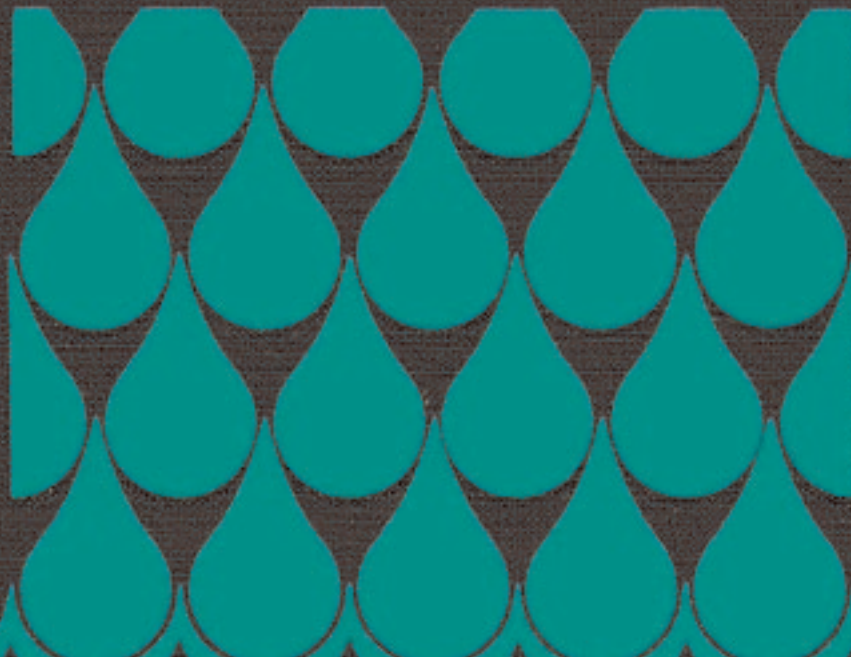


THE INDIANA WATER RESOURCE



RECOMMENDATIONS FOR THE FUTURE

*The
Indiana
Water Resource*

*Recommendations
For the Future*

GOVERNOR'S
WATER RESOURCE STUDY COMMISSION,
STATE OF INDIANA

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December 15, 1980

The Honorable Otis R. Bowen, M.D.
Governor
The State of Indiana
206 State House
Indianapolis, Indiana 46204

Dear Governor Bowen:

The Governor's Water Resource Study Commission presents herewith its second phase report, *The Indiana Water Resource: Recommendations for the Future*.

During the past three years the Commission has held fourteen formal meetings, together with the more than thirty public meetings in various areas of the state. In addition the staff, comprised of personnel from the Department of Natural Resources and the State Board of Health, analyzed every aspect of the water resource. These findings are published in the first phase report, *The Indiana Water Resource: Availability, Uses, and Needs*.

The culmination of the previous three years work is presented in this second report. The issues, conflicts, and existing and potential problems associated with the utilization of the water resource through the year 2000 are identified. In addition, an evaluation is made as to the adequacy of the current system of policy, law, and management to meet the needs during this period. It was through this analysis that the deficiencies in the present management system to deal with current and anticipated resource conflicts surfaced.

The Commission's objective is to develop recommendations for the solution of these current and forthcoming management and resource problems. The general public participated in more than fifteen meetings, where their opinions of five management options were solicited. The Commission developed its conclusions and recommendations for an integrated management system based upon the input from these public meetings and the findings of an expert staff.

The Commission transmits this report to you with the earnest hope that it, together with the *Availability, Uses, and Needs* report, will contribute to the wise use of our water resource.

Respectfully submitted,

A handwritten signature in black ink that reads "William J. Watt". The signature is written in a cursive style with a large, prominent "W" at the beginning.

William J. Watt,
Chairman

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Introduction

The Governor's Water Resources Study Commission was created by Governor Otis R. Bowen on July 10, 1977, pursuant to Executive Order 11-77. The basic task of the Commission, as set forth in the order, is as follows:

The Commission shall develop recommendations for an integrated system of policy, law, and management to provide the essential framework within which the human, social, and economic water needs of the people of Indiana may be satisfied in a timely and equitable manner. The Commission's recommended water policy shall be based upon a comprehensive examination of water availability, law, management, and present and projected human, social, and economic needs.

At its first meeting on September 22, 1977, the Commission adopted the following statement of its general goal, objective, scope, and plan of study.

Goal To establish a comprehensive water program for Indiana; that is, an integrated system of policy, law, institutions, and management to provide the essential framework within which the human, social, and economic water needs of the people of Indiana may be satisfied in a timely and equitable manner.

Objective To develop a recommended water program for Indiana, based upon a comprehensive study of water availability and quality; present and projected human, social, and economic uses and needs; and laws, institutions, and management programs.

Scope The investigation and study will give consideration to:

- 1) All forms of the water resource in Indiana (surface, ground, and atmospheric) and their availability and quality.
- 2) The present and projected human, social, and economic uses and needs.

- 3) The definition of the general nature and types of problems to be reasonably anticipated in meeting the various uses and needs for water.
- 4) The determination of the measures and actions needed to provide a sound basis for meeting those needs.
- 5) The adequacy of existing policies, laws, institutions, and programs to serve as a basis for solving those problems.
- 6) The development of recommendations for new and/or amendatory policies, laws, institutions, and programs.

General Plan of Study

The course of investigation was divided into two phases. The first phase included the: 1) development and implementation of a strong public involvement program; 2) determination of the availability and quality of the water resource of the state, including surface, ground, and atmospheric water; 3) assessment of the nature, extent and magnitude of excess water conditions; 4) an inventory of the current development and use of water in the state; 5) projections of the future uses and needs for water for all purposes for a period extending to the year 2000; and 6) compilation of existing water resource policies, laws, institutions, and management programs at both state and local levels, together with applicable existing federal policies, laws, institutions, and programs as they relate to the ability of state and local governments to solve water resource problems.

The second phase included an 1) analysis of water resource availability and quantity versus present and projected water uses and needs to the degree necessary to define the general nature and types of actions and measures necessary to meet those needs; 2) analysis of the adequacy of existing state and local policies, laws, institutions, and programs, considered in the light of federal aids or constraints, to address defined problems; and 3) development of recommendations for new and/or amendatory policies, laws, institutions, and programs to provide an effective water program in Indiana.

The results of the first phase are published in a report entitled *The Indiana Water Resource: Availability, Uses and Needs*. Frequent reference is made to that document in this report. Such references are cited in the form (IWR: AUN, page number).

