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**Working Title:** Institutionalizing the Regulatory Dialogue in the US Pulp and Paper Industry: 1930-1970

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This paper considers examples of the response of the pulp and paper industry in the United States to largely state government efforts to address water pollution problems from 1930 to 1970. As part of a broader study of activities at the mill, firm, and industry association level during this period, it focuses on collaboration between pulp and paper producers and governmental agencies to establish acceptable standards and methods for measuring pollution levels and assessing the impact of abatement efforts. The interactions between early regulators and industry representatives had a far-reaching impact on the development of subsequent regulatory approaches as well as the later path of technological innovation within the US pulp and paper industry. In its current form, the paper looks mainly at the activities of the National Council for Stream Improvement, an organization formed by member industries, during the 1940s and 1950s. Eventually NCSI became an important conduit for scientific and technological information to both state and federal regulators.

The decades prior to 1970 are generally viewed as a time during which state governments' efforts to protect their waterways were enfeebled by their own overriding economic interests and a lack of funding and expertise. It is widely concluded that manufacturers were largely unresponsive and successfully resisted regulatory challenges. From this perspective, progress toward effective environmental protection began only with the actions of the federal government in the early 1970s.

Closer examination of the preceding four decades suggest that they were a time of considerable achievement regarding the institutionalization of working relations between government and industry, consensus on standards and measurements, and recognition of mutually acceptable expertise. Also during this period, there is evidence of a significant shift in research efforts within the pulp and paper industry that directly or indirectly addressed pollution problems. What once was a widely divergent set of efforts undertaken at several levels within the industry had converged by the 1960s into a more structured approach pursuing a narrower range of pollution solutions. These conditions, the result of activities since the 1940s, had a significant impact on the regulatory regimen that emerged during the 1970s, subsequent technological innovation within the pulp and paper industry, and the response to environmental issues that arose regarding the industry in the 1980s and 1990s. A historical understanding of the way in which early efforts at pollution control affected technological convergence is relevant given current attempts to restructure the federal-state system of environmental regulation.

Throughout the first fifty years of the 20th century, the U.S. Congress regularly

debated the federal government's potential role in protecting the nation's water resources. Eventually the Water Pollution Control Act of 1948 defined a narrow scope for federal involvement in water pollution regulation. The act largely maintained the priority of state governments in such matters, stating that it was "the policy of Congress to recognize, preserve, and protect the primary responsibilities and rights of the states in controlling water pollution." Although the U.S. Surgeon General was given responsibility for developing comprehensive programs to eliminate or reduce the pollution of interstate waters, he was to do so largely in an advisory capacity. All "police powers" in water quality matters were reserved to state and local authorities.<sup>1</sup> The Act was therefore a disappointment to those who had argued for strong direct federal intervention to plug the gaps in inconsistently written and enforced state statutes.<sup>2</sup>

The new law prioritized treatment of municipal wastes, at the time believed to be a far more serious threat to public health than industrial wastes. Nearly half the nation's populace lived in communities without sewers or communities that dumped their sewage untreated into lakes, streams, or the ocean. Representatives of the American Pulp and Paper Association (APPA) were among those testifying before congressional committees that industrial waste in water was not a public health hazard, arguing that pollution abatement efforts should focus on municipalities. By claiming their discharges did not constitute health hazards, industry also hoped to remain outside the purview of the Surgeon General. The Act's emphasis on municipal waste treatment systems would have long term implications for technological responses to industrial waste pushed by later

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<sup>1</sup> U.S. House of Representatives, Committee of Public Works, *Water Pollution Control Legislation - 1947 (H.R. 123, 315,470) Hearings*, 80th Congress, 1st Sess, June 11, 1947, testimony of Dr. Thomas Parran, Surgeon General of the United States. P.L. 80-845 Water Pollution Control Act of 1948, Ch. 758, 62 Stat. 1155. *The Clean Water Act--25th Anniversary Edition* (Alexandria, VA: The Water Environment Federation, 1997), 1-3. The 1948 Act amended The Federal Water Pollution Control Act of 1912 mandating that the U.S. Public Health Service research human health problems associated with water pollution. The 1912 Act, grounded in the Progressivism of the period, focused on the connection between human waste, especially in urban settings, and health consequences. With its roots in the forestry sector, the pulp and paper industry was much more involved in and responsive to the conservation movement of the day with its emphasis on efficient use of natural resources.

