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International Control of River Water Pollution

Fred V. Witaschek*

This article presents technical and administrative suggestions for controlling the pollution of international rivers. It is the author's contention that current technological developments will enable the doctrine of equitable utilization to be more accurately implemented. He concludes that once technology demonstrates the capability of coping with pollution, current criticism of administration will be replaced by active support. Ed.

Reduced to simplest terms the word "pollute" means to make unclean or impure. When referring to water, pollution implies visible evidence of debris floating in the current. Further study reveals that volumes are required to define the many types and sources of physical and chemical water pollution and to delineate the physical, chemical and biological tests which scientifically catalogue and measure the degree of pollution.

"Control" means to exercise authority over; to restrain or curb; to regulate. This implies the need for a legal entity which authority to regulate and curtail river pollution. The benefits of a river are manifold in nature and these benefits have been multiplied by man's creativeness. Conflicts of authority are inherent in the control of pollution due to man's urge to devise multiple use projects which are often contrary to efforts to control pollution. Consequently, the annals document countless adjudications, scientific experiments, and economic studies conducted in search of equitable and optimum use solutions for water resources.

Our subject, as cursorily defined above, is complex. When we add the term "'international", meaning existing or conducted among nations, two salient issues arise. Foremost is the handicap on the authority to control stemming from the basic

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U.N. policy (art. 27) which precludes intervention in the internal affairs of a member state. How can we interfere with anything so basic as the right to modulate, use and control nature's rivers within a nation's boundaries? Secondly, we are confronted by the differences in the degree of development among nations. Where one nation's desire is to abate river pollution, another nation's desire is to develop means to use rivers to rid their cities of wastes.

Despite the complexity and high cost of river pollution control, clean water is within our grasp. This possibility is conditioned upon efforts being carefully correlated to a "time-location" priority concept designed to achieve optimum use of water resources within environmental boundaries and compatible with each nation's stage of development. The challenge posed by our title is addressed in stages:

I. River Water Resources: optimum use related to the time-location concept.
II. River Water Pollution: a new dimension added to a complex problem.
III. River Water Pollution Controls:
   A. Functional overview.
   B. Cost
   C. Legal and administrative elements.
IV. International Control of River Water Pollution: summary and conclusion.

I. RIVER WATER RESOURCES: OPTIMUM USE RELATED TO THE TIME-LOCATION CONCEPT

Mankind began coping with water resource problems in his earliest history. Efforts toward use of a central water supply made by man are documented by archeological records of 5,000 years ago. These early efforts were multiplied as mankind's ingenuity enabled him to discover the many other beneficial uses which could be made of flowing waters. The evidence of early (312 B.C.) Roman aqueducts and works to permit storage and conveyance of waters for domestic use, for stock watering, and for irrigation are still visible. Men have increasingly used the rivers for navigation, transportation of goods, for conveyance of wastes and for power for milling and mining. In recent years man has designed increasingly larger dams, often located and spaced within a drainage basin so as to provide virtually complete control of river flow. These multipurpose installations provide electric power, water for irrigation or other controlled water supply purposes, and artifically created lakes for recreation.

While today, in industrially developed nations, substantial control of most river basins has been achieved, many of the rivers of South America and other developing areas flow virtually unchanged by man. Efforts to develop and utilize rivers for other than the basic natural benefits are rare, and it is likely that it will be a considerable time before multipurpose facilities within their boundaries are achieved. Thus the spectrum of river control and development towards optimum use varies among nations over a wide range of time.

The location variable also has material significance in river development. Generally, a river will traverse many states and nations before emptying into the sea. Obviously the goals of a downstream user with respect to river development and control may be directly opposed to the goals of a user located upstream. The downstream nation may desire the upstream nation to divert a large measure of the river's flows to alleviate a potential flood danger; at other times the downstream user may desire an increased flow of water for some special purpose. The upstream nation's desire to utilize the river to convey industrial wastes to the sea may conflict with the downstream nation's desire to utilize the river for irrigation water.

In summary, two factors stemming from the time variable confront optimum use planners and developers of river water resources: (1) multi-purpose utilization of water resources must inherently vary with time just as need and opportunity for development vary with time; and (2) equity leads us to consider that the first person to develop and utilize the resource should sustain the prior right. The location variable in river water resources control and development adds additional dimensions to the problems. Both the upstream user and the riparian owner have control of the river and could, if unchecked, devise and construct works which would divert the river to their own uses and completely deprive the downstream user.

Because of the discordance introduced by this time-location dichotomy, it was inevitable that a conflict between endeavors would arise. Accordingly, controls are required to equitably regulate the flow and utilization of rivers by neighboring states which are seeking to develop a share of the potential benefits as quickly as practicable. The laws and doctrines formulated to achieve an optimum water resource control system which is equitable within the time-location concept are cited and described in section IV. Before examining the legal elements of water resource control it is necessary to review and correlate the river water pollution aspect of the problem.

II. WATER POLLUTION: A NEW DIMENSION ADDED TO A COMPLEX PROBLEM

The first efforts at water purification may be traced to 2,000 B.C. Egyptian wall inscriptions depicting man's efforts to purify water by boiling it in copper vessels.[1] The installation of sewers to carry away storm runoff and domestic sewage was first experimented with in the First Century A.D. in Rome. However, progress in sewer design and development was slow until the Nineteenth Century when a causal connection was made between contamination of water supplies due to inadequate human waste disposal methods and the dread diseases and plagues which were prevalent in that century. Today, a major cities of developed nations have underground sewage and storm-runoff disposal systems.

