m)} \tag{2.2}$$

In this case, the index i is summed over each set, S_m, of plant alternatives at site m, where m runs from 1 through NS.

(b) Demand of each load center must be satisfied:

$$\sum_i Y_{ij} \geq 1 \qquad \text{(for all j)} \tag{2.3}$$

(c) Coefficients must be zero-one integers:

$$X_i = 0,1 \qquad \text{(for all } i\text{)} \qquad (2.4)$$

$$Y_{ij} = 0,1 \qquad \text{(for all } i,j\text{)} \qquad (2.5)$$

In addition to the above "fixed" constraints, two kinds of "variable" constraints deal with plant generating capacity and temperature standards:

(d) Maximum permissible plant generating capacities:

$$\sum_j Y_{ij} L_j \leq X_i M_i \qquad \text{(for all } i\text{)} \qquad (2.6)$$

where M_i is the maximum generating capacity at plant alternative i. (Note that if a plant alternative is not selected, the corresponding value of X_i is zero, so the amount of power transmitted must be zero.)

(e) Maximum permissible receiving water excess temperatures:

$$\sum_i A_{ik} R_i \left[\sum_j Y_{ij} L_j \right] \leq C_k \qquad \text{(for all } k\text{)} \qquad (2.7)$$

The right side of this expression, C_k, represents the critical excess temperature at each receiving water sampling station k, where k runs from 1 through NC. The left side represents the sum of the excess temperature contributions at sampling station k from each plant selected. Each temperature contribution is computed by multiplying the plant generating capacity, $\sum_j Y_{ij} L_j$, by the product of the unit temperature rise at the plant site, R_i, and a dimensionless "decay" coefficient, A_{ik}, for transferring excess temperatures from the plant site to the sampling station. Note that in cases where the applicable temperature standard is expressed as an absolute temperature ceiling (rather than as a maximum permissible excess temperature), the value of C_k is the difference between the specified temperature ceiling and the undisturbed ambient temperature.

2.4 Solution by Operations Research Algorithm

The fact that the siting problem can be explicitly formulated, as in the previous section, does not necessarily imply that it can be solved without totally enumerating all the possible alternatives and minimizing the cost by inspection. For the zero-one integer model, however, a satisfactory solution technique is currently available for computer use. Geoffrion (3,4,5)* has suggested an algorithm for the solution of zero-one integer programming problems by the method of implicit enumeration using an imbedded linear program. The algorithm is concerned with determining the values of the n variable that optimize the mathematical programming problem. Since these are zero-one variables, which can take on only two possible values, total enumeration would require the evaluation of 2^n possible combinations. (For example, if the number of plant alternatives and load assignment possibilities sums to 90, the total number of possible combinations is 2^{90}, which is approximately 10^{27}, i.e. a prohibitively large number.) The relationships among the various possible solutions may be visualized as a tree-shaped structure in which each node represents a variable, and the branches emanating from that node represent the possible values for that variable. Implicit enumeration provides a means for searching the tree efficiently by eliminating branches which are obviously dominated by better solutions. The particular program used allows the bound at each node to be computed either by a simple additive rule, by the solution of a linear program, or by a composite strategy. An optimal solution is guaranteed if the

* Numbers in parentheses refer to references in Appendix D.

problem is run to completion.

An available FORTRAN IV computer code, based on Geoffrion's algorithm, has been adapted by the authors for application to the siting problem (see Appendix B). Size limitations of the available digital comptuer (an IBM 7094) dictated that no more than 90 variables or 34 constraints could be used. Some modifications have been made to the original program in the form of special input and output routines which accept the required engineering input data (such as costs and temperature standards, etc.) and build the constraint equations of the model.

2.5 Specifications for Input Information

(a) Intercept Cost for Production, F_i

The intercept cost represents the hypothetical expenditure required to establish and operate a generating facility, excluding those expenditures which depend on the plant generating capacity. For any site, the value of F_i is evaluated by plotting total plant costs (sum of capital costs and operating costs during the expected plant lifetime) versus generating capacity for several plant sizes, and by extrapolating the straight line of "best fit" back to zero generating capacity (see Figure 8 in Appendix B).

(b) Load-Dependent Costs

For each plant site and load center, these costs comprise the sum of three components (for production, transmission and distribution) each of which is expressed as a product of the load center demand, L_j, and the appropriate cost rate for that component. The cost rates are evaluated as follows:

(1) Load-Dependent Production Cost Rate, P_i

For each plant site, the load-dependent production cost rate is the slope of the straight line referred to in paragraph (a) above, expressed in units of cost per unit of plant generating capacity.

(2) Transmission Cost Rate, T_{ij}

For each plant site and load center, the transmission cost rate is evaluated by dividing the total transmission costs (sum of capital costs and operating costs during the expected lifetime) by the capacity of the transmission line.

(3) Distribution Cost Rate, D_j

For each load center, the distribution cost rate is evaluated

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by dividing the total distribution cost by the capacity of the distribution system.

(c) Temperature Transfer Coefficients, A_{ik}

In order to use the temperature constraint feature of the model, it is necessary to predict the effect of each thermal discharge on the temperature of the receiving water body at one or more designated sampling stations. For each plant alternative and sampling station, the temperature transfer coefficient, A_{ik}, represents the residual fraction of any initial excess temperature at the plant discharge location that would be expected to reach the sampling station (taking into account the various processes of advection, mixing and cooling). In the case of a relatively simple flow situation, such as a river, the estimation of typical transfer coefficients is exemplified in the subroutines described in Appendix B. For more complex receiving water bodies, the user must provide such data. One should expect the transfer coefficient values to depend on environmental conditions, such as quantity of flow, meteorological conditions, etc. Whether or not this dependence is sufficiently important to warrant investigation may be tested by running the model with transfer coefficients based on design conditions, and then testing the sensitivity of the solution to changes in the transfer coefficients.

(d) Temperature Rise, R_i

For each plant alternative, the temperature rise is evaluated by dividing the excess temperature at the discharge location by the plant generating capacity (taking into account the effect of any proposed supplementary cooling facilities for that plant alternative).

The exact discharge location at which the value of R_i is determined is not important, provided that the corresponding temperature transfer coefficients are evaluated in the same terms. For river sites, it is convenient to base R_i on the mixed stream temperature (see Appendix B), but for many situations the condenser temperature rise will suffice.

2.6 Notes on Other Applications of the Model

The model may be adapted with only minor modifications to study air quality standards instead of receiving water temperature standards. To achieve this, the transfer coefficient matrix, A_{ik}, must be redefined and recomputed in terms of air quality criteria at each sampling station due to a unit concentration of pollutant at each discharge location. The parameter R_i must also be reconstituted to express the concentration of pollutant at each discharge location divided by the generating capacity of the plant alternative at that site.

The effects of non-quantitative constraints, such as those which might prohibit the use of a particular site for political reasons, may also be evaluated using this model. First, the problem is run as if the site in question is not so constrained. If the optimal solution to this problem selects a plant alternative at that site, the total cost of this solution is noted, and the model is rerun with the plant alternatives at that site omitted. The difference in total costs between the two solutions is then a measure of how much extra the utility (and society) must spend to forgo the use of that particular site.

3. APPLICATION TO A HYPOTHETICAL SITING PROBLEM

3.1 Description of the Sample Problem

In constructing the following synthetic problem, a deliberate attempt has been made to maintain the strictest geometrical simplicity, in order to clarify the interpretation of its solution. Basically, the problem involves satisfying equal demands (of 250 MW) from each of five load centers which are spaced at uniform intervals along a straight river. Only five possible thermal plant sites are considered, one at each load center. At each of these sites there are only two proposed plant alternatives, one with abatement equipment (e.g. cooling ponds or evaporative towers) and one without. General locations of the proposed plant sites and load centers are shown diagrammatically in Figure 2. Note that, in this hypothetically simplified case, transmission costs are assumed to be negligible between each plant site and its corresponding load center at the same location.

Plant alternatives numbered 1 and 2 are located at Site 1, which is the most upstream load center, and the others are paired in sequence downstream, the furthest being plant alternatives 9 and 10 at Site 5. Thus, for computing purposes, the plant alternatives at each site may be coded simply by specifying the number of the first plant alternative at each site (e.g. NFSITE(1) = 1, NFSITE(5) = 9).

Estimates of the input cost parameters for the problem are developed in detail in Appendix B. In summary, the production costs are characterized by a relatively small "intercept cost" (F_i = \$60,000 per

General Locations

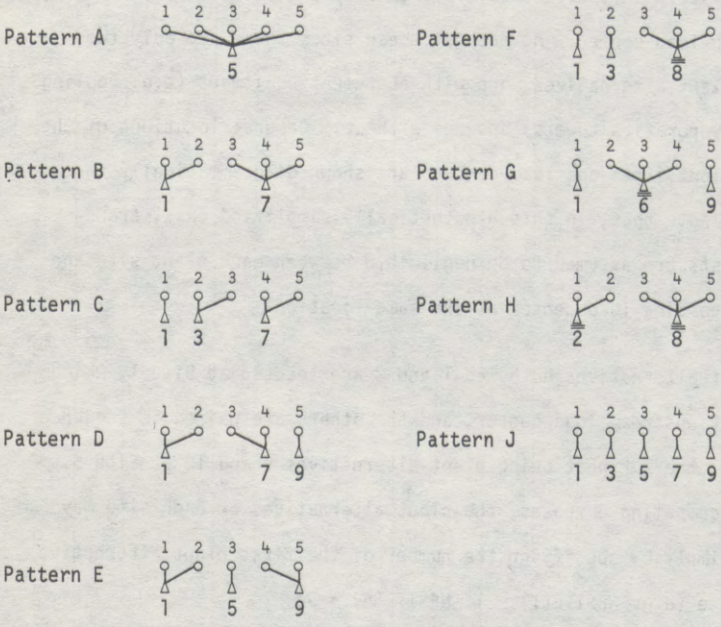
Load Centers	1	2	3	4	5
Possible Sites	1	2	3	4	5
Plant Alternatives*	1	3	5	7	9
	2	4	6	8	10
Sampling Stations	1	2	3	4	5

Spacing: |← Z →|← Z →|← Z →|← Z →|

(Stream flow direction →)

*Even numbers signify plants with abatement equipment, odd numbers without.

Patterns of Selection



△ = plant alternatives without abatement equipment (odd numbers)

▲ = plant alternatives with abatement equipment (even numbers)

○ = load centers (numbered 1-5)

FIGURE 2. Diagrams of Optimal Plant-Load Allocations for Sample Problem (See Table I)

TABLE I. Optimal Plant-Load Allocations for Sample Problem
(See Tables II, III and IV, Appendix B and Figure 2)

	Pattern of Selection								
	A	B	C	D	E	F	G	H	J
Base Cost ($\$x10^3$/wk)	*	880	895	895	895	916.75	916.75	917.25	925
Plant Alt.	(Load centers served)								
1	--	1,2	1	1,2	1,2	1	1	--	1
2	--	--	--	--	--	--	--	1,2	--
3	--	--	2,3	--	--	2	--	--	2
4	--	--	--	--	--	--	--	--	--
5	1,2,3,4,5	--	--	--	3	--	--	--	3
6	--	--	--	--	--	--	2,3,4	--	--
7	--	3,4,5	4,5	3,4	--	--	--	--	4
8	--	--	--	--	--	3,4,5	--	3,4,5	--
9	--	--	--	5	4,5	--	5	--	5
10	--	--	--	--	--	--	--	--	--

* Not based on same intersite distance as patterns B-J.

week), and a relatively steep "slope rate" (P_i = \$450/MW per week). Both these costs are increased by 5% for plants with supplementary cooling facilities. Transmission costs are based on a rate of \$4/wk/MW per mile, and distribution costs at load centers are assumed to be \$50/MW per week. Note that the optimization involves a trade-off between production and transmission costs. The distribution costs, which do not vary between solutions, are included for completeness only.

Flow conditions in the river, along which the five sites are located, are assumed to be the same at all sites (i.e., independent of downstream position). The basic conditions, in terms of which the mixed stream temperatures and transfer coefficients are computed (see Appendix B), are characterized by a mean flow of 3000 cubic feet per second, a mean width of 400 feet, a mean depth of 5 feet, a mean velocity of 1.5 feet per second, and a prevailing surface cooling rate of 150 Btu/ft^2/day/°F. Note that the heat to be dissipated from each plant alternative is based on an arbitrarily assumed thermal efficiency of 33%.

A two-stage approach was made to the study of this problem. First, by suppressing the constraints on stream temperatures and maximum plant generating capacities, a study was made of the basic relationship between the optimal cost of satisfying the load center demands and the number, size and location of the selected plant alternatives, for various load center spacing intervals (unspecified above). Second, for a chosen basic load center spacing (45 miles), a study was made of the sensitivity of the optimal solution pattern and cost to variations in the component cost rates and the constraints on generating capacity

and stream temperatures. Note that, for the application of temperature standards in this hypothetical problem, only five stream sampling stations were considered, one just downstream from each plant site.

As many as 32 sensitivity runs were made (see following sections), all using the same number of variables and constraints. It should be noted that there are 2^{60} combinations of variables which constitute possible solutions to the sample problem formulation. It would be an impossible task to manually sort through all the possible solutions to minimize the total cost by inspection. The algorithm used, however, is a very efficient solution technique, as evidenced by the fact that the execution times of the sensitivity runs averaged 120 seconds on the IBM 7094 computer. The actual times varied widely (from 30 to 185 seconds) because of the sensitivity of the algorithm to changes in the data.

The primary purpose of the sensitivity runs was to determine how accurately the various input parameters must be estimated in order to be certain of obtaining the optimal solution to the hypothetical sample problem. It is emphasized that any apparent sensitivity or stability of the solution for the sample problem considered in this chapter does not indicate that similar characteristics might be expected for any other problem. The objective of this chapter is merely to demonstrate the technique of interpreting the results of such a sensitivity analysis.

3.2 Sensitivity to Variations in Intersite Distance

The first set of seven runs was designed to examine the geometry of the sample problem by varying the distance, Z, between possible plant sites (and load centers) from a minimum of 10 miles to a maximum of 100 miles. For these "distance" runs, all the cost parameters were set at the estimated basic levels listed in the preceding section. The results of these seven runs are summarized in Table II. It should be noted that, although the transmission cost rate per mile remained fixed, the segmental transmission costs, T_{ij}, varied with the transmission distances.

It is observed (see Table II, Run 1) that, when the intersite distance Z = 10 miles, the optimal solution has an associated cost of $745,000 per week (pattern A, see Table I) and prescribes the construction of one centrally located plant which serves all five load centers. The same solution is also optimal when the intersite distance is 15 miles (see Run 2) although the total cost of the solution increases to $775,000 per week due to the increased transmission costs. It is possible to calculate by hand the cost of a theoretical situation in which the intersite distance is zero, i.e., there is, in effect, only one possible site and one associated load center. In this case, of course, all transmission costs vanish. The cost of this theoretical solution (pattern A for the case Z = 0 miles) is $685,000 per week. Plotting the costs of all three solutions involving pattern A versus intersite distance yields the segment labelled "Pattern A" in Figure 3. This segment may be extended indefinitely, representing the cost of

TABLE II. Summary of Intersite Distance Sensitivity Runs
(Numbers in parentheses refer to footnotes)

Set No.	Run No.	Input Parameter Level								Opt. Patt.	Total Cost
		F_i	P_i	T_{ij}	D_j	M_i	C_k	Q	Z		
(Notes)		(1)	(1)	(1)	(1)	(2)	(2)	(2)	(2)	(3)	(3)
(Units)		%	%	%	%	MW	°F	cfs	mi	--	$\$x10^3$/wk
1	1	100	100	22	100	1600	15	3000	10	A	745
1	2	"	"	33	"	"	"	"	15	A	775
1	3	"	"	55	"	"	"	"	25	B	820
1	4	"	"	100	"	"	"	"	45	B	880
1	5	"	"	111	"	"	"	"	50	B	895
1	6	"	"	144	"	"	"	"	65	J	925
1	7	"	"	222	"	"	"	"	100	J	925

Notes:

(1) F_i=intercept prod. costs, P_i=prod. cost rate, T_{ij}=trans. cost rate, D_j=distr. cost rate. All component costs are expressed as percentages of basic levels computed in Appendix B. The transmission cost rate per MW varies with the intersite distance, Z, because the basic level is expressed as \$4/wk/MW/mile.

(2) M_i=maximum generating capacity, C_k=maximum permissible excess temperature, Q=stream flow, Z=intersite distance.

(3) Optimal pattern of solution and associated total costs. (See Table I and Figure 2.)

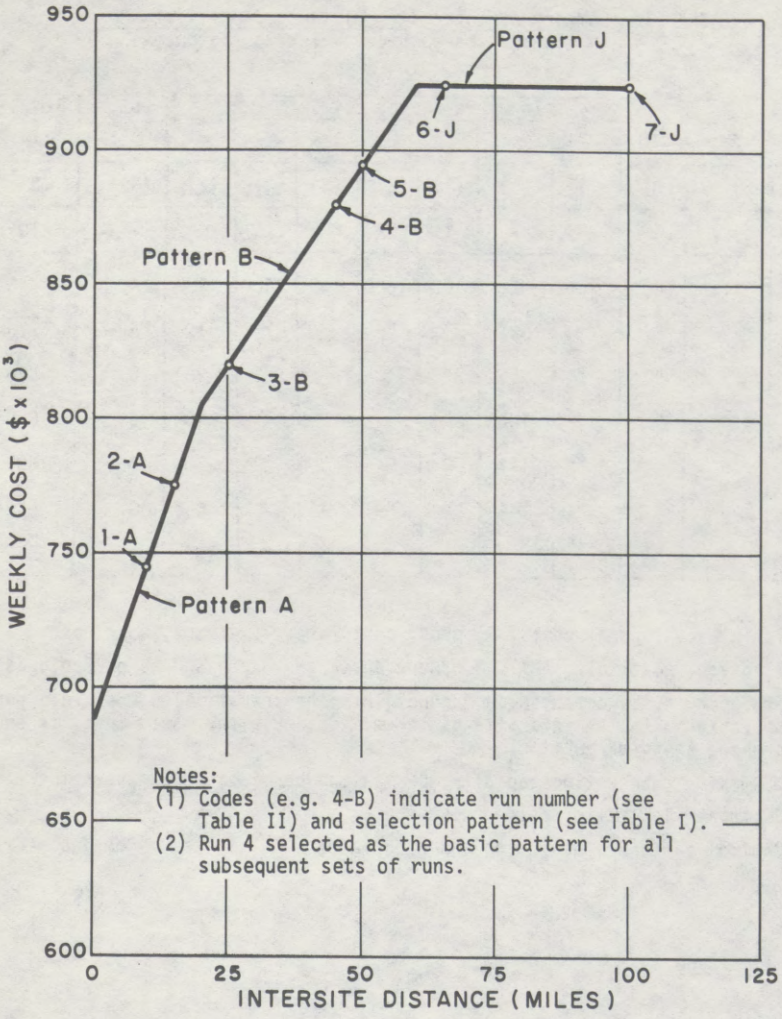


FIGURE 3. Optimal Solution Cost versus Intersite Distance

pattern A for all values of Z. When Z exceeds about 20 miles, however, the cost of pattern A apparently exceeds the cost of pattern B. Table II indicates that when Z = 25 miles (Run 3), the optimal solution costs $820,000 per week (pattern B, see Table I). This solution selects two generating plants, with capacities of 750 MW and 500 MW, and divides the total demand between them. For Z = 45 miles and Z = 50 miles (Runs 4 and 5), pattern B remains optimal with costs of $880,000 and $895,000 per week, respectively. Thus pattern B appears preferable over the whole intersite distance range of 20-60 miles. When Z exceeds 60 miles (Runs 6 and 7), the optimal solution involves building plants at all five sites (pattern J, see Table I). The cost of this solution remains constant at $925,000 per week, and is no longer distance-dependent since all the transmission costs again vanish. Note that suppression of the temperature constraint (by relaxing the value of C_k) inhibits the selection of plant alternatives with supplementary cooling facilities.

The results of this first set of sensitivity runs demonstrate the classical trade-off between transmission costs and production costs in serving a group of linearly separated load centers (such as cities located along a river). If the load centers are sufficiently close together, the economies of scale for production at a large central plant outweigh the extra costs of transmission to the outlying load centers. At the other extreme, if the load centers are sufficiently far apart, the excessive transmission costs are avoided by constructing separate generating facilities next to each load center. Between these two extremes (20 to 60 miles spacing) an intermediate arrangement involving two generating stations becomes optimal.

From the results of these seven runs, an intersite distance of 45 miles was selected as the basic level for the remainder of the sensitivity analysis runs. This spacing was chosen for three reasons: (a) because it represented a realistic distance between large load centers in terms of current power supply problems, (b) because it yielded an intermediate (i.e., non-extreme) solution pattern which would probably exhibit interesting variations in subsequent sensitivity runs, and (c) because it represented a somewhat central (and therefore relatively stable) location in terms of the segment labelled "Pattern B" in Figure 3.

3.3 Sensitivity to Errors in Cost Estimates

The second set of runs (Nos. 8-10) was made to test the sensitivity of the basic optimal solution (Run 4) to variations in the level of intercept production costs, F_i, leaving all other input parameters at their basic levels. The design and results of these runs are included in the summary of all the component cost sensitivity runs in Table III. It is apparent that setting the F_i values at 80% and 130% of their basic level resulted in the same optimal solution pattern (i.e., pattern B) as for the base run, although the corresponding total costs were respectively 2.7% lower and 4.1% greater than the base run cost. These results are included in the plot of optimal solution cost versus component cost change in Figure 4. Note that decreasing the value of F_i to 70% of the basic level resulted in a shift to optimal pattern J, although the total cost decreased by only slightly more than would have been expected if pattern B had remained optimal. In general, therefore, since relatively large variations in F_i caused relatively small changes in the total cost, it would appear that the need to refine the estimates of the intercept costs may be negligible in this case. However, the fact that the solution pattern showed some instability should be regarded with caution at this stage.

The load-dependent production costs, P_i, were the next group to be examined. The results of the third set of runs (Nos. 11-13 in Table III) indicate that the optimal solution pattern remains unchanged for P_i values set at 70%, 120%, and 130% of the basic level. Although some variations in the total costs were anticipated, the resulting range from 80.8% to 119.2% of the base run cost are much larger than

TABLE III. Summary of Component Cost Sensitivity Runs
(Numbers in parentheses refer to footnotes)

Set No.	Run No.	Input Parameter Level								Opt. Patt.	Total Cost
		F_i	P_i	T_{ij}	D_j	M_i	C_k	Q	Z		
(Notes)		(1)	(1)	(1)	(1)	(2)	(2)	(2)	(2)	(3)	(3)
(Units)		%	%	%	%	MW	°F	cfs	mi	--	$\$x10^3$/wk
1	Base	100	100	100	100	1600	15	3000	45	B	880
2	8	70	"	"	"	"	"	"	"	J	835
2	9	80	"	"	"	"	"	"	"	B	856
2	10	130	"	"	"	"	"	"	"	B	916
3	11	100	70	"	"	"	"	"	"	B	711.25
3	12	"	120	"	"	"	"	"	"	B	992.5
3	13	"	130	"	"	"	"	"	"	B	1048.75
4	14	"	100	70	"	"	"	"	"	B	839.5
4	15	"	"	130	"	"	"	"	"	B	920.5
5	16	"	"	100	70	"	"	"	"	B	861.25
5	17	"	"	"	130	"	"	"	"	B	898.75

Notes:

(1) F_i=intercept prod. costs, P_i=prod. cost rate, T_{ij}=trans. cost rate, D_j=distr. cost rate. All component costs are expressed as percentages of basic levels computed in Appendix B and using 45 miles as the intersite distance for all runs, as described in Section 3.2.

(2) M_i=maximum generating capacity, C_k=maximum permissible excess temperature, Q=stream flow, Z=intersite distance.

(3) Optimal pattern of solution and associated total costs. (See Table I and Figure 2.)

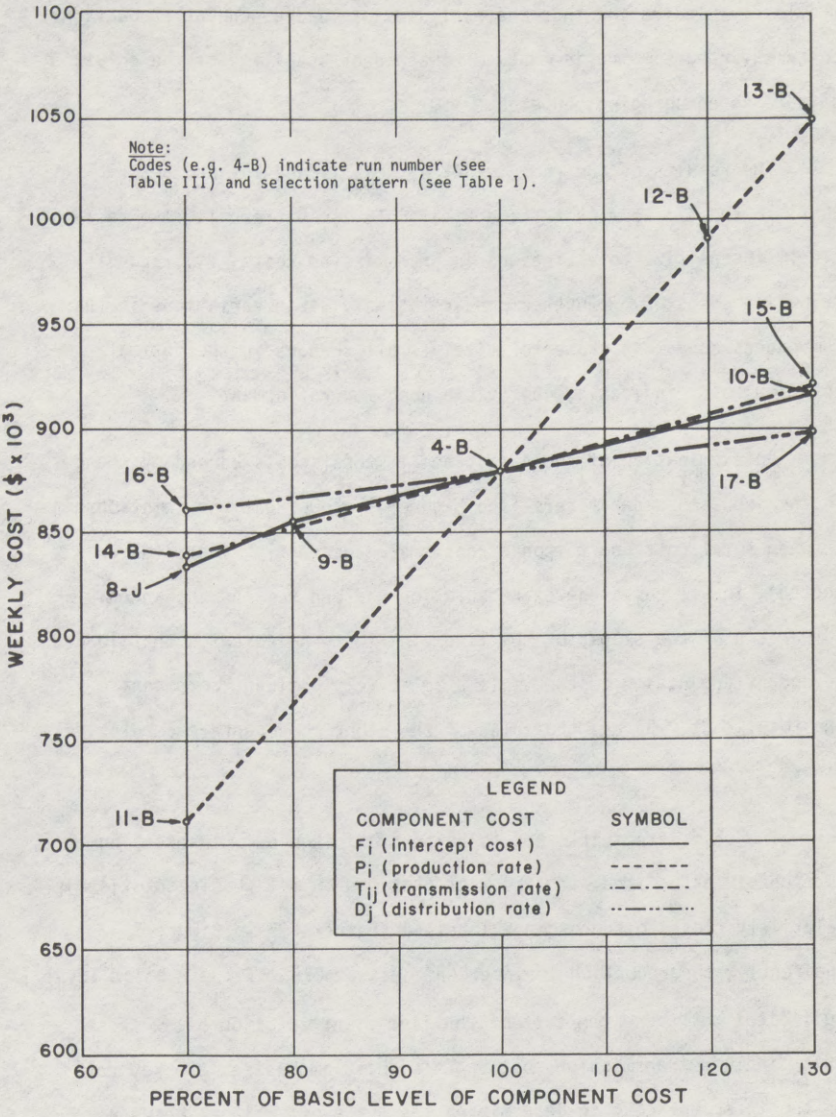


FIGURE 4. Optimal Solution Cost versus Changes in Component Costs

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previously, indicating that the estimates of load-dependent production costs may need some refinement. The apparent stability of the solution pattern is encouraging, however.

The results of the runs in Set 4 (Nos. 14 and 15) and Set 5 (Nos. 16 and 17) show that the optimal solution pattern is also relatively insensitive to variations in transmission costs, T_{ij}, and distribution costs, D_j. Furthermore, relatively large variations in these components appear to cause relatively small changes in the optimal solution cost, indicating negligible need for refinement.

An examination of the variations in total costs caused by changes in the input cost parameters (see Figure 4) shows that the relationships between total cost and component costs are apparently linear (as expected), in all cases where the solution pattern remains unchanged. Comparison of the slopes of the lines in Figure 4 indicates that load-dependent production cost, P_i, is a relatively dominant component of the total cost, whereas the roles of the other components are relatively minor.

The shift from pattern B to pattern J in Run 8 is interesting. It is probably associated with the fact that the 45-mile basic solution is relatively close to the segment labelled "Pattern J" in Figure 3. Apparently, the reduction in intercept costs to 70% of their basic level is sufficient to reduce the cost of the five-plant solution below those which include transmission costs. This shift emphasizes the key role of the intercept cost in determining the trade-off balance between production and transmission costs. If the intercept cost were zero,

the optimal solution would always include a plant at the nearest site to every load center, purely to minimize transmission costs. For the sample problem, it is apparent that the estimated value of the intercept cost (see Appendix B) is sufficiently small to make the solutions interesting when the transmission distances are of the order of 45 miles.

3.4 Costs of Restricting Maximum Generating Capacity

The sixth set of runs (Nos. 18 and 19) was designed to test the effect of a constraint on plant size by limiting the maximum generating capacity that may be installed at any site. Such a situation might arise in practice whenever the available cooling capacity of a receiving water body is known to be insufficient to dissipate more than a certain amount of waste heat. Alternatively, in the case of a nuclear plant, the amount of land available at a particular site might limit its maximum generating capacity in terms of the exclusion radius required to comply with the AEC regulations.

For the sample problem, the effects of restricting the maximum generating capacity at all sites are included in the summary in Table IV. It is apparent that a limit of M_i = 700 MW precludes the (basic run) use of a 750 MW plant (pattern B) and causes a shift to pattern C, with three plants and a consequent increase in the optimal solution cost. Similarly, when the M_i values are set at 450 MW, (i.e., less than the sum of demands from two load centers), the solution pattern again shifts, to pattern J, with a further cost increase. Of course, if the M_i are less than 250 MW, there is no feasible solution to the problem.

The relationship between optimal solution cost and maximum permissible generating capacity is shown in Figure 5. The scale on the left of this figure indicates the total weekly costs in the same units as for Figures 3 and 4. The corresponding lifetime costs (over a 30 year period) are presented for comparative purposes on the right side of Figure 5. It is evident, from this figure, that the cost of restricting the generating capacity to 700 MW, in this case, is of the order of $25,000,000.

TABLE IV. Summary of Other Sensitivity Runs
(Numbers in parentheses refer to footnotes of Table III)

Set No.	Run No.	Input Parameter Level								Opt. Patt.	Total Cost
		F_i	P_i	T_{ij}	D_j	M_i	C_k	Q	Z		
(Notes)		(1)	(1)	(1)	(1)	(2)	(2)	(2)	(2)	(3)	(3)
(Units)		%	%	%	%	MW	°F	cfs	mi	--	$\$x10^3$/wk
1	Base	100	100	100	100	1600	15	3000	45	B	880
6	18	"	"	"	"	700	"	"	"	C	895
6	19	"	"	"	"	450	"	"	"	J	925
7	20	"	"	"	"	1600	10	"	"	B	880
7	21	"	"	"	"	"	8	"	"	B	880
7	22	"	"	"	"	"	7	"	"	C	895
7	23	"	"	"	"	"	6	"	"	E	895
7	24	"	"	"	"	"	5	"	"	F	916.75
7	25	"	"	"	"	"	3	"	"	G	916.75
7	26	"	"	"	"	"	2	"	"	H	917.25
7	27	"	"	"	"	"	1	"	"	H	917.25
8	28	"	"	"	"	"	10	2500	"	B	880
8	29	"	"	"	"	"	"	2000	"	C	895
8	30	"	"	"	"	"	"	1500	"	D	895
8	31	"	"	"	"	"	"	1000	"	F	916.75
8	32	"	"	"	"	"	"	500	"	H	917.25

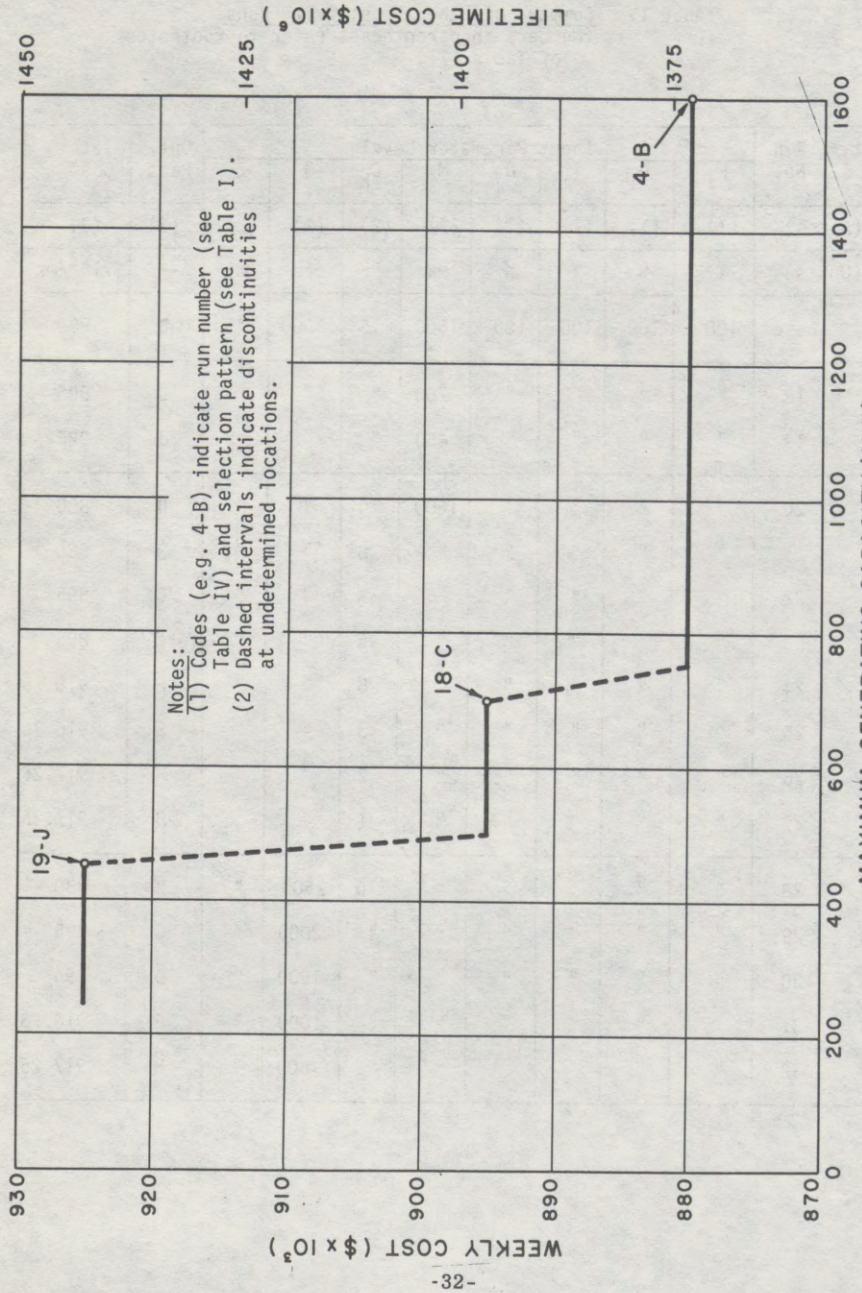

FIGURE 5. Optimal Solution Cost versus Maximum Generating Capacity

3.5 Costs of Complying with Temperature Standards

The variable results of the runs involving stream temperature standards (see Table IV, Set 7, Runs No. 20-27) indicate that, for the sample problem, temperature constraints are an important factor in the location decision. This analysis demonstrates the effect of an "excess temperature" standard, by which the stream temperature may not be raised above ambient more than a specified amount. Figure 6 shows the effect on the optimal solution cost of varying the maximum permissible excess temperature, C_k, over the range from 0°F to 15°F.

It is evident, from Figure 6, that the basic optimal solution (pattern B), which is effectively unconstrained when C_k = 15°F, remains optimal even when C_k is reduced to 8°F. When the permissible excess temperature is reduced to 7°F, however, the optimal solution shifts to pattern C, which is the same three-plant solution that appeared when maximum generating capacities were limited to 700 MW in the previous section. Thus the lifetime cost of this 1°F reduction in permissible temperature is about $25,000,000 as before.

An interesting intermediate case occurs when C_k is reduced to 6°F. At this point, the pattern C solution is apparently no longer satisfactory, although an equivalent three-plant solution (pattern E, see Figure 2) is selected at no extra cost. Apparently pattern E is preferred, in this case, because it separates the two larger (500 MW) plants by a greater distance (180 miles), thereby yielding a lower combined excess temperature at the most downstream sampling station. It should be noted, however, that when C_k = 7°F, the model probably selects pattern C,

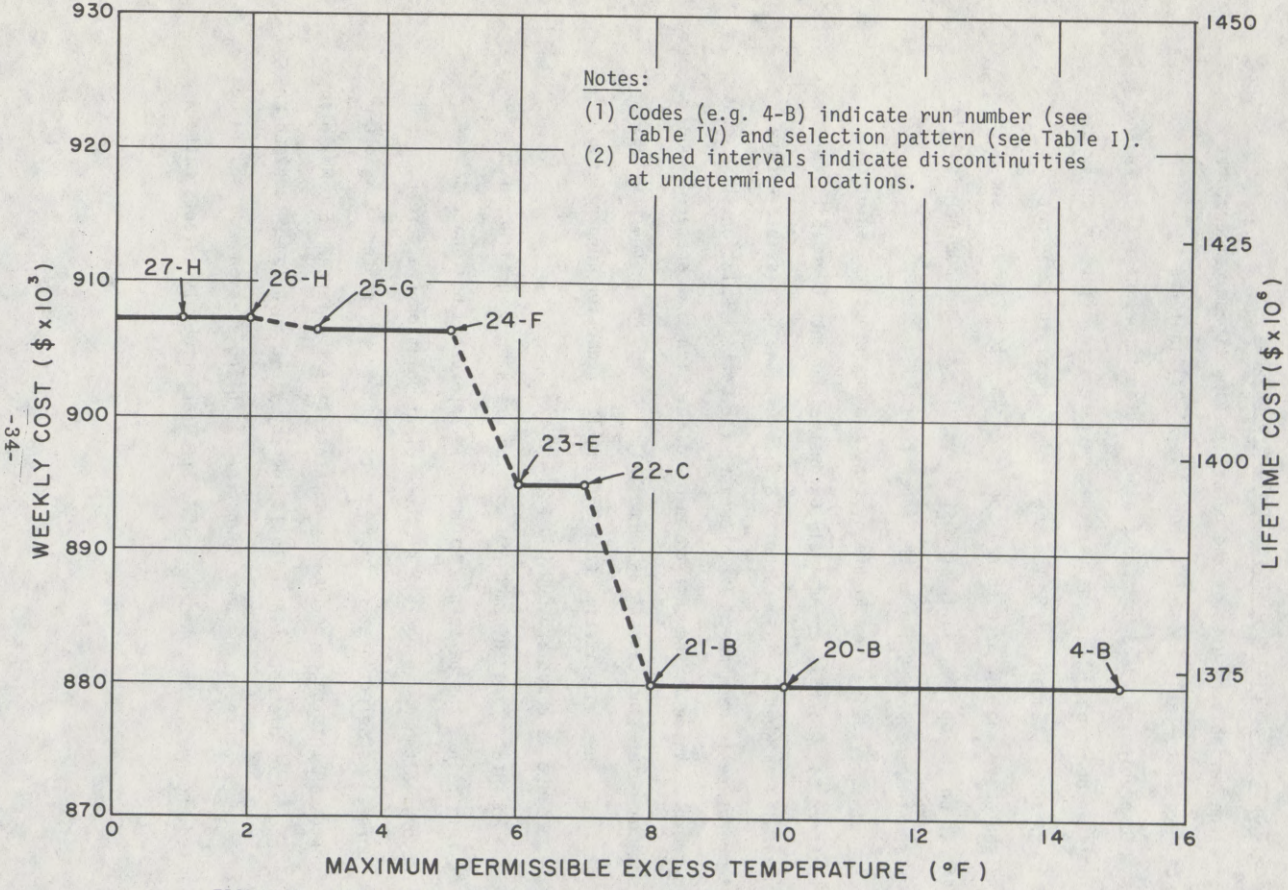

FIGURE 6. Optimal Solution Cost versus Maximum Permissible Excess Temperature

rather than pattern E, purely by chance. This emphasizes the need to test the sensitivity of the model's optimal solutions.

Since pattern E represents the lowest-temperature three-plant solution, it is not surprising that a further reduction in C_k invokes the use of supplementary cooling facilities. When C_k is reduced to 5°F, the optimal solution shifts to pattern F, accompanied by a significant increase in lifetime cost (about $35,000,000). Pattern F utilizes a single 750 MW plant complete with abatement equipment, and two 250 MW plants with once-through cooling systems.

Further reductions in maximum permissible excess temperature cause relatively insignificant changes in the optimal solution. First, when C_k = 3°F, pattern G is selected, in preference to pattern F (at no extra cost) for the same reason that pattern E superseded pattern C previously. In pattern G, the two 250 MW plants are located as far apart as possible, in order to permit the maximum amount of surface cooling to occur between them. Finally, when C_k = 2°F, the optimal solution shifts to pattern H, involving two plants (750 MW and 500 MW) both with abatement equipment. Of course, this solution is satisfactory for all more stringent excess temperature standards, since it is assumed that no excess heat is permitted to reach the stream in this case.

In summary, therefore, it is evident that the overall effect of reducing permissible excess temperatures in the receiving water from 8°F to 5°F may be to raise the lifetime cost of the unconstrained optimal solution by as much as 4% ($60,000,000 for the sample problem).

Further reduction, however, has negligible effect on total costs in this case. This apparently erratic sensitivity of the optimal solution to variations in temperature standards emphasizes the importance of using this technique to ensure that arbitrary decisions involving temperature standards are not made without a full appreciation of their consequences.

3.6 Sensitivity to Variations in Stream Flow

The sensitivity runs involving variations in stream flow were designed to test the dependence of the results of the previous section on the values of the stream flows on which the excess temperature computations are based. An excess temperature standard of 10°F was used for these runs because it was considered to represent a more practical level for this purpose than the 15°F value (which had been arbitrarily inflated for the first set of runs in order to ensure that the basic solution would be unconstrained).

Runs 28 to 32 in Table IV, plotted in Figure 7, indicate that reducing the stream flow from 3000 cfs to 500 cfs involves four shifts in optimal solution pattern and similar increases in total costs to those observed in the preceding section. A comparison of Figures 6 and 7 shows that both tests began with the basic pattern B and shifted through patterns C and F to pattern H as conditions in the stream became more restrictive. It is apparent, therefore, that both stream flows and maximum permissible temperatures warrant a similarly high degree of attention.

Ultimately, it would be desirable to base the maximum temperature considerations on a low flow with a specified probability of occurrence (rather than to choose a historical low flow, which may be statistically extreme) and to test the optimal siting model for sensitivity to temperature criteria at this level. For discussion of a proposed siting model with such probabilistic temperature constraints, the reader is referred to Appendix C.

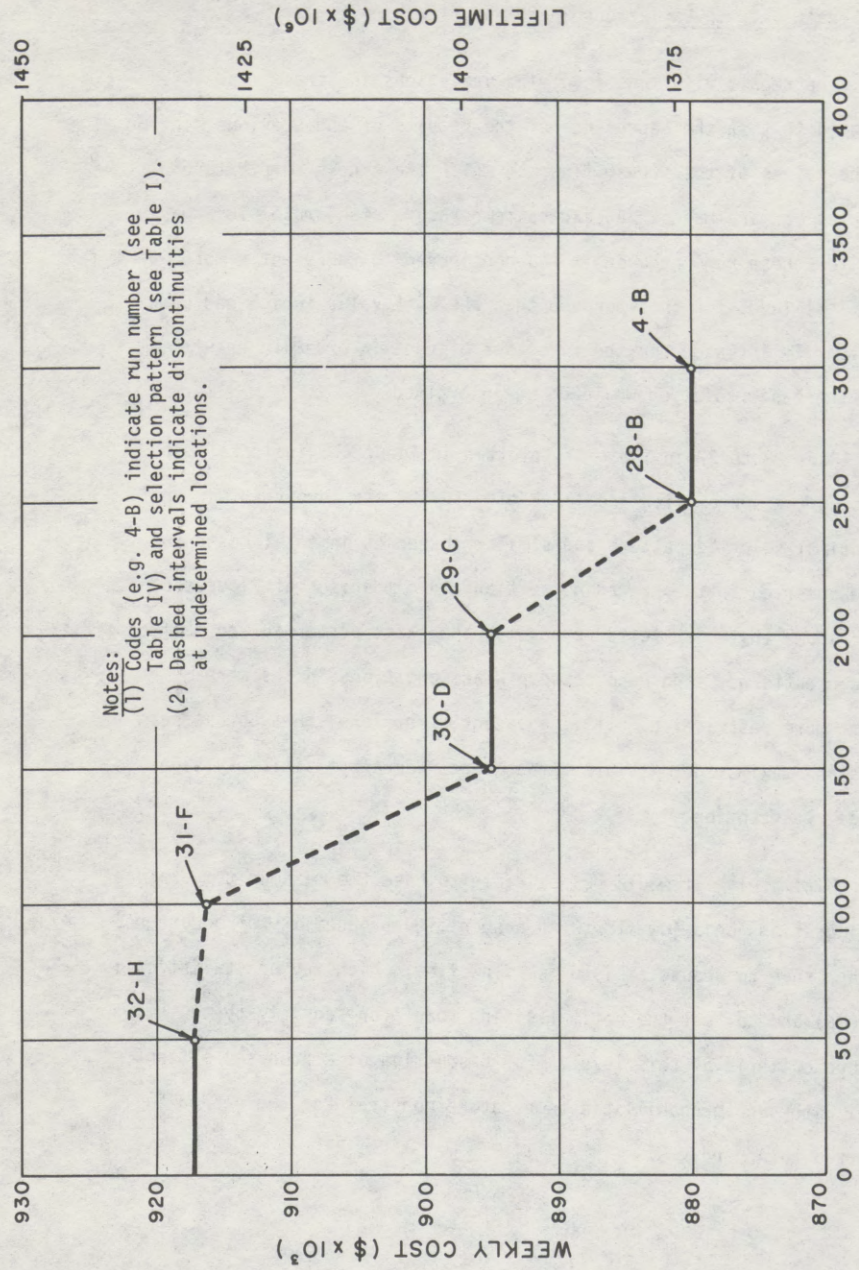

FIGURE 7. Optimal Solution Cost versus Stream Flow

4. SUMMARY

The results of this study demonstrate that physical factors which influence the siting of proposed generating plants in a localized electric power system can be successfully modelled in mathematical form. Such models can be used to obtain information concerning the sensitivity of their optimal solutions to various cost and environmental factors, which results in a generally improved understanding of the system as a working unit.

In particular, the zero-one integer model has been developed for use in determining the optimal choice of locations for thermal generating plants in a sample problem, based on the lowest total cost of satisfying the demand for power in a given region. This application has demonstrated that, in the sample problem, the optimal solution depends critically and unpredictably on the temperature constraints assumed for the receiving water body.

Such an analysis can be of immense value to public regulatory agencies and industry executives faced with siting decisions.

Work on the less restrictive but currently unsolved mixed-integer and probabilistic models is the next step in the development of optimal siting models for thermal plants with temperature constraints. This constitutes a current objective of the physical program of the EEI Cooling Water Discharge Project.

APPENDIX A

NOTATION

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APPENDIX A

NOTATION

A1. Symbols Used in Mathematical Formulations

Symbol	Definition	Units
A_{ik}	Temperature transfer coefficient between plant alternative i and sampling station k	--
C_k	Maximum permissible excess temperature at sampling station k	°F
C_p	Specific heat of water	Btu/lb/°F
D_j	Cost rate for distribution at load center j	$/wk/MW
F_i	Intercept cost for production at plant alternative i	$/wk
H	Waste heat	Btu/hr
h	Flow depth of stream	ft
K	Surface cooling coefficient	$Btu/ft^2/day/°F$
k	Coefficient in temperature die-away equation	ft^{-1}
L_j	Power demand at load center j	MW
M_i	Maximum permissible generating capacity of plant alternative i	MW
NC	Number of receiving water sampling stations	--
NL	Number of load centers	--
NP	Total number of plant alternatives for all sites	--
NS	Number of different sites to be investigated	--
P_i	Load-dependent cost rate for production at plant alternative i	$/wk/MW
Q	Stream flow	ft^3/sec,cfs
q	Number of time periods under consideration in model with probabilistic temperature constraints	--
R_i	Unit temperature rise at the site of plant alternative i	°F/MW

Symbol	Definition	Units
T_o^*, T^*	Initial and downstream excess temperatures in temperature die-away equation	°F
T_{ij}	Cost rate for transmission from plant alternative i to load center j	$/wk/MW
U	Mean velocity of stream	ft/sec
w	Mean width of stream	ft
X_i	Plant selection coefficient (unity if selected, and zero otherwise)	--
Y_{ij}	Load assignment coefficient (unity if plant alternative i is assigned to serve load center j, zero otherwise)	--
Y'_{ij}	Amount of power transmitted from plant alternative i to load center j in mixed integer formulation	MW
Z	Interplant distance	mi
α	Thermal efficiency	--
ρ	Density of water	lb/ft^3

A2. Index of Computer Program Code Names

Code Name	Definition	Mathematical Symbol
C(I)	First NALTS numbers: Intercept cost for production at plant alternative i	F_i
	Next NALTS*NDMDA numbers: Cost rate for transmission from plant alternative i to load center j	T_{ij}
CAP(I)	Maximum permissible generating capacity of plant alternative i	M_i
COORD(I)	Downstream distance (in feet from site 1) of each plant site and stream sampling point	--
DEPTH	Flow depth of stream	h
DMD(J)	Power demand of load center j	L_j
HEAT(I)	Unit temperature rise at the site of plant alternative i	R_i
MAXT	Internal execution time cutoff	--
NALTS	Total number of plant alternatives for all sites	NP
NDMDA	Number of load centers	NL
NFSITE(I)	Number of first plant alternative at site i	--
NHCONS	Number of receiving water sampling stations	NC
NSITES	Number of different sites to be investigated	NS
U(J)	Cost rate for distribution at load center j	D_j
VAR(I)	Load-dependent cost rate for production at plant alternative i	P_i
VELOC	Mean velocity of stream	U
WIDTH	Mean width of stream	w

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APPENDIX B

SAMPLE PROBLEM FOR THE ZERO-ONE INTEGER MODEL

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B5.	Computation of Temperature Constraint Parameters	B 78
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B1. Development of Input Cost Data

In order to assess the true value of the model, it was necessary to use reasonably realistic estimates of the various costs involved in building and operating an electric power system to supply a given demand. Of great value in the evaluation of these cost estimates was a research report prepared by Battelle-Northwest (6). A Federal Water Pollution Control Administration (FWPCA) publication on industrial waste (2) was also helpful in estimating cooling system costs.

(a) Production Costs

As indicated in Section 2.5 of this report, the total production cost (capital plus operating cost) must be subdivided into two components --the "intercept" and "load-dependent" costs--by plotting total plant cost versus generating capacity for several plant sizes, extrapolating the straight line of best fit back to zero generating capacity, and observing the intercept and slope of this line. A good basis for constructing such a plot is the classical graph of power production cost versus generating capacity which shows the typical hyperbolic decrease in cost per unit of production made possible by the economies of scale. Such a graph is reproduced here as Figure 8.*

The dashed curve in Figure 8 shows the power production cost in $/MW-hr (=mills/KW-hr) as a function of the plant generating capacity. To convert this relationship to yield the total production cost in units convenient for computer use (e.g., $/wk) the following conversion was used:

Total production cost ($/wk) = Power production cost ($/MW-hr) x (168 hr/wk) x Plant capacity (MW).

*Adapted from "Power Generation Costs as a Function of Plant Size for Public Agency Financing at 4-1/2% Interest, 80% Plant Factor," Fig. III.2-9, p. 507, Reference (6).

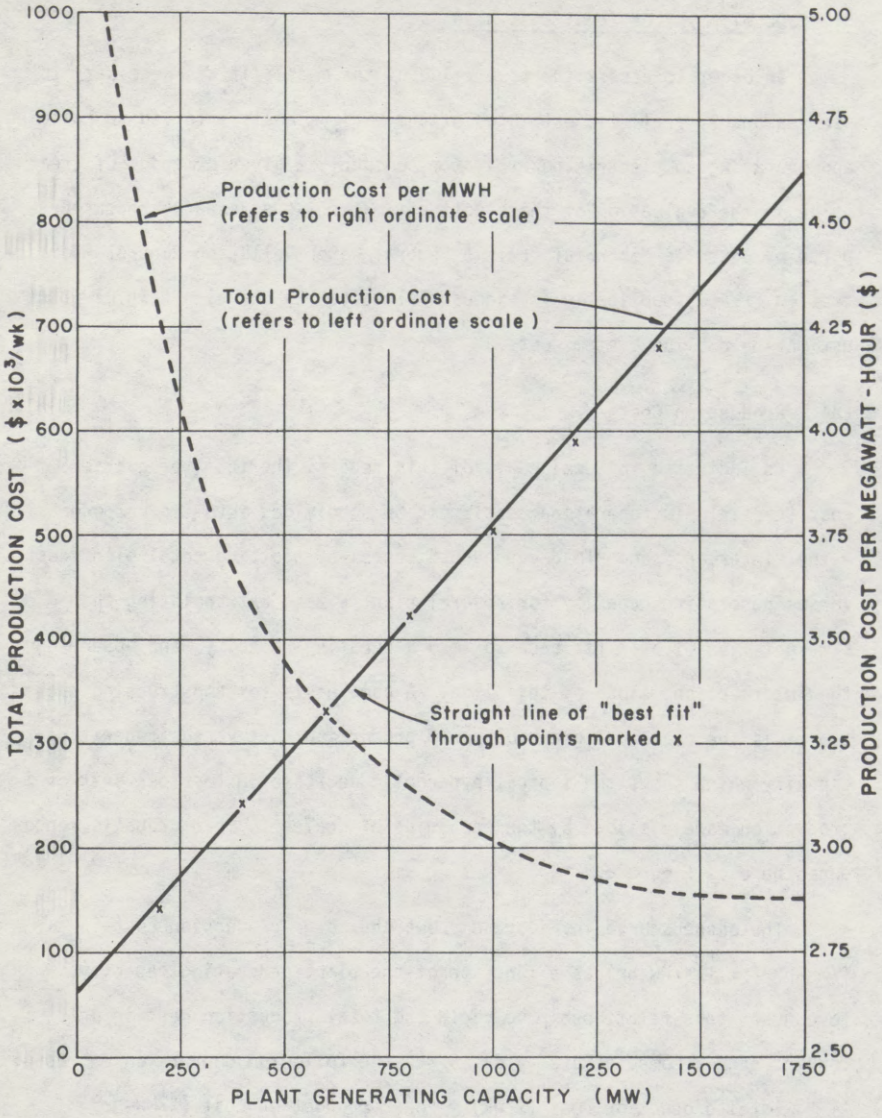


FIGURE 8. Power Production Costs versus Plant Generating Capacity

The straight line of "best fit" for the total production cost curve (solid line in Figure 8) was then extrapolated back through zero generating capacity. The resulting intercept cost, F_i, is thus approximately \$60,000/wk.

The load-dependent production cost rate, P_i, as determined by the slope of the solid line in Figure 8, is approximately \$450/wk/MW. It should be noted that the straight line of "best fit" exhibits a maximum deviation from the points on which it was based of less than 5% over the capacity range from 200 MW to 1600 MW.

(b) Supplementary Cooling Costs

According to Reference (6), cooling towers for disposing of the surplus heat from a 1000 MW nuclear-fueled power plant with a capital cost of \$130 million would cost an additional \$6.5 million. Reference (2) cites a cost of \$200 per °F of cooling per cfs of coolant flow in estimating the cost of natural draft cooling towers, which, for a 1000 MW power plant with a condenser temperature rise of 20°F and a coolant flow of 1600 cfs, yields a cost of \$6.4 million, which is in close agreement with the above figure. Since these figures constitute approximately 5% of the total capital cost of a 1000 MW plant cited above, it was decided to adopt this fraction as a basis for converting the values of F_i and P_i estimated in the previous section for application to plant alternatives with abatement equipment (viz., F_i = \$63,000/wk and P_i = \$475/wk/MW).

Transmission and Distribution Costs

A rate of \$2000/MW/mile was assumed for the capital costs of construction (including right-of-way) of transmission lines between plants and load centers. When this construction cost rate is amor-

tized at 8% over an assumed 30-year lifetime, a weekly cost of approximately $3.50/MW/mile is obtained. The National Power Survey (1964), referred to in Reference (6), cites power losses amounting to 0.3 mills/KW-hr/100 miles for bulk power transmission. This is equivalent to about 50 cents/MW/mile on a weekly basis. Combining the amortized capital cost and the above figure for transmission losses yields a load-dependent transmission cost rate of approximately $4/wk/MW/mile.

Distribution costs at the load centers (which, as pointed out in Section 3.1, do not affect the optimization since they are constant throughout) were arbitrarily assumed to be $50/wk/MW.

B2. Size Constraints on Input Parameters

When working with a 32,000-word memory machine such as the IBM 7000 series, the following constraints on the variable size (using the notation summarized in Appendix A) must be met:

$$NALTS + NALTS * NDMDA \leq 90$$

$$NSITES + NALTS + NDMDA + NHCONS \leq 34$$

and in addition:

$$NALTS \leq 10$$

$$NDMDA \leq 10$$

$$NHCONS \leq 7$$

$$NSITES \leq 7$$

MAXT is an internal execution time cutoff which may be set as desired--180 seconds is recommended for a problem such as this sample.

B3. Input Data Card Format Requirements

Table V illustrates the coding of input data for the sample problem. The general grouping and formats of input data cards are as follows (numbers in parentheses after input variables refer to card columns):

1. Problem title card:

   Title (1-72) (Any identifying information)

2. Problem size cards:

   Card 1 - Format(8I10) - NALTS(1-10),NDMDA(11-20),NHCONS(21-30), NSITES(31-40),MAXT(41-50)

   Card 2 - Format(8I10) - NFSITE(1)(1-10),NFSITE(2)(11-20),...

3. Plant alternative cards:

   Card 1 - Format(4F15.0) - C(1)(1-15),CAP(1)(16-30),HEAT(1)(31-45)*, VAR(1)(46-60) *See para. 6.

   Card 2 - Format(4F15.0) - C(2)(1-15),...

4. Transmission cost rate cards:

   Card 1 - Format(8F10.0) - T_{11}(1-10),T_{12}(11-20),T_{13}(21-30),..., T_1,NDMDA(--),T_{21}(--),...

   Card 2 - Format(8F10.0) - etc.

5. Load center cards:

   Card 1 - Format(8F10.0) - DMD(1)(1-10),U(1)(11-20)

   Card 2 - Format(8F10.0) - DMD(2)(1-10),...

6. Mixed temperature cards:

   Option 1 (mixed temperature rise known):

   On plant alternative cards, punch HEAT(I)(31-45) according to format in para. 3.

   One mixed temperature card is punched as follows:

   Card 1 - Format(I1) - zero(col. 1)

Option 2 (mixed temperature rise to be computed):

On plant alternative cards, punch one in col. 45 if the plant alternative uses a once-through cooling system, zero if the plant alternative uses a cooling pond or cooling towers.

Mixed temperature cards:

Card 1 - Format(I1) - one(col. 1)

Card 2 - Format(3F8.2) - VELOC(1-8),WIDTH(9-16),DEPTH(17-24)

7. Transfer coefficient cards:

Option 1 (transfer coefficients known):

Card 1 - Format(I1) - zero(col. 1)

Card 2 - Format(15F5.3) - A_{11}(1-5),A_{12}(6-10),...,$A_{1,NSITES}$

Card 3 - Format(15F5.3) - A_{21}(1-5),...

Option 2 (transfer coefficients to be computed):

Card 1 - Format(I1) - one(col. 1)

Card 2 - Format(7F10.0) - COORD(1)(1-10),COORD(2)(11-20),...,
COORD(7)(61-70) (COORD(I)=distance from most upstream plant site in feet)

Card 3 - Format(7F10.0) - COORD(8)(1-10),...

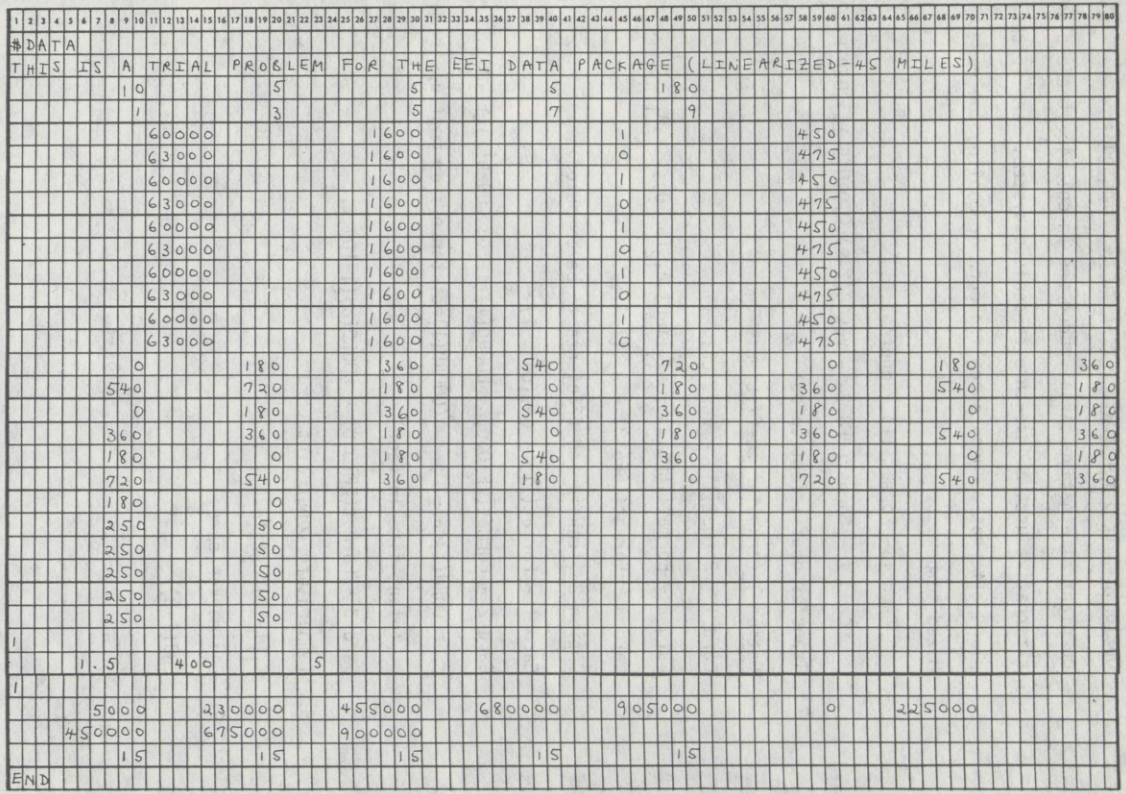
8. Temperature constraint card:

C_1(1-10),C_2(11-20),...