<sup>2</sup> See for example the testimony of Kenneth A. Reid, Ex. Dir., Izaak Walton League of America, before U.S. Senate Committee on Public Works Hearings on S. 418, April 1947. Reid stated that agreement had been reached between conservationists, PHS, state health officers, sanitation engineers about reasonable federal enforcement procedures, ending "the cat-and-dog fight" that had been going on for over ten years. The Izaak Walton League had campaigned for federal involvement in water pollution control since the mid-1930s, serving as a perfect example of those entities organized around the wildlife community cited by Hayes and others as links between the conservation movement and later environmental interests.

federal regulations.<sup>3</sup>

After this initial step, Congress enacted further legislation throughout the 1950s and 1960s incrementally expanding the federal role in environmental regulation. The Federal Water Pollution Control Act of 1956 increased federal funding for waste treatment, refined the notification and public hearing process by which federal authorities could intervene in perceived instances of pollution, and to some degree strengthened the state role by encouraging state and interstate abatement actions.<sup>4</sup> The Water Quality Act of 1965 created the Federal Water Pollution Control Administration (FWPCA) and required the states to develop water quality standards for interstate waters and their tributaries. (Originally the FWPCA was part of the Department of Health, Education, and Welfare; in 1966 it was transferred to the Department of the Interior under an executive government reorganization plan. In 1970 it was renamed the Federal Water Quality Administration and became part of the new Environmental Protection Agency.<sup>5</sup>) Following FWPCA guidelines, the states were to define water quality criteria based on the designated use of streams. State personnel were required to develop pollution control and abatement plans that would result in meeting appropriate water quality criteria. FWPCA had the power to accept, revise, or reject and replace the state plans. These standards were to serve as the basis for enforcement actions against violators. The Clean Water Restoration Act of 1966 authorized major increases in federal subsidies, for the first time including grants to industry for the demonstration and improvement of waste treatment processes. (Several such grants were awarded to pulp and paper firms.) This law also initiated federal studies of the expense to industry of efforts to meet state water quality standards. By 1971, such studies were underway for twenty-two industrial groups, including pulp and paper, aiming to ultimately prepare effluent standards for each industry.<sup>6</sup>

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<sup>3</sup> See testimony of E.W. Tinker, Ex. Sec., American Pulp and Paper Association, to the Stream Pollution Control Sub-Committee of the U.S. Senate Committee on Public Works at the May 1, 1947 hearing.

<sup>4</sup> *The Clean Water Act*, 5-6

<sup>5</sup> Samuel P. Hayes considered the departmental relocation of the water pollution control program to have been the result of the rising emphasis on protecting streams and lakes as ecological systems as opposed to preventing public health problems. See Hayes, "Three Decades of Environmental Politics" in Michael J. Lacey (ed.), *Government and Environmental Politics* (Washington, D.C., Johns Hopkins University Press, 1991), 31. Once moved into the EPA of the 1970s, however, water pollution regulations took on the characteristics of water use programs, more in line with the conservationist approach of the early decades of the 20th century merged with an industrial technology diffusion project resembling Hoover's 1920s associationalism.

<sup>6</sup> *The Clean Water Act*. Harvey Lieber, *Federalism and Clean Waters* (Lexington, MA: Lexington Books, 1975), 11-12. Stanley Deglar, *Federal Pollution Control Programs: Water, Air, and Solid Wastes* (Washington, D.C.: Bureau of National Affairs, Inc. 1971),

Prior to and throughout this period of federal legislative activity, many state governments were actively dealing with water pollution problems. As reported in the Congressional hearings leading to the passage of the Water Pollution Control Act of 1948, thirty-nine of forty-six states surveyed reported having laws in effect for the control of water pollution. Of these thirty-nine, thirteen had established special agencies accountable for regulating the use of lakes, streams, and rivers, while the remainder had delegated such responsibilities to health departments, boards of sanitation, and fish and wildlife commissions. The state officials of fourteen states surveyed at the time reported deficiencies in their water pollution control laws, citing the absence of enforcement powers, extensive exemptions written into laws, and the lack of licensing authority. Despite these limitations and drawbacks, state officials generally were unfavorable toward attempts to expand federal involvement.<sup>7</sup>

It was common for pulp and paper industry spokespersons (as well as those from other industries) to join with state regulators in advocating continued local control over water resources. For example, at a 1950 conference of New England states to discuss regional water problems, pulp and paper industry representatives joined members of the New England Conference of Public Utility Commissions and the New England Interstate Water Pollution Control Commission in arguing that water resource problems should be administered at the lowest level of government that was practicable and that existing local and regional agencies had proven themselves adequate to the task.<sup>8</sup>

A prominent example of state-initiated pollution control activity focusing on the pulp and paper industry was that of Wisconsin, beginning in the mid-1920s and gaining momentum throughout the 1930s. In 1925, the Wisconsin Board of Health was made responsible for carrying out a program to reduce pollution caused by sewage and

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11-14. Michael E. Kraft, *Environmental Policy and Politics: Toward the Twenty-first Century* (New York, NY: HarperCollins, 1996), 88-89.