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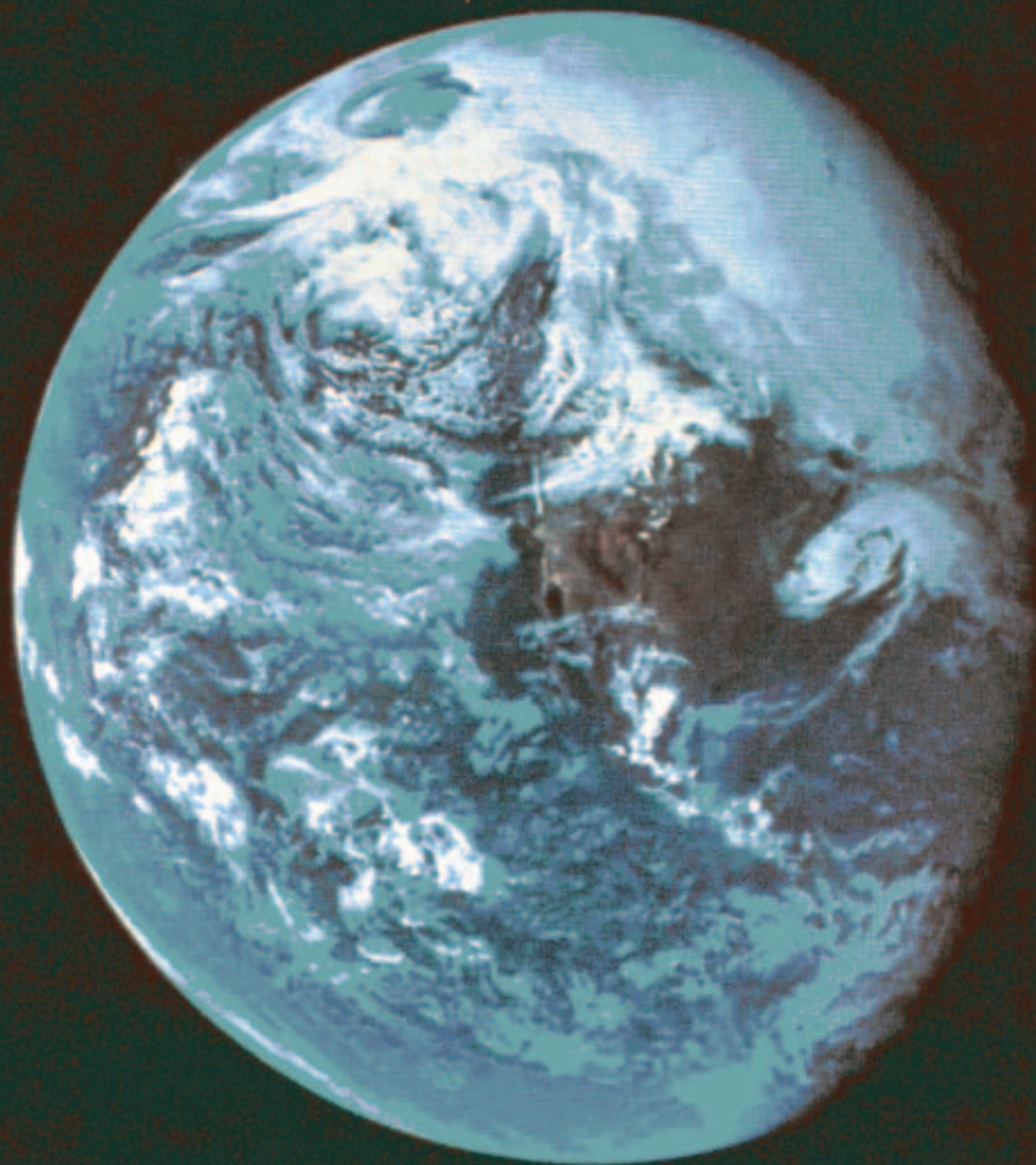
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*The
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*"All the rivers run into the sea;
yet the sea is not full;
unto the place from whence the rivers come;
thither they return again."*

A vertical column of four black water droplets of varying sizes, with the largest at the bottom. The top droplet is partially cut off by the top edge of the page.

*The Water
Resource*





General Characteristics and Summary

In the general sense, the amount, physical availability, and mode of occurrence of the water resource is the result of a combination of natural forces and factors that are not subject to substantial alteration by man. It then follows that the State of Indiana must accept this natural regime and formulate its water resource policies and practices in harmony with those natural forces and factors that determine the availability of the water resource. The following discussion of general characteristics concerning precipitation, soil moisture, ground water, and surface water is summarized from the report *The Indiana Water Resource: Availability, Uses, and Needs*.

Precipitation

Although water moves through the closed hydrologic cycle, it is convenient to regard precipitation as the source of supply for Indiana's water. Precipitation on Indiana is a function of the world climate and, more particularly, of the continental climate. Its overall type, amount, and distribution is governed by natural forces beyond the substantial control of man, either now or foreseeably. This is not to say that there are not areas in which local influences exist; for example, those resulting from heat and particulate emissions from some metropolitan centers and from weather modification efforts. The long-term average precipitation regime for Indiana is such that the supply is well distributed throughout the year and, on an average annual basis, the state receives an ample supply of water. However, despite the overall favorable precipitation supply, as depicted by both long-term annual and monthly averages, there are substantial, sometimes critical, and generally unpredictable variations as to periods of both excess and deficiency. Because precipitation is the source of supply, these variations have direct and relatively immediate impacts. The degree of impact caused by these variations in precipitation depends upon the nature (excess or deficiency), areal extent, duration, and time of occurrence of the precipitation event. Since these variations do occur

and are not subject to substantive control or even advance prediction, it follows that they must be recognized and incorporated in the water resource planning, development, and management process.

Soil Moisture

The general climatic regime of the state, including its length of growing season, and its favorable precipitation, both in amount and time distribution, together with a high proportion of fertile and productive soils, makes Indiana one of the leading states in agriculture. The term *soil moisture* is used to describe that water held or contained within the soil profile. Soil moisture is the source of supply that supports vegetation, including crops. The availability of soil moisture to vegetation, especially during the critical growing season, is dependent directly on precipitation, and is therefore subject to variations in precipitation. Periods of substantial deficiency in precipitation can and do result in loss or reductions in crop yields. The phenomena of precipitation deficiencies during the growing season is responsible for the expanding practice of agricultural irrigation in those areas where suitable soils and available water supplies exist. Periods of excess precipitation may result in excessive soil moisture, and are particularly detrimental to those soils having either poor internal drainage characteristics or that have not been provided with adequate drainage facilities, or both. The impacts resulting from excess soil moisture may be no less severe in terms of effects upon crop yields and consequent economic loss than those from periods of deficient supply.

Ground Water

Ground water is defined as water that occurs in those unconsolidated and bedrock formations which, because of their physical characteristics, are capable of absorbing, storing, and transmitting water. Such formations are known as aquifers. The source of supply to ground water, commonly called recharge, is that portion of the precipitation that infiltrates through the soil profile and migrates under the influence of gravity into the aquifer.

As noted previously, precipitation is subject to substantial variations in time, space, and amount. It therefore follows that ground-water recharge is subject to the same variability. In addition, ground-water recharge is generally limited during the growing season when most of that precipitation which enters the soil profile is utilized by vegetation through the process of evapotranspiration. Recharge is also limited when the ground is frozen.

Thus ground-water availability depends upon the presence and relative capability of the aquifers; upon precipitation with all its attendant variations as a source of supply; and upon the capacity of the overlying soils to absorb precipitation. Further, and unlike natural streamflow, ground-water availability is influenced by the volume of water stored in the aquifer. Such storage is a function of the porosity, permeability, areal extent, and saturated thickness of the aquifer. The role of aquifer storage is substantially comparable to that of surface water impoundments, where stored water serves as the supply during periods when the rate of use exceeds streamflow.

Surface Water

Surface water is defined as water in streams, lakes, and reservoirs. It has three components of supply: (1) the portion of precipitation that falls directly upon the lake or stream, (2) diffused surface water, and (3) the ground-water contribution to streamflow. As will be noted in the following discussion, each of these supply components is either directly or ultimately reflective of precipitation.

The portion of precipitation that falls directly upon the lake or stream is self-explanatory. Obviously, such supply occurs only during precipitation events, and depends upon the amount of precipitation and the areal extent of the stream or lake upon which it falls. On an average annual basis, precipitation upon a body of water is approximately equal to its evaporation.

Diffused surface water is defined as the portion of precipitation that falls at rates in excess of the infiltration capacity of the land surface and flows vagrantly over the land surface to find its way to a watercourse. The term diffused surface water indicates its intermittent and transient character. It is directly dependent upon precipitation and upon its time and mode of occurrence, intensity, duration and areal extent. Diffused surface water is not directly available for use, but is the major source of supply to surface water.

The ground-water supply component to surface water results from aquifer discharge into streams and lakes. Its relative contribution to surface water is reflective of ground-water availability. The effects of variations in precipitation, while very real, are delayed and muted with respect to the ground-water contribution to streamflow because of the modifying effect of ground-water storage.