On the other hand, modern day water pollution with all its forms and ramifications was scarcely recognized until 1950. In general terms the types and sources of river water pollution which the major city must confront today may be described as follows:

(1) Organic matters originating from domestic, animal industry, and other industrial wastes, including bacteria and other organisms.

(2) Inorganic matters originating from mining or inorganic-chemical industries.

(3) Specific toxic substances such as phenols, oils, and detergents originating from industry and, to some extent, from domestic sources.

(4) Radioactive contaminants from certain industries or introduced through rain clouds contaminated by nuclear-weapons tests.

(5) Physical pollution including suspended substances such as silt and sludge from mining industry and extreme temperature change influences such as coolant water from steam power plants, all of which induce organic growth and minimize self-purification.

The main measures of the degree of pollution (aside from such simple, physical-sense criteria for recognizing water pollution by smell, taste, or visible effects of turbidity, algae, or floating debris) include:

(1) The biochemical oxygen demand (BOD): the higher the demand for oxygen (to decompose by natural processes and assimilate wastes deposited in the water) as determined by tests, the greater the pollution.

(2) The dissolved oxygen test: a low oxygen content indicates a high degree of pollution.

[1] *See* J. CLARK & W. VIESSMAN, WATER SUPPLY AND POLLUTION CONTROL 1 (1966) [hereinafter cited as CLARK].

(3) The coliform bacteria count: a high count indicates a high degree of pollution. Results are stated by plate count, as the most probable number (MPN) of coliform bacteria per hundred milliliter.

(4) The pH number test: a straight-forward chemical determination of the relative acidity of the water.

(5) Physical tests for color units, odor, temperature, and turbidity.

The model pollution law issued by the Department of Health, Education and Welfare in May, 1965, gave the following definition of pollution:

> "Pollution" means such contamination, or other alteration of the physical, chemical or biological properties, of any waters of the state, including change in temperature, taste, color, turbidity, or colors of the waters, or such discharge of any liquid, gaseous, solid, radioactive, or other substance into any waters of the state as will or is likely to create a nuisance or render such waters harmful, detrimental or injurious to public health, safety or welfare, or to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or to livestock, wild animals, birds, fish or other aquatic life.[2]

The language of the model act is consistent with the modern trend to define pollution in very broad and all-inclusive terms.

A later publication recognized five basic water use classifications of concern to anti-pollution efforts and set forth criteria and standards necessary to support water use in each classification.[3] The criteria, generally couched in the terms defined above, also listed ranges of test results recommended as allowable under "permissible criteria" and under "desirable criteria". The five basic classifications of water use addressed in the publication, a work of a committee comprised of nearly one hundred scientific experts and administrators from the field of water resources, are listed below:

(1) Recreation and aesthetic uses, including general aesthetic criteria for unique or outstanding waters and criteria for surface water recreational use and for significant body contact recreational use.

(2) Public water supplies, dealing with criteria for raw water to be used for domestic water supply.

(3) Fish, other aquatic life, and wildlife.

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2 Cited in J. SAX, WATER LAW, PLANNING & POLICY, CASES AND MATERIALS 390 (1968).

3 *See* FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, REPORT OF THE COMMITTEE ON WATER QUALITY CRITERIA vii (1968) [hereinafter cited as Committee Report]. The Committee applied the meanings shown below to the following key words:

Standard — a plan that is established by governmental authority as a program for water pollution prevention and abatement.

Criteria — a scientific requirement on which a decision or judgment may be based concerning the suitability of water quality to support a designated use.

(4) Agricultural uses, including farmstead water supplies, livestock supplies, and irrigation water.

(5) Industry uses, including steam generation and cooling, textiles, lumber, paper, chemical, petroleum, coal, primary metals, food and kindred products, and cement industries.[4]

The intent of the publication is to afford guidelines for states to use in promulgating their own standards and criteria for water quality control which are required in accordance with the provisions of the Federal Water Pollution Control Act as amended by the Water Quality Act of 1965.[5] The publication, however, emphasizes that the types and sources of water pollution, as well as the standards and criteria for control, will vary widely with geographic location, geology, land use, and climate. Further, it points out that the published water quality criteria should be considered as tentative, and suggested that several issues needed clarification.

> Foremost among these is the lack of adequate knowledge concerning many of the quality characteristics upon which criteria and, hence, standards should be based. Complicating factors in setting standards are varying natural conditions affecting water quality, such as climate, geography, and geology of a specific location.[6]

Because the types and sources of water pollution as well as the standards and criteria for control must be considered as tentative and subject to wide variation among states within this nation, it follows that the criteria and parameters for optimum control when the international dimension is introduced will likely become grossly incompatible. That which may be decreed in unlawful pollution activity in one nation may be an essential use of water resources in another. For example, the Water Quality Criteria publication recommends that it be made unlawful to dispose of treated sludge solids in rivers, whereas, in many developing nations, life in the urban areas would become virtually intolerable without rivers for domestic waste riddance. On the other hand, this example should not be viewed with alarm. It is offered to point out that international pollution criteria and standards must be comprehensively adjusted in accordance with the time-location concept discussed above.

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[4] *Id.* at viii.

[5] Federal Water Quality Administration, 33 U.S.C. § 1152 *et seq.* (1970).

[6] *See* COMMITTEE REPORT at vii.

III. RIVER WATER POLLUTION CONTROLS

A. *Functional Overview*

Twenty years ago a student of civil engineering recognized sanitation as being related to water supply and sewerage[7], but no courses in his curriculum dealt with water pollution as such. Today, major colleges offer courses which deal expressly with water pollution. Adequate funding has been the key to advancement in water pollution control, as evidenced by the large sums currently funded for research and development.[8]

There are three basic procedural alternatives available to control water pollution: (1) enjoin the offensive activity; (2) treat the contaminants at their source to bring the effluent within tolerable standards; and (3) isolate, convey to a central treatment plant, and treat pollutants collectively. Prior to examining these basic procedural alternatives in more detail it is desirable to review the facilities traditionally provided to control the predominant sources and types of water pollution.