<sup>7</sup> Arthur D. Weston, "Federal Legislation on Water Pollution Control," presentation to annual meeting of TAPPI, Feb. 1948 (found in *Paper Trade Journal*, Vol. 126, No. 9, 2/26/1948; pp. 92-105.) Weston, chief engineer in the MA Dept. of Public Health, served as the chairman of the Committee on National Water Policy of the Conference of State sanitary Engineers. The Committee was one of the participants in the effort to find a broadly acceptable approach to federal intervention in abatement actions, although Weston himself opposed any expansion of federal powers beyond funding and research coordination. Weston frequently testified before congressional hearings leading up to the passage of P.L. 80-845. Lieber reports that by 1972 45 states had established permit programs for industrial discharges, due to federal legislation and funding that encouraged states to develop and expand their water pollution control programs (*Federalism and Clean Waters*, 13).

<sup>8</sup> "New England's Water Problem," *Paper Trade Journal* (August 10, 1950), 18-19.

industrial wastes. At the time there were thirty-nine mills in Wisconsin producing pulp, paper, and paperboard. The industry was prominent as a contributor to both the state's economy and the status of its streams. Following an incident in northern Wisconsin in 1925 in which a pulp mill discharge killed twenty-five to thirty tons of fish, the state initiated a systematic effort to address pollution problems. A survey of stream conditions undertaken in 1926 included the gathering of data regarding mills on the Fox, Wisconsin, Flambeau, and other rivers throughout the state. The following year the Wisconsin State Board of Health published *Stream Pollution in Wisconsin*, a 327-page report documenting the detrimental effects of industrial effluents on dissolved oxygen levels in streams throughout the state.

Although state officials had little or no authority to mandate changes by industry, their on-going survey activities began to affect both the technical and institutional aspects of pollution control activity. Data on the fiber content and the suspected pollutants of wastes were collected from each mill in the state in throughout the 1930s. State engineers held annual conferences with mill personnel, explaining survey objectives and methodologies and reviewing the results of prior surveys. Arrangements were made for the collection of future samples and flow data from the mills, incorporating the process improvement recommendations of mill managers. To gain support and broaden mill participation, state personnel emphasized the economic benefits of reducing fiber loss in effluent discharges as well as recapturing and reusing process chemicals rather than discharging them.

The survey process motivated formation of an industry advisory committee of seven mill representatives to provide advice to state officials on acceptable sampling techniques. This committee and state representatives agreed on the use of analytical methods conforming to the standards of the Technical Association of the Pulp and Paper Industry (TAPPI) and the American Public Health Association (APHA). The surveys reflected significant variation among the Wisconsin mills in the volume of waste water discharged per ton of production, in fiber loss to sewage as a percent of production, and in five-day biological oxygen demand (BOD-5) per ton of production. By 1936, the State Board of Health was beginning to compare such indicators of mill operations. State officials proposed that mills should be able to reduce fiber loss to one per cent or less of total production and that discharged waste waters should be no more than 20,000 gallons per ton of production. The state surveyors observed that differences among mills could be attributed to a variety of factors, including greater diligence by some mill operators to recycle waste waters and to recapture and reuse process chemicals. They claimed that the survey data refuted industry arguments that mill characteristics uncontrollable by management accounted for greater amounts of suspended solids and BOD. The use of the Wisconsin mill survey data serves as an early example of attempts at regulatory standard setting and the potential benefit to be derived from comparisons of mill performance.

The state's surveys verified what the citizens of Wisconsin could determine using their eyes and noses, especially those who lived along the banks of the Fox River and in the town of Green Bay where it emptied into Lake Michigan. Public concern, like that

of the state surveyors, focused on the dumping of sulphite waste liquors by pulping operations throughout the state, but especially along the Fox. Aroused by the evidence of the dumping of both untreated sewage and industrial waste from several industries, public demands for pollution control were taking a political form by the mid-1930s. Elected officials criticized the local industry for not implementing developments that seemed to reduce waste dumping in streams at sulphite mills elsewhere. In 1939, in response to negative public attention and the state's continuing survey activities, the owners of ten sulphite pulp and paper operations organized the Sulphite Pulp Manufacturers of Wisconsin Committee on Waste Disposal. Its stated purpose was to study collectively and vigorously the problem of disposing the industrial wastes produced by the sulphite pulping process.

The waste disposal problems resulting from sulphite pulping, especially those associated with the spent pulping liquor, had long been evident. In the 1930s, sulphite pulping in the United States was calcium-based, meaning that wood chips were cooked in a solution of sulphur dioxide and calcium-sulphite. Although by the 1930s sulphite pulping was no longer the dominant process in the U.S., it remained of great prominence in Wisconsin because of its effectiveness when used with spruce and other native growth to produce a pulp of great brightness for making tissue papers. Wisconsin was at the time the leading producer of toilet paper in the country. Unlike producers using the kraft (or sulphate) pulping process, sulphite pulpers had been unsuccessful in their efforts to find a means for recovering pulping chemicals because of their corrosiveness. As a result, they turned their attention to searching for waste liquor byproducts or alternative uses that would at least reduce the volume of spent solution discharged to streams. Of course, the revenues produced by such byproducts had to at least cover the costs associated with manufacturing and marketing them.