Thus, water in watercourses is primarily dependent upon the components of diffused surface water and ground-water discharge. Diffused surface water contributes approximately seventy to seventy-five percent of the average annual surface water yield on a statewide basis. As noted, the diffused surface water supply is intermittent, of short duration, highly variable in amount as to a specific event and generally unpredictable as to specific time of occurrence. Diffused surface water is almost entirely responsible for the high degree of variability in natural streamflows.

Of vital importance is the fact that the streamflow resulting from the diffused surface water component occurs as sporadic medium to high flow events of relatively short time duration. Further, these flows pass through the stream system and outside the boundaries of the state in a matter of a few days to a few weeks. Thus, in the natural system, these flows are available for use only intermittently and for short time spans. On the other hand, the ground-water contribution is the basic source of supply to the low flow regime, thereby sustaining those flows that are present on a more or less continuing basis.

Conclusion

On the basis of the foregoing general characteristics of the water resource, the Commission concludes that:

Indiana has a single water resource. It is composed of the inter-related elements of atmospheric moisture, precipitation, soil moisture, evapotranspiration, diffused surface water, surface water (water in lakes and watercourses), and ground water.

SUMMARY OF WATER AVAILABILITY

Recognizing that the water resource and its availability in time, mode of occurrence, quantity, and geographic location is subject to the operation of the general principles and characteristics noted in the previous section, it is desirable to summarize in general terms the availability of water throughout the state.

Precipitation

As stated, precipitation is the source of supply for Indiana's water resource. The gross long-term supply of water, in the form of precipitation, amounts to a statewide annual average of 38 inches per year, ranging from 36 inches in the north to 44 inches in southern Indiana. Approximately 26 inches is returned to the atmosphere through direct evaporation and transpiration by vegetation. The remaining 12 inches represents the long-term average annual net supply of the water resource. Approximately 8.4 to 9.0 inches of the net supply is diffused surface water, while the remaining 3.0 to 3.6 inches constitutes recharge to the ground-water system and is eventually contributed to streamflow. The net annual supply of the water resource ranges from 10 to 18 inches from northern to southern Indiana (IWR: AUN, p. 26).

Ground Water

In general, the ground water resource of northern Indiana can be classified as being good to excellent, and exclusive of areas bordering Lake Michigan, eastern Allen County, Benton, southern Lake, Jasper and western White Counties, properly constructed individual well yields of from 200 to 2,000 gallons-per-minute can be expected in most areas. Major areas of availability are found in the Silurian-Devonian bedrock aquifer system, in inter-till sand and gravel aquifers, and in sand and gravel deposits along the St. Joseph, Elkhart, Pigeon, Fawn, Eel, and Tippecanoe River valleys (IWR: AUN, p. 34).

In the central portions of the state, ground-water conditions range from fair to good, with properly constructed individual well yields in the range of 100 to 400 gallons-per-minute. Both outwash sands and gravels and limestone and dolomite bedrock are utilized. Major ground-water sources are found in the valleys of the West Fork of the White, Whitewater, Eel, and Wabash Rivers and in portions of the valleys of Eagle, Fall and Brandywine Creeks and Blue River (IWR: AUN, p. 34).

Large areas of the southern part of the state are particularly lacking in ground water and only limited amounts, generally less than 10 gallons-per-minute, are available. The major sources in this area of the state are confined to the valleys of the Ohio, Wabash, Whitewater and Eel Rivers and the White River and its East and West Forks (IWR: AUN, p. 34).

Surface Water

The availability of surface water is a complex subject and, with respect to any given type and amount of use, must ultimately be addressed in a local or site-specific sense. Overall, it has been noted that the long-term average annual runoff

for the state is about 12 inches, with a range from 10 to 18 inches from north to south. This, combined with inflows from interstate streams and that available from Lake Michigan and the Ohio River, represents the sum total of the available water resource.

Examination of the data from stream gaging stations with a reasonable period of record indicates average annual flows of about 460,000 to 610,000 gallons-per-day-per-square-mile of drainage area occur in those streams within the Upper Mississippi drainage basin; from 470,000 to 690,000 in the Great Lakes basin; from 500,000 to 860,000 in the Wabash River basin; and from 659,000 to 850,000 in the Ohio River drainage (exclusive of the Wabash basin). It should be noted that, because of generally increasing precipitation from north to south, watersheds in southern Indiana have higher overall basin yields than those in northern Indiana.

However, the total yield of a watershed is only one of the important parameters. Equally important, from the standpoint of the availability and utility of natural streamflow, is the distribution of flow throughout the year. Since the low flows are derived basically from the ground-water supply, the more favorable flow distribution is found in those areas possessing the best ground-water characteristics. Thus, streams in the ground-water rich areas of extreme north-central Indiana have higher and more dependable sustained flows than those in the ground-water poor regions of southern Indiana.

Two special cases of surface water availability are the Ohio River and Lake Michigan. The Ohio River constitutes the 357 mile southern boundary of the state, involving twelve counties. The average flow of the Ohio River is 73,680 million-gallons-per-day at Louisville. Low flows of the Ohio River are augmented by an extensive system of reservoirs in the upriver watershed.

A portion of Lake, Porter and LaPorte Counties lies in Lake Michigan, and hence Indiana has the use of that water, at least within that portion of the state lying within the Lake Michigan drainage basin. The capability of the lake to supply water within that area poses no physical limitations to use.

In summary, the long-term supply of surface water in Indiana is very substantial. However, individual streams may experience wide fluctuations in flow. As a result, many withdrawal uses, depending largely upon the rate of withdrawal and the degree of dependability required, can be met only by the use of supplemental storage.

Water Quality

The chemical quality of the ground water in the state is generally good, meeting most of the basic requirements for household, municipal, industrial and irrigation uses. However, these waters are normally hard, exceeding 180 parts-per-million in most cases. Some form of iron or manganese treatment is required in many areas.

Surface water quality is managed by the Indiana Stream Pollution Control Board pursuant to both federal and state law. Water quality standards are based upon the seven day, once in ten year low flow of the receiving stream. With the exception of accidental spill events, direct discharges during extreme precipitation events by communities having combined sewage and storm-water drainage systems, and stream segments immediately downstream from the outfalls of the major wastewater

treatment plants, most of the surface waters of Indiana are within the water quality standards. Therefore water quality does not usually pose any limitations to the availability of the resource for withdrawal uses.

Conclusions

With respect to availability, the Commission concludes that:

- (1) *The overall availability of the water resource is both substantial and adequate. It is, however, characterized by a high degree of variability in mode of occurrence, in geographic location and in availability with respect to time.*
- (2) *Water resource planning and management are necessary to overcome the problems of variability so as to enable the resource to meet present and projected needs.*

EXISTING WATER RESOURCE UTILIZATION

It is useful and convenient to classify the utilization of the water resource into the two broad categories of instream uses and withdrawal uses. Instream uses are defined as those that utilize water in place in streams, lakes and reservoirs. Hence such uses involve only the surface water component of the water resource, not ground water. Instream uses consist generally of commercial navigation, hydroelectric power generation, recreational boating, fish and wildlife habitat, swimming, wastewater assimilation, and general environmental and aesthetic values. In addition, streams serve the major instream functions of drainage and the discharge of flood waters. Withdrawal uses are defined as those uses which involve the physical removal of water from its ground or surface source. Examples of such withdrawals include those for the purpose of municipal, industrial and rural water supplies, irrigation and the generation of energy. Withdrawal uses may be classified further as to consumptive and non-consumptive uses. Consumptive uses are those which, because of evaporation, transfer out of the basin of origin, incorporation into manufactured products, or other processes, preclude the return of some or all of the withdrawn water to its source. Non-consumptive uses, as the term implies, are those in which the withdrawn water is returned to the source of supply essentially undiminished in volume.

Instream Uses

Indiana is served by two of the major inland waterway systems of the United States, the Great Lakes-St. Lawrence River system and the Ohio-Mississippi Rivers system. Both serve to provide Indiana industries and farmers with access to efficient, low-cost transportation.