The first contaminate for which facilities were provided was human waste. Paradoxically, an early method of disposal which is still utilized to a degree in certain undeveloped nations was a network of open canals or gutters to convey untreated human excrement to the rivers and thence to the sea. While this practice works satisfactorily for the upstream user, it transfers a serious problem to the downstream user.

Later, municipal sanitary systems were constructed to collect and convey the untreated sewage through underground pipe networks to a central plant. Commonly, central sewage treatment plants combine screening processes, large sludge-settling and treatment tanks, and aeration, chlorination, and drying processes to separate the suspended solids and other pollutants and decontaminate the water. Secondary and tertiary treatments are often utilized where desirable, depending on reuse plans for the effluent water. The drained sludge may be disposed of by composting, burial or incineration. Most urban areas today provide modern sewage treatment systems administered by municipal or other governmental agencies, with the services paid for through taxes. In remote areas, however, individual sewage systems are often provided which utilize a septic

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[7] *See* E. STEEL, WATER SUPPLY AND SEWERAGE 238-40, 341 (1947).

[8] I FEDERAL WATER QUALITY ADMINISTRATION, RESEARCH, DEVELOPMENT, AND DEMONSTRATION PROJECTS (1970). This publication lists and describes over 400 research and development projects which have been authorized and funded under the provisions of the Federal Water Pollution Control Act.

tank to ingest sewage solids through bacterial action and a leeching field to purify the effluent by absorption and evaporation.

Most major cities also developed means to dispose of storm runoff. Until this development, storm runoff, carrying all varieties of contaminates and animal wastes picked up from streets and living areas, would either create stagnant ponds within the urban areas or flow to nearby streams resulting in a concentrated inflow of polluted waters.

While it is relatively inexpensive to provide street intakes to city sewage disposal systems for storm runoff, a functional problem arises because the "peak" runoff from a storm, of even a low frequency magnitude, far exceeds the normal carrying capacity of the typical sanitary system. This situation favors a design providing wholly separate storm and sanitary sewer systems. Nevertheless, many of the old, larger cities still utilize combined systems resulting in a spill of the overflow directly into the river.

Recent innovations resulting from the Federal Research, Development and Demonstration Projects currently underway show great promise toward relief of storm pollution at a comparatively low cost.[9] It is possible to demonstrate that underwater storage tanks made of rubber can be economically utilized to store peak-runoff until the storm had subsided, allowing the stored pollutants to drain into the sanitary sewage treatment systems at a rate compatible with normal flow capacity.[10] Roof ponding and storage has also been demonstrated to be a feasible method of reducing storm runoff peak capacity requirements.

In the well-developed nations where sanitary and storm sewage facility construction has matched the population and urbanization increase, the greatest river water polluter is the vast industrial complex. The diversity of types and sources of industrial river water pollution is in nearly direct proportion to the diversity of types of industry. Nevertheless, causes of industrial pollution can generally be catalogued in the following categories:

(1) Industrial production of durables (generally resulting in inorganic pollutants) including iron and steel, nonferrous metals, electrical machinery, machinery, autos, trucks, aerospace, other transportaticn equipment, fabricated metals and instruments, stone, clay, glass, and other durables.

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[9] *See id.* at 14.

[10] FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, CONTROL OF POLLUTION BY UNDERWATER STORAGE (1969).

(2) Industrial production of nondurables (often resulting in organic pollutants) including chemicals, paper and pulp, rubber, petroleum, food and beverages, textiles, and other nondurables.

(3) Mining, milling, and other industrial production creating sediment and acid mine reduction problems.

(4) Electricity and gas production creating thermal pollution.

Of the three procedural alternatives available for control of water pollution listed above, alternative (1), enjoining the offensive activity, has been increasingly applied to curtail industrial pollution. With current awareness of the threat of water pollution, increased resort has been made to the courts to halt offensive activities at their source. The liberalizing of requirements for "standing to sue" and the formation of environmental groups seeking to curtail all activities threatening our ecology have both contributed to this increase. Also partially responsible is the knowledge of the wide range of technological alternatives available today. Thus, where a polluting activity has been enjoined and the cost of compliance with standards is high, it is customary to expect industry to develop new products or processes to substitute for the enjoined activity.

There is a great variety of technological processes and methods applied under procedural alternative (2), wherein treatment to remove contaminants is made at the plant to purify the effluent prior to discharge. Physical treatment processes include screening, cooling, mixing and agitation, flocculation, sedimentation, and filtration. The processes employ a variety of plants and facilities for accomplishment. Chemical treatment processes include water stabilization, coagulation, precipitation, and ion exchange. Biological treatment processes include biological oxidation, photosynthetic processes, and aeorbic and anaerobic digestion. However, despite the wide variety of treatment facilities and methods available, it is of interest to note that the current contaminant removal efficiency of the total inorganic chemical industry in the United States has been estimated to be only 27%. This is less than half of the efficiency of municipal waste plants.[11]

There is a growing propensity for factories to connect to public systems for collective waste treatment, parallel with procedural alternative (3). This has been proven to afford benefits in efficiency and economy.

[11] FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, THE ECONOMICS OF CLEAN WATER SUMMARY REPORT 9 (1970) [hereinafter cited as ECONOMICS OF CLEAN WATER].