Prior to the formation of the Sulphite Pulp Manufacturers Committee, the search for potential uses for sulphite waste liquor had been pursued primarily at the mill level. Such an effort had been underway at the Marathon Paper Company Mill at Rhinelander, Wisconsin since 1929, prompted in part by the threat of legal action on the part of the state. By the mid-1930s, Marathon managers believed their efforts had paid off. In a paper presented at a meeting of the American Pulp and Paper Mill Superintendents' Association in June 1936, Howard described the Marathon process of treating sulphite waste liquor with lime in a series of reaction tanks. Howard claimed to be on the verge of achieving several tangible benefits. It was expected that full implementation of the new technology would result in the recapturing that fraction of the waste containing calcium sulphite and returning it to the cooking acid makeup system; retrieving cellulose fiber from the waste stream that was otherwise being lost; and generating an organic precipitate consisting of lignin components that could be burnt as fuel for the mill or used to produce marketable by-products. The remaining effluent would have considerably reduced stream polluting characteristics. The profitable use of lignin, the cell-binding component of wood that must be broken down and removed in the pulping process, had long been the holy grail of chemists and engineers in the industry. By the late 1940s, Howard's mill based efforts had become the responsibilities of research groups in the

Pulp and Paper Division and the Chemical Division of Marathon Corporation, where the search continued to achieve Howard's expected results.

The Wisconsin Committee on Waste Disposal soon announced that its objectives consisted of finding a suitable means of disposing sulphite waste liquors safely through either treatment or evaporation or discovering some means of utilizing the wastes. Soon the organization hired J.M. Holderby, recently the Assistant Sanitary Engineer for the State Board of Health, to coordinate its various investigations, some of which were in association with the Institute of Paper Chemistry (IPC) in Appleton, Wisconsin. By 1946, the Committee had been reorganized as the Sulphite Pulp Manufacturers' Research League, with a membership consisting of twelve corporations operating fourteen mills. In the early 1950s, the League reportedly employed a research staff of fourteen housed in offices at IPC and was operating several pilot plant installations. In addition to its continuing relationship with IPC, the League had research grants in place at the Universities of Wisconsin, Minnesota, New Hampshire, and Wyoming, and also at Michigan State College. Throughout its history, the League worked closely with the array of state agencies that evolved as water pollution in Wisconsin garnered greater attention, frequently working on joint research studies and pilot projects with them, even as its member firms were embroiled in increasingly antagonistic legal and public relations battles.

The experience of the sulfite pulping segment of the pulp and paper industry exemplifies the combination of economic and regulatory influences that contributed to technological change in the decades prior to the advent of federal domination of environmental policy in the United States. Sulfite pulping initially involved the use of calcium slurry as the sulfite liquor base because of an ample and inexpensive supply of limestone. However, it is difficult and expensive to recover or burn spent liquor from this base. Subsequent efforts to develop alternative uses, as creative as they became through the endeavors of mill managers, corporate researchers, and associations such as the Sulphite Pulp Manufacturers' Research League, never succeeded in accounting for more than a trivial percentage of the spent liquor. As more restrictive state regulations inhibited discharge of the pulping liquor as untreated effluent and as issues arose between industrial users of the same water source, end-of-pipe treatment costs became prohibitive. As a result, by the 1970s sulfite mills had either adopted a soluble chemical base using magnesium, ammonia, or sodium that allowed the recovery or incineration of spent liquor, converted to the kraft pulping process, or ceased operations altogether due to a variety of circumstances.<sup>9</sup>

Research focused on finding potentially profitable uses for the byproducts of

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<sup>9</sup> EPA, *Development Document for Effluent Limitations Guidelines for the Bleached Kraft, Groundwood, Sulfite, Soda, Deink, and Non-Integrated Paper Mills Segment of the Pulp, Paper and Paperboard Point source Category* (Washington, D.C., 1976), 18. "Wisconsin Mills Lead Way in Nation's Stream Improvement Effort," *The Paper Industry* (Jan. 1956), 948-952.

spent sulfite liquor that might offset the investment and operating expenses associated with effluent treatment were also underway at mills in Pennsylvania. Both Wisconsin and Pennsylvania were noted for their early and consistent regulatory efforts, based on what was portrayed as a generally cooperative dialogue with manufacturers. In a May, 1950 address to mill superintendents, Thomas E. Brookover, a paper company chemist, was especially complimentary of the process whereby the Pennsylvania State Sanitary Board and the Bureau of Engineers arrived at new standards for allowable effluent discharges. In his comments, Brookover described the effectiveness of the National Council of the Pulp and Paper Industry for Stream Improvement in interacting with state officials in a role that presaged its involvement with EPA during the 1970s.<sup>10</sup>