9. End marker card:

END(1-3)

TABLE V. Coding of Input Data for Sample Problem



B4. Listing of Computer Program

A listing of the computer program used to solve the sample problem described in this report appears on the following pages. Copies of the FORTRAN IV card deck for this program may be obtained by writing to the authors at The Johns Hopkins University.

```
C                        LOCATION MODEL 2
C                        ----------------
C
C
C     THIS PROGRAM IS DESIGNED AS AN AID IN MAKING DECISIONS CONCERNING
C     THE OPTIMAL LOCATION OF THERMAL GENERATING PLANTS.
C
C     DEFINITION OF VARIABLES
C     -----------------------
C     NALTS     =TOTAL NUMBER OF PLANT ALTERNATIVES FOR ALL SITES
C     NDMDA     =NUMBER OF LOAD CENTERS
C     NSITES    =NUMBER OF DIFFERENT SITES TO BE INVESTIGATED
C     NHCONS    =NUMBER OF RECEIVING WATER SAMPLING STATIONS
C     MAXT      =INTERNAL TIME CUTOFF
C     NFSITE(I)=NUMBER OF FIRST PLANT ALTERNATIVE AT SITE I
C     C(I)      =COST VECTOR
C     VAR(I)    =LOAD-DEPENDENT COST RATE FOR PRODUCTION AT PLANT ALT. I
C     U(J)      =COST RATE FOR DISTRIBUTION AT LOAD CENTER J
C     DMD(J)    =POWER DEMAND OF LOAD CENTER J
C     CAP(I)    =MAXIMUM PERMISSIBLE GENERATING CAPACITY OF PLANT ALT. I
C     HEAT(I)   =UNIT TEMPERATURE RISE AT SITE OF PLANT ALTERNATIVE I
C
      INTEGER S,SMAX,SC,T                                              00080
      DIMENSION A(50,90),JF(50,90),B(100),C(100),BS(100),S(100),SB(100)
      DIMENSION NS(100),NF(100),ITEMP(4),JTEMP(4),ATEMP(4),SMAX(100)
      DIMENSION SMAXB(100),T(100),CS(100),XL(90),D(90),E(90,90),JH(100)
      DIMENSION XX(100),Y(100),PE(100),KO(6)
      COMMON/PARAM/NALTS,NDMDA,NHCONS,NSITES,MAXT
      COMMON/STRM/TRANS(7,7),SPDIST(7,7),COORD(30),HEAT(10),HSTAN(10)
      COMMON/MISC/ISCMAX,ISCFR,KENUM,SC,L,MAXC,NOP,ZKBAR,ITB,NCHK
      COMMON/ODD/VER,COOL,EFF,M,N
      COMMON/PLANT/CAP(10),CC(100),VAR(10),U(10),DMD(10),NFSITE(10),
     *TITLE(12)
      COMMON /BLS/MS(90),ZBAR                                          00090
      COMMON /VWD/VELOC,WIDTH,DEPTH
      DATA BCIB/6HB      /
      DATA BLANK/6H      /
  100 DO 110 I=1,90                                                    00120
      MS(I)=0
      XL(I)=0.0
      D(I)=0.0
      DO 105 J=1,90
  105 E(J,I)=0.0
      B(I)=0.0                                                         00130
      C(I)=0.0                                                         00140
      BS(I)=0.0                                                        00150
      S(I)=0                                                           00160
      SB(I)=BLANK                                                      00170
      NS(I)=0                                                          00180
      NF(I)=0                                                          00190
      SMAX(I)=0                                                        00200
      SMAXB(I)=BLANK                                                   00210
      T(I)=0                                                           00220
      DO 110 J=1,50                                                    00230
      A(J,I)=0.0                                                       00240
      JF(J,I)=0.0                                                      00250
```

```
  110 CONTINUE                                                          00260
      DO 115 I=1,100
      JH(I)=0
      XX(I)=0.0
      Y(I)=0.0
      PE(I)=0.0
  115 CONTINUE
      II=0                                                              00270
      NCON=0                                                            00280
      NRED=0                                                            00290
      NAUG=0                                                            00300
      NOPT=0                                                            00310
      NID=0                                                             00320
      NAP=0                                                             00330
      NLPF=0                                                            00340
      NSIMP=0                                                           00350
      NFATH=0                                                           00360
      NENUM=0                                                           00370
      NTCE=0                                                            00380
      NCID2=0                                                           00390
      IPOST=1                                                           00400
      IFRST=1                                                           00410
      IINS=5                                                            00420
C  READ A NEW SET OF DATA                                               00430
C  PARAMETER CARD FIRST                                                 00440
C  'S' CARD SECOND                                                      00450
C  'C','B','A' MATRICES FOLLOW 'S'                                      00460
C  MINIMIZE SUM C(J)*X(J)                                               00470
C  CONSTRAINTS ARE B(I)+SUM A(I,J)*X(J) GE ZERO                         00480
      CALL EEIPKG(C)
      WRITE(6,9993)                                                     00520
 8105 FORMAT(12A6)
 8106 FORMAT(5I10)
 8113 FORMAT(8F10.0)
 9000 FORMAT (4I3,I5,E6.0,3I3,I5,I3,E6.0,I3,2A6)                        00510
C     WRITE(6,9001)M,N,L,SC,KENUM,ZBAR,ISCMAX,ISCFR,MAXC,MAXT,           00530
C    *          NOP,ZKBAR,ITB,H1,H2                                     00540
 9001 FORMAT (4I3,I5,1X,E11.4,3I3,I5,I3,E11.4,1X,I3,1X,2A6)             00550
      IF (MAXT.EQ.0) MAXT=999999                                        00560
      MAXT=1000*MAXT                                                    00570
      MO=M                                                              00580
      M1=MO+1                                                           00590
      JSCFR=ISCFR                                                       00600
      ZKBAR=ZKBAR+.99999                                                00610
C     WRITE(6,9010)M,N                                                  00620
 9010 FORMAT (3HOM=,I3,2X,2HN=,I3)                                      00630
C     WRITE(6,9992)                                                     00640
 9991 FORMAT (1H )                                                      00650
 9992 FORMAT (1HO)                                                      00660
 9993 FORMAT (1H1)                                                      00670
      L1=L                                                              00680
      IF (L.LE.0) L1=0                                                  00690
 9100 FORMAT (14(I4,A1))                                                00710
      IF (L.GE.0) GO TO 130                                             00720
      L=0                                                               00730
      IFRST=0                                                           00740
```

```
  130 CONTINUE                                                          00750
 9200 FORMAT (6(E11.0,1X))                                              00770
 8109 FORMAT(3F10.0)
 8110 FORMAT(F10.0)
   11 FORMAT(F3.0)
 8112 FORMAT(15F5.4)
      IF (MAXC.EQ.0) GO TO 141                                          00790
      DO 140 J=1,N                                                      00800
  140 C(J)=-C(J)                                                        00810
  141 CONTINUE                                                          00820
C COMPUTE CONSTRAINTS
      DO 8114 KI=1,NSITES
      NDELTA=NFSITE(KI+1)-NFSITE(KI)
      DO 8115 J=1,NDELTA
      KJ=NFSITE(KI)+J-1
      CALL CLASS(KI,KJ,NF,JF)
 8223 FORMAT( 2X,4I5,F20.2)
 8224 FORMAT(2X,I10,F10.0)
 8115 A(KI,KJ)=-1.0
 8114 B(KI)=1.0
      DO 8116 I=1,NALTS
      KI=NSITES+I
       KJ=I
      CALL CLASS(KI,KJ,NF,JF)
      A(KI,KJ)=CAP(I)
C     WRITE (6,8223) KI,KJ,NF(KI),JF(KI,KJ),A(KI,KJ)
      DO 8117 J=1,NDMDA
      KJ=NALTS+(I-1)*NDMDA+J
      CALL CLASS(KI,KJ,NF,JF)
 8117 A(KI,KJ)=-DMD(J)
      B(KI)=0.0
 8116 CONTINUE
C EQUALITY CONSTRAINTS
      DO 8118 I=1,NDMDA
      KI=NALTS+NSITES+I
      DO 8119 J=1,NALTS
      KJ=NALTS+NDMDA*(J-1)+I
      CALL CLASS(KI,KJ,NF,JF)
      A(KI,KJ)=1.0
 8119 CONTINUE
      B(KI)=-1.0
 8118 CONTINUE
C HEAT CONSTRAINTS
      DO 8121 NSP=1,NHCONS
      KI=NALTS+NDMDA+NSITES+NSP
      KJ=NALTS
      DO 8122 NPS=1,NSITES
      NDELT=NFSITE(NPS+1)-NFSITE(NPS)
      DO 8122 J=1,NDELT
      NAS=NFSITE(NPS)+J-1
      DO 8122 JJ=1,NDMDA
      KJ=KJ+1
      CALL CLASS(KI,KJ,NF,JF)
      A(KI,KJ)=-TRANS(NSP,NPS)*HEAT(NAS)*DMD(JJ)
C     WRITE(6,8223) KI ,KJ,NF(KI),JF(KI,KJ),A(KI,KJ)
 8122 CONTINUE
```

```
      B(KI)=HSTAN(NSP)
 8121 CONTINUE
 8107 FORMAT(2I10)
 9500 FORMAT (14(3X,I4,A1))                                          01030
C     WRITE(6,9600)(C(J),J=1,N)                                     01050
C     WRITE(6,9600)(B(I),I=1,M)                                     01070
C     WRITE (6,9993)
C     DO 251 I=1,M                                                  01090
C     WRITE(6,9600)(A(I,J),J=1,N)                                   01100
C     WRITE(6,9991)                                                 01110
C 251 CONTINUE                                                      01120
C     WRITE(6,9992)                                                 01130
      CALL PROUT(C)
C  ALL DATA READ FOR THIS RUN                                       01140
C  PERFORM CHANGE OF VARIABLES NOW IF NECESSARY                     01150
      DO 255 J=1,N                                                  01160
      CS(J)=C(J)                                                    01170
      IF (C(J).GE.0.0) GO TO 255                                    01180
      C(J)=-C(J)                                                    01190
      DO 253 I=1,M                                                  01200
      B(I)=B(I)+A(I,J)                                              01210
  253 A(I,J)=-A(I,J)                                                01220
  255 CONTINUE                                                      01230
 9600 FORMAT (6(2X,1PE15.8))                                        01240
      IF (ZBAR.GT.0.0) GO TO 300                                    01250
      ZBAR=0.0                                                      01260
      DO 275 J=1,N                                                  01270
  275 ZBAR=ZBAR+C(J)                                                01280
  300 ZS=0.0                                                        01290
      DO 325 I=1,M                                                  01300
  325 BS(I)=B(I)                                                    01310
      DO 330 J=1,N                                                  01320
  330 NS(J)=J                                                       01330
      IF (L.EQ.0) GO TO 400                                         01340
      DO 375 K=1,L                                                  01350
      J1=S(K)                                                       01360
      K1=IABS(J1)                                                   01370
      NS(K1)=0                                                      01380
      IF (J1.LE.0) GO TO 375                                        01390
      ZS=ZS+C(J1)                                                   01400
      DO 350 I=1,M                                                  01410
  350 BS(I)=BS(I)+A(I,J1)                                           01420
  375 CONTINUE                                                      01430
  400 CONTINUE                                                      01440
      IF (M0+ISCMAX.GT.50) ISCMAX=50-M0                             01450
      I1=M0+ISCMAX                                                  01460
      DO 425 I=M1,I1                                                01470
      NF(I)=N                                                       01480
      DO 425 J=1,N                                                  01490
      JF(I,J)=J                                                     01500
  425 CONTINUE                                                      01510
      CALL DATIME(0,IT0)
      IT1=IT0                                                       01530
      IT2=IT0                                                       01540
      IT3=IT0                                                       01550
C  INITIALIZATION COMPLETE NOW. START FIRST ITERATION               01560
```

```
      GO TO 1910                                                        01570
C  PREPARE TO COMPUTE SURROGATE CONSTRAINT                             01580
 1000 CONTINUE                                                         01590
      IF (SC.EQ.0) GO TO 2400                                          01600
      JSCFR=JSCFR+1                                                    01610
      IF (ISCFR.GT.JSCFR) GO TO 2400                                   01620
      ML=N-L                                                           01630
      IF (ML.LE.1) GO TO 2400                                          01640
      JSCFR=0                                                          01650
 1050 DO 1060 J=1,N                                                    01660
 1060   MS(J)=0                                                        01670
      NSIMP=NSIMP+1                                                    01680
      IF(L.EQ.0) GO TO 1076                                            01690
      DO 1075 I=1,L                                                    01700
        J=IABS(S(I))                                                   01710
 1075   MS(J) =-S(I)                                                   01720
      IF (NOP.NE.0) GO TO 1076                                         01730
      WRITE(6,3600) (S(K),SB(K) ,K=1,L)                                01740
C  SOLVE THE IMBEDDED LINEAR PROGRAM                                   01750
 1076 CALL SIMPLE(II,N,MO,A,C,B,KO,XL,D,JH,XX,Y,OBJ,E,NOP)
      IF (NOP.NE.0) GO TO 1077                                         01770
      WRITE(6,9600)OBJ,ZBAR                                            01780
 1077 CONTINUE                                                         01790
      II=II+IPOST                                                      01800
C  KO(1) EQ 0 MEANS OBJ LESS THAN ZBAR, EQ 2 MEANS INFINITY, EQ 4 MEANS 01810
C  TROUBLE, EQ 6 MEANS OBJ GE ZBAR                                     01820
      IF (KO(1).EQ.2) GO TO 3400                                       01830
      IF (KO(1).EQ.4) GO TO 100                                        01840
      IF (KO(1).EQ.6) GO TO 1500                                       01850
      VLPS=-OBJ                                                        01860
      IF (VLPS.LE. (-ZBAR))GO TO 1499                                  01870
      DO 1350 I=1,N                                                    01880
      IF (D(I).NE.AINT(D(I)).AND.NS(I).NE.0)  GO TO 1500               01890
 1350 CONTINUE                                                         01900
      DO 1450 J=1,N                                                    01910
      IF (NS(J).EQ.0) GO TO 1450                                       01920
      I=J                                                              01930
      L=L+1                                                            01940
      NS(J)=0                                                          01950
      SB(L)=BCIB                                                       01960
      IF (D(I).NE.0.0) GO TO 1400                                      01970
      S(L)=-J                                                          01980
      GO TO 1450                                                       01990
 1400 S(L)=J                                                           02000
      ZS=ZS+C(J)                                                       02010
      DO 1425 I1=1,M                                                   02020
 1425 BS(I1)=BS(I1)+A(I1,J)                                            02030
C  NATURAL DUAL INTEGER SOLUTION FOUND                                 02040
 1450 CONTINUE                                                         02050
      NID=NID+1                                                        02060
      GO TO 2320                                                       02070
 1499 KO(1)=6                                                          02080
C  COMPUTE NEW SURROGATE CONSTRAINT                                    02090
 1500 IF (ISCMAX.LE.0) GO TO 1599                                      02100
      BMP1=ZBAR                                                        02110
      DO 1505 I=1,MO                                                   02120
```

```
 1505 BMP1=BMP1+XL(I)*B(I)                                              02130
      IF (ABS(BMP1-B(M)).LE.0.0005) GO TO 1599                          02140
      IF (M-M0.LT.ISCMAX) GO TO 1520                                    02150
      DO 1510 I=M1,M                                                    02160
      B(I)=B(I+1)                                                       02170
      BS(I)=BS(I+1)                                                     02180
      DO 1510 J=1,N                                                     02190
 1510 A(I,J)=A(I+1,J)                                                   02200
      M=M-1                                                             02210
 1520 B(M+1)=BMP1                                                       02220
      DO 1550 J=1,N                                                     02230
      ZJH =XX(J)                                                        02240
      IF (JH(J).GE.(-N)) ZJH=-ZJH                                       02250
      IF (JH(J).GT.0) ZJH=0.                                            02260
 1550 A(M+1,J)=ZJH                                                      02270
      M=M+1                                                             02280
      BS(M)=B(M)                                                        02290
      DO 1575 K=1,L                                                     02300
      K1=S(K)                                                           02310
      IF (K1.LE.0) GO TO 1575                                           02320
      BS(M)=BS(M)+A(M,K1)                                               02330
 1575 CONTINUE                                                          02340
      IF (NOP.NE.0) GO TO 1599                                          02350
      WRITE(6,1598)M                                                    02360
      WRITE(6,9600)(A(M,J),J=1,N),B(M),BS(M)                            02370
 1598 FORMAT (22HOSURROGATE CONSTRAINTS,2X,I4)                          02380
 1599 IF (KO(1).EQ.6) GO TO 3400                                        02390
C  CHECK THE ROUNDED DUAL SOLUTION FOR FEASIBILITY                     02400
 1900 CONTINUE                                                          02410
      TD=.5                                                             02420
  900 F=ZS                                                              02430
      F1=BS(M)                                                          02440
  905 DO 910 J=1,N                                                      02450
      IF (NS(J).EQ.0) GO TO 910                                         02460
      IF (D(J).LT.TD) GO TO 910                                         02470
      F=F+C(J)                                                          02480
      F1=F1+A(M,J)                                                      02490
  910 CONTINUE                                                          02500
      IF (F.GE.ZBAR) GO TO 2400                                         02510
      IF (F1.GE.0.0) GO TO 920                                          02520
  915 GO TO 2400                                                        02530
  920 DO 930 I=1,M0                                                     02540
      F2=BS(I)                                                          02550
      DO 925 J=1,N                                                      02560
      IF (NS(J).EQ.0) GO TO 925                                         02570
      IF (D(J).LT.TD) GO TO 925                                         02580
      F2=F2+A(I,J)                                                      02590
  925 CONTINUE                                                          02600
      IF (F2.LT.0.0) GO TO 915                                          02610
  930 CONTINUE                                                          02620
C  ROUNDED DUAL SOLUTION FEASIBLE                                       02630
  931 NCID2=NCID2+1                                                     02640
  932 NOPT=NOPT+1                                                       02650
      CALL DATIME(0,IT3)
      IF (M.EQ.M0) GO TO 940                                            02670
      DO 935 I=M1,M                                                     02680
```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```
      B(I)=B(I)+F-ZKBAR-ZBAR                                          02690
  935 BS(I)=BS(I)+F-ZKBAR-ZBAR                                        02700
  940 ZBAR=F-ZKBAR                                                    02710
      DO 945 J=1,L                                                    02720
      SMAXB(J)=SB(J)                                                  02730
  945 SMAX(J)=S(J)                                                    02740
      K=L                                                             02750
      DO 950 J=1,N                                                    02760
      IF (NS(J).EQ.0) GO TO 950                                       02770
      K=K+1                                                           02780
      SMAXB(K)=BLANK                                                  02790
      SMAX(K)=J                                                       02800
      IF (D(J).LT.TD) SMAX(K)=-J                                      02810
  950 CONTINUE                                                        02820
      IF (NOP.NE.0) GO TO 960                                         02830
      WRITE(6,3310)F                                                  02840
      WRITE(6,3600)(SMAX(J),SMAXB(J) ,J=1,N)                          02850
  960 CONTINUE                                                        02860
      NOBJ=OBJ                                                        02870
      ZOBJ=NOBJ                                                       02880
      IF (OBJ.NE.ZOBJ) ZOBJ=ZOBJ+1.0                                  02890
      IF (F.EQ.ZOBJ) GO TO 3500                                       02900
      GO TO 2400                                                      02910
C  BEGINNING OF AN ITERATION. MAKE CHEAP ATTEMPT TO FATHOM            02920
 1910 IJK=0                                                           02930
 1920 CONTINUE                                                        02940
      IF (ZS.GE.ZBAR) GO TO 3100                                      02950
      DO 1950 I1=1,MO                                                 02960
      IF (BS(I1).LT.0.0) GO TO 1980
 1950 CONTINUE
      GO TO 2320                                                      02980
C  SEE IF ANY VARIABLES MUST BE 0                                     02990
 1980 CONTINUE                                                        03000
      DO 2000 J=1,N                                                   03010
      IF (NS(J).EQ.0) GO TO 2000                                      03020
      IF (ZS+C(J).LT.ZBAR) GO TO 2000                                 03030
      NS(J)=0                                                         03040
      L=L+1                                                           03050
      SB(L)=BCIB                                                      03060
      S(L)=-J                                                         03070
 2000 CONTINUE                                                        03080
      KINS=0                                                          03090
      IF (IJK.EQ.1) GO TO 2050
      IF (IJK.EQ.2) GO TO 1000                                        03110
      IJK=1                                                           03120
      IF (M.LT.M1) GO TO 2025                                         03130
      MSC=0                                                           03140
      I1=M1                                                           03150
      I2=M                                                            03160
      GO TO 2050                                                      03170
 2025 MSC=1                                                           03180
      I1=1                                                            03190
      I2=MO                                                           03200
C  PERFORM BINARY FEASIBILITY TEST                                    03210
 2050 DO 2220 I=I1,I2                                                 03220
      Q=BS(I)                                                         03230
```

```
      DO 2100 J=1,N                                                    03240
      IF (NS(J).EQ.0) GO TO 2100                                       03250
      IF (A(I,J).GT.0.0) Q=Q+A(I,J)                                    03260
 2100 CONTINUE                                                         03270
 2110 IF (Q.LT.0.0) GO TO 3000                                         03280
C  SEE IF ANY FREE VARIABLE MUST BE 0 OR 1                             03290
      K=NF(I)                                                          03300
      DO 2200 K1=1,K                                                   03310
      J1=JF(I,K1)                                                      03320
      IF (NS(J1).EQ.0) GO TO 2200                                      03330
 2120 IF (Q.GE.ABS(A(I,J1))) GO TO 2200                                03340
      NS(J1)=0                                                         03350
      L=L+1                                                            03360
      SB(L)=BCIB                                                       03370
      IF (A(I,J1).GT.0.0) GO TO 2150                                   03380
      S(L)=-J1                                                         03390
      GO TO 2200                                                       03400
 2150 S(L)=J1                                                          03410
      ZS=ZS+C(J1)                                                      03420
      DO 2175 I9=1,M                                                   03430
 2175 BS(I9)=BS(I9)+A(I9,J1)                                           03440
      KINS=KINS+1                                                      03450
 2200 CONTINUE                                                         03460
      IF (KINS.GE.IINS) GO TO 1920                                     03470
 2220 CONTINUE                                                         03480
      IF (MSC.EQ.0) GO TO 2025                                         03490
      IF (KINS.EQ.0) GO TO 1000                                        03500
      IJK=2                                                            03510
      GO TO 1920                                                       03520
C  A BETTER FEASIBLE SOLUTION HAS BEEN FOUND                           03530
 2320 CONTINUE                                                         03540
      IF (M.EQ.MO) GO TO 2340                                          03550
C  REVISE B(I) AND BS(I) USING NEW ZS                                  03560
      DO 2325 I=M1,M                                                   03570
      B(I)=B(I)+ZS-ZKBAR-ZBAR                                          03580
 2325 BS(I)=BS(I)+ZS-ZKBAR-ZBAR                                        03590
 2340 ZBAR=ZS-ZKBAR                                                    03600
      DO 2350 J=1,N                                                    03610
 2350 SMAX(J)=S(J)                                                     03620
      GO TO 3300                                                       03630
C  AUGMENTATION STEP                                                   03640
 2400 K1=0                                                             03650
      IF (SC.EQ.0) GO TO 2415                                          03660
      IF (IFRST.NE.0) GO TO 2415                                       03670
      IFRST=1                                                          03680
      DO 2410 J=1,N                                                    03690
      IF (NS(J).EQ.0) GO TO 2410                                       03700
      J1=0                                                             03710
      IF (D(J).EQ.1.0) J1=J                                            03720
      IF (D(J).EQ.0.0) J1=-J                                           03730
      IF (J1.EQ.0) GO TO 2410                                          03740
      L=L+1                                                            03750
      NS(J)=0                                                          03760
      S(L)=J1                                                          03770
      IF (J1.LT.0) GO TO 2410                                          03780
      ZS=ZS+C(J)                                                       03790
```

```
      DO 2405 I=1,M                                                    03800
 2405 BS(I)=BS(I)+A(I,J)                                               03810
 2410 CONTINUE                                                         03820
 2415 CONTINUE                                                         03830
      IF (ITB.EQ.0) GO TO 2425                                         03840
      IF (JSCFR.NE.0) GO TO 2425                                       03850
      DO 2420 J=1,N                                                    03860
      IF (NS(J).EQ.0) GO TO 2420                                       03870
      IF (D(J).EQ.AINT(D(J))) GO TO 2420                               03880
      K1=K1+1                                                          03890
      T(K1)=J                                                          03900
 2420 CONTINUE                                                         03910
      GO TO 2505                                                       03920
 2425 CONTINUE                                                         03930
      DO 2500 J=1,N                                                    03940
      IF (NS(J).EQ.0) GO TO 2500                                       03950
      K1=K1+1                                                          03960
      T(K1)=J                                                          03970
      GO TO 2500                                                       03980
 2500 CONTINUE                                                         04000
 2505 CONTINUE                                                         04010
      IF (K1.EQ.0) GO TO 3200                                          04020
      NAP=NAP+1                                                        04030
      P=-1.0E10                                                        04040
      DO 2575 K=1,K1                                                   04050
      J=T(K)                                                           04060
      P1=0.0                                                           04070
      DO 2550 I=1,M                                                    04080
      P2=BS(I)+A(I,J)                                                  04090
      IF (P2.GE.0.0) GO TO 2550                                        04100
      P1=P1+P2                                                         04110
 2550 CONTINUE                                                         04120
      IF (P1.LE.P) GO TO 2575                                          04130
      P=P1                                                             04140
      J1=J                                                             04150
 2575 CONTINUE                                                         04160
      NS(J1)=0                                                         04170
      L=L+1                                                            04180
      S(L)=J1                                                          04190
      ZS=ZS+C(J1)                                                      04200
      DO 2600 I=1,M                                                    04210
 2600 BS(I)=BS(I)+A(I,J1)                                              04220
      GO TO 1910                                                       04230
C  FATHOMED DUE TO BINARY INFEASIBLE CONSTRAINT                        04240
 3000 NCON=NCON+1                                                      04250
      GO TO 3500                                                       04260
 3100 NRED=NRED+1                                                      04270
      GO TO 3500                                                       04280
C  FATHOMED DUE TO LACK OF FREE VARIABLES                              04290
 3200 NAUG=NAUG+1                                                      04300
      GO TO 3500                                                       04310
 3300 NOPT=NOPT+1                                                      04320
      CALL DATIME(0,IT3)
      IF (NOP.NE.0) GO TO 3500                                         04340
      WRITE(6,3310)ZS                                                  04350
      WRITE(6,3600) (S(K),SB(K) ,K=1,L)                                04360
```

```
 3310 FORMAT (23HO BETTER SOLUTION FOUND,5X,2HZ=,1PE15.8)                  04370
      GO TO 3500                                                          04380
 3400 NLPF=NLPF+1                                                         04390
      GO TO 3500                                                          04400
C  BACKTRACK STEP                                                        04410
 3500 CONTINUE                                                            04420
      NENUM=NENUM+1                                                       04430
      IF (NENUM.LT.KENUM) GO TO 3530                                      04440
      NENUM=0                                                             04450
 3505 CONTINUE                                                            04460
      ENUM=0.0                                                            04470
      DO 3510 K=1,N                                                       04480
 3510 IF (SB(K).EQ.BCIB) ENUM=ENUM+.5**K                                  04490
      CALL DATIME(0,IT2)
      ELT1=IT2-IT0                                                        04510
      ELT2=IT2-IT1                                                        04520
      IT1=IT2                                                             04530
      ELT1=ELT1/1000.0                                                    04540
      ELT2=ELT2/1000.0                                                    04550
      IF (IT2-IT0.LT.MAXT) GO TO 3515                                     04560
      MAXT=-1                                                             04570
      GO TO 3517                                                          04580
 3515 CONTINUE                                                            04590
      IF (NOP.NE.0) GO TO 3700                                            04600
 3517 CONTINUE                                                            04610
      WRITE(6,3520)ENUM,ELT1,ELT2,L                                       04620
 3520 FORMAT (1HO,F10.5,38H OF THE SOLUTIONS HAVE BEEN ENUMERATED,5X,     04630
     *        15HTIME IN SECONDS,2X,5HTOTAL,F8.3,2X,7HELAPSED,F8.3,      04640
     *        5X,2HL=,I3)                                                04650
 3530 CONTINUE                                                            04660
      IF (MAXT.LT.0) WRITE(6,3600)(S(K),SB(K),K=1,L)                      04670
 3600 FORMAT (15(2X,I4,A1))                                               04680
      IF (MAXT.LT.0) NCHK=NCHK+1
      IF (MAXT.LT.0) GO TO 3738                                           04690
 3700 NPATH=NPATH+1                                                       04700
 3710 IF (L.EQ.0) GO TO 3738
      IF (SB(L).EQ.BLANK) GO TO 3900
      J=IABS(S(L))                                                        04720
      NS(J)=J                                                             04730
      IF (S(L).LT.0) GO TO 3735                                           04740
      ZS=ZS-C(J)                                                          04750
      DO 3725 I=1,M                                                       04760
 3725 BS(I)=BS(I)-A(I,J)                                                  04770
 3735 SB(L)=BLANK                                                         04780
      S(L)=0                                                              04790
      L=L-1                                                               04800
      IF (L.GT.0) GO TO 3710                                              04810
C  FINISHED NOW. PREPARE AND GIVE FINAL OUTPUT.                           04820
 3738 CONTINUE                                                            04830
C     WRITE(6,3739)H1,H2                                                  04840
 3739 FORMAT (1H1,5X,2A6)                                                 04850
      DO 3740 J=1,N                                                       04860
 3740 S(J)=0                                                              04870
      DO 3742 J=1,N                                                       04880
      K=IABS(SMAX(J))                                                     04890
      IF (K.EQ.0) GO TO 3744                                              04900
```

```
3742 S(K)=1                                                              04910
3744 DO 3746 K=1,N                                                       04920
     IF (S(K).NE.0) GO TO 3746                                           04930
     SMAX(J)=-K                                                          04940
     J=J+1                                                               04950
3746 CONTINUE                                                            04960
     CALL DATIME(0,IT2)
     ELT1=IT2-IT0                                                        04980
     ELT1=ELT1/1000.0                                                    04990
     IF (MAXT.LT.0) GO TO 3752                                           05000
     WRITE(6,3750)ELT1                                                   05010
3750 FORMAT (30HOIMPLICIT ENUMERATION COMPLETE,5X,11HTOTAL TIME=,F8.3)   05020
     GO TO 3758                                                          05030
3752 WRITE(6,3755)ELT1                                                   05040
3755 FORMAT (14HOTIME EXCEEDED,5X,11HTOTAL TIME=,F8.3)                   05050
3758 CONTINUE                                                            05060
     ZBAR=0.0                                                            05070
     DO 3835 J=1,N                                                       05080
     K=IABS(SMAX(J))                                                     05090
     IF (CS(K).LT.0.0) SMAX(J)=-SMAX(J)                                  05100
     IF (SMAX(J).GT.0) ZBAR=ZBAR+CS(K)                                   05110
3835 CONTINUE                                                            05120
     WRITE(6,3840)ZBAR                                                   05130
3840 FORMAT (33HOLEAST Z BEFORE VARIABLE CHANGE =,1PE15.8)               05140
3800 DO 3810 K=1,N                                                       05150
3810 T(K)=0                                                              05160
     DO 3820 K=1,N                                                       05170
     K1=IABS(SMAX(K))                                                    05180
3820 IF (SMAX(K).GT.0) T(K1)=K1                                          05190
     WRITE(6,3830)(T(K),K=1,N)                                           05200
3830 FORMAT (15(4X,I3))                                                  05210
     ELT3=IT3-IT0                                                        05220
     ELT3=ELT3/1000.0                                                    05230
     NITER=NFATH+NFATH-1                                                 05240
     WRITE(6,9993)
     CALL LOCOUT(T,C,NOPT)
     WRITE(6,3850)NOPT,NRED,NCON,NAUG,NAP,NID,NCID2                      05250
     WRITE(6,3851)NLPF,NSIMP,NITER,ELT3                                  05260
3850 FORMAT (23HONO. FEASIBLE SOLUTIONS,I5/                              05270
    *        11H ZS GE ZBAR,I5,6H TIMES/                                 05280
    *        22H CONSTRAINT INFEASIBLE,I5,6H TIMES/                      05290
    *        24H AUGMENTATION IMPOSSIBLE,I5,6H TIMES/                    05300
    *        22H AUGMENTATION POSSIBLE,I5,6H TIMES/                      05310
    *        14H INTEGER DUALS,I5,6H TIMES/                              05320
    *        26H NO. OF ROUNDED INT. DUALS,I5)                           05330
3851 FORMAT (12H LP FATHOMED,I5,6H TIMES/                                05340
    *        10H LP CALLED,I5,6H TIMES/                                  05350
    *        15H NO. ITERATIONS,I5/                                      05360
    *        26H LAST FEASIBLE SOLUTION AT,F8.3,9H  SECONDS)             05370
C  END OF FINAL OUTPUT. LOOK FOR ANOTHER PROBLEM NOW.                     05380
     GO TO 100                                                           05390
C  COMPLEMENT AND UNDERSCORE LAST REMAINING ENTRY IN S.                  05400
3900 SB(L)=BCIB                                                          05410
     S(L)=-S(L)                                                          05420
     J=IABS(S(L))                                                        05430
     IF (S(L).GT.0) GO TO 3950                                           05440
```

```
      ZS=ZS-C(J)                                                        05450
      DO 3925 I=1,M                                                     05460
 3925 BS(I)=BS(I)-A(I,J)                                                05470
      GO TO 1910                                                        05480
 3950 ZS=ZS+C(J)                                                        05490
      DO 3975 I=1,M                                                     05500
 3975 BS(I)=BS(I)+A(I,J)                                                05510
      GO TO 1910                                                        05520
      END                                                               05530



      SUBROUTINE TRANSF
      COMMON/PARAM/NALTS,NDMDA,NHCONS,NSITES,MAXT
      COMMON/ODD/VER,COOL,EFF,M,N
      COMMON/STRM/TRANS(7,7),SPDIST(7,7),COORD(30),HEAT(10),HSTAN(10)
      COMMON/VWD/VELOC,WIDTH,DEPTH
      FTPDAY=VELOC*3600.*24.
      WGT=WIDTH*DEPTH*62.4
      NNN=NHCONS+NSITES
      READ(5,113) (COORD(I),I=1,NNN)
C     WRITE(6,115)(COORD(I),I=1,NNN)
C     WRITE(6,111)
  111 FORMAT(1HO)
  113 FORMAT(7F10.0)
  115 FORMAT(1X,7F10.0)
      DO 112 NSP=1,NHCONS
      DO 112 NPS=1,NSITES
      JJ=NHCONS+NPS
      SPDIST(NSP,NPS)=COORD(NSP)-COORD(JJ)
      IF(SPDIST(NSP,NPS).LT.0.) GO TO 119
      TRAVEL=SPDIST(NSP,NPS)/FTPDAY
      EXPON=COOL*WIDTH*TRAVEL/WGT
      TRANS(NSP,NPS)=1./EXP(EXPON)
      GO TO 112
  119 SPDIST(NSP,NPS)=0.
      TRANS(NSP,NPS)=0.
  112 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE EEIPKG(C)
      DIMENSION C(1)
      INTEGER S,SMAX,SC,T
      COMMON/MISC/ISCMAX,ISCFR,KENUM,SC,L,MAXC,NOP,ZKBAR,ITB,NCHK
      COMMON/PARAM/NALTS,NDMDA,NHCONS,NSITES,MAXT
      COMMON/STRM/TRANS(7,7),SPDIST(7,7),COORD(30),HEAT(10),HSTAN(10)
      COMMON/ODD/VER,COOL,EFF,M,N
      COMMON/PLANT/CAP(10),CC(100),VAR(10),U(10),DMD(10),NFSITE(10),
     *TITLE(12)
      COMMON /BLS/MS(90),ZBAR
      COMMON /VWD/VELOC,WIDTH,DEPTH
      DATA END/6HEND   /
C SPECIAL PACKAGE FOR READING EEI TYPE DATA
      ZBAR=0.0
      ISCMAX=4
      ISCFR=8
      KENUM=20
      SC=1
      L=-1
      MAXC=0
      NOP=1
      ZKBAR=0.0
      ITB=0
      NCHK=0
      EFF=.33
      VER=(1.-EFF)/EFF
      COOL=150.
      READ(5,8105) TITLE
      IF (TITLE(1).EQ.END) STOP
      READ(5,8107) NALTS,NDMDA,NHCONS,NSITES,MAXT
      READ(5,8107) (NFSITE(I),I=1,NSITES)
      M=NHCONS+  NDMDA+NSITES+NALTS
      N=NALTS+NDMDA*NALTS
      NFSITE(NSITES+1)=NALTS+1
      DO 8108 I=1,NALTS
      READ(5,81) C(I),CAP(I),HEAT(I),VAR(I)
 8108 CONTINUE
      NNN=NALTS+1
      READ(5,8113) (C(I),I=NNN,N)
      DO 3267 I=1,100
      CC(I)=C(I)
 3267 CONTINUE
      DO 7117 J=1,NDMDA
      READ(5,8113) DMD(J),U(J)
 7117 CONTINUE
      K=NALTS
      DO 85 I=1,NALTS
      DO 85 J=1,NDMDA
      K=K+1
   85 C(K)=DMD(J)*(C(K)+VAR(I)+U(J))
      READ(5,11) KJ
      IF(KJ.NE.1) GO TO 10
      CALL HEATCO
   10 READ(5,11) KJ
      IF(KJ.EQ.1) GO TO 17
```

```
      DO 8111 I=1,NHCONS
      READ(5,8112) (TRANS(I,J),J=1,NSITES)
 8111 CONTINUE
      GO TO 16
   17 CALL TRANSF
   16 READ(5,8113) (HSTAN(I),I=1,NHCONS)
      RETURN
   11 FORMAT(I1)
   81 FORMAT(4F15.0)
 8105 FORMAT(12A6)
 8107 FORMAT(8I10)
 8112 FORMAT(15F5.4)
 8113 FORMAT(8F10.0)
      END



      SUBROUTINE CLASS(KI,KJ,NF,JF)
      DIMENSION NF(1),JF(50,1)
      KJF=NF(KI)+1
      NF(KI)=KJF
      JF(KI,KJF)=KJ
      RETURN
      END



      SUBROUTINE HEATCO
      COMMON/PARAM/NALTS,NDMDA,NHCONS,NSITES,MAXT
      COMMON/ODD/VER,COOL,EFF,M,N
      COMMON/STRM/TRANS(7,7),SPDIST(7,7),COORD(30),HEAT(10),HSTAN(10)
      COMMON /VWD/VELOC,WIDTH,DEPTH
      READ(5,110)VELOC,WIDTH,DEPTH
C     WRITE(6,107)VELOC,WIDTH,DEPTH
      TOTWGT=3600.*VELOC*WIDTH*DEPTH*62.4
      DO 111 I=1,NALTS
      IF (HEAT(I).EQ.0.) GO TO 111
      HEAT(I)=VER*3.4130E6/TOTWGT
  111 CONTINUE
  110 FORMAT(3F8.2)
C     WRITE(6,108)
  108 FORMAT(1H0)
  107 FORMAT(1X,3F8.2)
      RETURN
      END
```

```
      SUBROUTINE LOCOUT(T,C,NOPT)
      DIMENSION T(1),C(1)
      INTEGER S,SMAX,SC,T
      COMMON/MISC/ISCMAX,ISCFR,KENUM,SC,L,MAXC,NOP,ZKBAR,ITB,NCHK
      COMMON/PARAM/NALTS,NDMDA,NHCONS,NSITES,MAXT
      COMMON/PLANT/CAP(10),CC(100),VAR(10),U(10),DMD(10),NFSITE(10),
     *TITLE(12)
      COMMON /BLS/MS(90),ZBAR
      COMMON /VWD/VELOC,WIDTH,DEPTH
      IF (NOPT) 100,100,210
  210 IF (NCHK) 200,200,500
  200 WRITE(6,250)
  220 WRITE(6,270) ZBAR
      WRITE(6,290)
      WRITE(6,295)
      IJ=NALTS
      DO 299 I=1,NALTS
      CAP(I)=0.
      DO 299 J=1,NDMDA
      IJ=IJ+1
      IF(T(IJ).LE.0) GO TO 299
      CAP(I)=CAP(I)+DMD(J)
  299 CONTINUE
      DO 300 I=1,NALTS
      IF(T(I)) 300,300,310
  310 WRITE(6,320) I,CAP(I),C(I)
  300 CONTINUE
      WRITE(6,350)
      WRITE(6,360)
      IJ=NALTS
      DO 400 I=1,NALTS
      DO 400 J=1,NDMDA
      IJ=IJ+1
      IF(T(IJ)) 400,400,410
  410 WRITE(6,420) I,J,C(IJ)
  400 CONTINUE
      GO TO 600
  100 WRITE(6,501)
      GO TO 600
  500 WRITE(6,510)
      GO TO 220
  600 CONTINUE
      WRITE(6,520)
      RETURN
  250 FORMAT(//2X23HTHE OPTIMAL SOLUTION IS)
  270 FORMAT(//2X18HTOTAL WEEKLY COST=3X1H$F10.0)
  290 FORMAT(//2X38HTHE PLANT ALTERNATIVES TO BE BUILT ARE)
  295 FORMAT(/43X6HDESIGN14X9HINTERCEPT/18X11HALTERNATIVE10X13HCAPACITY
     *(MW)10X11HCOST ($/WK))
  320 FORMAT(18X16,F24.0,F23.0)
  350 FORMAT(//2X59HTHE LOAD CENTERS TO BE SERVED BY EACH PLANT ALTERNAT
     *IVE ARE)
  360 FORMAT(/59X14HLOAD-DEPENDENT/18X11HALTERNATIVE10X11HLOAD CENTER10X
     *12HCOSTS ($/WK))
  420 FORMAT(18X16,I21,F25.0)
```

```
501 FORMAT(5X50HTHERE IS NO FEASIBLE SOLUTION TO THE GIVEN PROBLEM)
510 FORMAT(30H BEST SOLUTION FOUND SO FAR IS)
520 FORMAT(1H1)
    END



   SUBROUTINE DATIME(I,J)
   DATA IFIRST/0/
   IF(IFIRST.NE.0) GO TO 1
   IFIRST=1
   CALL SETCLK
 1 CALL READCK(TIME)
   J=TIME*1000.0+0.5
   RETURN
   END



         ENTRY   SETCLK      CALL SETCLK
         ENTRY   READCK      CALL READCK(TIME)

   SETCLK CLA    5
          STO    ITIM
          TRA    1,4
   READCK CLA    5
          SUB    ITIM
          ADD    MASK
          FAD    MASK
          XCA
          FMP    =.016667
          STO*   3,4
          TRA    1,4
   ITIM   OCT    0
   MASK   OCT    233000000000
          *LORG
          END
```

```
      SUBROUTINE PROUT(C)
      DIMENSION C(1)
      COMMON/PARAM/NALTS,NDMDA,NHCONS,NSITES,MAXT
      COMMON/STRM/TRANS(7,7),SPDIST(7,7),COORD(30),HEAT(10),HSTAN(10)
      COMMON/PLANT/CAP(10),CC(10C),VAR(1C),U(10),DMD(10),NFSITE(10),
     *TITLE(12)
      WRITE(6,100)
      WRITE(6,105) TITLE
      WRITE(6,110) NDMDA
      WRITE(6,115)
      DO 1000 J=1,NDMDA
      WRITE(6,120) J,DMD(J),U(J)
1000  CONTINUE
      WRITE(6,195)
      WRITE(6,125) NSITES
      WRITE(6,130)
      DO 1005 I=1,NSITES
      K=NALTS+NDMDA*NFSITE(I)-NDMDA+1
      LM=K+NDMDA-1
      WRITE(6,135) I,(CC(L),L=K,LM)
1005  CONTINUE
      WRITE(6,195)
      WRITE(6,140) NALTS
      WRITE(6,145)
      IJ=0
      DO 1010 I=1,NSITES
      K=NFSITE(I+1)-NFSITE(I)
      DO 1010 J=1,K
      IJ=IJ+1
      WRITE(6,150) IJ,I,C(IJ),VAR(IJ),CAP(IJ),HEAT(IJ)
1010  CONTINUE
      WRITE(6,195)
      WRITE(6,155)
      WRITE(6,160)
      IJ=NALTS
      DO 1015 I=1,NALTS
      DO 1015 J=1,NDMDA
      IJ=IJ+1
      AY=C(IJ)/DMD(J)
      WRITE(6,165) I,J,VAR(I),CC(IJ),U(J),AY,DMD(J),C(IJ)
1015  CONTINUE
      WRITE(6,195)
      WRITE(6,170)
      WRITE(6,175)
      DO 1020 I=1,NSITES
      JJ=NHCONS+I
      Q=CCORD(JJ)/1000.
      WRITE(6,177) I,Q
1020  CONTINUE
      WRITE(6,179)
      DO 1022 I=1,NHCONS
      Q=CCORD(I)/1000.
      WRITE(6,178) I,Q
1022  CONTINUE
      WRITE(6,100)
```

```
      WRITE(6,180)
      DO 1025 K=1,NHCONS
      WRITE(6,185) K,HSTAN(K),(TRANS(K,I),I=1,NSITES)
 1025 CONTINUE
      WRITE(6,100)
      RETURN
  100 FORMAT(1H1)
  105 FORMAT(30X12A6)
  110 FORMAT(10HOTHERE AREI3,13H LOAD CENTERS)
  115 FORMAT(1HO19X5HPOWER10X11HDISTR. COST/12H LOAD CENTER5X11HDEMAND (
     *MW)5X14HRATE ($/WK/MW))
  120 FORMAT(1XI6,F18.0,F17.0)
  125 FORMAT(10HOTHERE AREI3,6H SITES)
  130 FORMAT(1H011X57HCOST RATES FOR TRANSMISSION TO EACH LOAD CENTER ($
     */WK/MW)/1HO35X12HLOAD CENTERS/5H SITE)
  135 FORMAT(1XI3,2X10F10.0)
  140 FORMAT(10HOTHERE AREI3,19H PLANT ALTERNATIVES)
  145 FORMAT(1HO30X9HINTERCEPT8X10HPROD. COST8X12HMAXIMUM GEN.8X9HUNIT T
     *EMP/12H ALTERNATIVE5X8HSITE NO.5X11HCOST ($/WK)5X14HRATE ($/WK/MW)
     *5X13HCAPACITY (MW)5X15HRISE (DEG.F/MW))
  150 FORMAT(1XI6,I15,F17.0,F16.0,F19.0,F20.4)
  155 FORMAT(28HOWEEKLY LOAD-DEPENDENT COSTS)
  160 FORMAT(1HO14X7HTO LOAD7X10HPROD. COST9X11HTRANS. COST8X11HDISTR. C
     *OST8X10HTOTAL COST10X5HPOWER8X14HLOAD-DEPENDENT/10H FROM ALT.6X6HC
     *ENTER4(5X14HRATE ($/WK/MW))5X11HDEMAND (MW)6X12HCOSTS ($/WK))
  165 FORMAT(1XI5,I13,F17.0,2F19.0,F20.0,F17.0,F19.0)
  170 FORMAT(64HOTHE DOWNSTREAM DISTANCES FROM SITE 1 (IN THOUSANDS OF F
     *EET) ARE)
  175 FORMAT(5HOSITE5X8HDISTANCE)
  177 FORMAT(1XI3,F12.0)
  178 FORMAT(1XI6,F17.0)
  179 FORMAT(13HOSTREAM POINT5X8HDISTANCE)
  180 FORMAT(72HOTHE TEMPERATURE TRANSFER COEFFICIENTS FROM SITE I TO ST
     *REAM POINT K ARE/1HO67X5HSITES/13H STREAM POINT5X17HMAX. EXCESS TE
     *MP.)
  185 FORMAT(1XI7,F20.0,9X7F12.2)
  195 FORMAT(1H0)
      END
```

```
      SUBROUTINE SIMPLE(INFLAG,MX,NN,A,B,C,KO,KB,P,JH,X,Y,OBJ,E,NOP)
C  AUTOMATIC SIMPLEX        REDUNDANT EQUATIONS CAUSE INFEASIBILITY          05550
      EQUIVALENCE (XX,LL)                                                   05600
C THE FOLLOWING DIMENSION SHOULD BE THE SAME HERE AS IT IS IN CALLER.       05610
      DIMENSION B(1),C(1),P(1),X(1),Y(1),KO(1),KB(1),JH(1),NF(90)
      DIMENSION E(90,1),A(50,1)
      REAL AA,AIJT,BB,COST,DT,RCOST,TEXP,TPIV,TY,XOLD,XX,XY,YI,YMAX,EM      05630
      INTEGER I,IA,INVC,IR,ITER,J,JT,K,KBJ,LL,M,N,JT2                       05640
      INTEGER NCUT,      NUMVR,NVER,NUMPV                                   05650
      INTEGER S,SMAX,SC,T
      LOGICAL TRIG,VER                                                      05660
      LOGICAL FINV,FFRZ,SCH                                                 05670
      COMMON /BLS/MS(90),ZBAR                                               05680
      DATA NF,IR,LPSEQ/92*0/
C         SET INITIAL VALUES, SET CONSTANT VALUES                           05700
      FINV = .FALSE.                                                        05710
      TRIG = .FALSE.                                                        05720
      ITER = 0                                                              05730
      LPSEQ = LPSEQ+1                                                       05740
      NUMVR = 0                                                             05750
      NUMPV = 0                                                             05760
      M = MX                                                                05770
      N = NN                                                                05780
      TEXP  =  .5**16                                                       05790
      NVER  =  M/2  +  5                                                    05800
      NCUT  =  4*M + 10                                                     05810
      IF (INFLAG.EQ.0) GO TO 1410                                           05820
C       IMPOSE CORRECT TEMPERATURE ON ROWS                                  05830
      FFRZ =.TRUE.                                                          05840
      L=1
  100 IF (MS(L).EQ.NF(L)) GO TO 1955
        IF(MS(L)*NF(L).GT.0.OR.(MS(L).EQ.0.AND.X(L).GE.0.)) GO TO 1950      05870
        I=L                                                                 05880
        IF (NF(L).NE.0) GO TO 1925                                          05890
 1920   IF (JH(I).GT.0) GO TO 1930                                          05900
C         IF JH DISAGREES WITH MS DO SPECIAL PIVOT                          05910
        IF (MS(L).GT.0.AND.JH(L).GE.(-M)) GO TO 1950                        05920
        IF (MS(L).LT.0.AND.JH(L).LT.(-M)) GO TO 1950                        05930
C  SPECIAL PIVOT, SWITCH SINGLETONS                                         05940
 1925   DO 1926  J=1,M                                                      05950
          P(J) = P(J) + E(I,J)                                              05960
          E(I,J) = -E(I,J)                                                  05970
 1926   CONTINUE                                                            05980
        OBJ = OBJ + X(I)                                                    05990
        X(I) = - X(I)                                                       06000
        JHL = JH(L)                                                         06010
        IF (JHL.GE.(-M)) JH(L) = -L-M                                       06020
        IF (JHL.LT.(-M)) JH(L) = -L                                         06030
        GO TO 1950                                                          06040
C       DO FULL PIVOT ON SINGLETON                                          06050
 1930   JT = -I                                                             06060
        COST = P(I)                                                         06070
        IF (MS(I).GT.0) GO TO 1931                                          06080
        JT = JT-M                                                           06090
        COST = 1.-COST                                                      06100
```

```
 1931   EN = 1.                                                          06110
        GO TO 630                                                        06120
C         GET COLUMN(JT)                                                06130
 1932   SCH = .FALSE.                                                    06140
        IF (COST.GT.0.) GO TO 1938                                       06150
 1935   GO TO 1000                                                       06160
C         SELECT ROW(IR)                                                06170
 1936   IF (IR.NE.0.OR.SCH) GO TO 1940                                   06180
        SCH =.TRUE.                                                      06190
 1938   EN =-EN                                                          06200
        DO 1937 J=1,M                                                    06210
          Y(J) = -Y(J)                                                   06220
 1937   CONTINUE                                                         06230
        GO TO 1935                                                       06240
 1940   IF((SCH.AND.ABS(COST).GT.TPIV).OR.IR.EQ.0)  GO TO 1980           06250
 1941   IF (EN.GT.0.)  GO TO 1945                                        06260
        DO 1942 J =1,M                                                   06270
          Y(J) = -Y(J)                                                   06280
 1942   CONTINUE                                                         06290
 1945   GO TO 901                                                        06300
C         PIVOT(IR,JT)                                                  06310
 1950   NF(L) = MS(L)                                                    06320
 1955   IF(JH(L).LT.0) GO TO 1960                                        06330
        IA=JH(L)                                                         06340
        KB(IA)=L                                                         06350
 1960 CONTINUE                                                          06360
      L=L+1
      IF (L.LE.M) GO TO 100
      FFRZ = .FALSE.                                                     06370
      GO TO 910                                                          06380
C*          START WITH SINGLETON BASIS                                   06390
 1410 DO 1402  J=1,N                                                    06400
        KB(J) = 0                                                        06410
 1402 CONTINUE                                                          06420
      FFRZ =.FALSE.                                                      06430
 1400 DO 1401  I = 1,M                                                  06440
        JH(I) =-I                                                        06450
        NF(I) = MS(I)                                                    06460
        IF (NF(I).LT.0.OR.(NF(I).EQ.0.AND.B(I).LT.0.)) JH(I)=-I-M        06470
 1401 CONTINUE                                                          06480
C*          CREATE INVERSE FROM 'KB' AND 'JH'      (STEP 7)              06490
 1320 VER = .TRUE.                                                      06500
      INVC = 0                                                           06510
      NUMVR   =  NUMVR  +1                                               06520
      TRIG = .FALSE.                                                     06530
      OBJ = 0.                                                           06540
      DO 1113  I = 1,M                                                   06550
        DO 1151  J=1,M                                                   06560
          E(J,I) = 0.                                                    06570
 1151   CONTINUE                                                         06580
        IF (JH(I).LT.(-M)) GO TO 1111                                    06590
        IF (JH(I).GT.0) JH(I) = 0                                        06600
        E(I,I) = 1.                                                      06610
        P(I) = 0.                                                        06620
        X(I) =  B(I)                                                     06630
        GO TO 1113                                                       06640
```

```
 1111   E(I,I) = -1.                                                    06650
        P(I)   = +1.                                                    06660
        OBJ = OBJ  + B(I)                                               06670
        X(I)   = -B(I)                                                  06680
 1113 CONTINUE                                                          06690
      JT=1                                                              06700
10101   IF (KB(JT).EQ.0)  GO TO 1102                                    06710
        GO TO 600                                                       06720
C       GET COLUMN(JT)                                                  06730
 1114   TY = TPIV                                                       06740
        IR = 0                                                          06750
        COST = C(JT)                                                    06760
        DO 1104 I = 1,M                                                 06770
        COST = COST + A(JT,I)*P(I)                                      06780
          IF(JH(I).NE.0.OR.X(I).NE.0..OR.ABS(Y(I)).LE.TY) GO TO 1104    06790
          TY = ABS(Y(I))                                                06800
          IR = I                                                        06810
 1104   CONTINUE                                                        06820
        IF (IR.NE.0) GO TO 1119                                         06830
        TY = 0.                                                         06840
        DO 1105 I = 1,M                                                 06850
          IF(JH(I).NE.0.OR.X(I).EQ.0..OR.ABS(Y(I)).LE.TPIV) GO TO 1105  06860
          IF (ABS(Y(I)).LE.TY*ABS(X(I)))  GO TO 1105                    06870
          TY = ABS(Y(I)/X(I))                                           06880
          IR = I                                                        06890
 1105   CONTINUE                                                        06900
 1119   IF (IR.NE.0) GO TO 900                                          06910
C       PIVOT(IR,JT)                                                    06920
        FINV = .TRUE.                                                   06930
      IF (NOP.EQ.0) WRITE(6,1199)LPSEQ                                  06940
 1199   FORMAT(15HOINVERT FAIL LP,I4)                                   06950
        GO TO 1410                                                      06960
 1102 CONTINUE                                                          06970
      JT=JT+1
      IF (JT.LE.N) GO TO 10101
C* PERFORM A SIMPLEX ITERATION                                          06980
 1200 VER = .FALSE.                                                     06990
  500 DO 503 I = 1,M                                                    07000
        IF (NF(I).EQ.0.AND.X(I).LT.0.) X(I)=0.                          07010
  503 CONTINUE                                                          07020
C*          FIND MINIMUM REDUCED COST              (STEP 3)             07030
  599 JT = 0                                                            07040
      BB  =  0.0                                                        07050
      DO 701  J =1,N                                                    07060
        IF (KB(J).NE.0)   GO TO 701                                     07070
        DT = C(J)                                                       07080
        DO 303 I = 1,M                                                  07090
          DT = DT + A(J,I)*P(I)                                         07100
  303   CONTINUE                                                        07110
        IF (DT.GE.BB)  GO TO 701                                        07120
        BB = DT                                                         07130
        JT = J                                                          07140
  701 CONTINUE                                                          07150
      DO 702 I=1,M                                                      07160
        IF (JH(I).LT.0) GO TO 702                                       07170
        IF (P(I).LT.BB) GO TO 703                                       07180
```

```
      IF ((1.-P(I)).GE.BB) GO TO 702                                    07190
      BB = 1.-P(I)                                                      07200
      JT = -I-M                                                         07210
      GO TO 702                                                         07220
  703 BB=P(I)                                                           07230
      JT = -I                                                           07240
  702 CONTINUE                                                          07250
      COST = BB                                                         07260
      IF (JT.EQ.0)  GO TO 203                                           07270
      IF (ITER.GE.NCUT)  GO TO 160                                      07280
      ITER = ITER +1                                                    07290
C*          MULTIPLY INVERSE TIMES A(.,JT)          (STEP 4)          07300
      IF (JT.LT.0) GO TO 630                                            07310
C     BEGIN SUBROUTINE GET COLUMN(JT)                                   07320
  600 DO 610  I= 1,M                                                    07330
        Y(I) = 0.0                                                      07340
  610 CONTINUE                                                          07350
      DO 605   I= 1,M                                                   07360
        AIJT = A(JT,I)                                                  07370
        IF (AIJT.EQ.0.) GO TO 605                                       07380
        DO  606  J = 1,M                                                07390
          Y(J) = Y(J) + AIJT*E(J,I)                                     07400
  606   CONTINUE                                                        07410
  605 CONTINUE                                                          07420
      GO TO 640                                                         07430
  630 JT2 = -JT                                                         07440
      EM = 1.                                                           07450
      IF (JT2.LE.M) GO TO 631                                           07460
      JT2 = JT2 - M                                                     07470
      EM = -1.                                                          07480
  631 DO 632  I=1,M                                                     07490
        Y(I) = EM*E(I,JT2)                                              07500
  632 CONTINUE                                                          07510
  640 YMAX = 0.                                                         07520
      DO 620  I  =  1,M                                                 07530
        YMAX = AMAX1( ABS(Y(I)),YMAX )                                  07540
  620 CONTINUE                                                          07550
      TPIV  =  YMAX * TEXP                                              07560
C     END OF GET COLUMN                                                 07570
      IF (FFRZ) GO TO 1932                                              07580
      IF (VER)  GO TO 1114                                              07590
      RCOST = YMAX/BB                                                   07600
      IF (TRIG.AND.BB.GE.(-TPIV)) GO TO 203                             07610
      TRIG=BB.GE.(-TPIV)                                                07620
C*          SELECT PIVOT ROW                        (STEP 5)          07630
 1000 AA = TPIV                                                         07640
      IR = 0                                                            07650
 1002 DO 1003 I = 1,M                                                   07660
        IF (X(I).NE.0..OR.Y(I).LE.AA.OR.NF(I).NE.0) GO TO 1003          07670
        AA = Y(I)                                                       07680
        IR = I                                                          07690
 1003 CONTINUE                                                          07700
      IF (IR.NE.0) GO TO 1020                                           07710
      AA = 0.                                                           07720
      DO 1010  I  = 1,M                                                 07730
        IF (NF(I).NE.0.OR.Y(I).LE.TPIV.OR.Y(I).LE.AA*X(I)) GO TO 1010   07740
```


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```
        AA = Y(I)/X(I)                                                  07750
        IR = I                                                          07760
 1010 CONTINUE                                                          07770
 1020 IF (FFRZ) GO TO 1936                                              07780
      IF  (IR.EQ.0)  GO TO 207                                          07790
C*          PIVOT ON (IR,JT)                          (STEP 6)          07800
  901 IA = JH(IR)                                                       07810
      IF (IA.GT.0)  KB(IA) = 0                                          07820
C     BEGIN SUBROUTINE PIVOT(IR,JT)                                     07830
  900 NUMPV  =  NUMPV  +  1                                             07840
      JH(IR) = JT                                                       07850
      IF (JT.GT.0)  KB(JT) = IR                                         07860
      YI = -Y(IR)                                                       07870
      Y(IR) = -1.0                                                      07880
      DO  904  J = 1,M                                                  07890
        XY = E(IR,J)/YI                                                 07900
        IF (XY.EQ.0.) GO TO 904                                         07910
        P (J) = P (J) + COST * XY                                       07920
        E(IR,J) = 0.                                                    07930
        DO 906  I = 1,M                                                 07940
          E(I,J) =  E(I,J) + XY * Y(I)                                  07950
  906   CONTINUE                                                        07960
  904 CONTINUE                                                          07970
      XY  =  X(IR) / YI                                                 07980
      DO 908  I  = 1, M                                                 07990
        XOLD = X(I)                                                     08000
        X(I) = XOLD + XY * Y(I)                                         08010
  908 CONTINUE                                                          08020
      Y(IR) = -YI                                                       08030
      X(IR) = -XY                                                       08040
C     END OF PIVOT                                                      08050
      OBJ =  OBJ + XY*COST                                              08060
      IF (VER) GO TO 1102                                               08070
C       EXCHANGE ROWS IF SLACK PIVOTED IN WRONG ROW                     08080
      IF  (JT.GT.0.OR.JT2.EQ.IR) GO TO 907                              08090
      XY = X(IR)                                                        08100
      X(IR) = X(JT2)                                                    08110
      X(JT2) = XY                                                       08120
      DO 909 I =1,M                                                     08130
        XY =  E(IR,I)                                                   08140
        E(IR,I) =  E(JT2,I)                                             08150
        E(JT2,I) = XY                                                   08160
  909 CONTINUE                                                          08170
      IA = JH(JT2)                                                      08180
      JH(JT2) = JT                                                      08190
      JH(IR) = IA                                                       08200
      KB(IA) = IR                                                       08210
  907 INVC   = INVC   +1                                                08220
C   TO STEP 1 IF NOT INVERTING, TO STEP 7 IF INVERTING                  08230
      IF (FFRZ) GO TO 1950                                              08240
      IF (OBJ.GE.ZBAR) GO TO 180                                        08250
      IF (FINV) GO TO 1200                                              08260
  910 IF (INVC.GE.NVER) GO TO 1320                                      08270
      GO  TO  1200                                                      08280
C*  END OF ALGORITHM, SET EXIT VALUES            ***                    08290
  207 IF              (RCOST.LE.(-1000.)) GO TO 203                     08300
```

```
C          INFINITE SOLUTION                                              08310
       K  =  2                                                            08320
       GO TO 250                                                          08330
  180 K=6                                                                 08340
       GO TO 250                                                          08350
C          PROBLEM IS CYCLING PERHAPS                                     08360
  160 K  =  4                                                             08370
       WRITE(6,161)LPSEQ                                                  08380
  161 FORMAT(31HOITERATION LIMIT EXCEEDED ON LP,I4)                       08390
       GO TO 250                                                          08400
C          FEASIBLE OR INFEASIBLE SOLUTION                                08410
  203 K  =  0                                                             08420
  250 DO 1399  J = 1,N                                                    08430
         XX  =  0.0                                                       08440
         KBJ  =  KB(J)                                                    08450
         IF (KBJ.NE.0)  XX = X(KBJ)                                       08460
         KB(J) = LL                                                       08470
 1399 CONTINUE                                                            08480
       KO(1) = K                                                          08490
       KO(2) = ITER                                                       08500
       KO(3) = INVC                                                       08510
       KO(4) = NUMVR                                                      08520
       KO(5) = NUMPV                                                      08530
       KO(6) = JT                                                         08540
       IF (NOP.NE.0) RETURN                                               08550
       WRITE(6,162)LPSEQ,(KO(I),I=1,6)                                    08560
  162 FORMAT(3H LP,I5,6H  KO  ,6I6)                                       08570
C      WRITE(6,1982)                                                      08580
 1982 FORMAT(21HOI  JH NF MS ,P,Y,X,B/1X)                                 08590
C      DO 1983 I=1,M                                                      08600
C        WRITE(6,1984)I,JH(I),NF(I),MS(I),P(I),Y(I),X(I),B(I)             08610
 1983 CONTINUE                                                            08620
 1984 FORMAT(1X,4I3,4F12.6)                                               08630
       RETURN                                                             08640
 1980 IF (NOP.EQ.0) WRITE(6,1981)LPSEQ,L,IR,SCH,COST                      08650
 1981 FORMAT( 3HOLP,I4,12H FAIL, SLACK,I3,4H IR=I3,5H SCH=L1,3H C=F19.6)  08660
       IF (IR.NE.0) GO TO 1941                                            08670
       GO TO 1410                                                         08680
        END                                                               08690
```

B5. Computation of Temperature Constraint Parameters

For application to a hypothetically simplified problem of a steady thermal discharge into a uniform, vertically and laterally mixed stream, the computer code used to solve the zero-one integer problem formulation incorporates two special subroutines which calculate (a) the elevation in mixed stream temperature, R_i, due to the discharge of waste heat for each megawatt of plant generating capacity, and (b) the temperature transfer coefficients, A_{ik}, from each plant site to each stream sampling station where temperature standards must be met. The user has the option of providing the necessary data for these subroutines (described below) or of inserting the values of R_i and A_{ik} directly. Consequently, the model is applicable to situations involving discharges into lakes, estuaries or the ocean provided the proper information is available.

(a) Mixed Stream Temperature Rise, R_i

To compute the mixed stream temperature rise associated with a production rate of 1 MW, only two input parameters are required. These are the thermal efficiency, α, of the power plant, and the stream flow, Q (ft^3/sec). For 1 MW of production, the rate of discharge of waste heat, H, to the stream is given by:

$$H = \left(\frac{1 - \alpha}{\alpha}\right) \times (3.4130 \times 10^6), \quad \text{(Btu/hr)}$$

To obtain the mixed temperature rise, R_i, of the stream receiving the discharge, the waste heat influx is divided by the total heat capacity of the water which receives it:

$$R_i = H \,/\, 3600\, Q\rho C_p,$$

where ρ is the density of water (lb/ft^3) and C_p is the specific heat (Btu/lb/°F).

(b) Temperature Transfer Coefficients, A_{ik}

The following is a simplified example of the estimation of temperature transfer coefficients for points downstream of a river discharge. It is assumed that the heat is completely mixed with the stream flow at the point of discharge, and that the downstream temperature distribution is largely determined by the combined effects of longitudinal advection and surface cooling (i.e., longitudinal mixing is neglected). T* is first defined as the excess temperature in the stream, i.e., the difference between the temperature of the stream below the discharge point and the undisturbed ambient temperature. The stream is assumed to be of constant width, so that the change in T* with respect to the distance travelled from the point of discharge is given by the classical differential equation yielding exponential die-away:

$$\frac{dT^*}{dx} = -kT^*, \text{ or}$$

$$\frac{dT^*}{T^*} = -k\,dx.$$

Integrating this expression gives:

$$\log_e T^* = -kx, \text{ or}$$

$$T^* = e^{-kx}\, T_o^*$$

where T_o^* is the initial mixed excess temperature($=R_i$).

Since both T* and T_o^* are in degrees, it is evident that the temperature transfer coefficient, e^{-kx}, must be a dimensionless quantity involving the appropriate surface cooling parameters. A typical surface cooling coefficient, K, is 150 Btu per square foot of surface area per day per degree above equilibrium temperature (see Reference (1)).

The factors required to convert this into the die-away coefficient, k, above, are the stream flow, Q, the surface width, w (ft), the density of water, ρ, and the specific heat of water, C_p, thus:

$$k = \frac{Kw}{86{,}400\ Q\rho C_p} \quad (ft^{-1}).$$

If the stream flow is expressed in terms of its dependence on the depth, h, width, w, and mean velocity, U (ft/sec), this equation becomes:

$$k = \frac{K}{86{,}400\ Uh\rho C_p} \quad (ft^{-1}).$$

The subroutine reads the coordinates of the possible plant sites and of the sampling stations at which temperature standards must be met, and computes the distance from each plant site to each stream sampling station for insertion in the equation:

$$A_{ik} = e^{-kx}.$$

B6. Output for the Sample Problem

Table VI shows the output obtained from the zero-one integer model using the basic data for the sample problem (see Table II, Run 4). The input for this run was presented in Table V in Section B3 of this appendix.

The first part of the output simply contains the input information in tabular form. First, the load centers are listed with their power demands and distribution cost rates. Next, the transmission cost rates involved in serving each load center from each site are printed. Following this, the plant alternatives are detailed with their location, intercept cost for production, load-dependent production cost rate, maximum generating capacity and mixed temperature rise, i.e., the number of degrees the mixed stream temperature will be raised by each MW of power production at that site. Then the total unit cost rate (per MW) of serving each load center from each alternative is determined by summing the load-dependent production cost rate of the appropriate plant alternative, the associated transmission cost rate and the distribution cost rate of the appropriate load center. The power demand of each load center is then repeated and is multiplied by the total unit cost to determine the total load-dependent cost per week for serving each load center from each plant alternative. After the cost information, the downstream distances of each site and each stream point are listed (in thousands of feet from Site 1), followed by the temperature transfer coefficients from each site to each stream point and the maximum permissible excess temperature at each stream point.

The optimal solution to the problem is printed after the input data and includes the total weekly cost of the solution; the plant alternatives to

be built, along with their design generating capacity and intercept cost for production; and finally a listing of the load centers to be served by each plant alternative and the corresponding total load-dependent costs.

(Note: Error messages of "underflow" may be encountered in the output of the program. These may be ignored, however, since the extremely small numbers resulting in underflow messages are generated as a consequence of the algorithm used to solve the problem.)

TABLE VI. Typical Computer Output for Sample Problem

THIS IS A TRIAL PROBLEM FOR THE EEI DATA PACKAGE (LINEARIZED-45 MILES)

THERE ARE 5 LOAD CENTERS

LOAD CENTER	POWER DEMAND (MW)	DISTR. COST RATE ($/WK/MW)
1	250.	50.
2	250.	50.
3	250.	50.
4	250.	50.
5	250.	50.

THERE ARE 5 SITES

COST RATES FOR TRANSMISSION TO EACH LOAD CENTER ($/WK/MW)

SITE	LOAD CENTERS				
1	0.	180.	360.	540.	720.
2	180.	0.	180.	360.	540.
3	360.	180.	0.	180.	360.
4	540.	360.	180.	0.	180.
5	720.	540.	360.	180.	0.

THERE ARE 10 PLANT ALTERNATIVES

ALTERNATIVE	SITE NO.	INTERCEPT COST ($/WK)	PROD. COST RATE ($/WK/MW)	MAXIMUM GEN. CAPACITY (MW)	UNIT TEMP RISE (DEG.F/MW)
1	1	60000.	450.	1600.	0.0103
2	1	63000.	475.	1600.	0.0000
3	2	60000.	450.	1600.	0.0103
4	2	63000.	475.	1600.	0.0000
5	3	60000.	450.	1600.	0.0103
6	3	63000.	475.	1600.	0.0000
7	4	60000.	450.	1600.	0.0103
8	4	63000.	475.	1600.	0.0000
9	5	60000.	450.	1600.	0.0103
10	5	63000.	475.	1600.	0.0000

WEEKLY LOAD-DEPENDENT COSTS

FROM ALT.	TO LOAD CENTER	PROD. COST RATE ($/WK/MW)	TRANS. COST RATE ($/WK/MW)	DISTR. COST RATE ($/WK/MW)	TOTAL COST RATE ($/WK/MW)	POWER DEMAND (MW)	LOAD-DEPENDENT COSTS ($/WK)
1	1	450.	0.	50.	500.	250.	125000.
1	2	450.	180.	50.	680.	250.	170000.
1	3	450.	360.	50.	860.	250.	215000.
1	4	450.	540.	50.	1040.	250.	260000.
1	5	450.	720.	50.	1220.	250.	305000.
2	1	475.	0.	50.	525.	250.	131250.
2	2	475.	180.	50.	705.	250.	176250.
2	3	475.	360.	50.	885.	250.	221250.
2	4	475.	540.	50.	1065.	250.	266250.
2	5	475.	720.	50.	1245.	250.	311250.

TABLE VI. Typical Computer Output for Sample Problem (cont'd)

3	1	450.	180.	50.	680.	250.	170000.
3	2	450.	0.	50.	500.	250.	125000.
3	3	450.	180.	50.	680.	250.	170000.
3	4	450.	360.	50.	860.	250.	215000.
3	5	450.	540.	50.	1040.	250.	260000.
4	1	475.	180.	50.	705.	250.	176250.
4	2	475.	0.	50.	525.	250.	131250.
4	3	475.	180.	50.	705.	250.	176250.
4	4	475.	360.	50.	885.	250.	221250.
4	5	475.	540.	50.	1065.	250.	266250.
5	1	450.	360.	50.	860.	250.	215000.
5	2	450.	180.	50.	680.	250.	170000.
5	3	450.	0.	50.	500.	250.	125000.
5	4	450.	180.	50.	680.	250.	170000.
5	5	450.	360.	50.	860.	250.	215000.
6	1	475.	360.	50.	885.	250.	221250.
6	2	475.	180.	50.	705.	250.	176250.
6	3	475.	0.	50.	525.	250.	131250.
6	4	475.	180.	50.	705.	250.	176250.
6	5	475.	360.	50.	885.	250.	221250.
7	1	450.	540.	50.	1040.	250.	260000.
7	2	450.	360.	50.	860.	250.	215000.
7	3	450.	180.	50.	680.	250.	170000.
7	4	450.	0.	50.	500.	250.	125000.
7	5	450.	180.	50.	680.	250.	170000.
8	1	475.	540.	50.	1065.	250.	266250.
8	2	475.	360.	50.	885.	250.	221250.
8	3	475.	180.	50.	705.	250.	176250.
8	4	475.	0.	50.	525.	250.	131250.
8	5	475.	180.	50.	705.	250.	176250.
9	1	450.	720.	50.	1220.	250.	305000.
9	2	450.	540.	50.	1040.	250.	260000.
9	3	450.	360.	50.	860.	250.	215000.
9	4	450.	180.	50.	680.	250.	170000.
9	5	450.	0.	50.	500.	250.	125000.
10	1	475.	720.	50.	1245.	250.	311250.
10	2	475.	540.	50.	1065.	250.	266250.
10	3	475.	360.	50.	885.	250.	221250.
10	4	475.	180.	50.	705.	250.	176250.
10	5	475.	0.	50.	525.	250.	131250.

THE DOWNSTREAM DISTANCES FROM SITE 1 (IN THOUSANDS OF FEET) ARE

SITE	DISTANCE
1	0.
2	225.
3	450.
4	675.
5	900.

STREAM POINT	DISTANCE
1	5.
2	230.
3	455.
4	680.
5	905.

TABLE VI. Typical Computer Output for Sample Problem (cont'd)

THE TEMPERATURE TRANSFER COEFFICIENTS FROM SITE I TO STREAM POINT K ARE

		SITES				
STREAM POINT	MAX. EXCESS TEMP.					
1	15.	0.98	0.00	0.00	0.00	0.00
2	15.	0.43	0.98	0.00	0.00	0.00
3	15.	0.18	0.43	0.98	0.00	0.00
4	15.	0.08	0.18	0.43	0.98	0.00
5	15.	0.03	0.08	0.18	0.43	0.98

THE OPTIMAL SOLUTION IS

TOTAL WEEKLY COST= $ 880000.

THE PLANT ALTERNATIVES TO BE BUILT ARE

ALTERNATIVE	DESIGN CAPACITY (MW)	INTERCEPT COST ($/WK)
1	500.	60000.
7	750.	60000.

THE LOAD CENTERS TO BE SERVED BY EACH PLANT ALTERNATIVE ARE

ALTERNATIVE	LOAD CENTER	LOAD-DEPENDENT COSTS ($/WK)
1	1	125000.
1	2	170000.
7	3	170000.
7	4	125000.
7	5	170000.

APPENDIX C

FORMULATIONS FOR PROPOSED FUTURE MODELS

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C2.	Model with Probabilistic Temperature Constraints	C 89

APPENDIX C

FORMULATIONS FOR PROPOSED FUTURE MODELS

C1. Mixed Integer Model

In the mixed integer formulation, presented in Table VII, the variables which indicate the facilities to be built, X_i, remain zero-one integers as before, whereas the variables Y'_{ij} now represent the amount of power to be transmitted from each plant alternative to each load center, and are no longer zero-one integers but continuous variables. In other words, instead of simply indicating whether or not any power is transmitted from plant alternative i to load center j, Y'_{ij} in the mixed integer formulation represents exactly how much power is assigned to each plant-load center link in the system. The other mathematical symbols are defined in the same way as in Section 2.3 and Appendix A. A solution of the mixed integer formulation using the implicit enumeration technique would supply answers to much larger problems than those solved by the zero-one integer model previously described. Work on this type of computer algorithm is the next developmental step in this field.

TABLE VII. Formulation of Mixed Integer Model

Minimize: $$\sum_{i}^{NP} [X_i F_i + \sum_{j}^{NL} Y'_{ij} \ (P_i + T_{ij} + D_j)] \qquad (1)$$

Subject to: $$\sum_{i \epsilon S_m} X_i \leq 1 \qquad m = 1,\ldots,NS \qquad (2)$$

$$\sum_{i}^{NP} Y'_{ij} \geq L_j \qquad j = 1,\ldots,NL \qquad (3)$$

$$X_i = 0,1 \qquad i = 1,\ldots,NP \qquad (4)$$

$$Y'_{ij} \geq 0 \qquad i = 1,\ldots,NP; \ j = 1,\ldots,NL \qquad (5)$$

$$\sum_{j}^{NL} Y'_{ij} \leq X_i M_i \qquad i = 1,\ldots,NP \qquad (6)$$

$$\sum_{i}^{NP} A_{ik} R_i \left[\sum_{j}^{NL} Y'_{ij}\right] \leq C_k \qquad k = 1,\ldots,NC \qquad (7)$$

C2. Model with Probabilistic Temperature Constraints

The mixed integer model is deterministic in that it yields no measure of the reliability with which the stream standards will be met in the future since the transfer coefficient and mixed temperature rise calculations are usually based on the worst possible conditions, as determined by past stream flow records. The probabilistic formulation of the problem, however, specifically takes into account the stochastic nature of environmental conditions in developing the temperature standard constraints, and thus has the advantage of providing both an explicit statement of the risk of violating the temperature constraints and a means of avoiding the additional expense involved in preparing for statistically extreme environmental conditions.