> There is no question that in a majority of cases public treatment of industrial wastes is more efficient than separate treatment of municipal and industrial wastes, in that it commonly costs less per gallon of water processed or per unit of pollutant removed to treat waste from several sources at a single point. There are two reasons for the cost advantage. On the one hand, economies of scale are attained by construction and utilization of larger plants that are required when a number of independent waste sources are collected at one point for treatment; on the other, staging capabilities and complimentary characteristics of sewage and industrial wastes often permit operational economies.[12]

While this trend seemingly shifts private costs to the public sector, a number of municipal plants have created user fees proportionate to the amount of wastes collected and treated to compensate for this apparent inequity. It should also be noted that the terminology "public treatment of private industrial waste" has a very flexible meaning. It is common practice for municipal sewage plants to accept, on the same basis as domestic sewage, the waste of restaurants, hotels, laundries, and so on, all of which are private commercial endeavors and all of which place a much greater burden on municipal sewage treatment plants than the typical single-dwelling effluent.

Perhaps the major impediment to inaugurating effective administration and control of industrial wastes has been the development of industry. It is natural to locate industry near rivers where possible to provide convenient waterway transportation for handling materials and supplies and convenient water supply for production, water power, and cooling facilities. It has accordingly become a common practice to allow utilization of the waterway for diret discharge of wastes.[13] Paradoxically, the natural location of industry by major waterways may be most advantageous in facilitating future cleanup of our rivers and curtailment of water pollution.

Figure 1 illustrates graphically a proposed, optimum development for cleanup of a polluted waterway. This would result from isolating the polluted wastes as they enter the waterway and conveying them separately from the normal, clean, river flow, while simultaneously preserving the natural advantage of the waterway for embodying and transporting the isolated wastes. Large central waste treatment plants would then be located at the outskirts of the industrial areas to treat the contaminated waters prior to allowing the purified waters to

12 I FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, THE ECONOMICS OF CLEAN WATER 130 (1970).

13 *See* FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, CHESAPEAKE BAY IN LEGAL PERSPECTIVE (1970).

re-enter the main stream beyond the industrialized area. The aesthetic value of the clean water stream, the berms and banks of such a channel improvement, contrasted to present-day polluted rivers, would be tremendous. It is envisioned that the waste conveyance conduits would be comprised of pre-cast, prestressed, thin wall concrete members within the industrialized reaches of the river. These conduits would be graduated in size to afford flexible capacity yet standardized in shape and design to provide easy city and state wide maintenance and expansion. Heavy vinyl or plastic tubing would be used as a single conduit, designed to flow-full, beyond the reaches of industrial inlets. By maintaining an equivalent water pressure within the enclosing conduit, as illustrated by Detail B on Figure 1, the need for structural integrity of the enclosing tubing would be reduced as required to permit use of flexible and less expensive materials. Automatic control and check structures, underground storage and pumping facilities, and metering and flood safety devices could all be practicably built into the system to facilitate maintenance of both uniform, low-velocity, clean-water flow in the channel and modular flow in the isolation conduits. The concept illustrated by Figure 1 is readily amenable to further study and development under a grant such as the Research, Development and Demonstration Projects. The initial study should be in the form of an investigative feasibility report engineered for a typical prototype city and industrial waterway. The concept illustrated is particularly well suited for developing nations wherein comprehensive plans and facilities for isolation of polluted water wastes within the normal waterway flow can be initiated as the necessities of industrial progress dictate.

B. *Cost of Pollution Controls*

A study was recently made of the cost of treating municipal, industrial and other effluents to determine the effort which would be required to achieve acceptable water pollution control standards.[14] The report concludes that on January 1, 1970, the nation's municipal waste-handling systems presented the need for the investment of $4.4 billion, and were generating additional needs at the rate of over $800 million a year. With expected growth of the systems, inflation, and considering that all existing deficiencies would be remedied and no new deficiencies allowed to occur, the total investment required over the five-year period 1970-1974 was estimated to be somewhat over $10 billion. The estimate included public waste treatment, transmission, and

[14] *See* ECONOMICS OF CLEAN WATER, *supra* note 11.

disposal facility requirements, new waste treatment plants, expansion, upgrading, and replacement of existing plants, interceptors, outfalls, collecting sewers, and industrial waste treatment needs; all as required to comply with water quality standards as set forth and patterned by the Federal Water Pollution Control Act. The yearly and five-year costs derived in the estimate are shown in Figure 2. It should be noted that independent estimates made by individual states of their intended expenditures for water pollution control closely coincide with the federal estimate.[15]

Figure 2 also shows for comparison a number of other cost statistics relating to existing facilities in the United States and other nations, including water resources developments and other public expenditures.[16] These statistics are offered to provide a significant comparison between the sum required to provide "clean water" and typical sums expended for other public needs.

An estimation of the costs involved for providing clean water on an international basis is impractical. However, the range of cost for European and other nations that have developed to a degree roughly equivalent to the United States may be estimated by the comparison of population, area and other geographical influence factors. As shown earlier, the costs for clean-up of industrial pollution for undeveloped nations would be far less, but the costs to provide or modernize sanitary and storm sewerage collection systems and treatment plants would be considerably higher than for a developed nation.

C. *The Legal and Administrative Elements of River Water Pollution Control*

Just as functional efforts to provide and construct proper water resource facilities date far back in history, so also do legal and administrative control efforts. In a report dated 98 A.D., Sextus Julius Frontinus, Water Commissioner of Rome stated:

> I desire that nobody shall conduct away any excess water without having received my permission or that of my representatives, for it is necessary that a part of the supply flowing from the water-castles shall be utilized not only for cleaning our city but also for flushing the sewers.[17]

It is of interest at this point to explore in a cursory manner the basic principles and doctrines evolved for legal and administrative control of water resources; first in the United States and

[15] *Id.* at 25.