The founding and early operations of the National Council for Stream Improvement (NCSI) began the consolidation of the pulp and paper industry's ongoing efforts to deal with the environmental consequences of its effluent, especially through improved treatment processes. Russell E. Wingate, NCSI's first executive director, claimed that the pulp, paper, and paperboard industry was the first United States industry to approach its waste disposal and utilization problems in a realistic manner on a national cooperative basis. According to Wingate, seventeen industry executives met in April, 1943 as the Organizing Committee of the National Stream Improvement Plan to draft by-laws and a certificate of organization, as well as appoint a board of governors, with funding for the organization's start-up activities provided by twenty-one pulp and paper companies. Its incorporation documents described NCSI as an autonomous non-profit corporation entirely independent of any other association or organization. Executive control was vested in a Board of Governors elected annually by the organization's membership, with representation proportional to the dollar value of dues paid by groups of members manufacturing various products. The stated purpose of the organization was to conduct research directed toward the treatment, abatement, recovery and utilization of wastes resulting from the manufacture of pulp, paper, and paperboard, and to assist its members in the application of the techniques developed through its research activities to mill operations. According to Wingate, the Council began active operations in June, 1944.

During the first years of its operation, NCSI spokesmen repeatedly enunciated several key policies. First, the Council's Board of Governors ruled that its primary research and advisory efforts would be devoted to abatement activities rather than the search for useful byproducts from mill effluents. As Wingate and others put it, the emphasis must be on short term stream improvement in light of growing public concern over stream pollution and increasing demands for national and state legislation. Second, NCSI would follow a policy of nonintervention in political matters, particularly legislation. While staying abreast of legislative and regulatory activities and advising its constituency on such matters, as well as orienting research activities to the probable

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<sup>10</sup> "Wisconsin Stream Pollution Hearing," *Paper Trade Journal* (Jan. 13, 1949), 18. "Sulfite Manufacturers' League Funds Research," *Paper Trade Journal* (Feb. 4, 1950), 6. "The Paper Industry and Stream Pollution," *Paper Trade Journal* (Aug. 10, 1950), 20-27.

demands of proposed legislation, the Council would not direct the industry's support or opposition in specific legislative matters. Third, the Council subscribed to the "reasonable use" policy said to be adopted by most of the outstanding authorities in the field of stream sanitation at the time. This policy was based on the concept that an industry or a municipality was entitled to use a given stream for the disposal of wastes provided that such use is not contrary to the public interest, does not constitute a public nuisance or menace the public health, does not deprive downstream industries of their right to a usable supply of water, and does not prevent the use of streams for any purpose to which they are normally put.

The decision by the NCSI managerial team to pursue abatement as opposed to by-products reflected a perceptive strategy for the establishment of organizational creditability. The search for pulp and paper waste byproducts with economic value was primarily of interest to the sulphite pulping branch of the industry and had already been the target of a lengthy and mostly unrewarding research agenda, as discussed above. Also, research into potentially economically beneficial byproduct use posed problems regarding corporate strategies, patent rights, and licensing issues, all best avoided by a fledgling association anxious to please its sponsors. Although the Council claimed a sponsoring membership accounting for 70% of the industry's productive capacity, its staff knew that its longevity depended on gaining recognition from mill managers. By linking a research-based approach to stream improvement emphasizing waste treatment while advocating a reasonable-use policy, the Council knew it would win favor from the broadest possible audience of mill managers. In addition, improved treatment of waste streams was not as likely to disrupt production as other, potentially more complex means of addressing stream improvement.

The Council moved quickly to regionalize its efforts, another astute tactic for enhancing its value to all aspects of the industry. By 1943 the industry was rapidly expanding its production of kraft pulps, especially at mills in the south. As discussed by Dr. Harry W. Gehm during a symposium at the first Industrial Waste Utilization Conference at Purdue University in 1944, NCSI had set up regional committees in five districts: the Northwest, New England, the Central States, Ohio, and the South. Later these would be increased to seven. These regional committees, consisting of mill representatives, were to meet twice a year under the direction of a prominent industry leader in the region to identify waste-related problems. Regional needs would be communicated to the central Board of Governors which would then establish a research agenda and instruct staff to involve qualified institutions, usually universities, to address the regional issues. Over time, NCSI sought out and involved well-known, creditable experts to serve as resources for the regional committees. Usually these experts had well established relations with the personnel of state regulatory agencies.

By 1946 NCSI had funded and organized research activities at the Mellon Institute, Manhattan College, Purdue University, Rutgers University and the University of Michigan. NCSI had also tapped into research already underway at the Institute of Paper Chemistry into the effect of mill waste on aquatic life, on the treatment of sulphite waste liquor using trickling filters, and a project involving river aeration. The council

was using most of its 1946 budget of approximately \$140,000 to fund projects and fellowships at the above institutions.

Later that year, Dr. Gehm discussed the Council's research agenda in greater detail. He described a process that aimed to link academic researchers with "technical men of the manufacturers," – presumably mill engineers – and even with regulatory agencies "to obtain their thoughts and ideas as to how the (selected) problems should be approached." In order to enhance the applicability of the results of the Council's funded research, research personnel were to evaluate their progress through pilot plant and demonstration site activities. Gehm stated that means had been provided whereby the Council could carry through complete development of waste treatment processes with the cooperation of mills to the point where they were ready for full scale application.