In the sample problem formulation, a critical factor in determining the stream temperature constraints is the temperature transfer coefficient which shows stream temperature response at a given point due to a unit temperature increase at the plant site. This factor is not constant over time, but rather exhibits variations because of the stochastic inputs which determine it, e.g., wind speed, air temperature and stream flow. ReVelle, Joeres and Kirby (7) have devised a method to attack constraints based on random stream flow as a straight linear programming problem. Their technique is to examine a stream flow frequency histogram and determine probability distributions for stream flow for each month. The temperature standards are expressed in the deterministic formulation as:

$$\sum_{i}^{NP} A_{ik} R_i \left[\sum_{j}^{NL} Y_{ij} L_j \right] \leq C_k, \text{ for all } k,$$

where A_{ik} is the temperature transfer coefficient, R_i is the mixed stream temperature rise per MW of plant production, and C_k is the maximum permissible excess temperature at stream point k. In the probabilistic formulation, the constraint is changed to require that the probability that the above constraint is met is greater than or equal to $1 - \alpha$, where α is the fraction of the time that the stream standard may be exceeded. Such a probabilistic standard is not amenable to linear programming techniques. However, since A_{ik}, R_i and C_k are all functions of the prevailing environmental conditions, which in the deterministic formulation are assumed to be at the worst possible level, it is possible to transform the probabilistic constraint into a linear equivalent by introducing A^*_{ik}, R^*_i and C^*_k based on a stream flow with a specified low probability of occurrence α, i.e.:

$$\sum_{i}^{NP} A^*_{ik} \; R^*_i \; \left[\sum_{j}^{NL} Y_{ij} L_j \right] \leq C^*_k, \text{ for all } k.$$

It is important to note that such a linear constraint containing an implicit probability consideration can be solved by the same computer model which has been developed, viz., the zero-one integer model. A subroutine could be added to the existing program to examine historical or synthetically generated stream flow for a given period of time, and for each month to choose a flow with a specified probability of occurrence α and build constraints using the corresponding values of A^*_{ik}, R^*_i and C^*_k. Each of the twelve (monthly) constraints so generated would then be examined, and the most binding one would be chosen to be used in solving the problem. This would assure that the stream temperature standards are met at least $100(1 - \alpha)\%$ of the time and would provide an idea of

the cost of planning to meet the worst possible conditions, on which the deterministic constraints are based, as compared with conditions which occur less than 100α% of the time.

In addition, provision could be made in the program to perform regression analysis on stream flow and temperature so that the former uniquely determines the latter by a regression equation. This could also be done outside of the present program using an available computer code.

A formulation for a model with probabilistic temperature constraints is presented in Table VIII.

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TABLE VIII. Formulation of Model with Probabilistic Temperature Constraints

Minimize:

$$\sum_{i}^{NP} [X_i F_i + \sum_{j}^{NL} Y_{ij} L_j (P_i + T_{ij} + D_j)] \qquad (1)$$

Subject to:

$$\sum_{i \in S_m} X_i \leq 1 \qquad m = 1,\ldots,NS \qquad (2)$$

$$\sum_{i}^{NP} Y_{ij} \geq 1 \qquad j = 1,\ldots,NL \qquad (3)$$

$$X_i = 0,1 \qquad i = 1,\ldots,NP \qquad (4)$$

$$Y_{ij} = 0,1 \qquad i = 1,\ldots,NP;\ j = 1,\ldots,NL \qquad (5)$$

$$\sum_{j}^{NL} Y_{ij} L_j \leq X_i M_i \qquad i = 1,\ldots,NP \qquad (6)$$

$$\Pr \left\{ \sum_{i}^{NP} A_{ik}^{n} R_i^{n} \left[\sum_{j}^{NL} Y_{ij} L_j \right] \leq C_k^{n} \right\} \geq 1 - \alpha \qquad k = 1,\ldots,NC;\ n = 1,\ldots,q \qquad (7)$$

where

α = Fraction of total time that temperature standards may be exceeded.

q = Number of time periods under consideration.

n = Particular time period.

APPENDIX D

LISTS OF REFERENCES

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APPENDIX D

LISTS OF REFERENCES

D1. References Cited in this Report

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A SUMMARY OF ENVIRONMENTAL STUDIES ON WATER PROBLEMS

By investor-owned electric utility companies recently completed, under way, and proposed.

EDISON ELECTRIC INSTITUTE
March, 1971

Enclosure II

1354

INTRODUCTION

In June, 1969, the Water Problems Task Force of the Edison Electric Institute's Committee on Environment published a survey of environmental studies made by electric utility companies in connection with water problems. (EEI publication 69-47). Ninety-seven investor-owned electric utility companies were represented in the first survey, which summarized 307 studies. In April, 1970, work was begun on a revision of the report to keep the information current. The present survey represents 121 companies and summarizes 445 studies. The increased number of studies results from a greater response to the questionnaire from utilities as well as an increase in numbers of studies of this kind.

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SUMMARY

ENVIRONMENTAL STUDIES ON WATER PROBLEMS

BY FPC REGION

REGION	COMPLETED STUDIES	STUDIES UNDER WAY	STUDIES PROPOSED
I	73	65	11
II	25	21	11
III	25	31	12
IV	20	25	7
V	22	24	7
VI	7	2	0
VII	8	3	0
VIII	22	14	2
Other	1	0	0
Joint	5	2	0
	208	187	50

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REGION I - NORTHEAST

Completed Studies

Study No.	Company No.	Date Completed	Conducted By	Type of Water	Description
1	5	Feb 1966	Dr John E Edinger Dr John C Geyer, Staff	Tidal Estuary	Analysis of water temperature near plant
2	5	Dec 1969	Alden Research Lab	Estuary	Hydraulic model study of bay at nuclear plant site
3	5	April 1969	Sheppard T Powell Assoc	Estuary	Field data for developing hydraulic model
4	8	Oct 1969	Quirk, Lawler & Matusky Engineers, and Staff	River	Effect of cooling water discharge on river
5	12	Aug 1966	Staff	River	Temperature survey on river below discharge
6	35	Sept 1963	Pritchard-Carpenter, Cons Johns Hopkins University	Estuary	Concentration distribution for material discharged into bay
7	35	Sept 1965	Dr Charles B Wurtz, Cons LaSalle College	Estuary	Biological study of bay, river and creek in vicinity of plant
8	35	Sept 1966	Burns and Roe, Inc	Estuary	Plant intake fish protection facilities
9	35	Sept 1969	Fellows, Read & Weber	Ocean	Report on ocean current testing program
10	35	June 1970	Dr J R Carpenter	Bay & Ocean	Temperature and dye distribution in bay with plant in operation and without dilution pumps
11	39	Aug 1965	Ebasco Services, Inc	Salt Water	Water temperature studies to determine the effect of two stations on the temperture of the adjoining water bodies

REGION I - NORTHEAST
Completed Studies (Cont'd)

Study No.	Company No.	Date Completed	Conducted By	Type of Water	Description
12	43	1970	Penn State University, Gilbert Assoc, Mc and Staff	River	Plume effects of natural draft hyperbolic cooling towers
13	48	May 1966	Pritchard-Carpenter Assoc	Coastal	Pre-operational tracer study to develop probable thermal distribution of CW discharge from plant unit I
14	48	April 1970	Pritchard-Carpenter Assoc	Coastal	Pre-operational tracer study to develop probable thermal distribution of CW discharge from plant unit I
15	48	Nov 1964	Stone & Webster Eng Corp	Estuary	River temperature survey
16	48	Jan 1966	Stone & Webster Eng Corp	Estuary	River temperature survey
17	48	Oct 1964	Stone & Webster Eng Corp	Estuary	Effects of plant on river
18	48	Sept 1968	Traveler's Research Center	Estuary	Thermal measurements to establish distribution of cooling water discharge in vicinity of plant
19	48	Dec 1968	Raytheon	Estuary	Survey of the thermal distribution patterns from an existing fossil fuel plant to establish a basis for predicting thermal patterns after addition of new unit
20	49	March 1970	Bechtel Corp	Estuary	Study of alternative methods of cooling condenser discharge from oil fired unit
21	55	Sept 1960	Lehigh U & Staff	River	Effects of condenser discharge water on aquatic life
22	55	1967	Staff	River	Temperature distribution in river at particular point

REGION I - NORTHEAST
Completed Studies (Cont'd)

Study No.	Company No.	Date Completed	Conducted By	Type of Water	Description
23	55	Dec 1968	Dr Charles B Wurtz & Staff	River	Effect of condenser discharge water on aquatic life
24	56	1959	Dr Charles B Wurtz	River	Effects of increased temperatures on biochemical oxygen demand
25	56	1960	Dr Charles B Wurtz	River	Biological method used in the evaluation of effects of thermal discharge in the river
26	56	1969	Dr E C Raney - Staff	All	"Heated Effluents and Effects on Aquatic Life with Emphasis on Fishes," a bibliography
27	56	1969	Hydro-Research Science	Reservoir	Hydraulic model study circulating water screen structure and intake basin
28	56	1969	Dr E C Raney - Staff	Reservoir	Study of stream temperatures and effects on aquatic life at a nuclear power plant
29	58	Oct 1968	St Anselm's College Institute for Research & Services	River	Effects of thermal releases on the ecology of river
30	58	1969	Normandeau Associates	River	Effects of thermal releases on the ecology of river, supplemental report #1
31	58	1969	Webster Martin Co	Estuary	Hydrographic test program
32	58	May 1970	Normandeau Associates	Estuary	Ecological considerations of proposed generating station
33	58	Sept 1968	Webster Martin Co	Estuary	Hydrographic test program

REGION I - NORTHEAST
Completed Studies (Cont'd)

Study No.	Company No.	Date Completed	Conducted By	Type of Water	Description
34	58	Aug 1969	Alden Research Labs	Ocean	Buoyant jet discharge model
35	60	Dec 1954	Staff	Connecting water between bays	Water temperature survey
36	60	Sept 1959	Staff	River	Water temp survey above and below station
37	60	Sept 1960	Staff	River	Water temp survey above and below station
38	60	Sept 1961	Staff	River	Water temp survey above and below station
39	60	Dec 1966	Sheppard T Powell Assoc	River	Capacity of river to assimilate thermal loads from existing and future generating stations
40	60	Sept 1966	Staff	Connecting water between bays	Station heat rejection and temp data. Tidal flow, water analysis, etc
41	60	Aug 1966	Staff	Connecting water between bays	Water temperature survey above and below station
42	60	Oct 1966	Staff	River	Surface water temperature survey of river to establish dispersion pattern of heated discharge water
43	60	March 1969	Pritchard-Carpenter Assoc	River & Estuary	Dispersion and cooling of waste heat released into river estuary
44	63	Oct 1969	Pritchard-Carpenter Assoc	Lake	Drift and dispersion characteristics of lake near shore waters - dye studies
45	77	Feb 1968	Ebasco Services, Inc	Estuary	Study of generating capacity limitation as controlled by water temperature regulations

REGION I - NORTHEAST
Completed Studies (Cont'd)

Study No.	Company No.	Date Completed	Conducted By	Type of Water	Description
46	78	Apr 1967	Webster-Martin	River	The fishes of the river drainage basin
47	78	Dec 1967	Webster-Martin	River	Water quality
48	78	Dec 1968	Webster-Martin	Ponded River	Report on ecological studies of river
49	78	Dec 1969	Webster-Martin	Ponded River	Report on ecological studies of river
50	84	Mar 1967	Quirk, Lawler & Matusky	Estuary	Salt water intrusion and pollutant study
51	84	Oct 1966	Northeastern Biologists, Inc	Estuary	Striped bass egg and larvae studies
52	84	Jan 1967	Quirk, Lawler & Matusky	Estuary	River and river basin water supply study
53	84	Nov 1966	Prof Milo C Bell	Estuary	Design of fish protection facilities
54	84	Oct 1967	Dr Alfred Perlmutter	Estuary	Fishery study of effects of pressure on fish
55	84	Sept 1966	Dr G W Prescott	Estuary	Effects of plant operation on river algae
56	84	Apr 1968	Quirk, Lawler & Matusky	Estuary	Effect of nuclear plant cooling water discharge on river temp distribution
57	84	Feb 1969	Quirk, Lawler & Matusky	Estuary	Effect of nuclear plant cooling water discharge on river temp distribution
58	84	Apr 1967	Northeastern Biologists, Inc	Estuary	River temp survey in the vicinity of nuclear plant
59	84	Oct 1968	Texas Instruments, Inc	Estuary	Aerial infra-red studies of temp distributions in river near nuclear plant

REGION I - NORTHEAST
Completed Studies (Cont'd)

Study No.	Company No.	Date Completed	Conducted By	Type of Water	Description
60	84	Nov 1968	Dr Alfred Perlmutter	Estuary	River fishery survey at nuclear plant site
61	84	Dec 1969	Northeastern Biologists Inc	Estuary	River fisheries study
62	84	May 1969	Alden Research Lab	Estuary	Hydraulic models
63	85	Aug 1968	Camp Dressert McKee	River	Report on comprehensive plant for domestic and industrial waste water disposal
64	87	Aug 1968	Staff	Marine bay	Temperature patterns at a coastal site
65	87	Dec 1969	Staff	Estuary	Water temperature and current study
66	87	Dec 1969	Univ of R I Marine Lab	Tidal Estuary	Literature search, water quality biology
67	90	Sept 1964	Dr John Storr University of Buffalo and Staff	Lake	Limnology section of safety analyses
68	90	Feb 1967	Stone & Webster Engr Corp and Staff	River	Flow characteristics and thermal capability of river in particular vicinity
69	101	Oct 1968	Bechtel Corp, R O Eaton & Dr A T Ippen, MIT, Dr D W Pritchard, Chesapeake Bay Institute; Dr John H Ryther, Woods Hale Oceanographic Institute, Prof Merril Eisenbud, N Y U Medical Center	Ocean	Salt water use and waterfront development; coastal engineering; physical oceanography; and cooling water dispersion; ecology and radiology

REGION I - NORTHEAST
Completed Studies (Cont'd)

Study No.	Company No.	Date Completed	Conducted By	Type of Water	Description
70	105	1967	Staff, Johns Hopkins University	Tidal Estuary	Biological study of the river
71	113	1969	John F Storr, Consultant in Oceanography & Limnology (State Univ of N Y at Buffalo)	Lake	Benthic zone studies
72	113	1969	Cornell Univ Water Resources & Marine Sciences Center	Lake	Ecology of a lake and the proposed nuclear powered station
73	113	1969	Cornell Aeronautical Laboratory	Lake	Investigation of the physical effects of thermal discharges into a stratified lake

REGION I - NORTHEAST

Studies Under Way

Study No.	Company No.	Date to be Completed	Conducted By	Type of Water	Description
74	5	Continuing	Sheppard T Powell Assoc	Estuary	Temperature studies at five power plants
75	5	Continuing	Sheppard T Powell Assoc	Estuary	Field data at nuclear power plant site
76	5	Continuing	Academy of Natural Sciences of Philadelphia	Estuary	Marine ecology studies at nuclear power plant
77	8	Oct 1970	Quirk, Lawler & Matusky Engineers	River	Effect of thermal discharge at three prospective generating plant sites on river
78	35	Continuing	Rutgers University	Estuary	Lethal limits and temperature preference ranges for fish and animal life in and on the water of the bay and study of marine life living in and on bottom of bay
79	35	Continuing	Staff	Estuary	Continuous temperature measurement on location
80	35	1976	Dr C B Wurtz	Bay	Biological sampling program for plankton distribution in bay
81	39	Undetermined	W Vanderborgh & Son (Oyster Growers)	Salt water	Study of the operation of an experimental oyster nursery in the discharge basin
82	39	1975	Dr A Perlmutter	Salt water	Ecological survey to determine the extent of any marine biological changes due to operation of nuclear station
83	39	July 1971	Oceanographic Analysts, Inc	Sea	Ecological study of the aquatic environs of a proposed nuclear power station site

REGION I - NORTHEAST
Studies Under Way (Cont'd)

Study No.	Company No.	Date to be Completed	Conducted By	Type of Water	Description
84	39	Mar 1972	Marine Sciences Research Center of State Univ of N Y at Stony Brook	Sea	Physical and ecological effects of thermal effluent upon a temperate estuary
85	43	1971	Consultant and Staff	River & Wells	Background radiation - soil, vegetation, fish, water and river silt
86	43	Continuing	Alden Lab and staff	River	Annual temperature survey of river
87	43	Continuing	Charles B Wurtz	River	Annual biological survey of river
88	43	After 1974	Pickard & Lowe, Dr Hoyt Whipple and Millersville State College	River	Radiological studies and fish population studies
89	48	Dec 1972	Dr Daniel Merriman & Staff	Estuary	River study - of biological, chemical, and physical characteristics before and after operation on the ecology of the river
90	48	Undetermined	Combustion Engrg Inc	Estuary	Environmental monitoring program - a preoperational and postoperational study of environmental radiation levels
91	48	Apr 1973	Battelle-Duxbury	Coastal	Survey of key ecological indicators to determine effect of thermal discharge from nuclear station
92	48	Undetermined	Tracerlab	Coastal	Survey of radiation levels in the marine environment to establish background and detect any change resulting from the operation of plant

REGION I - NORTHEAST
Studies UnderWay (Cont'd)

Study No.	Company No.	Date to be Completed	Conducted By	Type of Water	Description
93	48	Undetermined	Battelle-Duxbury	Estuary	Study to determine the effects of increased plant capacity on the ecology and aquatic life of the river
94	48	1973	Woods Hole Oceanographic Lab	Coastal	Effects of temperature pressure and water chemistry on marine organisms passing through generating system condensers
95	55	Continuing	Staff	River	River water quality survey
96	55	Continuing	Staff	River	Effect of operation of station on ice formation
97	55	Continuing	Dr Charles B Wurtz	River	Macroinvertebrate study of river
98	56	1972	Alden Research Lab	Reservoir	Model study to determine temperature effects of heated effluent from two 1000 mw BWR units
99	56	1975	Dr Edward C Raney	Reservoir	A study of the fishes and plankton of reservoir
100	56	1969	Corps of Engineers, Dr Leslie J Hooper	Estuary	Model study to determine thermal capabilities
101	56	1977	Dr Edward C Raney	River	Biological study of the river to determine the effects of the operation of a nuclear plant
102	56	1972	Dr Edward C Raney	Estuary	Study of the effects of thermal discharges on fish movements

REGION I - NORTHEAST
Studies Under Way (Cont'd)

Study No.	Company No.	Date to be Completed	Conducted By	Type of Water	Description
103	56	1975	U S Dept of Interior, Dr Raney & Staff	River	Development and testing of fish passage facilities at a hydro electric dam
104	56	1970	Dr Ruth Patrick	Estuary	Study of the biological effects of heated discharges
105	58	May 1971	Normandeau Associates	Estuary	Reproductive & larval behavior of shell fish
106	58	Jan 1971	Normandeau Associates	Estuary	Ecological study of river
107	58	April 1971	Normandeau Associates	River	Ecological surveillance program
108	60	Dec 1970	Dr Ruth Patrick	River	Effects of heat and temperature changes on ecology of rivers including effects of chlorination on marine life
109	60	1976	Dr Edward C Raney	River & Estuaries	Ecological study of river
110	60	July 1970	Staff	River & Estuary	Review current water uses by company and to determine adherence to water quality criteria
111	63	Undetermined	Staff	Lake	Temperature profile mapping
112	63	June 1973	John F Storr	Lake	Ecological survey - fish population, rate of growth, bottom ecological survey
113	75	Continuing	Commonwealth of Penn	River	Automatic water quality monitoring
114	75	Undetermined	P E A - Special committee on Acid Mine Drainage	River	Evaluate progress reports on research

REGION I - NORTHEAST
Studies Under Way (Cont'd)

Study No.	Company No.	Date to be Completed	Conducted By	Type of Water	Description
115	77	Aug 1970	Ebasco & Pritchard-Carpenter	Estuary	Study of the effect of condenser cooling water discharge on the temperature distribution in harbor
116	77	Undetermined	Raytheon & Normandeau Assoc	Estuary	Ecological studies of harbor
117	84	Undetermined	Alden Research Lab	Estuary	Hydraulic models for thermal studies at nuclear plant sites
118	84	Undetermined	NYU Institute of Environmental Medicine	Estuary	Comprehensive ecological study of river near nuclear plant site
119	84	Undetermined	NY State Atomic & Space Development Authority	Estuary	Aerial infra-red thermal studies of water areas adjacent to existing and proposed generating plants
120	84	Jan 1971	Battelle-Northwest	Estuary	Power plant environmental feasibility in lower bay
121	84	Nov 1970	Battelle-Northwest	Estuary	Cooling water diffusion and dispersion in the sound
122	84	Undetermined	Quirk, Lawler & Matusky	Estuary	Assimilative capacity of additional heat input from generation station expansion
123	84	Feb 1971	Burns & Roe	Estuary	Establishment of chemical effluent standards of water quality control
124	84	Dec	Raytheon	Estuary	Comprehensive ecological study of river near nuclear site

REGION I - NORTHEAST
Studies Under Way (Cont'd)

Study No.	Company No.	Date to be Completed	Conducted By	Type of Water	Description
125	84	Undetermined	Ichthyological Associates	Estuary	Biological studies of white perch and striped bass as to swim speed and behavior in screened flows and various temperatures
126	84	Undetermined	Dr John F Storr	Estuary	Investigation into fish densities at nuclear plant site
127	87	1971	Dr G C Matthiessen Braincon Corp, Raytheon Corp Alden Research Lab	Tidal Estuary	Water currents, temperature chemistry, biological sampling, hydraulic model
128	87	Undetermined	Raytheon Corp	Marine bay	Water temperature and chemistry, biological sampling
129	90	Continuing	Staff - Dr John Storr	Lake	Effects on aquatic life in lake
130	101	Feb 1973	Mass Division of Marine Fisheries of the Dept of Natural Resources	Ocean	Biological investigation of marine life both before and after operation of plant
131	102	Oct 1974	Univ of Maine, and Ira C Darling Center for Research	Estuary	Survey of sediments, plankton, benthos and the commercially important plants and animals in river
132	102	Sept 1972	Staff	Estuary	Reconnaissance survey of water temperature
133	102	Nov 1974	Sea & Shore Fisheries	Estuary	Mariculture research
134	102	Undetermined	Malpeque Corp	Estuary	Fish rearing, (Brook trout)

REGION I - NORTHEAST
Studies Under Way (Cont'd)

Study No.	Company No.	Date to be Completed	Conducted By	Type of Water	Description
135	102	Oct 1974	Dept of Fish & Game	Marsh	Wildlife habitat
136	105	Conducted annually Summer	Staff	Tidal Estuary	Synoptic study of river conditions using floating laboratory
137	105	Aug 1970	Marine Laboratories Univ of Delaware	Tidal Estuary	Effect of thermal enrichment on oysters in river
138	105	1970-71	Dr Ruth Patrick, Academy of Natural Sciences	Tidal Estuary	Physical and biological study of river

REGION I - NORTHEAST

Studies Proposed

Study No.	Company No.	Proposed Date	Conducted By	Type of Water	Description
139	48	Sept, 1970	Undetermined	Coastal	Postoperational survey of thermal distribution of CW Discharge
140	55	1970	Staff	Rivers	Temperature distribution
141	63	1969	Sheppard T Powell & Assoc	River	Temperature profile mapping
142	63	1970	Dr J Carpenter	Lake	Temperature profile mapping - high momentum discharge
143	84	Undetermined	Quirk, Lawler & Matusky	Estuary	Hydrological study of sound with emphasis on a particular area
144	84	Undetermined	Contractor to be selected	Estuary	Model Study to determine temp distribution in the sound water adjacent to Island
145	84	Undetermined	Contractor to be selected	Estuary	Ecology study of the lower river
146	84	Undetermined	Marine Sciences Research Center	Estuary	Ecological study of the sound waters adjacent to Island
147	87	1970-71	Research Institute	Tidal Estuary	Water quality and biology at undeveloped site
148	102	1970	Staff	Estuary	Water quality profile and brook trout experiments
149	105	Undetermined	Staff	Tidal Estuary	Measure thermal gradients due to cooling water discharge

REGION II - EAST CENTRAL

Completed Studies

Study No.	Company No.	Date Completed	Conducted By	Type of Water	Description
150	13	Nov 1970	Photo Science	River	Thermal mapping and infra-red photography
151	13	Nov 1970	Clyed E Williams & Assoc	River	Thermal plume dispersion studies for circulating water discharge
152	17	Fall 1967	Staff	River	Water temperatures in mixing zone
153	17	Fall 1967	Staff	Lake	Water temperatures in mixing zone
154	17	Fall 1968	Staff	Creek & Lake	Water temperatures in mixing zone
155	17	Oct 1968	Beak Consultants	Lake	Ecological study
156	17	Oct 1968	Staff	Lake	Temperature study
157	19	Oct 1962	Staff	River	Flow, temperatures, dissolved oxygen, BoD, air temp, weather, 12 mile stretch of river
158	19	Oct 1954	Prof T J Velz University of Michigan	River	Define waste assimilation capacity of two rivers under natural drought stream flow; and, under regulated flow to serve as a basis for determining reservoir capacity requirements under present and future pollution loads.
159	21	May 1968	Pennsylvania Electric Association & Staff	River	Study to determine the amount of heat presently discharged to the rivers, and an attempt to forecast the heat rejection of future units through the year 1990
160	21	May 1969	Alden Research Lab	River	Model study of power station

REGION II- EAST CENTRAL
Completed Studies (Cont'd)

Study No.	Company No.	Date Completed	Conducted By	Type of Water	Description
161	31	May 1964	Staff	River	Effects of power plants & weather conditions on river temperatures
162	31	Mar 1966	Staff	River	Adequacy of river as a source of condensing and cooling water
163	31	May 1967	Pioneer Serv & Engr Co	River	Circulating Water System Study. (Necessity of added cooling towers at existing plants)
164	61	Sept 1966	Staff	River	Downstream temperature measurements
165	61	Sept 1967	Staff	River	Downstream temperature measurements
166	74	Jan 1970	Dr John C Ayers, Great Lakes Research Div Univ of Michigan	Lake	Complete limnology of lake at plant site
167	74	1969	Dr D W Pritchard Chesapeake Bay Inst, Johns Hopkins Univ	Lake	Predictions of thermal plumes in lake
168	86	Jan 1962	Staff	River	Investigation of the effects of plants on the temperature of river
169	86	Oct 1966	Staff	River	Investigation of plant cooling
170	99	1966	Staff, VPI & others	Reservoir	Water quality of pumped storage reservoir
171	99	1967	Staff, VPI & others	Reservoir	Water quality of pumped sotrage reservoir
172	99	1968	Staff	Reservoir	Dissolved oxygen study
173	99	1968	Staff	Reservoir	Water quality studies
174	104	1969	Staff	Lake	Thermal survey of lake at company plants

REGION II - EAST CENTRAL

Studies Under Way

Study No.	Company No.	Date to be Completed	Conducted By	Type of Water	Description
175	2	Continuing	Staff	River	Circulating water temp effect #1
176	2	Continuing	Staff	River	Circulating water temp effect #2
177	2	Continuing	Staff	River	Circulating water temp effect #3
178	13	Feb 1971	Battelle	River	Effects of thermal effluents from power plants
179	17	Fall 1970	Staff	Lake	Temperature in mixing zone
180	17	Fall 1972	Beak Consultants, Inc	Lake	Ecological study
181	19	Continuing	Dr Frank Parker Vanderbilt Unit	River	To determine effect of low flow augmentations of river on operation of two steam generating stations
182	19	Continuing	Miami Conservancy District Ohio	River	"Regional Water Quality Management Program"
183	21	Continuing	Staff	River	Study at each plant to determine status of compliance with Article 301 of the State Water Pollution Control Rules and Regulations
184	21	Oct 1970	Staff	Ash slurry & mine	Treatment and clarification of a mixture of mine and ash slurry waters
185	21	June 1970	NUS Corp	River	Survey of existing and future compliance to state regulations.

REGION II - EAST CENTRAL
Studies Under Way (Cont'd)

Study No.	Company No.	Date to be Completed	Conducted By	Type of Water	Description
186	31	May 1971	Indiana Univ Water Resources Research Found	River	Study of Biologic Effects of Heated Water Discharge - before and after addition of generating units
187	31	Continuing	US Geological Survey	River	Effects of atmospheric conditions on downstream river temperatures with constant plant load
188	49	----	Industrial Bio-Test	Lake	PSAR Bailly Nuclear-1
189	61	Continuing	Staff	River	Annual downstream temperature measurements
190	86	Aug 1973	Water Research Inst Mich State Univ and Staff	Fresh	Effects of heated water on aquatic habitat
191	86	Aug 1970	Staff	Fresh	Development of mathematical model for use in the dispersion of heated discharges in receiving water bodies
192	86	Oct 1970	Staff	Fresh	Fate of biological organisms on passage through condensers
193	99	1971	VPI	River	Aquatic life study of spill of ash pond water
194	99	1974	U Of Mich	Lake	Pre-& post operational studies for new plant
195	115	June 1970	Commonwealth Assoc	River	Thermal hydrology study in connection with the installation of a new power plant

REGION II - EAST CENTRAL

Studies Proposed

Study No.	Company No.	Proposed Date	Conducted By	Type of Water	Description
196	12	Oct 1970	WAPORA	River	Effect of temperature on aquatic life
197	17	1970	Consultant	Bay	Effects of existing thermal discharge and possible expansion on aquatic ecology
198	17	1970-77	Cooperative	River	Pre and post operational effects of thermal discharge on aquatic ecology
199	21	1975	NUS Corp	River	Ecological studies (biological, physical, chemical) and radiological surveilance.
200	49	Undetermined	Staff	Lake	Thermal increase in lake due to plant discharge
201	49	Summer 1971	Contractor not yet chosen	Lake	Environmental survey of lake
202	86	Aug 1973	Water Research Inst Mich State	Fresh	Study of effects of heated water on aquatic habitat and the fate of radio-nuclieds in aquatic environment at station
203	86	Oct 1970	Staff	Fresh	Characterization of thermal plumes at three major fossil power plants on Lake and River
204	86	Undeterminded	Contractor not yet selected	Lake	Cooling water discharge dispersion research - 5 year biological survey of lake in vicinity of plant
205	104	1971	Architect/engineer or consultant	Lake	Thermal Plume definition and modification
206	104	1970	Clyde Williams Assoc, Inc	Lake	Infra-red study

REGION III - SOUTHEAST

Completed Studies

Study No.	Company No.	Date Completed	Conducted By	Type of Water	Description
207	1	Sept 1960	Staff and T Jaffe, Auburn University	River	Pre-impoundment water quality study
208	1	Sept 1965	Staff and Dr J V Walters University of Alabama	Lake	Water quality study of company reservoirs
209	1	Sept 1966	Staff	Lake	Water quality study of company reservoirs
210	1	Summer 1966	Staff	River	Water quality at intake of paper mill - Comparison of summers of 1965 and 1966
211	1	Apr 1967	Staff	Reservoir	Study of water quality above and below powerhouse during summer 1966
212	1	July 1966	Staff	River	Survey of water quality through river improvements
213	1	Aug 1966	Staff	Reservoir	Survey of water quality in reservoir
214	1	Summer 1966	Staff	Reservoir	Study of water quality in reservoir
215	1	Sept 1967	Staff	Lake	Water quality study of company reservoirs
216	1	Sept 1968	Staff	Lake & River	Temperature study of water at company steam plant sites and continuing study of company reservoirs
217	1	Feb 1970	Staff	Lake & River	Second annual report of effects of company dam on downstream water quality

REGION III - SOUTHEAST
Completed Studies (Cont'd)

Study No.	Company No.	Date Completed	Conducted By	Type of Water	Description
218	1	July 1969	Staff	River	Auxiliary cooling pond study at nuclear power site
219	1	Nov 1969	Staff	River	Study of assimilative capacity of river made in conjunction with large thermal plant addition
220	7	1971	N C State University	Estuary	Effects of heated water effluents on river and estuaries
221	7	Aug 1969	Dr Carpenter, Johns Hopkins University	Estuary	Hydrological study to determine effects of heated water discharge on temperatures
222	7	Jan 1967	Staff and N C State Stream Sanitation Comm	River	Effect of heated water effluent on temperature and biology of a river
223	7	May 1970	Staff and NUS Corp	Lake	Radioactive materials in the vicinity of a nuclear power plant site
224	20	1960	Staff and Dr Charles M Weiss, Consulting Limnologist	Lake	Preliminary study. Influence of hydro-electric reservoirs upon water quality of river
225	20	1969	FWPCA, South Carolina Water Pollution Control Authority, staff	Lake	Eutrophication
226	20	1970	U S Geological Survey	River	Thermal loading
227	25	1968	Gilbert Assoc & Staff	Gulf (salt)	Thermal effects on the marine environment

REGION III - SOUTHEAST
Completed Studies (Cont'd)

Study No.	Company No.	Date Completed	Conducted By	Type of Water	Description
228	25	April 1970	Cornell Aero Lab	Ocean	Aerial infra-red mapping of ocean surface temps
229	26	1969	Emory University	River	Mussel study near proposed nuclear plant site
230	65	Nov 1967	Stone & Webster Eng Corp	River	Thermal effects on river
231	79	Oct 1969	Staff	Lake	Temperature distribution in a cooling lake serving two 550 Mw units

REGION III - SOUTHEAST

Studies Under Way

Study No.	Company No.	Date to be Completed	Conducted By	Type of Water	Description
232	1	Sept 1973	Staff	Lake	5-year evaluation of effects of dam on downstream water quality
233	1	Dec 1970	Staff	River	Effects of large thermal power plant additions on heat regime of river (2 studies)
234	1	Oct 1971	Staff	Lake-River	Use of hydroelectric turbines to aerate discharge
235	7	Continuing	Dr J R Hobbie N C State University	Estuary & Ocean	Effect of plant intake on the biology of an estuary and effect of heated discharge on the biology of the ocean
236	7	1973	U S Geological Survey	Lake	Effect of thermal loading on water balance of a cooling lake
237	7	Continuing	D'Appolonia Engineers	Ground Water	Intrusion of saline water into ground water from an unlined canal
238	7	1975	N C State University	Estuary	Effect of warm water discharge of marine environment and laboratory study of thermal tolerance of important marine and estuarine organisms
239	20	Continuing	Staff, Dr Charles M Weiss, University of North Carolina	Lake	Influence of hydroelectric reservoirs upon water quality on river
240	25	1974	Staff	Gulf	Temperature monitoring
241	25	Jan 1973	Fla Dept of Natural Resources	Ocean	Biological survey for thermal effects

REGION III - SOUTHEAST
Studies Under Way (Cont'd)

Study No.	Company No.	Date to be Completed	Conducted By	Type of Water	Description
242	25	Continuing	State of Florida Div of Health	Ocean	Preoperational radiological survey
243	26	1971	Staff	River	Water quality downstream from steam plant
244	26	1971	Staff	Lake	Biological effect in lake near steam plant
245	26	Indefinite	Staff-USGS State Board	River	Water quality in river near nuclear plant under construction
246	26	Indefinite	Staff-Dr Wurtz	River	Biological & ecological study near nuclear plant
247	26	Indefinite	Emory University	River	Ecological study in river and estuary near nuclear plant
248	26	Indefinite	University of Georgia	River	Ecological study in river and estuary near nuclear plant
249	26	Indefinite	Staff & Consultants	River	Reconcentration factors in aquatic life
250	26	Indefinite	Emory University	River	Ecological effects of cooling tower
251	28	Indefinite	Staff	River	Monitoring temperature, dissolved oxygen and salenity of plant
252	28	1970	MAPCO	River	Thermal mapping of river at plant sites
253	29	1972	Va Inst of Marine Science	Estuary	Ecological study of the estuary before and after installation of two nuclear reactors

REGION III - SOUTHEAST
Studies Under Way (Cont'd)

Study No.	Company No.	Date to be Completed	Conducted By	Type of Water	Description
254	79	1972	Staff	Estuary	Pre and post-operational radiological study
255	79	Dec 1972	Johns Hopkins University Staff	River	Study of the ecology of river before and after installation of 690 Mw unit
256	79	Continuing	Staff	River	River water temperatures #1
257	79	Continuing	Staff	River	River water temperatures #2
258	79	Continuing	Staff	River	River water temperatures #3
259	79	Continuing	Staff	River	River water temperatures #4
260	118	1975	Staff	Mixed River	Pre and post-operational environmental study for AEC nuclear power stations
261	118	1977	Staff	Mixed River	Pre and post-operational environmental study for nuclear power stations
262	118	1971	Staff	Reservoir	Biological survey of influence of heated effluents

REGION III - SOUTHEAST

Studies Proposed

Study No.	Company No.	Proposed Date	Conducted By	Type of Water	Description
263	1	Sept 1973	Staff	Lake	Evaluation of effects of powerhouse on downstream water quality
264	7	1972-74	No Decision. Consulting firm with capability of performing program	Estuary & Ocean	Radioactivity in the vicinity of a coastal nuclear power plant prior to operation
265	7	Indefinite	Dr D Adams	Estuary	Construction of productive marshland in spoiled area
266	25	1969	State Board of Conservation	Gulf	Quantitative marine ecology measuring program
267	25	Oct 1970	U of So Fla Marine Sci Institute	Ocean	Marine Ecological survey (4 years)
268	25	May 1970	U of So Fla Marine Sci Institute	Ocean	Thermal Plume investigation
269	25	Nov 1970	U of Florida	Ocean	Preoperational radiological survey
270	26	1973	Staff	Rivers	Water quality downstream from steam plants
271	79	1970	Alden Research Lab	Estuary	Working scale model of lower river estuary
272	79	1971	Virginia Commonwealth Univ	River	Preimpoundment ecological study
273	118	1970-71	Staff	Tidal Estuary	Biological survey of influence of heated effluent
274	118	1970-72	Staff	Mixed River	Biological survey of influence of heated effluent

REGION IV - NORTH CENTRAL

Completed Studies

Study No.	Company No.	Date Completed	Conducted By	Type of Water	Description
275	14	June 1968	Dr L P Beer - Staff Dr W O Pipes Northwestern University	Lake	Environmental effects of condenser water discharge
276	14	1968	G E Stigal NUS Corp	Lake	Effects of nuclear power station liquid waste discharges
277	14	1968	E R Smith NUS Corp	Lake	Evaluation of potential contamination by effluent from particular station
278	14	Oct 1968	Dr L P Beer - Staff Dr W O Pipes Northwestern University	River	Effects of discharge of condenser water into river
279	14	1968	Dr L P Beer Dr W O Pipes, Staff Northwestern Univ	River	Effect of condenser water on river
280	14	1968	Boyle Laboratories	Lake	Effect of condenser water in cooling lake
281	32	Aug 1968	Dr Wesley O Pipes Pollution Biologist Northwestern Univ, Dr Donald Mc Donald, Univ of Iowa	River	Effects of discharge of condenser water into river
282	41	1968	Univ of Wisconsin	Lake	Heat dissipation and induced circulations from condenser cooling water discharges into lake

REGION IV - NORTH CENTRAL
Completed Studies (Cont'd)

Study No.	Company No.	Date Completed	Conducted By	Type of Water	Description
283	50	Sept 1964	Staff	River	River temperature study - effects of condenser cooling
284	50	Aug 1965	University of Minnesota	Lake	Effects of condenser cooling water discharge on water temperatures in lake including model study
285	50	Sept 1966	University of Minnesota	River	Model study of the cooling water outlet channel
286	82	Sept 1967	Paul M Kronbert Staff	Various	Survey of water conditions near power plants
287	82	April 1969	Univ of Wis, Dept of Zoology	Lake	Ecological responses of lake fishes to heated influent water
288	83	Dec 1957	Wisconsin Valley Improvement Co, Staff	River	Dissolved oxygen and temperatures above and below plant
289	83	Dec 1957	Staff, Wis Valley Improvement Co	River	Dissolved oxygen on inlet and outlet of circulating water
290	83	Dec 1961	Staff, Wisconsin Valley Improvement Co	River	Dissolved oxygen and temperatures above and below plant
291	83	Jan 1966	Staff, Wisconsin Valley Improvement Co	River	Temperature increase in western circulating water
292	83	Mar 1968	Staff and Water Dept	River	River heat rejection over 30 miles of industrial use
293	97	May 1968	Texas Instruments Inc	Lake	Airborne infra-red imagery of power plant cooling water discharges
294	97	July 1967	MIT	River	A model study of thermal stratification produced by condenser water discharge

REGION IV - NORTH CENTRAL

Studies Under Way

Study No.	Company No.	Date to be Completed	Conducted By	Type of Water	Description
295	9	Undetermined	Staff	River	Cooling water discharge data
296	9	Continuing	Staff	Ash pond discharge	Fish survival and reproductivity in pond effluent
297	14	June 1970	Dr L P Beer, BioTest Dr W O Pipes Northwestern Univ	Lake	Preoperational study of lake
298	14	June 1970	Dr L P Beer, BioTest Dr W O Pipes Northwestern Univ	River	Preoperational study of river #1
299	14	June 1970	Dr L P Beer, BioTest Dr W O Pipes Northwestern Univ	River	Preoperational study of river #2
300	32	Undetermined	Staff	River	Thermal effect
301	41	1971	University of Wisconsin	Lake	Ecological responses of lake fishes to heated influent water
302	41	1971	Univ of Wisconsin	Pond	Heat utilization to counteract eutrophication
303	50	1971	Staff and consultants	River	Environmental monitoring program
304	50	1973	Dr A J Hopwood St Cloud State College	River	Ecological study at Nuclear plant
305	50	1973	Dr A J Brook University of Minnesota	River	Algal study of Nuclear plant

REGION IV - NORTH CENTRAL
Studies Under Way (Cont'd)

Study No.	Company No.	Date to be Completed	Conducted By	Type of Water	Description
306	50	Continuing	Staff and Dept of Health	River	Radiation monitoring program at nuclear plant
307	50	Sept 1971	FWPCA National Water Quality Lab	River	Effect of heated discharges on fish productivity, constant temperature regime (study done entirely by FWPCA company contribution was furnishing circulating water and space with facilities in a construction building for a lab-type study)
308	50	Oct 1971	Dr A J Brook University of Minnesota	River	Phytoplankton study of river at nuclear plant site
309	50	Oct 1979	Staff	River	Water quality study of river at plant site
310	50	1977	E F Miller, St Mary's College	River	Ecological study of river at nuclear plant site
311	50	Continuing	Staff	River	Radiation monitoring program
312	76	1970	Westinghouse	River	Temperature survey and minimum ecology study
313	82	Continuing	Univ of Wisc,(Milwaukee)	Lake	Atomic plant lake sites studied in attempt to ascertain effect of heated water on lake conditions
314	83	Continuing	Univ of Wisc, (Milwuakee)	Lake	Preoperational environmental studies at nuclear plant site
315	83	Sept 1970	BioTest Lab, Inc	Lake and feeder streams in plant area	Environmental radiation monitoring

REGIONAL IV - NORTH CENTRAL
Studies Under Way (Cont'd)

Study No.	Company No.	Date to be Completed	Conducted By	Type of Water	Description
316	83	Continuing	Pioneer Service & Eng	Lake	Circulating water discharge and mixing zone model study for plant
317	88	1975	Staff	River - Lake	Cooling water survey -- sample temp, turbidity, dissolved 02 and pH weekly at 18 points in river-lake used for cooling water at two steam electric stations
318	97	1970	University of Wisconsin	Lake	Preoperational study of ecology at site of nuclear plant. Initial work will establish present status of marine population. Post-operation work will study change in biota and effect of circulating water discharges on life cycle
319	109	Undetermined	Staff	River	Study of temperature profile before plant

REGION IV - NORTH CENTRAL

Studies Proposed

Study No.	Company No.	Proposed Date	Conducted By	Type of Water	Description
320	9	1970	Staff	River	Survival and reproductivity of game fish
321	14	1970-74	Staff	Lake	Long-term environmental effects of heated effluents and radioactive liquid discharges on lake
322	50	Sept 1970	FWPCA National Quality Lab	River	Effect of heated discharges on fish productivity - constant temperature regime
323	50	1976	FWPCA National Quality Lab	River	Thermal tolerance of fish and fish food organisms - natural regime at nuclear plant
324	50	1970-77	College Professor	River	Ecological study near nuclear plant
325	50	1970-77	College Professor	River	Algal study near nuclear plant
326	76	Undetermined	Contractor not yet selected	River	Temperature studies - vertical and horizontal at one or two large plants

REGION V - SOUTH CENTRAL

Completed Studies

Study No.	Company No.	Date Completed	Conducted By	Type of Water	Description
327	3	Aug 1969	Hydro Science Co	River Impoundment	Model study of reservoir formed by lock and dam to study effects of nuclear effluents into reservoir for both flow pattern and thermal dispersion effects.
328	11	April 1970	Tracor, Inc	Estuary	Water quality analysis at generating station
329	29	Sept 1968	Pyburn & Odum and Stone & Webster	River	Thermal effects of additional unit on river
330	30	1966	Southwest Research Inst	Estuary	Temperature effects in lake and bay
331	30	1967	Southwest Research Inst	Estuary	Oxygen balance of generating station cooling water canal
332	30	1967	Southwest Research Inst	Estuary	Temperature distribution in lake
333	30	1967	R H Hand, Jr	Estuary	Water quality
334	30	1969	Southwest Research Inst	Estuary	Heat distribution patterns in bay
335	30	1970	Southwest Research Inst	Lake	Performance of lake as a source of cooling water for generating station
336	30	1970	Southwest Research Inst	Lake	Characteristics of foaming in generating stations cooling water discharge canals
337	40	Dec 1970	Texas Instruments Inc	River	Aerial infra-red study of temperature distribution in river near fossils and nuclear plants

REGION V - SOUTH CENTRAL
Completed Studies (Cont'd)

Study No.	Company No.	Date Completed	Conducted By	Type of Water	Description
338	44	1951	Burns & McDonnell Eng Co	Pond	Surface cooling and study of water requirements
339	44	1965	Gilbert Assoc	River	Temperature rise
340	51	Oct 1964	Staff	Lake & cooling tower	Cooling water for generating station
341	70	1968	Staff	Sewage disposal plant effluent	Use of waste water for cooling tower makeup
342	73	Oct 1955	U S Geological Survey	Lake	Effect of the addition of heat from a power plant on the thermal structure and evaporation of lake
343	73	Oct 1960	U S Geological Survey	Lake	Effect of an increased heat load on the thermal structure and evaporation of lake
344	73	1968	Staff	Lake	Miscellaneous lake temperature studies
345	73	1965	Staff	All	A projection of per capita water use for electric power generation in state-report for water commission
346	73	1968	Staff	All	Cooling Water Requirements for Steam Electric Plants - a report for the ASCE conference on research needs for power
347	73	1969	Staff	Lakes	Thermal requirements to protect aquatic life
348	94	1967	Staff & Univ of Mo	Reservoir	Thermal discharge and water quality in reservoir

REGION V - SOUTH CENTRAL

Studies Under Way

Study No.	Company No.	Date to be Completed	Conducted By	Type of Water	Description
349	3	1978	University of Arkansas, Little Rock	River impoundment	Survey to obtain background analysis and post-operating data on thermal chemical, biological and radiation characteristics of the reservoir due to nuclear station effluents
350	11	Continuing	Marine Science Inst University of Texas Dr E W Behrens	Estuary	Ecology of surpulid worms
351	11	July 1972	Univ of Corpus Christi Dr B J Copeland & Mr Frank N Moseley	Estuary	Ecological survey of bay to determine effects of heated cooling water before and during operation of generating unit
352	18	Continuing	Staff	Reservoirs	Temp surveys, temp dispersion and capabilities for supporting additional generation. Studies include operation data and isotherm plottings of the reservoirs
353	29	Undetermined	Staff	River	Effect of salt water barrier on salt water intrusion on river
354	29	Continuing	Staff	Estuary	Temp surveys on generation station discharges
355	30	1973	Texas A&M University	Estuary	Numbers and survival rates of economically important organisms passing through generating station
356	30	1970	Tracor, Inc	Estuary	Development and verification of temperature model for power plant discharge

REGION V - SOUTH CENTRAL
Studies Under Way (Cont'd)

Study No.	Company No.	Date to be Completed	Conducted By	Type of Water	Description
357	30	1975	Texas A&M University	Estuary	Species diversity and abundance of the bottom fauna, macroplankton, commercially important invertebrates before and after the construction of generating plants
358	30	Continuing	Staff	Estuary	Temperature monitoring and synoptic temperature surveys of generating station cooling water discharge
359	30	Continuing	Staff	Estuary	Survey of ambient temperatures in bay prior to operation of generating station
360	51	Oct 1973	U S Geological Survey, Water Board, Staff	River	River flow study
361	51	Undetermined	Staff	River	River water quality
362	59	1970	Stearns-Roger Corp	River	Cooling tower and ash sluicing water effects
363	68	Undetermined	State Parks & Wildlife Dept	Lake	Lake fisheries survey
364	72	Summer-1971	Staff	Lake	Temperature survey
365	72	1971	Texas A&M University	Lakes & Estuary	The effects on fishes and commercial invertebrates of heated water discharge into an estuary and three reservoirs
366	73	Continuing	Staff	Lake	Miscellaneous temperature studies

REGION V - SOUTH CENTRAL
Studies Under Way (Cont'd)

Study No.	Company No.	Date to be Completed	Conducted By	Type of Water	Description
367	73	Continuing	Staff	Lake	Fish production in heated water discharge
368	73	Continuing	Staff	Lakes	Miscellaneous lake temp studies
369	73	Continuing	University of Texas	Lakes	Use of a 2-dimensional model to simulate a reservoir used for cooling
370	73	1971	University of Texas at Arlington	Lake	Relationship of the heated effluent to plankton diversity and density
371	73	1972	Texas Christian University	Lake	Biological and chemical data on two reservoirs
372	91	1970	Mississippi State Univ	River	Thermal environmental research to study effects of cooling water discharges into river

REGION V - SOUTH CENTRAL

Studies Proposed

Study No.	Company No.	Proposed Date	Conducted By	Type of Water	Description
373	40	1971	Staff	River	Thermal distribution of generating station cooling water discharges
374	40	1974	Staff and Consultants	River	Complete environmental monitoring program prior to nuclear start up
375	72	Undetermined	Staff	Lake	Temperature survey
376	72	1974	Southern Methodist Univ	Lake	Pre and post-operational ecological study
377	72	Undetermined	Baylor University Dr Lind	Reservoir	Effects of heated water discharge on aquatic life
378	73	1971	Staff and/or Univ of Texas	Lake	Complete hydrological and biologic study of lake
379	73	1970	University of Texas & Staff	Lake	Development of a mathematical or physical model of a cooling reservoir

REGION VI - WEST CENTRAL

Completed Studies

Study No.	Company No.	Date Completed	Conducted By	Type of Water	Description
380	45	June 1965	EBASCO Services	River & Lake	Site reconnaissance for 1971 Gen unit
381	45	Dec 1965	EBASCO Services	River vs Lake sites	Economic site selection 200 MW 1971
382	45	Jan 1967	FPC & Basin Interagency Comm	River & Pond	Water requirements for thermal elec generation
383	45	1962	U S Geological Survey & State Water Comm & State Geological Survey	Wells	Test drilling
384	45	Mar 1969	State Water Comm	Cooling Pond	SWC Project - Dam - Hydrology, Design and cost
385	52	Aug 1964	Dept of Health	River	Report on investigations of waste disposal at various plants
386	52	Dec 1968	Bechtel Corp	Lake & River	Ecology and associated economics of alternate plant sites for 400 & 600 MW units

REGION VI - WEST CENTRAL

Studies Under Way

Study No.	Company No.	Date to be Completed	Conducted By	Type of Water	Description
387	45	Continuing	Staff & Fed Water Pollution Control Admin	River	Sampling & testing natural water quality network
388	45	1970	State Water Comm & U S Geological Survey	Underground water	Ground water investigation

REGION VI - WEST CENTRAL

Studies Proposed

Study No.	Company No.	Proposed Date	Conducted By	Type of Water	Description

REGION VII - NORTHWEST

Completed Studies

Study No.	Company No.	Date Completed	Conducted By	Type of Water	Description
389	57	June 1968	Battelle-Northwest Lab	River	Research related to the development of a power reactor site on river, includes temp regime, turbulance related to potential for mixing of discharge with main flow, current flow reversals due to tidal influences and other conditions concerned with use of the river for once thru cooling
390	57	Feb 1968	Battelle-Northwest Lab	River, Tidal Estuary	Information on timing and abundance of fishes near plant important to the commercial or sport fisheries of the river
391	57	May 1968	Battelle-Northwest Lab	River, Tidal Estuary	Information and responses to elevated temperature of fishes near plant important to the commercial or sport fishery of the river
392	57	Mar 1969	Battelle-Northwest Lab	River, Tidal Estuary	An improved estimate of the cooling effects of the dams and the effect on downstream temperature regimes, including an estimate of time during which temperature would exceed 20°C, and predictions of the effect at downstream points of the revised thermal conditions coupled with operations of a direct cooled 1,000 MW nuclear plant
393	95	Feb 1965	Dr Wayne U Burt Water Research Assoc Oregon State University	River	Water temperature forecasts of river below proposed dam

REGION VII - NORTHWEST
Completed Studies (Cont'd)

Study No.	Company No.	Date Completed	Conducted By	Type of Water	Description
394	95	Oct 1968	Howard D Copp Albrook Hydraulic Laboratory Washington State University	River	Predicted outflow temperatures from proposed reservoir
395	95	June 1969	Howard D Copp Albrook Hydraulic Laboratory Washington State University	River	Predicted outflow temperatures from proposed reservoir
396	106	Nov 1962	Staff	River	Oxbow salmon and steelhead counts and relation to water flow around plant

REGION VII - NORTHWEST

Studies Under Way

Study No.	Company No.	Date to be Completed	Conducted By	Type of Water	Description
397	80	1973	NALCO	River	Determine quality and chemical characteristics of river water prior to and after steam electric generating plant operation. Primary purpose to develop data to aid in selection of water treatment equipment for 1400 MW plant being constructed
398	96	1971	Staff	River	Recording river temp vs plant load
399	106	Continuing	US Dept of Interior	Reservoir	Air-water temp record study

REGION VII - NORTHWEST

Studies Proposed

Study No.	Company No.	Proposed Date	Conducted By	Type of Water	Description

REGION VIII - SOUTHWEST

Completed Studies

Study No.	Company No.	Date Completed	Conducted By	Type of Water	Description
400	53	1953	Staff & J E Kerr Bechtel Corp	Estuary	Fish screening & temperature effects on fish passing through condenser tubes
401	53	1955	Staff	Estuary	Cause & solution to fish screen clogging by anchovies
402	53	1958	Staff	Estuary	Dispersion of cooling water containing radioactive wastes
403	53	1961	Staff & Dr E O Salo Humboldt State College	Ocean	Dispersion of cooling water and possible effects on clams
404	53	1964	Staff & Dr E O Salo, Dr J A Gast Humboldt State College	Ocean	Temperature, current, and diffusion studies for proposed nuclear plant, and ecological survey
405	53	1962	Staff	Estuary	Temperature study for recirculating problems
406	53	1965	Staff	Estuary	Surface water temperature survey with airborne infrared thermometer-plant #1
407	53	1965	Staff	Estuary	Surface water temperature survey with airborne infrared thermometer-plant #2
408	53	1965	Staff	Ocean	Surface water temperature survey with airborne infrared thermometer-plant #3
409	53	1965	Staff	Estuary	Temperature, current, and dispersion studies for possibility of recirculation
410	53	1965	Staff	Estuary	Temperature, current, and dispersion study

REGION VIII - SOUTHWEST
Completed Studies (Cont'd)

Study No.	Company No.	Date Completed	Conducted By	Type of Water	Description
411	53	1965	Dr E O Salo University of Washington & Staff	Estuary	Concentration of Zinc-65 in oysters held in discharge water from nuclear plant
412	53	1968	Staff & Dr W J North California Institute of Technology	Ocean	Influence of thermal discharge on flora and fauna, and on dissolved oxygen along thermal gradient
413	53	1968	Dr G Allen Humboldt State College	Estuary	Distribution of sport fish around nuclear thermal power plant outfall
414	64	Oct 1968	Bendix Marine Advisers Inc	Bay	Thermal diffusion study of bay
415	89	July 1967	Staff	Ocean	Environmental monitoring program
416	89	Aug 1968	Bendix Marine Advisers Inc	Ocean	Annual Report - Oceanographic Surveys
417	89	May 1968	Oceanographic Service Inc	Ocean	Quarterly Progress Report Oceanographic Study
418	89	June 1968	State Dept of Fish & Game	Harbor	Harbor Biological Monitoring Program
419	89	June 1968	Bendix Marine Advisers Inc	Ocean	Proposed Power Plant Discharge Oceanographic Study
420	89	Jan 1969	California Dept of Fish & Game	Ocean	Biological monitoring
421	89	Feb 1970	Calif Dept of Fish & Game	Ocean	Study of environment in vicinity of generating station

REGION VIII - SOUTHWEST

Studies Under Way

Study No.	Company No.	Date to be Completed	Conducted By	Type of Water	Description
422	53	1971	Staff	Estuary	Uptake of radioactive waste by marine organisms along discharge gradient
423	53	1973	Staff & Dr W J North California Institute of Technology	Ocean	Nuclear-preoperational study of temperature dispersion oceanographic background, study, including ecological survey of flora and fauna
424	53	1970	Staff	Estuary	Model study of effect of submerged cooling water discharge system. Infrared study using Bendix Thermal mapping system. Studies on different arrangements of intake and discharge using U S Army Corps of Eng Bay Model
425	53	1973	State Dept of Fish & Game funded by company	Ocean	Baseline study of flora and fauna at proposed nuclear site
426	53	1970	State Dept of Fish & Game funded by company	Estuary	Effects of power plant on opposum shrimp
427	53	1971	Staff	Estuary	Hydro-biological survey for proposed nuclear plant
428	53	1973	Staff & State Dept of Fish & Game, funded by Company	Estuary	Effects of power plant on striped bass king salmon and opposum shrimp
429	53	1971	Staff	Estuary	Biological comparison of intake and discharge area of nuclear power plant
430	53	1971	Staff	Estuary	Model study of predicted cooling water dispersion

REGION VIII - SOUTHWEST
Studies Underway (Cont'd)

Study No.	Company No.	Date to be Completed	Conducted By	Type of Water	Description
431	89	Undetermined	Bendix Marine Advisers Inc	Ocean	The benthic environment offshore from beach
432	89	Undetermined	Bendix Marine Advisers Inc	Ocean	The marine environment offshore from beach
433	89	Undetermined	Bendix Marine Advisers Inc	Ocean	The physical environment offshore from beach
434	89	1970	Bendix Marine Advisers Inc	Ocean	Summary report of the oceanographic monitoring program
435	89	Feb 1970	Calif Dept of Fish & Game	Ocean	Marine environment in the vicinitv of nuclear generating station

REGION VIII - SOUTHWEST

Studies Proposed

Study No.	Company No.	Proposed Date	Conducted By	Type of Water	Description
436	53	1971	Staff	Ocean	Evaluation studies of ocean and biological characteristics
437	89	1973	Bendix Marine Advisers, Inc	Ocean	Oceanographic monitoring program for generating station expansion

OTHER

Completed Studies

Study No.	Company No.	Date Completed	Conducted By	Type of Water	Description
438	92	Jan 1968	State University Dr Klaus Wyrtki	Ocean	AM evaluation of the effects of a warm water outlet from a power plant on the temp of bay

JOINT STUDIES

Study No	Company No.	Proposed Completion Date or Date Completed	Conducted By	Type of Water	Description
439	(56 (55 (43 (75	1966	U S Dept of the Interior Maryland Board of Natural Resources N Y Dept of Conservation Pennsylvania Fish Commission	River	Suitability of river for restoration of shad
440	(54 (43 (2	1961	Pennsylvania Electric Association Subcommittee on Water Utilization	River	Heated discharges -- their effect on streams
441	(55 (43	1967	Dr Charles B Wurtz	River	Biological survey of river
442	(11 (18 (29 (30 (68 (72 (73 (81	1970	Texas A&M University	Lake & Estuary	Effects on fishes of heated water discharge into selected estuaries and impounded waters
443	(10 (29 (40 (47	1972	Gulf South Research Institute	Lake & Estuary	Quantitative studies on fish populations and their food-web structure in thermally stressed areas, to be conducted in state waters
444	(12 (19 (74 (104 (115	Undetermined	Water Pollution Research and Applications, Inc, Dr Bregman	River	Effect of temperature on aquatic life in river
445	(80 (95	Aug 1968	Dr Wayne Burn Water Research Assoc Oregon State University	River	Water temperature forecasts below proposed dam

EEI RESEARCH PROJECT # 49

Cooling Water Studies

In March, 1963, Edison Electric Institute contracted with the Institute of Cooperative Research of the Johns Hopkins University to study the basic mechanisms of cooling surface waters, to summarize the effects of warm water on fish life, and the physics of natural cooling processes in water bodies surrounding condenser cooling water discharges. In 1965 the project was expanded to include on-site monitoring of water temperatures, salinity, dissolved oxygen and rates of flow as well as weather data. Eleven field sites were established for this phase of the program, which was further expanded to include supplementary biological research. Six reports on various phases of the project, known as RP 49, have been published to date.

EEI RP-49
COOPERATING UTILITIES AND FIELD SITES

Site No.	Cooperating Utility	Name of Station	Site Location	Receiving Water Body	Nearest USWB Station
1	Ohio Power Company	Philip Sporn Plant	New Haven, West Virginia	Ohio River	Parkersburg, West Virginia
2	Central Illinois Light Company	E D Edwards Station	near Peoria, Illinois	Illinois River	Peoria, Illinois
3	Central Louisiana Electric Company	Coughlin Station	St Landry, Louisiana	Mountain Bayou Lake	Alexandria, Louisiana
4	Delmarva Power & Light Company	Indian River Plant	near Millsboro, Delaware	Indian River Estuary	Salisbury, Maryland
5	Duke Power Company	Marshall Steam Station	near Charlotte, North Carolina	Lake Norman	Charlotte, North Carolina
6	Georgia Power Company	Plant Hammond	near Rome, Georgia	Coosa River	Rome, Georgia
7	Houston Lighting & Power Company	W A Parish Station	near Houston, Texas	Smithers Lake	Houston, Texas
8	Kentucky Utilities Company	Green River Station	near Central City, Kentucky	Green River	Madisonville. Kentucky
9	Pacific Gas & Electric Company	Moss Landing Station	near Monterey, California	Monterey Bay	Salinas, California
10	Mississippi Power Co Southern Services, Inc	Plant Jack Watson	near Gulfport, Mississippi	Biloxi River Estuary	Mobile, Alabama
11	Southwestern Electric Power Company	Wilkes Station	near Jefferson, Texas	Wilkes Lake	Shreveport, Louisiana

PUBLICATIONS

EEI Cooling Water Discharge Research Project (RP49)

EEI Pub. No.	
65-901	Water Temperatures and Aquatic Life (Price: $2.00)
65-902	Heat Exchange in the Environment (Price: $2.50)
68-901	Report No. 3, Field Sites and Survey Methods (Price: $2.35)
69-900	Report No. 4, The Effects of Elevated Temperatures Upon Aquatic Invertebrates (Price: $4.00)
69-901	Report No. 5, Surface Heat Exchange at Power Plant Cooling Lakes (Price: $2.85)
70-902	Report No. 6, An Optimal Siting Model for Thermal Plants With Temperature Constraints (Price: $2:00)

Note: Copies of these publications may be obtained by writing to:

Edison Electric Institute
750 Third Avenue
New York, New York 10017

Enclosure III

Office of the Chief of Engineers
Washington, D. C. 20314

Attention: ENGCW-ON

UNITED STATES OF AMERICA

DEPARTMENT OF DEFENSE

DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS

PERMITS FOR DISCHARGES OR DEPOSITS INTO NAVIGABLE WATERS	)	33 CFR Part 209
Proposed Policy, Practice, and Procedure	)	

COMMENTS OF THE

EDISON ELECTRIC INSTITUTE

The Edison Electric Institute (Institute), the trade association of the investor-owned electric public utility industry whose members together serve more than three-fourths of our nation's users of electricity, submits these comments in response to the notices of proposed regulations entitled Permits for Discharges or Deposits into Navigable Waters, dated December 23, 1970 and January 18, 1971 and published in the Federal Register, Volume 35,

No. 253, Thursday, December 31, 1970 and Volume 36, No. 14, Thursday, January 21, 1971 (Proposed Regulations).

The Institute recognizes that it is appropriate that procedures be established for the control of water pollution. It is essential, however, that such procedures be designed so that overlapping regulatory reviews and conflicting regulatory policies are minimized to the extent feasible and so that the terms and provisions of applicable statutes are implemented in accordance with their true intent and meaning.

The Institute questions the accuracy of Section (d)(1) of the Proposed Regulations, wherein it is stated that —

> "Except as otherwise provided in the Refuse Act (33 U.S.C. 407), all discharges or deposits into navigable waters of the United States or tributaries thereof are, in the absence of an appropriate Department of the Army permit, unlawful."

The Refuse Act provides that —

> "It shall not be lawful to throw, discharge, or deposit, or cause, suffer, or procure to be thrown, discharged, or deposited . . . any refuse matter of any kind or description whatever . . . [into navigable waters or tributaries]"

It is submitted that the words "refuse matter" in the Refuse Act cannot be ignored in the Proposed Regulations by the

expedient of changing the Refuse Act's verbs "throw, discharge, or deposit" into the Proposed Regulations' nouns "all discharges or deposits". The effect of this omission can be illustrated by example: the discharge of pure water without a permit would be proscribed by the Proposed Regulations, but could not possibly be held to be unlawful under the Refuse Act. The Institute respectfully suggests that the words "of refuse matter of any kind or description whatever" be inserted following the word "deposit" in the first sentence of Section (d)(1) of the Proposed Regulations.

The Institute also urges that the significance of the words "refuse matter" be given careful consideration. These words are accorded further emphasis in the portion of the Refuse Act which authorizes the issuance of permits (and which is quoted in Section (e) of the Proposed Regulations), where it is provided that —

> "the Secretary of the Army, whenever in the judgment of the Chief of Engineers anchorage and navigation will not be injured thereby, may permit the deposit of any material above mentioned in navigable waters, ..." (emphasis supplied)

Moreover, the Refuse Act is a penal statute, and all of its words should be given effect in accordance with the traditional legal canon that penal statutes must be restricted within the confines of their language. Neither the Standard

Oil case (384 U.S. 224), nor any other which has come to the attention of the Institute, has held that cooling water taken from a watercourse, heated, and returned to the watercourse, constitutes "refuse matter" or "material" within the intent and meaning of the Refuse Act. This issue is presently before the United States Court of Appeals for the Fifth Circuit in the case of Florida Power & Light Co. v. United States of America (Petition for Permission to Appeal under 28 U.S.C. §1292(b) filed December 19, 1970). Pending the outcome of this case, the Institute respectfully suggests that, insofar as the Proposed Regulations purport to require the procurement of a permit for cooling water discharges of the sort above described, they are premature and should not be adopted at this time.

The Institute suggests that the Proposed Regulations are unlawful in the role that they afford the Environmental Protection Agency (EPA) and its Administrator. The statutory pattern underlying the Proposed Regulations seems quite clear:

(a) The Refuse Act itself, and the actions of the Secretary of the Army and the Chief of Engineers thereunder, are directed at the prevention of discharges or deposits which may occasion injuries to anchorages or navigation.

(b) The Fish and Wildlife Coordination Act requires consultation with the Department of the Interior where the discharges or deposits might modify or affect the course or depth of a navigable waterway.

(c) The National Environmental Policy Act of 1969 requires the Secretary of the Army and the Chief of Engineers to utilize a systematic, interdisciplinary approach in decision-making so as to insure the integrated use of natural and social sciences and environmental design arts and the according of appropriate consideration to unquantified environmental amenities and values.

(d) And finally, Section 21(b) of the Federal Water Pollution Control Act directs the Secretary of the Army and the Chief of Engineers not to permit any discharge or deposit until they are in receipt of assurance that water quality standards promulgated in accordance with the Federal Water Pollution Control Act will not be violated. Section 1(b) of that Act declares that it is "the policy of Congress to recognize, preserve, and protect the primary responsibilities and rights of the States in preventing and controlling water pollution"; and Section 21(b) implements this policy by directing that the required assurance of compliance with water quality standards take the form of

"a certification from the State in which the discharge originates or will originate, or, if appropriate, from the interstate water pollution control agency having jurisdiction over the navigable waters at the point where the discharge originates or will originate". Nothing in this statutory pattern authorizes or mandates that EPA or its Administrator possess the literal veto power found in Sections (d)(4), (d)(6), (i)(7) and (p), or the effective veto power found in Section (o)(2), of the Proposed Regulations. When the Secretary of the Army, acting through the Corps of Engineers, is satisfied that anchorage and navigation will not be injured by the proposed discharge or deposit, when any consultations required by the Fish and Wildlife Coordination Act have been held, when EPA has commented with regard to the matters enumerated in Section (d)(3) of the Proposed Regulations, and when the appropriate State or interstate certification has been furnished pursuant to Section (h) of the Proposed Regulations, the statutory authority for denying a permit is exhausted, and the Secretary and the Corps may not lawfully refuse to issue the permit on the ground that EPA or its Administrator has determined that the permit should be denied. If EPA has independent statutory authority

to prohibit the discharge or deposit in question, it has no need for this veto power. If, on the other hand, EPA has no such authority, it cannot acquire the same through the issuance of regulations, either its own or those of another agency. The Institute respectfully suggests that the Proposed Regulations be amended by deleting the words "determine and" from the third sentence of Section (d)(3); by amending Section (d)(4) to read as follows:

> "(d)(4) In any case where a District Engineer of the Corps has received notice that a State or other certifying agency has denied a certification prescribed by section 21(b) of the Federal Water Pollution Control Act, the District Engineer, within 30 days of receipt of such notice, shall deny the permit and provide notice of such denial to the Regional Representative of EPA.";

by amending the introductory clause of Section (d)(5) to read as follows:

> "(d)(5) In any case where a District Engineer of the Corps has received the required certification from a State or other certifying agency, the District Engineer may take action denying a permit only if:";

by deleting Section (d)(6); by amending the final sentence of Section (e) to read as follows:

> "Accordingly, within these limitations, District Engineers are authorized to issue permits or to deny permit applications for discharges or deposits covered by the Refuse Act.";

by deleting the phrases "by the Regional Representative of EPA or" in the first and second sentences of Section (i)(7); by deleting the final sentence of Section (i)(7); by amending item (2) of the text of the public notice statement set forth in Section (j) to read as follows:

> "(2) water quality standards and related water quality considerations as determined by State authorities and/or the Environmental Protection Agency, and";

by deleting Section (o)(2); and by deleting Section (p).