[16] *See* BUREAU OF THE CENSUS, U.S. DEPARTMENT OF COMMERCE, STATISTICAL ABSTRACT OF THE UNITED STATES 412, 687 (1969).

[17] CLARK, *supra* note 1, at 4.

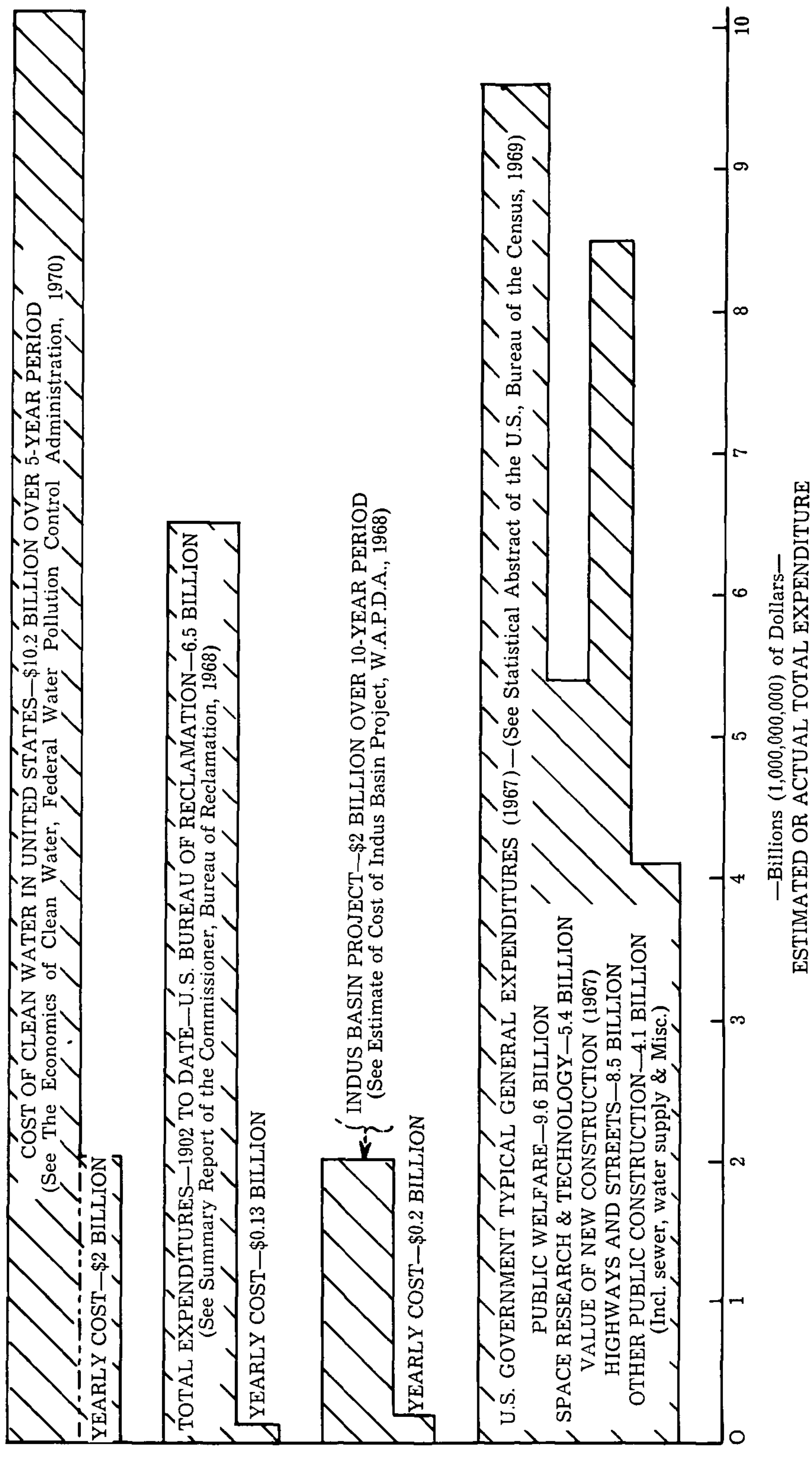
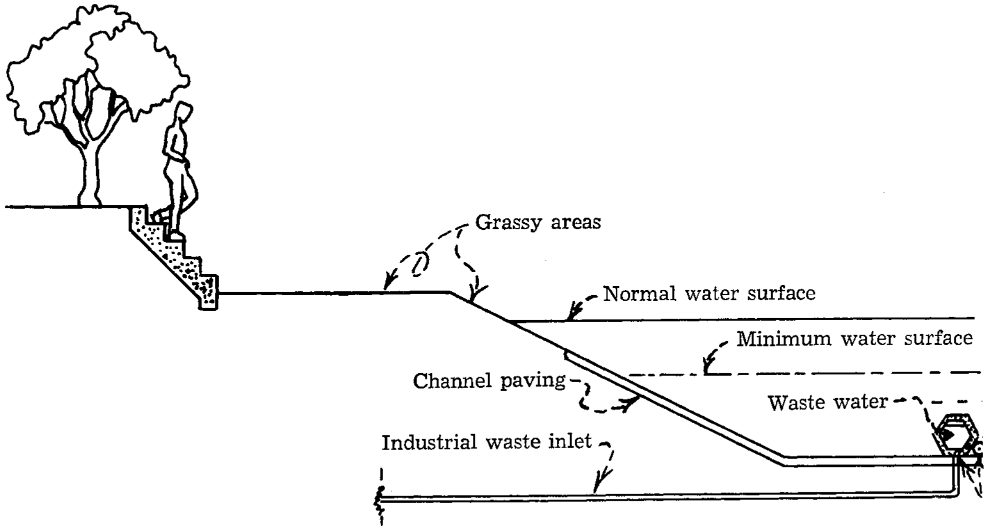