The research projects cited by Gehm included investigation by sanitary engineers at the Mellon Institute of methods for treating de-inking waste, a problem that was of particular concern to recycling plants in the Kalamazoo River Valley of Michigan. In the South, the Council had contracted with Louisiana State University to investigate the treatment of dilute kraft mill black liquors not completely processed by standard evaporation and incineration methods. The Council also worked with Dr. Clarence Velz of Manhattan College who was engaged in the sanitary analysis of all the watersheds of the United States in which the pulp and paper industry was situated. The purpose of this survey was to determine the industry's responsibility for existing stream conditions in relation to other industries and municipalities and also to determine the degree of treatment the pulp and paper industry's wastes required to be rendered acceptable for discharge into the stream. Dr. Velz and his Stream analysis Project would later relocate to the Department of Public Health Statistics at the University of Michigan. These research efforts continued to focus on the refinement of sampling methodology and techniques, the organization of data for analysis, the establishment of assumptions for formulating the relationships between such variables as temperature, flow volume and rate, configuration of stream beds, composition and source of waste discharges, and others.

NCSI's early research and experimental work drew heavily upon the established expertise and techniques of sanitation engineering. Dr. Gehm exemplified these connections. A native of Elizabeth, N.J., Gehm received his Ph.D in Engineering from Rutgers, where he subsequently worked for several years as an associate professor in the department of sanitation within the university experimental station. Before joining NCSI as its Technical Advisor in 1944 he had already published widely in technical journals on a variety of sanitation engineering topics. His career with NCSI would involve almost constant travel to mills throughout North America.

Although there was arguably little new that had been added to the original research projects list by 1950, Council staff was by this time engaged deeply in the dialogue between pulp and paper mills and state agency regulators. The passage of P.L. 845 in 1948 had heightened the awareness of industry to pollution problems as well as instigated activity on the part of state legislatures and agencies who were motivated to

maintain their prerogative in regards to regulation and enforcement. An example of this was the enactment of the Ostetag Bill in New York providing for the appointment of a Water Pollution Control Board. In keeping with what was becoming a standard pattern in states with active regulatory bodies, the first order of business was to classify the state's streams on the basis of conditions and use. Taking a proactive stance, NCSI representatives and executives of the New York mills meet in early 1950 to develop a program to assay the industry's waste disposal requirements and assist the state in its stream classification activity. By the end of the year, thanks to collaborative activity between Council engineers and mill staffs, NCSI reported that it had gathered data sufficient to develop equitable and progressive stream classifications with the state that would be advantageous to all water users.

This effort was similar to an earlier project that NCSI had undertaken in Pennsylvania, a state that had been for some time among the most active in attempts to address waste disposal problems. Here, Council engineers worked directly with State Sanitary Board staff on a survey of mill waste streams. Survey data was then used to establish standards for normal raw wastes in terms of suspended solids and BOD per ton of product. Separate standards were arrived at for each distinct production process. As cited in the Council's annual report, these values were submitted to the Sanitary Board which accepted them with some minor adjustments, to be used as a base by which to determine subsequent reductions in waste discharges by Pennsylvania mills. The Council reported to the industry that this work was an outstanding example of industry and government cooperation in stream pollution control. Similar examples in Florida and the Northwest were given in the annual report, in the later case mentioning the benefits to be derived from the Council's inclusion of regional "engineers in residence" with established knowledge of local conditions and established relationships with regulatory agencies. Elsewhere there was evidence at this time of close cooperation between NCSI and federal personnel. In Louisiana, the Gaylord Container Corporation, the U.S. Public Health Service, and NCSI jointly cooperated in a survey of the company's mill and its receiving waters. In accordance with P.L. No. 845, PHS was anxious to evaluate the biological factors involved in kraft pulping wastes and requested the cooperation of the company and the Council.

NCSI's studies of the potentially toxic effects of pulp mill wastes on aquatic life were characteristic of its investigations during the 1950s. Fish kills were among the most obvious environmental mishaps occurring with some regularity in the vicinity of industrial waste streams, especially those of pulp mills. Groups such as the Izaak Walton League, drawing its membership from sport fishers, had been at the forefront of public consciousness of stream degradation and had played a major role in efforts to enact federal legislation. Some scientists claimed that the cumulative effects of pulp mill wastes on fish were manifested in some cases only after a lengthy period of time. Not surprisingly, then, numerous mill operators facing public objections sent the request up through the regional committees to address the issue. Pulpers, both kraft and sulphite, in the Midwest, Northwest, and the South looked to NCSI to expand research activities into the problem.