Without compromising in any way its position in the foregoing respects, the Institute also wishes to point out some specific weaknesses and inequities in the Proposed Regulations, as follows:

Section (d)(6) of the Proposed Regulations provides for referral to and consultation between the Secretary of the Army and the Administrator of EPA "where the District Engineer believes that following the advice of the Regional Representative with respect to the issuance or denial of a permit would not be consistent with the purposes of the Refuse Act permit program". The Institute respectfully suggests that the applicant should be entitled to this procedural remedy irrespective of the belief of the District Engineer, and that the words "or the applicant"

should be inserted following the word "Engineer" in the initial phrase of this Section.

Section (g)(2) of the Proposed Regulations requires that a corporate application be signed by "the principal executive officer of that corporation or by an official of the rank of corporate vice president or above who reports directly to such principal executive officer and who has been designated by the principal executive officer to make such application on behalf of the corporation". The Institute respectfully suggests that this degree of specifity is unnecessary to fix corporate responsibility for the application, and is inappropriate in that it cannot be accommodated to the organizational structures of all corporations. It is suggested that a corporate application be signed by an employee who will certify that he is familiar with the information provided and that it is complete and accurate to the best of his knowledge and belief.

The second and third sentences of Section (h)(1) of the Proposed Regulations provide that, in the absence of special circumstances, a State or interstate agency should be afforded "a full year within which to take action [on a request for certification] before determining that a

waiver has occurred". The Institute respectfully suggests that these sentences are inconsistent with Section 21(b)(7) of the Federal Water Pollution Act, which provides that "the certification requirements . . . shall be waived" if the certifying agency "fails or refuses to act on a request for certification, within a reasonable period of time (which shall not exceed one year) after receipt of such request". It is suggested that the following sentence be inserted in place of the second and third sentences of Section (h)(1):

> "In cases where certification is required and no express notice of waiver has been received from the certifying agency, the District Engineer shall determine a reasonable period of time (which shall not exceed one year) for the certifying agency to take action, and shall advise the certifying agency of the need for action within such period of time and that if certification is not received within such period of time it will be considered that the requirement for certification has been waived."

Sections (h)(3), (i)(2) and (i)(3) of the Proposed Regulations provide that, in the case of a facility on which actual construction was lawfully commenced prior to April 3, 1970, the Corps of Engineers will not "fully process any permit application until the applicant or the State has provided a letter from the State describing the

impact of the proposed discharge or deposit and indicating the view of the State on the desirability of granting a permit. If such a letter is not provided within 1 year or within such lesser reasonable period of time as the District Engineer may have determined this requirement shall be waived." Further, Section (n)(2)(ii) of the Proposed Regulations provides that when a permit for such a facility is fully processed and issued, it shall be "conditioned so as to require annual demonstration by the permittee that the discharge or deposit is in compliance with State water quality implementation schedules". The Institute respectfully suggests that, in both of these respects, the Proposed Regulations are inconsistent with the clear Congressional directive in Section 21(b)(7) of the Federal Water Pollution Act that no State or interstate certification with respect to water quality standards be required for the issuance of a permit to operate such a facility until April 3, 1973. Moreover, Section (n)(2)(ii) of the Proposed Regulations deprives the facility owner of his option to phase-out operation of the facility prior to April 3, 1973. The Institute also suggests that Section (i)(2) of the Proposed Regulations is unduly restrictive in the limitation

placed upon processing in advance of certification, where certification is required. Accordingly, it is suggested that Sections (h)(3), (i)(2), (i)(3) and (n)(2) be amended to read as follows:

> "(h)(3) In cases involving a discharge or deposit from a facility, the actual construction of which was lawfully commenced prior to April 3, 1970, District Engineers shall accept and fully process a permit application without the certification required by section 21(b)(1).
>
> "(i)(2) If all of the required information has been provided but the applicant has failed to provide, if required, the certification prescribed in paragraph (h)(2) of this section, the applicant should be advised that no permit will be issued until the required certification is provided.
>
> "(i)(3) When all of the required information has been provided and the applicant has also provided, if required, the certification prescribed in paragraph (h)(2) of this section, together with assurances that the character of the discharge or deposit was fully described to the State agency prior to the issuance of the certification, the applicant shall be advised that his application is in order and that its processing will be completed as expeditiously as possible.
>
> "(n)(2) In cases involving a facility, the construction of which was lawfully undertaken prior to April 3, 1970, and it appears after evaluation that issuance of a permit would be appropriate, a permit shall be issued provided that the

> permit will expire on April 2, 1973 unless appropriate certification is submitted prior to such date."

Institute respectfully suggests, in the alternative, that Section (i)(3) should be amended so as to incorporate a complete cross-reference to Sections (h)(1) and (h)(3) as follows:

> "(i)(3) When all of the required information has been provided and (i) the applicant has also provided, as appropriate, the required certification or letter discussed in paragraph (h) of this section, together with assurances that the character of the discharge or deposit was fully described to the State agency prior to the issuance of the certification or letter, or (ii) the requirement for a certification or letter has been waived as provided in paragraph (h)(1) or paragraph (h)(3) of this section, the applicant shall be advised that his application is in order and that it will be processed as expeditiously as possible."

Section (i)(4) of the Proposed Regulations affords the Regional Representative of EPA an unlimited time period within which to provide his comments to the District Engineer. The possibility of extended delays in permit processing due to inaction by, or heavy work load on, Regional Representatives presents a frightening prospect to the electric public utility industry, where delays in construction and operation of generating plans can involve staggering

sums of money and cause or aggravate power shortages. The Institute respectfully suggests that Section (i)(4) be amended to provide a fixed period of time within which the Regional Representative of EPA must comment or be deemed to have concurred in the advice of the State or other certifying authority.

Section (d)(5) of the Proposed Regulations provides that, in the absence of any objection by the Regional Representative of EPA, a District Engineer may deny a permit only if anchorage or navigation will be impaired or consultations required by the Fish and Wildlife Coordination Act reveal that the proposed discharge or deposit will have a significant adverse impact on fish or wildlife resources. The Institute respectfully suggests that the wording of Section (i)(7) of the Proposed Regulations should be amended so as to be consistent with Section (d)(5), by substitution of the word "shall" for the word "may" in the first sentence of Section (i)(7).

The Institute respectfully suggests that Constitutional due process requires that an applicant be afforded a full and complete hearing, with a transcript and record, in conformity with Sections 556, 557 and 558 of the Federal

Administrative Procedure Act, before the District Engineer may deny a permit or issue a permit with conditions unacceptable to the applicant. It is suggested that Section (k) of the Proposed Regulations be amended to include appropriate provision for such a hearing.

Section (n)(1) of the Proposed Regulations provides that "no permit may be issued which authorizes a discharge or deposit for more than 5 years without providing for revalidation of such permit". The details of the "revalidation" procedure are not set forth. However, the Institute respectfully suggests that both the five-year limitation and the provision for revalidation should be deleted from the Proposed Regulations on the grounds that they are unduly burdensome and unnecessary. Section (o)(1) of the Proposed Regulations accomplishes all that can possibly be required in these respects, by providing that the continuing validity of each permit is dependent upon compliance with existing and future water quality standards and conformity with future discoveries relative to health and safety.

The Institute respectfully suggests that the provisions for suspension or revocation of a permit in Sections (o)(1)(iii) and (o)(1)(iv) of the Proposed Regulations

are subject to and should be invoked only in accordance with the requirements of Section 558 of the Federal Administrative Procedure Act regarding written notice and opportunity to demonstrate or achieve compliance. It is suggested that Sections (o)(1)(iii) and (o)(1)(iv) of the Proposed Regulations be amended to make specific reference to the Federal Administrative Procedure Act in this regard.

Respectfully submitted,

EDISON ELECTRIC INSTITUTE

By _____
President

February 11, 1971

STATEMENT OF P. H. GLATFELTER CO.

P. H. GLATFELTER CO.,
Spring Grove, Pa., March 10, 1971.

Hon. EDMUND A. MUSKIE,
U.S. Senate, Senate Office Building,
Washington, D.C.

Sir: As a representative of a progressive company that is well known for its accomplishments in environmental improvement, I'm quite interested in S 523 and recommend the following minor, but important changes in the bill.

I.

Concerning obligation of grant funds allotted to States within six months or else forfeiture, page 15, line 13–14 should read nine (9) (or more desirably twelve (12) months) instead of six (6) as now written.

Reason.—You are quite familiar with legislative implementation case histories, and must surely realize that a six month deadline to obligate large sums wisely and effectively will logically be, in most cases, insufficient.

You also must realize that the application of this paragraph will usually involve (to be frank) overadministered, bureaucratically dominated, politically encumbered efforts at Local, State, and Federal levels. A six month limit for fund obligation will, in many cases, result in quick decision rush type headlong spending by State Governments, simply to avoid forfeiture of their assigned quotas.

You are certainly aware of scarcity of funds. Therefore, let's not weaken proposals (otherwise sound) with a built in threatening deadline before which huge amounts must be committed, when perhaps 3–6 months longer should logically result in more sound spending.

II.

Exactly the same reasoning as above should apply to page 16, line 4, which should read nine (9) (or more desirably twelve (12) months).

III.

In regard to achievement of Water Quality Standards, page 22, line 15 should read "5 years"—not three (3).

Reason.—If we mandate progress too rapidly, unwise use of tax payers' money will result. You surely know, only too well, how dismal has been the real value obtained for the monies already spent.

I speak from the grass roots level where legislation must be finally translated into grass roots action. I have worked on projects and grants with overadministrated consultants, politicians, bureaucrats, governmental levels, suppliers of hardware, and engineers, and realize how long these matters usually take. Delivery alone on major paper mill items for environmental improvement is 2–3 years, let alone process selection and design, engineering plans, bids, construction, completion and testing.

Simply to beat a three (3) year deadline and to gain necessary lead time for completion by management will not allow rushing headlong through unsound planning and engineering phases to place an order. We must get the most out of our funds—whether industry or tax payer generated.

IV

On page 24, line 22, an addition should be made as follows: "unless it can be shown that water quality standards of the degree of stringency already in effect are not actually needed to insure such present or future uses as the waters, tributaries, or portion of tributaries would serve, or that down stream quality will not be adversely affected for present or contemplated future uses".

Reason.—Higher than required quality attainment is a waste of industry and tax payer's hard earned funds. Each reach of each river or creek must be judged on its merits. This is not to say that we belong to the "Dirty as possible" crowd, because our company does advocate secondary treatment in practically every instance—not just simply primary clarification.

V

On page 28 after line 6, there should be added: "or except as economic consideration would preclude such closed cycle production".

Reason.—Closed cycles would be theoretically and technically possible in many industrial processes, but in most of these, absolutely economically forbidding, with present technology.

We appreciate this opportunity to express our views. Like you, we are sincerely and constructively interested in progress. Progress will not result simply because we have passed another bill. The law, if too restrictive or inequitable, will simply cause confusion, and retard progress as is evident today in many areas. Economics and value analysis will continue to be the common denominator for action.

I would like to hear from you or the Committee concerning these requests.

Sincerely yours,

P. H. GLATFELTER CO.
PHILIP H. HERSHEY,
Manager, Environmental Control.

GRAIN PROCESSING CORPORATION

GRAIN PROCESSING CORPORATION,
Muscatine, Iowa, June 18, 1971.

HON. EDMUND S. MUSKIE,
Chairman, Subcommittee on Air and Water Pollution, Committee on Public Works, U.S. Senate, Washington, D.C.

DEAR CHAIRMAN MUSKIE: The purpose of this letter is to register the opposition of Grain Processing Corporation to proposed new Subsection 8(a)(2)(I) of the Federal Water Pollution Control Act as contained in S. 1013 being considered by the Subcommittee on Air and Water Pollution.

This subsection provides as follows:

"(I) No grant shall be made for any project which will treat industrial wastes of a liquid nature unless the grantee makes provisions satisfactory to the Administrator, in accordance with regulations promulgated by him, for the full recovery by the grantee, from the industrial users of the project, of that portion of the estimated reasonable cost of construction of such project (as determined by the Administrator) which is allocable to the treatment of such industrial wastes. The amount of estimated reasonable project costs recovered from each industrial user shall be equitably based on the proportion which the volume and strength of such user's wastes treated by the project bears to the volume and strength of all wastes treated by the project. Revenues derived from such cost recovery, to the extent apportionable to the Federal share of eligible project costs allocable to the treatment of industrial wastes, shall revert to the Treasury of the United States, unless the grantee has, or, in accordance with regulations to be promulgated by the Administrator, makes satisfactory provision for developing, a user charge system and other legal, institutional, managerial and financial capability to assure adequate operation, maintenance, expansion and replacement of treatment works throughout the grantee's jurisdiction, in which case such revenues may be retained by the grantee to assist in providing the financial capability referred to in this subparagraph."

Grain Processing Corporation feels this new subsection is unwise for the following reasons:

1. It would tend to encourage industry to consider more seriously their own individual plants rather than joining with a municipality in a joint plant. To the extent that joint plants are not constructed the economies of size which would result from joint plants will be unavailable both to the industry and to the municipality.

2. Somewhat related to 1. is the fact that the federal government seems to be trying to encourage plants to be as large as possible. It is easier to supervise one large plant than it is several smaller ones. It minimizes the problem of finding trained operating personnel.

3. Industry pays a very large federal tax bill and should not be denied the opportunity to benefit from grants which their taxes in part make possible.

4. Industry located within a municipality or close enough that it could participate in a joint plant, pays state and municipal taxes which help finance the municipal treatment facility. Such industry should not be denied the opportunity to participate in a joint plant by eliminating a major portion of the financial advantage from doing so.

5. This provision will increase the cost to industry of water pollution control compliance by about four times. This assumes, of course, maximum state participation. This increased cost may very well make the difference between some industry being able to bear the burden or not.

6. Some industry has already participated in federal grants for joint facilities and would thus have a competitive advantage over industry which has not participated heretofore.

7. Industry which does not have the opportunity to partcipate in a municipal plant because of its location usually has tax advantages due to being located outside an urban area.

8. We have always contemplated paying a user charge to cover operation, maintenance, repair and replacement of our share of the facility. By requiring industry also to pay the federal grant portion of the original construction cost you are at least doubling the treatment costs which must be paid during the period of amortization of the original construction cost.

We recognize the need for uniformity from state to state in the treatment of the portion of pollution control costs which industry must bear. We believe this could well be achieved through the regulations existing at the present time, which in effect require user charges to recover the industry's share of the applicant's (city's) cost of the treatment facility.

For the reasons mentioned above, we strongly urge that this subsection be deleted from any legislation recommended by the Subcommittee on Air and Water Pollution.

We would appreciate having this comment included in the hearing record.

Respectfully submitted.

ELMER E. BLOOM,
Vice-President.

STATE OF INDIANA

OFFICE OF THE GOVERNOR,
STATE OF INDIANA,
Indianapolis, Ind., June 21, 1971.

Hon. EDMUND S. MUSKIE,
Chairman, Subcommitte on Air and Water,
Senate Office Building, Washington, D.C.

DEAR SENATOR MUSKIE: It is important that legislation currently under consideration for extending the construction grant funds under the Federal Water Pollution Control Act include adequate provisions for reimbursement to the states which have made commitments out of their own fiscal resources to finance construction of such facilities.

The federal funding of the construction grant programs was not until the last two years in the amounts of the authorization proposed by Congress requiring greater commitment on the part of the states to maintain progress in the construction of sewage treatment facilities. Also, the present federal commitment to reimburse has not been adequate to permit the states to finance the continuing pollution abatement program.

I would urge your favorable consideration of amendments which would:

1. Authorize commitment of federal funds to assume the state and local prefinancing commitments made between July 1, 1966 and June 30, 1971.
2. Provide a set percentage of funds appropriated for the payment of state and municipal prefinancing obligations.
3. Provide that any funds prefinanced by states and local governments after July 1, 1971 shall constitute a commitment or obligation of the federal government.

These amendments are needed to assure reimbursement to the states to maintain the progress in the construction of municipal waste treatment works.

Sincerely,

EDGAR D. WHITCOMB, *Governor.*

INTERNATIONAL BOATING ASSOCIATION

By JOHN C. MURPHY, Vice President

The International Boating Association, a service organization founded to meet the needs and advocate the interests of pleasure boat owners throughout the United States, wishes to take this opportunity to comment upon legislative items pending before the Subcommittee on Air and Water Pollution pertaining to water pollution control.

The boatsman, perhaps more than anyone else because of his close proximity to the water, is keenly aware of the fact that our waterways are a national disgrace, having been degraded to a dangerous level by pollutants. This condition is critical to him for it has an adverse effect on his enjoyment of recreational boating, to say nothing of the fact that it may endanger his life or health and that of the general public. He also knows that abatement of his condition will not occur on a voluntary basis, and, therefore, it appears that coercion, financial assistance or both must be provided by Federal, state and local units of government to reverse the steady degradation of our precious water resource.

The Association, in its 1971 Statment of Legislative Policy, asserts that a tool for combating water pollution presently exists, namely the Water Quality Standards Program. What is needed, however, is an extension of the Program to cover all of the navigable waters of the United States, rigid enforcement of the Standards, and an adequate level of funding to bring about complete implementation of the Standards Program.

With respect to the two pending items of legislation before the Subcommittee, namely the Muskie bill (S. 523) and that proposed by the Administration, we wish to offer our support for the Muskie bill—S. 523. Although there is a good measure of similarity between the two, that which is proposed in S. 523 is more realistic and responsive to answering the need for combating a major source of water pollution—inadequately treated effluent from municipal waste treatment systems. We concur with the call for a 5 year, $25 billion program for additional municipal sewage treatment plant construction as a very necessary step toward insuring an acceptable standard of quality of our Nation's waters. We also support stricter Water Quality Standards and greater Federal enforcement powers to insure compliance with such Standards.

The International Boating Association strongly urges the members of the Subcommittee on Air and Water Pollution to favorably report the "National Water Quality Standards Act of 1971" to the full Public Works Committee and likewise urge it, and ultimately the Congress of the United States, to enact into law this vital piece of legislation.

Very truly yours,

JOHN C. MURPHY, *Vice President.*

LAKE CARRIERS' ASSOCIATION

LAKE CARRIERS' ASSOCIATION,
Cleveland, Ohio, March 17, 1971.

Hon. EDMUND S. MUSKIE,
Chairman, Subcommittee on Air and Water Pollution, Committee of Commerce, U.S. Senate, Washington, D.C.

DEAR MR. CHAIRMAN: Last Friday in your absence I had an opportunity to meet with a member of your staff to chat briefly about one of the most pressing problems on the Great Lakes—the varying pollution laws and regulations that have been enacted by state and local governments since the Federal Water Quality Improvement Act was passed last April.

I am proud to point out for our industry that on most of our ships built or acquired since World War II, we have installed sewage treatment plants that produce approximately a secondary level treatment. This has been done as part of our pursuit of cleaner water in the Great Lakes even when there were no federal or state standards or requirements talked about, showing early industry concern *and action.*

The local and state legislative actions, which are doomed to a limited degree of effectiveness on the total Great Lakes system because of lack of coverage and uniformity, is a manifestation of a concerned citizenry—and perhaps an over-reacting law making body. It may also point to an inadequate national program. The result is quite clear, not only an ineffective Great Lakes water quality program but an unreasonable burden on interstate commerce.

In an immediate effort to wring some sense out of a chaotic picture, lake shipping (19 out of 21 of our member companies) filed suit this week in the U.S. District Court at Detroit seeking a declaratory judgment in an effort to determine which standards govern. A temporary restraining order has been issued and a hearing on the case scheduled for April 6th.

Since almost half the Great Lakes system waters are Canadian, we must recognize that country's concomitant interest and responsibility for a clean water program also. The province of Ontario plays a part, as well as the national government of Canada.

I will point to several problems that we in lake shipping have with the 1970 Water Quality Improvement Act for non-oil discharges:

(1) No federal standards have been issued almost a year after enactment.

(2) After issuance of the federal standards there will be an apparent five-year period for existing vessels before federal pre-emption occurs.

(3) Even if a vessel installs a federally approved sewage treatment device during the five-year period, the vessel apparently is not protected against state or local requirements.

(4) The Act deals only with sewage discharge, leaving other potentially polluting discharges to state and local laws and regulations. The problem here again is lack of uniformity in dealing with the other discharges which results in an unreasonable burden on interstate commerce, not to mention the ineffectiveness of a local approach.

(5) Insofar as the Great Lakes are concerned, the Act deals unilaterally with U.S. interests only.

I am convinced that there is a genuine universal interest in Great Lakes water quality in both the United States and Canada. Consequently, the most effective and timely approach appears to be an international agreement between the United States and Canada covering water quality standards for the Great Lakes. Such an agreement, if confirmed by the Senate, would be nationally pre-emptive insofar as state or local actions in the United States are converned.

To minimize the time to achieve such an international agreement, general terms could be agreed upon with separate "annexes" to be concluded without Senate ratification on an "as needed" basis to cover pollutants subsequently identified.

For your information, I am attaching a copy of a letter recently sent to Mr. Russell E. Train, Chairman of the President's Council on Environmental Quality.

We share your interest for an immediate program to improve our environment. We hope you share our concern for a rational approach.

Sincerely yours,

PAUL E. TRIMBLE,
Vice Admiral, USCG (Ret.)
President.

Attachment:

FEBRUARY 10, 1971.

RUSSELL E. TRAIN,
Chairman, President's Council on Environmental Quality,
Washington, D.C.

DEAR MR. TRAIN: Would we not all benefit, especially clean water enthusiasts (and we proudly include ourselves in that category) if the federal standards called for in Section 13(b)(1) of the "Water Quality Improvement Act of 1970," approved April 3, 1970, were published without further delay? We do not contend that such publication will be a panacea for Great Lakes shipping, i.e., domestic, Canadian and ocean-going vessels of the world entering through the St. Lawrence Seaway, since there are many state and local requirements confronting us with various standards and timetables, not to mention Canadian involvement. But publication would be an important step toward solution.

A federal standard as visualized by the Act cited above would help to clear the air and provide a base from which to work, both as to quality and as to timetable. Concomitantly, technological development of marine waste systems would have a basis for moving forward to meet those standards.

Further, the recently announced Administration water quality legislative program for 1971 should include clarification of the pre-emption features of the 1970 Act. Specifically, after federal standards are established by your office, and after implementing regulations are established by DOT, if an approved device is installed immediately by a vessel engaged in interstate commerce, what protection does the vessel have against state or local laws for the remainder of the five-year grace period? Would not an immediate protection provide an incentive for vessels to conform without waiting for the five-year grace period to expire?

Then, looking at the Great Lakes navigable water system as one huge body of fresh water of intense interest to Canada as well as the United States, would it not make sense to develop and adopt universal water quality standards in the form of an international treaty between the two countries?

Such standards should go beyond the restraints contained in the 1970 Act and deal with phosphates and other pollutants in addition to sewage. Presumably, a reasonable timetable for compliance would be agreed upon between the two countries, the agreement would be formally ratified and would pre-empt federal, state or local laws with a sensible, meaningful and timely water quality program. We are aware that some work is going on now under the aegis of the IJC, but probably only on sewage wastes.

Informal discussions in the lakes shipping industry and with Canadian government officials suggest such an approach is not only acceptable but urgent. A number of waste treatment systems are being tested in this country and internationally, but until the national or U.S./Canadian standards are clarified, there is little incentive for interested companies to move forward in this field. We in the U.S. lakes shipping industry have installed sewage treatment systems in all replacement vessels built since World War II, even when there was no standard or public clamor for environmental quality. We are anxious to take the lead in a new and higher quality program for the Great Lakes. Will you help us?

In summary, three urgent proposals are advanced:

(1) Expedite publication of federal water quality standards called for in PL 91–224, approved last April.

(2) Clarify PL 91–224 so that approved marine sewage treatment installations made thereunder will have federal protection against state or local laws as an incentive to stop polluting before the five-year grace period expires.

(3) Push for joint U.S./Canadian water quality standards for the Great Lakes covering all pollutants.

I am sending a similar letter to Mr. William D. Ruckelshaus, Administrator, Environmental Protection Agency, in Washington, D.C.

Urgently yours,

PAUL E. TRIMBLE,
Vice Admiral, USCG (Ret.)
President.

HON. WALTER F. MONDALE

U.S. SENATE,
Washington, D.C., May 26, 1971.

Hon. THOMAS F. EAGLETON,
U.S. Senate,
Washington, D.C.

DEAR TOM: Now pending in the Air and Water Pollution Subcommittee is my Clean Lakes Act of 1971, Senate bill 1017.

I greatly appreciated the Subcommittee's courtesy and interest during my testimony on March 16.

A number of the questions raised by the Subcommittee then have since been asked in other forums and the news media.

On May 21, Life Magazine, in an article on phosphates pollution, pointed out how lakes are lost to all use through entrophication, premature aging. S. 1017 would provide the additional treatment funds necessary to protect lakes from phosphorous and other effluent not now removed by most treatment plants. But most importantly, the bill would provide grants for cleanup programs, to reclaim damaged lakes from weeds and algae after pollution is curtailed; no current federal program directly addresses this need.

Over the years, research has produced a number of methods for cleaning up lakes. Attached is a list of such techniques recently published by the Department of the Interior. These methods have been tested in pilot programs in sixteen states. Now a program of assistance for the actual lakes cleanup is needed. These techniques can be used in all our states to provide highly visible evidence of the Congress' continuing efforts to protect water quality.

On May 18, the front page of the Wall Street Journal reported a number of recent successful efforts at restoring lakes previously lost to pollution. The article cited the success of the Upper Great Lakes Regional Commission in treating enthropied lakes with several chemical and mechanical techniques. I enclose an excerpt of that article. I have asked the Commission to report some of its data for the use of the Subcommittee.

For most Americans, inland lakes are one of the most visible aspects of the environment. In addition to recreational, sporting, and aesthetic considerations, lakes are very clearly basic to the ecology of the planet.

I ask your support of this Clean Lakes legislation as you consider the 1971 national water quality legislation.

With warmest personal regards.

Sincerely,

WALTER F. MONDALE.

Attachments:

TECHNIQUES WITH POTENTIAL FOR CLEANING EUTROPHIC LAKES

DEVELOPMENT OF THE DREDGING TECHNIQUE OF NUTRIENT REMOVAL FOR PRACTICAL APPLICATION

A lake bottom is virtually a "mine" of nutrient compounds, a portion of which may be re-suspended and re-dissolved rendering them available on a continuing basis, from year to year, for new algal growth. The feasibility of dredging either portions or all of lakes and reservoir bottoms must be investigated.

DEVELOPMENT OF TECHNIQUES FOR FLUSH-OUT OF EUTROPHIC LAKES WITH LOW-NUTRIENT WATER

The "triggering" mechanism for the development of an algal bloom appears to be related to the concentration of nutrient compounds in water. In areas where water containing very low concentration of nutrients is available, the flushing technique should be explored.

DEVELOPMENT OF METHODS AND APPLICATION OF MATERIALS FOR THE PREVENTION OF NUTRIENT INTERCHANGE WITH THE BOTTOM SEDIMENTS

During the periods of the spring and fall overturn, a new supply of nutrients is made available from the bottom muds, since circulation of lake contents is possible. Techniques to prevent this interchange must be developed.

WEED HARVESTING FROM SHORE AREAS AND LAKE BOTTOMS

Rooted vegetation utilizes dissolved nutrients in water in the same sense that plankton algae (also plants) do. Even though the removal of plants would remove only a small fraction of the lake's nutrient content, the nuisance odors, and interference with boating, fishing and water contact sports would be temporarily eliminated with the harvested weeds. Physical and chemical removal techniques should be investigated.

USE OF ALGAL PREDATORS—PARASITES AND GRAZERS

Results of recent research efforts at the Cincinnati Water Research Laboratory have resulted in the discovery of a virus which is parasitic, specifically to blue-green algae. This discovery permits the consideration of the use of these viruses to control algal blooms in lakes. This technique should be further explored, and if found satisfactory, should be demonstrated.

USE OF CHEMICALS FOR ALGAL GROWTH CONTROL

Chemicals such as copper sulfate have been used in the past to control the development of blooms for very short periods of time, a matter of days. Chemical treatment has had the primary disadvantage of serious side effects. For example, many young fish are killed as a result of applications of lethal chemicals. The chemical soon disperses and is incorporated in the bottom sediments and its usefulness has been exhausted. Many new chemicals are available which may be lethal specifically to plankton-algae forms. These should be sought and their usefulness demonstrated.

CHEMICAL INACTIVATION OF NUTRIENTS

It is possible to chelate or chemically inactivate many compounds in water solution. Methods to tie up algal nutrients, thereby preventing their participation in algae metabolism, should be explored and developed.

CONTROL OF TEMPERATURE STRATIFICATION IN LAKES

Past research efforts related to quality control in impoundments have resulted in techniques for stratification and destratification of bodies of surface water. It appears both technically and economically feasible to consider the application of mechanical and diffused-air pumping for lake destratification. The indications are that the growth of green algae forms can be encouraged at the expense of blue-green algae types, thus reducing the nuisance potential. These techniques are ready for large-scale application.

[From the Wall Street Journal, excerpted, May 18, 1971]

(By Frederick C. Klein, Staff Reporter)

Fishing in an increasing number of lakes in the Midwest and South has been spoiled by eutrophication, a process of overfertilization in which lakes' plant populations grow out of control because of the addition of nitrogen and phosphorous from sewage and farm-land runoffs. Eventually, the fish die. The problem has been harder to cure than an overabundance of undesirable fish species because the removal of plants by dredging is very expensive.

Since 1969, however, the Upper Great Lakes Regional Commission, a federally sponsored economic development unit that includes Michigan, Minnesota and Wisconsin, has been seeking new ways to treat eutrophied lakes. Among other things, scientists for the group have pumped out whole lakes and refilled them with uncontaminated water and spread black plastic sheeting on lake bottoms to discourage plant growth.

The most promising treatment to date has been with aluminum sulphate, which acts as a magnet to attract and hold plant and animal particles and sink them to lake bottoms. Lakes thus treated have become clear and less clogged after only two weeks, and the cost has been low. The chemical isn't harmful to humans—it is used to remove impurities from drinking water.

"The main thing we don't know about aluminum sulphate is how long it will keep a lake clean," says Thomas Wirth, Wisconsin's chief of water resources research and head of the Upper Great Lakes project. "If its effectiveness runs into years, we might have a solution for a tough problem."

Summary of Clean Lakes Act of 1971

(By Walter F. Mondale)

The Clean Lakes Act of 1971 provides for a coordinated and comprehensive program to restore lakes which are in danger of becoming lifeless and useless. It would initially cover a four-year period.

To qualify for assistance, applicants must develop a plan for their lakes which will ensure that steps are taken to maintain the improved standards reached through this program.

The bill covers four major points.

First, the bill authorizes an increase in the Federal grant now available under section 8 (b) of the Water Pollution Control Act for treatment works which are located near or adjacent to a lake and which discharge wastes into the lake or tributary waters. The increase would be to a maximum of 65 per cent of the costs, if the State pays at least 20 percent of the costs. To be eligible for this increase, enforceable water quality standards must be established and the works be consistent with the plan for the implementation, maintenance and enforcement included in the standards. These works must discharge only treated water, and industries hooking up to the municipal system must provide pretreatment of their wastes. The bill authorizes an annual appropriation of $150 million for fiscal years 1972, 1973, 1974, and 1975 for the purpose of funding these increased grants.

Second, the bill directs the Administrator of the E.P.A. to provide technical and financial assistance to the states and municipalities in carrying out a comprehensive program of pollution control. This would include the use of harmless chemicals to destroy unwanted supplies of algae that accelerate the aging process of lakes, the dredging of lake bottoms to remove decaying sludge and other noxious pollutants, the recovery of over-growth of algae and trash from the surface, and the improvement of lake shores. The bill authorizes up to 80 per cent Federal grants for this program from a total appropriation of $900 million over a four-year period beginning in fiscal year 1972.

Third, the bill authorizes the use of experienced Federal water resource agencies such as the Bureau of Reclamation and the Corps of Engineers, to help carry out this program under agreements with the States.

Fourth, the bill provides measures to enforce water quality standards for lakes subject to this program. These measures include penalties and injunctive relief.

[From the Congressional Record, 92d Cong., first sess., Friday, Feb. 26, 1971]

By Mr. MONDALE (for himself), Mr. Bible, Mr. Burdick, Mr. Cannon, Mr. Church, Mr. Cranston, Mr. Gravel, Mr. Harris, Mr. Hart, Mr. Hartke, Mr. Hughes, Mr. Humphrey, Mr. Inouye, Mr. Jackson, Mr. Javits, Mr. Kennedy, Mr. Magnuson, Mr. Mansfield, Mr. McGee, Mr. McGovern, Mr. McIntyre, Mr. Metcalf, Mr. Moss, Mr. Muskie, Mr. Nelson, Mr. Percy, Mr. Prouty, Mr. Randolph, Mr. Ribicoff, Mr. Sparkman, Mr. Tunney, Mr. Williams, and Mr. Young):

S. 1017. A bill to amend the Federal Water Pollution Control Act, as amended, and for other purposes. Referred to the Committee on Public Works.

Mr. MONDALE. Mr. President, the Water Quality Improvement Act, signed into law on April 3, 1970, cleared the way for the enactment of a comprehensive program to improve the deteriorating condition of our waterways. Its passage marked the culmination of a long struggle to strengthen the Federal Water Pollution Control Act.

I was especially pleased by this action because of the enactment of the clean lakes research provision originally introduced by Senator BURDICK and me in 1966. It enables the Federal Government to undertake basic research or to make grants for studies into the cause and prevention of lake pollution.

The Environmental Protection Agency supplemental appropriation, in December, began the funding of this program with $2 million for the last half of this fiscal year. It is my hope that the administrattion will utilize these minimal funds carefully to stimulate this vital research, and that more adequate funding will be sought and provided in the 1972 appropriations process.

This is an important first step in what I hope will be a concerted campaign to restore the thousands of lakes which are jeopardized by pollution.

But we need to move immediately beyond research and study and begin implementing programs to restore and preserve these lakes.

Many of the Nation's fresh water lakes are deteriorating. Some of these lakes are in such desperate condition that they cannot wait for the processes set up by the recently passed research provision.

It is to this problem that I am addressing my new legislation.

The bill I am introducing today goes beyond the research program approved by the last Congress. It is in line with the conclusion reached by the 1967 House Committee on Government Operation's report "To Save America's Small Lakes" which stated:

"A twin-pronged approach to the problem of accelerated eutrophication would seem desirable—an expanded program of basic research to add to the limited knowledge about the eutrophication processes and their effective and economical control, plus immediate action in the form of demonstration projects utilizing present knowledge and skills."

The new clean lakes bill would establish a coordinated program of increased waste treatment and lake cleansing utilizing the latest technology. It is aimed at rehabilitating the lakes which are in particularly poor condition.

I am concerned about the hundreds of lakes which already have been fouled by man's carelessness; lakes which have been used as a convenient dumping area for municipal, industrial and agricultural wastes, and lakes which have deteriorated because of runoff from careless shoreline development projects.

Municipal sewage in increasing, filled with phosphorous materials from detergents or human wastes. In many instances, it is dumped untreated into nearby lakes. A recent report by the University of Minnesota Limnological Laboratory indicated that it may take up to 35 years for an urban lake to return to natural equilibrium after the influx of sewage is ended.

Industries find it expedient to locate adjacent to lakes where they can pump their chemical-filled discharges.

Lakes also suffer from agricultural runoffs. Overflows contaminated with pesticide, herbicide, and fertilizer residues wash into the lakes. Construction projects on lake shore areas cause increased runoff of soil and vegetation. Siltation adds to the load.

Unlike moving rivers, lakes have very slow flushing systems to purge themselves of these burdens.

The unrelieved surge of nutrients into these lakes causes the waters to be enriched past their capacity. The problem becomes one of eutrophication—the aging of lakes.

The element added to the lakes by sewage and runoffs act as fertilizers of aquatic growth causing a veritable population explosion of algae. These plants have a self-generating cycle and create an increasing demand on the oxygen in the water, thus killing desirable bacteria which work naturally to cleanse the water.

Meanwhile, lakebeds fill with sludge and debris, and the marine life chokes and dies.

A recent survey by the University of Minnesota indicated that the State's once-sparkling lakes are gradually taking on a new color—green. The study identifies sewage seeping from inadequate disposal systems of lakeshore homes as the main source of pollution. In the West, one of the world's clearest bodies of water, Lake Tahoe, which lies over 6,000 feet high in the mountains, may turn green within 15 years.

This is largely a result of population increase and the boom in water recreation. The population on the shore of Minnesota's recreational lakes is doubling every 20 years. The population on the shores of Lake Minnetonka, outside the Twin Cities, increased by 50,000 in 10 years, and will reach 200,000 by 1980. In 1 year, more than 100,000 pounds of nitrogen entered that lake from seven sewage

plants. The University of Minnesota study showed that municipal sewage is dumped directly into the water of 34 major recreational lakes studied.

Runoff of fertilizers from farmland and nutrients from cattle feedlots reduce the quality of many lakes.

The problems are not endenic to the 11,500 lakes in Minnesota which are in excess of 10 acres. Many of the more than 100,000 fresh water community lakes in the Nation are being victimized by the same problems.

Our lakes have too often been forgotten in the rush to improve our environment. Since lakes are so essential to our way of life and represent such an irreplaceable resource, it is obvious that they cannot be neglected.

Yet, unless restorative measures are taken soon, many of our priceless lakes will be irretrievably lost.

The bill I am introducing today recognizes the desperate plight of these lakes and provides for a plan to reclaim these waterways.

There are four major points covered in this new Clean Lakes Act.

First, the bill authorizes an increase in the Federal grant now available under section 8(b) of the Water Pollution Control Act for treatment works which are located near or adjacent to a lake and which discharge treated wastes into the lake or tributary waters. The increase would be to a maximum of 65 percent of the costs, if the State pays at least 20 percent of the costs. To be eligible for this increase, enforceable water quality standards must be established and the works be consistent with the plan for the implementation, maintenance, and enforcement included in the standards. These works must discharge only treated water, and industries hooking up to the municipal system must provide pretreatment of their wastes. The bill authorizes an annual appropriation of $150 million for fiscal years 1972, 1973, 1974, and 1975 for the purpose of funding these increased grants.

Second, the bill directs the administrator to provide technical and financial assistance to the States and municipalities in carrying out a comprehensive program of pollution control. This would include the use of harmless chemicals to destroy unwanted supplies of algae that accelerate the aging process of lakes, the dredging of lake bottoms to remove decaying sludge and other noxious pollutants, the recovery of overgrowth of algae and trash from the surface, and the improvement of lake shores. The bill authorizes up to 80-percent Federal grants for this program from a total appropriation of $900 million over a 4-year period beginning in fiscal year 1972.

Third, the bill authorizes the use of experienced Federal water resource agencies such as the Bureau of Reclamation and the Corps of Engineers, to help carry out this program under agreements with the States.

Fourth, the bill provides measures to enforce water quality standards for lakes subject to this program. These measures include penalties and injunctive relief.

I believe we must take these steps if we are to save these troubled waters.

There are several techniques which can be employed to clean the lakes.

Obviously, we can move to upgrade the waste treatment facilities to cut back the flow of nutrients into their waters. This kind of preventive procedures can sometimes result in rapid improvement, as happily occurred, for example, on Lake Washington in Seattle.

There are other direct measures to be used to rid the lakes of pollution.

Chemicals are being developed which attack algae forms, but do not harm the fish life of the lake. Copper sulfate has been used in the past to control algal bloom for a short period of time. Experiments are also being conducted with alum, which sinks surface sediments, and with lime, which attacks the acidity in some "bog lakes." Research efforts at the Cincinnati Water Research Laboratory resulted in the discovery of a virus which is parasitic, specifically to blue-green algae.

Dredging and surface screening operations have proven successful in clearing lakes of sludge, weeds, and other undesirable contents.

A special treatment developed for the Snake Lake in Wisconsin was less costly than dredging or screening. This consisted of literally flushing the lake's waters into a nearby earth area. There the foul water was strained through a natural filter of sand to seep back into the lake bed. The project, administered by the University of Wisconsin and the Wisconsin Department of Natural Resources through a grant from the Upper Great Lakes Regional Commission, has apparently been a success. The cost was $10,000 to pump the lake's 21 million gallons.

I am hopeful that we can extend our support of such efforts, for the benefit of future generations. Lakes provide not only a source of water but offer recrea-

tional outlets, wildlife habitat, and they are a basic part of the beauty of the earth landscape. Clean lakes are basic to the life balances on which our existence depends.

Our lakes are a priceless commodity. To delay action in cleaning our lakes is to risk losing them. We cannot afford this.

Mr. President, I ask unanimous consent that the full text of the bill be printed at this point in the RECORD.

There being no objection, the bill was ordered to be printed in the RECORD, as follows:

S. 1017

A bill to amend the Federal Water Pollution Control Act, as amended, and for other purposes be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Clean Lakes Act of 1971".

Sections 22 through 27 of the Federal Water Pollution Control Act, as amended, are redesignated as sections 23 through 27 and there is added after section 21 a new section 22 to read as follows:

"LAKE POLLUTION ABATEMENT AND QUALITY ENHANCEMENT

"SEC. 22. (a) The Congress finds and declares that—

"(1) the public fresh water lakes of the United States are irreplaceable resources for meeting many of man's public water supply, recreational, esthetic, industrial, agricultural, navigational, and other needs;

"(2) some such lakes, both urban and rural, are carpeted with green scum and formations of slime, their waters grossly turbid and unpleasant in taste and odor, and have been thoughtlessly pillaged by man's technological advances;

"(3) many of America's lakes are suffering from manmade pollution caused by the continuing discharge of untreated or inadequately treated industrial and municipal wastes, from agricultural and urban runoff, including siltation due to soil erosion, and from manufactured products containing harmful pollutants discharged into municipal treatment systems which greatly accelerate the natural eutrophication resulting from the normal aging process of the lakes;

"(4) because a lake has relatively little motion, it has less capacity than a flowing stream to rid itself of wastes;

"(5) while there has been a great deal of publicity about the deterioration of some of our larger lakes, many small community lakes are losing the same battle;

"(6) destruction of water quality in our Nation's navigable lakes cuts deeply into their recreational uses; swimming beaches and picnic areas close, fishing and boating activities decline sharply; shoreline property values fall off; the water supplies of nearby communities and industries are adversely affected and economic disasater can result for the towns and cities whose economic well-being is dependent upon good quality water;

"(7) the restoration or rehabilitation of a navigable lake involves more than the control and abatement of water pollution, since even though the wastes entering these lakes are made less harmful, the discharge of cleaner water into a still degraded lake would solve only part of the problem; and

"(8) It is therefore the purpose of this section to provide a comprehensive and coordinated action program, using the latest technology and available resources, to enhance the quality of public fresh water navigable lakes in urban and rural areas of the United States, with particular attention given to small community lakes.

"(b)(1) The Administrator of the Environmental Protection Agency is authorized to increase the grant percentage for treatment works under section 8(b) of this Act to a maximum of 65 per centum if he finds that the State agrees to pay not less than 20 per centum of the estimated costs of such works and that, in addition to complying with the requirements for treatment works eligible for 30 per centum grants under said section, such works:

"(A) are located in an area near or adjacent to any fresh water navigable lake and discharge treated wastes into such lake or into waters tributary to such lake;

"(B) are located in an area where enforcible water quality standards have been approved by the Administrator for such lake and the waters into which the treatment works discharge wastes, and are constructed or reconstructed in accordance with the plan for the implementation, maintenance, and enforcement included in such water quality standards;

"(C) are planned, constructed, or reconstructed, and equipped, operated, and maintained in a manner that utilizes available up-to-date treatment technology and trained personnel; and

"(D) discharge only treated wastes into such waters and provide for the pretreatment, when necessary, of industrial wastes before entering such treatment works.

"(2) There is authorized to be appropriated annually the sume of $150,000,000 for such increased grants for the fiscal years ending June 30, 1972, through June 30, 1975.

"(c) (1) The Administrator shall provide technical and financial assitance, in accordance with an application approved of all or part of any public fresh water navigable lake located in such States. In addition to controlling effluent discharges, the program should include a description of means and measures to be employed to improve water quality using all available technology including, but not limited to, the use of safe chemical process, the dredging of lake bottoms near shore to remove decaying sludge and other pollutants; the recovery of overgrowths of algae, the recovery of trash and other materials from the wastes and shorelines, and the grading of shorelines and planting of grass, trees, and shrubs to protect banks and improve the scenic beauty.

"(2) The Administrator shall annually approve any application submitted under this subsection by a State which

"(A) puts forth the programs, policies, and methods to be followed, consistent with water quality standards established for such lake, in carrying out such programs;

"(B) provides that such State or political subdivision thereof has, or will have within eighteen months after the effective date of this subsection, adopted enforcible laws to control industrial, agricultural, and municipal sources of effluents discharged into such lakes and to require persons developing land areas near or adjacent to such lakes or waters tributary thereto for commercial purposes to control soil erosion;

"(C) provides such fiscal control and fund accounting procedures as may be appropriate to grants to the States under this subsection;

"(D) contains assurances that such grants will supplement, not supplant, existing water pollution control programs of a State;

"(E) provides that such State will make reports to the Administrator in such form and containing such information as the Administrator may from time to time require; and

"(F) meets such additional conditions as the Administrator deems appropriate to effectuate the purpose of this section.

"(3) The amount granted to any State for a fiscal year under this subsection shall not exceed 80 per centum of the amounts expended by such State in such year for carrying out such a program. There is authorized to be appropriated $150,000,000 for fiscal year 1972; $200,000,000 for fiscal year 1973; $250,000, for fiscal year 1974 and $30,000,000 for fiscal year 1975, for grants to States under this subsection which sums shall remain available until expended. The Administrator shall provide for an equitable distribution of sums appropriated for such grants to the States where there is an approved application. Applications for grants under this subsection shall be filed at least sixty days prior to the beginning of such fiscal years.

"(4) In addition to such technical and financial assistance, the Administrator may, at the request of a State, enter into agreements with the Secretary of Agriculture and the Secretary of the Army to provide personnel, services, and facilities to the State in carrying out such a program including the constructing of water impoundments or other facilities designed primarily to improve water quality or control pollution for any fresh water navigable lake for which the Administrator has approved an application under this subsection, or the Administrator may provide such personnel, services, and assistance, may enter into contracts with public or private agencies, organizations, and individuals and may acquire by purchase, lease, donation, or exchange lands or interest therein and transfer such acquired lands to such State as part of any grant made to a State for any fiscal year.

(d) (1) In case of any public fresh water navigable lake for which an application for a grant is approved under subsection (c) of this section in any fiscal year, no person shall thereafter discharge waters from any public, commercial, or industrial facility of any kind into such lake or waters tributary thereto in violation of established water quality standard or in violation of any other applicable provision of this Act.

"(2) In addition to any other provision of this Act or other law providing for the enforcement of water quality standards for such lake, any person who knowingly violates paragraph (1) of this subsection shall, upon conviction, be fined not more than $10,000 for each violation, or imprisoned for not more than one year, or both, and one-third of said fine shall be paid to the person giving information which leads to a conviction. Each occurrence of a violation may constitute a separate offense.

"(3) The Administrator may also institute a civil action for relief, including a permanent or temporary injunction, restraining order, or any other appropriate order in the district court of the United States for the district in which a person subject to the provisions of paragraph (1) of this subsection is located or resides or is doing business whenever such person violates the provision of said paragraph. Each court shall have jurisdiction to provide such relief as may be appropriate, except that such court shall have jurisdiction only with regard to the issue of relief being sought pursuant to this paragraph. Temporary restraining orders shall be issued in accordance with rule 65 of the Federal Rules of Civil Procedure, as amended, except that the time limit in such orders, when issued without notice, shall be seven days from the date of entry. In actions under this section, subject to the direction and control of the Attorney General, as provided in section 507(b) of title 28 of the United States Code, attorneys appointed by the Administrator may appear for and represent him."

Phosphates Get Clothes Clean but Damage Lakes

Phosphates are not poisons. Phosphorus is a normal, indeed vital, component of all living things. It is part of every cell and fluid of the human body. For green plants, it is a fertilizer. That is precisely the problem.

Depending on where you live, the detergents you wash down your drains eventually flow through sewers into the ground or streams. Ultimately, they dump into lakes or the ocean. In the ocean (which receives the sewage of roughly half the U.S.) phosphates seem to cause less problem, but when they flow into lakes, they help kill them by overfertilization.

Aging and death are normal processes for lakes: as millennia pass, they become choked with plant life and finally turn back into dry land. Scientists call the process "eutrophication." Over the past several decades, man has vastly accelerated the process. His pollutants fertilize the growth of algae and other plants, which eventually die and decay, using up oxygen that fish need for survival. It has been estimated that Lake Erie has aged the equivalent of 15,000 years in the past 50.

The 200 million pounds of detergent phosphorus the U.S. pours into its water each year are not wholly responsible, but they make a major contribution. Algae and other plants found naturally in lakes need a balanced diet of 15 to 20 different nutrients. Some of these elements—carbon, oxygen—are so ubiquitous they are impossible to control; others are so rare they are impractical to remove. The critical element is usually phosphorus or nitrogen. Ecologists have zeroed in on phosphorus because it is the easiest element to control, and in most lakes it is the crucial, limiting factor.

The International Joint Commission, a U.S.-Canadian agency which spent six years studying pollution of the lower Great Lakes, concluded that phosphates are the important factor in Lakes Erie and Ontario and, furthermore, that detergents *are* the largest single source of phosphates. About 67% of the phosphorus going into the lakes comes from municipal sewage: 70% of the phosphorus in this sewage is from detergents. In its final report, released in January, the commission recommended "complete replacement of all phosphorus in detergents . . . by December 31, 1972." This report set off the spurt of local antiphosphate legislation.

Yet a controversy continues among ecologists over the precise role in other bodies of water of phosphates versus nitrogen and other nutrients. Two scientists from Woods Hole Oceanographic Institution recently showed that coastal marine waters already contain excess phosphorus. Thus nitrogen has become the limiting factor. Switching away from phosphates in coastal areas, they believe, would have little effect on ocean eutrophication.

NATIONAL ASSOCIATION OF HOME BUILDERS

This statement is submitted on behalf of the National Association of Home Builders with respect to the hearings your Subcommittee has held on S. 523, the National Water Quality Standards Act of 1971, and related legislative proposals.

The National Association of Home Builders is the trade association for the American home building industry. Its membership totals over 54,000 persons who belong to 494 affiliated state and local associations in the 50 states and Puerto Rico. We estimate that our members build two-thirds of all the apartments and houses produced by professional builders.

NAHB supports the provisions of S. 523, calling for an appropriation of $2.5 billion for each of the next five years. An absolute essential element to meeting the 10-year housing goal of 26 million units as established in the Housing Act of 1968 is an adequate supply of water and waste treatment systems. NAHB has long supported the various programs to eliminate water pollution and to provide adequate sewere facilities as a necessary part of the production of housing for the American people. Such production is being increasingly thwarted by problems relating to inadequate facilities and increased pollution.

The problem of development of water and treatment systems is one of such magnitude that local communities and states are not capable of solving it without massive financial assistance. This assistance should be broad enough and provided over a sufficient time period in order for local agencies to undertake necessary long term projects.

We should be pleased to furnish the subcommittee with any additional required information with respect to our position on this matter.

Sincerely,

JOHN A. STASTNY, *President.*

NATIONAL ASSOCIATION OF MANUFACTURERS

(By DANIEL W. CANNON, Director of Environmental Affairs)

The limited purpose of this statement is to comment on proposed new subsection 8(a)(2)(I) of the Federal Water Pollution Control Act as contained in S. 1013 being considered by the Subcommittee on Air & Water Pollution.

This subsection provides as follows:

"(I) No grant shall be made for any project which will treat industrial wastes of a liquid nature unless the grantee makes provisions satisfactory to the Administrator, in accordance with regulations promulgated by him, for the full recovery by the grantee, from the industrial users of the project, of that portion of the estimated reasonable cost of construction of such project (as determined by the Administrator) which is allocable to the treatment of such industrial wastes. The amount of estimated reasonable project costs recovered from each industrial user shall be equitably based on the proportion which the volume and strength of such user's wastes treated by the project bears to the volume and strength of all wastes treated by the project. Revenues derived from such cost recovery, to the extent apportionable to the Federal share of eligible project costs allocable to the treatment of industrial wastes, shall revert to the Treasury of the United States, unless the grantee has, or, in accordance with regulations to be promulgated by the Administrator, makes satisfactory provision for developing, a user charge system and other legal, institutional, managerial and financial capability to assure adequate operation, maintenance, expansion and replacement of treatment works throughout the grantee's jurisdiction, in which case such revenues may be retained by the grantee to assist in providing the financial capability referred to in this subparagraph."

Joint solutions to wastewater problems can achieve economies resulting from efficiency of scale and can also achieve certain technical advantages. In addition, they make possible a coordinated area-wide approach to these problems. Therefore, national policy should encourage such joint solutions rather than discourage them.

This provision apparently disregards completely the role which industrial companies play as major taxpayers and providers of employment in the communities and areas where their plants are located. As major taxpayers, these companies perforce bear a proportionate share of the construction cost (including the Federal grant) and operating and maintenance cost of municipal treatment plants. As providers of employment, they make possible other sources of tax revenue for municipalities and for the Federal Government. Equitable arrangements have been worked out between industrial companies and municipalities, including treatment of industrial wastewater in municipal treatment plants, treatment of municipal wastewater in industrial treatment plants, and industrial re-use of treated municipal wastewater. Such arrangements should be encouraged rather than discouraged.

We believe that the municipalities and the industrial companies should have a great deal of freedom and flexibility to work out equitable arrangements based on the facts of local situations, no two of which are the same.

We submit that it would be a serious error for the national government to lay down a rigid and inflexible formula to apply to these arrangements, and would greatly reduce the present encouragement to participate in these joint solutions. Therefore, we strongly urge that this subsection be deleted from any legislation recommended by the Subcommittee on Air & Water Pollution.

59-068—71—pt. 3——19

STATEMENT OF THE NATIONAL FARMERS UNION

(By WELDON V. BARTON, Assistant Director of Legislative Services)

We appreciate this opportunity to express the views of the National Farmers Union on legislation to extend the Federal Water Pollution Control Act of 1965.

As the Subcommittee begins executive sessions on this legislation, I wish to reiterate the support of Farmers Union for the "Plan for Clean Air" transmitted to members of the Public Works Committee earlier this year by a coalition of Environmental Action, Farmers Union, and other groups. A strong water pollution abatement bill, containing the basic provisions of the "Plan for Clean Air," is absolutely required.

I want to express special concern that provision for citizen suits, as outlined in the "Plan," be included in any bill reported by the Subcommittee. The bill should provide the right of citizens, as under the Clean Air Act of 1970, to go to court and force administrative or industrial action if the law is not enforced. Only if the public can act as a watchdog in this way will the law be effectively enforced.

Farmers Union urges the Subcommittee to report a bill providing the federal water quality standards, monitoring devices, and enforcement procedures required to come to grips with the water pollution crisis in America.

COMMENTS

(1) Deadlines.—It is vital to include in the legislation deadlines for the setting of state water quality standards and deadlines for the achievement of those standards. Without statutory deadlines polluters will continue to delay the enforcement process for their own profit. Pollution is cheap from their point of view. Probably the most effective deadline is three years for the attainment of the standards outlined by the state implementation plans.

(2) Burden of proof.—Legislation must reflect the assumption that it is up to the polluter to prove that his effluent will not damage the quality of the water. The public should not have to prove damage to water quality; our rivers and streams belong to the public. The presumption must be that any dumping is unlawful until proven otherwise.

(3) Water use.—Present law requires the states to designate the use of all bodies of water within their jurisdiction (major categories include recreational, industrial, agricultural, etc.) and then devise standards of water quality sufficient to protect that use. Environmentalists feel that no body of water should be used as the dumping grounds of industry as is presently often the case. The following restrictions should be put on the state's right to designate water uses: no use set can degrade the present quality of the water; no use can adversely affect the downstream uses of the water; all uses should conform to a national minimum water quality. Such a national minimum should aim for the protection of humans, fish and wildlife. Some waters in the United States, such as Lake Michigan, Lake Tahoe, etc., are particularly sensitive to ecological change and should be protected with a "no dumping" policy right now. Citizen participation must be insured in the setting of water uses. Citizens should have the right to petition for change in water use designations.

(4) Mandatory actions.—Enforcement in past water quality legislation has been less than casual. The Administrator of the Environmental Protection Agency (formerly Secretary of the Department of the Interior) has never been required by the legislation to enforce anything for anybody. It is vital that legislation this year require the Administrator to act upon a pollution violation when that is discovered. He must also be required to establish a monitoring system to insure that officials know what industrial polluters are discharging into our waters. Such authority has been granted the Administrator, but not used in the large scale manner that the situation requires.

(5) Penalties.—Penaltes for failure to comply with state and federal water quality law must match the crime. A mandatory criminal fine is necessary to

insure that polluters do not delay court action in the hopes of a negotiated, therefore, lower fine. This minimum could be keyed to corporate assets so that those who pollute in a large scale way are forced to "pay their own way." Civil fines must also be established to make action by the Administrator credible in the eyes and pocketbooks of polluters. Fines should also be levied on a daily basis until the polluter proves his violation is corrected.

(6) Citizen participation.—Citizens must have the right, as they do with the Clean Air Act of 1970, to go to court and force administrative or industrial action if the law is not enforced. It is only with the public acting as a watchdog that the law will be fully enforced. This right is the rock-bottom minimum. We also ask that citizens be allowed to collect part of any fine levied if their information leads to conviction of a polluter. Such a statutory *qui tam* would allow the citizen to collect part of what the government should have assessed in the first place.

(7) New sources.—All new sources of pollution should be required to conform to the latest available pollution control technology. They must be required to conform to national performance standards before construction and during operations. If we do not require national regulation of this matter, industry will engage in "pollution plea bargaining" at the local level to insure the cheapest location for their plant.

(8) Hazardous substances.—There are certain substances whose discharge into our waterways are so dangerous to human health and welfare that their dumping must be regulated to zero. The Administrator must be required to set such discharge limits and enforce them with strict penalties and damages assigned to those affected.

(9) User fees.—Under the present system the Federal Government is actually subsidizing the pollution of industry in their waste treatment grant programs. This billion dollar subsidy program comprises more than 90 percent of the annual federal water pollution control budget. Present law requires only that a treatment facility be publicly owned in order to qualify for a grant. Industries and cities often join together to treat their wastes in order to get the 55 percent federal subsidy of the construction costs. The city retains nominal ownership. According to the Nader Task Force Report on Water Pollution, "Water Wasteland" (1971), "The federal Water Quality Administration's best estimates show that somewhere around half and possibly a great deal more of the (organic) wasteload in the nation's municipal treatment plants comes from industry. This means that it is likely that somewhere around half and possibly more of the annual $1 billion (fiscal 1970 appropriation) in municipal grant subsidies—i.e., somewhere around $500,000,000 and more—is currently being funnelled through municipal middle men to pay the cleanup costs of private industry." These subsidies actually increase the production of industrial wastes. It is cheaper to run wastes through the city waste treatment plant a cut rate costs than alter the means of production to decrease those wastes or install pollution control equipment. Although economies of scale point to economic efficiency in joint municipal-industrial plants, industry must begin to pay its share. User charges administered at the local level are presently woefully inadequate and do not reflect the true cost. A system of user fees must be instituted whereby industry pays back to the federal government their share of the waste treatment grant. This fund could be established as a revolving loan fund at the federal level to insure future waste treatment grant monies. Not only should such charges be levied for the construction, but they should also be instituted for the operation of the plant as well.

(10) Federal facilities.—Federal facilities and sources of pollution should be required to comply with the law. Sanctions should be instituted which the Administrator would be required to use. In addition, the Federal Government should be forbidden from contracting with any firm violating water quality laws.

(11) Review.—To insure a continual upgrading of the quality of our rivers and lakes, states should be required to conduct a public review of water quality uses and standards every 5 years.

(12) Jurisdiction.—Present law only requires the regulation of interstate waters. This restriction of federal water quality laws does not conform to the broader jurisdiction of the Refuse Act of 1899, an extremely important tool in enforcing water quality. It is necessary that present law be brought up to date in requiring the applicability of standards and enforcement mechanisms to all interstate, intrastate and navigable waters.

NATIONAL GOVERNORS' CONFERENCE

MAY 11, 1971.

Hon. EDMUND S. MUSKIE,
U.S. Senate,
Washington, D.C.

DEAR SENATOR MUSKIE: At your request, we have compiled governors' responses to questions you suggested would contribute to the work of the Subcommittee on Air and Water Pollution in constructing effective water pollution control programs. The replies we received, herewith enclosed, offer a concise statement of state efforts in abating water pollution. They do demonstrate a consistency which should assist your committee in resolving certain issues that have been raised in the course of hearings recently completed. It would appear that the principal cause of delay among those states whose programs are not fully operational is lack of funds. There is also a strong indication that additional consideration should be given to the problem of national effluent standards and their efficacy in promoting federal, state, and local efforts to clean up our nation's waterways.

The following is a brief summary of the responses to the questions you have asked:

(1) Have you identified all sources of discharge into interstate, intrastate and coastal waters? If not, how long would it take to do it? How much would it cost?

Reply.—In general, most sources of discharge have been identified from industrial and municipal points. A problem still exists with regards to agricultural and natural sources.

(2) Have the nature and quantites of effluent from each source been identified? If not, how long would it take and how much would it cost?

Reply.—The nature and quantity of effluents from these sources have also been generally identified with the exceptions noted in Question 1. In addition, newly discovered toxic materials will require review of discharges in many instances.

(3) Do you have water quality standards for the receiving waters into which each of these sources discharge? If not, How long? And how much? Do standards for intrastate and interstate waters differ?

Reply.—All responding states have established water quality standards for interstate waters. Those who have not done likewise for intrastate waters are in the process of so doing. There appears to be no difference between the standards set for intra or interstate waters.

(4) Do you have effluent standards or limitations for each individual source of discharge? Are your standards or limitations quantified as to specific amount and specific pollutant? Do you have a permit or similar system? Is the performance of such sources monitored? If not, how long and how much?

Reply.—Responses to the question of effluent standards manifest a divergence of opinion regarding the efficacy of such standards even at the state, let alone national, level. It would seem that the general consensus of experts presently engaged in pollution abatement programs raises serious questions with regard to the approach suggested in S. 523 and other measures presently being considered by your committee. Specific commentary on this point is included among the enclosed documents.

Almost all states do have permit systems. In this regard, serious consideration must be given to the federal permit system recently established under the 1899 Refuse Act. Inherent in current administrative procedures for implementation of this resuscitated program is the potential for such intergovernmental chaos as may well evoke a counter-productive reaction ill-suited to achieving our common purpose.

The degree to which pollution sources are monitored varies and here again the major impediment to adequate monitoring programs is lack of funds.

(5) Will these effluent limits maintain, enhance or achieve water quality standards?

Reply.—All states indicate that their water pollution control programs are designed to enhance or, at the very least, maintain water quality.

We trust this information will contribute substantially to your excellent and longstanding efforts to insure cleaner waters for all the people of this nation. We would be most happy to provide any additional help which may assist your committee in its critically important work.

Sincerely,

R. DEANE CONRAD,
Special Assistant.

[Responses follow:]

ALASKA

STATE OF ALASKA,
OFFICE OF THE GOVERNOR,
Juneau, Alaska, May 6, 1971.

Mr. CHARLES BYRLEY,
National Governors' Conference,
Office of Federal-State Relations,
Washington, D.C.

DEAR MR. BYRLEY: This is in reference to your telegram of April 26, 1971, concerning pending water pollution control legislation.

In answer to points one and two of your telegram, the Alaska Department of Health and Welfare has identified the majority of sources of discharge into interstate, intrastate and coastal waters. However, the Department has not yet determined the nature and quantities of effluent from each source. It is estimated that it would take two years at the minimum to complete a program of point source identification and effluent analysis. We do not have a definite cost for such a program, but based on past projects, it would be approximately 1.7 million dollars.

Point Number Three.—The State has water quality standards for receiving waters, and there is no difference in the standards for intrastate and interstate waters.

Point Number Four.—The State does not have standards or limitations for each source of discharge. The State has a permit system in that plans must be approved by the State Department of Health and Welfare. Approved sources of discharge are monitored by the State Division of Environmental Health. Time and cost of implementing a new system are not available.

Point Number Five.—The present system, if properly utilized and administered, will maintain, enhance, and achieve water quality standards.

Sincerely,

WILLIAM A. EGAN, *Governor.*

ARIZONA

OFFICE OF THE GOVERNOR,
STATE HOUSE.
Phoenix, Ariz., April 29, 1971.

CHARLES A. BYRLEY,
National Governors' Conference,
Washington, D.C.

DEAR CHARLIE: This is in response to your telegram relative to revision of pending water pollution control legislation. We reply to the questions in the order in which they were presented:

1. All sources of discharge are believed known with possible exception of some irrigation return flows from minor ditch companies.

2. Specific numerical values regarding quantity and quality not known for all sources. Estimate collection and verification of such data would take minimum of one man year and cost of $25,000.

3. Water quality standards have been established for all waters of the state. No distinction is made between intra and interstate waters.

4. Secondary treatment or its equivalent is minimum requirement for any discharge. Uniform effluent standards have not been adopted but specific numerical limits have been set for given discharges when appropriate. Permit system is authorized by statute but presently not implemented. Will await results of federal implementation of 1899 refuse act before establishing state permit system. Prior approval by the state is required before construction of a new source of discharge may commence. Present sources monitored on random basis only. Full implementation of effluent standards, permits and monitoring system would take minimum of two years and require minimum of $30,000 per year above present budget.

5. All waters presently in compliance with water quality standards and expected to remain so. Program emphasis is on reclamation of wastes for beneficial use and protection of health.

If we may be of further assistance in this matter please let me know.

Sincerely,

JACK WILLIAMS.

ARKANSAS

ARKANSAS POLLUTION CONTROL COMMISSION,
Little Rock, Ark., April 30, 1971.

MR. CHARLES A. BYRLEY,
National Governors' Conference,
Washington, D.C.

DEAR MR. BYRLEY: In answer to your telegram regarding pending water pollution control legislation, we offer the following answers in the same order as presented:

(1) We have not identified all sources at this time. We have a continuing basin survey program in motion at all times, about 60% of the area of the State having been covered at this time. This program is being intensified for the next two years in the hope of covering the State by the end of 1972. If funding and personnel remain available, we will operate two mobile units four months a year for the foreseeable future at a cost of $75,000 per year. Under our present limited operating conditions, some of our data is ten years old and under our best possible operating conditions some of the data would be 5 to 7 years old.

(2) Under our basin survey procedure, the nature and quantities of effluents are determined, therefore the costs and time involved are as described in Item (1).

(3) Arkansas does have identical Water Quality Standards for all interstate and intrastate streams of the State. This does not include mineral standards which are to be set by the end of 1972. The cost of setting the mineral standards, including the cost of gathering background data which we are now doing, will run roughly $100,000.

(4) We do not have effluent standards as such, only operating guidelines. We do have a permit system and have had, now for some 20 years. The performance of these sources is monitored by means of basin and special surveys. To monitor each source on an annual basis would approximate $200,000 per year if an actual analysis and flow measurement were necessary.

(5) There is no answer to this question, but if effluent standards were to be set there would be some streams with quality maintained, some enhanced. In other streams quality could not be maintained by a uniform set of effluent standards.

If we can provide further information, please advise.

Very truly yours,

LOUIE C. COCKMON, Jr., P.E.,
Assistant Director.

CALIFORNIA

STATE WATER RESOURCES CONTROL BOARD,
Sacramento, Calif., May 14, 1971.

MR. CHARLES A. BYRLEY,
National Governors' Conference.
Office of Federal-State Relations,
Washington, D.C.

DEAR MR. BYRLEY: This will answer your recent questions about California's water quality control program.

1. Have you identified all sources of discharge into interstate, intrastate, and coastal waters?

Answer.—All waste discharges within the State of California have been identified by our Board.

2. Have nature and quantities of effluents from each source been identified?

Answer.—The quantity of all discharges from all sources is identified. The nature of all discharges is identified with regard to all major pollutants that may be contained in the effluent.

3. Do you have water quality standards for receiving waters into which each of these sources discharge? Do standards for interstate and intrastate differ?

Answer.—Water quality standards have been established for all interstate waters and for all major intrastate waters. The standards do not differ in degree of protection afforded the receiving waters.

4. Do you have effluent standards with limitations for each individual source of discharge? Are your standards for limitation qualified as to specific amount and specific pollutants? Do you have a permit or similar system for the performance of monitoring?

Answer.—Waste discharge requirements containing specific effluent standards are established on all individual waste discharges throughout the State. These standards specifically limit the quantity and concentration of deleterious substances that may be contained in the waste.

Each waste discharger is required to conduct a self-monitoring program and to submit reports, normally on a monthly basis. All dischargers are inspected routinely and analyses are made of the effluent to verify the self-monitoring program.

5. Will these effluent limitations maintain, enhance, or achieve water quality standards?

Answer.—The effluent limitations established on individual waste discharges throughout California will continue to enhance existing water quality and assure maintenance of water quality at a level far above established water quality standards.

I am hopeful that this information will assist you in your endeavors.

Sincerely,

KERRY W. MULLIGAN,
Chairman.

COLORADO

STATE OF COLORADO,
DEPARTMENT OF HEALTH,
Denver, Colo., April 28, 1971.

Mr. CHARLES A. BYRLEY,
National Governors' Conference,
Office of Federal-State Relations,
Washington, D.C.