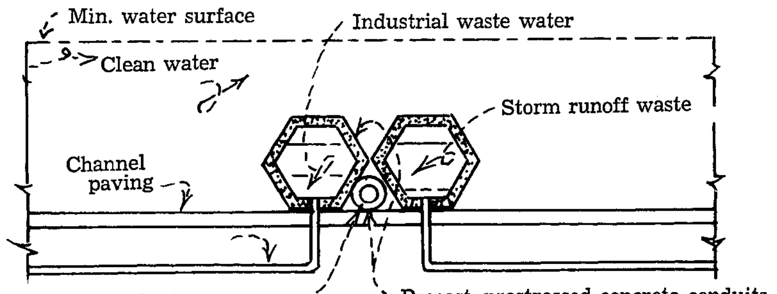
Figure 2. Cost of Pollution Control in the United States
(Plotted with other cost statistics for comparison)



Isolation conduits, see
DETAIL A & DETAIL B below

TYPICAL SECTIO

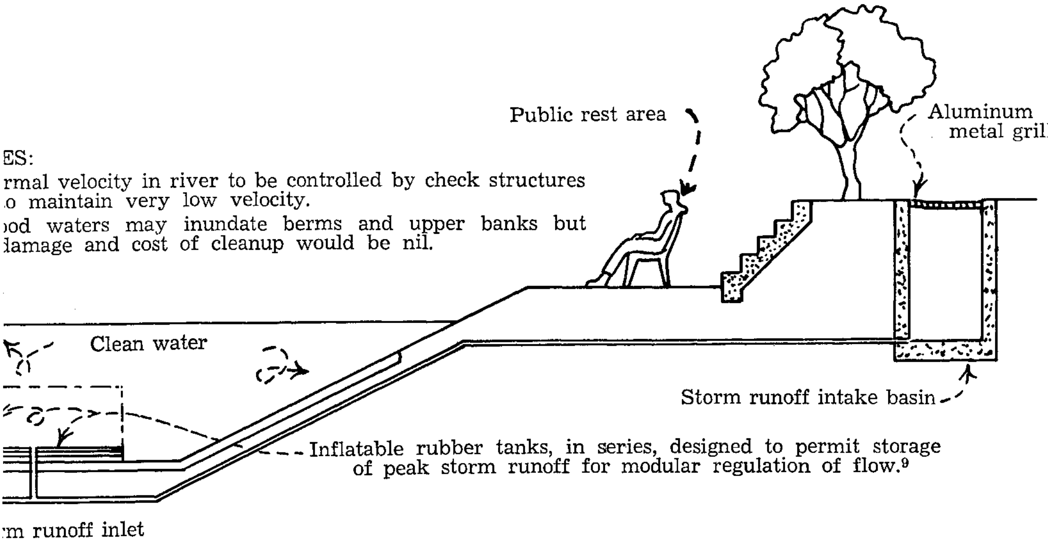
Note:
Within industrial reach, inlet industrial waste, storm runoff, and sanitary wastes to separate conduits, each designed for modular, partially full flow.



DETAIL A
Industrial (Inletting) Reach

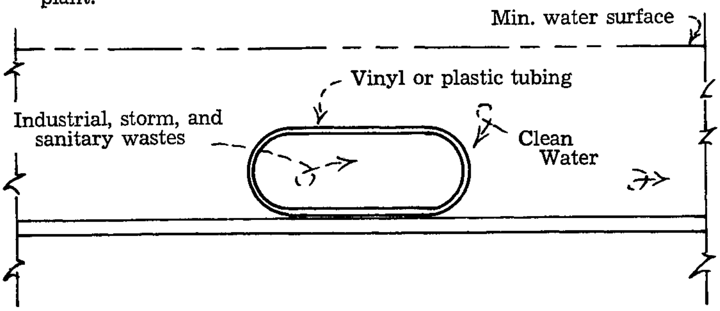
Figure 1. CLEANUP OF POLLUTED WATERWAY BY ISOLATION OF WASTES

ES:
rmal velocity in river to be controlled by check structures .o maintain very low velocity.
ɔod waters may inundate berms and upper banks but lamage and cost of cleanup would be nil.



te:
Jnwatering procedures for construction and conduit anchorage requirements will vary in accordance with channel dimensions and flow capacity.

Note:
Beyond industrial reach, collect all waste types into a single conduit, designed to flow full under pressure approximately equal to static river pressure, to a central treatment plant.



DETAIL B
Conveyance Reach

then on an international basis.

In the United States two basic legal regimes exist for governing the use of water resources. Their derivation on the basis of the "time-location" concept discussed in Section II is evident. The "riparian rule" provides that rights to the use of water in a stream are created by ownership of land which is riparian (under or adjoining the bed or banks) to that stream. The water right is an incident of land ownership and it cannot be lost by mere disuse; neither may water be sold for use from the riparian land nor may it be used unreasonably. The "appropriation doctrine" was developed in the arid west where water was a precious commodity; in fact, the key to development of the frontier lands. This doctrine allows establishment of a right to water, irrespective of land ownership on a stream, by taking the water first in time and placing it to beneficial use.

Pollution is considered an unreasonable use under riparian law and a non-beneficial use under appropriation law, and damages as well as injunctions are available remedies. However, the field of pollution control has been recently pre-empted by federal and state statutory schemes. While there are still isolated cases dealing with individual controversies involving pollution, it has become increasingly clear that litigation instigated by private parties cannot cope with the water pollution problems created by large industrial and municipal complexes.