The university biologists and engineers working with the Council came to question previous studies linking mill wastes with increased pathologies and mortality rates in downstream aquatic populations. They argued that laboratory studies leading to such conclusions had not properly replicated the natural environment. As a result, researchers at Oregon State College's Yaquina Bay experiment station replicated natural conditions by transplanting silt and gravel bottoms as well as aquatic plants and organisms of a type thought to be actually encountered by trout, salmon and other fish in the stream environment. IPC's investigators challenged claims about long term cumulative impacts. More importantly, the researchers sponsored by NCSI were developing new methods of measuring and analyzing the composition of mill wastes themselves in order to replicate them in their experiments. NCSI then served as a link for carrying over such newly gained expertise to stream survey work performed in cooperation with state and federal regulators.

As far as pulp mill operators, especially those in the South, were concerned, the most important NCSI-sponsored research was taking place at Louisiana State University. NCSI signed a contract with LSU in 1946 for investigating the treatment of dilute kraft mill black liquors that escaped the evaporation process that was commonly part of such mills' chemical recovery process. As stated by Harry Gehm in a 1954 article, the objective of the project was to study the storage method of kraft effluent oxidation and determine how best to alter mechanisms involved in the purification process. After deciding that the storage of mill wastes in lagoons allowed a biological oxidation process to take place, researchers began to search for methods of improving the efficiency of the process. By 1950 laboratory findings suggested that the key to speeding up the process was the maintenance of an aerobic environment by means of aeration accompanied by the addition of chemical nutrients in the form of nitrogen salts. It should be pointed out that this was a relatively simple modification of the common domestic sewage activated sludge process. According to experiment results, the biochemical oxygen demand (BOD) of kraft effluents could be reduced by as much as 80-90% in as little as four to six hours under these treatment conditions.

From 1951 to 1952, these findings were evaluated on a pilot plant basis to determine optimum treatment conditions, type and size of equipment, and the capital and operating costs involved. Several southern kraft mills provided funds to construct a pilot plant at the Macon Kraft Company in Macon, Georgia. Engineers from the technical staff of the National Council guided and supervised the plant pilot studies, one of them being onsite much of the time. The pilot plant work included aeration of the incoming mill effluent with compressed air, initial seeding with sewage plant sludge to introduce the desired bio-organisms on which the functioning of the activated sludge process depended, addition of nutrients, and evaluation of the detained treated waste to determine necessary time interval and holding tank capacity required for effective reduction of BOD content. In this particular instance, the pilot plant operations indicated that assumptions about the effectiveness of some treatments based on laboratory results were overly optimistic, especially in regards to bleach waste treatment.

The steady expansion of the kraft pulp industry during this time generated great interest in the research activity of the Council focused on improvement in the treatment of kraft effluents. Production increased from approximately three million tons in 1939 to 7.5 million tons in 1950. There were numerous factors contributing to this expansion. Kraft pulps made strong paper and the process had been found to be applicable to more species of wood than any other method. Once considered too difficult to bleach, new bleaching techniques had been developed so kraft pulps could now be used for many grades of white paper. From its early use for wrapping papers and grocer bags, kraft pulp was by 1950 in high demand for paperboard used for box construction. The industry argued that boxes made from kraft paperboard should replace wooden boxes because they cost less, weighed less, and made for more reliable packaging. Kraft boxes could be salvaged and made into new paper for new boxes. To meet the growing demand, new mills were being built, existing mills were being expanded, and sulphite mills were being converted to the kraft process.

NCSI eventually became involved with plant development activities stemming from its funded research. The credibility of its staff was by now such that they were frequently providing direct consulting services to the industry regarding treatment facilities and equipment selection, pilot plant design and operation, and even mill site decisions. Examples of such implementation activity by Council personnel were their direct involvement with treatment systems at the Covington, VA plant of West Virginia Pulp and Paper Company National container Corporation mill in Valdosta, GA., both undertaken during the 1950s.

As it established itself as the centralizing agent for the pulp and paper industry's response to the environmental concerns of federal, regional, state, and local authorities, NCSI was also establishing acceptance of several key principles that would influence the attitudes of both producers and regulators in the years to come. Most significant was simply establishing a reputation for science-based research that gave it the credibility required to engage in collaborative activities with government entities. Another critical contribution was in shaping the means of defining and evaluating stream conditions and the impact of waste discharges. Overtime, the evolution of these definitions directly shaped regulatory standards. Finally, by tirelessly emphasizing the assimilative capacity of streams and the importance of local and seasonal conditions, NCSI underscored the importance of state and local control authority.