DEAR Mr. BYRLEY: Your telegram of April 26 to Governor John A. Love has been referred to my office for reply. Your questions are answered in the same order in which they are posed in the telegram:

Colorado has had effective legislation with regard to domestic waste treatment facilities and as a result *all such sources of discharge* into both intrastate and inter-state waters of the State *have been identified.* At present, it is estimated that 95% of Colorado's population of 2.2 million is presently connected to some type of a municipal sewer system. By the end of this calendar year we hope that 100% of those connected to a municipal sewer system will have adequate waste treatment facilities in the form of secondary treatment with disinfection. Adequate legislation with regard to industries has only been in effect since 1966. However, we are notified by our Water Pollution Control Division that, again, by the end of this calendar year all manufacturing and food processing type industries will be in compliance with State Standards by providing adequate waste treatment facilities. This latter category does not include wastes discharged to streams as a result of mine drainage, or the effect that irrigation return flows have on the streams of Colorado.

It is estimated that there are some 2,000 feedlots in Colorado. A survey conducted a year or two ago by a member of the Water Pollution Control Division located 800 of these feedlots. The former Deputy Director of Mines for the State of Colorado estimates that there are some 30,000 mines in Colorado. Most of these, of course, are abandoned. *How many of these may be contributing to pollution of our State waters is not known at this time.* Limited studies have been made by both the staff of the Water Pollution Control Division and Federal water pollution people. The staff of the Water Pollution Control Division feels that this type of inventory lends itself towards contractual work with one of our universities to have college students conduct such a mine drainage inventory during the summer months. Funds have been requested for such a study and at this time it looks as though the Legislature will look favorably upon the appropriation of such funds. It is estimated that such a study will take *three or four summers* at a cost of about *$20,000* per summer. Some states have obtained such an inventory with the minimum of expenditure and a minimum of time by merely requiring registration of all such feedlots and mine drainage facilities. Of course, to make any such law effective, it is necessary that there be a stiff penalty involved for failure to register such a discharge. A concentrated enforcement effort is presently underway with regard to feedlot wastes. Once this prob-

lem is resolved the efforts of Water Pollution Control Division will be concentrated on the mine drainage wastes.

Again the nature and quantities of all domestic waste treatment facilities have been identified and, in most cases, those for industrial facilities in the manufacturing and food processing industries have also been identified. The recent resurrection of the 1899 Refuse Act should give us a better insight as to just how adequately we have been able to keep up with an inventory of these discharges and the nature and quantity of these discharges.

Again, we are lacking in having the nature and quantity of discharges from mine drainage, feedlots and irrigation return flows. At this time we have no idea what it would cost to obtain this data or how long it would take. We do know that our Laboratory at present is working at maximum capacity. To require them to conduct further analyses on the scale that would be needed would require both enlargement of the Laboratory and an increase in the personnel. This is also true within the Water Pollution Control Division with regard to technicians who would be required to sample all of these outfalls.

Water Quality Standards, which have been approved by the Environmental Protection Agency without exceptions, are in effect for all of our receiving waters and there is no differentiation in Standards for intra-state waters or inter-state waters.

Colorado's Water Pollution Control legislation does allow the setting of effluent standards only when stream Standards are being exceeded. A committee is presently engaged in the preparation of effluent standards. It is assumed that these proposed effluent standards will set specific limits for specific pollutants. Colorado is, I understand, one of six states in the nation that does not have a permit system for its waste discharges.

Performance of all waste treatment facilities, both municipal and industrial, are checked periodically by the staff of the Water Pollution Control Division to determine whether they are getting the percent of removal required in our Water Quality Standards. Regulations are presently being proposed by the Division to require mandatory testing and analyses for operational control within these waste treatment facilities. Such results would have to be reported to the State on a monthly basis.

It is our sincere hope that effluent limitations will serve to enhance or achieve our Water Quality Standards as set by the Commission for the various streams in Colorado.

Sincerely,

ROY L. CLEERE, M.D., M.P.H.,
Executive Director.

CONNECTICUT

TELEGRAM

My water resources commission informs me that they have identified all sources of discharge into inter-state, intra-state, and coastal waters. The general nature and quantity of each effluent is known and available.

Water quality from all receiving waters have been established and approved by the Federal Government. They approve the treatment facilities rather than the effluent standards. The approved facilities are those which will provide a degree of treatment that is presently technologically feasible. All discharges are under order or in conformance with a permit.

During the present construction period, monitoring is not systematic but only as required to answer specific questions. The effluent treatment recently completed, now under construction, or to go under construction in the immediate future will enhance the quality of our receiving waters.

THOMAS MESKILL,
Governor of Connecticut.

DELAWARE

STATE OF DELAWARE,
EXECUTIVE DEPARTMENT,
Dover, Del., May 11, 1971.

Mr. CHARLES A. BYRLEY,
National Governors Conference,
Office of Federal-State Relations, Washington, D.C.

DEAR CHARLEY: The following answers are submitted in reply to your telegram:

1. Have you identified all sources of discharge into interstate, intrastate and coastal waters?

Answer.—Delaware has identified the sources of discharge into its waters.

2. Have the nature and quantities of effluent from each source been identified?

Answer.—The nature and quantity of sources have been identified.

3. Do you have water quality standards for the receiving waters into which each of these sources discharge?

Answer.—Water quality standards have been established for all Delaware waters. Delaware standards are slightly more stringent than our upstream neighbors.

4. Do you have effluent standards or limitations for each individual source of discharge? Are your standards or limitations quantified as to specific amount and specific pollutant? Do you have a permit or similar system? Is the performance of such sources monitored? If not, how long and how much?

Answer.—While we do not have an effluent standard as such, a discharge loading is assigned to control the pollutant or pollutants discharged. All major sources and all major stream basins are monitored at least twelve (12) times a year. Special studies follow any sampling that shows unusual or noncompliance values.

5. Will these effluent limits maintain, enhance or achieve water quality standards?

Answer.—The treatment requirements contemplated will enhance water quality.

Should you desire additional information, please do not hesitate to contact us.

Sincerely,

RUSSELL W. PETERSON,
Governor.

FLORIDA

STATE OF FLORIDA,
DEPARTMENT OF AIR & WATER POLLUTION CONTROL,
Tallahassee, Fla., April 27, 1971.

MR. CHARLES A. BYRLEY,
Office of the National Governors' Conference,
Washington, D.C.

DEAR MR. BYRLEY: Reference your telegram of April 26, 1971 addressed to Governor Askew. He has asked this agency to reply to your questions.

1. A considerable number of sources of discharge have been identified. We estimate that the remainder will be identified, in detail, by September or October 1971.

2. Our comprehensive permit system will provide information about the nature and character of these effluents. It is difficult to estimate the cost as a separate item, but the work time of about 50% of our field staff has been involved in this matter. As a quick, rough estimate, the total cost to identify and process permits was about $706,800 for the fiscal year 1970–1971.

3. We have water quality standards for all receiving waters, by class. A copy of 17–3 FAC and a copy of the latest classification are attached.

4. The limitations are based on a minimum of 90% treatment efficiency. If the receiving waters are limited, higher efficiencies can be and are required including a prohibition against discharge into a body of water which can not assimilate waste. Each discharge is considered with respect to possible pollutants. Each discharger is required to monitor his discharge and report, subject to checking by this agency.

5. The State of Florida is committed to maintain, protect, and enhance its waters as rapidly as possible.

If we can be of further help, please let us know.

Sincerely,

VINCENT D. PATTON,
Executive Director.

GEORGIA

EXECUTIVE DEPARTMENT,
Atlanta, Ga., May 3, 1971.

Hon. CHARLES A. BYRLEY,
National Governors' Conference
Office of Federal-State Relations
Washington, D.C.

DEAR CHARLES: Listed below are the answers to the five questions posed in your earlier communication:

1. Yes, practically speaking, all sources of wastewaters, municipal and industrial, have been identified for intrastate, interstate and marine waters.

2. Volume and characteristics of effluents and other information needed to design and implement adequate abatement programs have been established.

3. Receiving water criteria were adopted in 1967 after 10 public hearings throughout the State; these were approved by the U.S. Interior Department on July 24, 1967.

4. Effluent standards (treatment requirements) were established by the State Water Quality Control Board in March 1965. The basic requirement was secondary (biological) treatment or equivalent; degree of oxygen demand reduction was set as 85 to 95 percent depending on stream flows, downstream uses, nature of pollutants, etc. Georgia has a dual permit system, for construction and operation (discharge) of waste treatment facilities. Each discharge must be considered on an individual basis in regard to specific pollutants and pollution load permitted to stream. Discharges are monitored and daily operating reports are required.

5. Effluent standards enhance and maintain water quality depending on the need for protection and preservation of the particular water resource.

If you need additional information, please feel free to call on me.

Sincerely,

JIMMY CARTER.

HAWAII

EXECUTIVE CHAMBERS,
Honolulu, Hawaii, May 4, 1971.

DEAR MR. BYRLEY: The following information is submitted in response to your cable of April 26, 1971.

1. All discharges into coastal waters which includes intrastate waters, have been documented under provisions of State Department of Health regulations.

2. The nature and quantities of the effluents discharged into receiving waters have been identified as required to meet both State and Federal standards. There are a few dischargers who have chemical analysis pending on their discharges and these will be provided to the State when completed.

3. Receiving waters have been classified into separate categories based on beneficial uses and the effluents discharged into receiving waters must be treated in accordance with the requirements for each category.

4. Existing regulations governing effluent discharge are directed towards the receiving waters, rather than the discharge. As such, each discharge is listed as to source, composition, degree of treatment, and quantity. There are no limitations on volume or composition so long as the discharge meets the receiving water standards. The system under which the discharges are administered is a permit system which provides for corrective measures to be taken for those discharges not meeting receiving waters standards. The application for a valid permit under this system will include a timetable for implementation required to treat the effluent so that it meets the water quality standards for the receiving body. Periodic monitoring by the water pollution control branch of the applicant's program of correction is carried on during the implementation phase. If he is found derelict in his performance, his permit is revoked, placing his discharge in violation.

5. Enforcement is provided for in the water quality regulations, and the State's goals of enhancement and preservation of the receiving waters surrounding our State can be accomplished through these regulations.

Aloha, and may the Almighty be with you and yours always.

Sincerely,

———— ————.

IDAHO

STATE OF IDAHO,
OFFICE OF THE GOVERNOR,
Boise, Idaho, April 28, 1971.

Mr. CHARLES A. BYRLEY,
National Governors' Conference,
Office of Federal State Relations,
Washington, D.C.

DEAR MR. BYRLEY: In answer to your message of April 26, 1971, which we received yesterday we have been able to ascertain the following:

1. Most point-source discharges into interstate and intrastate waters have been identified. The effects of agricultural drainage, irrigation return water, storm water, construction projects, logging operations and some mining operations have not been determined in a quantitative manner. A general inventory of

such diverse activities would require at least two years and the cost would exceed $100,000.

2. The nature and quantity of all major point-source effluents have been determined. Non-point source drainage from a variety of activities has not been quantitated. Such a determination would require five years and the cost would exceed $500,000.

3. Idaho has water quality standards for interstate and intrastate waters. Intrastate standards are slightly more stringent than interstate standards.

4. Idaho does not have effluent standards. A permit system is currently under development. Implementation of the permit system will require a yearly budget increase of at least $50,000.

5. Effluent limits will maintain the quality of some waters and enhance the quality of others.

We hope this information will be of help to you. Let us know if we may be of further assistance.

Sincerely,

CECIL D. ANDRUS,
Governor.

ILLINOIS

STATE OF ILLINOIS,
OFFICE OF THE GOVERNOR,
Springfield, Ill., May 4, 1971.

Mr. CHARLES BYRLEY,
National Governors' Conference
Washington, D.C.

DEAR CHARLEY: The attached memorandum is in specific response to your telegram of last week regarding pending water pollution control legislation. Please use this information as you see fit in your efforts for the states on the Hill.

Sincerely yours,

RICHARD B. OGILVIE,
Governor.

cc–Mr. Thomas Corcoran

MEMORANDUM

Subject: Response to telegram request by National Governors' Conference for information with respect to pending water pollution control legislation.

The following paragraphs provide the answers requested in the above referenced telegram. The numbers on the paragraphs correspond to the numbered questions contained in the telegram.

(1) The Illinois Environmental Protection Agency has identified all consequential industrial and municipal sources of discharge into interstate, intrastate and coastal waters. The Agency has not identified all sources of agricultural and natural discharges. It is impossible to estimate the time and cost to identify the latter sources. Such sources, however, do not represent immediately pressing problems.

(2) The Illinois Environmental Protection Agency has identified the nature and quantities if the chemical, physical, and biological constituents of all significant sources of pollutional discharge. Newly identified pollutants, such as mercury and selenium, are presently undergoing an initial source monitoring. To monitor and analyze all constituents for all points of discharge in a routine semi-annual or quarter-annual basis will require a major expansion of the Agency's field surveillance staff and laboratory facilities. A rough estimate of the cost is approximately $200,000 for laboratory services alone.

(3) The State of Illinois has comprehensive Water Quality Standards for the receiving waters into which each of these sources discharge. The standards differ according to whether the waters are intrastate or interstate, and further distinctions are made depending in the usage of the stream and on a basin or watershed basis.

(4) The State of Illinois presently has effluent guidelines for each individual source of discharge. These guidelines are quantified as to specific concentrations and specific pollutants. In addition, the Illinois Pollution Control Board and Illinois Environmental Protection Agency are currently developing a new and more comprehensive set of effluent regulations. The Illinois Environmental Protection Agency administers a comprehensive permit system for all pollutional discharges. The performance of such sources is minitored on at least an annual basis; additionally, there is a mandatory reporting system required of each permit holder.

(5) The Illinois Environmental Protection Agency is vigorously enforcing all Illinois water pollution control laws. The current effluent guidelines, and to a greater extent the proposed effluent regulations, will maintain, enhance and achieve the Illinois Water Quality Standards.

INDIANA

STATE OF INDIANA,
STREAM POLLUTION CONTROL BOARD,
Indianapolis, Ind., June 4, 1971.

Re Water pollution control program, Indiana.

Hon. EDMUND S. MUSKIE,
Chairman, U.S. Senate Subcommittee on Air and Water Pollution,
Washington, D.C.

DEAR CHAIRMAN MUSKIE: Your telegram of May 28, 1971, to Governor Whitcomb, which posed five questions about our water pollution control program, has been referred to this office for reply.

The following responses are in reply to your numbered questions:

1. Indiana has not identified *all* sources of discharge into interstate and intrastate waters. Most of the significant sources have been identified and timetables have been established for control programs and/or enforcement actions for correction of discharges where required to maintain Water Quality Standards. The applications filed for discharge permits under the 1899 Refuse Act will identify industrial outlets that may not presently be listed. It is anticipated that all significant discharges will be listed in fiscal 1972 and that the cost of accumulating and assembling the data will be in the range of $50,000.

2. The nature and quantities of the effluent from each source, where not presently available, will be obtained in connection with item 1 at little additional cost.

3. Water Quality Standards have been adopted for all of Indiana waters. Standards for intrastate and interstate waters are identical with the exception of the Lake Michigan-Calumet Area where standards have been adopted for specific waters.

4. Effluent standards have not been adopted. Plans for treatment facilities are reviewed with respect to anticipated effluent characteristics and the effect on the receiving waters. Indiana does not have a permit system. Operation reports are required and field investigations are made to determine the effect of discharges on receiving waters. A water quality monitor program with nearly 100 stations that are sampled every two weeks has been in effect since 1957. Automatic robot monitor stations are being installed on major streams.

5. Indiana Water Quality Standards will enhance water quality in existing streams in areas of substantial population and/or industrial development and maintain existing high quality in more sparsely developed areas.

Very truly yours,

PERRY E. MILLER,
Technical Secretary.

IOWA

OFFICE OF THE GOVERNOR,
STATE CAPITOL,
Des Moines, Iowa, May 5, 1971.

MR. CHARLES BYRLEY,
Director, Federal State Relations, National Governors' Conference, Washington, D.C.

DEAR MR. BYRLEY: In answer to your telegram of April 26th, I submit the following:

1. All sources of discharge into interstate and intrastate waters have *not* been identified. With present staff, the identification of all sources of significant discharge could not be accomplished. We estimate that it would require 6 man-years to accomplish this identification. Estimated cost of this identification is $75,000.

2. Naure and quantity from each source have not been identified. If the nature of effluent is to be determined in relative strengths or concentrations as detailed in Part 601.32(3) of Title 18—"Conservation of Power and Water Resources," Federal Register 35:128, July 2, 1970, we estimate this determination will require 8 man-years and cost $150,000.

3. We have water quality standards for receiving waters. There is no significant difference between standards for interstate and intrastate waters.

4. We do not at present have effluent standards or limitations for each individual source of discharge. Effluent limitations exist for wastewater treatment plants constructed after 1949.

Limitations are quantified to both specific amount and specific pollutant.

We have a permit system.

Performance of such sources is monitored by their being required to submit operation reports monthly, submit effluent samples quarterly and undergo inspection.

5. In most cases, effluent limitations maintain water quality standards.

Sincerely,

ROBERT D. RAY,
Governor.

KENTUCKY

WATER POLLUTION CONTROL COMMISSION,
Frankfort, Ky., April 30, 1971.

Mr. CHARLIE BYRLEY,
Director, Federal State Relations, National Governors' Association, Washington, D.C.

DEAR MR. BYRLEY: In response to your telegram of April 26, 1971, to Governor Nunn relative to the request of the Senate Sub-Committee on air and water pollution, we are submitting the answers to your question in the order requested.

1. All significant sources of discharge have been identified on interstate and intrastate streams.

2. The general nature and quantity of effluent from each of the approximately 500 discharges in Kentucky are known. Testing for chemical trace constituents and bioassay requirements on each discharge has not been accomplished due to the lack of resources. In order to close the trace constituent gap in each discharge and to fulfill requirements for bioassay in the State of Kentucky the following resources would be required. To carry out the work enumerated above a capital cost of $85,000 and, an operating cost of $125,000 per year would be required.

3. Water quality standards have been adopted for interstate streams. Standards for intrastate streams are under consideration and it is anticipated such standards will be adopted this year. Do not expect substantial differences between interstate and intrastate standards.

4. Effluent standards are presently under consideration by the Kentucky Water Pollution Control Commission for all source discharges. Generally limitations on quality of effluent are tied to the quality of the receiving stream through the permit system. Kentucky does have a mandatory permit system. Monitoring of sources is restricted due to staff limitations. Additional Federal funds to support State program activities can be used to increase monitoring programs. Consideration should be given to Federal funding of States activities associated with new Federal programs, such as the Refuse Act of 1899 and the comprehensive basin planning requirements for construction grants eligibility.

5. Effluent standards and water quality standards will enhance the quality of water of the Commonwealth.

Sincerely yours,

W. W. SMITHER,
Acting Director, Division of Water Pollution.

LOUISIANA

STATE OF LOUISIANA STREAM CONTROL COMMISSION,
Baton Rouge, La., April 28, 1971.

Mr. CHARLES A. BYRLEY,
Director, National Governors Conference, Office of Federal-State Relations, Washington, D.C.

DEAR MR. BYRLEY: Your telegram of April 26, 1971, to the Governor of the State of Louisiana, John J. McKeithen, has been referred to this office for response.

1. We have identified 90 to 95 per cent of all industrial waste discharges in Louisiana; this includes ALL of the major discharges to interstate, intrastate and coastal waters.

2. The nature and quantities of effluents for each industry are known in virtually every instance, except for some of the very small discharges.

3. We have adopted water quality standards for ALL surface waters in Louisiana. Three of the water quality standards adopted are awaiting approval

by the Federal Water Quality Office, Environmental Protection Agency. They were adopted by this agency in July 1970; apparently, the reason for the delay in approving these standards is known only by the Washington office of EPA.

4. There are NO differences between standards for intrastate waters as compared to interstate waters.

5. Effluent Standards: (a) There are no effluent standards, per se, except for waste discharges from raw sugar factories—implementation has been difficult.

(b) All other effluent limitations are implemented on an individual basis. It would, for example, be almost impossible to develop effluent standards for petrochemical plants due to the extreme variance of types of materials encountered in the individual effluents. (See Exhibit A.)

If we are required to develop effluent standards as would be provided in S. 523, it would be very difficult, and in some cases impossible. We feel that we should be permitted to implement the specified level of waste treatment that has been promulgated without complicating the picture by introducing effluent standards.

6. Louisiana operates on a permit system that requires: (a) complete description of waste discharge, (b) a physical description of waste discharge, and (3) a complete comprehensive narrative description of waste treatment facilities. (A specified level of treatment, secondary or its equivalent, has been ordered not later than December 1972.)

7. Individual sources are monitored, to the extent of our capabilities, along with our statewide water quality monitoring program.

We believe that we can successfully achieve our water quality standards.

With respect to funds expended for our total efforts in the area of industrial wastes, our 1970–1971 budget is approximately one-third of a million dollars; $185,000 are identified as Federal funds, Section 7, P.L. 660.

Very truly yours,

ROBERT A. LAFLEUR, *Executive Secretary.*

MAINE

STATE OF MAINE,
OFFICE OF THE GOVERNOR,
Augusta, Maine, May 17, 1971.

Mr. CHARLES A. BYRLEY,
National Governors' Conference,
Office of Federal-State Relations, Washington, D.C.

DEAR MR. BYRLEY: I requested the State's Environmental Improvement Commission to answer your recent request relative to this State's water pollution control laws. They have answered your questions categorically as follows:

1. Yes.

2. Yes. However, information needs updating and must be re-inventoried in greater detail. If it were to meet the new Corps requirements it would take approximately six man years at a cost of approximately $50,000 plus their maintenance at an additional $50,000.

3. First part of question yes; second part of question no.

4. New waste discharges require licensing. Licenses contain conditions relative to quantity and quality of allowable discharges. Older existing discharges have Grandfather licenses. This license contains no conditions and is limited only in respect to the discharge not violating established water quality standards. Legislation is being sought to license all discharges and if passed all effluents would be limited in quantity and characteristics. Waste discharges are presently being monitored only on a spot check basis. Agency staffing does not allow monitoring on a regular basis. If regular monitoring were necessary, we would need a minimum of ten new permanent people at an annual cost in the order of $150,000.

5. Present State law has sufficient enforcement provisions to achieve and maintain water quality standards.

I sincerely hope that the answers provided by the Environmental Improvement Commission will meet your immediate needs in regard to proposals for new water pollution control legislation.

Sincerely,

KENNETH M. CURTIS,
Governor.

[Telegram]

MARYLAND

MAY 4, 1971.

Mr. CHARLES A. BYRLEY,
Director, National Governors Conference, Office of Federal-State Relations, Washington, D.C.

Responses to your inquiries about air and water pollution activities in Maryland are numbered to correspond to five specific questions in telegram as follows:

1. Maryland has identified all significant sources of discharges into interstate, intrastate and coastal waters. Action to control the lesser comparatively insignificant discharges is now under way and will be completed within the next 3 to 5 years. The cost for complete identification of all discharge sources and to implement corrective action is estimated at $300,000.

2. The quality and quantity of effluent discharges from all significant sources is known at the present time.

3. Maryland has established as of 1967 specific water quality standards and general water quality criteria for all of the waters of the State. Therefore standards have been established for all receiving waters into which all sources discharge. Maryland's water quality standards were established for both intrastate and interstate waters.

4. Maryland has established, by regulation, effluent standards for industrial wastes and has, furthermore, committed itself to requiring that all sanitary sewage receive secondary treatment, and that all industrial wastes receive treatment, which, at the minimum is equivalent to secondary treatment. Generally applicable numeric values limiting the concentration of specific parameters are established for solid matter, turbidity, biochemical oxygen demand, color, ph, temperature, oils and grease, taste and odor in effluents from industrial operations. In addition, toxic compounds in effluents must be eliminated or reduced to limits of tolerance for humans, livestock, fish, aquatic life and wildlife. The State is now in the process of establishing a discharge permit regulation, which has been subjected to a public hearing on April 12, 1971 and will be promulgated within the next several months. The State is monitoring all significant sources, and is also performing detailed points of discharge evaluations.

5. Yes.

MARVIN MANDEL,
Governor of Maryland.

STATE OF MARYLAND EXECUTIVE DEPARTMENT,
Annapolis, Md., June 17, 1971.

Hon. EDMUND S. MUSKIE,
Chairman, Subcommittee on Air and Water Pollution, Committee on Public Works, U.S. Senate, Washington, D.C.

DEAR ED: I am sending letters to the other members of your subcommittee on Air and Water Pollution about the special problems of the Washington, D.C. area. I hope that you will be able to give this matter your personal attention, since it is of the utmost importance to my State.

You undoubtedly know that because of deficiencies in the sewer system and tardiness in expanding and improving the Blue Plains wastewater treatment plant, a sewer emergency of grave consequences exists in the metropolitan Washington area.

Quite frankly the problem is money and, more specifically, Federal money to finance the Federal share and to pay the District of Columbia's share of the cost. After 15 years of tedious talk and repetitive sessions of a marathon federal enforcement conference, it has been determined that improvements at the Blue Plains wastewater treatment plant will cost $250,000,000 over the next two fiscal years. I am advised that this cost is probably underestimated and realistically we can look forward to expenditures approaching a half billion dollars.

Much of this cost can be attributed to the desire of the Federal officials to make the Blue Plains plant a model for the nation and the steadfast refusal of the Department of the Interior to permit a fill in the adjacent flats of the Potomac River to provide space for plant expansion. Those Federal policy decisions dictate the use of expensive, untried sewage treatment processes which account for the major share of the cost of expansion.

While Maryland and her political subdivisions have been and are prepared to pay their fair shares, appropriations and allotments of Federal construction grant monies have never been large enough to even come close to the Federal

share. At the presently authorized 55% Federal grant, the Federal share would be about $138 million just to cover the conservative estimate of the FY72–FY73 expenditures of $250,000,000 for the Blue Plains improvements alone. In addition to the Blue Plains improvements, a vital section of the main sewer leading to the plant—the "Georgetown gap"—has never been constructed and this too must be financed to stop the spillage of raw sewage before it reaches the plant.

I recognize that you cannot give special consideration to every metropolitan area, but the Nation's Capital is different in that Congress has given it special consideration and guided its sewerage policy for more than half of a century. Congress wisely discouraged the construction of sewage treatment plants in the Maryland metropolitan area that would drain effluent through the District of Columbia. Congress reacted to the threat of sewage discharges above Washington, D.C. by authorizing and financing the construction of the Dulles Interceptor sewer. That sewer picks up sanitary waste from as far away as Dulles Airport and conveys it into the District for treatment at Blue Plains.

These measures have afforded protection to the upper Potomac River and the creeks flowing through the parks of the District. But, because sewers in the District have not been completed and because improvements at the Blue Plains plant have lagged far behind the demand placed on it, the lower Potomac as it flows through the District and into Maryland is severely polluted. As a desperate emergency measure of last resort to protect public health and prevent further pollution of the Potomac, Maryland has placed a ban on authorizations for new sewer connections that would increase the Blue Plains loading. The ban is causing major economic hardships and denying sorely needed homes and facilities. Obviously this cannot be maintained as a permanent policy.

I understand that the Committee is considering legislation which would establish the Federal share as 75% of the grant eligible cost, provide funding authority at an adequate level of several billion dollars per year, and give the Administrator of the Environmental Protection Agency discretionary authority to use unobligated funds to increase the allotment to states to cover special needs. I urge the Commitee and Congress to act favorably on these long overdue measures, but I also urge you to take a further step.

I would ask you to incorporate specific language directing the Administrator of EPA to authorize full funding of the improvements needed in the Nation's Capital. The improvements here are of such magnitude and of such importance to the nation that they should not be dependent on annual variations in the amount of unobligated funds nor on the discretion of the Administrator, but should be mandated by the Congress itself. I appreciate your consideration in this very important matter.

Sincerely,

MARVIN MANDEL, *Governor.*

MASSACHUSETTS

R. DEANE CONRAD,
Special Assistant, Counsel of State Governments,
Washington, D.C.

DEAR DEANE: Our replies to the five questions asked by the Air and Water Subcommittee staff members are as follows:

(1) We have identified all of the significant sources of municipal and industrial pollution in the Commonwealth except for one coastal city where there is an industrial survey being performed at this time. It should be pointed out that the municipal and industrial pollution problem is a continuing one and requires constant surveillance by our regional offices.

(2) The nature and quantities of the effluent from the majority of sources in the State have been documented in engineering reports that have been submitted to this Division for approval. Since 1967, 115 municipal engineering reports have been reviewed and approved and 369 industrial reports evaluated and approved. Each of these included information on the nature and quantities of all effluents.

(3) We have water quality standards for all interstate, intrastate, and coastal and marine waters.

(4) Effluent standards and limitations for individual sources have been set where basin plans have been prepared. Again, this is a continuing program and the basin plans according to Federal rules and regulations must be completed by 1973. Specific amounts of and limitations on individual pollutants are set

where deemed appropriate. The State does have a permit system. Sources are monitored in three ways: a) by requiring monthly reports to this agency; b) by automatic water quality monitoring systems; and c) by stream surveys. In many cases, automatic equipment is required at the municipal and industrial sources. A complete State continuous monitoring program with data logger systems, telemetering or microwave is not contemplated at this time due to the tremendous cost involved.

(5) Effluent limits will achieve the water quality standards and will allow for continued growth by estimated projections that are made in the development of the State's basin plan.

The Division of Water Pollution Control has been designated by the Governor as the agency to prepare the river basin plans in the Commonwealth. I hope that these comments are of some service to you and to the subcommittee.

Very truly yours,

THOMAS C. MCMAHON,
Director.

MICHIGAN

STATE OF MICHIGAN,
EXECUTIVE OFFICE,
Lansing, April 26, 1971.

MR. CHARLES BYRLEY,
Director, Office of Federal-State Relations,
National Governors' Conference,
Washington, D.C.

DEAR MR. BYRLEY: Following are the answers to the questions posed in your telegram of this date regarding Michigan's water pollution control programs:

1. Yes, we have identified all sources of discharge into interstate, intrastate and coastal waters.

2. Yes, the nature and quantity of effluent from each source have been identified.

3. Yes, we have water quality standards for the receiving waters into which each of these sources discharges, with the exception of temperature standards, which will be developed in four months. Our standards for interstate and intrastate waters do not differ.

4. Yes, in most instances we have effluent standards or limitations for each individual source of discharge. Our standards are specific as to amount and pollutant. We do have a permit system and the performance is monitored.

5. The effluent standards include a safety factor so that receiving water quality should be enhanced to a level above water quality standards.

I hope the above information is helpful to you. Please don't hesitate to contact my office if we can be of further assistance.

Kind personal regards.

Sincerely,

WILLIAM G. MILLIKEN,
Governor.

MINNESOTA

STATE OF MINNESOTA POLLUTION CONTROL AGENCY,
Minneapolis, Minn., May 12, 1971.

NATIONAL GOVERNORS CONFERENCE,
Office of Federal-State Relations,
Washington, D.C.

Attn.: Mr. Charles A. Byrley.

DEAR MR. BYRLEY: Your recent telegram to Governor Anderson has been referred to this office for reply. The response to your questions is given below.

1. and 2. Major point sources and the nature and quantities of wastes have been identified.

3. Water quality standards have been adopted covering all waters of the state. There is little difference between standards for inter-state and intra-state waters.

4. Effluent standards have been adopted covering all waters of the state. These standards apply to all discharges. These standards are written in terms of concentrations or quality rather than quantity of specific parameters. This state requires permits for all dischargers. Monthly reports on effluent quality are required, and there is a prorgam to review such reports.

5. The effluent standards will, in most cases, require a higher degree of treatment than would the water quality standards. Where this is not the case, the water quality requirements will prevail.

If you have any further questions, please let us know.

Yours very truly,

GRANT J. MERRITT,
Executive Director.

MISSISSIPPI

STATE OF MISSISSIPPI EXECUTIVE DEPARTMENT,
Jackson, April 30, 1971.

Mr. CHARLES A. BYRLEY,
Director, The National Governors' Conference,
Office of Federal-State Relations, Washington, D.C.

DEAR MR. BYRLEY: In response to your telegram of April 26, this is in answer to your questions in the order asked:

(1) Mississippi's identification of sources of discharge is 25% by numbers, 60% by volume of waste. We estimate that it will take a minimum of two years to complete the identification, but would probably cost $2,000,000 to do it in that length of time.

(2) Identification of the nature and quantities of effluent from each source would be included in the effort required in Number One.

(3) We do have water quality standards for receiving waters. Intrastate and interstate water quality standards are the same.

(4) We do not have effluent standards for each individual source of discharge. We do have limitations in that each individual discharge must receive secondary treatment or equivalent. These limitations are not quantified as to specific amounts and pollutants. We do have a permit system. We do not monitor performance of individual sources. We do require monitoring by the individual where the discharge is significant. It would be extremely difficult to estimate time and money required to set up such a procedure. To do so would require a complete reversal of the program which has existed up to this time and the amount of money involved would be very substantial.

(5) Since we do not have effluent limits, we cannot respond to your question.

Sincerely yours,

JOHN BELL WILLIAMS,
Governor.

MISSOURI

MISSOURI WATER POLLUTION BOARD,
Jefferson City, Mo., June 1, 1971.

Hon. EDMUND S. MUSKIE,
Chairman, Subcommittee on Air and Water Pollution,
New Senate Office Building, Washington, D.C.

DEAR SENATOR MUSKIE: This is in reply to your telegram dated May 28, 1971 to Warren E. Hearnes, Governor of Missouri. Our answers are as follows:

1. Question.—Have you identified all sources of discharge into interstate, intrastate and coastal waters? If not, how long would it take to do it? How much would it cost?

Answer.—While all sources of discharge into waters of the State have not been identified, our records cover approximately 90% of the sources. To be sure that we have information on all discharges would require from 3 to 5 man years with a minimum cost of $50,000.

2. Question.—Have the nature and quantities of effluent from each source been identified? If not, how long would it take and how much would it cost?

Answer.—To identify the nature and source and quantity of all effluents would require 2 years and an expenditure of 1.5 to 5 million dollars depending on the amount of detail required.

3. Question.—Do you have Water Quality Standards for the receiving waters into which each of the sources discharge? If not, how long? And how much? Do standards for intrastate and interstate waters differ?

Answer.—Water Quality Standards have been adopted for all streams in the State of Missouri with no difference as to inter and intra state standards.

4. Question.—Do you have effluent standards or limitations for each individual source of discharge? Are your standards or limitations quantified as to specific amount and specific pollutant? Do you have a permit or similar system? Is the performance of such sources monitored? If not, how long and how much?

Answer.—Effluent Guidelines are the process of being finalized and published. Effluent amounts are used in the review of plans and specifications. Missouri law requires that a construction permit be obtained prior to the installation of any facilities and following the completion an operating permit is required. Effluent sampling is conducted by an estimated 50% of the dischargers in a voluntary program and some stream monitoring is performed routinely by the Water Pollution Board. Additional effluent monitoring is needed with a minimum expenditure of $200,000 per year in addition to the $60,000 for the cost of the present program.

5. Question.—Will these effluent limits maintain, enhance or achieve Water Quality Standards?

Answer.—We expect the Effluent Guidelines to maintain, enhance and achieve existing Water Quality Standards depending on the location and nature of the discharge.

If we may be of further assistance in the future, please advise.

Yours truly,

JACK K. SMITH,
Executive Secretary.

MONTANA

OFFICE OF THE GOVERNOR,
Helena, May 3, 1971.

Mr. CHARLES BYRLEY,
National Governors' Conference,
Office of Federal-State Relations, Washington, D.C.

DEAR MR. BYRLEY: In response to your telegram of April 26, I have had the State Development of Health, our major pollution control agency, answer your questions as follows:

1. No. Only industrial and most sanitary sewage. With sufficient staff this would take about four years and $500,000 to accomplish. Wastes not presently identified are mainly agricultural.

2. No. With sufficient staff this would take about four years and $1,500,000 to accomplish.

3. Yes. Standards for intra and interstate waters are the same.

4. There is secondary treatment requirement for industrial and domestic sewage discharges. Effluent limitations are not quantified in most cases, but will be where there is potential pollution problems as better information is received on limitations which should be imposed. State has permit system for industrial and domestic sewage discharges. Major discharge sources submit monitoring data to state. For the state to do this, it would cost an estimated $100,000 per year and at least an estimated $1,000,000 per year if all sources were monitored by the state.

5. Effluent limits will simplify water pollution control administration. It essentially means monitoring of effluents rather than receiving waters. It will not in all cases maintain, enhance or achieve water quality standards and may place an unnecessary burden on some—particularly small industries, farmers, etc.

If you need additional information, please let me know.

Sincerely,

FORREST H. ANDERSON,
Governor.

NEBRASKA

LINCOLN, *April 30, 1971.*

Mr. CHARLES A. BYRLEY,
Office of Federal-State Relations,
National Governors' Conference, Washington, D.C.

DEAR MR. BYRLEY: The following remarks are in answer to your message of April 26, 1971 requesting information needed to help the U.S. Senate Sub-Committee on Air and Water Pollution in their consideration of pending water pollution control legislation.

1. We have not yet identified all sources of discharge into interstate and intra-state waters. It would take about two years and cost about $100,000 to identify *all* sources of waste discharge in the State. It would take about one year and cost about $30,000 to identify all *major* sources of waste discharge.

2. The nature and quantities of effluent from each waste source have not been identified. This task will involve a considerable amount of sampling and laboratory analysis and require an estimated four years and one million dollars to complete.

3. The State of Nebraska has adopted water quality standards for all intra-state receiving waters into which these sources discharge. Water quality standards for inter-state streams (Missouri River) have been proposed and are currently being reviewed by the U.S. Environmental Protection Agency. The proposed standards were submitted to EPA in November, 1970. If these standards are acceptable, no further time or expenditures would be involved. The present standards for intra-state and inter-state waters are different, however, the proposed standards treat both types essentially the same.

4. We do not have effluent standards for *each* individual source of discharge. The Nebraska Water Quality Standards are quantified as to specific amount on some specific water quality parameters. The State of Nebraska does not have a permit system, although enabling legislation allows for the establishment of such a permit system. Although some water quality monitoring is performed in the State, it would cost nearly $500,000 annually to implement a fairly complete monitoring system for the State's receiving waters and waste discharge sources.

5. Effluent limits will of course help maintain, enhance and achieve water quality standards, however, other factors must also receive consideration.

I hope this information will assist you in briefing the Sub-Committee on Air and Water Pollution.

Sincerely yours,

J. JAMES EXON,
Governor.

NEVADA

THE STATE OF NEVADA EXECUTIVE CHAMBER,
Carson City, May 3, 1971.

CHARLES A. BYRLEY,
National Governor's Conference,
Washington, D.C.

DEAR MR. BYRLEY: In reply to your telegram of April 26, 1971:

1 and 2. No, not according to federal planning guidelines. Three years time required $110,000 for gathering of data and additional $200,000 for completion of planning requirements.

3. Standards have been established on all interstate waters and one intra-state stream. Fifteen thousand dollars ($15,000) over a three year period would be required. The same policy is followed for establishing standards for both interstate and intrastate streams. Standards differ from stream to stream and for different reaches of the streams since the traditional a, b, c, d, classifications are not followed, but standards are established near existing water quality or better than existing water quality to maintain and enhance quality of Nevada's streams.

4. Yes, standards are established for each municipality or industrial source. The effluent standards specify the amount and type of pollutant from municipal and industrial discharges. Yes, a permit system is used. Performance is monitored by the discharger and the water pollution control agency.

5. Yes, the effluent limits maintain, enhance, or achieve water quality standards, except in those instances where natural conditions exceed the desired water quality standards.

Sincerely,

MIKE O'CALLAGHAN,
Governor of Nevada.

NEW HAMPSHIRE

CONCORD, *April 30, 1971.*

Mr. CHARLES A. BYRLEY,
National Governors' Conference,
Office of Federal State Relationships,
Washington, D.C.

DEAR MR. BYRLEY: At your request, listed below are our reactions to your telegram. For your convenience, the comments are arranged in the same order as the inquiry presented on the telegram.

1. For all practical purposes the State of New Hampshire pollution control agency has identified all sources of discharge to intrastate as well as interstate waters, including tidal waters. The legislative classification procedures long ago made it necessary that the Commission and staff provide comprehensive assessment of the extent of pollution problems as well as the costs and methods re-

quired to abate pollution in the surface waters of the state. This, of course, would not mean that every single item of pollution, however small, has been identified and evaluated. During surveillance work, however, field crews do note any new sources or those which may have been inadvertently omitted at the time of earlier studies.

New Hampshire currently plans to expand its monitoring systems and personnel associated therewith in order to protect the very substantial investment made by Federal, state and local governments in pollution control facilities. Overall, New Hampshire is now spending approximately $550,000 annually in program activities and we expect to add anywhere from 12 to 22 more people at a net cost of $130,000 to $240,000 more in connection with our monitoring and inspection programs to keep pace with the growing demands for clean waters. Presently, the Federal Government contributes only $60,000 to $65,000 to aid New Hampshire in facing up to this task of adequate administration and staff for the program. Obviously, under these circumstances, we welcome provisions in Federal legislation now being proposed whereby the grants to the states for program work would be substantially increased to about $20 million per year.

2. The character of waste discharges is well-known with regard to all New Hampshire streams but this is not to say that separated and detailed analytical data are available with regard to each and every source of untreated discharge.

3. The State of New Hampshire does, in fact, have water quality standards for all receiving waters and these have been developed through legislative classifications enacted for each and every stream throughout the state. The work in this area of interest was completed in 1967 and we are now engaged in implementing the terms of the stream classifications by means of treatment plant construction, thus, placing the waters in the duly adopted classification. The remaining estimated eligible cost of municipal treatment facilities alone amounts to $250 million dollars. Obviously, with this investment in prospect, the suggested Federal appropriations in the range of $2 to $2 and a half billion dollars per year is certainly needed. It is significant, too, that an effort will be made to recognize the extent of the problem in establishing grant allocations to the states. Among others, this state has had to delay projects because the magnitude of the control problem was not considered in relation to the amount of Federal funds made available to finance needed facilities.

Referring now to standards or water quality criteria, whichever term is used, those adopted here apply equally whether interstate or intrastate waters are involved.

4. The State of New Hampshire has a permit system which does allow for the setting of effluent requirements in terms of volume of discharge as well as other criteria used in evaluating the character and quality of the wastes. It appears reasonable that the states should attend to this responsibility and make data available to Federal agencies as necessary. On the other hand, it seems to make little sense for Federal agencies to duplicate the process as is now being planned. All municipally-operated pollution control systems are now monitored and reports are compiled monthly for submission to the Commission for record and control purposes. Field personnel in this activity will have to be increased as the growth in municipal plants develops. More significantly, however, we believe that ultimate plants success can be achieved only through complete assumption by the state of full responsibility for planning, financing and constructing interceptor and treatment systems on behalf of our municipalities. This will totally relieve local government of the obligation to fund or construct disposal plants. The costs under this arrangement would be borne entirely through Federal and state grants.

5. Treatment effluent measurements are, as indicated in (4) above, being carried out on a routine basis and this will continue to be the most direct means for evaluating the effect of treatment. Likewise, in this manner, the state agency will be able to record compliance, or lack of it, with water quality standards.

Aside from the foregoing, it would seem in order to register our concern with the pronounced tendency to consolidate more and more control and direction over pollution control programs at the Federal level and thereby weaken the ability of the states to effectively manage important daily operations which are necessary to an on-going and successful pollution control program. Conferring blanket authority on a Federal administrator to impose stringent and unnecessary procedural requirements on state agencies, in order to qualify for grant funds, is highly questionable. Additionally, the Federal pollution control agencies requirements continue to generate increasing amounts of paper work and nonproductive

effort in terms of accounting and auditing procedures, and the legislation currently under consideration enhances the opportunity for even more activity in this area of concern. Therefore, a real effort to define and limit the authority of the administrator should be made. Otherwise, the threat of funds will continue to be an ever present threat to state agency heads trying to cope with Federal directives, which not only are burdensome but subject to frequent changes. One thing is certain, they never are designed to relax undue restraints and restrictions. Proposals for increasing Federal enforcement powers are not considered desirable or necessary. Adequate machinery presently exists whereby the Federal government can, if it so elects, require appropriate compliance by states, municipalities, and industries alike.

Sincerely,

WALTER PETERSON,
Governor.

NEW JERSEY

DEPARTMENT OF ENVIRONMENTAL PROTECTION,
Trenton, N.J., May 28, 1971.

Mr. CHARLES A. BYRLEY,
National Governors' Conference Office of Federal State Relations,
Washington, D.C.

DEAR MR. BYRLEY: This is in reply to your recent communication in which you request information on water pollution matters.

1. We have identified most of the sources of discharge into interstate, intrastate and coastal waters with the possible exception of combined storm sewer discharges. Assuming adequate staffing, to complete this identification would take about one year at a cost of approximately $150,000.

2. Although we have identified the nature and volumes of effluent from most known sources, it would also take at least one year, again assuming adequate staffing, to complete this work at a cost of some $300,000.

3. New Jersey has water quality standards for all of its waterways.

4. We have minimum effluent standards for discharge into all waterways. In certain instances, these standards quantify specific permissible levels while in other areas studies are underway to establish, in an objective fashion, allowable levels. Where wastewater treatment effluents are involved, a permit system has been in effect for many years with each discharge monitored periodically. Those discharges not meeting minimum effluent requirements have been or will be ordered to do so.

5. We consider the establishment of effluent limits to be necessary in order to maintain, enhance or achieve water quality standards.

Very truly yours,

CHARLES M. PIKE,
Director, Division of Water Resources.

NEW MEXICO

ENVIRONMENTAL SERVICES DIVISION,
San Fe, N. Mex., May 4, 1971.

NATIONAL GOVERNOR'S CONFERENCE,
Office of Federal State Relations,
Washington, D.C.

GENTLEMEN: Reference your message to the Governor, State of New Mexico requesting answers to five primary questions. The paragraph numbers shown are keyed to your numbered questions.

1. All municipal and most industrial discharges have been identified. An industrial inventory was recently completed.

2. The nature and quantity of all municipal sources are established. The nature of industrial discharges are known in general terms but the quantity is not. It would take at least two years to actually conduct quantity measurements by two people. An estimated cost for salaries, equipment, travel, per diem and administrative support would be approximately $60,000.00.

3. Water quality standards have been adopted for all interstate and intrastate streams. Standards are the same.

4. Effluent regulations have been adopted which include numerical limitations for specific parameters for *any* effluent discharge. We do not have a permit system.

Our community treatment plants are monitored but we monitor industrial discharges on a problem basis only. To monitor industrial discharges on a year-round basis, for a one-year period, would require approximately $210,000 for field personnel, laboratory support, shipping and equipment, and administrative support. This would include measurement of quantity addressed in paragraph #2.

5. The current effluent regulations plus additional parameter limitations now under consideration should assure maintenance of our water quality standards.

Very truly yours,

JOHN R. WRIGHT,
Executive Secretary.

NEW YORK

STATE OF NEW YORK EXECUTIVE CHAMBER,
Albany, N.Y., June 3, 1971.

Mr. CHARLES A. BYRLEY,
Director, Office of Federal-State Relations, National Governors' Conference, Washington, D.C.

DEAR CHARLIE: Governor Rockefeller has asked me to reply to your telegram of April twenty-seventh requesting answers to specific questions as they relate to water pollution control legislation.

1. Have you identified all sources of discharge into interstate, intrastate and coastal waters?

New York State has a list of 679 unabated polluters. This covers all significant discharges from municipal, institutional and industrial sources but does not include individual residences.

2. Have the nature and quantities of effluent from each source been identified? If not, how long would it take and how much would it cost?

From our list of unabated polluters, we have general information on the types of wastes and quantities. If precise information was needed which would require flow measuring at the site and analyses of the samples collected, we estimate the average cost would be $10,000 per polluter and would probably take six years as it would be necessary to hire consultants to do the work. Thus the total cost would be $6.8 million.

We believe that our current figures will be refined in the next 6 to 12 months due to the certification procedure being pursued by the Corps of Engineers under the 1899 Refuse Act.

3. Do you have water quality standards for the receiving waters?

Yes. New York State started classifying its receiving waters in 1950. The waters are continually being reviewed for reclassification.

4. Do you have effluent standards or limitations for each individual source of discharge? Are your standards or limitations quantified as to specific amount and specific pollutant? Do you have a permit or similar system? Is the performance of such sources monitored? If not, how long and how much?

The New York program is based on stream standards not effluent standards. Under this program a permit is issued to discharge and the specific amount of specific pollutants allowed is spelled out in the permit. The permit also requires the filing or operating reports which include information on the quality of the discharges and their effects on the stream. We have been unable to set up a satisfactory monitoring system to check on the data submitted. A complete analysis of a sample for monitoring purposes, if done in connection with the United States Geological Survey who works on a monitoring program, would cost $200. A program of this type would require 4 to 5 samples per year or $1,000 per outlet. There are about 3,500 outlets in the state that should be sampled on a routine basis for monitoring or a total cost of $3.5 million per year. It would probably take a year to get such an arrangement set up.

5. Will these effluent limits maintain, enhance or achieve water quality standards?

These effluent limitations will maintain or exceed the water quality standards where they are now met and will achieve or exceed (i.e., enhance existing receiving water quality) the standards where they currently are being contravened.

I hope that this information will be of use to you.

Sincerely,

BOB DOUGLASS.

[Telegram]

NORTH CAROLINA

RALEIGH, N.C.

Mr. CHARLES A. BYRLEY,
Office of Federal-State Relations, National Governors' Conference, Washington, D.C.

The following information is furnished in connection with questions raised in your telegram of April 27, 1971. All sources of waste discharges to waters of State have been identified along with the general characteristics and quantities of effluent from each source. Water quality standards have been established for all surface waters and are the same for both interstate and intrastate waters.

Effluent standards are not considered desirable and have not been established; however, a minimum of secondary treatment or better is required at all waste sources. A permit system is employed and all waste treatment facilities that are receiving waters are monitored to determine compliance with standards but increased monitoring needed. Program is designed to achieve and maintain water quality standards under critical temperature and stream flow conditions.

ROBERT W. SCOTT, *Governor.*

NORTH DAKOTA

STATE OF NORTH DAKOTA EXECUTIVE OFFICE,
Bismarck, April 28, 1971.

Mr. CHARLES A. BYRLEY,
National Governors' Conference, Office of Federal-State Relations, Washington, D.C.

DEAR CHARLES: The following answers are in response to your telegram on behalf of the Senate Subcommittee on Air and Water Pollution:

1. *Have you identified all sources of discharge into interstate, intra-state and coastal waters?* Yes.

2. *Have the nature and quantities of effluent from each source been identified?* Nature and quantities from all major sources have been identified.

How long would it take and how much would it cost? It would take approximately one year at a cost between $20.000 and $25,000 to identify minor sources.

3. *Do you have water quality standards for the receiving waters into which each of these sources discharge?* Yes.

Do standards for intra-state and interstate waters differ? Standard is different for each basin.

4. *Do you have effluent standards or limitations for each individual source of discharge?* We have effluent standards on the Red River.

Are your standards or limitations quantified as to specific amount and specific pollutant? Yes.

Do you have a permit or similar system? We do not have a permit system as of now. However, we are instituting a permit system on lagoons effective July 1, 1971.

Is the performance of such sources monitored? Yes, to the best of our ability.

5. *Will these effluent limits maintain, enhance or achieve water quality standards?* Yes.

Sincerely yours,

WILLIAM L. GUY, *Governor.*

OHIO

DEPARTMENT OF NATURAL RESOURCES,
Columbus, May 25, 1971.

WASHINGTON OFFICE OF NATIONAL GOVERNORS' CONFERENCE FOR TRANSMITTAL,
Washington, D.C.

Attention: Mr. Charles A. Byrley.

DEAR MR. BYRLEY: Your recent request for our response to the following are:

(1) Have you identified all sources of discharge into interstate, intra-state and coastal waters? If not, how long would it take to do it? How much would it cost?

Response. All significant sources of discharge have been identified. A continuous program of surveillance to identify new sources is maintained.

(2) Have the nature and quantities of effluent from each source been identified? If not, how long would it take and how much would it cost?

Response. Yes. For the majority the remainder in about six months with the possible exception of the Mahoning River system.

(3) Do you have water quality standards for the receiving waters?

Response. Yes. All but minor tributaries to the Ohio River. Interstate and intra-state standards are similar.

(4) Do you have the effluent standards or limitations for each individual source of discharge? Are your standards or limitations quantified as to specific amount and specific pollutant? Do you have a permit or similar system? Is the performance of such sources monitored? If not, how long and how much?

Response. We have no effluent standards. We have a permit system requiring monthly reporting and monitoring.

(5) Will these effluent limits maintain, enhance or achieve water quality standards?

Response. No. We have no effluent standards.

Should you need additional information, please feel free to request it.

Very truly yours,

WILLIAM B. NYE,
Director.

OKLAHOMA

STATE DEPARTMENT OF HEALTH,
Oklahoma City, Okla., June 9, 1971.

SENATE SUBCOMMITTEE ON AIR AND WATER POLLUTION,
New Senate Office Building,
Washington, D.C.

Attention Miss Ann Garrabrant.

DEAR MISS GARRABRANT: The following is to confirm the information given you by telephone June 9, 1971, in response to a request from Governor Hall's office to provide information for the Subcommittee on Air and Water Pollution relative to five specific questions:

1. Have you identified all sources of discharge into intrastate and interstate waters? If not, how long will it take and how much cost?

Virtually all major point sources of waste discharges have been identified and probably 80 to 90 percent of the lesser significant point sources are identified. Unidentified sources would be primarily those which discharge to storm sewers or drains in metropolitan areas and isolated discharges in counties not covered by county health departments. Considerable effort would be required to document these remaining sources. It is estimated that three to five man-years, salary and travel would be required. Estimated cost—$45,000 to $75,000.

2. Have nature and quality of each source been identified? How long will it take and how much cost?

Considerable data are available on the major sources of waste discharges, however, the number of parameters identified would generally fall short of the number of parameters now requested in the federal regulations. Only a small amount of data for the individual point sources which may discharge to storm sewers or drains within metropolitan areas would be available. Because of the high cost of proper collection, transportation and laboratory analysis of samples, considerable expense would be involved with the ultimate cost based on the number and kinds of parameters to be evaluated. Three to six man-years would probably be required to develop background data on the discharges. The estimated cost for salaries and travel and laboratory equipment would range from $50,000 to $100,000.

3. Do you have water quality standards for the receiving waters into which all these sources discharge? If not, how long and how much? Do standards for interstate and intrastate differ?

Water quality standards are applicable to both interstate and intrastate waters. It should be noted, however, that the water quality standards are developed in 1965 and 1966 pursuant to the Federal Water Pollution Control Act as amended are based on instream standards. The current trend seems to be from reliance on in-stream standards to a greater degree of confidence in effluent standards. The Health Department has historically administered a program largely based on effluent standards which is controlled by minimum design requirements for treatment facilities. The State Water Resources Board is currently in the process of developing effluent guidelines for industrial wastes which are not discharged through municipal systems. The State Corporation Commission is also considering development of effluent standards.

As enforcement agencies begin to rely on effluent standards for the control of pollution, rather than in-stream standards, there will be a growing necessity for upgrading the water quality standards as originally adopted. Such effluent standards, in all probability, will vary from basin to basin, depending on beneficial uses to be made of the waters of the basin which in turn are dependent upon the water quality management plan for the basin. Thus, the completion of Items 1 and 2 appears to be a necessary prerequisite to substantial standards modifications. Personnel time and effort associated with the re-drafting and modification of standards will be a continuing activity and will probably require the equivalent of two full time persons having considerable expertise in water quality management. The cost for this activity would probably range from $30,000 to $40,000 per year over a two- or three-year period.

4. Do you have effluent standards or limits for each individual source of discharge? Are your standards or limitations qualified as a specific amount and specific pollutant? Do you have a permit or similar system? Is the performance of such sources monitored? If not, how long and how much?

As previously stated, the State Department of Health has issued permits for discharges from municipalities and is authorized and required to review plans and specifications prepared by consulting engineers for conformity with minimum design requirements for specific wastes prior to issuance of such permits. The State Water Resources Board and the State Corporation Commission, which have jurisdiction over industrial wastes not discharged through municipal systems, in general require that effluent discharges meet the water quality standards. As indicated, these agencies are at present giving consideration to the establishment of certain limits on effluent quality.

The existing water quality standards do not for every parameter establish numerical values or limits on pollutants. Under the authority vested in the Commissioner of Health, the State Department of Health is presently establishing numerical limits for certain parameters, such as nutrients, in critical basins and it is anticipated that this procedure will continue until a general upgrading of discharge requirements from municipal wastes throughout the state has been achieved.

The waste discharges are monitored by the agency having jurisdiction. Operating reports from industry and municipalities are required. Agency representatives collect samples for analysis. The monitoring effort for municipal wastes is currently being expanded through the establishment of county health department laboratories and through recently adopted requirements for minimum tests to be made at the plant by the operational staff. This program should be expanded, particularly at the local and county level, wherever possible. The cost of a monitoring program will be great and therefore monitoring should be limited to those parameters essential for the administration of an effective program. The cost could vary from $100,000 to $500,000 per year, depending on the number and frequency of parameters that may be required by some agencies. $100,000 to $200,000 per year added to this program would be of tremendous assistance.

5. Will these effluent limits maintain, enhance, or achieve water quality standards?

As a minimum, the effluent standards would be established to maintain existing water quality standards and through upgrading of requirements, particularly on the smaller intrastate streams which during dry weather carry predominantly waste effluents, are expected to result in considerable enhancement of water quality conditions across the state.

Sincerely,

LOYD F. PUMMILL,
Deputy Commissioner for Environmental Services.

OREGON

DEPARTMENT OF ENVIRONMENTAL QUALITY,
Portland, Oreg., April 29, 1971.

NATIONAL GOVERNORS' CONFERENCE,
Office of Federal-State Relations,
Washington, D.C.

GENTLEMEN: We are pleased to submit the following information in response to your questionnaire.

1. To the best of our knowledge we have identified all point sources of discharge into the interstate, instrastate and coastal waters of Oregon. There may be a few minor ones that we do not know about but, if so, they are of little significance.

2. We have identified the nature and quantity of the effluents from all major sources and from most of the minor sources. Those that have not been fully identified are not significant sources of pollution. We are continually working to get them all identified.

3. We have comprehensive water quality standards for all receiving waters into which these sources discharge, including interstate, intrastate and coastal waters. Our standards for intrastate and interstate waters do not differ. They were developed specifically for each river basin with no regard as to whether it was interstate or intrastate.

4. We have effluent standards or limitations for each discharge which are set forth in the respective waste discharge permits issued by our department. In each case where it is significant the limitation is quantified as to specific amount and specific pollutant.

Since January 1, 1968, we have had a comprehensive waste discharge permit program in operation. It was authorized by the 1967 Oregon Legislature. It covers all sources, both municipal and industrial, and all activities which may affect water quality. The performance of such sources is monitored.

5. The effluent limits which we have established will maintain, enhance and achieve water quality standards.

Very truly yours,

KENNETH H. SPIES,
Director.

RHODE ISLAND

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS.
Providence, May 4, 1971.

MR. CHARLES A. BYRLEY,
National Governors' Conference,
Office of Federal-State Relations, Washington, D.C.

DEAR MR. BYRLEY: The Governor has asked me to respond immediately to the questions contained in your wire of April 27.

First, we have identified all sources of waste water discharge into interstate, intrastate and coastal waters. This applies to all those sources which we have reason to believe contribute to pollution in any significant degree.

Secondly, we have estimates on both the nature and the quantities of the discharge from each such identified source.

Third, we have water quality standards for the receiving waters into which each source of pollution is discharged.

Fourth, effluent requirements are set for each discharge in accordance with the standards assigned to the receiving water. Limitations are made as to the amount of a specific pollutant which might prove detrimental to meeting stream standards. Any new discharge to a waterway of the State requires the approval of the Department of Health. Discharges are monitored at varying intervals depending upon the magnitude of the discharge.

Fifth, the effluent limits are generally set to achieve the highest quality of water in the receiving stream that can be provided through modern technology.

This information was provided by the Rhode Island Department of Health. Should you desire additional information or elaboration on any of the information contained herein, I would urge you to contact the following person directly: Mr. Walter Shea, Assistant Director, Environmental Health Services, Department of Health, 331 State Office Building, Providence, Rhode Island 02903.

Kind regards.

Sincerely yours,

DAVID V. EVANS,
Administrative Assistant.

[Telegram]

SOUTH CAROLINA

COLUMBIA, S.C.

Re Senator Edmund S. Muskie's telegram of May 28, 1971.
SUBCOMMITTEE ON AIR AND WATER POLLUTION,
New Senate Office Building,
Washington, D.C.

The following has been developed by the South Carolina Pollution Control Authority in response to the five questions about the State's water pollution control program for use in developing effective water pollution legislation.

1. Essentially all sources of discharge to interstate, intrastate, and coastal waters have been identified only as to facility name. Data as to exact geographical location is not presently available nor is available data in a format which can be efficiently used. Resources required to adeequately assemble and compile this data will necessitate an expenditure of $100,000 over a period of 2 years.

2. The nature and quantity of effluent from each source have not been adequately identified. It is estimated that an expenditure of $100,000 per year for the next 3 years will be required to procure this data. This estimate gives adequate consideration to the fact that significant quantities of data will be collected as a result of the new Corps of Engineers permit program and the implementation of expanded operations and maintenance activities for waste treatment facilities within the State by the pollution control authority.

3. Water quality standards presently exist for all waters within the State. No significant differences exist between those standards adopted for interstate and intrastate waters.

4. The State does not have effluent standards for individual sources of discharge. Each waste source discharging to a receiving stream and all septic tanks and/or ground absorption systems of 2,000 or more gallons per day are required to obtain proper permits from the pollution control authority. Implementation of a viable operation and maintenance program during this fiscal year has provided a mechanism for monitoring waste sources. The operation and maintenance monitoring program after full implementation, is estimated to require an average annual expenditure of $300,000. Full implementation will require an estimated 3 years.

5. Implementation of effluent standards as an adjunct to water quality standards, probably will provide the State with a more effective pollution control program. However, the thrust of implementing such a program will be determined on the basis of the level of Federal funding available to the State for monitoring activities.

JOHN C. WEST, *Governor.*

SOUTH DAKOTA

STATE OF SOUTH DAKOTA,
EXECUTIVE OFFICE,
Pierre, May 5, 1971.

MR. CHARLES A. BYRLEY,
National Governors' Conference,
Office of Federal-State Relations, Washington, D.C.

DEAR MR. BYRLEY: This will acknowledge receipt of your telegram regarding the pending Federal water pollution control legislation. We will answer your questions in the order of presentation:

1. The State Department of Health, through the Division of Sanitary Engineering and Environmental Protection, is the administrative and technical agency for the Water Pollution Control Program. As far as we know, all sources of wastes to the surface waters have been identified; however, we do find a previously unknown source occasionally.

2. We have not determined the quality and quantity of effluent from each source as is required under the Comprehensive Basin Plan to qualify for Federal monies for construction of wastewater facilities. We estimate that this information could be obtained by a $500,000 annual appropriation to employ six additional personnel and also operate a continuing monitoring program.

3. Water quality standards have been adopted for all surface waters of South Dakota. The interstate and intrastate standards are the same.

4. We now have partial effluent standards which include limitations on biochemical oxygen demand (BOD) and suspended solids (SS) concentrations. On high quality trout waters, the effluent standard is 10 mg/1 BOD and 10 mg/1 SS. In the remainder of the State it is 30 mg/1 BOD and 30 mg/1 SS.

We do have a permit system. One of the requirements of the Permit for Discharge of Waste is monitoring of the effluent. State personnel are unable to carry out this surveillance program so each municipal and industrial source is required to do the sampling of the waste. The cost for the State personnel to do the job is outlined in item No. 2.

5. Depending upon the waters into which the waste is discharged, our water quality standards will achieve, maintain, and enhance the quality of the waters.

If any additional information is needed, we would welcome any members of your staff to come to South Dakota and work with our State personnel. We wish to point out that our staff members have spent much time answering questionnaires that would be better spent on our water pollution control program. This contributes to our lack of a good surveillance program.

Sincerely,

RICHARD F. KNEIP,
Governor.

TENNESSEE

OFFICE OF URBAN AND FEDERAL AFFAIRS,
Nashville, June 8, 1971.

Senator EDMUND S. MUSKIE,
Chairman, Subcommittee on Air and Water Pollution, Public Works Committee, New Senate Office Building, Washington, D.C.

DEAR SENATOR MUSKIE: Governor Dunn is in receipt of your telegram of May 28 requesting additional information on Tennessee's Water Pollution Control Program. The Governor is out of town this week and has asked that I reply in his behalf. I have responded to your five questions in the order in which you asked them.

1. Essentially all sources of discharge to surface waters have been identified. The exceptions would be small sources that no one has reported or where the quantity is so small it does not affect the water quality except perhaps in the immediate vicinity of the discharge. We do not have accurate records on all pumping stations that bypass during heavy rains but the major problems are accurately identified.

2. The nature and quantities of the effluent of all sources have been identified sufficiently to make recommendations for correction. The existing quantities and strength is not known in many cases. It would require about two years and about $600,000 to accurately remeasure the quantity and strength of each waste.

3. Water quality standards based on use were established for all streams in Tennessee in 1951. Following the passage of the Federal Water Quality Act, Tennessee reestablished General Water Quality Criteria for all waters in 1967 and also established stream standards for all interstate waters in 1967. Since that date standards have been established for about 50 percent of the intrastate waters. Hearings have been held on four additional basins, and schedules have been established to hold hearings on the remainder of the waters during the next 12 months. The cost will be about $100,000. There is no difference in the Criteria or Standards for interstate and intrastate waters. Our standards vary only with the use classification of specific water.

4. Effluent standards have been established for each new plant built for many years. These effluent standards could not be enforceable until 1970 when our law was amended and were, therefore, not as well documented as desirable. For the past 12 months the effluent standards specify amounts and the pollutants. About one-half of the 1,100 systems have specific effluent limits now. New limits are being established as new permits are issued.

We have had a permit system since 1945. The permits were not enforceable until 1970. Our new Water Quality Control Act of 1971 to become effective on July 1, 1971, is very specific as to the legal status of permits which will include the effluent standards. If the permit, effluent standard, or water quality standard are violated, the system will be subject to a fine or an injunction.

All sources are not monitored each year either by a visit or analyses. With an additional $300,000 per year for the next two years above the amount listed in Question 2, we could establish an adequate monitoring program. About one-half of the systems now make their own analytical determinations and quantity measurements of their effluents with reports submitted monthly to the Department of Public Health. Our laboratory trains their technicians and runs quality control on their analyses.

5. The effluent limits or standards that we set will achieve the water quality standards and enhance the water quality. We may fail to accurately determine the correct effluent standard in a few cases, but recommendations or legal action following monitoring will correct these conditions.

Sincerely,

LEONARD K. BRADLEY,
Federal-State Coordinator.

TEXAS

PRESTON SMITH,
GOVERNOR OF TEXAS,
June 1, 1971.

SUBCOMMITTEE ON AIR AND WATER POLLUTION,
New Senate Office Building,
Washington, D.C.

DEAR SIR: Below are answers to the five questions concerning the State Water Pollution Control Program in Texas. I am sorry your original request did not get answered.

1 and 2.—Yes. Presently Texas has a permit procedure which is required of *all* municipal or industrial dischargers. This permit includes the quantity of flow and the major quality parameters. For simple municipal wastes only 8–10 parameters are required, whereas for complex industrial wastes, 50 or more are required (Note: This is supplemented by a "self-reporting" system which requires each discharger to monitor his effluent stream. So far the results of this have been *very* good—*e.g.*, discharges appear to be telling the truth, even when that shows them in violation of their permits. This is supplemented by random field sampling.).

3.—Yes. Stream standards have existed since 1967 for all waters in or bordering on Texas. Interstate and intrastate standards do not significantly differ.

4.—Yes. See first responses.

5.—In most cases, existing effluent standards should maintain the existing quality. Under certain conditions, where excessive discharges have taken place in the past, these standards will improve the quality. Data substantiate these in some cases: for example, major pollutant parameters (BOD, COD, SS, heavy metals, etc.) have significantly *decreased* in the Houston Ship Channel/Galveston Bay within the last three years. In certain other cases where substantial growth will occur, present effluent criteria will have to be "tightened" (as is presently being done in a systematic fashion by Operation Cleansweep) or receiving waters will deteriorate.

Hopefully, the above information will provide you with the answers you need. If I can be of further assistance, please contact me or my assistant at 512–475–2782.

Sincerely,

JAMES T. GOODWIN,
Coordinator of Natural Resources, Division of Planning Coordination.

UTAH

STATE OF UTAH,
OFFICE OF THE GOVERNOR,
Salt Lake City, May 5, 1971.

Mr. CHARLES A. BYRLEY,
Director, National Governors' Conference,
Office of Federal-State Relations,
Washington, D.C.

DEAR CHARLIE: In reply to your wire of April 28, 1971 regarding Utah's water pollution control program, I am furnishing the enclosed information from Dr. Lyman J. Olsen, Director of Health.

I hope this will prove sufficient for your purpose.

Sincerely,

CALVIN L. RAMPTON,
Governor.

STATE OF UTAH—DEPARTMENT OF SOCIAL SERVICES,
DIVISION OF HEALTH,
Salt Lake City, Utah, April 29, 1971.

Hon. CALVIN L. RAMPTON,
Governor of Utah,
State Capitol Building, Salt Lake City, Utah.

DEAR GOVERNOR RAMPTON: The following is in answer to a telegram dated April 28, 1971 which you received from Mr. Charles A. Byrley, National Governor's Conference, Washington, D.C., relating to the Utah water pollution control program.

1. Utah has identified major sources of municipal and industrial discharges to intra-state and inter-state waters as indicated by attached bulletins—"In-

ventory of Domestic Wastewater Facilities in Utah—1968" and "Inventory of Industrial Wastewater Facilities in Utah—1967" (supply of the 1968 bulletin is presently exhausted and the bulletin is now in process of updating and reprinting).

We realize there remain some small sources which have not yet been detected, but anticipate these will be identified and corrected through continuing efforts of this Division, in cooperation with local health agencies.

The animal and agricultural waste discharge problems remain to be identified. A program of definition of these problems was initiated in July of 1970, but of necessity was deferred as a result of a demand for water quality planning imposed by the Federal Water Quality Administration. Through budgetary relief effected by the 1971 Legislative session it is felt that above problems may be identified and defined within the next two years, barring further Federal impositions, at an estimated total cost of approximately $40,000.

2. The nature and quantities of municipal effluents have been identified. With respect to industrial effluents, many have been identified, but several will require further detailed evaluation. It is estimated that completion of such an evaluation will require approximately three years at an expenditure of about $70,000 total cost.

3. Water quality standards have been established by classification of all of Utah's interstate-waters and by classification of two intra-state river systems. Classification and establishment of water quality standards for remaining intra-state waters was initiated early in Fiscal Year 1971, but was interrupted by imposition of detailed planning requirements of the Federal Water Quality Administration.