The northwest Indiana heavy industrial complex was located primarily because of the availability of water transportation and access to a very large and dependable supply of water. In addition to the essentially industrial Indiana, Gary and Buffington Harbors, the Port of Indiana in Porter County provides the state with one of the newest and most modern general cargo port facilities on the Great Lakes system. Michigan City harbor is now primarily used for fishing and recreational craft.

The Ohio River navigation system provides Indiana shippers access to a waterway system serving most of the central and south-central United States, including ports on the Gulf of Mexico. The Ohio River system has recently been improved with new locks and dams suited to modern navigation. The two new Indiana ports under development at Jeffersonville and Mount Vernon are expected to provide outstanding facilities for Indiana shipping, both imports and exports.

A very minor amount of hydroelectric power is generated in Indiana. The largest and only modern plant is that of Public Service Indiana, located in the Markland Dam on the Ohio River in Switzerland County with a capacity of 81 megawatts. The Indiana and Michigan Electric Company has two small plants on the St. Joseph River in St. Joseph and Elkhart Counties totalling 7.7 megawatts. The Northern Indiana Public Service Company has two small plants on the Tippecanoe River in White County totalling 17.6 megawatts.

Recreational boating, including such related activities as fishing, pleasure cruising, skiing, and canoeing, is very popular in Indiana. An estimated twenty-six percent of the population participate in boating, nine percent in skiing, eight percent in canoeing, and forty-five percent in fishing. A total of 169,620 boats were registered in Indiana in 1979. This does not include canoes and other small craft not subject to registration. It should be noted that only the few large rivers of the state and those lakes and reservoirs more than 300 acres in size are available for power boating in the normal sense of that term. Canoeing is not nearly so restricted in the sense of area and depth limitations, but because of seasonal flow characteristics, is generally feasible only on the larger creeks in addition to the waters available to power boating.

The major recreational activities, fishing and hunting, are based in whole or in part upon the fishery and the riparian habitat. The fishery is, of course, dependent upon the aquatic habitat provided by streams and lakes. Its quality is a function of water availability and quality, cover, and the food chain. Lakes and streams in Indiana typically support populations of warm water fish and the food chain necessary to sustain those populations. The best aquatic habitat is found along the major streams, with the smaller streams seemingly more sensitive to the impacts of land use. However, some small waterways in the forested areas of south-central Indiana and in the Pigeon and Elkhart River basins of north-central Indiana provide aquatic habitat of high quality.

The Indiana fishery has been enhanced by the introduction of salmon in Lake Michigan, intensive management practices, the creation of new lakes, and by generally improving water quality. The fishery resource attracts more than one million fishermen to make some 34 million fishing trips per year.

The riparian habitat along streams serves to help support both upland game and seasonal waterfowl. There are an estimated 200,000 acres of wetland remaining in the state. These are predominately located in the northern two tiers of counties and in a narrow band along the Ohio River, with some scattered areas along the Wabash River. The open-water types, comprising about fifty percent of the total, possess the highest fishery value, while shallow marshes, accounting for about twenty percent of the total, possess the highest wildlife values.

A very important instream use is that for wastewater assimilation. All streams serve this function with respect to non-point sources of pollution. A great many others serve as the receiving waters for municipal and industrial discharges. Although current water quality management programs have a goal of zero discharge of pollutants, that objective will not be reached in the foreseeable future, if ever, although vast strides have been made in relation to past practices. It is reasonable to assume that there will always be a residual pollutant discharge, together with that from non-point sources, which the stream will have to receive. Assimilative capacity is a function of streamflow. Hence the better the flow characteristics of the stream, the better it is equipped to handle the pollution load imposed upon it.

In summary, instream uses play a vital role for a variety of purposes. The ability of the stream to sustain these uses is a function of streamflow, especially during the low-flow regime.

Withdrawal Uses

A statewide summary of water withdrawals and consumptive uses for major purposes is shown in Table 1.

TABLE 1
The 1977 water withdrawals and consumption
rate in millions-gallons-per-day

Water Use	Withdrawal	Consumption*
Public Water Supply	553	68
Industrial Self Supply	3,456	146
Rural Water Supply	147	147
Irrigation	196	196
Energy	9,492	48
Coal Processing	9	9
Oil Well Injection	1	1
Total	13,854	615

* Does not include water considered as consumed due to the transfer out of the basin of origin.

The largest single water withdrawal use in Indiana, about 9.5 billion-gallons-per-day, or almost sixty-nine percent of the total withdrawal, is for electric power generation. Once-through cooling, the typical practice for all plants constructed prior to recent imposition of thermal standards, requires vast quantities of water. Withdrawals of 300 million-gallons-per-day (mgd) or more are common. Because of these high intake requirements, all of the generating stations in Indiana use surface water. All large plants are located along major rivers having good rates of sustained flow. These large plants are located along the Wabash River downstream from Attica, on the White River and its West Fork, on the Kankakee River, on the Ohio River, and on the shore of Lake Michigan. The largest number of plants are found along the Ohio River.

The second largest category of withdrawal uses is that for self-supplied industrial water. This use totals 3.4 billion-gallons-per-day, or approximately twenty-five percent of the total withdrawals. Importantly, about 3.1 billion-gallons-per-day, or some eighty-nine percent of self-supplied industrial water, is utilized by the heavy industrial complex in north-western Indiana and is withdrawn from Lake Michigan. As might be expected, the remaining 364 mgd of self-supplied industrial withdrawals are primarily (seventy-eight percent)

centered in and around South Bend, Fort Wayne, Lafayette, Anderson-Muncie, Indianapolis and Terre Haute. With the exception of the north-west area, the major source of self-supplied industrial withdrawals is ground water.

The third largest category of withdrawals, consisting of 553 mgd (or about four percent of the total withdrawals) is for public water supply. Approximately fifty-one percent of the water distributed by the public water supply utilities is withdrawn from surface water sources. The remaining forty-nine percent is withdrawn from ground water. Usually, only those utilities with limited access to adequate quantities of ground water rely upon surface sources. Thus the majority of utilities withdraw water from aquifers (IWR: AUN p. 54). However, the four largest utilities in the state, serving the Indianapolis, Gary-Hobart, Fort Wayne, and Evansville areas, obtain at least ninety-five percent of their supply from surface sources.

The principal areas using surface sources are extreme north-west Indiana (Lake Michigan), Fort Wayne (St. Joseph River), Evansville-Mount Vernon (Ohio River), Indianapolis and Muncie (West Fork White River and tributaries), and a relatively large area in south-central Indiana where ground water is very limited.

A large number of rural water systems have been constructed in the approximate southern one-third of the state since 1960 (IWR: AUN p. 55). These systems, while capable of supplying only domestic household needs, are very popular in this area of general ground-water deficiency, replacing unreliable wells and cisterns. These systems are generally supplied from a public water supply utility or from wells in one of the major river valley aquifers.

The most rapidly increasing withdrawal use is for agricultural irrigation, with some 64,400 acres irrigated in 1977. In Indiana, irrigation is practiced on coarser grained, reasonably well drained soils that do not hold soil moisture well. This causes deficient soil moisture during the peak growing season of July and August, adversely affecting agricultural yields. Irrigation is a seasonal water use that varies from year to year depending upon the amount and distribution of rainfall during the growing season. Those soils which produce increased yields from irrigation are found in northern Indiana in the Kankakee River Valley and along the St. Joseph and Elkhart Rivers. There is also a corridor of suitable soils along the Wabash River, the Blue River, and both forks of the White River (IWR: AUN p. 59). Water for irrigation is withdrawn either from wells or from nearby surface streams, depending upon local water availability. In the flat, sandy soils of the Kankakee valley a special form of irrigation known as water table control is practiced by controlling the elevation of water in drainage ditches in or adjacent to irrigated fields. Irrigation is also practiced on small acreages of specialty crops throughout the state and on golf courses. It should be noted that irrigation withdrawals usually coincide with the periods of declining streamflows and ground-water levels. The drier the agricultural season, the greater the demand for irrigation withdrawals.