By the time of the passage of the Clean Air and Clean Water Acts in the early 1970s, the pulp and paper industry reported that it had significantly expanded its treatment of effluents since 1950. NCSI's 1955 survey found just over half of the nation's pulp and paper mills treated their effluents before discharge. By 1971, mills producing 90% of the industry's total output were found to be providing effluent treatment on site or by discharge to a municipal system. Just over half the mills with on-site facilities were using biological treatment, which was nearly twice the number in 1969. Commonly found systems of effluent treatment included mechanically cleaned

clarifiers, aerated stabilization basins, activated sludge processes, and sludge dewatering prior to incineration.<sup>11</sup>

Such “end-of-the-pipeline” treatments were frequently accompanied by production process modifications. It is difficult to determine to what extent growing awareness of environmental issues or pressure from either state or federal regulators encouraged the development of these process changes. However, it is clear from discussions in the industry journals and at its meetings that the contribution of process change to pollution control was evident and frequently cited as a reason for implementation. When eventually it was necessary for the Environmental Protection Agency to identify process changes that reduced pollutants, it found examples already in place that included more efficient pulp washing, closed brown stock screening, oxygen bleaching, steam stripping of condensates, collecting and processing chemical and fiber spills, and dry barking.

Pulp and paper industry activity to moderate wastewater discharges prior to the 1970s have many of the earmarks of what would later be characterized as “the greening of industry” or the “pollution prevention pays” viewpoint. By reducing the volume of water used to produce pulp and paper, recycling chemicals in the kraft pulping process, attempting to increase raw material productivity, and seeking to turn wastes from sulfite pulping into profitable by-products, the industry in many ways reflected the conservationist movement given birth by the Progressive Movement. By detaching itself from the public health issues associated with municipal sanitation, the industry sought to mitigate the imposition of strict pollution controls by state regulatory authorities and, during the 1960s, the growing involvement of federal authority.

The Federal Water Pollution Control Act Amendments of 1972 drastically altered the relation between the federal and state governments in regards to protecting water resources. Although the environmental movement arguably had its origins in the intensifying interests of local communities in their ecological welfare, environmentalists had long believed that their goals could be achieved only when federal powers overrode the economic interests of states. During the early 1970s, both the Nixon administration and members of Congress with national ambitions attempted to capture the environmental vote and thereby completed -- at least temporarily -- the lengthy process of federal ascendancy in the environmental regulatory process.

The 1972 Act was a radical departure from earlier federal water legislation in several ways. It set ambitious national goals for water quality, but also mandated specific standards for effluents. These standards were to be achieved by the compulsory

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<sup>11</sup> “Wisconsin Mills Lead Way in Nation’s Stream Improvement Effort,” *The Paper Industry* (January, 1956), 948-952. Comments of George Gove, research engineer, NCASI, at meeting of CPPA, *Pulp and Paper* (Sept. 30, 1968), 28-29. “Industry Has Spent \$1.1 Billion on Pollution Control...,” Says NCASI,” *Paper Trade Journal* (March 12, 1973), 19.

implementation of effluent treatment technology by all parties – both municipal and industrial – discharging effluents into the nation’s waterways. For industry, implementation was to be in two stages: by 1977, all dischargers were to have in place what EPA was to define as the Best Practicable Control Technology Currently Available (BPCTCA); then, by 1983, the Best Available Treatment Economically Achievable (BATEA) was to be installed. The law required that the recently established Environmental Protection Agency (EPA) define effluent standards by industry based on the appraised effectiveness of the applicable control technology. These standards in turn would be written into the permits and licenses to be issued to all dischargers by EPA (or delegated state agencies) under the National Pollutant Discharge Elimination System (NPDES). These minimum effluent standards could be made even more restrictive under NPDES if local water quality conditions, as determined by state regulators, so dictated. This combination of required control technology, effluent standards, and licensing was to be enforced by a system of monitoring, reporting, site visits, and fines for violations. The ultimate goal of the new law was to eliminate the discharge of pollutants into the nation’s water system by 1985.<sup>12</sup>

This legislation handed EPA a monumental task. In the case of the pulp and paper industry, EPA was required to issue two sets of effluent limits and technology compliance options, first for the unbleached kraft and semichemical pulp segments of the industry, then for the bleached kraft, groundwood, sulfite, soda, deinking, and non-integrated segments. To develop these standards, EPA turned to several parties, including the National Council on Air and Stream Improvement of the Pulp and Paper Industry, the successor organization to NCSI, whose input was invaluable on the current state of water pollution control methods and their effectiveness. Eventually EPA’s standards defined acceptable thirty-day average and maximum daily amounts of BOD-5 and total suspended solids (TSS) that could be discharged in the effluents of mills. Standards also were set for pH, color, and in the cases of some mill-types, zinc. These variables and their preferred values, as well as the methodology for accurately obtaining them, had figured prominently in the research agenda of the National Council since its founding thirty years earlier.<sup>13</sup>

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<sup>12</sup> *The Clean Water Act--25th Anniversary Edition*, 11-28. Kraft, 89-91.

<sup>13</sup> EPA, *Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Unbleached Kraft and Semi-Chemical Pulp Segment of the Pulp, Paper, and Paperboard Mills Point Source Category* (Washington, D.C., May 1974). EPA, *Development Document for Effluent Limitations Guidelines for the Bleached Kraft, Groundwood, Sulfite, Soda, Deink, and Non-Integrated Paper Mills Segment of the Pulp, Paper, and Paperboard Point Source Category* (Washington, D.C., December 1976).