It is estimated that a period of three years will be required to complete the classification and establishment of water quality standards for Utah's remaining intra-state waters at an estimated cost of $70,000.

Utah's water quality standards are the same for application to both inter-state and intra-state waters.

4. While Utah does not apply effluent standards, as such, the water quality standards established for receiving waters, and terms of initial approval for a treatment and discharge, in essence define limitations for the quantity and nature of pollutants. The water quality standards are comprehensive in relation to control of the broad spectrum of pollutants. Utah has a permit system for the treatment and disposal of wastewater. The performance of waste treatment facilities is supervised regularly by this Division through some 225 monitoring stations. It is our feeling that an additional 150 monitoring stations (stream and effluent) should be activated as rapidly as resources will permit. Full realization of the total monitoring program is estimated to require about five years at an additional cost of about $50,000 per year.

5. With adequate program resources it is our feeling that Utah water quality control activity will maintain, enhance or achieve water quality standards, as appropriate, for specific locations and installations.

We will be pleased to supply additional information if such is felt to be desirable.

Sincerely yours,

LYMAN J. OLSEN, M.D.,
Director of Health.

VERMONT

AGENCY OF ENVIRONMENTAL CONSERVATION,
Montpelier, Vt., May 3, 1971.

Mr. CHARLES A. BYRLEY,
National Governor's Conference,
Office of Federal-State Relations, Washington, D.C.

DEAR MR. BYRLEY: Governor Davis has forwarded your telegram to me. Your questions are answered in the order presented.

1. All major point sources of pollution have been identified.

2. Nature and quality of effluent from major point sources of pollution should be identified by January 1, 1972.

3. Revised water quality for inter and intra state waters pending and will be promulgated by July 1, 1971.

4. Minimum treatment standards are required by State. Effluent standards by volume are specified for certain toxic materials and metals. We do not have absolute standards. All dischargers are required to have a permit from Depart-

ment of Water Resources whether or not the discharge degrades the quality of receiving water. Performance of major discharges monitored annually.

5. Effluent and treatment standards will improve water quality at present levels of discharge.

I trust this is responsive to your inquiry.

Yours very truly,

ROBERT B. WILLIAMS,
Secretary for Environmental Conservation.

VIRGINIA

STATE WATER CONTROL BOARD,
Richmond, Va., May 6, 1971.

MR. CHARLES A. BYRLEY,
The Council of State Governments,
Washington, D.C.

DEAR MR. BYRLEY: We are replying to your telegram of April 27, 1971, to Governor Holton, requesting information in regards to the Senate Subcommittee on Air and Water Pollution.

1. Have you identified all sources of discharge into inter-state, intra-state and coastal-waters? If not, how long would it take to do it? How much would it cost?

Answer. All waste discharges into inter-intra and coastal waters have been identified. We are attaching a map of the Shenandoah basin, which is typical of the information available statewide in this regard.

2. Have the nature and quantities of effluent from each source been identified? If not, how long would it take and how much would it cost?

Answer. The nature and quality of effluent from each source have been identified. However, until recently, we did not consider certain impurities (such as mercury, cadmium, etc.) to be present in a number of waste discharges. A program is now underway to identify, within 12 months, these and other impurities. This work is considered a part of our continuing program, and therefore, we do not have good information in regards to the exact cost figures for the collection of this additional information.

3. Do you have water quality standards for the receiving waters into which each of these sources discharge? If not, how long? And how much? Do standards for intra-state and inter-state waters differ?

Answer. Water quality standards have been adopted by the Board and approved by the Water Quality Office of the Environmental Protection Agency for both intra- and interstate waters. Standards are uniform throughout the state.

4. Do you have effluent standards on limitations for each individual source of discharge? Are your standards or limitations quantified as to specific amount and specific pollutant? Do you have a permit or similar system? Is the performance of such sources monitored? If not, how long and how much?

Answer. Effluent standards have not been uniformly adopted by the Board, but have been applied in 2 or 3 instances where required. In these few instances, the effluent standards are specified as to amount and specific materials. The Board does have a permit system, and performances of treatment facilities are monitored in several ways. Monthly samples are collected from approximately 500 selected stream locations throughout the State and chemical analyses are performed, giving the staff and the Board information on the quality of water existing at these various stations. In addition, we have in excess of 100 biological sampling stations from which bottom organisms are collected twice yearly. In addition, municipalities and industries submit monthly and quarterly data in regards to the operation of waste treatment facilities and the Board has a program of spot-checking these results to determine the efficiency of the treatment facilities.

5. Will these effluent limits maintain, enhance or achieve water quality standards?

Answer. In the few instances where effluent standards have been adopted, water quality standards will be enhanced.

Sincerely,

A. H. PAESSLER,
Executive Secretary.

WASHINGTON

STATE OF WASHINGTON,
OFFICE OF THE GOVERNOR,
Olympia, May 14, 1971.

Mr. CHARLES A. BYRLEY,
National Governors' Conference of Federal-State Relations,
Washington, D.C.

DEAR CHARLEY: The following comments are in relation to your telegram of April 26, requesting information concerning the State of Washington's water quality program. This State has been active in the water pollution control area for a considerable number of years and, therefore, answers in the affirmative to the questions posed. A more specific discussion, however, would better define our position.

The State of Washington has adopted both intrastate and interstate water quality standards. The intrastate standards differ from the interstate standards only in the area of further defining specific water quality criteria for lakes. In all other aspects the standards are identical. In preparing a plan of implementation for both sets of standards, all sources of discharge into State waters were identified. Those dischargers which were not in compliance with the standards were placed on a specific time schedule which would insure compliance.

In 1955, our State Legislature adopted legislation which set up an industrial waste discharge permit program. Since that time, the State water pollution control agency has been very active in issuing permits and enforcing the conditions contained therein. The State has not as yet adopted specific effluent standards for all industrial and/or municipal discharges. Through the industrial permit program, however, effluent limitations have been placed on each individual discharge. These limitations are quantified as to specific amounts and specific pollutants. These specific effluent limitations will not only maintain but in many cases will enhance the water quality of the State of Washington. In those instances where a specific discharge is not currently meeting the water quality standards, the effluent limitations specified in the industrial waste discharge permit will achieve water quality standards as a minimum. In most cases, however, because of the stringent limitations being set, it is felt that the resultant water quality will be above the standards set by the State.

Through the application form used for the permit program, the State has a very excellent record of the nature and quantity of industrial effluent being discharged into State waters. In addition, the State requires that all plans and specifications for industrial and municipal waste treatment facilities be reviewed and approved by the State before construction of said facilities may commence. This requirement furnishes further information pertaining to the nature of industrial discharges and also supplies information concerning the nature and quantity of municipal discharges into State waters.

In conjunction with the State permit program, the water quality standards, and the State plan review functions, a routine compliance inspection is carried out of all waste dischargers in the State. This program includes effluent source monitoring and receiving water quality surveillance activities. These programs, then, insure the strict compliance with the State permit conditions and water quality standards.

In general the State of Washington, in being active in the water pollution control field, does not feel there is a need for federal intervention. The greatest need lies in the area of federal financial assistance and in the area of federal research activities on a national scale, which the states cannot afford to finance individually. If I can be of any further assistance, please let me know.

Sincerely,

DANIEL J. EVANS, *Governor.*

WEST VIRGINIA

OFFICE OF THE GOVERNOR,
Charleston, June 1, 1971.

Mr. CHARLES A. BYRLEY,
National Governors' Conference, Office of Federal State Relations,
Washington, D.C.

DEAR CHARLIE: In response to your recent telegram on matters related to water pollution, the following comment is offered:

The State of West Virginia has approved, with exceptions, Water Quality Standards on interstate streams and has Water Quality Standards on intra-state streams. No differential is made between criteria on these streams.

The State of West Virginia operating through an established permit system, has identified all pollution sources and set effluent limits. The limits are tailored to the receiving stream and are established to enhance water quality for present and future uses.

It therefore appears to this office that additional legislation on water pollution control is an unnecessary venture into the vested rights of the State of West Virginia.

Sincerely,

ARCH A. MOORE, JR.,
Governor.

WISCONSIN

OFFICE OF THE GOVERNOR,
Madison, Wis., June 14, 1971.

Hon. EDWARD S. MUSKIE,
U.S. Senator, Senate Office Building,
Washington, D.C.

DEAR SENATOR MUSKIE: In response to your five questions concerning water-pollution control, I am submitting the following information. I hope the answers to your questions will assist the Subcommittee on Air and Water Pollution in developing effective legislation. For convenience sake, I will restate the five questions and follow each question with the information and narrative discussion on the matter.

(1) Have you identified all sources of discharge into interstate, intrastate and coastal waters? If not, how long would it take to do it? How much would it cost?

The Department of Natural Resources makes systematic pollution investigations of all drainage basins in the state on approximately a five-year cycle. Sources of significant direct discharges into all surface waters have been identified. These include all municipal sewage and separate industrial waste discharges where the latter does not use municipal sewers. Storm water is normally not considered pollutional and, therefore, not usually checked. The same situation holds true for diffuse and intermittent sources of potential pollution such as precipitation, rural land runoff and groundwater discharges. Discharges may also come from some of the estimated 300,000 to 400,000 private sewage disposal systems that we have in Wisconsin. We rely mainly on zoning septic tank permits and plumbing licenses to control discharges from the latter. An estimated 90 to 95 percent of the controllable point sources of pollution have been identified. It is questionable whether all sources of discharges can be identified. The checking of a single private waste disposal system may involve one-half man day, and there is little assurance that if it is satisfactory now that it will continue to be satisfactory in a year from now or during a wet season. A detailed survey to try and include all discharges could involve about two years' time and a cost of ten million dollars.

(2) Have the nature and quantities of effluent from each source been identified? If not, how long would it take and how much would it cost?

Included in the periodic drainage basin investigations is a determination of the nature and a measurement or an estimate of the quantity of effluent. Normally, only those pollution parameters are measured that we feel are relevant for the specific waste source involved. For sewage wastes, we would be interested in BOD, pH, bacterial counts, solids and nutrients. For brine wastes, a single measurement for chlorides might suffice and for thermal pollution, just the temperature of the wastes may be adequate. There are probably well over a thousand different pollution tests that might be applied, but rather than do a thousand tests on a handful of samples, it is better to do a few germane tests on thousands of samples. For the tests to be meaningful, suitable sampling procedures are needed to obtain a representative sample. This might involve composite sampling over a 24-hour period. Obtaining substantially more information on the quantities and nature of effluents could involve three to four years and a cost of 10 to 20 million dollars.

(3) Do you have water quality standards for the receiving waters into which each of these sources discharge? If not, how long? and how much? do standards for intrastate and interstate waters differ?

Water quality standards have been established for all interstate and intrastate waters of Wisconsin. At the present time, both standards are the same.

(4) Do you have effluent standards or limitations for each individual source of discharge? Are your standards or limitations quantified as to specific amount and specific pollutant? Do you have a permit or similar system? Is the performance of such sources monitored? If not, how long and how much?

We do not have effluent standards as such, but we do have limitations on many individual sources of pollution. Effluents must be compatible with the established water quality standards and use designations. We require secondary treatment and disinfection of municipal effluents and in some cases also require phosphorus removal. Detailed plans and specifications of proposed treatment facilities require approval before commencement of construction. New industries, or those expanding their operations, must submit a report on steps they will take to protect against new or additional pollution. Construction cannot commence until such report has been approved. Some of our orders, particularly those to the pulp and paper industry stipulate discharge limits with respect to suspended solids and BOD. Monthly reporting is required of municipal treatment facilities, and we are beginning to require this also of major industrial pollution sources. Spot checks are made of the municipal and industrial reporting. Additionally, stream monitoring stations have been established on heavily industrialized sections of the Wisconsin and Fox Rivers.

Due to the nature of water quality standards, many relatively small dischargers do not effect water quality standards. This problem demonstrates the need for effluent standards to back up Wisconsin's enforcement program.

(5) Will these effluent limits maintain, enhance or achieve water quality standards?

Effluent standards represent somewhat of a different approach to controlling pollution than water quality standards. Both federal and state laws are now geared to water quality standards. However, prior to that time Wisconsin did use modified effluent standards, and our water quality standards state: "Although surface water quality standards are set forth herein, it may be necessary in individual cases to stipulate effluent quality requirements in order to achieve the stated objectives" There are inconsistencies between the two standards, but I believe that using effluent standards in individual cases for certain pollutants and certain industries would complement the existing water quality standards.

Sincerely,

PATRICK J. LUCEY,
Governor.

WYOMING

DEPARTMENT OF HEALTH AND SOCIAL SERVICES,
Cheyenne, Wyo., April 27, 1971.

MR. CHARLES A. BYRLEY,
National Governors' Conference, Office of Federal-State Relations, Washington, D.C.

DEAR MR. BYRLEY: In answer to your telegram concerning proposed Water Pollution Control legislation, your numbered questions are answered as follows:

1. All municipal and major industrial discharges are defined for all waters. Oil production generally defined by fields. Irrigation defined by areas. Identification of specific discharges in the last two categories would require a minimum of 2 years and $50,000.

2. The nature and quantities of effluents has not been determined. To obtain minimum data would require 2 years and $50,000.

3. The State of Wyoming has established Water Quality Standards only for interstate waters. For the establishment of water quality standards for intrastate streams I would schedule a minimum of two years and $40,000.

4. The State of Wyoming has not established effluent standards for individual sources or on a generalized basis.

We do not utilize a permit system; however, all new construction must be reviewed and approved by the State.

There is no continuous monitoring of effluents from individual sources.

A monitoring system for effluents could be established within one year, however, a minimum yearly cost would be in the range of $75,000.

5. We have never felt the effluent standards were of any great value. The important item is that the stream quality be maintained. Unless effluent quality can be tied to stream flow, it frequently ends as a permit to pollute.

Very truly yours,

ARTHUR E. WILLIAMSON, M.S., P.E.,
Director.

NATIONAL LEAGUE OF CITIES—U.S. CONFERENCE OF MAYORS

APRIL 5, 1971.

Hon. EDMUND S. MUSKIE,
Chairman, Subcommittee on Air and Water Pollution, Senate Public Works Committee, Senate Office Building, Washington, D.C.

DEAR SENATOR MUSKIE: The National League of Cities and the U.S. Conference of Mayors have closely reviewed a number of proposals to amend the Federal Water Pollution Control Act which are currently before your Subcommittee. We believe that many amendments proposed in these bills would make needed improvements in the Federal Water Pollution Control Act, though some do not go as far as we would like. Attached is a memorandum we have prepared commenting on key points in these bills. The bills discussed include, S. 523, S. 1012, S. 1013, S. 1014, S. 1015, S. 1143 and S. 1259.

As the June 30, 1971 expiration date for the grant-in-aid program under the Federal Water Pollution Control Act is approaching, we urge you to give priority consideration to legislation extending this program so localities may be assured of continued and expanded support for their clean water programs.

Sincerely,

DONALD G. ALEXANDER,
Legislative Counsel.

Attachment:

NCL AND USCM COMMENTS ON LEGISLATION TO AMEND THE FEDERAL WATER POLLUTION CONTROL ACT

The National League of Cities and the U.S. Conference of Mayors urge favorable consideration of amendments proposed in S. 1143 to improve the financing structure for the grant-in-aid program under the Federal Water Pollution Control Act. The proposals embodied in S. 1143 were developed after an in-depth examination of the current grant-in-aid program by many local officials and represent their collective judgments as to what changes are needed to improve operation of the grant-in-aid program. Three key changes recommended in S. 1143 call for:

A level of Federal assistance averaging $3 billion annually over the next five years.

Federal assumption of 75 percent of project costs, and

A long term contract authority replacing the annual appropriations process.

The legislation commented on below does not include recommended increases in the level of Federal financing or the Federal share of costs comparable to those we support in S. 1143. Also, the proposed long term contract authority, which we believe absolutely necessary to a successful program, is included in S. 1259 but not in the other proposals discussed. We urge that these three key points in S. 1143 be included in final legislation and note these differences here as general comments rather than citing them in the comments on each specific bill.

COMMENTS ON SPECIFIC BILLS

S. 523. Amendments to Section 7: NLC and USCM support the proposed language changes which would tie the grant-in-aid program closer to state plans for implementation and enforcement of water quality standards. However, we do not believe that the language goes far enough and should be strengthened by amendment of paragraph (6) of Subsection (b) to require that criteria used by states in determining project priorities place primary emphasis on a project's effectiveness in abating water pollution.

Amendments to Section 8: Paragraph (3) of Subsection (b) appears to allow a Federal contribution of 60 percent of project costs without any state contribution if the project is part of an approved river basin plan. A 60 percent Federal assumption of costs would be a major improvement over the existing situation. However, achievement of the 60 percent figure still requires action entirely beyond the control of an individual locality, in this case development of a river

basin plan, in order for the higher level of assistance to become available. NLC and USCM do, however, support the concept of river basin planning and would not object to a river basin planning requirement being a precondition to the 75 percent grants proposed in S. 1143.

The language of subparagraph (5) of Subsection (d) must be clarified to indicate whether requirement of effective treatment of "all sewage" applies to all sewage in the normal operation of the plant or sewage including storm water overflows. NLC and USCM would support an interpretation allowing grants for treatment of all sewage including storm water overflows. Some changes in legislative history and the definition of the term "treatment works" in Section 23(c) of the Act may be necessary to clarify eligibility of facilities which deal with storm water problems.

It may be difficult for many communities to develop, on a short notice, a system of user charges to pay a share of construction costs as called for in the proposed Subsection (e). Currently, many localities have difficulty paying the operating costs of their sewage treatment facilities from user charges. Further, inflation, a desire to improve plant efficiency, and new Federal and state requirements relating to inspection of treatment plants and certification of treatment plant operators are creating heavy pressures to substantially increase operating costs and thus user charges in many communities. Requiring users to pay a share of today's heavy demand for construction also places an unfair burden the existing users by making them pay for generations of neglect in sewage plant construction. Any requirements relating to user charges should not be set so as to require that proceeds from the user charges be spent for construction.

The proposed requirement in Subsection (e) that approved river basin plans must be compatible with long range land use and zoning plans may unduly delay facilities construction. Many states do not now have land use and zoning plans, and NLC and USCM have very serious reservations about such state plans as may be developed because of the history of state failure to recognize needs of urban areas in any planning and fund distribution activities. The proposal in Subsection (e) requires that such a land use plan be "approved." There is no provision, however, to suggest who should approve such a plan. EPA, concerned solely with environment, would not be a proper agency for approving comprehensive land use plans. There already is an incentive in the Act (Section 8(f)), to develop programs consistent with regional plans. Perhaps this incentive could be made a mandatory precondition for receiving a 66 percent grant rather than just an incentive for a 10 percent increase in the Federal share. We do not believe that requirements going beyond this finding of consistency with regional plans is appropriate for the Federal Water Pollution Control Act at this time because of the lack of general state land use plans and very serious questions about the appropriateness of state land use planning activities or the fairness with which state land use plans may be administered. The issue of land use planning and the appropriate role of Federal, state and local governments in land use planning needs close and thorough consideration by the Congress without being tied as a secondary issue to one of the many programs land use planning will affect.

NLC and USCM support the accelerated reallotment of funds which may not be used by one state as proposed in paragraph (2) of Subsection (g). Such acceleration is necessary to allow quicker use of Federal funds and provide urgently needed assistance to projects in states with heavy waste treatment facility requirements. We would note here that adoption of the long term contract authority which we suggest would make such reallotment provisions unnecessary as funds would only be allotted to approved projects. Under the proposal in S. 1143, states would have to submit plans for use of funds before the fiscal year in which they would be expended, and reallotment of a state's unused obligational authority would occur at the start of the fiscal year.

Amendments to Section 10: NLC and USCM believes that the proposals relating to certification of compliance with pollution control standards in Subsection (e)(1) need to be clarified to assure that they do not call for a Federal permit for every commercial building which may be constructed in a community. Such an interpretation would require a burdensome and costly administrative mechanism at the Federal level for approving building permits and might unduly delay local economic improvement programs even where there was little or no water pollution problem.

Amendments to Section 11: NLC and USCM believe that municipalities should be exempted from application of Subsection (i) relating to citizen suits. There

is a strong justification for this distinction because of the special nature of municipalities in the sewage treatment field.

1. Citizen suits may cause courts to mandate priorities for expenditure of limited local revenues which are inconsistent with local needs and disregard other vital services. Many states impose revenue raising ceilings on local governments, and in many cases local revenue raising capacity has reached these ceilings. Thus, if the locality is suddenly required to construct a sewage treatment facility, its only choice may be to slash funds from other vital municipal services such as education, sanitation, hospitals, or, to the extent allowed by the Federal government, welfare. The end result would be a lowering of the quality of life in a municipality.

2. The Federal enforcement program relating to municipalities was created in 1965 and 1966 with the assumption that large amounts of Federal and state assistance would be available so that most localties would have to pay 25 percent or less of project costs. This assumption of available assistance has not proven valid as both Federal and state resources aiding localities have fallen far short of projections.

3. Citizen initiated enforcement actions against individual municipalities may be wholly inconsistent with the regional treatment facility plan concept proposed in this legislation. Theoretically, a locality may: (1) be used for contributing to a pollution problem, (2) be ineligible for Federal assistance because it has been determined that Federal assistance will be used for a regional treatment facility to be constructed in another community, (3) because this facility has not been constructed the individual municipality may be in violation of clean water standards, and (4) may be mandated by the court to spend its own funds to construct a facility for itself which the regional planning mechanism has already determined is not needed and may be inefficient.

Amendments to Section 23: The proposed Subsection (g) should include a requirement for reporting of projected costs of needed local treatment facilities as part of the general report of the administrator.

S. 1012. Amendments to Section 7: Subparagraph (6) of the proposed Subsection (e) needs to be strengthened to assure that state priorities place primary emphasis on a project's effectiveness.

S. 1013. Amendments to Section 8: As in the amendments in Section 7, we suggest that the language of subparagraph (D) of Subsection (a) (2) needs to be strengthened to require that project priority systems are related to enforcement of water quality standards and place primary emphasis on a project's effectiveness in controlling pollution. These changes are necessary to avoid the difficulties which presently exist because many states allocate funds in patterns which discriminate against major urban areas where the greatest pollution control needs exist and where greatest standards enforcement pressures are exerted.

NLC and USCM would not object to a requirement that a system of user charges exist as a precondition for receiving a larger Federal share of costs as proposed in subparagraphs (F) and (G). However, we believe that the Federal share of costs proposed should be larger than 55 percent and emphasize that any system of user charges developed should not have attached a requirement that proceeds be used for construction.

NLC and USCM strongly support the proposal that some funds be available for grants to be made at the discretion of the EPA administrator to localities with serious water pollution problems. Such grants will allow a greater concentration of funds in areas where the greatest problems, as determined by EPA exist. Such concentration of funding is now frustrated by the absolute control which the Act gives to state priority lists in determining funding for local projects.

For the Federal program supporting local treatment works to be effective, NLC and USCM believe that at least a five year authorization is necessary, rather than the three year authorization proposed in this bill. The five year authorization, at the higher funding level proposed in S. 1143, will allow long range planning in many communities which is not possible with a three year authorization program.

S. 1014. Amendments to Section 10: Subparagraph (B) of the proposed Subsection (d) (8) should be amended to require that plans for implementation and enforcement should not be approved by the administrator unless they include not only schedules for water clan up, but also, in the case of municipalities, an indication of the sources of financing for the water clean up efforts and establish a relationship between available financing of municipal projects and the enforcement schedule.

Our comments on proposals for authorization of citizen suits in Subsection (k) would be the same as those offered in the comments on S. 523. Municipalities should be exempt from the citizen suit requirement.

S. 1015. NLC and USCM cannot support the establishment of the Environmental Financing Authority to aid localities in financing their share of waste treatment facility costs for the following reasons:

1. Any proposal to provide assistance for the local share of Federally assisted capital projects should apply to all Federally aided capital improvement programs. Approval of separate local share financing devices related to each individual Federal aid program would create much confusion at the local level once several separate devices have been adopted. There is a definite need for Federal action to relieve municipalities of the burdens they face because of the difficulty of selling bonds and paying heavy interest charges to finance the local share of costs in grant-in-aid programs. However, a single solution to this problem must be developed, applying to all grant-in-aid programs, rather than the piecemeal approach which would result from adoption of EFA and similar proposals.

2. If EFA were adopted, it would have little impact in easing the capital financing burden on municipalities for the following reasons:

(a) Before assistance can be provided under EFA there must be certification that the government requesting the assistance has been unable to obtain sufficient financing on reasonable terms. "Reasonable terms" is a very vague phrase. If this was interpreted to mean that a locality could not sell its bond to the market at generally prevailing interest rates, most of the big issues for waste treatment works would not be covered as they can be sold at prevailing interest rates. The difficulty comes in the high cost of prevailing rates. If the EFA was to result in a substantial interest subsidy for local governments, it would become more attractive. However, it must be emphasized that it should be considered as part of a broader market for financial relief for all local capital issues.

(b) A difficulty which many localities face, and which would not be addressed by EFA, is that they cannot enter into more obligations because they have reached statutory bonded indebtedness limits. While a substantial increase in the Federal share of costs would affect their ability to participate in the program, no device which continues to require that these localities issue substantial sums of bonds will be much help, regardless of who buys the bonds.

For these reasons, we urge that you defer consideration of S. 1015 until the Congress is able to consider broader measures designed to provide across-the-board relief for localities in financing the local share of costs for federal assistance programs.

S. 1259. Amendments to Section 8: NLC and USCM strongly endorse the long term contract authority proposed in S. 1259.

If the Congress does not deem a substantial increase in the Federal share of project costs appropriate, NLC and USCM also support Section 2 of S. 1259 which would increase the Federal share of costs for projects in those localities which have received inadequate assistance in the past. Unless there is a substantial across the board increase in the Federal share of costs such a provision is necessary to redress the deficiencies which have resulted from past discrimination against major projects in urban areas.

NLC and USCM strongly support the proposed amendments to Section 23, to assure that facilities to treat storm and sanitary sewer overflows are eligible for assistance. There is no quesiton that sewage overflows are part of the water pollution problem, as such, assistance should be available to deal with it.

NATIONAL ASSOCIATION OF METAL FINISHERS

By E. B. WIGGINS, President

We are pleased to submit this statement for the record in connection with your subcommittee's hearings on pending water pollution legislation. However, we do regret your committee's schedule limitations which denied us an opportunity to voice *small business'* concerns and problems in the area of pollution and pollution abatement *in person*, for we sincerely believe that we would have been able to impart information that doubtless will not be covered by scheduled witnesses, none of whom represent or could speak for small businesses which make up the contract or job metal finishing industry.

It is our hope, however, that this statement will assist the committee in its workings and shed important light on the small business sector which too often is given insufficient consideration by law-makers when they ponder legislation of the magnitude of the pending water pollution law.

The contract or job metal finishing industry in the United States comprises some 3,000 firms which average 25 to 35 employees per firm and do $250,000 to $350,000 in sales per year, per firm. There are fewer than 10 companies which produce $4 million in sales and employ more than 400 employees per year. Our industry, therefore, an owner-operator-type operation in the main, is the exemplification of the free enterprise system in action!

Value of products handled are in the multi-billion dollar range.

Speaking for a broad segment of our industry, the National Association of Metal Finishers has pioneered in pollution control. Long before active pollution control activities on a national level had been undertaken, this Association had prescribed pollution control procedures to both members and nonmembers via its various publications. In addition, special pollution control posters were prepared and supplied to all members at no cost and for posting in the shops. These posters outlined in simple terms specific "good housekeeping" practices to minimize pollution and to provide instructions as to how to guard against accidental creation of pollution problems.

In our various local affiliates, platers, painters, and others involved in the various additional finishing activities, have worked closely with technicians involved in municipal sewage disposal to make certain that the effluents of our member shops are compatible with various procedures and limitations created by the operation of the sewage control facilities.

It is the position of the Association that under conditions other than those created by an unusual industrial accident, the actual volume of pollutants produced by metal finishing job shops is extremely small. In fact, in the case of those plants discharging into sophisticated municipal sewer systems, the volume of chemical pollutants is so nominal that it can be absorbed without affecting the disposal process.

It is important to note, also, that recent research data have been released which indicate that certain of these chemical pollutants are actually beneficial to sewage disposal beds.

It is regrettable that our industry uses certain material normally considered extremely poisonous and as a consequence considered synonymous with pollution. High among these are the cyanides which are a part of many plating and finishing processes, as well as certain acids and cleaners.

In 1967 our Association established a Foundation supported chiefly by contributions from our members which has undertaken, with Government assistance, research into methods of eliminating these pollutants from our members' effluents. In this research, we have endeavored to ascertain economically feasible methods of achieving this end since operating costs of this control equipment will, of necessity, require corresponding increases in charges for metal finishing and plating. Another aim of our research has been to bring the cost of the required equipment to as reasonable a figure as possible since our membership (and industry) consists chiefly of small businesses to whom a sizeable outlay for

equipment which contributes nothing to efficiency of production would be catastrophic.

It is the position of our Association that the various controls as established should give consideration to the extent and character of the pollution and that the administration of these controls should be selective, i.e., if the material in the effluent can effectively be absorbed or destroyed by existing sewage disposal facilities, a requirement for its destruction in the producer's plant should not be made simply because the material is considered objectionable or that at some other location in some other volume the pollutant in question would be detrimental to the environment.

It should also be noted that anti-pollution devices and systems are available in our industry. The problem, however, is primarily economic rather than technical. The range of financial capability of metal finishers is as broad as is their geographical location. No single standard effluent control directly from the plant is, therefore, feasible without intolerable disruption.

It is our sincere belief that full compliance even with existing polluiton standards would a) put most of the very small shops out of business, b) require relocation of many shops to areas where municipal treatment could be had, and c) require subsidization of capital expenditures on operations.

We, therefore, urge and respectfully recommend that your committee consider tax credits for the various small businesses which we represent for those sums expended for the purchase of pollution control equipment. We take this position since the pollution control equipment is in itself non-productive and may well represent a capital outlay greater than the business would actually consider or find economically feasible were it productive.

Our small businesses provide an extremely vauable service to innumerable other businesses, both large and small, in plating and finishing activities; and should a sizeable number be eliminated through inability to accommodate these expenditures, a large segment of the economy would be seriously affected.

We earnestly believe that something should be done to create a better, cleaner, and healthier environment through cleaner air and cleaner water—as our industry has attempted to do for years through our pollution abatement programs. However, we are fearful that the strong and oftentimes unreasonable public outcry against pollution will bring about new Federal and State laws which, in time, could not only sweep away air and water pollution problems, but many small businesses as well. A reasonable middle course of action is necessary.

It is our hope, therefore, that the Federal Government will do all in its power to *assist* our industry in solving its problems rather than inadvertently *legislating* it out of existence.

NATIONAL FISHERIES INSTITUTE, INC.

NATIONAL FISHERIES INSTITUTE, INC.,
Washington, D.C., March 12, 1971.

HON. JENNINGS RANDOLPH,
U.S. Senate,
Washington, D.C.

DEAR SENATOR RANDOLPH: A major news story December 23, 1970, illustrated to the public most emphatically the concern of the National Fisheries Institute over environmental degradation. That date marked the announcement by the Food and Drug Administration that swordfish was unusable as food because it contains more mercury than considered safe.

This discovery has cost our industry millions of dollars in immediate losses because of condemned product stocks; it has rendered obsolete hundreds of swordfishing vessels; and has reduced overall volume by $25-million per year.

The industry will survive the swordfish loss. Many small businessmen and fishermen will not survive . . . to them the swordfish problem is a total disaster.

The reason for this letter is to point out as graphically as possible that the need to protect our ocean resources is immediate. For the fish industry, it is a most specific problem and one that must be solved *now*.

Mercury in swordfish is, of course, just an example of a much larger problem. Solutions are difficult. During the current session of Congress, we are looking for increased spending in the area of waste plant construction; aids for local government. We believe coastal zone management is needed with jurisdiction over the coastal zone placed in the hands of the National Oceanic and Atmospheric Agency, the one Federal authority concerned with the needs of renewable resources.

We are looking for legislation that would require establishment of industrial effluent standards.

Our Institute believes fish product inspection must be legislated and that it should contain pollution monitoring mechanisms at the resource level.

Finally, some sort of financial protection, such as an insurance program similar to the Federal Crop Insurance Program, must be provided our fishermen.

This letter is somewhat general, listing a number of concepts our industry supports. We've enclosed a copy of our Resource Conservation Policy brochure to provide a more detailed expression of our views.

The Institute would be pleased to discuss with you any of the policies or the suggestions of this letter. We thank you for your attention to these matters of such crucial importance to the fish and seafood industry.

Sincerely,

ROBERT A. ERKINS,
Chairman, Resource Conservation Committee.

[Brochure follows:]



NATIONAL FISHERIES INSTITUTE

STATEMENTS OF POLICY

RESOURCE CONSERVATION

OCTOBER, 1970

On Living Aquatic Resources

The NFI policy on living aquatic resources is based on the premise that their protection, maintenance and full utilization should be for the benefit of mankind, with their use as food having overriding priority.

The policy includes the following objectives:

1. To maintain sufficient populations of all species of marine organisms to insure their continued existence.
2. To press for vigorous programs of environmental protection and improvement, consistent with National Fisheries Institute policy on estuarine protection, oil pollution, thermal pollution, and pesticide pollution.
3. To encourage the growth and development of local, distant-water, and overseas fishery enterprises, and to foster the development and utilization of unused resources, taking into consideration the necessity of regulating all catches within the limits of maximum sustainable yields.
4. To support management of all fisheries on the basis of adequate scientific information, and to participate in the management of all fisheries in which U. S. fishermen are engaged, with the objective of maximizing the sustained harvest.
5. To press for review of existing fishery laws and regulations and other institutional barriers, to determine if they are properly designed in terms of biological, economic, social and other criteria, and to press for revision of those which are improperly designed and elimination of those which serve no useful purpose.
6. To recognize the aesthetic, educational, scientific, and non-extractive recreational uses of the living resources, and where a species is the object of sport fishing, to encourage the maintenance of sufficient resource to support a reasonable sport use, taking into consideration the necessity of regulating individual sport fishery bag limits to the quantity that is consistent with other demands on the resource.

On Estuarine Protection

While National Fisheries Institute recognizes that estuarine areas have multi-use values, it considers that the commercial fisheries, which contribute directly to the nation's food supply and which use the estuarine resources in renewable fashion, are of highest priority.

The National Fisheries Institute supports:

1. Federal funding to the limit of the Congressional authorization to build and improve waste treatment plants;
2. The limitation of shoreline filling to areas landward of the line of mean high water except where an applicant demonstrates clear public need or benefit from fills extending beyond that line;
3. The limitation of navigation channel construction to dimensions which are compatible with the draft and safe navigational needs of the vessels which will use them;
4. Continuation of the work of Federal Water Quality Administration on estuarine pollution and of the Fish and Wildlife Service in their estuarine inventories;
5. Coordination of United States research and management programs for the eleven "Estuarine Register Areas" (F.W.Q.A. National Estuarine Inventory Handbook of Descriptions) which are international, with the government of Canada or of Mexico as may be appropriate;
6. Coordination of United States research and management programs for the Great Lakes with the appropriate agencies of the government of Canada;
7. Establishment of systems of selected estuaries having reasonably natural conditions, as preserves to be utilized as baseline study areas and allowing therein only compatible and legal uses;
8. An increase in the capability of the Office of River Basin Studies to protect estuarine and coastal resources through additional staffing and by provisions of research results essential to planning needs:

Recognizing that knowledge of estuarine ecology is insufficient, the National Fisheries Institute supports:

1. Fundamental research on 'natural' estuarine systems, including studies in hydrology, energy cycles, productivity, species interactions, sediments, physics and chemistry and life histories and requirements of their plant and animal species.
2. Studies of the effects of environmental changes or pollutants on species which are dependent upon estuaries, determinations of biological indications of changed environments.
3. Development and use of new techniques to predict effects of proposed environmental changes, including physical and mathematical models.
4. Developing and use of new techniques for rehabilitation of damaged estuarine areas.
5. Development and use of new techniques to increase fish and wildlife production and improve husbandry.
6. Development of plans for minimizing the effects of shoreline activities on estuarine resources.
7. Studies to establish the magnitude of economic and social benefits both tangible and intangible derived from estuaries and their living resources.
8. Studies of institutional barriers which prevent sound management and use of estuarine resources, including means of removing and replacing them.
9. The training of scientists, management personnel and technicians to achieve the purposes of this resolution.
10. A national system of estuarine zonation, designed to obtain maximum utilization of the renewable estuarine resources and to insure preservation of the remaining unique or non-renewable resources.

On Pesticide Pollution

The Federal Government and the various State Legislatures should push aggressively and rapidly for the phase-out use of all hard pesticides in this country.

The Executive Branch of the Federal Government should act immediately to implement the provision of the Water Quality Improvement Act of 1969 which provides for development of Water Quality Standards respecting pesticide levels.

Through its international aid program and its participation in United Nations organizations, the United States should extend its influence to reduce the use of hard pesticides throughout the world as fast as possible.

Since the phase-out of hard pesticides will take some time, and since the fish and seafood industry cannot control the levels of pesticide pollution in the waters, and thereby in its products, the Department of Health, Education and Welfare should review the existing levels of tolerance for pesticides in fish and seafood. The recommendations of the Mrak Commission should be considered in this re-evaluation, including consideration of the relative values of fish and seafood nutritionally and the typical rate of consumption by humans.

The Congress should extend to the fishing industry, fishermen and processors the same provisions of compensation afforded agriculture for product losses due to pesticide pollution when these result from uncontrollable sources.

On Oil Pollution

The Corps of Engineers, U. S. Army, should vigorously enforce the Refuse Act of 1899 both in respect to oil pollution and other wastes in navigable waters as specified in that Act.

The Department of the Interior should utilize its full legal authority to enforce the provisions of the Water Quality Improvement Act to minimize the possibility of oil spills.[1]

This should include the adoption of appropriate authority to withdraw the operating license from a company not properly equipped with all prescribed safety devices.

Civil and criminal liability should be established in all cases of major spills, and the offending parties prosecuted.

The Department of Commerce, through its National Marine Fisheries Service, National Oceanic and Atmospheric Administration (formerly BCF of USDI), should promptly investigate the effects of major oil spills on the safety and quality of marine resources affected. The Department should advise the industry as to proper action to eliminate harm in the market place resulting from inaccurate press reports.

On Thermal Effluents

The heated water effluents from power plants are not necessarily detrimental to but may affect aquatic plants and animals in estuarine areas where they are discharged. With the rising demands for power it is certain that many more power plants, both fossil fuel and nuclear, will be required. To protect commercial and sport fishery resources from adverse effects and make constructive use of the heated discharges, careful evaluation should be made of the effects of increased temperatures on exploitable resources, and on other animal and plant populations on which they depend, before sitings of power plants are approved. Responsible governmental agencies should investigate possible uses of heated water effluents for increasing growth rates of cultured aquatic plants and animals.

It should be the responsibility of the sponsors of power plants to determine what effects the operation of their plant will have on aquatic life, and to finance pre- and post-operational studies as needed. However, responsible government agencies should conduct necessary basic research on the effects of increased temperatures on the environment and on aquatic plants and animals to provide a basis for judgement in the siting of thermal power plants.

Design of the power plants should include methods of complying with water quality standards adopted by the states. The best methods of control of both heated water and other discharges such as biocides, blow-down water, plant floor drains and sanitary sewage, should be required. Water diversions (i.e. intake streams) associated with power plants should be screened to protect aquatic life. State and Federal conservation agencies should work with the power companies to develop new concepts and more efficient methods of screening fish from such diversions.

State and Federal agencies which are responsible for insuring the conservation of all resource values, including fish and wildlife, should review existing water temperature standards of the states in respect to allowable maxima for thermal effluents and change them where needed to provide adequate protection for aquatic life. Where existing water quality is higher than the new quality standards adopted by the states, the existing water quality should be the prevailing standard. Continuing efforts should be made to develop methods of utilizing waste heat for the production of fish and shellfish and for other beneficial uses.

[1] Effective December, 1970, this Act will be enforceable by the Environmental Protection Agency.

NATIONAL FISHERIES INSTITUTE
1225 Connecticut Avenue N.W.
Washington, D.C. 20036
202-223-3161

APRIL 14, 1971.

Mr. ROBERT A. ERKINS,
Chairman, Resource Conservation Committee,
National Fisheries Institute, Inc., Washington, D.C.

DEAR MR. ERKINS: Thank you for your letter of March 12, 1971, expressing support for the effective environmental quality legislation.

The Subcommittee on Air and Water Pollution is conducting hearings on pending water pollution control legislation. Because of your interest, I have arranged for your letter to be included in the hearing record.

Legislation is pending which provides for the control of ocean dumping, also. Hearings have been held at Rehoboth Beach, Delaware, as part of the current series. When these hearings are published, a copy will be forwarded to you.

I have introduced a Senate Joint Resolution calling for an International Conference on Ocean Dumping. A copy of this resolution is enclosed. It is my understanding from Senator Baker, who is working with Christian Herter in the State Department, that a major emphasis on the United States position at the 1972 United Nations Conference on "Man and the Human Environment" will be the need for an international agreement covering the ocean disposal of wastes. You may wish to contact Mr. Herter directly on this matter.

With warm regards,

Truly,

JENNINGS RANDOLPH,
Chairman.

NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS

NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS,
Washington, D.C., April 9, 1971.

Hon. EDMUND S. MUSKIE,
Chairman, Subcommittee on Air and Water Pollution, Committee on Public Works, U.S. Senate, Washington, D.C.

DEAR MR. CHAIRMAN: We were advised by the Air and Water Pollution Subcommittee staff that due to time limitations and the extensive hearings held in the last Congress, the Subcommittee cannot schedule testimony by the National Society of Professional Engineers on the current package of Administration water pollution bills (S–1012 through S–1015) and your waste treatment construction measure (S–523). The Subcommittee's letter of advice did, however, invite us to submit a statement for the record.

This we are pleased to do by supporting the very fine statement which was submitted to you on March 30, 1971, in a letter from the Conference of State Sanitary Engineers over the signature of Mr. Wesley E. Gilbertson, that organization's chairman-elect. Mr. Gilbertson is a past vice president of the National Society of Professional Engineers and knowledgeable and experienced in the matters covered by the subject legislation. He had agreed to act as our witness had the presentation of testimony been possible.

We request that our general support of his statement be incorporated in the hearing record.

Very truly yours,

PAUL H. ROBBINS, P.E.,
Executive Director.

NATIONAL WATER RESOURCES ASSOCIATION

NATIONAL WATER RESOURCES ASSOCIATION,
Washington, D.C., April 14, 1971.

HON. EDMUND S. MUSKIE,
Chairman, Senate Subcommittee on Air and Water Pollution,
Old Senate Office Building, Washington, D.C.

DEAR MR. CHAIRMAN: This relates to the provisions of Section 10(d)(3), S. 1014, which apparently would maintain higher qualities of waters than is useful (see print of S. 1014, Feb. 26, 1971, page 6, lines 3 through 6).

This Association opposes that Section; it appears useless and costly. Our opposition is based on analyses which follow.

To maintain conditions whereby qualitative characteristics are "higher" than criteria applicable to use would cost people money; this is especially significant since S. 1014 extends jurisdiction to ground and other non-navigable waters. For such costs, people are entitled to benefits. But how do people benefit from money spent to maintain characteristics of waters "higher" than their criteria for use?

A case—acid wastes "pollute" a stream, but without adverse effect on any use downstream for several miles. Since acid lowers quality—as fixed for uses elsewhere in a State—should money be spent to stop the degradation, lacking use on the reach concerned?

Further downstream, alkaline waters "pollute" the stream; they would offset the acidity of the upstream input, were it to be permitted. What actions are appropriate to a policy based on no degradation, *regardless* of use? Administrators argued; the case is real.

Another point about Section 10(d)(3) and its phrase: "quality of water higher than water quality criteria applicable to use designations"—Is there any such thing?

S. 1014 defines "use designations" as "legitimate and beneficial uses". Which qualitative characteristics could legitimately be "higher" than those based on beneficial uses? Maintaining a characteristic higher than matches beneficial uses * could be harmful, as well as costly.

The confusion of Sec. 10(d)(3) is avoidable by following the law, as in Section 10(a)(3) . . . for which see Senate Committee Print 91–33, page 22. It says:

"In establishing such standards the Secretary . . . shall take into consideration their *use* and *value* . . ."

That specific direction of law—to consider *use* and *value*—follows directly the broad provisions that "standards are to enhance water quality". Yet this generally is often quoted to justify a disregard for the specifics of *use* and *value*!

Standards which consider use and value are meaningful; concepts of "higher" quality, of something beyond "legitimate and beneficial use" would be meaningless. Thus we find no benefit in the proposed Section 10(d)(3).

Sincerely,

CARL H. BRONN.

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*As "designated."

NEW ENGLAND INTERSTATE WATER POLLUTION CONTROL COMMISSION

NEW ENGLAND INTERSTATE WATER POLLUTION CONTROL COMMISSION,
Boston, Mass., April 23, 1971.

Senator EDMUND S. MUSKIE,
Chairman, Subcommittee on Air and Water Pollution, Committee on Public Works, U.S. Senate, Washington, D.C.

DEAR SENATOR MUSKIE: Thank you for your letter of April 13th and the opportunity of submitting additional comments on pending water pollution legislation. A summary of the pending bills will be distributed to our Commissioners at the Spring Meeting being held in Albany, New York on April 27th. I am sure the Commission will wish to express its own views in addition to those of the Association of State and Interstate Administrators.

In response to your question relative to standards for intrastate waters, the Compact-member States, namely the six New England States and New York State, have adopted standards for these waters. All except Vermont apply the interstate standards to their intrastate waters. Vermont has adopted slightly different standards. A copy of Vermont's standards for both inter- and intrastate waters is attached for your convenience.

All of the Compact-member States' standards except Vermont's have been approved by the Secretary of the Interior or the Administrator of EPA and therefore are also Federal standards. Vermont's standards, although essentially the same as those approved for the other states, are still under negotiation. Considerable difficulty has been experienced by all states in obtaining approval of their respective standards. Criteria changes demanded of one State were not always consistent with those demanded of a neighboring State. There is concern that the standards, as approved to date, reflect these inconsistencies. Following our Commission Meeting on the 27th, we will undertake a review of the approved standards to determine their degree of uniformity with respect to shared waters. We shall be pleased to advise you of our findings.

Sincerely,

ALFRED E. PELOQUIN,
Executive Secretary.

STATE OF VERMONT WATER RESOURCES BOARD, MONTPELIER, VT.

RULES AND REGULATIONS, WATER QUALITY STANDARDS, INTERSTATE

The Vermont Water Resources Board does hereby adopt and promulgate the following rules and regulations implementing or effectuating the provisions of Title 10, Vermont Statutes Annotated, Chapter 33, and does declare its intent to enforce such rules and regulations as required.

The General Policy for Water Use Classes and Standards of Quality for Interstate Waters and the Water Use Classes and Standards of Water Quality for Interstate Waters, both being adopted by the Vermont Water Resources Board on May 29, 1967, will apply to all streams, ponds and lakes which are contiguous to Vermont and one or more neighboring states, or which flow through Vermont and one or more neighboring states, or which have a tributary contiguous to Vermont and a neighboring state, or flowing from Vermont into a neighboring state, as set forth in the New England Interstate Water Pollution Control Compact, Article I. This action is consistent with Articles V and VI of said Compact, wherein it is provided that; "The Commission shall establish reasonable physical, chemical and bacteriological standards of water quality satisfactory for various classifications of use", and wherein Vermont, as a signatory state, pledged that it would provide for the abatement of existing pollution and for the control of future pollution of interstate waters as set forth above. These rules and regulations are developed in accordance with the provisions of Title 10, Vermont Statutes Annotated, Section 575(a), paragraph (12).

59-068—71—pt. 3——22

Public hearings were held on December 1, 1966, March 3, 1967, and May 25, 1967, to obtain testimony on the water quality standards. Copies of these rules and regulations and of the standards included by reference are filed with the Secretary of State and with the State Librarian, in accordance with Title 3, V.S.A., Section 703, and with the Town Clerks, and for the convenience of all parties they are also available upon request from the Department of Water Resources.

Attached hereto and made a part hereof is Exhibit A—"General Policy for Water Use Classes and Standards of Quality for Interstate Waters" adopted May 29, 1967, and Exhibit B—"Water Use Classes and Standards of Quality for Interstate Waters" adopted May 29, 1967.

The Board will receive requests as required by Title 10, V.S.A., Section 575(12)(B) for thirty days following the official date of filing of this document with the Secretary of State.

Done at Montpelier, Vermont, this 29th day of May, 1967.

GENERAL POLICY FOR WATER USE CLASSES AND STANDARDS[1] OF QUALITY FOR INTERSTATE WATERS

(As adopted May 29, 1967, by Vermont Water Resources Board)

1. The New England Interstate Water Pollution Control Commission acting in accordance with Article V of the Compact has reviewed and revised the "Water Use Classes and Standards of Quality for Interstate Waters" in order to assist the states in the administration of more effective and expeditious water pollution control programs in the New England Compact area. The Water Resources Board hereby ratifies the Standards of Quality as revised and adopts them in principle.

2. In the classification of waters due consideration will be given to all factors involved including public health, public enjoyment, propagation and protection of fish and wildlife, and economic and social development. Classifications are not intended to permit indiscriminate waste disposal or to allow minimum efforts of waste treatment under any circumstances.

3. Water quality control problems not specifically referred to in this document shall be evaluated on a case by case basis by the affected states water pollution control agencies and departments of health.

4. Appropriate treatment shall be defined as secondary treatment with disinfection or its industrial waste equivalent as determined by the signatory state regulatory agency. Lesser degrees of treatment or control will be permitted only where it can be demonstrated that attainment of the specified water use class criteria of quality can be effectuated.

5. In the discharge of effluents to the receiving waters, cognizance shall be given both in time and distance to allow for mixing of effluent and stream. Such distances required for complete mixing shall not affect the water usage Class adopted but shall be defined and controlled by the regulatory authority.

6. Recommendations on other waste parameters will constitute a portion of the continuing effort of the Commission in assisting the states in solving interstate water quality problems. The Commission reserves the right to amend or extend the following recommendations as improved standard methods are developed or revisions consistent with the enhancement of water quality are justified.

THE VERMONT WATER RESOURCES BOARD: WATER USE CLASSES AND STANDARDS OF QUALITY FOR INTERSTATE WATERS (AS ADOPTED MAY 29, 1967)

CLASS A: SUITABLE FOR WATER SUPPLY AND ALL OTHER WATER USES; CHARACTER UNIFORMLY EXCELLENT. (SEE NOTE 11)

1. Dissolved oxygen: 75% saturation, 16 hours/day 5 mg/1 at any time.

2. Sludge deposits—solid refuse—floating solids, oils, and grease—scum: None allowable.

[1] Standards have the same meaning as criteria as defined in "Guidelines for Establishing Water Quality Standards for Interstate Waters," published May 1966 by the U.S. Department of Interior, Federal Water Pollution Control Administration.

3. Color and turbidity: None other than of natural origin.
4. Coliform bacteria per 100 ml.: Not to exceed a median of 100 nor more than 500 in more than 10% of samples collected.
5. Taste and odor: None other than of natural origin.
6. pH: As naturally occurs.
7. Allowable temperature increase: None other than of natural origin.
8. Chemical constituents (See Note 5).

CLASS B: SUITABLE FOR BATHING, OTHER RECREATIONAL PURPOSES, AGRICULTURAL USES, INDUSTRIAL PROCESSES AND COOLING; EXCELLENT FISH AND WILD LIFE HABITAT; GOOD ASETHETIC VALUE; ACCEPTABLE FOR PUBLIC WATER SUPPLY WITH APPROPRIATE TREATMENT

1. Dissolved oxygen: 75% saturation, 16 hours/day 5 mg/1 at any time.
2. Sludge deposits—solid refuse—floating solids, oils, and grease—scum: None allowable.
3. Color and turbidity: None in such concentrations that would impair any usages specifically assigned to this Class.
4. Coliform bacteria per 100 ml.: Not to exceed a median of 1,000 nor more than 2,400 in more than 20% of samples collected.
5. Taste and odor: None in such concentrations that would impair any usages specifically assigned to this Class.
6. pH: 6.5 to 8.0.
7. Allowable temperature increase: Only such increases that will not impair any usages specifically assigned to this Class (See Note 7).
8. Chemical constituents (See Note 5).

CLASS C: SUITABLE FOR FISH AND WILD LIFE HABITAT; RECREATIONAL BOATING, AND INDUSTRIAL PROCESSES AND COOLING; UNDER SOME CONDITIONS ACCEPTABLE FOR PUBLIC WATER SUPPLY WITH APPROPRIATE TREATMENT; GOOD AESTHETIC VALUE

1. Dissolved oxygen: 5 mg/1, 16 hours/day; not less than 3 mg/1 at any time. For cold water fishery not less than 5 mg/1 at any time.
2. Sludge deposits—solid refuse—floating solids, oils, and grease—scum: None (See Note 8).
3. Color and turbidity: None in such concentrations that would impair any usages specifically assigned to this Class.
4. Coliform bacteria per 100 ml.: None in such concentrations that would impair any usages specifically assigned to this Class.
5. Taste and odor: None in such concentrations that would impair any usages specifically assigned to this Class.
6. pH: 6.0 to 8.5.
7. Allowable temperature increase: Only such increases that will not impair any usages specifically assigned to this Class (See Note 7).
8. Chemical constituents: (See Note 5).

CLASS D: SUITABLE FOR NAVIGATION, POWER, CERTAIN INDUSTRIAL PROCESSES AND COOLING, AND MIGRATION OF FISH; GOOD AESTHETIC VALUE

1. Dissolved oxygen: A minimum of 2 mg/1 at any time.
2. Sludge deposits—solid refuse—floating solids, oils, and grease—scum: None (See Note 8).
3. Color and turbidity: None in such concentrations that would impair any usages specifically assigned to this Class.
4. Coliform bacteria per 100 ml.: None in such concentrations that would impair any usages specifically assigned to this Class.
5. Taste and odor: None in such concentrations that would impair any usages specifically assigned to this Class.
6. pH: 6.0 to 9.0.
7. Allowable temperature increase: None except where the increase will not exceed the recommended limits on the most sensitive water use and in no case exceed 90° F.
8. Chemical constituents: (See Note 5).

NOTES

1. The Standards do not apply to conditions brought about by natural causes.
2. Class D waters will be assigned only where a higher water use Class cannot be attained after all appropriate waste treatment methods are utilized.

3. All sewage treatment plant effluents shall receive disinfection before discharge to the watercourse. The degree of treatment and disinfection shall be as required by the state pollution control agency.

4. Any water falling below the standards of quality for a given Class shall be considered unsatisfactory for the uses indicated for that Class. Waters falling below the standards of quality for Class D shall be considered to be in a nuisance condition.

5. Waters shall be free from chemical constituents in concentrations or combinations which would be harmful to human, animal, or aquatic life for the appropriate, most sensitive and governing water class use. In areas where fisheries are the governing considerations and approved limits have not been established, bioassays including assessment of taste and odor in edible fish shall be performed as required by the appropriate agencies. For public drinking water supplies the limits prescribed by the United States Public Health Service may be used where not superseded by more stringent signatory state requirements.

6. Radioactivity limits to be approved by the appropriate state agency with consideration of possible adverse effects in downstream waters from discharge of radioactive wastes; limits in a particular watershed to be resolved when necessary after consultation between states involved.

7. The temperature increase shall not raise the temperature of the receiving waters above 68° F. for waters supporting cold water fisheries and 83° F. for waters supporting a warm water fishery. In no case shall the temperature of the receiving water be raised more than 4° F.

8. Sludge deposits, floating solids, oils, grease and scum shall not be allowed except for such amounts that may result from the discharge of appropriately treated sewage or industrial waste effluents.

9. The minimum average daily flow for seven consecutive days that can be expected to occur once in ten years shall be the minimum flow to which the standards apply.

10. Class B and C waters shall be substantially free of pollutants that:

(a) Unduly affect the composition of bottom fauna,

(b) Unduly affect the physical or chemical nature of the bottom,

(c) Interfere with the propagation of fish.

11. Class A waters reserved for water supply may be subject to restricted use by state and local regulation.

STATE OF VERMONT, DEPARTMENT OF WATER RESOURCES, TECHNICAL GUIDELINES FOR INTRASTATE WATERS

INTRODUCTION

The following guidelines are designed to promote uniform and consistent procedures for measuring and evaluating water quality of intrastate waters in Vermont. This document is made a part of and is to be used in connection with the "WATER USE CLASSES AND STANDARDS OF QUALITY FOR INTRASTATE WATERS," as adopted by the Vermont Water Resources Board on March 10, 1967.

GENERAL

A. Effluent Discharges

When an effluent is permitted to be discharged from an appropriate waste treatment facility, as approved by the Vermont Water Resources Board, a zone of mixing will be defined by the Board. This zone is not to be construed as a variance in the Class of water so assigned but only as a zone of water to allow for diffusion of the approved effluent. Class D water will be assigned only where a higher water use class can not be attained after all appropriate waste treatment methods are utilized as provided by Vermont Statutes.

B. Appropriate Treatment

Appropriate treatment shall be defined as secondary treatment with disinfection or its industrial waste equivalent as determined by the Vermont Water Resources Board. Lesser degrees of treatment or control may be permitted where it can be demonstrated definitely that attainment of the specified water use class standards of quality can be accomplished.

C. Unusual Pollutants

Water quality standards not specifically described in the descriptive table shall be evaluated on a case-by-case basis by the Vermont Water Resources Board.

Such pollutants may include but are not limited to radioactive substances, pesticides, herbicides or algicides.

D. Effluent Restrictions

There shall be no discharge of effluent from any sewage treatment plant or facility into:

(1) Class A waters of the State; 10 V.S.A., 903, paragraph 1.

(2) Class B lakes or ponds lying within the State's boundaries; 10 V.S.A., 903, paragraph 2, and 10 V.S.A., 901 through 908.

(3) Class B streams or rivers from the headwaters down to the point where such properly treated effluent is presently being introduced, except in cases of extreme need or reasonable necessity, in which cases, tertiary treatment or its equivalent will be required; 10 V.S.A., 901 through 908.

E. Appropriate Disinfection

These terms shall be defined as any process that has equivalent bactericidal effects to that achieved by chlorination with twenty minute detention and at least 0.5 mg/1 of chlorine residual in the effluent.

TECHNICAL

A. Hydrology

Standards shall apply to stream conditions existing during critical minimum low flow periods. In the administration of the State's comprehensive water pollution control program, consideration shall be given to providing mechanical means at dams for sustained flow where necessary to eliminate the hazard of water quality degradation during periods of interrupted streamflow.

B. Sampling

1. *Dissolved Oxygen*

Class B waters: 7.0 mg/1.

Class C waters: Not less than 5 mg/1 during at least 16 hours of any 24-hour period nor less than 4 mg/1 at any time.

Class D waters: Not less than 2 mg/1 during at least 16 hours of any 24-hour period nor less than 1 mg/1 at any time.

2. *Coliform Bacteria:*

Class A waters: Not to exceed a median value of 100 coliform organisms per 100 ml for a minimum of five samples collected during any 30-day period. Individual daily value shall not exceed 500 coliform organisms.

Class B waters: Not to exceed a median value of 500 coliform organisms per 100 ml for a minimum of five samples collected during any 30-day period. Individual daily value shall not exceed 2,500 coliform organisms.

Class C waters: All domestic sewage effluents must be disinfected. Other waste effluents not specifically of a domestic origin but containing organisms that could influence public health conditions must also be disinfected when so directed by the Board. Limits on coliform organisms shall be a median of 5,000 per 100 ml for a minimum of five samples collected during any dry weather flow period.

Class D waters: All domestic sewage effluents must be disinfected. Coliform counts permissible in these waters will be that value obtained after the effluent has received appropriate disinfection.

C. Chemical Constituents

Waters shall be free from chemical constituents in concentrations or combinations which would be harmful to human, animal, or aquatic life for the appropriate water use class. In areas where fisheries are the governing consideration and approved limits have not been established, bioassays shall be performed as required by the Vermont Water Resources Board. For public drinking water supplies the limits prescribed by the United States Public Health Service may be used where not superseded by more stringent State Health Department requirements.

D. Temperature

Class C waters: Thermal pollution will be evaluated on an individual discharge basis. Treatment of thermal discharges must be effected so that the resulting stream temperatures follow the normal diurnal fluctuation.

Class D waters: Thermal pollution will be evaluated on an individual discharge basis. In no case shall a maximum temperature of 90° be reached for more than six hours of each 24-hour period. Treatment of the thermal discharges should be effected so that the resulting stream temperatures follow the normal diurnal fluctuation.

STATE OF VERMONT, DEPARTMENT OF WATER RESOURCES, WATER USE CLASSES AND STANDARDS OF QUALITY FOR INTRASTATE WATERS (AS ADOPTED MAR. 10, 1967)

Statutory, water use classes and description	Standards of quality							
	Dissolved oxygen	Sludge deposits-Solid refuse-Floating solids, oils, and grease-Scum	Color and turbidity	Coliform bacteria per 100 ml.	Taste and odor	pH	Chemical constituents	Allowable temperature increase
Class A: Suitable for public water supply with disinfection when necessary. Character uniformly excellent.	No change	No change	No change	Not more than 100	No change	No change	No change	None.
Class B: Suitable for bathing and recreation, irrigation and agricultural uses; good fish habitat; good aesthetic value; acceptable for public water supply with filtration and disinfection.	Not less than 7 mg/l.	do	do	Not more than 500	do	No reduction but allowable increase to 8.0.	do	Do.
Class C: Suitable for recreational boating, irrigation of crops not used for consumption without cooking; habitat for wild life and for common food and game fishes indigenous to the region; and such industrial uses as are consistent with other class "C" uses.	Not less than 5 mg/l.	That may result only from appropriately treated effluents provided it does not cause a violation of the classification of contiguous waters.	That may result only from appropriately treated effluents provided it does not cause a violation of the classification of contiguous waters.	Not more than 5,000	That may result only from appropriately treated effluents provided it does not cause a violation of the classification of contiguous waters.	6.0–8.5	That may result only from appropriately treated effluents provided it does not cause a violation of the classification of contiguous waters.	None, except as may be consistent with fish and wild life habitat and the uses specified provided it does not cause a violation of the classification of contiguous waters.
Class D: Suitable for supporting aerobic aquatic life, for power, navigation and certain industrial process needs consistent with other Class D uses and for restricted zones of water to assimilate appropriately treated wastes.	Not less than 2 mg/l.	do	do	Only those resulting after appropriate disinfection.	do	6.0–9.0	do	Only such increases as will not cause a violation of the classification of contiguous waters or a temperature to exceed 90°F in the zone of mixing.

NOTES

1. These standards do not apply to conditions brought about by natural causes.

2. These standards are to be applied to all waters of the State as defined in 10 VSA 901(d), except interstate boundary waters as defined in 10 VSA 992. The standards are to be used in connection with the "Technical Guidelines" as adopted by the Vermont Water Resources Board on Mar. 10, 1967 and in technical evaluation of chemical, physical and bacteriological data.

NEW MEXICO WATER QUALITY CONTROL COMMISSION

By JOHN R. WRIGHT, Executive Secretary

Comments on S. 523

The proposed Senate Bill 523, dated February 2 (legislative day, January 26), 1971, among other things will require the establishment of effluent requirements and a permit system to be established jointly by EPA and the State agencies. The establishment of effluent permits has not been provided for in past legislation and does not appear to be necessary for the control of water pollution in New Mexico.

This State's Water Quality Act does not provide for a permit system but does permit the establishment of effluent regulations for the control of water pollution. It is New Mexico's position that effluent requirements are sufficient to control water pollution and that a permit system is overly cumbersome for the problems within this State.

The proposed amendment to Section 10 of the Water Quality Act requires the establishment of Water Quality Standards and stipulates deadlines for attainment of the new standards within three years. It would appear that the repassing of Section 10 would require the establishment of water quality standards all over again. New Mexico's Water Quality Standards were totally approved by the Secretary of the Interior on August 29, 1969, and it would be a horrendous waste of administrative effort if Water Quality Standards would have to be readopted.

S–523 would prohibit any degradation of present water quality and would require that all water quality standards be adopted within a statutory deadline and attained within 3 years after approval. A prohibition against any degradation of present water quality will cause gross inequity within several river basins in the Western United States.

Interstate Compacts apportion the use of interstate streams among the western states. What is apportioned by these compacts is in effect "beneficial consumptive use." Beneficial consumptive use is defined as the amount of water diverted from the stream, less the return flow thereto.

When water is diverted from a stream for irrigation—or for that matter, for most municipal and industrial uses in the southwest—a part of the water is evaporated and the remainder returns to the stream. For example, about two-thirds of the water applied to the land for the irrigation of crops is consumed by evaporation and moves off on the wind; the balance returns to the stream.

That part of the water diverted that is consumed, or evaporated, is pure H_2O and that part which returns to the stream carries all of the dissolved minerals or salinity that was in the water diverted.

Thus, an inescapable consequence of the beneficial consumptive use of water is a degradation of its quality by an increase in the concentration of dissolved solids in the water. Even though the tonnage of dissolved solids remains the same, the amount of water in which it is carried is less and the concentration is increased.

New Mexico intends to limit pollution of her portion of the Colorado Basin and can report that at this time all sewered communities in the basin in New Mexico have secondary sewage treatment; however, S–523 as proposed would preclude any increase in beneficial consumptive use above present levels thereby depriving New Mexico of any future growth.

The Colorado River Compact of 1922 apportioned the beneficial consumptive use of the waters of the Colorado River System 7.5 million acre-feet annually to the Upper Basin and 8.5 million acre-feet annually to the Lower Basin. The Upper Basin states of New Mexico, Colorado, Utah and Wyoming presently are consuming only about 3 million acre-feet, or less than ½ of the allocation made to them. Under S–523 this consumptive use could not be increased and the Upper Basin states would be deprived of more than ½ of their entitlement.

New Mexico, for example, would lose about 560,000 acre-feet of the approximately 800,000 acre-feet of consumptive uses that we are entitled to make annually for the Upper Basin of the Colorado River system. Such a curtailment would affect both Indian and White irrigation and municipal and industrial usages.

S–523 would prohibit the beneficial consumptive use of water that states are entitled to under solemn interstate agreements and would have the effect of reapportioning the water of the Colorado River system and other systems where the upstream state has not yet applied to beneficial use, her lawful share.

In 1967 the states of the Colorado River Basin (recognizing that answers to important questions regarding total dissolved solids, chlorides, sulfates and sodium were lacking or were based on factors not yet well defined) established guidelines for formulating water quality standards for the interstate waters of the Colorado system. Following the adoption of the guidelines, the Colorado River Basin states and the Upper Colorado River Commission, submitted to the Secretary of the Interior the attached resolutions relating to mineral standards for salinity of the Colorado River system.

One of the agency reports referred to in the resolutions has only recently been released to the states of the Colorado River Basin, the other is still not available. Until such reports and other data are available for study and interpretation, a meaningful determination of quantitative standards for the salinity of the Colorado River systems cannot be made.

The State of New Mexico strongly urges that S–523 be amended to allow salinity degradation resulting from beneficial consumptive use of waters apportioned under solemn interstate agreements.

Yours truly,

JOHN R. WRIGHT,
Executive Secretary, N.M. Water Quality Control Commission.

COLORADO RIVER BASIN STATE CONFEREES, NOVEMBER 15, 1967

RESOLUTION RELATIVE TO NUMERICAL STANDARDS FOR SALINITY OF THE COLORADO RIVER SYSTEM

Whereas representatives of the water pollution control agencies of the seven Colorado River Basin states held several interstate meetings to develop guidelines to enable each of the states to adopt individual water quality control standards for the Colorado River System that would be in compliance with the Federal Water Quality Act of 1965 and compatible with the other states' standards; and

Whereas it was agreed at these meetings that there was not sufficient information available to set specific levels for total dissolved solids; and

Whereas it was further agreed that specific numerical salinity standards would not be set until after sufficient data were available to answer the many questions regarding causes and effects of salinity; and

Whereas the announced FWPCA Policy is that "Specific numerical criteria for TDS will be required for the Colorado River system based upon present quality, contiguous state, compatibility and a not-to-exceed limit of 1000 mg/l at Imperial Dam"; and

Whereas the Conferees of the seven Colorado River Basin states met on November 15, 1967, to consider the suggested standard of 1000 mg/l; and

Whereas it was determined at this meeting that currently available information does not justify the setting of meaningful numerical salinity standards; and

Whereas the Public Health Service and subsequently the FWPCA has since January 1960 comprehensively investigated the water quality of the Colorado River System; and

Whereas the Bureau of Reclamation has underway investigations designed to project the quality of the water of the Colorado River system under full development and to determine feasible water management measures to reduce the salinity of the waters of the Colorado River; and

Whereas the states need the information from these comprehensive studies to establish meaningful numerical standards; now, therefore, be it

Resolved, That the Conferees do not believe it is appropriate that a standard of 1,000 mg/l or any other definite number for TDS at Imperial Dam be set by the basin states or the Secretary of the Interior at this time; and be it further

Resolved, That the Conferees urge the completion of water quality reports of the Federal Agencies at the earliest practicable date, and that thereafter the basin states and federal agencies again consider the setting of salinity standards for the Colorado River System; and be it further

Resolved, That the Conferees hereby urge the FWPCA to consider the approval of the water quality standards of the seven Colorado River Basin states conditioned upon ultimate establishment of acceptable numerical salinity standards after completion and consideration of FWPCA and Bureau of Reclamation reports presently underway.