In the United States water resources are almost totally administered by municipal or other governmental agencies which are generally headed by a board of commissioners. River basin commissions and interstate compacts to administer water problems among the several states embodied in a single drainage basin are common.

Prior to setting forth the basic legal history and doctrine developed for regulation of international river drainage basins it is desirable to review certain fundamental definitions. An international drainage basin may be defined as a geographical area, extending over the territory of two or more nations, bound by the watershed extremities of the surface and underground waters which gravitate into a common terminus. All nations encompassed within the drainage basin or bounded by a portion of the river are said to be coriparian and the nation located uppermost in the drainage basin is said to be an upper-basin state. All others are said to be lower-basin states. It has only been recently that the entire drainage basin including all of its tributaries, as opposed to only particular rivers forming part of the basin, has been viewed as the proper basis for international regulation.[18]

Four basic theories concerning the rights of coriparians to utilize the waters of an international river have been promulgated as follows:

> (1) The "territorial integrity" theory wherein the downstream riparian is considered to have the right to demand the continuation of the natural flow of the river.
>
> (2) The "absolute territorial sovereignty" theory wherein a riparian state can dispose freely of waters of the drainage basin flowing through its territory but has no right to demand the continued flow from other states.
>
> (3) The "community" theory whereby the basin is regarded as an economic unit, and the waters are either vested in the community or divided among the coriparian states by agreement.
>
> (4) The "limited territorial sovereignty" theory which restricts the principle of "absolute sovereignty" to the extent necessary to insure each coriparian a reasonable use of the basin's waters.[19]

There has been no application of the "territorial integrity" theory in international practice. Neither has the "absolute territorial sovereignty" theory had significant application in international river control, although this doctrine was widely quoted near the end of the nineteenth century. The so-called Harmon Doctrine arose at this time as an outgrowth of the "absolute territorial sovereignty" theory in an opinion by Attorney General Harmon of the United States in connection with a complaint by Mexico concerning the waters of the Rio Grande in which he said:

> Whether the circumstances make it possible or proper to take any action from considerations of comity is a question which does not pertain to this Department; but that question should be decided as one of policy only, because in my opinion the rules, principles, and precedents of international law impose no liability or obligation upon the United States.[20]

Of the theories listed above only the latter two have current significance. Treaties, the most common method of controlling international waters, are an application of the "community" theory. The "limited territorial sovereignty" or reasonable use theory is also widely accepted. This principle is the forerunner of, and inherent in, the "equitable utilization" doctrine applied to arbitrate today's conflicts and disputes.

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[18] *See* INTERNATIONAL LAW ASS'N, HELSINKI RULES ON THE USES OF THE WATERS OF INTERNATIONAL RIVERS 7 (1967).

[19] *See* Lipper, *Equitable Utilization*, in THE LAW OF INTERNATIONAL DRAINAGE BASINS 18 (1967).

[20] *Id.* at 20; *see also* 21 OP. ATT'Y GEN. 274, 283 (1895).

The equitable utilization doctrine purports to weigh the benefit to one state in use of water against the injury which might result to another because of such use through evaluation of the following factors:

(1) The inherent right of each to a reasonable use of the water. Equality of right is the cornerstone to equitable utilization.

(2) The extent of the dependence of each state upon the waters of the disputed river.

(3) The comparative social and economic gains accruing to each and to the entire river community.

(4) Pre-existent agreements among the states concerned.

(5) Pre-existent appropriation of water by one state. (It should be noted, however, in international law there is no doctrine applying inflexibly the "prior in time, prior in right" concept as applied internally by many of the United State's States).[21]

Theoretically, in the settlement of international water disputes the doctrine of equitable utilization should be applied by first examining the economic and social needs of the coriparian states by an objective review of the various factors and conflicting elements relevant to their proposed use of the waters. Secondly, the planned distribution of the waters among the coriparians must be shown to satisfy the needs of each to the greatest extent possible. Lastly, the planned distribution must be shown to achieve maximum benefit for each coriparian consistent with minimum detriment to each.

The doctrine of equitable utilization also conforms well in theory with the aims of controlling pollution, because it curtails use by a state which would result in a material detriment to a coriparian. While there is a paucity of cases dealing with river pollution before the International Court of Justice or any other international tribunal, there are cases in analagous areas which in general appear to establish that:

(a) A state has the right to use the waters of an international drainage basin located within its territory, subject, however, to a duty not thereby to cause injury to a coriparian state.

(b) A state may be restrained from a use or may become liable to pay damages for such use if causing serious injury to a coriparian state.[22]

The obvious administrative mechanism for planning of development and for control of international river basin resources

[21] *Id.* at 43; *see also* REPORT OF THE 48th (NEW YORK) CONF., INT'L LAW ASS'N Res. II, at ix (1959).

[22] Lester, *Pollution*, in THE LAW OF INTERNATIONAL DRAINAGE BASINS 102 (1967).

is through agencies and commissions created by international agreements. The rather limited number of such agencies now in existence include The European Commission of the Danube, The Central Commission for Navigation on the Rhine, The Committee for Co-ordination of Investigations of the Lower Mekong Basin, The River Niger Commission and The Permanent Indus Commission. While such existing international commissions have all performed the important function of bringing nations together to cooperate in planning for comprehensive river development, their decisions have generally been limited to an advisory or recommendatory level. On the other hand it is commonly accepted that the formation of an agency or commission which is staffed with men of diverse nationalities and competitive interests is a major step in proper river basin management. The accomplishments of the Indus Basin Advisory Board and the many other interested world agencies and entities who were responsible for the successful recent development of the Indus Basin, which resulted in the solution of a most serious international conflict, is testimony of the great potential of such international commissions.[23]

It should be recognized that the laws governing water use and control of international drainage basins are somewhat vague and theoretical. Further, member nations of an international drainage basin must generally rely on comity as their sole authority to solve problems and to enforce the equitable doctrines concerning water rights among their fellow coriparian member states. Also, that formulation of international commissions with administrative authority to properly plan and provide for comprehensive development of international waters has been decidedly limited.