Some water is developed in the state on an individual basis for rural residential use and livestock watering. In most cases, ground water is the source for these individually small household uses, with numerous ponds serving livestock.

PROJECTED WATER RESOURCE UTILIZATION

Instream Uses

The Great Lakes-St. Lawrence River system carried more than 340 million tons of freight in 1970. This amount is projected to double by the year 2000. The Ohio River navigation system carried more than 170 million tons in 1970.

The ongoing water quality control program is designed to meet water quality standards recognizing the seven day, once in ten year low flow. The projected increase in consumptive use could locally compromise these standards.

Demands for additional water-related outdoor recreational opportunities are expected to increase by about fifty percent by the year 2000. While this is within the theoretical total statewide capability of the resource for boating, waterskiing and canoeing, there will be substantial deficiencies in such activities as fishing, swimming and ice-skating. These two latter demands will undoubtedly be largely met, without any stress on the resource, by artificial pools and skating rinks. It is expected, even on the basis of the total theoretic resource availability, that the existing supply of fishable water will meet only sixty-four percent of the projected demand by the year 2000.

The statewide data concerning the extent of the total resource base for recreational uses is susceptible to misinterpretation with respect to boating, waterskiing and fishing, for a number of reasons. First, with respect to Lake Michigan, it is true that the Indiana portion of the lake comprises some 154,000 acres. All of this is theoretically available for boating and fishing. As a matter of fact, there are severe limitations to general boating because much of the area lies at considerable distances from harbors and because hazardous rough water conditions not only occur frequently, but with little advance warning. With respect to fishing, only about 23 miles of the 45 mile shoreline is generally open to the public access for shoreline fishing. The entire 154,000 acre area is not considered particularly useful general fishing waters primarily due to the difficulties with boating and, with the exception of salmonid species at certain seasons, much of these waters are not particularly productive to the fishermen. Secondly, the resource availability assessment for inland waters was made without regard to the availability of public access. The streams of Indiana, with the exception of those which are navigable under federal or state law or which lie within areas of public ownership, are on private property and available for recreational use only with the permission of the owners. Even for the public fresh water lakes and navigable streams, means of public access must be provided in order to render them useful in the satisfaction of recreational pursuits. Thirdly, the matter of the time or distance which the participant must travel to the resource must be considered in assessing the usefulness of the supply or availability of the resource. In the light of the foregoing, it is considered that there is presently a deficit of opportunity for boating, waterskiing and fishing in certain areas of the state. These are the Fort Wayne area, the western two tiers of counties from Parke County to Lake County, and an extensive portion of the central part of the state. The summary of the supply and demand for boating, skiing, and fishing is presented in Table 2.

TABLE 2

The regional supply and demand summary for boating, waterskiing and fishing.*

REGION	BOATING		SKIING		FISHING	
	1980	2000	1980	2000	1980	2000
1 - A	100+	100+	100+	100+	100+	100+
1 - B	100+	91	100+	100+	83	71
2	100+	100+	100+	100+	100+	100+
3 - A	100+	100+	100+	100+	100+	88
3 - B	4	4	1	1	12	11
4	72	63	82	81	48	45
5	96	100+	100+	100+	54	55
6	5	5	0	0	10	10
7	100+	100+	85	90	77	81
8	16	14	4	4	8	8
9	100+	100+	100+	100+	53	50
10	100+	100+	100+	100+	90	69
11	62	55	60	56	54	46
12	100+	100+	100+	100+	100+	100+
13 - A	100+	100+	80	75	64	60
13 - B	100+	100+	100+	100+	100+	100+
14	100+	100+	100+	100+	100+	100+
15	100+	100+	100+	100+	100+	100+

*The existing supply is expressed as a percentage of projected demand, therefore when the percentage exceeds 100 the supply exceeds demand. This analysis is based only upon the supply within the region and the recreational demands of the residents of that region.

The supply, with respect to natural lakes and miles of stream, is constant. The only prospect for meeting increased demands in these areas is that of providing additional public access to and rights of use on such waters. Since all natural lakes and miles of streams were included in the supply and demand analysis, it is assumed that these waters are accessible. However, many of these waters are not accessible by the general public. Therefore the deficits in supply exceed the estimates presented in Table 2.

The present outlook for the construction of significant new impoundments is almost totally negative. Therefore, absent some new initiatives and directions, the only outlook for those areas of substantial deficiencies is for increasing and perhaps undesirably high pressures on the existing supply, more extensive travel to areas of higher availability or a shift in demand to other pursuits.

Withdrawal Uses

The future demands on the water resource for withdrawal purposes are a function of future populations, economic activity and leisure time activities. In formulating its projections for the future water withdrawal uses, the Commission relied upon a number of recognized projections of future economic activity and a number of specific projections made by the Commission itself.

The Commission's assessment of present and past water withdrawals in Indiana indicates that different types of water uses have markedly different growth characteristics. In some cases, the increase in water consumption is significantly greater than the projected increase in water withdrawals.

Existing federal and state standards virtually assure that future electric generating plants will be equipped with offstream cooling facilities. This means that as new plants are constructed to meet increased demands and to replace aging generating stations, the old once-through cooling methods will be replaced by cooling towers or cooling lakes. These cooling facilities will sharply decrease water withdrawals while substantially increasing water consumption. The Commission's projections, which take into consideration the age of existing generating facilities, forecast a fifty percent decrease in the quantity of water which must be withdrawn by the year 2000 (IWR: AUN, p. 60). However, the amount of water which will be consumed will increase at least four-fold. It is impossible to predict the exact location of new generating facilities. But since the water demands of even new generating plants are still substantial, it is reasonable to assume that newer facilities will be situated along the same major water courses that support the existing facilities.

The economic projections utilized by the Commission in studies of future economic industrial activity forecast a doubling of industrial output by the end of the century. But at the same time, the Commission's studies demonstrate that substantial gains in the efficiency of the use of water within industrial plants can be expected in the same period. While efficiency gains vary from industry to industry, the overall industrial mix in Indiana is such that industrial water withdrawals by the year 2000 should be about one percent less than current withdrawals. More efficient water use, however, results in greater water consumption. Therefore, the Commission's forecast indicates that industrial water consumption will increase by about seventy-four percent.

While the overall industrial water withdrawal in Indiana is expected to be steady, it must be recognized that changes in the local industrial mix can occur at any point in time or at any location in the state. A new industry can have a significant impact on the water resource in its immediate vicinity.

The rural water systems that have proliferated in southern Indiana have capacity limitations such that they are not able to supply additional significant quantities of industrial water. Therefore, future water-intensive industrial development in the southern third of Indiana is expected to occur along the major water courses of the region to take advantage of the surface flows or more likely, the valley aquifers.

Water intake for public water supplies is expected to increase by the end of the century, although at a decreased rate of growth. By the year 2000, Indiana public water utilities may be withdrawing about thirty-seven percent more water than at present and consuming thirty-nine percent more. The rural water systems in southern Indiana cannot increase capacity on their existing lines without expanding and developing new systems.

The concentration of water supply demands in the major metropolitan areas of central and north-east Indiana may exceed local water resource availability, thus requiring additional sources of supply beyond the local area. Continued southward

expansion of the suburban areas of Lake, Porter and LaPorte Counties will outstrip the geographical availability of Lake Michigan water as a supply. By federal law, the waters of the Great Lakes may only be used within their immediate drainage basins. Southern Lake, Porter and LaPorte Counties are outside of this area (IWR: AUN, p. 21).

Agricultural irrigation is expected to be the fastest growing use of water in Indiana. Perhaps as much as 145 percent more water will be necessary for application during the growing season by the year 2000. A particularly dry season may require approximately three and one-half times the current average water use rate. This increase is expected to have a particular impact across much of the northern third of Indiana and down the middle reaches of the Wabash River.