RESOLUTION BY UPPER COLORADO RIVER COMMISSION

WATER QUALITY CRITERIA FOR COLORADO RIVER SYSTEM

Whereas, the Federal Water Pollution Control Administration has proposed that quantitative criteria for total dissolved solids be set at various points in the Colorado River system based on an upper limit of 1000 mg/l at Imperial Dam; and

Whereas, the concentration of dissolved solids at Imperial Dam in recent years has exceeded 1000 mg/l; and

Whereas, the Colorado River Compact of 1922 allocated the beneficial consumptive use of 7.5 million acre feet of water annually to the Upper Colorado River Basin; and

Whereas, the beneficial consumptive use of water in the Upper Colorado River Basin currently is less than 3.0 million acre feet annually; and

Whereas, consumptive use of water for irrigation, municipal, industrial or solids by consuming a part of the water diverted from the stream and leaving all of the salts diverted in the remainder; also an increase in concentration of dissolved solids results from the addition of some dissolved solids not reasonably and economically removable; and

Whereas, the information currently available is inadequate to project the concentration of dissolved solids at Imperial Dam taking into consideration the reasonable use of water in the Upper Basin under full development within the limits of the Colorado River Compact along with good water management practices including possible measures to control natural sources of saline water; and

Whereas, the Department of Health, Education and Welfare and subsequently the Federal Water Pollution Control Administration have had an investigation known as the Colorado River Basin Water Quality Control Project underway for seven years; and

Whereas, the Bureau of Reclamation under Public Laws 84–485, 87–483 and 87–590 has underway an investigation designed to project the quality of the water of the Colordao River system under full development; and

Whereas, representatives of the seven states of the Colorado River Basin, at a meeting in Denver on July 27, 1967, agreed to continue studies of the salinity of the Colorado River system and to attempt to agree upon numerical criteria for dissolved solids to be established at selected points on the system; now, therefore, be it

Resolved, That water quality criteria on the Colorado River should not preclude or interfere with the reasonable use of water in the Upper Basin within the terms of the Colorado River Compact; and be it further

Resolved, That quantitative criteria for dissolved solids in the waters of the Colorado River system should not be proposed or adopted by the States or the Secretary of the Interior until the studies currently being made by Department of the Interior agencies have been completed; and be it further

Resolved, That the Secretary of the Interior be commended for his recent order to the Federal Water Pollution Control Administration and the Bureau of Reclamation to accelerate studies and reports on the salinity of the waters of the Colorado River system; and be it further

Resolved, That the Secretary of the Interior be urged to make the Department of the Interior agency reports available to the States at the earliest possible date so that these reports may be considered and utilized in the determination of quantitative standards for the waters of the Colorado River sysem to be unanimously proposed by the States of the Colorado River Basin pursuant to the Water Quality Act of 1965; and be it further

Resolved, That copies of this resolution be transmitted to the Secretary of the Interior and the Governors of each of the seven Colorado River Basin States.

CERTIFICATE

I, Ival V. Goslin, Executive Director of the Upper Colorado River Commission, do hereby certify that the above Resolution was unanimously adopted by the Upper Colorado River Commission at an Adjourned Regular Meeting and Annual Meeting held at Moran, Wyoming on September 21, 1967.

Witness my hand this 22nd day of September, 1967.

IVAL V. GOSLIN,
Executive Director.

STATEMENT OF COMMITTEE ON ENVIRONMENTAL QUALITY OF PHILADELPHIA BAR ASSOCIATION

This testimony is submitted on behalf of the Committee on Environmental Quality of the Philadelphia Bar Association as a supplement to our previous testimony on pending water quality legislation which was presented before your Subcommittee on June 10, 1970.[1]

We are greatly impressed by the number and variety of bills which are before the subcommittee at this time. It is indeed heartening to witness so much legislative energy being channeled into such a critical area. We are optimistic that such enthusiasm will continue so that the arduous and long term project of enhancing our waters will come to fruition.

In reviewing S. 523 and S. 1013, S. 1014 and S. 1015, we were immediately struck by the substantial areas of agreement among the proposed amendments to the Water Pollution Control Act.[2] We applaud, in particular, their agreement on increased funding and the extension of the Water Pollution Control Act to all waters in the United States, both of which we believe are essential if the pollution of our waters is to be curbed. Our task of evaluating these proposals was greatly eased since we find that both the Administration and the Muskie proposals mark a substantial and substantive advance over the present legislation. However, there are areas of particular importance to which we now turn our attention.

Environmental Financial Agency

(1) We would like to express our vigorous support for S. 1016, which would establish an Environmental Financing Agency. It is especially crucial in light of the financial plight of our municipalities and the magnitude of their water pollution problems that approaches to ease their financial burden of funding waste treatment works be pursued and implemented.

Improved Plan

(2) S. 1012, in contrast to S. 523, would amend § 7 of the water Pollution Control Act to provide for increased funding to states with "improved" plans to enhance water quality. We believe this method provided a unique incentive to encourage states to redouble their water pollution control efforts.

Self-Sufficiency

(3) We strongly support the concept of "self-sufficiency" embodied in S. 1013. We believe that local initiative must be encouraged in order to accomplish the long term, sustained efforts needed to improve our water quality.

User Charges

(4) We also are in full support of user charges, under which the industrial polluters must bear their share of pollution clean-up expenses. Unless the industrial polluter is financially burdened by his pollution, he has no business reason to abate his pollution. Thus, the user charge must be sufficiently costly so that industry is encouraged to install its own pollution control devices. However, our Committee finds itself in a somewhat paradoxical position for we favor S. 523 under which user charges would recoup from industry only industry's proportionate share of non-federal costs. Under S. 1013 user charges would recoup industry's share of federal and non-federal costs. We strongly urge that the immediate need for such waste treatment plants is so great that any pro-

[1] This testimony was prepared by a special task force of the Committee on Environmental Quality whose members are Philip J. Wiesner, Chairman; Frank Friedman, Sheridan P. Hunt, Jr., Edward F. Mannino, and Kenneth R. Myers. Our original testimony appears in Water Pollution—1970 (Part 5), pp. 1843–45.

[2] Senator Muskie recently commented on the wide areas of agreement. See *BNA Environment Reporter, Current Developments*, pg. 1257 (March 17, 1971).

posal which is likely to create local resistance must be avoided. S. 253, which places a lesser burden on local industry than S. 1013 with regard to funding waste treatment works, is better tailored to accomplish quick results. We would encourage industry to install pollution control devices through the use of tax credits which we believe are easy to administer.

Regional Planning

(5) Our Committee strongly supports metropolitan or regional planning as the most effective means of controlling the pollution of too many of our waters which meander through multitudinous jurisdictions. Thus, we believe that S. 523 presents the superior approach with its incentives for river basin projects [§ 8(e)]. Also on point is S. 601 which would provide additional funds to states with intrastate basin water quality management agencies.

Anti-Degradation

(6) S. 523 would amend § 10(b)(1) to provide that "No State standards and plan shall be approved which provide for the degradation of the present quality of *any waters*, or which in any way interfere with the attainment of approved water quality standards within the statutorily required time in any downstream or other State." (emphasis added.) While we approve of the concept of anti-degradation, situations might arise where prudent pollution planning might require the reduction of the present concentration of industry in one area with a concomitant increase in another area. Moreover, this provision apparently rules out zoning different areas of a river basin to provide for water quality standards which vary according to use. This approach has been used successfully by the Delaware River Basin Commission. We suggest, therefore, that the language of 10(b)(1) be qualified to read "provide for the degradation of the present quality of the waters of *any river basin*" (emphasis added) as a substitute for the present proposed language cited above.

Closed Cycle Systems

(7) S. 523 would add § 10(e)(2) which provides that "whenever the Administrator finds . . . that closed-cycle production or treatment systems are available or can be made available any effluent equipment applicable to a new building, structure or facility shall provide for no discharge except as may be required to operate such closed-cycle system." While-closed cycle production or treatment systems must be encouraged, the language "can be made available" is subject to many conflicting interpretations. Also the permit system, which is effective as of July 1, 1971 and will be administered jointly by the U.S. Army Corps of Engineers and the Environmental Protection Agency requires the consideration of alternative means of disposal in applying for a discharge permit. Thus, if a closed-cycle system is a feasible alternative a permit should not be granted.

Citizen Suits

(8) Last year, in separate testimony before this Subcommittee on the proposed legislation which later was enacted as the Clear Air Amendments of 1970, and on the then-pending water pollution bills, our Committee indicated its vigorous support for the concept of the citizen suit to abate air and water pollution.[3] We are encouraged that a right of citizen suit was ultimately conferred by Section 304 of the Clean Air Amendments, and that both of the major bills presently before this Committee—S. 523 and S. 1014—would extend that concept to the water quality area. In reviewing the differences in the citizen suit provisions of S. 523 and S. 1014, we find, on balance, that the broader and less intricate standards of S. 523 are preferable to the analogous provisions of S. 1014. In addition, we offer the following specific comments:

(a) Section 11(i)(1)(A) of S. 523 would permit citizen suits against any private party or governmental instrumentality or agency to enjoin violations *inter alia* of "any water quality standard, effluent requirement, schedule, or timetable of compliance, or prohibition of discharge. . . ." The comparable provision of Section 10(k)(1)(A) of S. 1014, however, extends only to violations of "any standard or limitation under this section." While it may well be that both provi-

[3] See Air Pollution—1970 (pt. 4), pp. 1483–84; Water Pollution—1970 (pt. 5), p. 1844.

sions are meant to embrace the same situations, we find the more precise language of S. 523 preferable to avoid confusion as to statutory coverage.

(b) We note that Section 10(k)(2)(A)(i) of S. 1014 follows the lead of Section 304 of the Clean Air Amendments, by requiring 60 days notice of the intent to commence a private suit. While we recognize the policy basis underlying such a requirement, we do feel that if such a provision (not contained in S. 523) is adopted, an express exception should be made for cases in which there is an imminent danger to public health or welfare. Otherwise, serious problems could ensue in cases where the administrator, for some reason, is unable to act promptly.[4]

(c) A majority of our committee finds undesirable the provisions in Section 10(k)(1) of S. 1014 which require courts to "take into account," before entering an order requiring compliance with the Act, an enumerated list of considerations including "the practicability of compliance," "the seriousness of the violation," and "any good faith efforts to comply" with requirements under the Act. The implication of such statutory language, the majority feel, is that such considerations might preclude entry of an order requiring compliance, an implication they find unacceptable. While in certain cases some relief from the requirements of the Act might conceivably be justified, the elevation of such considerations as are set forth in S. 1014 virtually to the status of affirmative defenses seems too broad a "solution" to the problem. The Committee is not in complete accord on this point. A minority find the enumerated list of considerations desirable and necessary, although all agree that the considerations must not be elevated to the level of affirmative defenses. The minority believe, however, that the courts must be given the express power to weigh these considerations so that the result in each decision can be fashioned to meet the equities of each given situation.

(d) We find the provisions of Section 10(k)(6) (A) and (B) of S. 1014 questionable, since the notice and preclusion features contained therein would apparently transform every citizen suit into a class action, and bar any subsequent suit no matter how ineffective the particular plaintiff may have been. Such a provision could, under extreme circumstances, lead to collusive non-adverse lawsuits to gain an immunity from citizen suits. Moreover, the mandatory notice provisions would impose, under the general rule that the class plaintiff bear the expenses of notice, yet another cost of suit upon the citizen plaintiff. We feel that the legitimate concern of this section to avoid a multiplicity of lawsuits might best be solved by a simple provision, such as that contained in Michigan's Environmental Protection Act, expressly recognizing that "The doctrines of collateral estoppel and res judicata may be applied by the court to present multiplicity of suits." Michigan Enrolled House Bill No. 3055, § 5(3), effective Oct. 1, 1970. *BNA Environmental Reporter, State Air Laws*, 411 :0121.

(e) Although, as indicated above, we favor the citizen suit provisions of S. 523, we are concerned with the possible consequences of section 11(i)(3), which permits, as does section 10(k)(4) of S. 1014, an award of attorney and expert witness fees against an unsuccessful citizen plaintiff. A possible effect of such a provision may be to deter even well-intentioned and meritorious suits, out of concern for incurring a ruinous liability. That such an effect is possible is vividly demonstrated by the experience in private litigation under the Securities Act of 1933 and the Securities Exchange Act of 1934. While Sections 11 and 12 of the 1933 Act reach much the same transactions involving fraud in securities sales as does Section 10(b) of the 1934 Act, comparatively few suits are instituted under the 1933 Act since it allows recovery of attorney fees against an unsuccessful plaintiff.[5] We would therefore suggest either that the provision for recovery of such costs against plaintiffs be deleted, or, alternatively, that the provision be amended to indicate that attorneys' fees and expert witness fees can only be awarded against an unsuccessful citizen plaintiff where his suit is found, after hearing, to have been instituted in bad faith, for the sole purpose of harrassing or vexing the defendant, or with knowledge that its claims were wholly baseless.

EXEMPTIONS

(9) We note that Section 10(1)(4) of S. 1014 permits virtually unlimited exemptions from proposed effluent limitations by the President. Since such exemp-

[4] We do not oppose the provisions of Section 10(k)(2)(A) (ii) or(iii), barring citizen suits where effective administrative action has already been taken, but do note that judicial doctrines of comity and deference to administrative action may be sufficient to attain the same objective, even absent express statutory provision therefor.

[5] See III Loss, *Securities Regulation* (2d ed. 1961), pp. 1778–80.

tions may well have a direct impact upon health and welfare, we suggest two amendments to this provision. First, the office of the President should not be additionally burdened by this responsibility, which falls properly within the expertise of the Administrator. Secondly, all exemptions should be required to be made in writing, with detailed findings of fact made to support the necessity for an exemption. If no such procedure is established, review of exemptions is made nearly impossible and a serious loophole opened wide. See generally *Citizens To Preserve Overton Park, Inc. v. Volpe*, No. 1066, Oct. Term 1970, U.S. Supreme Court, March 2, 1971, 39 *U.S.L. Week* 4287, 4292, 2 E.R.C. 1250, 1256.

Conclusion

Again, our Committee wishes to express its appreciation for this opportunity to state our views on the pending water pollution bills before this Subcommittee.

STATEMENT OF DR. JOHN O. RASMUSSEN

YALE UNIVERSITY, DEPARTMENT OF CHEMISTRY,
New Haven, Conn., April 14, 1971.

Hon. EDMUND MUSKIE,
Senator from Maine,
Senate Office Building, Washington, D.C.

DEAR SENATOR MUSKIE: I would take the occasion of this letter to enclose a speech of mine touching on the preservation of the environment, a matter to which you have been sensitive long before the rest of the country. I feel disillusioned that federal funding in water quality research and development has actually gone down at the same time that billions of dollars are being made available for construction of sewage treatment plants of decades-old technology. I don't have the figures from the actual budget last year, but the enclosed sheets from the President's budget of a year ago show the general picture—a decrease in funds in the analytical methods development for water pollutants.

A year ago I had persuaded my brother, the President of Space Vector Corporation in California, to divert some of his company's efforts to development of a nuclear device for measurement of nitrogen and phosphorous compounds in water. The removal of these micronutrients is, as you well know, a matter of prime concern and the reason for tertiary treatment stages in sewage plants. Our proposal was caught in the funding squeeze. The concluding paragraphs of our enclosed talk give the story. (70 proposals reviewed in Athens, 20 recommended for funding, 4 actually funded.)

I am concerned that the administration's environmental protection program may be far too heavily weighted toward massive construction by existing technology—things tangible that can be pointed out for short-term political impact. At the same time they are cutting funds not only for extramural grants but also for their own water quality laboratories in Athens, Georgia; W. Kingston, Rhode Island; and Cincinnati, Ohio, (where I visited). The pay-off of research and development may be too intangible and not sufficiently immediate for maximum political impact, but I fear serious consequences of the extreme unbalance in the program.

Sincerely yours,

JOHN O. RASMUSSEN.

Enclosures.

P.S. The President's budget sheets will not be enclosed—have been misplaced.

AMERICAN CHEMICAL SOCIETY

(161st National Meeting, Los Angeles, March 28–April 2, 1971)

A NUCLEAR ALPHA-PROTON REACTION SENSOR FOR NITROGEN AND PHOSPHORUS COMPOUNDS IN NATURAL AND WASTE WATERS

(By J. O. Rasmussen Jr., and R. O. Rasmussen)

A common theme recurring in the literature on water quality of streams is the need to monitor nitrogen and phosphorus compounds, since their concentrations affect importantly the growth of algae and other plant life. The eutrophication processes by which lakes age are greatly accelerated by excessive concentrations of nitrogen compounds available for aquatic plant life. Heavy loadings of these nutrient elements may come from agricultural run-off, carrying dissolved agricultural chemical fertilizers. Other sources are the effluents from sewage treatment plants, through which pass phosphate-containing detergents.

Not only is reliable monitoring of nitrogen and phosphorus in fresh waters important, but such measurements may also be important for estuarine and ocean waters. The fertility of sea water for phytoplankton at the lower end of the food chain is dependent on these nutrients. Recent studies have shown the possibilities for optimized secondary sewage processing through measurement of ammonia

and nitrate concentration changes as control indicators for the aeration stage.

The analytical methods by wet chemistry for nitrogen and phosphorus are complicated and subject to interference. Great ingenuity has been applied to automating the wet chemical methods, but there is clearly a need for further development of simpler, more reliable sensors. The recent report of the Subcommittee on Environmental Improvement (American Chemical Society Committee on Chemistry and Public Affairs) made a number of specific recommendations for cleaning our environment. Recommendation W5 states, "Systematic studies should be encouraged on the flow and reactions of forms of phosphorus and nitrogen, and various organic substances, in soil and ground water." Recommendation W16 is: "Basic data should be gathered systematically to delineate the relative importance of the various agricultural and rural sources of compounds of nitrogen and phosphorus in surface waters and ground waters". Recommendation W22 is: "Emphasis should be placed on the development of analytical methods for specific organic pollutants at all concentrations and in all waste sources and receiving water, including estuaries and the oceans. Similar effort should be devoted to developing methods for low levels of phosphorus, nitrogen, and other nutrients that are involved in eutrophication".

In what concentration range would sensors need to operate? R. S. Green has called for development of sensors with high ranges on various forms of nitrogen spanning 0–10 mg/1 and for phosphorus spanning 0–20 mg/1, with a low range of a tenth of these values.

It has been known since 1940 that excessive nitrate content in drinking waters can cause methemoglobinemia in infants ("blue babies"). This problem has been of main concern in Iowa, Minnesota, and Ohio, and on the basis of studies there, the U.S. Public Health Service in 1962 recommended that nitrate concentration should not exceed 10 mg nitrogen per liter in public water supplies. The three main Los Angeles water sources averaged 1,2, and 6 mg/1 nitrogen nitrate in 1968–1969.

Analysis for nitrate has its problems, and Sawyer and McCarty in their book on *Chemistry for Sanitary Engineers* state: *"The determination of nitrate nitrogen is probably one of the most difficult an analyst has to perform in order to obtain results in which he has real confidence. Two methods are recommended in "Standard Methods": The phenoldisulfonic acid and brucine methods. Both have severe limitations, and results obtained on natural samples can best be classed as semi-quantitaive. The need is great for a more refined and exact method of analysis."*

Phosphorus is analyzed by converting polyphosphates or organic phosphates to the orthophosphate, which is usually determined colorimetrically with ammonium molybdate. Some of the reagent solutions must be refrigerated to preserve them longer than a day.

Sewage treatment plants have great need for nitrogen analyses, since known concentrations are required for optimum action of biological treatment processes. When sewage sludges are to be sold for fertilizing purposes, the nitrogen content of the sludge is a major factor in determining the value.

Considerable difficulties are encountered in measuring nitrogen and phosphorus contents of sewage treatment sludges, though these determinations are needed to evaluating their worth as fertilizers. Typical concentrations in sludges are 4–6% nitrogen and 1–1.5% phosphorus.

Incidentally, thermal neutron activation analysis is unsuitable for nitrogen and phosphorus, though fast neutron (n,2n) and (n,α) products are possibilities but not very practical. Certainly we need more specificity than the fast neutron methods would give—hence, we have looked to possibilities of charged particle analysis based on alpha emitters.

The inspiration of course came from the Turkevich, Patterson, and Franzgrote lunar analyyer boxes that flew on the Surveyor series. If NASA selected the alpha analysis above all others for remote, automated, chemical analysis of the moon, surely the method has application on earth, where we have a wide choice of options in sample preparation. However, we also have some restrictions, namely the lack of the natural lunar vacuum and the need to cover alpha sources more carefully to prevent contamination. Ideally, the sensors should be fast and cheap.

We have conducted preliminary experiments and have considered a wide variety of possible schemes to meet the expressed needs of the Federal Water Quality laboratories at Athens, Georgia or Cincinnati, Ohio. In order to be sufficiently specific in the allotted time I shall focus for the rest of this talk on one special problem, that of measuring the ammonium and nitrate-nitrite concentrations at various stages of the sewage treatment process.

The first slide schematically shows the secondary processing stage in sewage treatment. The biologically active mass of bacteria constituting the activated sludge assimilates organic foodstuffs over several hours in air-blown tanks: oxygen is consumed and carbon dioxide liberated.

(Fig. 1 follows:)

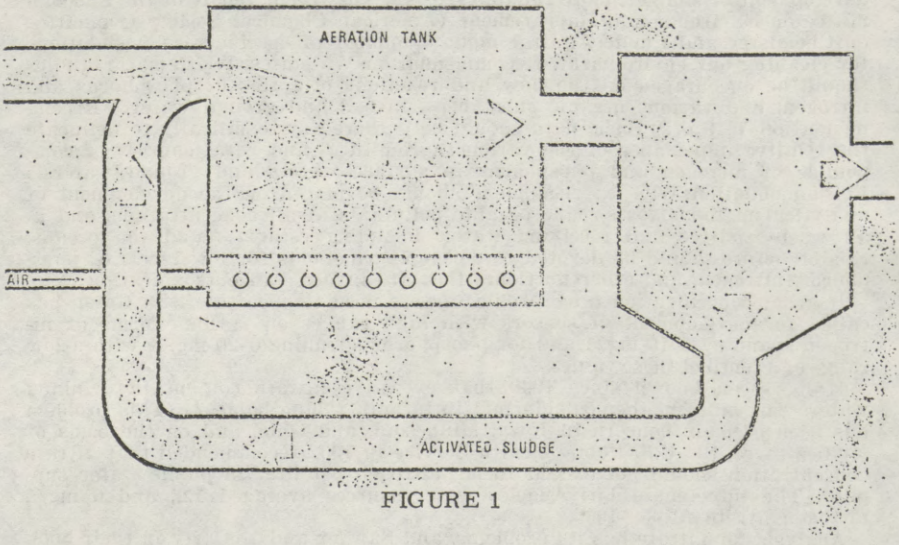

FIGURE 1

The primary stage is mainly a screening and settling stage which does not appreciably affect concentrations of most dissolved species.

Tertiary processing, which is in full-scale use at only a few plants, such as, that at Lake Tahoe, aims at removal of nitrogen and phosphorus.

The next slide gives an orientation as to chemical changes during the secondary aeration stage. These figures are the 1969 averages at the big Hyperion treatment plant in Santa Monica. We are very grateful to Bill Garber for providing us with these figures and initiating our education in this important field. Note first the 20-fold reduction in biochemical oxygen demand, the measure of organic foodstuffs. Of course, this reduction is the main objective of secondary treatment. Phosphate decreases somewhat due to precipitation with metallic ions, principally iron and aluminum. Of main importance to us are the changes in ammonium and nitrate. Raw sewage is high in ammonium, a principal degradation product of urea and proteins. Under aerobic conditions of sewage plant or stream ammonium is oxidized through nitrite to end up as nitrate, very little going off as nitrogen gas. We have not plotted nitrite, as its concentration is much lower than nitrate or ammonium here.

(Fig. 2 follows:)

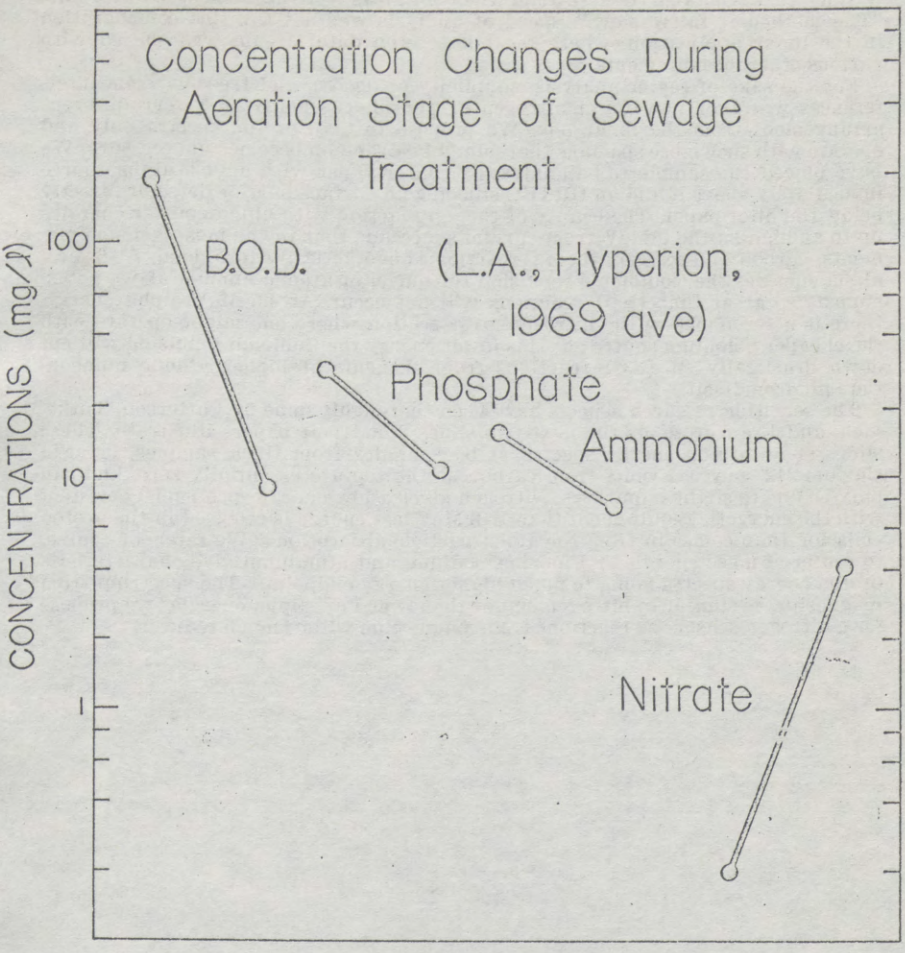

FIGURE 2

Since it is easier to get rid of ammonium than nitrate in tertiary treatment (the Tahoe plant makes the solution basic with lime and blows out ammonium gas), it would be desirable to have on-line monitors of nitrate to be able to stop the aeration process before excessive conversion to nitrite. Sewage is of such variable concentration between night and day, week days and weekends, that the optimum aeration time will greatly vary.

Current analytical methods for nitrate in the parts per million concentration range are not ideal. Automation of the colorimetric techniques has helped but has not essenetially reduced the need stressed by the Frank Long Committee of the A.C.S. and by Sawyer and McCarty for "a more refined and exact method of analysis."

The Turkevich moon box used two nuclear processes for analysis of the light elements. Firstly, they measured the back-scattered alpha spectrum from Curium-242 alphas, making use of the billiard-ball collision laws that make the maximum energy of back-scattering an increasing function of target mass—going from zero for atomic mass four up to full energy for masses large compared to four.

Secondly they extracted secondary information by measuring proton spectra arising from (α,p) reactions on the material.

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Tony Turkevich remarked to John when our ideas were first discussed with him, "The method is fairly slow." Speed of analysis was not a prime consideration in the lunar application, where the telemetered data stream was shared with various other measurements.

For the sake of faster analysis, simplicity of design, and freedom from interferences we favor now for a nitrogen or phosphorus analyzer a very different arrangement from the lunar box. We propose to take proton spectra only and operate with such close spacings that pumping a vacuum becomes unnecessary. We have placed the sample to be analyzed on filter paper with a Po^{210} alpha source immediately above it and an ORTEC silicon-gold surface barrier detector directly below the filter paper. The beauty of the α,p reaction with alpha emitter energies up to as high as the 6 MeV from curium sources is that in the most common elements, carbon and oxygen, the α,p reaction is energetically forbidden. At 6 MeV alpha energies the Coulombic repulsion for nuclei of atomic number above potassium is so great that (α,p) reactions will not occur. At 4.5 MeV alpha energy, there is a resonance in the nitrogen cross section where one might operate with the cheaper polonium source; at this lower energy the Coulomb repulsion will cut down drastically on (α,p) reactions from elements of higher atomic numbers than nitrogen itself.

The scientific research aspects have been thoroughly done by Patterson, Turkevich, and Franzgrote, as the next two slides from their papers illustrate. These slides show proton energy spectra at back angles from thick samples, using a Curium-242 source. Events from carbon at the top are essentially zero, and can only be due to slight impurities. Nitrogen gives a low energy spectrum, consistent with the energetic requirement than 1.19 MeV less energy is released in the proton emission than comes in from the alpha particle absorption. (We refer, of course, to center-of-mass energies.) Fluorine, sodium, and aluminum give characteristic proton energy spectra going to much higher energy endpoints. The spectrum from magnesium is similar to nitrogen, but at the lower Po^{210} alpha energies we propose for a nitrogen sensor the reactions from magnesium will be much reducer.

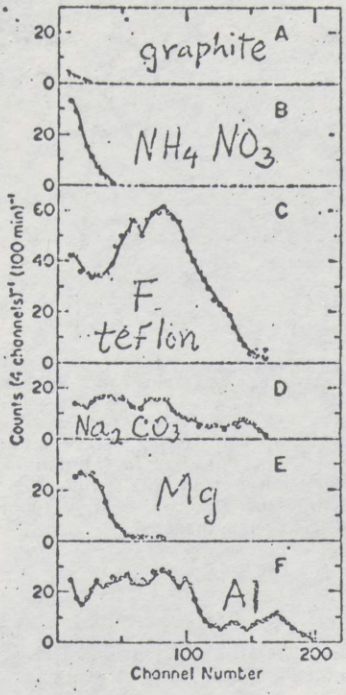

Fig. 8. Protons from (α, p) reactions from various elements. These data were obtained with the prototype instrument using a source strength of approximately 1.4×10^6 d/m of Cm^{242}. The detectors were covered with gold foils (approximately 15 μ thick) to remove the scattered α particles. The background in the system has already been subtracted. Data are presented for (*A*) carbon in the form of graphite, (*B*) nitrogen in the form of NH_4NO_3, (*C*) fluorine in the form of teflon, (*D*) sodium in the form of Na_2CO_3, (*E*) magnesium metal, and (*F*) aluminum metal.

FIGURE 3

The next slide shows additional proton spectra from their work, adding phosphorus and silicon to the elements of the previous slide.

We had hoped to be able to show a comparable library of proton spectra at 4.5 MeV incident alpha energy, but by mistake the polonium source we bought evidently had a much thicker mica window than we had specified. The energy was insufficient for (α,p) reactions, though we were able to check out our detector and pulse height analysis system on the alpha backscattering plateau from lead. lead.

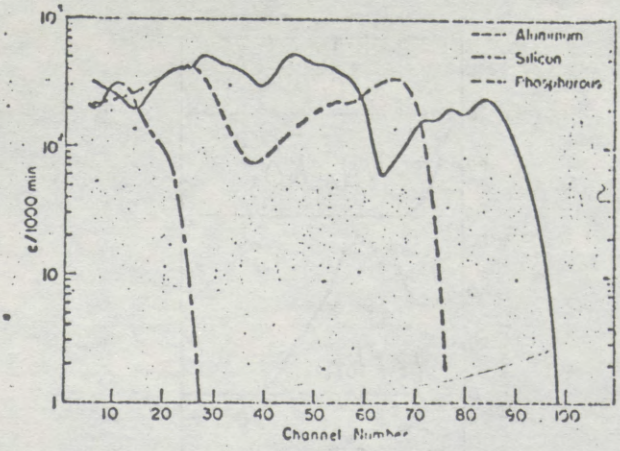

FIG. 8. Response of the alpha scattering instrument in proton mode to three pure elements. The data are for aluminum, silicon, and phosphorus. The ordinates are events per channel per 1000 min as a function of channel number. The source strength was 6.72×10^{10} dis/min. Background has been subtracted.

FIGURE 4

It seemed clear to use then that the application of the α,p reaction method to analysis for some of the light elements was not a matter calling for further research, but rather a developmental and hardware project and it seemed appropriate for an aerospace company, such as the Space Vector Corporation, to carry out preliminary experiments and propose a production of proto-type instruments with assistance from some federal agency. The practical problem then is one of optimum sampling methods. We have considered many schemes beginning from simple evaporation of water samples and anlysis of the residue. Generally, the main dissolved constituents of water are not of a great deal of interest in the pollution problem, and indeed sodium in large amounts will interfere. Thus, the problem is to prepare a sample containing the nitrogen compound of interest on a metal foil or a piece of filter paper with the nitrogen being at least several per cent of the weight of the material in order to get reasonable sensitivity. It may be necessary to remove species, such as, magnesium or silica, which might contribute low energy proton spectra difficult to distinguish from that of nitrogen. In an earlier slide we showed the concentration of a few constituents in the influent and effluent solutions from the secondary processing stage. Ammonium was in the range of 10 mg/1 and nitrate in the vicinity of 1 mg/1. Major dissolved constituents are sodium, chloride, sulfate, and bicarbonate ions all in the 200 mg/1 range. Magnesium and silica are at about 20 mg/1 level. In the sample preparation stages, we have wished to avoid elaborate wet chemistry, for then the hoped-for advantages of the method for automatic applications may be lost. At any rate, let me give an example of a specific sample-preparation we would suggest here for application to ammonium and nitrate analysis in sewage plant solutions. (Sludges and solids need only be spread on filter paper to be analyzed.)

The next slide is from the FWQA Primer on water treatment and is intended to illustrate electrodialysis as a potential means of desalting tertiary effluent so the water can be re-used. You have all read, and many of you know much more than I, about the electrodialysis methods that have been studied as a means of obtaining pure water from brackish waters. Membranes are commercially available which quite selectively will pass either cations or anions. We propose for the basic analysis equipment to employ an electrolytic cell with a mercury anode and a mercury cathode. The sewage process solution be analyzed would be in a central compartment separated from the smaller anode compartment by an anion selective membrane and from the cathode compartment by cation selective membrane. As the voltage is applied to the cell, the central compartment will gradually be depleted of ions. The cations concentrate in the cathode compartment. The solution in this compartment may, after a specified length of time, be made strongly basic and ammonia evolved by heating. The ammonia could be converted to an ammonium salt by drawing the vapor through a filter paper moistened

either with a mineral acid, such as hydrochloric acid or an organic acid such as oxalic. Another alternative would be the adsorption of the ammonia on a thin charcoal disc. The filter or charcoal plate would then be placed between the alpha source and proton detector and the proton pusle height analysis spectra determined. An added incidental advantage of this arrangement would be that a number of the metallic elements concentrated in the cathode compartment would form amalgams in the mercury, and the mercury cathode could periodically be distilled and analyzed for the trace metals that have so accumulated. Here the X-ray fluorescence method or spark spectrograph could be used.

(Fig. 5 follows:)

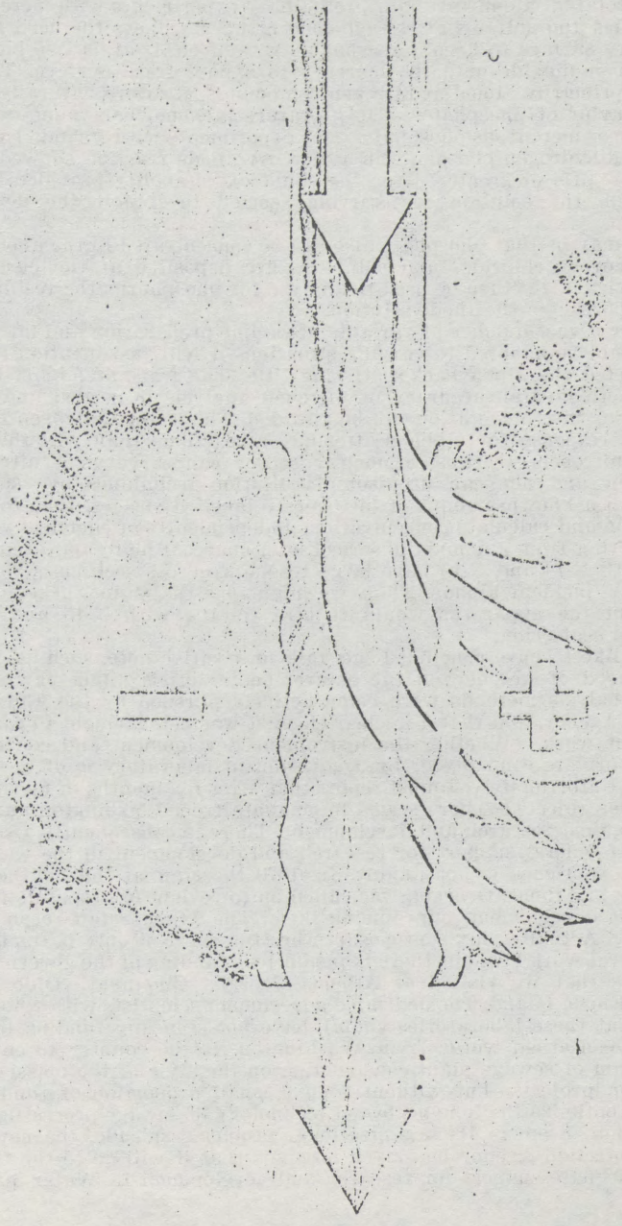

FIGURE 5

In the anode compartment we would concentrate the nitrate ions while the chloride and sulfate go out of solution as insoluble mercurous chlorides and sulfates during the electrode reaction. After a sufficient period of electrodialysis, the solution in the anode compartment could be drained off, made strongly basic, and reacted with metallic aluminum. Under these conditions nitrate is quantitatively reduced to ammonia, which is carried off in the stream of hydrogen liberated in the reaction of aluminum with the base. This nitrate reduction is the basis for the quantitative analytical scheme for nitrate detailed in Swift's, Quantitative Analysis text. This ammonia can then be collected on the filter paper and analyzed as before by the (α,p) reaction. Of course, any nitrite present will in this scheme be converted to ammonia, and we will actually be analyzing total nitrite-nitrate. Our preliminary experiments with mercury anodes and chlorides and sulfates at sewage concentrations shows the need for stirring the mercury surface to keep a reasonable rate of electrolysis. We blow a jet of air or carbon dioxide onto the mercury to expose fresh surface. Though this method is primarily aimed at nitrogen compounds, we were naturally interested in the behavior of phosphates. The literature is somewhat vague on solubility of mercuric or mercurous phosphates. Our experiments with 100 mg/1 phosphorus as sodium dihydrogen phosphate in a mercury anode reaction showed formation of a solid at pH4 or greater. Even the slight extra acidity provided by blowing CO_2 through the solution for stirring seemed to inhibit the deposition of phosphate.

Thus, it may be that phosphate also can be concentrated in the anode solution, while mercurous chlorides and sulphates are deposited at the electrode. The alpha,p device might then be used to analyze for phosphorus the residue from an evaported portion of the anode solution.

There are a vast number of variants of sample preparation and nuclear analysis that could be adapted to varying situations. I will just mention the variant that prompted the alpha back-scattering title. This variant might still be preferable where greater accuracy of nitrogen analysis is needed and somewhat more complex instrumentation can be afforded. The isotope nitrogen-15 will give a different response for alpha scattering or reactions than will the naturally abundant nitrogen-14. Thus, a nuclear sensor can serve as a nitrogen mass spectrometer and one can use isotopic dilution techniques by "spiking" the sample with a known amount of nitrogen-15 labelled species, then measure the isotope ratio and calculate concentrations independently of chemical yield. Alpha back-scattering from ammonia absorbed on a charcoal plate appeared attractive because both N-14 and N-15 have large resonance cross sections at back angles for 4.5 MeV incident alphas. Thus, we might use the main Turkevich analysis concept, but the apparatus would require spiking with N-15 and a vacuum chamber for scattering.

I would like to have concluded this talk on positive note, such as, that in the national mood of urgency on the environmental crisis alpha particle nuclear chemical analysis methods were being actively pursued by the Environmental Protection Agency, and that a nuclear chemist was being sought to carry out the development work. (Whether the instrument development and construction be done by a private company or by a government laboratory is of secondary importance.) Unfortunately, I must report that after ten months of uncertainty our proposal was rejected. There seems to emanate from Washington an anti-scientific bias against research and development. There is consequently a surprisingly low level of federal support for research and development in the water quality area. Our experience is not unique. In 1970 the staff at the Southeast Water Laboratory in Athens, Georgia, was called on to review 70 proposals for analytical methods development, ours among them. The Athens staff recommended 20 for funding. Actually only 4 proposals were funded. Not only is funding clearly of extramural work low, but there is insufficient funding of the government's own laboratories that we visited at Athens, Georgia, Cincinnati, Ohio, and West Kingston, Rhode Island. The dedicated government scientists with whom we came in contact at these laboratories simply have not seen any funding increases to match the concerned words from Washington. Is the country to embark on a vast program of sewage plant construction on the style of the massive highway construction projects—but without even a small proportion of funds going to R. & D. to optimize the long-neglected technology of sewage processing? I would hope not, but, even as its organizational problems subside, the new Environmental Protection Agency has given no signs that it will go to the Congress to demand adequate support for research and development in Water quality area.

RESTORING THE QUALITY OF WISCONSIN RIVER WATERS[1]

By ANTHONY H. J. DORCEY, CHARLES S. FALKNER, and IRVING K. FOX

Between the years 1967 and 1971 a research group at the University of Wisconsin was engaged in a study of water quality management in the Wisconsin River Basin. The general objective of the study was twofold: On the one hand the objective was to discover whether economies could be attained from a regional approach to water quality management, that is to say, utilizing regional rather than localized administration, that would analyze all the different interrelating physical and biological factors affecting the basin. The second objective was to examine the implications of such regional system management for institutional design, that is to say, for creating the appropriate set of interrelating laws, regulations, and organizations to govern decision-making in this field. This paper attempts to summarize what was learned. It also seeks to outline the nature of the water quality management problem in the Wisconsin River, to suggest how this problem might effectively be dealt with, and to put forward both immediate and long-range measures for preserving and improving the quality of the river waters.

To provide a perspective on the subject, the first portion of the paper contains a brief description of the physical features of the basin, its early history, and economic development. This is followed by a section which attempts to define the nature of the physical and biological problems and the political-administrative-economic problems. The third section outlines the basic features of a first-stage effort to bring water quality in the Wisconsin River under suitable control. The concluding section examines the possibility of establishing long-range goals and of undertaking a long-range program that would preserve, over time, a desirable level of quality in the Wisconsin River.

THE WISCONSIN RIVER BASIN IN PERSPECTIVE[2]

The water quality situation in the Wisconsin River Basin today is a product of its physical and biological natural characteristics and the impact that man has had upon these characteristics, particularly since the time of immigrant settlement.

The Wisconsin River system drains the central region of the state of Wisconsin, at first southward from the Michigan border, and then southwest to the

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[1] This paper is based on a study entitled, "Institutional Design for Water Quality Management: A Case Study of the Wisconsin River Basin," conducted under the auspices of the Water Resources Center, University of Wisconsin. It was supported by the Office of Water Resources Research of the United States Department of the Interior, the Department of Natural Resources of the State of Wisconsin, The Economic Research Service of the United States Department of Agriculture, and the University of Wisconsin. Reports on the Study may be secured from the U.S. Department of Commerce, National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22151.

Titles and authors of these reports are:

Volume I, Summary, by Irving K. Fox, *et al.*;

Volume II, Hydrology, by A. Mac Cormick and G. Stadler;

Volume III, The Development of Predictive Water Quality Models, by C. Falkner V. Kapoor, C. McQuillan, A. Merten, S. Sethi, D. Watts, and L. Wible;

Volume IV, (Section E), Cost Functions for Influencing Water Quality, by E. David, R. Howe, and J. Quigley;

Volume IV, (Section F), Public Attitudes Toward Water Quality, by E. David;

Volume V, Systems Analysis of Hydropower Production on the Wisconsin River, by G. Storey;

Volume VI, The Nature of Minimum Cost Systems for Water Quality Management on the Wisconsin River, by C. Falkner;

Volume VII, Five Legal Studies on Water Quality Management in Wisconsin, by P. Davis;

Volume VIII, The Economic and Fiscal Aspects of a Regional Water Quality Management System, by A. Dorcey; and

Volume IX, An Analysis of Alternative Institutional Patterns for Managing Water Quality on a Regional System Basis, by D. Ranney.

[2] Much of the historical material in this section has been taken from August Derleth, *The Wisconsin: River of a Thousand Isles* (New York: Farrar and Rinehart, 1942).

Mississippi River. This is an area with a continental climate, having relatively cold winters with substantial accumulations of snow, and warm summers. Precipitation over the basin averages about thirty inches per year.

The Wisconsin River Basin comprises 12,280 square miles, which is approximately one-fifth of the total area of the state of Wisconsin. By comparison, the Potomac River Basin above Washington, D.C. is 11,560 square miles, and the Delaware River Basin above Trenton, New Jersey is only 6,780 square miles.

The average flow of the Wisconsin River Basin is approximately 8,500 cubic feet per second at Muscoda, a few miles above the mouth of the river. By comparison, the average flow of the Potomac at Washington, D.C. is 11,260 cubic feet per second, and the average flow of the Delaware at Trenton is 11,850 cubic feet per second. A distinguishing feature of the Wisconsin River is the relatively stability of its natural flow due to storage in lakes and underground aquifers throughout much of the basin. It is noteworthy that the peak flow at Muscoda is only 80,000 cubic feet per second, whereas the record flow on the Potomac at Washington is 484,000 cubic feet per second. This stability can also be seen in a comparison of low flows. The record low flow on the Wisconsin River at Muscoda is 2,000 cubic feet per second, whereas the Potomac has been known to decline to a low flow of 484 cubic feet per second.[3]

An important resource of the Wisconsin River Basin is its supply of groundwater. Throughout the basin, groundwater is available at reasonable depth, and these supplies are of suitable quality for domestic purposes. Hence cities and communities in the basin draw on groundwater for municipal supply and do rely on the river.

In general, the topography of the region is one of low relief, bearing the marks of successive advances and retreats of the Ice Age. In the north, glaciation has resulted in many natural lakes, which drain into the Wisconsin River system. In the southwest, the so-called Driftless Area, which is considered to have escaped the last period of glaciation or at least to have suffered less from it, has a much more rugged character with low hills intersected by steep-sided valleys and frequently crowned with jagged outcrops of rock. The river falls about a thousand feet over its length, from 1,650 feet at its source to 660 feet at the confluence with the Mississippi.

The northern half of the state, besides having a very large number of lakes, is extensively forested. Swamps, also in these upper reaches, impart a distinctive dark color to the river water. In the middle reaches, in particular the area between the Dells and Tomahawk, there used to be many natural rapids and waterfalls which became the location of power dams. Atlhough the southern part of the state lies within the Corn Belt, the steep hillsides and rocky outcrops of the Driftless Area result in most of the land there being used for pasture or for woodlots.

Indians hunted, fished, and grew crops in the Wisconsin River Basin before the arrival of the white man. An excellent description has come down to us of one of their settlements at what is now called Sauk City, just before the Wisconsin River enters the Driftless Area mentioned above. The following account is from the journal of Jonathan Carver, who was the first Englishman to reach the Wisconsin, in 1770, over the portage from the Fix River:

"On the 8th of October we got our canoes into the Wisconsin River, which at this point is more than a hundred yards wide; and the next day arrived at the Great Town of the Saukies. This is the largest and best built Indian town I ever saw. It contains about 90 houses, each large enough for several families. These are built of hewn plank neatly joined, and covered with bark so completely as to keep out the most penetrating rains. . . . The streets are regular and spacious; so that it appears more like a civilized town than the abode of savage. The land near the town is very good. In their plantations, which lie adjacent to their houses, and which are neatly laid out, they raise great quantities of Indian corn, beans, melons, etc., so that this placce is esteemed the best market for traders to furnish themselves with provisions, of any within 800 miles of it."[4]

This was thirteen years before the first recorded settlement by Europeans on theWisconsin River, which was at Prairie du Chien, at the junction of the Wisconsin and the Mississippi, in 1779.

The first record of Europeans to reach the Wisconsin River, however, was more than a century earlier. In 1659, the French explorers, Pierre Radisson and his

[3] The data on stream flows in this paragraph are from Committee Print No. 4, *Surface Water Resources of the United States*, Select Committee on National Water Resources, U.S. Senate, Government Printing Office (1960).

[4] Derleth, *The Wisconsins*, p. 14.

brother-in-law, the Sieur de Groseilliers, travelled up the Fox River from Green Bay and crossed over to the Wisconsin River at what is now Portage. Shortly thereafter Father Jacques Marquette and Louis Joliet, who were searching for a route to the Pacific Ocean, similarly ascended the Fox and crossed over into the Wisconsin, following the latter all the way to the Mississippi. Marquette, in his journral, described theh river and its shorelands as follows:

"It very wide; it has a sandy bottom, which forms various shoals that render its navigation very difficult. It is full of islands covered with vines. On the banks one sees fertile land, diversified with woods, prairies and hills. There are oak, walnut and basswood trees; and another kind whose branches are armed with long thorns. We saw there neither feathered game nor fish, but many deer and a large number of cattle." [5]

Marquette and Joliet were followed a few years later by La Salle. A letter attributed to him, which is to be found in Margry's *Découvertes et Etablissements des Franscais*, gives this account of the Wisconsin River:

"It flows at first from north to south to about the 45th degree of north latitude, and then turns to the west and west-south-west, and after flowing sixty leagues it falls into the Mississippi. It is nearly as wide as that of the Islinois, navigable to that bend (and perhaps below it) where the canoes are portaged across an oak grove and a flooded meadow to reach the Kakaling [Fox] river, which falls into the bay of the Puans [Green Bay]. Misconsing [sic] flows between two ranges of hills which widen out from one another at times, leaving between them quite large meadows and lands without trees, sandy and of but little fertility. At other places the level land between the hills and the river is lower, and swampy in some spots; and then it is covered with timber, and flooded by the overflowing of the river. The mountains gradually diminish as the river is ascended; and finally, about three leagues from the portage, the land becomes level and swampy without trees on the side of the portage, but covered with pines on the other side. The place where the canoes are carried over is marked by a tree, on which two canoes have been clumsily drawn by the savages." [6]

The route these early explorers took, from Green Bay in Lake Michigan, up the Fox River, over the portage to the Wisconsin, and thence down to the Mississippi, became an important one during the fur trade era. Indeed, throughout the period of settlement, the Wisconsin River remained the chief artery of traffic, with numerous landing places betwen Portage and Prairie du Chien, and remained so until the railroad took over. Until dams were built, the river was navigable from the Mississippi to what is now Nekoosa, though boats normally stopped at Portage. In 1861, the Fox-Wisconsin canal at Portage was opened, creating an unbroken waterway from the Great Lakes to the Gulf of Mexico.

While the fur trade was an important economic activity during the 18th and early 19th centuries, this type of exploitation involved relatively little increase in the white populatiton of the region. However, the 19th century saw the Midwest being settled at a rapid rate, with Wisconsin supplying much of the lumber required for the construction associated with the development of the treeless Great Plains to the west.[7] During the lumbering period the Wisconsin River Basin was an important source of supply and the river a major avenue of transport.

The first saw mill on the river was built at what is now Nekoosa in 1832 not far below Wisconsin Rapids. A second was built in 1836 at Port Edwards. In 1848, 24 mills with 45 saws were operating; and by 1857, 107 mills along the river were producing more than 100 million board feet of lumber a year.[8]

The operation of lumber mills required power and this was provided by the construction of mill dams. The first dam on the Wisconsin River itself was built in 1840 at what is now Wausau. This was followed by the construction of dams at a number of other locations in the upper portion of the river, and by 1870, 33,700 horsepower had been developed through the installatiton of waterwheels along the Wisconsin and its tributaries.[9] Most of these were, of course utilied by the lumbering industry.

In the lower part of the river, the logs were moved by large rafts which floated on down to the Mississippi. The upper portion of the river with its many bends

[5] *Ibid.*, p. 10. The "cattle" he refers to were of course bison.
[6] *Ibid.*, pp. 11–12.
[7] W. H. Glover, "Lumber Rafting on the Wisconsin River," *The Wisconsin Magazine of History*, Vol. XXV, No. 2 (1941).
[8] William F. Raney, "Pine Lumbering in Wisconsin," *The Wisconsin Magazine of History*, Vol. XIX, No. 1 (1935).
[9] Derleth, *The Wisconsin:* p. 228.

and rapids was unsuitable for rafting so logs were floated individually. Since the river fluctuated substantially, dams were built at the outlets of the many lakes in the upper reaches in order to regulate the flow and facilitate the driving of logs and the floating of rafts. These early regulatory devices have been maintained and are still utilied to control the flow of the Wisconsin River today.

In the latter part of the 19th century the pulp and paper industry began to develop in the state of Wisconsin. Beginning in the 1870's the Fox River Basin became the center of the pulp and paper mill industry and in 1888 the first pulp and paper mill on the Wisconsin River was built about three miles below Wisconsin Rapids. Over the next ten or so years, several other mills were built and today there are fifteen pulp and paper mills in the upper Wisconsin River between Rhinelander and Nekoosa.[10]

In the first decade of this century the construction of hydroelectric facilities was begun in the upper Wisconsin River Basin. The last major addition to this system was completed in 1950. Today there are thirty-one plants with a total installed capacity of 149,000 KW. Most plants are quite small, with only four having installed capacities in excess of 10,000 KW.

Flows are regulated by twenty-one reservoirs, of which sixteen are natural lakes which have been adapted to permit some regulation of outflows. However, man-made reservoirs account for nearly three-fourths of the storage capacity of seventeen billion cubic feet.

Settlement of the basin has been, in large part, associated with agriculture, especially in the south. At one time wheat was virtually the only crop, but as the soil deteriorated without crop rotation other types of farming were developed. Wool and dairy industries grew up and today Wisconsin is the principal dairy-farming state in the Union with corn as a subsidiary. For a few years in the 1860's, hop-growing was spectacularly successful, especially in Sauk County. and breweries started up along the river; but the boom was short-lived owing to the appearance in the area of the destructive hop-louse. Agriculture in the north is less productive; but cranberry farming in the bogs is a profitable industry.

With the growth of population in the large cities around the region, such as Chicago, Milwaukee, Minneapolis-St. Paul, and Madison, the river system and particularly the lakes in the northern part of the basin have been used to an increasing extent for recreation purposes. Thus, today we find that the economy of the region looks to support from agriculture, the tourist industry, and a modest amount of manufacturing associated largely with the production of pulp and paper and the processing of agricultural products. The pulp and paper industry is the largest single source of employment in manufacturing and provides a major portion of the support for the economy of the small cities along the river in the northern portion of the basin.

The basin is not what one would call an economic region with economic activities linked closely with one another. The long, narrow character of the basin, intersecting, as it does, different geographic regions, means that the economic linkages tend to be with communities and centers outside of the basin rather than within it. In one sense, however, the northern two-thirds of the region (from the Wisconsin Dells northward) does have substantial homogeneity. Here there are a number of communities of reasonable size located on the river and having a high degree of dependence on the pulp and paper and tourist industries.

It is noteworthy that the major cities in the basin are relatively small. There are only two cities on the river with populations over 25,000. The large metropolitan centers lie outside the basin. These include Milwaukee to the east. Madison, the capital of Wisconsin, with a metropolitan population of about 200,000, lies just to the south of the basin.

No rapid growth in the economy of the basin is in prospect. Studies indicate that the Wausau-Wisconsin Rapids-Stevens Point area may constitute what one might call a growth center, but even here no explosive changes appear likely. Population projections suggest that overall the population of basin counties will increase by only a modest amount over the next couple of decades.

Of particular interest from the point of view of water quality is the future outlook for the pulp and paper industry and recreation in the basin. A general appraisal of the outlook for the pulp and paper industry indicates that although no dramatic increase in this activity within the region is in prospect, it seems likely that it will continue at approximately its present level for sometime to

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[10] 1848–1948: *A History of the Wisconsin Paper Industry*, compiled and published by the Howard Publishing Co. (Chicago, 1948).

come. The rapid growth of the pulp and paper industry in the southern United States, it is reported, cannot be sustained indefinitely; and since Wisconsin is a source of raw materials for pulp, and is also close to important markets, a significant industry will probably remain in the state. This does not, of course, indicate that future plants will necessarily be located on the Wisconsin River, but there seems to be no reason why these locations should not continue to be utilized in view of policy development, it is reasonable to assume that the pulp and paper industry will continue to make a demand for waste discharge upon the waterway corresponding approximately to what it is at present.

The recreation use of the area and particularly of the northern two-thirds of the basin should continue to grow. Land values of recreation property have increased at a rapid rate in recent decades. Participation rates in outdoor recreation activities continue to rise. The proximity of the basin to major population centers, particularly Chicago and Milwaukee, together with the potential offered by its forests, lakes, and streams for providing types of recreation in growing demand, offers strong evidence that use of the basin for recreation will increase greatly in the years ahead. This means that the value of the Wisconsin River and its tributaries in regard to recreation will rise rapidly over the next two or three decades.

As the foregoing comments suggest, the economy of the basin is associated in an important measure with the water resources of the region. These linkages are of three kinds. First, the industries of the basin, and particularly the pulp and paper industry, rely heavily upon the Wisconsin River as a source of industrial water supply and as a means of waste disposal. Second, hydroelectric facilities have developed which supply power to portions of Wisconsin, and particularly to the pulp and paper industry. Third, the lakes and reservoirs of the basin, as well as the tributaries and the main stem of the river, are used for recreation purposes, such as boating, fishing, and swimming.

It is of considerable significance that two of the major sources of economic support in the basin rely heavily on the water resources of the area; namely, the pulp and paper industry and the tourist industry. It is also significant that these two uses of the waterway conflict with one another. The pulp and paper industry produces large quantities of organic wastes which tend to reduce the value of the waterway for recreation purposes in the reaches of the river where the wastes are discharged and assimilated. A major concern of public policy in the region is to find a proper balance between this waste disposal use of the waterway and use of its water resources for recreation.

Development has left its mark on the resources of the Wisconsin River Basin. The virgin forests were felled and have been replaced by second growth stands of timber, cultivated fields, and pastures. The balance of wildlife has been altered, and while deer have increased, other species are reduced in numbers or have disappeared entirely, such as the "cattle" that Father Marquette reported seeing. The upper reaches of the river system are regulated by reservoirs; the river itself is harnessed by its twenty-one hydroelectric stations and widened into "flowages" at numerous locations, so that the natural rapids have all but disappeared. Resorts and summer homes have sprung up around the lakes and along many sections of the river, altering the landscape and producing wastes to be absorbed by the river. Cities have developed at a number of locations and discharge their effluent into the waterway. Pulp and paper mills withdraw large quantities of river water, use it in pulp and paper production, and discharge it back to the river loaded with fiber and other organic and inorganic substances. Farmers and foresters apply fertilizers and pesticides, the residues of which are carried into the river. The contaminants from these many sources have altered the ecology of much of the river, impairing the habitat of many desirable species of wildlife.

All these factors have had a substantial effect on the physical and biological environment. While the impact has been considerable and much of it undesirable, Wisconsin River waters can, however, be restored, the related resources can be preserved and enhanced, and the base for a prosperous economy maintained indefinitely into the future.

THE WATER QUALITY PROBLEM

The task of improving the quality of Wisconsin River waters falls into two general categories. On the one hand, the design of a set of physical-biological measures to achieve the desired improvement is of major importance. But this is only half the task. The degradation of the river is the direct result of

certain economic forces and the response of our institutions to these forces. The second aspect of the task, therefore, consists of redesigning our institutions in order that the necessary physical-biological programs to improve water quality might be brought about. These two components of the water quality problem in the Wisconsin River Basin are briefly described below.

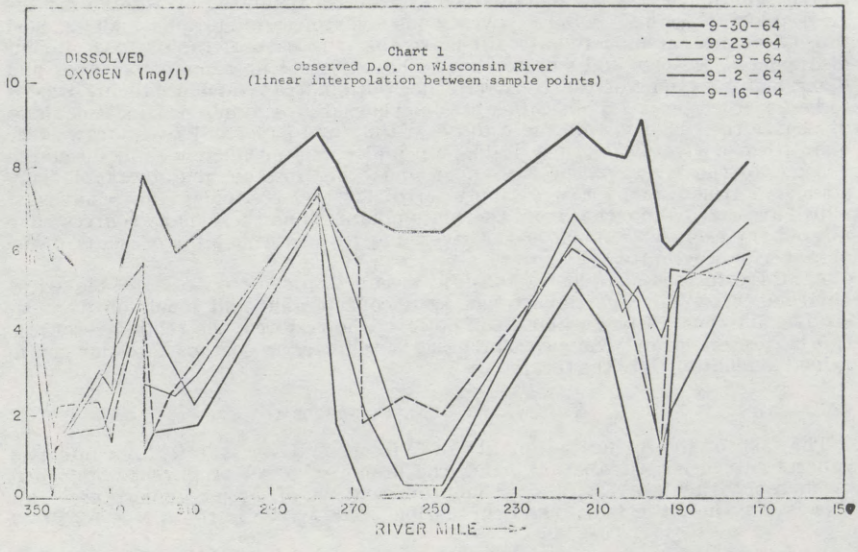
Physical and Biological Aspects

A review of data on water quality in the Wisconsin River, collected by the state of Wisconsin since the late 1920's, shows that the major problems are to be found in the reach between river mile 350 at Rhinelander and river mile 170 above Petenwell Dam. This is where the pulp and paper mills and major communities are located. Below Wisconsin Dells the river tends to recover from the contamination upstream, and what degradation there is can be attributed either to upstream discharges or to some localized situations. The discussion of the water quality problem in this paper will, therefore, concentrate upon that reach of the river between river miles 170 and 350.

In studying water quality, there are a number of measures of quality (or parameters) that may be considered. These vary according to circumstances and some, applicable to other waterways, have no particular significance in the Wisconsin River Basin. The following are those parameters most relevant to this river:

1. Temperature.—Power plants are the major thermal polluters of water, by discharging heated water back into the body of water. Heat is not a major pollutant of the Wisconsin River at the present time. It could become a problem if new power installations were to be built along the river, utilizing river water for cooling purposes.

2. Dissolved Oxygen.—One way of testing water quality is by taking a sample of water and measuring the amount of oxygen that disappears under controlled conditions. The loss is proportional to the amount of organic matter in the water. The result of the test is called the biochemical oxygen demand (or B.O.D.). There is a certain amount of B.O.D. in the water from natural sources, particularly in the slow-flowing, swampy areas of the upper river where there is a considerable amount of decaying vegetation, but this is not enough to impair the potential for aquatic life. On the contrary, this is rich and varied. In the reach of the river where the pulp and paper mills are concentrated, however, it is another story. Here, the discharge of organic wastes from the pulp and paper processes creates a high B.O.D., and the sharp decline in oxygen levels that occurs reduces the capability of the water to sustain life. The average discharges of the pulp and paper industry and the municipalities used in this study are shown in Table 1. It is noteworthy that the pulp and paper mills account for over 90 per cent of the total B.O.D. Chart 1 provides a set of rather typical profiles of oxygen levels in the Wisconsin River between mile 360 and mile 170.



3. Suspended Solids.—While suspended solids may be of several different types, one of major concern in the Wisconsin River is the fibrous material discharged by the pulp and paper mills. Since pulp and paper processing began in the basin, large quantities of these fibers have been discharged into the river. In reaches of the waterway where the stream moves slowly these fibers settle on the bottom. As a result there are sections of the river with large accumulations of organic, fibrous materials on the bottom, and these create what is known as a benthic demand for oxygen, that is to say, a demand for oxygen from organisms living on the bottom of the river involved in the breakdown and decay of the fibers. The result, of course, is the same as that described in the previous section: a depletion of the oxygen content of the water and subsequent impairment of aquatic life. While it would be very costly to eliminate these beds of fibrous materials, the contribution of additional fibrous materials to the waterway must be reduced if the water quality of the river is to be improved over the long range.

TABLE 1.—AVERAGE WASTE LOAD, UPPER WISCONSIN RIVER

Source	Mile point	Average load[1]
Aspen (I)	349.4	49.0
Rhinelander (M)	348.6	2.7
Birch (I)	327.5	.1
Cypress (I)	323.4	.3
Dogwood (I)	322.1	20.3
Tomahawk (M)	319.9	.4
Elm (I)	292.5	.5
Merrill (M)	291.4	1.5
Fir (I)	278.2	15.0
Brokaw (M)	278.0	.1
Wausau	271.3	6.7
Gum (I)	265.2	49.0
Rothschild (M)	264.9	.8
Hemlock (I)	256.0	12.0
Mosinee (M)	255.7	.2
Juniper (I)	230.5	.9
Stevens Point (M)	229.3	5.0
Lemon (I)	226.9	4.0
Maple (I)	226.5	1.2
Oak (I)	214.3	4.0
Biron (M)	213.9	.1
Poplar (I)	211.7	27.0
Wisconsin Rapids (M)	208.3	7.7
Sycamore (I)	205.6	75.0
Port Edwards (M)	205.1	.4
Teak (I)	201.9	60.0
Nekoosa (M)	200.9	.6

[1] Thousand pounds of B.O.D. (5-day, 20° C) per day.

Code: I—Industry. M—Municipality. (Names of industrial plants are fictitious.)

Sources: (1) Cost of Clean Water, vol. III, FWPCA, Pub. No. I.W.P.-3 (November 1967). (2) 1963-64 report on survey Wisconsin River by Committee on Water Pollution and Board of Health of State of Wisconsin.

4. Coliform Bacteria.—These are bacteria whose natural home is the human intestine. Though usually harmless themselves, they are easily identifiable and are a reliable indication of the degree of contamination of water from human sewage. Infectious bacteria do not pose a major water quality problem in the Wisconsin River as all of the communities of the basin use groundwater for municipal purposes. In addition, the major communities treat their wastes, and especially if these wastes are chlorinated, there should be no problem either in using the river for water contact sports. However, continuous attention is needed to make sure that waste treatment facilities follow adequate treatment practices.

5. Toxic Elements.—While there are many toxic pollutants that may enter streams, two in particular are of significance in the Wisconsin River Basin. One is mercury, which has recently been discovered in fish taken from the river, and as a result the state has had to place severe restrictions on fishing. The other is pesticides which drain into the river and there is evidence that some of these, DDT in particular, have had serious consequences for wildlife, especially the fish-eating birds of prey like the bald eagle and osprey. If the undesirable effects of toxic contaminants are to be avoided, their use must be strictly controlled. It is difficult to say at this stage what can be done with heavy metals like mercury which are already in the stream, either in deposits on the stream

bed or in the food chain. And although DDT is now subject to control, residues from past use of it will remain in the environment for a long time.

6. *Nontoxic elements.*—There are other compounds entering the water which appear to be relatively harmless, but which may have adverse aesthetic effects and be deleterious in other ways. For example, the compounds used in making wood pulp impair the taste of fish if they are discharged into the river.

Also, nutrients of various types, particularly compounds of nitrogen and phosphorous from fertilizers, on entering water bodies in run-off from agricultural lands, stimulate plant growth and may cause undesirable water quality conditions. An example of this is the algal "blooms" which so often turn our lakes and estuaries green in the summer time. In this investigation of the Wisconsin River Basin the nutrient problem was not studied; but it is a matter that deserves attention. particularly in the reservoirs along the waterway.

7. *Color.*—Another measure of water quality may be its color, though this may be more of an aesthetic consideration than a sanitary one. The water in the upper Wisconsin River is naturally dark, particularly where it flows through the northern muskegs where decaying vegetation discolors it. In the lower reaches, however, the dark color appears to be related to the waste discharges of the pulp and paper industry. Johnathan Carver, whose journey in 1766 is mentioned above, described the river as follows:

> "The Ouisconsin, from the Carry Place to the part where it falls into the Mississippi, flows with a smooth but strong current; the water of it is exceedingly clear, and through it you may perceive a fine and sandy bottom, tolerably free from rocks." [11]

The conclusion that the Wisconsin River could be as clear as Jonathan Carver describes is controversial. There are claims that the color imparted to the water in the marshes of the river's source would never wash out to obtain Carver's description. These claims might be true. The construction of reservoir storage and hydroelectric dams could have the effect of maintaining the water color. It is probable that waste discharges enhance water color. We have insufficient knowledge to know how man's activities may have affected the color of the Wisconsin River.

8. *Turbidity.*—As a result of human activity in its valley, the Wisconsin River is fairly turbid, which makes it not as attractive for water contact sports as it might otherwise be. This turbidity is caused by a variety of factors, but particularly by the suspended solids present in the water. It is difficult to say how much this condition might be improved through a water quality management program. The problem of wood fibers has already been discussed. Presumably if these were eliminated, turbidity also would diminish.

In summary, then, a water quality management program for the Wisconsin River must be concerned with the maintenance of dissolved oxygen levels, control of disease-causing bacteria, a reduction in the discharge of wood fibers, control of both toxic and nontoxic contaminants, and temperature. Although the level of quality to be achieved for each of these features is a matter of public policy, the present state of our technology does make it possible to improve the quality of Wisconsin River waters very substantially at reasonable cost, even in the near future. Furthermore, we are confident that over the long range, through the advancement of science and technology of water quality management and the design of appropriate public policies, it will be possible to restore the quality of Wisconsin River waters to a level close to what it was before settlement, and at reasonable cost. If this goal is to be achieved, however, efforts must not be limited to the scientific and technical aspects of the problem. Of equal importance is to establish an institutional framework through which water quality management programs may be formulated, planned, and carried out.

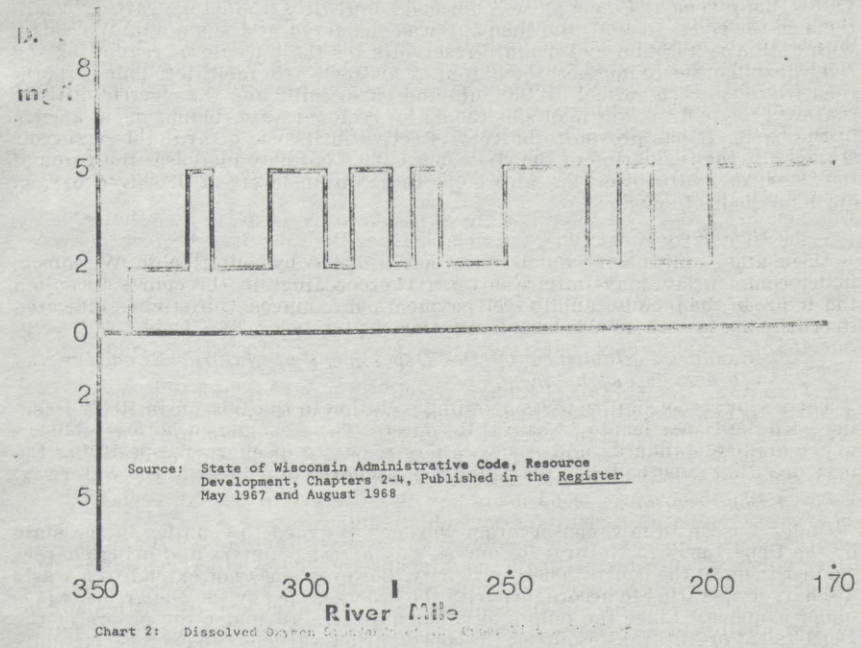
Political-Administrative-Economic Aspects of Water Quality Management

It is difficult to analyze and assess the many different influences that determine the response of society to the water quality situation in the Wisconsin River. An obvious one is the dependence of the economy of the region upon the river, and the perceptions that people have of what they would gain or lose should measures be undertaken to alter the water quality in a substantial way. These perceptions, in turn, influence the political behavior of people both within the basin and outside it who have an interest in it. Another factor influencing public attitudes is the formal institutional structure, that is to say, the various administraive, legal, and fiscal arrangements, dealing either

[11] Derleth, *The Wisconsin:*, p. 15. The "Carrying Place" is the portage between the Fox and Wisconsin Rivers.

directly with water quality problems or influencing human activities responsible for altering water quality. Finally, there are the values deriving from our cultural heritage which influence people's perceptions of the problem and their ideas of how it might best be dealt with, and which, in turn, influences the behavior of politicians and administrators. Although it is extremely difficult to refine and evaluate these various factors, if an improvement in water quality is to be achieved it is essential to try to understand this aspect of the problem and to develop the appropriate institutions for dealing with it. Some of these influences are discussed below.