It is anticipated that the problems of establishing proper controls for international drainage basin management and the sharing of rights and responsibilities among member nations will become increasingly acute as the present population explosion continues to accelerate. Considering normal industrial expansion, the world-wide consumption of water is expected to double in the next twenty years.[24] International legal and adminstrative problems concerning water will multiply accordingly.

The ever-present and growing problem of water pollution

[23] Address by Field Marshall Mohammad Ayub Khan, President of Pakistan, Presidents' House, Karachi, Oct. 15, 1967; *see also* Baxter, *The Indus Basin,* in THE LAW OF INTERNATIONAL DRAINAGE BASINS 443-85 (1967).

[24] Olmstead, *Introduction,* in THE LAW OF INTERNATIONAL DRAINAGE BASINS 5 (1967).

further endangers the chances of harminous use of international drainage basin waters among all users. While technological means are available to prevent essentially all known forms of pollution, the financial requirements for pollution control are higher than some nations consider themselves able to afford. Many nations which have used international rivers as open sewers for centuries are adverse to giving up that which they consider an established beneficial use.

On the other hand, the growing scarcity of water and the increase of types and amounts of recognized pollution activities has resulted in a recent impetus towards creation of joint basin administrative agencies and formal treaties among co-basin nations. The very essence of the inducement toward formulation and adherence to an international rule of law governing the use of water has been recent awareness of the dire need for cooperative beneficial use of this valued resource. Advances in international cooperation in control and use of water are aptly demonstrated by recent treaties governing the Indus,[25] the Nile,[26] and the Columbia River[27] basins. Also the interest of scholarly and professional organizations in the subject of international river law has greatly increased in recent years. Several important international law conferences and the subjects which they studied and discussed are enumerated below:

(1) The Hamburg Conference, 1960, devoted its attention to the rights of coriparian states to the use of waters of an international drainage basin.

(2) The Brussels Conference, 1962, was concerned with the subject of pollution of waters of an international drainage basin.

(3) The Tokyo Conference, 1964, considered the subjects of navigational uses, timber floating, pollution and the settlement of disputes.

(4) The United Nations sponsored committee meetings held in London, 1970, considered the formulation and implementation of policies affecting the management of river basins.

A review of a number of the papers submitted at the above and other conferences has revealed the following generally accepted conclusions regarding the status of law and authority concerning international river water control:

(1) While there is no established law or authority other than international comity to govern water use, the view that a

25 Treaty Between India and Pakistan (Indus Water Treaty), Sept. 19, 1960, 419 U.N.T.S. 125.

26 Treaty Between the United Arab Republic and Sudan, Nov. 8, 1959, 453 U.N.T.S. 51.

27 Treaty with Canada (Columbia River Basin), Jan. 17, 1961, [1965] 2 U.S.T. 1555., T.I.A.S. No. 5638.

state is under a general obligation to refrain from using its water resources in a way which may cause substantial injury to the territory of a neighboring state is generally accepted. This inherent obligation is also generally, but not universally, considered to preclude practices causing pollution of waters.

(2) Growing water demand and threatening pollution require the creation or strengthening of river basin authorities responsible for rational water resources management, including integrated water quality planning, implementation of the plans, and operation.

(3) Planning of integrated basin wide water resources development should, as much as possible, involve measures for the rational development of other natural resources, their conservation, and the improvement of the human environment.

(4) There is a need for greater efforts to combat the considerable lag of water management techniques behind scientific and technological progress in water resources use and control.[28]

IV. International Control of River Water Pollution: Summary and Conclusion

As stressed previously, the problems confronting international efforts to regulate and control river water pollution are complex. Because of this complexity, coupled with the broad spectrum of interests generated by recent environmental awareness, reports and discussions concerning this subject often incline towards vague one-dimensional recognitions of the problems. There is a tendency towards a pessimistic view that comprehensive remedies can not be formulated. Attention is deliberately directed herein to the fundamental components comprising the functional legal and administrative challenges facing adequate international water pollution control in order to demonstrate that the problem is not as difficult as might initially be presumed. It has been illustrated that while the cost required to overcome the problem in this country is high, it is not an insurmountable sum.

It can be predicted that the many new ideas and concepts currently being generated through world-wide research will serve as the cornerstone bringing the task increasingly nearer to fruition. The legal and administrative problems will be solved as a natural outgrowth of the research and development efforts. After sufficient publicity illustrates the feasibility of comprehensive water pollution controls and the mutual benefits to be at-

[28] *See* Economic Commission for Europe, Proceedings of the Seminar Organized by the Committee on Water Problems of the U.N. Economic Commission for Europe, (London on June 15-22, 1970).

tained through international cooperation, each involved entity will naturally desire to cooperate and to contribute their own skills and efforts towards accomplishment.

We should dispel any concern that elements may be involved in achieving pollution control, or in the realization of clean water, that could be cause for what Alvin Toffler describes as "future shock".[29] Scientific and technological development is on the threshold of mastering water pollution controls and can accomplish the task with no more public awareness or disturbance that that caused by the construction of the vast system of interstate highways. Once specific and comprehensive efforts are undertaken to overcome water pollution, mankind will gravitate towards becoming involved in the overall program of enhancing the environment.

[29] A. TOFFLER, FUTURE SHOCK (1970).