Rural water use is expected to increase by approximately twenty-three percent for livestock and fifty percent for residential water. The demand for rural water is sporadic across the state. Except for the generally ground-water poor area of southern Indiana, additional supplies can reasonably be met by individual wells. Some of the anticipated increase in residential water use in southern Indiana will probably be met by expansion of rural water systems.

Table 3 identifies the projected water withdrawals and consumptive use of water by the major use categories by the year 2000. When these figures are compared with the current withdrawal and consumption rates, it will be noted that total withdrawals are projected to decrease by twenty-eight percent, while consumptive use is expected to increase by more than two hundred percent.

TABLE 3

The projected water withdrawal and consumption rates
by the year 2000, in million-gallons-per-day.

Water Use	Withdrawal	Consumption *
Energy Production	5050	386
Industrial Self Supply	3430	257
Public Water Supplies	758	96
Irrigation	452	452
Rural Water Supply	209	209
Total	9899	1400

* Does not include water considered as consumed due to the transfer out of the basin of origin.

EXCESS WATER CONDITIONS

Excess water conditions are caused by the presence of water above or immediately below the surface of normally dry land. Typical excess water conditions include flooding, saturated fields, and ponded water in urban areas. Basically, these are limitations to the use of land caused by the presence of water. The types of economic damage induced by excess water are property damage from floodwaters, interruptions to transportation, crop losses, reduced crop yields, hazards to life, hazards to health, scour and erosion. Conditions of excess water are further aggravated by upland erosion. Soil erosion and consequent stream sedimentation adversely affects both the aquatic habitat and the flow capacity of the stream and can carry land based pollutants into waterways. The excess water conditions of flooding and drainage are discussed separately.

Flooding

All Indiana streams react to excessive precipitation within their watersheds. Heavy precipitation and the resulting rapid diffused surface water contribution to streamflow will occasionally cause all stream levels to raise, spill out of their normal banks and occupy adjacent lands. On infrequent occasions, precipitation may be so intense that the stream spreads out and flows across an entire valley floor.

There are a wide variety of flooding conditions encountered in Indiana. In areas of high relief, the smaller streams are characterized by narrow valleys, rapid rates of rise in water levels, and high flood water velocity. Streams exhibiting these characteristics are located in south-central and south-eastern Indiana. In areas of low relief, such as south-western and northern Indiana, floodplains are generally wide and shallow, rates of stream rise are slow, and floodwater velocities are low. In addition, there are several areas in Indiana where major streams are confined to deep narrow valleys. Examples of these areas include the region north of the White River in Martin County and the Ohio River upstream from Tell City.

The widest floodplains found in Indiana are along the Wabash River below Terre Haute, along the East Fork of the White River above Bedford, the West Fork of the White River below Muncie, the Kankakee River, and the Ohio River below Tell City. Most of these floodplains are used as cropland. Urban areas with particularly notable flood problems are Indianapolis, Fort Wayne, Evansville, and the northwestern Indiana communities in the Little Calumet River valley. Overall, there are some 1,700,000 acres in Indiana considered to be subject to riverine flooding (IWR: AUN, p. 68), with average annual flood damages conservatively estimated at \$126.7 million per year. Of this amount, some \$83.5 million is classified as rural damages and \$43.2 million as urban damages.

Drainage

When excessive precipitation occurs over areas of low topographic relief, the resulting water tends to remain either above the surface of the earth in the form of temporary shallow pools or held high in the soil profile as excess moisture creating

waterlogged soil conditions. Productive soil landscapes subject to these problems are not able to sustain agriculture as it is practiced today without some form of artificial drainage. Approximately two-thirds of the soil associations in Indiana are subject to this problem.

The need for drainage was recognized early in the history of Indiana's development. In order to open vast areas of the state for agricultural use, an extensive system of ditches and drains was constructed. Some shallow lakes in northern Indiana were also drained for agricultural uses. In the fields themselves, field tile is used to carry excess water to surface ditches or to major tile drains. Over its history, Indiana has used a variety of legal mechanisms to construct and maintain these drainage systems. Currently the legal vehicle used for most of this work is the County Drainage Board. It is periodically necessary to remove silt and debris from ditches and other waterways to maintain their drainage potential.

Artificial drainage is particularly necessary in the Kankakee River Valley, in north-central and in east-central Indiana. To a lesser extent, artificial drainage is necessary across the northern tier of Indiana counties and in the flat river valleys in south-central and west-central Indiana, including the valleys of the Wabash, White, and Eel Rivers. It is also necessary in the Ohio River Valley and along its tributaries west of Tell City.

Table 4 indicates the distribution of soil associations with severe and moderate wetness characteristics where artificial drainage is needed to maintain agricultural productivity.

TABLE 4

Area distribution of soil associations with severe
and moderate wetness characteristics

Area	Percentage of Land Surface
Northern Indiana	84.0
Central Indiana	70.9
Southern Indiana	29.6

PROJECTED EXCESS WATER CONDITIONS

Excess water conditions are closely associated with topography and soil types. Therefore, it can be expected that the majority of land subject to excess water today will continue to be likewise subject in the future.

Flooding

The Commission made no projections of future flood damages. National projections indicate, however, that flood damages are expected to increase in the future. Reasons for this increase are the anticipated increase in the value of crops grown in floodplains and hence subject to flood damage. In a similar manner, as living standards rise, it is anticipated that the value of existing buildings that are located in floodplains and their contents will increase. Future floods, therefore, will cause greater losses than a comparable flood under present conditions. Little additional damage is attributed to new structural development in floodplains. This assumption is predicated on continued implementation of the state's floodplain management program and such nonstructural flood control measures as the National Flood Insurance Program. It will be noted however that some sixty-six percent of existing flood damages are classified as rural in nature and that non-structural measures will have little impact in reducing such damages.

Drainage

As with flooding, the Commission made no projections of future drainage problems in Indiana. A review of the Commission's data suggests that very little in the way of major new rural drainage projects will be constructed in the last quarter of the 20th century. The major activity in the field of agricultural drainage will be a continuing effort to maintain the existing system of drains and ditches.

Urban drainage is now and will continue to be a major problem in Indiana. One of the problems is that the urban public has increasingly higher expectations as to the capability that an urban drainage system should have. These expectations are even now substantially higher than the basis on which most of the existing systems were designed and installed.

The problem of the older systems is exacerbated not only by deterioration with age, but by the continuing addition of the drainage from newly-developed areas. The rehabilitation and enlargement of old systems is not only disruptive, but is enormously expensive. Although the practice is growing, much more extensive consideration to storm-water drainage needs to be given by planning and zoning authorities to providing new outlets and to on-site retention as a means of alleviating the overloading of old systems.



*Managing
The Water
Resource*





Withdrawal and Instream Uses

The Commission adopted the concept that Indiana has in fact a single water resource, composed of the interrelated elements of atmospheric moisture, precipitation, evapotranspiration, soil moisture, surface water, and ground water. A necessary corollary is that utilization or manipulation of some one or more of these phases has impacts on other phases of the resource.

The Commission also concluded that the water resource, on a statewide basis, is adequate to meet current and reasonably foreseeable human, social, and economic needs, *given proper planning and wise management*. The force of this qualification as to the statewide adequacy of the water resource must be emphasized. There is in fact, extensive variability in both time and space in the physical availability and the quality of water within the state. Further, there is in fact, similar variability in the type, amount and point of use and need. Finally, the location of points of need, with few exceptions, is governed by factors and events other than water resource availability. The result is that the resource must be managed in such a way as to make water available where and as needed.

The basic questions are, therefore: Is the system of planning and management (law, policy and programs) that has prevailed in the past, adequate to serve present and foreseeable human, social, and economic needs? Does that system adequately recognize the interrelated nature of the several components of the resource? Does it have the capacity to accommodate existing and foreseeable future uses and needs with equity for all interests?