1. *Economic Forces.*—The water quality standards that have been adopted by the state of Wisconsin for the Wisconsin River, and the conclusions of state officials concerning how much improvement in water quality it is practicable to seek, are a reflection, at least in part, of economic forces. Chart 2 shows the



Source: State of Wisconsin Administrative Code, Resource Development, Chapters 2-4, Published in the Register May 1967 and August 1968

Chart 2: Dissolved Oxygen

oxygen standards in force on the river at the time this study was made. These standards reflect the opinion, that in reaches below the pulp and paper mills industrial use of the waterway should be the dominant consideration. Accordingly, in these reaches relatively low oxygen levels and discharges of considerable amounts of fibrous materials are permitted. The standards are evidently based upon the conclusion that the adoption of higher standards would cause undue hardship to the pulp and paper mills, and therefore to the communities in which they are located. The analyses of our study indicate that, when the economic viability of a pulp and paper mill has been threatened by possible action on the part of the state to curb pollution, opposition to this action has come not only from officials of the mill, but from the labor and business interests of the local community as well.[12] It is evident, therefore, that the community of interest likely to be adversely affected, if pollution control measures adversely affect the economic prosperity of the pulp and paper mills, constitutes an important political-economic force, and this in turn influences the actions of public representatives responsible for pollution control.

There is, however, another, countervailing economic influence which is becoming increasingly important in the state of Wisconsin. This is the tourist industry and the interests concerned with the recreation use of water resources. The northern part of the state, including a substantial portion of the Wisconsin River Basin, looks increasingly to the tourist industry for economic support.

[12] See Chapter 5 of Volume IX of the Reports cited in footnote 1.

Recently, when the Department of Natural Resources suspended fishing in certain areas because of mercury contamination, resort operators and others serving the tourist industry were badly affected and reacted accordingly. There is no doubt that the growing importance of this body of interests is resulting in a powerful force demanding the preservation and enhancement of water quality.

2. *The Formal Institutional Framework.*—As in other fields, a rather complex set of institutions governs decision making on the use of wisconsin rivers. While it is impossible here to go into this institutional framework in detail, some of its components are outlined below in order to provide some understanding of this aspect of the water quality management problem.

a. The Wisconsin Valley Improvement Company

During the lumbering period, in the 1860's, a company called the Wisconsin Valley Improvement Company was formed to create satisfactory rafting conditions on the river. In 1907, the company was chartered by the state of Wisconsin with authority to build and operate reservoirs for the purpose of regulating the river flow in order to increase the output of hydroelectric facilities. This corporation, whose stock is owned by the pulp and paper mills and the electric utilities that own the hydropower plants, is the major regional water management agency in the basin. It has proven to be very effective in its use of available reservoir storage for the regulation of the river flows. This not only increases the value of the river for hydropower, but also helps to maintain levels of dissolved oxygen during periods of low flow.

b. Common law

As in other states, individuals adversely affected by pollution in Wisconsin, under common law may initiate adversary proceedings in the courts to enjoin the action of the polluter and to seek payments of damages. Our studies indicated that little use is made of this legal institution.

c. Standards established by the Department of Natural Resources and orders issued by them.

The major responsibility for controlling pollution in the Wisconsin River Basin lies with the Department of Natural Resources. The Department both establishes water quality standards and issues orders to waste dischargers specifying the measures that must be taken regarding the discharge of effluent to the waterway.

d. *Conservation wardens*

Under Wisconsin law, conservation wardens assigned to counties in the state by the Department of Natural Resources may arrest polluters and bring charges against them in the courts. Their authority, however, does not extend to a waste discharger operating in accordance with the orders issued by the Department (see under c. above). Since the pulp and paper mills are all under the orders of the Department of Natural Resources, the conservation wardens can exercise virtually no influence over the principal dischargers of wastes into the Wisconsin River.

e. Regulation of shoreland use by the Department of Natural Resources and county governments

Under state legislation each county is required to adopt ordinances governing the use of shorelands. These ordinances must conform to standards established by the Department of Natural Resources. Most counties of the state have now adopted such ordinances and these control shorelands use in the interest of preserving the general environment of the waterway.

f. Subsidies

Municipalities are entitled to grants from the Federal Government to assist in the construction of waste treatment facilities, generally amounting to about 50% of the cost of initial construction. To supplement these federal grants, the state of Wisconsin provides grants to municipalities amounting to 25% of the cost of construction. Industries benefit from state legislation which provides for rapid amortization and an exemption from local property taxes on investments in facilities to reduce wastes. This provision results in a subsidy of about 15% of the initial construction cost.

g. Planning

Under state law, the Department of Natural Resources is required to prepare a state water plan. To date, because of limited funds the Department has been

unable to do much toward the development of such a plan. To do so, considerable preliminary research would be necessary, and it is significant that there is no state agency or regional organization in Wisconsin equipped to undertake the investigations that are needed to develop a regional water management program, and certainly no agency has the authority to implement such a program.

Besides those mentioned above, there are numerous other elements of the institutional structure but they are of less importance to this study. For example, the United States Federal Power Commission licenses the construction of dams on the river. The Corps of Engineers of the Department of the Army and the Soil Conservation Service of the Department of Agriculture engage in water resources planning and may build water management facilities. However, it is not necessary to review their activities because currently they have little influence upon the water quality problems under discussion here. Since the Wisconsin River is not an interstate stream, the federal Environmental Protection Agency does not have responsibility for approving state standards. The state Geological and Natural History Survey and the U.S. Geological Survey, in cooperation with state agencies and private organizations, collect data on stream flow and groundwater in the region. These miscellaneous institutions, however, while important in themselves, are not of central significance for the design of more effective water quality management institutions in the Wisconsin River Basin.

3. *Cultural Factors.*—In addition to the political influence exercised by those having a direct economic interest in water quality in the Wisconsin River Basin, and the behavior resulting from the interactions of elements of the formal institutional structure, discussed above, there are other factors influencing political administrative reactions to water quality matters that may be called "cultural" in nature. These are perceptions that are widely held concerning the nature of the pollution problem, its importance, and how it might best be dealt with. Three of these factors are mentioned below.

a. *Development Values*

The view has long been held that economic growth must be a major objective of public policy. When pollution control is thought to conflict with this value, reservations develop about the desirability of measures to control pollution. This view has declined in importance somewhat in recent times with the increasing concern over the environment, but in times past it has been one of the major factors responsible for the toleration of environmental pollution and it has by no means disappeared.

b. The "Conservative Ethic"

Counterbalancing the above, and arising out of the concern for the environment being felt today, is the view that pollution of the environment should be kept to the minimum and natural resources preserved. This value is being increasingly widely held and is of growing importance, so much so that it is strongly influencing political and administrative behavior in support of efforts to improve water quality.

c. Reliance upon Regulation

It is generally accepted by the people of the State of Wisconsin and officials concerned with pollution control that improvement in water quality should be achieved by regulating the behavior of the individual waste dischargers. The problem is widely viewed as involving simply the establishment of standards and the issuance of orders to achieve these standards, much as the Department of Natural Resources is now doing. It is not viewed as a matter of systematic study and planning, involving 1) the identification of opportunities to achieve the improvement of water quality by systematic analysis of the different physical, biological, and economic interrelationships prevailing, 2) the establishment of standards in the light of these opportunities, and 3) the implementation of coordinated regional programs to achieve the desired results in the most economical fashion. It would appear that this lack of appreciation of the advantages of systematic study and planning is responsible for the failure of the State to invest any significant amount in the planning of water quality management programs. Without a change in this perception of the pollution problem, it will be difficult to achieve efficiently the potential long-range improvements that now appear practicable.

Criteria for the Design of Policies

Restoring Quality—The Immediate Task

In the preceding section it was seen that the water quality problem exists as a result of the interaction of both physical and biological factors, and the political-administrative-economic aspects of society. In particular, it was seen that past policies and institutions have failed to deal adequately with ths problem. Fundamental to the objectives of our study were those criteria for evaluating the design of policies and institutions for water quality management. These three criteria were economic efficiency, effectiveness, and equity.

Economic Efficiency

The policy should be economically efficient in that the desired policy objectives would be attained at minimum cost. Thus, specific objectives for the water quality parameters of dissolved oxygen, suspended solids, etc., should be met through a combination of technical measures which required the least cost.

Effectiveness

The policy should be effective in that there would be a high probability of the desired objectives being attained. Thus, it was recognized that the policy and the institutions would have to be designed with an awarness of the difficulties of implementing a least cost system in a political-administrative-economic environment such as has been described in the preceding section.

Equity

The policy should distribute the costs and benefits of water quality improvement in accord with some explicit, generally accepted criteria of equity. It was recognized that equity is a value judgment and hence considerations of an appropriate criterion would be the responsibility of each individual. Thus, as was discussed earlier, opinions concerning the appropriate distribution of the costs and benefits of water quality management will vary widely between groups. In the study, an equity criterion was assumed in order to illustrate the consequences of this third criterion. It was assumed that society considers it to be equitable that waste discharges should pay some proportion of the total costs of system management and that this cost should be distributed among dischargers in the same proportion as their contribution to the total waste load in fhe system.

A program to deal with a complex problem of the kind that has been described must fulfill three sets of requirements. First, a set of measures must be found, capable of dealing with the physical and biological aspects of the water quality managemnt problem connected with pollution. Second, changes in the formal institutional structure that governs decision-making must be designed. The institutions must be capable of evaluating alternative measures that might be taken, and of implementing effectively a program that will meet the criteria of economic efficiency and equity. Third, steps to overcome the cultural factors inhibiting systematic consideration of ways to improve water quality must be worked out and defined.

Technical Measures to Achieve Water Quality Improvements

One of the premises of our study was that any system of measures we developed must be not only technically efficient, but economically efficient as well. This premise was based on the view that the chances for achieving the desired improvements in water quality would be increased if the costs involved were kept to the minimum.

In our study we placed emphasis upon the interrelationship between organic waste discharges and the dissolved oxygen measure of water quality. The reasons for this emphasis were numerous. The foremost reason was the availability of extensive data and a generally accepted theory of cause and effect

relationship. A reason for not including other quality parameters was a lack of data. However, we felt that quality improvement with respect to dissolved oxygen would result in improvements with respect to suspended solids, color, and turbidity even though quantitative estimates of these improvements would not be made.

Furthermore, we considered policies which would reduce the contribution of wood fibers to the river; thus, curbing the accumulation of these materials on the river bottom would reduce the future benthic demands for oxygen that these fibers create.

To predict the consequences of various alternative water quality improvement measures four interrelating studies were undertaken; described as follows.

First, we developed a model, i.e., a description of cause and effect relationships, capable of predicting the dissolved oxygen levels along the 180 miles of river studied based on alternative patterns of waste discharges, river flow, and river temperature conditions.

Second, analyses were made to estimate what the cost would be for (1) treating the wastes to varying degrees for each municipal and industrial source and (2) increasing the oxygen content of the waterway by artificial aeration at key locations. Artificial aeration can be achieved in two ways, by installing venting tubes into the hydroelectric turbines that draw air into the turbines and therefore add oxygen to the water, or by installing mechanical aeration devices which in one version are huge fans churning the water to absorb oxygen from the air.

Third, hydrologic studies were undertaken to ascertain what the natural river flow would be if there were no storage reservoirs and to estimate the maximum river flow attainable during the critical summer months which could be used to alleviate water quality problems.

Fourth, programs for achieving patterns of specified minimum levels of dissolved oxygen at minimum cost were devised, taking into account various *a priori* policy constraints and various degrees of risk of violating water quality standards because of low flows or high river temperatures.

These analyses had certain limitations. It was not practicable, for example, to make a thorough assessment of the possibilities of changing production processing methods in the pulp and paper mills in order to reduce the quantity of waste generated. For the pulp and paper mills, therefore, least-cost analyses were made regarding waste-treatment methods only. Furthermore, since it would have been very costly to make studies of particular mills, the estimates apply only to those that are typical of the ones found along the river. In addition, it was not possible to completely validate our cause and effect model of dissolved oxygen in the river. This was primarily due to a high degree of uncertainty about the actual levels of waste discharged to the river and the fact that zero dissolved oxygen is prevalent in several reaches of the river—an effect which our model was not intended to predict.

Nevertheless, we believe that our studies provide an indication of the economies that can be achieved through a systems approach (i.e., on the basis of the region as a whole) to water quality management in the Wisconsin River.

Table 2 illustrates some of the alternatives we considered, and gives the estimated annual cost of each (annual cost is the pro-ration of the investment required over 20 years at 9 per cent interest, plus the estimated yearly operating and maintenance expenditures). Based on our analysis of Table 2, and other studies, we were able to make the following conclusions.

a. An across-the-board policy of secondary waste treatment is not economical. The cost of providing a secondary waste treatment plant for most municipalities is considerably higher for improving the dissolved oxygen, than gaining the improvement through treatment of the industrial wastes. Some municipalities will have to provide secondary treatment, but not all (System H compared to System D).

TABLE 2.—COSTS OF ALTERNATIVE QUALITY MANAGEMENT SYSTEMS

Type of system	Waste load	Risk level (percent)	Constraint	Oxygen level	Cost (In thousands)
A. Uniform secondary treatment	Average		All industrial 85 percent and municipal 90 percent removal level, no aeration.		$6,966
B. Unconstrained waste treatment system.	do	10		2 to 5	3,745
C. Constrained waste treatment system.	do	1	No aeration, 50 percent municipal removal.	do	5,276
D. Constrained waste treatment system.	do	10	do	do	4,467
E. Constrained waste treatment system.	do	20	do	do	3,930
F. Constrained waste treatment system.	do	50	do	do	3,611
G. Constrained waste treatment system.	do	10	No aeration, 50 percent municipal removal, 25 percent industrial.	do	5,088
H. Constrained waste treatment system.	do	10	No aeration, 90 percent municipal removal.	do	4,830
I. Constrained waste treatment system.	do	10	No aeration, 50 percent municipal.	3 to 6	5,764
J. Constrained waste treatment system.	Maximum	10	No aeration, 50 percent municipal removal.	2 to 5	5,783
K. Constrained waste treatment system.	Minimum	10	do	do	2,605
L. Turbine aerating and waste treatment.	Average	10	50 percent municipal removal	do	4,120
M. Turbine plus in-stream aeration plus waste treatment.	do	10	do	do	3,208
N. Turbine plus in-stream aeration plus waste treatment.	do	10	50 percent municipal removal, 25 percent industrial.	do	4,116
O. Constrained waste treatment system.	do	10	No aeration, 50 percent municipal removal.	1 to 4	3,730

b. The most economical method to achieve desired levels of dissolved oxygen is to reduce industrial discharges. Since all of the industrial sources were pulp and paper plants this conclusion is probably not generally applicable to other rivers where different types of industry are located (System B).

c. The cost of waste treatment can be considerably reduced by assuming a higher risk that the oxygen level will fall below the specified minimum level for some periods during the summer, yet significant water quality improvements can still be achieved (Systems C, D, E, and F).

d. The cost of implementing a waste treatment plan that requires a minimum of primary treatment for all industries in order to eliminate fibers from the river is high, (System G), but a combination of waste treatment and mechanical aeration can perhaps achieve this result at a more reasonable cost (System N).

e. The uncertainty about the actual amounts of waste being discharged to the river is too great and impedes the selection of the proper alternatives to achieve desired oxygen levels (Systems J, D, and K).

f. The alternative systems tend to be controlled by those reaches designated to maintain fish and aquatic life (Chart 2—5 mg/l). As a consequence, the dissolved oxygen will be increased to above 5 mg/l over the entire reach of river, despite the fact that some subreaches are allowed to have lower dissolved oxygen due to their industrial and cooling water use designation.

g. The construction of municipal waste treatment facilities tends to reduce the requirement for industrial waste reduction to achieve desired dissolved oxygen levels. Thus, in effect, municipal waste treatment provides a subsidy to some industrial waste dischargers.

h. The Wisconsin Valley Improvement Company, in its management of the reservoir system, is currently achieving flow augmentation for water quality to almost the full potential of the reservoir system.

The alternative systems listed in Table 2 are efficient in that under the various assumptions they provide water quality improvement at minimum cost. The incidence of costs and benefits under any of these systems does not meet an explicit criteria of equity. For instance, under a particular least-cost-system two adjacent waste sources may have different waste reduction requirements. One source may have to provide secondary treatment while the other may not need to reduce its waste discharges at all. Hence it is necessary to find a policy

mechanism that will effectively implement these economically efficient systems and meet a criterion of equity.

Strengthening the Policy Mechanism

In describing the water quality problem it was stated that the traditional policy mechanism of regulation has not been successful. Thus it is necessary to consider alternative policy mechanisms that will effectively implement economically efficient systems for meeting water quality objectives and distributing the generated costs and benefits in accordance with an agreed upon criterion of equity.

Effluent Charges

Economists have suggested that economic incentives should be used to induce improvements in water quality. In this study we examined the use of an "effluent charge" to implement economically efficient systems for meeting water quality objectives.

The theory of an effluent charge has been developed by Allen Kneese.[12a] Basically, this mechanism imposes a charge on each unit of waste discharged to the stream and depends on the charge being sufficiently high to induce the waste discharger to abate his wastes by the desired amount. In order for this mechanism to perform this way in practice, it is necessary that certain requirements be met.

There must exist a level of charge for each waste discharger that will induce the levels of reduction that are necessary at that source, if the least-cost-system is to be implemented. This requirement was examined for the municipal and pulp and paper waste sources on the Wisconsin River. It was found that the available technical alternatives for abating wastes and the behavior of their average costs were such that it was not possible to levy charges that would induce all desirable technical alternatives to be implemented. Hence it is not possible to implement the least-cost-system with the policy mechanism of an effluent charge, and meet the criterion of economic efficiency.

Three variations on this pure effluent charge mechanism were considered, in order to assess their implications for the criterion of economic efficiency, where the least-cost system is set up as a standard of comparison. While all three variations were capable of eventually achieving water quality objectives it was found generally that apparent gains in ease of administration were counteracted by heavy losses of economic efficiency. Briefly, the three alternatives were:

(*a*) The Zoned Effluent Charge: This approach divides the stream into zones so that a different level of charge can be levied in each. Administration is eased slightly by not having to identify the level of charge for each source in the zone. The charge is set sufficiently high in the zone in order to induce sufficient abatement to meet the water quality objectives. An assessment of this policy mechanism on the Wisconsin River indicated that such an approach might result in an increase in total cost of 62 per cent over the least-cost system for meeting the same objectives.

(*b*) The Single Effluent Charge: This approach eases administration further by considering the total stream as one zone, i.e., same effluent charge throughout the basin. Our studies indicated that this might result in an increase in total cost of 71 per cent over the least-cost system for meeting the same objectives.

(*c*) The Escalating Charge: This approach attempts to drastically ease administration by avoiding the analysis of the required level of charge. Here the level of charge would be progressively raised until the water quality objectives were attained. This could be a zoned or single charge. Whereas the first two variations would be inefficient, they would meet the quality objectives. The escalating charge, on the other hand, would be at least as inefficient, and probably even more so, and gives no indication of when, or if, quality objectives will be met.

This analysis of the effluent charge led to serious reservations about its use as a policy mechanism. As described above, there could be serious losses in economic efficiency from the use of this mechanism. Obviously, this mechanism does not meet an explicit criterion of equity that is likely to be generally acceptable. Finally, the administrative ease gained by sacrificing various degrees of planning and analysis is superficial. This is particularly true of the third variation, where the escalating charge would put the agency in a bargaining position with industry and the municipality. Without the benefit of planning and

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[12a] Allen V. Kneese and Blair T. Bower, *Managing Water Quality: Economics, Technology, Institutions* (1968).

analysis the agency, under this variation, would be negotiating from a position of blind weakness.

Order System—Cost Sharing Arrangement

As no available policy mechanism met the desirable criteria, a mechanism called the "order system—cost sharing arrangement" was developed. This mechanism attempted to combine the desirable attributes of both regulation and economic incentives. That is, regulation has the advantage of directly and explicitly conveying information between the agency and the waste discharger, while economic incentives can be used to induce compliance with regulation.

Basically, this mechanism utilizes the fact that the agency knows the level of abatement and the technical means to be used to achieve it at each waste source, if a least-cost system is implemented. This information is conveyed directly to the waste discharger by the agency in order to effectively achieve the criterion of economic efficiency. Since the agency knows the total cost of the least-cost system, and can check it against an annual audit, it is possible to redistribute the cost of the least-cost system according to some generally acceptable criterion of equity. Thus, utilizing the illustrative criterion that was used in the study, it can be seen that the total costs of the least-cost system could be redistributed in proportion to the wase load generated by each waste source, i.e., if the source generates 13 per cent of the total organic waste load, then it will bear 13 per cent of the total cost of the least-cost system. Matching the redistributed costs against the actual costs incurred, charges will be assessed against those who have incurred lower costs than their allocation, and payments would be made to those incurring higher than allocated costs.

This, in outline, is a policy mechanism which it was felt could meet the criteria of economic efficiency and equity. Additionally, the mechanism has been designed to facilitate improved effectives in water quality management. However, to fully meet this third criterion, it is necessary to examine ways in which the institutional structure might be strengthened.

Strengthening the Institutional Structure

It is necessary to determine what constitutes an appropriate institutional design, or structure, before deciding upon the changes that are needed in present institutions in order to deal more effectively with water quality problems. These two aspects are discussed below.

1. *Factors bearing upon appropriate institutional design.*—The criteria to be considered in institutional design are threefold: the technical nature of the task to be undertaken; the basic principles of individual and organizational behavior; and the requirements of the democratic political process.

The technical nature of the task requires the institutional design to be capable of providing sophisticated hydrological, biological, engineering, and economic analyses of water quality management problems and opportunities on a regional basis; and of implementing and operating a coordinated program of mnagement for the region.

It is not possible in a short paper to review in detail the principles of individual and organizational behavior that are relevant to the design of an institutional structure. In addition, some of these "principles" have not been sufficiently studied and must therefore be viewed more as assumptions than as established theory. However, the available literature on this subject indicates that the following postulates are relevant:

(*a*) *Organizations will generally try to maximize returns.* This postulate used to be expressed in terms of profit-making entities attempting to maximize their economic profits. More recently this principle has been broadened to state that organizations will generally try to maximize their own satisfaction as they see it.

(*b*) *Public regulatory bodies have a powerful motivation to reach an accommodation with those whom they regulate.* As a result, regulations tend to be issued only with the consent of those to be regulated.

(*c*) *Public agencies, in designing and implementing their programs, tend to be responsive to a limited and relatively well-defined clientele rather than to the public interests in general.* Therefore, if different groups in society have substantially diffrent objectives or value preferences, a number of active organizations—public or private—representing the different groups is needed, in order that their differing interests be taken into account in public decision-making processes.

(*d*) *Where a given set of interests is widely diffused among a large number of people, a public agency with the power of law is needed to represent these interests, rather than voluntary, private organizations which cannot be relied*

upon. In other words, the fifteen pulp and paper mills along the Wisconsin, having well-defined interests are capable of organizing effectively on a voluntary basis. On the other hand, the broad public interest in water quality improvement can only be represented effectively through a public agency designed to serve this objective through the power of law and the support of taxes.

The third criterion for institutional design, the requirements of democratic political processes, is of major importance. The decomocratic principles on which society in the United States functions include the following:

(a) those affected by an action should have an opportunity to participate in or be represented in the decision;

(b) decisions should be made in the light of reliable information on the consequences of alternative courses of action; and

(c) where substantial differences exist among parties affected on what is the best course of pursue, there should be an opportunity for negotiation and compromise, and the deciding body should be so constituted and function in such a manner that its deliberations be widely regarded as judicious and fair.

2. *Proposed Institutional Changes.*—The foregoing considerations underlie the following suggestions for strengthening the institutional structure for water quality management in the Wisconsin River Basin.

(a) *A well-staffed investigation and planning agency should be established which is fully responsive to the broad public interest in improving environmental quality.* This agency should be capable of determining what the opportunities are for improving water quality through the application of advanced techniques of analysis. It should undertake studies in depth of situations such as those found in the upper Wisconsin Basin, and then be able to recommend standards of water quality and programs for achieving them. This is the most urgent need that has emerged from our own study. Until such a source of information is provided, those interests concerned with the environment simply will not know what advances are practicable, and will therefore not be satisfactorily represented in water quality management decisions. In fact, two of the basic principles of democratic decision-making mentioned above demand this action. The responsibility for providing the type of information needed might well be assigned to the Department of Natural Resources, but it would have to be relieved of its regulatory responsibilities.

(b) *Responsibility for setting standards, issuing regulations, and enforcing them should be assigned to an independent quasi-judicial body.* At the present time, regulatory responsibilities in the field of water quality are assigned to the Department of Natural Resorces. This is the conservation agency of the State as well as the resource planning agency. For an agency that is presumably representative of one set of interests to have this responsibility makes it hard for it to be viewed by everyone as completely fair and judicious. Thus it violates one of the principles of democratic decision-making. At the same time, because it has this regulatory responsibility, the Department is inhibited from being the forthright representative of the environmental interests. The Department has therefore become an anomaly. It should be freed of its regulatory responsibility so that it can become an effective information-generating agency (from the environmental viewpoint), and an effective representative of the environmental interests. The pulp and paper and associated interests are capable of voluntary organization. Furthermore, their information-generating needs, and to some extent their representational needs, would be provided by the regional management agency discussed below. The independent regulatory body that should be set up would make decisions on the basis of representations from these two broad sets of interests.

(c) *A regional water quality management agency for the Upper Wisconsin should be established to implement a regional water quality management system, which would meet standards and be in accord with regulations of the independent regulatory body.* While it is important for the state to have an independent regulatory body and a well-staffed and equipped planning organization, a regional agency is also necessary to implement a regional water quality management program.

This agency would be capable of operating joint facilities (such as the reservoirs to regulate river flow, the mechanical aeration devices discussed earlier, and waste treatment facilities). It should also be able to monitor waste discharges and collect charges to defray the costs of managing the program. It might also under contract operate the waste treatment plants of municipalities, since the smaller cities have difficulty in employing adequately trained personnel for their treatment plants.

There are a number of different ways in which this agency could be established in Wisconsin, such as, for example, through a regional authority or conservation district. Probably the simplest and easiest way would be to expand the authority and responsibility of the Wisconsin Valley Improvement Company. This company already has the nucleus of a staff for such an organization. It has working arrangements with the major waste dischargers. It would appear to be a relatively simple task to increase its authority and responsibility and to expand its staff to implement the kind of regional management program which our studies indicate to be desirable. Under such an arrangement, it would of course be essential that the Department of Natural Resources should continue to be the planning agency, and that the independent regulatory body that is set up should be responsible for determining water quality standards and seeing that the regional agency complied with them.

(d) *Each waste discharger should have an economic incentive to reduce his discharges into the regional water quality management system to the extent that he is able to reduce his wastes more economically than the system is able to deal with them.* Our studies indicate that it would be difficult to administer a system that relies primarily upon an effluent charge in order to achieve desirable levels of water quality. On the other hand, charges that reflect the costs of managing the system might be used to encourage waste dischargers not to impose a burden on the system when they could handle the wastes more economically themselves.

(e) *Selective subsidies could be provided to industrial waste dischargers to avoid the burden upon local communities that would result if the cost of meeting acceptable water quality standards would force a plant to reduce or discontinue production.* It is our conclusion that the existing subsidies contribute very little towards improving water quality in the Wisconsin River Basin. It is possible that some of the plants along the river might be so severely affected by the requirements of a water quality improvement program that they would not be able to continue without some type of assistance. It would appear from our study that the existing tax subsidies are unnecessary in some instances and may be insufficient in others to keep a plant from curtailing its operation. At the same time, our analysis indicates that if investments are made to achieve State standards, the loss in revenues to the State and local government from existing tax benefit subsidies would amount to between two and three million dollars.

If it is decided that a producer should not go out of business because of its high costs of waste abatement, then a subsidy may be merited. It would seem desirable, therefore, for the State to establish a fund that could be used to assist individual plants to install facilities for reducing waste discharges, where a plant can demonstrate clearly that in the absence of such assistance it would be unable to maintain production. Such a program would have a dual effect. It would avoid the hardship that would be imposed on a community by the loss of an industrial base in consequence of a water quality improvement program. In addition it would diminish the political influence of those who might oppose the imposition of higher water quality standards. The granting of such subsidies might be handled by the quasi-judicial regulatory body.

Overcoming Cultural Inhibitions Concerning an Effective Water Quality Management Program

The third requirement for an effective water quality management program is the need to overcome cultural inhibitions influencing people's attitudes. Before changes of the type described above can be instituted, it is essential that the perceptions of policy-making officials and the public generally on what is necessary for an effective water quality management program be enlarged. There must be general recognition of the fact that systematic management on a regional basis is essential if it is to be effective, and that for this purpose a well qualified staff of professionally trained individuals must be employed to plan water quality management programs. There is no easy solution to this problem. It is hoped that the Wisconsin River study itself will help develop an appreciation of the need for investment in such a body of talent.

Immediate Prospects

The adoption of a regional system approach to water quality management in the upper Wisconsin River Basin could produce important early results through the use of currently available technologies. Of foremost importance, it should be possible in the relatively near future to restore and maintain oxygen levels that will support fish and aquatic life in many of the reaches where it is now deficient.

Although we recognize that rectifying the water quality problem with respect to oxygen level alone does not guarantee immediate recreational use of the river, we feel a healthy aquatic environment will increase public acceptance of the waterway as a recreational resource.

It also should be possible to eliminate almost completely the discharge of additional wood fiber to the waterway, which has had such long-range deleterious effects and which has been an important cause of turbidity. While it is uncertain whether or not these measures will result in a decrease in turbidity and an alleviation of the color problem which may be necessary to induce high recreational acceptability for the river, we feel that they are an important first step.

In addition, the regulatory procedures envisaged should be capable of preventing further contamination by toxic pollutants and an unwarranted increase in water temperatures. These would be major steps forward, but there would still be important problems to be dealt with.

RESTORING QUALITY: LONGER RANGE GOALS

While immediate improvements can be made through the type of regional approach to water quality management that has been described, it is important not to lose sight of the fact that when the immediate goals are achieved, significant problems will remain in the upper Wisconsin River Basin. Some reaches of the river may continue to experience low oxygen levels. It seems unlikely that in the initial stage the pulp and paper chemical discharges can be completely eliminated. Therefore, there will continue to be odor problems and the taste of fish will still be affected. More important, however, is the fact that new demands may be made upon the waterway for waste disposal purposes if industry expands. It will be necessary to keep these demands under control if water quality is to be preserved and enhanced into the more distant future. These considerations emphasize the importance a) of providing an incentive to make the scientific and technological advances to eliminate the remaining water quality deficiencies, and b) of adopting policies which will prevent future growth from degrading the quality of the river waters. These factors are discussed briefly below.

Incentives for Scientific and Technological Advance

It seems likely that if available research capabilities were mobilized, advances could be made that would enable the maintenance of oxygen levels in the river sufficient for the propagation of desirable species of fish, and the elimination of virtually all chemical contaminants.

To foster the mobilization of such a research effort, we propose that the State, operating through its independent regulatory body outlined above, establish water quality goals for specified future dates, such as, for example, 1980, 1985, 1990. These goals would be translated into types and amounts of waste discharge to be permitted at locations on the river at each of the specified dates. This would place all waste dischargers on notice that, as old investments were amortized and new investments made, specified reductions in waste discharge must be achieved. There seems little doubt that over a fifteen year period the capability can be developed to meet water quality conditions approaching those found under natural conditions.

Controlling Future Demands on the River for Waste Discharge

No doubt new economic activities as they are developed will wish to discharge waste effluents into the Wisconsin River. It is therefore extremely important that the State adopt a positive policy for dealing with such demands by new industries. Unless this is done in advance of the demands, the pressure to accommodate new economic activities may result in gradual degradation of water quality.

If there were a regional management agency of the type we suggest, it would be a relatively simple matter for the State to establish a procedure for exercising control over future demands. The regional agency would be required to meet the water quality standards of the State. Potential waste dischargers, together with the regional water quality management agency, might be required to demonstrate that satisfactory arrangements would be made to accommodate the additional wastes without violating the standards. The issuance of a license in accord with the proceedings now being instituted by the Federal Government under the 1899 Refuse Act might be contingent upon such a demonstration. It would be up to the regional agency to work out suitable financial arrangements between the new waste discharger and the other participants in the system.

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Implications for Other Regions and Federal Policy

The Wisconsin River was the empirical situation in which it was decided to examine the concept of regional management of a water quality system. It would be dangerous to generalize all the conclusions to other regions. In fact a major conclusion of the study is that a regional approach is essential in order that each situation might be considered unique. While the criteria of economic efficiency, equity, and effectiveness are desirable in all regional management systems, it is illogical to conclude that the policies which best meet these criteria for the Wisconsin River will likewise apply to the Delaware or the Penobscot. It is, however, necessary to comment on a number of policy issues which are either in use or proposed in other regions.

(a) Effluent Charges: It was concluded that each region must be examined in order to identify the most appropriate policy mechansm. However, while some of the conclusions are based on the cost functions for treating pulp and paper mill wastes and may well differ for other industries, it is felt that this mechanism has serious problems which will apply to a greater or lesser extent in all regions of application.

(b) Fiscal Policy and Tax Incentives: Present Federal and State corporate income taxes result in a tax saving to the waste discharger of 52 per cent of the annual cost of waste abatement. Additional tax benefits, such as accelerated depreciation and property tax exemption, are offered in Wisconsin (as in many other states) and result in a further tax saving of more than 15 percent of the capital cost. Two points must be made about these provisions. 1) They are not incentives to abate pollution but subsidies which must rely on other forces, such as regulation or public opinion, in order to provide the incentive. 2) These policies result in a reallocation of the costs for abating waste discharge and must be recognized for that.

(c) *Secondary Treatment Policy:* It is the policy of the Federal, Wisconsin, and other state governments to require all municipalities to provide a minimum of secondary treatment for municipal wastes. Concentration on this physical objective rather than resultant water quality has been shown to be inefficient in the case of the Wisconsin and that a requirement of primary treatment plus chlorination is sufficient to efficiently meet water quality objectives. These conclusions have general application in a region where municipal waste loads are small relative to industrial waste loads. In any situation it would be dangerous to assume that a uniform secondary treatment policy was merited.

(d) Grants to Municipalities: As with tax incentives the grants must be recognized as substantial subsidies and not incentives. Present policies enable most municipalities to obtain about 70 per cent of the capital costs of treatment facilities from the Federal and state government.

In general, it was concluded that a regional approach to water quality management, which utilized analysis and planning, would reap the benefits of efficient improvement of water quality and that Federal policy should encourage this type of regional approach.

CONCLUSION

Compared with many waterways in the world, the Wisconsin River presents a relatively uncomplicated water quality management problem. A single industry is responsible for the major waste discharges, and the technology exists, or is in prospect, to enable the water quality of the river to be restored over time to near normal conditions. It should be possible to maintain an attractive waterway from its source at Lac Vieux Desert on the Michigan border, to its confluence with the Mississippi. As we see it, in its upper reaches above Eagle River, the river would forever meander, as it does now, through muskeg and forest, a sanctuary for the bald eagle and other rare and beautiful forms of wildlife. In the middle section, the flowages above the dams and the intervening reaches would provide facilities for swimming, boating, and fishing, where excessive turbidity would not obscure the clarity and where the fish caught would no longer be contaminated by the taste of the wastes of the pulp and paper plants. Below Portage the river, as it flowed gently over and around the sandbars through the hills of the Driftless Area, would once again be "exceedingly clear", as Jonathan Carver described it long ago. Throughout its entire length, man's activities should be in harmony with the natural beauty of the riverscape.

This may be a dream but it is also a genuine possibility. The Shoreland Protection legislation of the State provides the means for preserving the riverscape. The analytical tools either exist already or are in prospect for achieving a dra-

matic improvement in water quality through regional system management. The essential features of the institutional framework necessary to achieve improvements are now understood. The rising demand for preserving and enhancing the quality of the environment makes this a propitious time to take action to improve the quality of the Wisconsin River waters. One can only hope that the people of Wisconsin will not let this opportunity go by.

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REX CHAINBELT, INC.

COMMENTS SUBMITTED FOR LEGISLATIVE RECORD IN REGARD TO S. 523

This statement is submitted on behalf of Rex Chainbelt Inc. for inclusion in the record of testimony offered at the March 1971 hearings on proposed water pollution control legislation.

Rex Chainbelt Inc., one of the largest manufacturers of water pollution control equipment in the country, appreciates the opportunity to offer constructive comments on S. 523, the proposed National Water Quality Standards Act of 1971.

We believe the role of the supplier of water pollution control equipment to be a vital one in the struggle for a better environment. It is also a role which, we feel, offers a unique vantage point from which to offer comments on legislative proposals dealing with problem areas with which we are deeply involved.

S. 523 is a sound piece of proposed legislation reflecting careful preparation and the unique depth of knowledge on environmental matters which the pollution control community has come to expect of the members and staff of the Subcommittee on Air and Water Pollution of the Senate Committee on Public Works.

Philosophically the proposed legislation appears to come to grips with the many flaws which emerged in past environmental proposals after they became law. Certainly the problems of open ended time sequences for compliance stages and unnecessarily burdensome steps for establishment of standards at state level have been vigorously addressed in S. 523. And we applaud this initiative.

We feel also that the emphasis placed on River Basin Planning in S. 523 will go a long way toward spurring the cooperation of adjoining jurisdictions in dealing with water pollution control problems. For too long River Basin Planning has been largely a theoretical rather than actual tool in the struggle for cleaner water. We hope the system of funding proposed in S. 523 corrects this situation.

But while we are in agreement with the thrust and initiative displayed in S. 523 our extensive experience in the water pollution control field leads us to offer some comments on some of the details of the proposed legislation.

Section 7(B)

While there is, undoubtedly, a need for the maintenance of a systemized flow of information on what each of the individual states and interest agencies is doing toward the goals of pollution abatement, we think there is a possibility that the manpower hours consumed in entering reports as extensive as those which could be requested under this subsection could work toward the detriment of the overall control programs. Both federal and state agencies are already burdened with paperwork far out of proportion to information gleaned and the limited resources available to them. Some consideration should, we feel, be given to whether the already scarce manpower of state agencies might be better utilized than in the extensive reportorial requirement that appear to be called for under this section.

Perhaps, too, some specific clarification should be given to the phrase "and the Administrator shall approve annually etc." since it carries the implication that plans approved one year may not be necessarily approved the next. Because of the extensive time needed for the engineering, fabrication and installation of water pollution control equipment . . . and the obvious funding commitment to each phase of the work . . . some assurance should, we feel, be given to the continuance of any control project once agency approval has been granted.

Section 8(I)

While the definition of "construction" is fairly broad in scope, we feel that an additional subsection (ie: (4)) should be added to cover the cost of the start-up of facilities and the inevitable adjustment of equipment once the control facility is brought on stream. In order to avoid dissipation of construction grant funding

in actual plant operation, we feel that a 90 day time limit for start-up and adjustment funds is reasonable.

Section 10(A)3

The dissemination of information on water pollution control techniques and methods is a constructive step, but we feel that the term "recommended" in this subsection should be dropped for two reasons. First, the term "recommended" implies that the government endorses a certain technique or piece of equipment and, secondly, that abatement plans must specify these methods in order to gain federal approval.

In addition we would like to recommend that either the term "workable" or "proven" be inserted in this section to clarify the phrase "the latest available technology", since this information is obviously designed to provide lower echelon control agencies with information applicable to their immediate needs and not deal with theoretical procedures or bench or pilot scale work.

Perhaps, too, a more considered review of Section 10(A)3 is in order in light of its prime objective of outlining ways in which to adequately meet the water quality standards to be established following the dissemination of criteria called for in Section 10(A)2. Are we not here putting ourselves in a position of undermining badly needed research and development work (in effect) implying what control methods to use and perhaps limiting the incentive for the development of fresh approaches to problems of water pollution control? Would not, perhaps, the attainment of long term goals be best served by leaving the methods of attainment of what are expected to be stringent water quality standards up to the highly capable community of technologists, scientists and engineers working in this field? Obviously there are available arguments both pro and con on this particular point. But our world wide experience of over 50 years in the water pollution control field has taught us that there are no two control problems alike and no set of standard tools for providing the best solution. We must therefore take serious issue with any proposal which would have the tendency to specify the methods by which water quality standards are to be achieved.

Section 10(B)1-2-3

While there is badly needed within proposed environmental legislation some system of timetables to assure that goals are consistently strived for, the time parameters within which S. 523 calls for the achievement of water quality standards appear to be neither realistic nor feasible. We are not sure, either, that the public will be best served by the mandate in Section 10(A)2 that gives the Administrator a mere 90 days to consult on, develop and publish "criteria of water quality" for the nation.

The three year outside limit for the achievement of water quality standards is, we feel, inconsistent with the type of long range program we so badly need in this area. There is no need for us to outline for this Subcommittee the tremendous task faced in cleaning our nation's waterways. It is a problem which ranks high in our order of national concerns. But we can't in all honesty pretend that any sort of crash program would eliminate our poverty, unemployment, housing or urban decay problems within three years. Is it fair to tell the American public that our water pollution problems will be solved in this time span?

As a firm with depth experience in the design, fabrication and installation of pollution control equipment we must aggressively caution that even a single major water pollution control facility can take more than three years from concept to start-up and the notion of completing the nation's entire backlog of needed control facilities within that time span is completely unrealistic. While all of us who supply consulting, engineering and construction services as well as equipment to the water pollution control industry would like to see full employment and a genuine upturn in the economy, we do not believe that the government or the people could provide the necessary funds to complete the task of eliminating water pollution within a three year period. This judgment would, we believe, prove valid no matter what funding level was ultimately decided upon. We would be happy to have Rex personnel outline in detail the time frame within which pollution control efforts are accomplished and we are prepared to meet with Committee or staff members at your convenience. Perhaps what is needed in regard to S. 523 is a clear indication of an order of priority for addressing the nations most severe water pollution control problems rather than an absolute and unattainable deadline for all our efforts.

Section 10(E)1

We must take issue with the thrust of this section in two specific areas.

First, there is a need to re-examine the point of calling for the installation and use of the "latest available pollution control techniques." Any judgment on the part of the Administrator as to what constitutes "latest" or "available" is bound to be highly subjective in light of the constantly evolving technology and the fact—as previously stated—that no two control situations are alike. It must be also pointed out that the mandating of installation of the "latest available" methods in effect completely undermines the reason for establishing water quality criteria and standards. It is not, we feel, reasonable to travel in both directions at one time. The legislation should either demand that the latest technology be applied and eliminate the cumbersome process of standard setting or set standards and leave it to the individual polluter what methods he feels most cost-effective in meeting the standards established.

Secondly, we must take issue with the dual certification provisions called for under this sub-section. State control agencies themselves are quite capable of ascertaining what the projected effluent composition and loading will be from any particular plant and whether such loading will lead to violation of a water quality standard. We fail to see what will be served by mandating what will be a redundant effort on the part of the Administrator. All control agencies are already awash in a sea of forms and paperwork and dual certification, in our opinion, merely adds to the problem.

Section 10(E)2

Perhaps some clarification is needed in regard to what is meant by a "closed-cycle production or treatment system" and what constitutes the potential for availability. Spacecraft already have closed-cycle systems but this is hardly applicable to an industrial facility. It must be pointed out, too, that numerous industrial applications of limited closed-cycle systems are already in use. These systems are largely geared to the multiple reuse of make-up and cooling water. If this is what is envisioned by the term "closed-cycle" it should be thus stated.

Again, under this sub-section, we must take issue with the philosophical thrust involved. We should as a national goal be striving for either a standard set of stringent water quality standards or for a system of constantly seeking and applying new technology. To go in both directions is to dissipate our efforts in achieving the overall goal.

PORT OF SAN FRANCISCO

By MIRIAM E. WOLFF, Port Director

S. 1238

This subject legislation would further regulate the dumping of material in oceans, coastal and other waters, and gives new authority to the Environmental Protection Agency. Until now the Army Corps of Engineers has regulated and monitored this problem.

As we indicated to the Corps of Engineers on their proposed regulations published in the Federal Register late last year, this matter must be divided between industrial waste disposal and dredged materials involved in port development and maintenance. The Corps agreed to the extent that they modified their proposed regulations to recognize this division.

The foreign commerce of the United States depends on port facilities and no one at a port wants to harm the environment. All ports want to abide by reasonable regulations, but it is our view that EPA is not the agency to regulate port dredging. The American Association of Port Authorities appeared before Mr. Dingell and testified against the form of regulation prescribed in this legislation.

We strongly urge you to use your influence to separate the industrial waste disposal problem from the port dredge disposal problem. It is our view that the Corps of Engineers, working with the EPA, will prescribe effective regulations to improve the quality of water while doing the least harm to the matter of disposal of maintenance dredging spoils.

SOUTHERN CALIFORNIA EDISON COMPANY

Southern California Edison Company is pleased to present its comments concerning S. 523, the proposed "National Water Quality Standards Act of 1971", and S. 1014 which propose amendments to the Federal Water Pollution Control Act, as amended.

Edison is a California corporation which generates and distributes the electric energy needs of over seven million people in central and southern California. The 1971 Edison system has thermal electric generating resources of 9 million KW and hydro electric generation resources of 1 million KW. It is currently estimated that our customers will require an additional 10 million KW of generating capacity in the next decade and another 18 million KW or more in the 1980's. In view of its large existing system and its future growth, Edison has been and is extensively involved in water quality control and other aspects of the preservation of the environment.

Background—Energy Needs and Water Quality

Electric energy is basic to the solution of a wide range of our environmental problems. Millions of kilowatts of future generating capacity will be needed to operate new systems to improve the environment like purifying water, cleaning up the air, recycling usable materials, disposal of waste, and powering rapid transit. We can't improve the quality of life in America by stopping the construction of vitally needed power plants. What is needed is a continued expansion of electric energy in a way that will better balance and control the negative impact on the environment. Until technology completely solves the problem of negative impact, we must work out livable compromises between more energy and preserving the environment.

California utilities have sufficient generating capacity and reserves so we will not have power shortages in California in the next few years. However, if we are precluded from building p'ants on the coastline and if we do not have a regulatory system that can make timely decisions, we can, in the future, experience power shortages and blackouts similar to those in New York and other parts of the east.

Almost everyone knowledgeable in the utility business as well as state officials agree that most, if not all, of new generating plants in California wil' have to be built on ocean sites utilizing salt water for cooling purposes. As you know, fresh water is precious, particularly in the southwest, and is not available in such large quantities. It takes about 30,000 acre-feet of consumptive water use annually for a nuclear plant of 1½ million KW. This is equivalent to the total water consumed in a city the size of 200,000 people, or about the amount of water used annually in a city the size of Fresno, California.

After 1976, most California utilities will rely mainly on nuclear power for their new units. Nuclear power is a clean form of energy. There is no combustion, so there are no sulfur oxides, nitrogen oxides, particulates or emissions to add to the smog problem. Despite the advantages of nuclear plants from the standpoint of minimizing air pollution, they are being attacked because of alleged adverse thermal effects of cooling water discharges.

What about thermal effects on the California coast? A good example is the San Onofre nuclear generating station. For four years before this plant was built, six ocean-bottom stations were monitored, 32 water-surface stations and a number of shore monitoring stations were established within a three-mile area of the plant. Seven years of studies, four before the plant was in operation and three since the operation, have demonstrated that there is no significant adverse effect on marine ecology of the area as a result of operation of the plant. State Fish and Game officials have reaffirmed this conclusion.

The thermal-effect controversy has been extended to all waters without an adequate rationale. The controversy should be primarily concerned with shallow and limited bodies of water, lakes, rivers and shoal waters of restricted circulation. Thermal discharges directly into the ocean in non-shoal areas is a different

matter. Our studies have resulted in the conclusion that it is possible to design thermal discharge systems so as to avoid significant adverse effects upon the marine ecology of ocean waters. We are fortunate in California to have a coastline with relatively deep waters and massive currents where we can site generating plants to provide the energy required for the health, safety and economic wellbeing of our people and at the same time avoid significant impairment of the natural environment.

BACKGROUND—FEDERAL WATER POLLUTION CONTROL ACT, AS AMENDED

Edison supports the principal purposes and approach of the Federal Water Pollution Control Act. Measures for the control of water pollution should be developed in accordance with water quality standards and enforcement plans developed by the States. State action to abate water pollution should not be displaced by Federal enforcement action, unless the State fails to take reasonable action to enforce water quality standards. Federal action to assure setting and enforcement of water standards and enforcement plans should not be initiated unless a State fails to take reasonable action to achieve these purposes. Proper implementation of the Federal Water Pollution Control Act would, we believe, result in the development of a technically sound and rational plan by which pollution sources would be controlled primarily by State and local enforcement agencies.

S. 523 departs significantly, and S. 1014 departs to a lesser degree, from the present approach of the Federal Water Pollution Control Act. We believe these departures are not in the total public interest. Both bills have the stated objective of encouraging more public participation in water quality control, yet this cannot be accomplished by moving control away from the local community. Under S. 523, the States are left without adequate substantive or procedural safeguards against Federal pre-emption of their jurisdiction.

COMMENTS ON PENDING BILLS

We submit the following analysis and comments concerning S. 523 and S. 1014.

1. PROTECTION OF HIGH QUALITY WATERS

Analysis.—Both bills seek to provide protection of high quality waters for the benefit of subsequent uses. S. 523 contains proposed Section 10(b)(1) which provides "no State standards and plan shall be approved which provide for the degradation of the present quality of any waters". S. 1014 contains proposed Section 10(d)(3) which provides "in cases where the quality of water . . . is higher than water quality criteria applicable to any use designation, such high quality shall be maintained . . .". These provisions could be construed to preclude any alteration of the chemical, physical, biological, bacteriological, radiological or other properties or characteristics of water.

Comments.—The objective of water control is to establish limits or levels of water quality constituents or characteristics necessary for the reasonable protection of beneficial uses of water. Any use of water alters its characteristics. To prohibit alteration is to prohibit any use. The objective of water quality control is achieved if quality after such use is still sufficient to reasonably protect subsequent uses. It is unrealistic and unwise to flatly prohibit uses of water which do not hinder the achievement of that objective. Unconditional and unqualified policy statements concerning the maintenance of high quality waters, such as those contained in S. 523 and S. 1014, can be misunderstood and in any event are unnecessary. They are unnecessary to protect subsequent beneficial uses if appropriate water quality criteria are established and enforced. If such policy statements are interpreted to prohibit any alteration of water quality, then the public is denied the use of a valuable resource with no offsetting public benefit.

2. OCEAN DISCHARGE PERMITS

Analysis.—S. 523 contains proposed Section 10(d)(2) which would prohibit the discharge of matter into the territorial sea unless the Administrator has issued a permit. S. 1014 contains no comparable provision.

Comments.—While this provision may have been intended to establish controls over ocean dumping, its language is sufficiently broad to cover the discharge of effluent from outfall structures. To this extent, proposed Section 10(d)(2) both duplicates and conflicts with existing law and regulations. Presently, ocean

discharges through outfall structures may be subject to permits under the Refuse Act of 1899 and certification of compliance with applicable water quality standards under Section 21(b) of the Federal Water Pollution Control Act.

It is recommended that proposed Section 10(d)(2) be deleted or be amended to exclude the discharge of any effluent from any outfall structure.

The imposition of new permit requirements in addition to existing law would only serve to further complicate and delay the authorization of needed utility facilities and would provide no further assurance of the protection of water quality.

As noted above, S. 1014 contains no provision comparable to proposed § 10(d)(2) of S. 523. However, the matter of ocean dumping is covered by the proposed Marine Protection Act of 1971 (H.R. 4723) which is not applicable to outfall structures. We submit that this approach is preferable.

3. CERTIFICATION OF NEW FACILITIES

Analysis.—S. 523 contains proposed Section 10(e)(1) which would provide for the issuance of regulations to insure that any person constructing new facilities subject to water quality standards "shall install, maintain, and use the latest available pollution control techniques". The construction of such facilities for commercial purposes is prohibited unless certification of compliance is received from the Administrator and the State pollution control agency. S. 1014 contains no comparable provision.

Comments.—We submit that this new provision has a number of undesirable features.

1. To the extent that such new facilities require other federal permits (as is the case with most, if not all, cooling water discharge facilities), it duplicates the certification requirements of Section 21(b) and the permit requirements of the Refuse Act of 1899.

2. No procedure is prescribed for obtaining these additional certifications. There is no time limit by which the Administrator or the State must act on an application.

3. No procedure is prescribed for appealing from the Administrator's denial of certification.

4. There is no requirement that the "latest available pollution control techniques" to be installed and used be among those that have been evaluated and recommended in accordance with § 10(b)(3).

5. It would appear that certification would be achieved at the cost of unnecessary and harmful delays in the completion of essential new generating units.

4. CLOSED-CYCLE TREATMENT SYSTEMS

Analysis.—Proposed Section 10(3)(2) of S. 523 would prohibit any discharge upon a finding "that closed-cycle production or treatment systems are available or can be made available" for any new facility.

The effect of this provision is to mandate the construction of new facilities in accordance with specifications prescribed by the Administrator. Insofar as electric generating plants in California are concerned, the implementation of the provision could lead to the prohibition of once-through ocean water cooling systems.

Comments.—Because of the absolute and inflexible nature of this provision, it could have an unintended and undesirable adverse impact on the environment and natural resources of southern California. After years of extensive monitoring of coastal sites in California, cooling water discharges have not been shown to have any significant adverse effect on the marine ecology. Most, if not all, of the new generating plants in California will have to be built on ocean sites utilizing salt water for cooling purposes. Fresh water is a precious resource, particularly in the southwest, and is simply not available in the large quantities needed for use in closed-cycle cooling systems. Salt water cooling towers and air cooling systems may eventually achieve technical feasibility, but the construction and use of such systems are known to pose other substantial problems of air quality, require large land areas and are generally unacceptable from an aesthetic standpoint.

The selection of cooling systems for electric generating plants must be based on a sound and balanced consideration of all environmental effects, the value and availability of water, air and land resources and the need for electric energy to achieve other desirable social and environmental goals. We seriously question the practicality and wisdom of proposed § 10(e)(2).

5. FEDERAL ENFORCEMENT PROCEDURES

Analysis.—Both bills provide for the issuance of compliance orders by the Administrator or for the initiation of civil actions by him and provide for civil penalties in the event of violation of such orders or of water quality standards. S. 523 contains proposed Section 11(b) which provides that such orders are effective after "an opportunity to confer with the Administrator". Proposed Section 11(b) contains no provision for hearing or for a direct appeal. S. 1014 contains proposed Section 10(f) which provides for notice and a 30-day waiting period prior to the issuance of an order and also provides an opportunity for hearing and judicial review of such orders. The provisions for civil penalties in each bill are essentially comparable. S. 523 provides in proposed Section 11(d)(1) that negligent violations are subject to "a civil penalty of $10,000 per day of violation" and knowing violations are subject to "a fine of not more than $25,000 per day of violation". S. 1014 contains proposed Section 10(f)(5) which provides for "a civil penalty in an amount, not to exceed $25,000 per day of violation, to be determined by the Administrator and subject to compromise by him . . .". Both bills delete Section 10(h) of the existing Act regarding judicial enforcement.

Comments.—We submit that the procedures for the issuance of compliance orders under S. 523 represent an unconstitutional violation of due process. The opportunity for consultation cannot properly be substituted for adequate notice, opportunity for hearing and an appeal based on a record. S. 1014 appears to contain procedural safeguards which meet minimum requirements of fairness. The penalty provisions of both bills are extremely harsh and those of S. 523 are less flexible than those of S. 1014, particularly with respect to the first occasion of a negligent violation for which it appears that no discretion to fix the penalty has been retained. Both bills would delete § 10(h) of the existing Act which permits the Federal court in acting on suits to enforce water quality standards, to give due consideration to the practicability and to the technological and economic feasibility of complying with such standards, and to enter such judgment or orders *as the public interest and equities of the case may require.* This provisions permits the court to weight and reconcile the public needs for protecting the environment from water pollution and for obtaining adequate, reliable economic electric energy.

6. INDIVIDUAL ENFORCEMENT PROCEDURES

Analysis.—S. 523 contains proposed Section 11(i) which would permit any person to bring a civil action in the United States District Court against any person, including a government instrumentality or agency, for declaratory and equitable relief or any other appropriate order to abate a violation of "any water quality standard, effluent requirement, schedule or timetable of compliance, or prohibition of discharge", or an order of the Administrator or of a State. S. 1014 also provides for civil actions brought by individuals but requires notice and a waiting period and the absence of Federal or State enforcement action.

Comments.—We believe that the enactment of either of these provisions would result in a multiplicity of abatement actions brought by private individuals and in harassment of defendants which would be contrary to the public interest. The parties involved would incur enormous costs as would the public in connection with the administrative costs of the district courts involved. We do not think that the result would be a gain in effective enforcement of water pollution regulations since adequate enforcement can be carried out by the regulatory agencies involved utilizing the remedies provided by existing Federal and State law. It must be recognized that there are individuals and groups who have the sole objective of preventing the construction of any new electric generating facilities. These persons and groups have and will continue to avail themselves of every opportunity to force delays by means of litigation or otherwise in order to frustrate plans to construct essential new generating capacity. To provide such persons or groups with a tool which can be so easily abused is to invite disaster from the shortage of essential electric service.

7. PROHIBITION OF CERTAIN CONTRACTS

Analysis.—S. 523 contains proposed Section 10(1) which would prohibit any Federal agency from entering into any contract with any person convicted of any offense under Section 10(d) for the procurement of goods or services from the

facility at which the violation occurred. These provisions are to be implemented by procedures established by the Administrator and by Executive Order.

Comments.—We seriously question the practicality or wisdom of this requirement. For an electric utility serving a Federal agency a finding of the absence of any conviction or a certification of the correction of the conditions giving rise to the conviction would have to be made for every generating plant on the utility's interconnected system. If any uncorrected conditions were found, the Federal agency could not continue to purchase electricity from the utility. Unlike most items procured by the government, there would be no alternative source of electricity in almost all instances. A ridiculous situation would thus develop, because it is inconceivable that any Federal department or agency could function without electricity. We submit that satisfactory achievement of water pollution control can better be achieved by methods of direct enforcement of pollution control laws, not by indirect or collateral methods such as this.

GENERAL CONCLUSIONS

1. An adequate and reliable supply of electric energy is essential to the solution of a wide range of environmental problems and legislation must be designed to reduce licensing and construction delays from proliferating Federal, State and local regulation.

2. The enforcement of water quality control regulations by State agencies in the manner contemplated by the Federal Water Pollution Control Act should be supported. The California Water Resources Control Board and the Regional Boards have been extremely diligent and effective in enforcing strict local regulations. A new Federal or individual enforcement mechanism would add nothing to the effectiveness of this local enforcement.

3. The provision for individual legal actions would permit court intervention at each and every level of the administrative process and would frustrate, delay and render ineffective the administrative agencies who have the expertise and the mandate to carry out and implement environmental policy.

4. An unconditional and unqualified policy concerning the maintenance of high quality waters and a policy mandating the use of closed-cycle treatment systems based solely on availability are overly simplistic and fail to permit consideration of the total impact of these policies on the environment and on other valuable national resources.

5. The imposition of new permit requirements or new certifications of compliance in addition to existing regulations would serve only to make it more difficult to secure timely decisions for the authorization of needed utility facilities and would provide no further assurance of the protection of water quality.

6. Certifications of compliance secured under Section 21(b) provide adequate assurance of the achievement of water quality objectives. Existing procedures would be improved and unnecessary delays avoided if Section 21(b) were clarified to assure that applications for Federal permits or licenses can be filed and processed during the period that such certification is being secured.

Thank you for the opportunity to present this statement.

TREASURY DEPARTMENT

THE GENERAL COUNSEL OF THE TREASURY,
Washington, D.C., March 24, 1971.

Hon. JENNINGS RANDOLPH,
Chairman, Committee on Public Works,
U.S. Senate, Washington, D.C.

DEAR MR. CHAIRMAN: Reference is made to your request for the views of this Department on S. 523, "To amend the Federal Water Pollution Control Act, as amended".

The bill would amend the Federal Water Pollution Control Act, as amended, to authorize the Administrator, Federal Water Quality Administration, to make grants to State and interstate agencies having approved plans for the enhancement of water quality through the prevention, control, and abatement of water pollution, to assist such States and interstate agencies to develop plans to implement water quality standards, train personnel, and assist political subdivisions of a State in carrying out water pollution control programs. The sum of $20,000,000 would be authorized to be appropriated annually for the fiscal years ending June 30, 1972 through June 30, 1976 for this purpose. The Administrator, Federal Water Quality Administration would also be authorized, during this same period, to make grants to States, municipalities, or intermunicipal or interstate agencies for the construction of waste treatment works which would be built in accordance with the approved State or interstate plan. The sum of $2.5 billion per year would be authorized to be appropriated for this purpose. In addition, the Administrator, Federal Water Quality Administration would be directed to develop criteria of water quality and would be given authority to enforce water quality standards.

On February 8, 1971, the President transmitted his 1971 Environmental Program to the Congress, including in it legislative proposals for water pollution control. These were subsequently introduced as S. 1012, S. 1013, S. 1014, and S. 1015.

In view of the foregoing, the Department would recommend favorable consideration of the Administration's proposals in lieu of action on S. 523.

The Department has been advised by the Office of Management and Budget that there is no objection from the standpoint of the Administration's program to the submission of this report to your Committee.

Sincerely yours,

SAMUEL R. PIERCE,
General Counsel.

WATER AND WASTEWATER EQUIPMENT MANUFACTURERS ASSOCIATION, INC.

By HARRY S. PRICE, Jr., President

SUMMARY OF STATEMENT

The Water and Wastewater Equipment Manufacturers Association is in general accord with the provisions of the proposed National Water Quality Standards Act of 1971 and Administration proposals.

The Association believes that delays in construction of water treatment facilities do not result from any lack of technical know-how, equipmnt or construction capabilities.

The delays are the result of lack of sufficient funds at Federal, state and local levels.

As stimuli to help channel more funds into water ecology projects, the Association proposes that the Subcommittee consider two additions to the proposed legislation.

1. Create an FHA-type Federal loan guaranty system to help make lower cost credit available at the State, and local government levels.

2. Stimulate the installation of industrial pollution control facilities by making the cost of such facilities fully tax deductible in the year of expenditure, for a limited number of years.

I am Harry S. Price, Jr., President of Price Brothers Company of Dayton, Ohio, a manufacturer of concrete pipe and fittings used extensively in the water supply and wastewater industries. I am President of the Water and Wastewater Equipment Manufacturers Association, Inc., a non-profit organization. I have been in the water supply and treatment business for 34 years.

This Association was organized in 1908 and long has had very close and harmonious relations with The Water Pollution Control Federal and the American Water Works Association, the two technical societies in the field. The Association represents some 300 member companies all engaged in the manufacture of equipment or supplies used in the water and waste-water equipment and supplies manufactured in the United States.

We are specially pleased to have an opportunity to present a statement to this Committee for not only is this proposed Act of vital interest to our members and their employees, but we also believe we are well qualified in the water and wastewater fields.

A great deal of progress in improving technology and equipment has been made in recent years. This progress has come primarily through the cooperative efforts of the municipal and private water utility engineers, the consulting engineers who specialize in this field and the manufacturers of equipment and supplies. While constant improvements in the industry's technology will continue to be made, I want to emphasize as a professional in the field, that the technology available today can handle existing water pollution problems.

As far as productive capacity of our industry is concerned, both the consulting engineers and the manufacturers consider themselves in the midst of a mini-depression, with a high level of unused capacity. This has come about largely due to expansion of production capacity in recent years in anticipation of an increase in demand which has not materialized as rapidly as the industry had anticipated.

I might comment that there recently has been voiced the complaint, by people not knowledgeable in the industry, that it takes at least six months to get delivery on water treatment equipment. Of course it does, and it should, for this is highly technical equipment for the most part custom designed and built to fit the specific needs of a particular situation. But even if the equipment could be delivered sooner, the project could not use it that quickly because the building and facilities to house the equipment would not be ready. It is interesting to note that in the average treatment plant, equipment represents only 10 to 20 percent of the total cost, the bulk of which is in the construction field.

Little water is actually used in the United States, but vast quantities are contaminated. When we flush the toilet, we don't use water, we contaminate it. The overall problem of a clean water supply then can logically be broken down into three parts:

1. There is the regional problem of developing and exploiting new sources of clean, and generally unused water, without damaging the environment by so doing.

2. There is the regional or local government problem of propertly treating effluent for return to the clean water supply source.

3. There is the same treatment problem as it relates to industrial effluent.

The National Water Quality Standards Act of 1971, which is under consideration by this subcommittee deals primarily with regional and municipal water treatment problems, standards and enforcement.

In the water treatment area, technological improvements constantly are being made which are resulting in faster, and therefore less costly, treatment methods. One area which only recently has come to light is the discovery of traces of heavy metals, such as lead and mercury, in water supply sources. Additional research and some new technology will be required to eliminate these. But, let me again emphasize it is not lack of technology, materials, skills, labor or equipment that is delaying the Clean Water Program. The only lack isof dollars to pay for new and improved facilities.

By and large, we feel the bill under consideration is a good one. Our suggestions to the subcommittee deal exclusively with the dollar prblem, through two specific proposals.

While there is urgent need for more speed in getting this job done, we should note that a great deal of progress already has been made. A considerable amount of this progress is not yet evident for the projects are not completed and on-stream. For example, the Department of the Interior reports that as recently as 1967, Federal aid funds for construction of municipal waste treatment facilities were granted for projects having a total cost of $470 million. By the fiscal year ended last June, the total cost of like projects was over $2 billion, a four-fold increase in just three years. It is interesting to note that only about 21 per cent of the total cost of these $2 billion worth of new treatment facilities is being paid through Federal grants. The other 79 per cent is being paid from state or local monies. We are pleased to note that the provisions of the bill under considerations would sharply increase the participation of Federal funds.

But the problem of local financing will still remain, and it is in this area that we believe more Federal help can be provided at very low cost to the Government.

The bulk of the State and local funds required come from bond issues. We all are well aware that the credit ratings of many of these borrowing entities, particularly at the municipal level, have deteriorated in recent years. The result sometimes has been difficulty in marketing these bond issues and almost invaribaly, high interest rates.

To help this situation, we respectfully suggest that the subcommittee consider the advisability of providing for Federal loan guarantees to help in the local financing of new treatment facilities. Specifically, we propose an FHA-type Federal loan guarantee for municipalities faced with the necessity of substantial borrowing to finance new water treatment facilities. This type of Federal guarantee has been successful in other areas, it has made credit available, it has kept interest rates at reasonable levels, and it has been done at remarkably low cost to the Federal Government.

We disagree with those who feel that municipal and industrial water treatment are two separate problems. While there are no reliable figures available that I am aware of, I would estimate that something like 50 per cent of all industrial effluent goes into municipal systems. This, of course, will vary in different parts of the country, but anything that can be done to quickly improve the treatment of industrial effluent will result in a marked benefit for municipal and regional systems.

Yet, we must recognize that investments in costly pollution control facilities are not attractive ones for business management. Such investments almost never produce profits. While there are many public spirited companies moving ahead in this area as rapidly as they can, there also are many companies that will do nothing above and beyond the requirements of law.

The problem, therefor, becomes one of making it as attractive as we can for industry to invest in more than minimal treatment facilities and to do it now. And above all, to do it without direct subsidy from the government. To accelerate industrial expenditures for pollution control, we respectfully propose that

for a limited period of time, the subcommittee consider making all capital expenditures for pollution control equipment a direct business expense in the year incurred, for income tax purposes.

There are a number of reasons for making this suggestion:

1. We believe it will quickly result in a substantial increase in industrial expenditures for pollution control, particularly if the tax incentive is provided for a limited period of time.

2. When combined with public and government-regulatory pressures, the immediate tax saving becomes a strong incentive for industry to buy more and better pollution control now, before costs go up.

3. Assuming a reasonably constant income tax rate, there will be no long-range loss of revenue for while taxes are reduced in the year of the expenditure, there will be no depreciation allowance on this equipment in future years. While some economists may argue that this is an interest-free Federal loan to industry, the government certainly will benefit through reduction of law enforcement costs, and it will get the job done.

4. This type incentive is easy to administer for any profit or cost reductions resulting from recycling of raw materials, reductions in process costs or recovery of by-products will automatically show up as increased taxable income in future years.

5. Government entities will benefit through lower water treatment costs resulting from higher quality industrial effluent.

In summary, it is the belief of the Water and Wastewater Equipment Manufacturers Association that the primary need is for more adequate financing if we are to succeed in accelerating the construction of more and better wastewater treatment facilities.

This need for additional financing exists at the Federal level, at the regional and local levels, and in industry.

WWEMA basically is in accord with the objectives and provisions of Senate Bill No. 523, but suggests two additions to help overcome the financing problems.

First, create an FHA-type system of Federal guarantees for local borrowing entities to help make funds more readily available at lower cost.

Second, acclerate the installation of industrial pollution control equipment by making the cost of new facilities or improvements fully tax deductable in the year of expenditure.

It is our belief that incentives are far more effective stimuli than bigger administrative agencies and more enforcement. These proposed stimuli will help generate activity in the construction of water treatment facilities *now*. New facilities will produce the ecological benefits the public is clamoring for.

[General Appendix, Section II, containing comments made on subcommittee draft print of July 2, 1971, by representatives from industry, government, conservation, and miscellaneous groups and individuals, follows as Part 4 of these hearings.]

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