The Commission addressed these questions through the following process: 1) An identification of the basic types of water resource problems; 2) A general review of the present and projected water use situation in the state, as a basis for determination of the existence of, or potential for, the types of problems identified above; 3) Identification of current and potential problems; 4) Identification of the existing system of planning and management, and review of its adequacy to address current and potential problems; and 5) A discussion of the type of management system required to adequately serve present and foreseeable human, social, and economic needs.

BASIC TYPES OF WATER RESOURCE PROBLEMS

The Commission addressed the natural characteristics and the general availability and quality of the water resource, both on a regional and a statewide basis. It also evaluated existing and projected uses of water, both withdrawal and instream. These uses are identified with respect to general type, amount and geographic location, as reported in *The Indiana Water Resource: Availability, Uses, and Needs*.

Problems Associated With the Characteristics of the Resource

The basic water resource conflicts and problems evident in Indiana are associated either with the characteristics of the resource, the use of that resource, or both. The natural characteristics that relate directly to use problems include the following:

- 1) The water resource is finite. There are both regional and statewide limits to water availability.
- 2) Both ground and surface water are in a constant state of motion or flow, although at varying rates. Therefore the impacts of withdrawal uses are not confined to the point of withdrawal, but are reflected as reduced availability at all points downstream from the point of withdrawal. All withdrawal uses, whether from ground or surface sources, have impacts in some degree on the resource and hence on other uses or users.
- 3) The ground and surface water components of the resource are highly interrelated. Streamflows and lake levels are supported in substantial measure by ground-water discharge. It then follows, and can be demonstrated, that ground-water withdrawals can have adverse effects on streamflows and lake levels. These, in turn, result in reduced availability of surface water for withdrawal uses, in impairment of instream uses, and in damage to wetlands.
- 4) Ground-water availability varies radically on a regional basis within the state, primarily as a result of differences in regional geologic settings. In large areas, especially southern Indiana, poor ground-water availability results in the necessity for impoundment of surface water or the importation of ground or surface water from other areas to satisfy withdrawal demands.

In addition, all except the largest streams in southern Indiana have a lack of substantial ground-water contribution to streamflow, and as a consequence, have poor low flow characteristics. These streams cannot, in their natural state, provide a dependable source of water for either withdrawal or instream uses.

- 5) Both ground and surface water availability is seasonally variable. Periods of drought and excess water are unpredictable in time of occurrence, areal

extent, duration, and severity. Variability is much more pronounced with respect to surface water than ground water.

Under normal conditions, the majority of total annual streamflow occurs during the first five or six months of the year. Streamflow during the remainder of the year is extremely low by comparison. In many cases these low flows can neither supply significant withdrawals with any degree of certainty nor support a desirable range and diversity of instream uses. This problem is intensified by the fact that a number of withdrawal use demands, including water supply, irrigation, and energy generation, reach their peaks during the normal low flow period. The demands placed upon low flows by withdrawal and instream uses are greatly exacerbated during droughts.

Problems Associated With the Characteristics of Withdrawal and Instream Uses

The several withdrawal and instream uses of water have inherent characteristics or requirements that must be recognized in the identification of the basic problems of resource utilization. The characteristics and requirements associated with the major withdrawal and instream uses are listed for each use category. It will be noted that some characteristics are common to many uses.

Public Water Supply 1) Requires a high degree of dependability of supply, even under very adverse conditions; 2) The cost of treatment of public water supplies is influenced substantially by the quality of the raw water supply; 3) Public water supply withdrawals are wholly or partially consumptive in nature with respect to either the resource itself or to other resource users in the following general cases: a) Where withdrawn from ground-water sources, the use is consumptive with respect to the aquifer in that no part of the withdrawn water is normally returned to that aquifer; b) Where withdrawn from surface sources, the use is totally consumptive with respect to the source if return flows are discharged to another stream; c) Totally consumptive with respect to that reach of a stream between the points of intake and discharge if return flows are discharged to the same stream; and d) Partially consumptive with respect to all points downstream of the point of return flow where discharged to the same stream; 4) Withdrawal requirements are seasonally variable, with highest demands during the summer months.

Industrial Self-Supplied Water 1) Most industrial water requires a high degree of dependability of supply, even under adverse conditions; 2) The cost of treatment of industrial water supplies, where required, is influenced substantially by the quality of the raw water supply; 3) Industrial water supply withdrawals exhibit a greater range of diversity than public water supply with respect to consumptive use; 4) In addition to the same general cases described for public water supply, some substantial withdrawals for cooling water are made from surface water and returned to the source very near the point of intake with no significant consumptive use; 5) Many, but not all, withdrawal requirements are seasonally variable, with peak demands during the summer months.

Rural Water Supply 1) Rural water supply is generally considered a totally consumptive use; and 2) Its requirements are seasonally variable with peak needs occurring during the summer months, particularly with respect to livestock.

Irrigation 1) Other than for golf courses and specialty crops, irrigation withdrawals are limited to specific geographic areas having favorable soil conditions; 2) Water quality is not a limiting factor to irrigation in Indiana; 3) The economics of supplemental agricultural irrigation, as practiced in Indiana, are not conducive to the development of central sources of supply or of supplies remote from the point of need; 4) Irrigation is considered to be a totally consumptive use; 5) Withdrawal requirements are highly seasonal, being limited to the growing season, and are highly variable from year to year, depending upon rainfall conditions.

Energy 1) Requires a high degree of dependability of supply, even under adverse conditions; 2) Once-through power plant cooling requires very large volumes of water, although the water is normally returned to the source very near the point of withdrawal. There is little consumptive loss, but the discharge is at elevated temperatures; 3) Where cooling towers or cooling ponds are required to meet thermal standards there are drastic reductions in intake requirements but significant increases in consumptive losses; 4) There is significant potential for the conversion of coal, shale and biomass to more directly useful forms of energy. The conversion requires substantial quantities of water, depending upon the process and the size of plant.

Instream Uses Instream uses are defined as those which are made of surface water in place. They include fishing, boating, swimming, urban and agricultural drainage, the disposal of liquid wastes, navigation, hydroelectric power generation, the passage of flood flows, and general aesthetic enjoyment. In addition, surface water is the natural habitat of aquatic organisms and of riparian vegetation which in turn serves as the natural habitat of a variety of birds and animals. Of these varied uses, aquatic organisms, fishing, swimming and aesthetic enjoyment are directly and immediately related to water quality. Commercial navigation, recreational boating, and hydroelectric power are dependent upon adequate and dependable flows, depths, and surface areas. The waste assimilative capacity of streams is a direct function of the rate of streamflow. Urban and agricultural drainage is a function not only of the capacity of the stream, but of its depth in relationship to the elevation of the lands to be drained. Finally, it is important to note that many instream use demands reach their peak during the natural low flow period for streams.

General Categories of Problems

Simple logic indicates that water resource *problems* are not caused by the resource itself, but by man and the uses that he makes of the resource. Water conflicts or problems are caused by the numerous, sometimes conflicting or incompatible uses that man applies to the resource. These various uses often result in competition for the same water resource. However this competition may be further aggravated by the natural and inherent characteristics of that resource.

The general categories of problems that arise from competition for water are outlined as follows:

- 1) Competition for surface water
 - a) As between multiple withdrawals from the same surface source, whether for the same or different purposes.
 - b) As between withdrawal uses and instream uses.
 - c) As between different kinds of instream uses.
- 2) Competition for ground water
 - a) As between multiple withdrawals from the same aquifer, whether for the same or different purposes.
 - b) As between withdrawal uses and instream uses, by reason of reductions in the ground-water contribution to streamflow.
 - c) As between ground-water withdrawals and surface water withdrawals, by reason of reductions in the ground-water contribution to streamflow.

REVIEW OF THE PRESENT AND PROJECTED WATER USE SITUATION

For the purposes of this review, the state has been divided into the three general areas of northern, central, and southern Indiana, as shown in Figure 1. Northern Indiana consists of Planning and Development Regions 1A, 1B, 2, 3A, and 3B and contains 20 counties. Central Indiana consists of Planning and Development Regions 4, 5, 6, 7, 8, and 9, and contains 40 counties. Southern Indiana consists of Planning and Development Regions 10, 11, 12, 13A, 13B, 14, and 15, and contains 32 counties. Each of these three areas is examined qualitatively with respect to existing or potential problems involving public water supply, industrial water supply, rural water supply, irrigation and energy. Current and projected use data is summarized from the more detailed information contained in *The Indiana Water Resource: Availability, Uses, and Needs*.

Northern Indiana

Public Water Supply The major public water supply uses are found in the Calumet region and in and around the cities of Michigan City, South Bend, Mishawaka, Elkhart, and Fort Wayne. The Calumet region and Michigan City are supplied from Lake Michigan. The South Bend-Mishawaka-Elkhart area is served entirely from ground water. South Bend is the largest city in the state that relies exclusively upon ground water for its supply. Fort Wayne is supplied exclusively from the St. Joseph River. New Haven is supplied by Fort Wayne. Bluffton, Huntington and Warsaw are supplied in part from ground water and in part from surface water, with ground water being the major source in each

instance. All other public water supplies in northern Indiana are obtained entirely from ground water. Total public water supply withdrawals are projected to increase from 186 million gallons-per-day (mgd) in 1977 to 244 mgd by the year 2000, with consumptive uses increasing from 21.7 mgd to 28.4 mgd.

Self-Supplied Industrial Water The major industrial water supply requirements are centered around the same three areas as those for public water supply. The Calumet area in Lake and Porter Counties, which represents by far the highest industrial water use area in the state, is supplied from Lake Michigan. In the South Bend-Mishawaka-Elkhart area, most industrial requirements are supplied from ground water, although a few industries use significant amounts from the St. Joseph River. In the Fort Wayne area, most self-supplied use is from ground water. In general, all other industrial water supplies are obtained from ground water.

Self-supplied industrial water withdrawals in northern Indiana are projected to decrease slightly from 3,188 mgd (of which 3,093 mgd is from Lake Michigan) in 1977 to 3,121 mgd by the year 2000. Consumptive use is projected to increase from 103 mgd to 171 mgd. Most of this will be in the Calumet area adjacent to Lake Michigan.

Rural Water Supply Rural water supplies throughout northern Indiana are obtained from ground water by means of individual wells. Such uses are projected to increase from about 43 mgd in 1977 to 71 mgd by the year 2000, and are considered to be totally consumptive.

Irrigation Northern Indiana possesses the majority of the soils in the state with an economic potential for agricultural irrigation. These soils are located in the basins of the Kankakee, Yellow, St. Joseph, Elkhart, Pigeon, and upper Tippecanoe Rivers. The total area possessing high irrigation potential is approximately 513,000 acres.

Approximately 50,840 acres were irrigated in 1977, with a projected increase to 100,000 acres by the year 2000. Average year irrigation withdrawals are expected to increase from some 134 mgd in 1977 to 263 mgd by the year 2000. Approximately 52.5 percent of the 1977 irrigation withdrawals was from ground water. Ground water may supply 66 percent of irrigation water by the year 2000. In addition to the agricultural irrigation, withdrawals for golf course irrigation is projected to increase from about 10 mgd in 1977 to 12.9 mgd by 2000. All irrigation uses are considered to be totally consumptive.

Energy One internal combustion, two hydroelectric, and six fossil-fueled generating plants are located in northern Indiana. Only the fossil-fueled plants have water withdrawal requirements. Of these, four are located on Lake Michigan, with one each on the Kankakee and St. Joseph Rivers. Some of the electrical energy requirements of the area are met by imports from other areas. Withdrawal uses are expected to increase from 588 mgd to 603 mgd by the year 2000, with increases in consumptive use from 21.8 mgd to 28.4 mgd.

Instream Uses Much of the area currently has an adequate supply of water for boating, skiing and fishing (assuming general access to lakes and streams) with the

notable exception of the Fort Wayne area, where opportunity for such activities is almost totally lacking. In addition, the assimilative capacity of the Maumee River is impacted in some degree by water supply withdrawals.

Overview In general, northern Indiana possesses very substantial water resources. With the exception of the southeastern, southwestern, and northwestern corners of the area, ground-water availability ranks as the best in the state. Streamflows generally are reflective of the high ground-water availability, having well sustained low flow characteristics. The area contains the great majority of the natural lakes in the state, as well as the significant wetlands. Lake Michigan affords an ample source of supply for all purposes within the drainage basin of the lake. Most of the future needs for public, industrial, and rural water supply (other than those in the drainage basin of Lake Michigan) will probably be met from ground water.

The area is an importer of electric energy. It appears that because of land use and environmental considerations, additional generating facilities on Lake Michigan may be limited to replacement or modernization of facilities on existing sites, other than the Bailly Nuclear unit now under construction. Elsewhere in the area, there is some potential (at least with respect to water availability) for new sites on the Kankakee and St. Joseph Rivers, although supplemental storage would undoubtedly be necessary.

Agricultural irrigation presents the most rapidly growing demand for water. Not only is irrigation a totally consumptive use, but it occurs during periods when streamflows are in seasonal decline, and at a time when ground-water recharge is normally limited. Irrigation withdrawals place a relatively high demand on the resource per unit area within the irrigated area. Some 513,000 acres, or 801 square miles, of soils have economic potential for agricultural irrigation. Full development of this potential would require on the order of 1,400 mgd during the average growing season.

Ground water is the most probable source of supply for about two-thirds of the projected irrigation. Although the northern area is generally characterized by the best ground-water resources in the state, there is a realistic potential for competition and conflicts between individual irrigators, between the impacts of irrigation withdrawals and those for public, industrial and rural water supply, and between ground-water withdrawals and instream uses.

The potential for conflicts between individual irrigators from ground-water sources exists in northern Indiana. Group enterprise or central source irrigation is not anticipated. As a result, wells will be located to fit individual ownership patterns without adequate regard to well spacings that would prevent or minimize well interference.

The potential for competition or conflicts between public, industrial self-supplied, rural supplies, and irrigation exists because of the potential general lowering of ground-water levels in the heavy ground-water use areas. Such effects will probably be reflected first on the numerous private wells for rural water supply, because these are normally no deeper than necessary to obtain water under existing ground-water level regimes.

The potential for conflicts between ground-water pumpage and instream uses is significant. The levels of the numerous natural lakes in the region are sustained in substantial measure by ground-water discharge, and even small deficiencies in normal levels are a matter of great concern to lake users. In like manner, the generally good low-flow characteristics of the streams of the region, which renders them especially valuable for instream uses, is the result of substantial ground-water contribution to streamflow. The rather extensive wetlands in the region are also heavily dependent upon ground-water levels and ground-water discharge to streamflow. Significant decreases in regional ground-water levels as a result of ground-water pumpage, whether from irrigation or public and industrial uses, would be reflected in decreased streamflows, lowered lake levels and impairment of wetlands.

It should be noted that agricultural irrigation withdrawals from surface water coincide with the normal period of declining streamflows. Depending upon the concentration of withdrawals upon a given stream or stream segment, there could be substantial conflict with other withdrawal uses, with instream uses and, depending upon circumstances, with lake levels and wetlands.

Central Indiana

Public Water Supply The major public water supply uses are found in and around Indianapolis, Lafayette, West Lafayette, Kokomo, Richmond, Anderson, Muncie, Marion, and Terre Haute. The range of supply sources is indicative of the somewhat "mixed bag" of relative availability of surface and ground water. Lafayette, West Lafayette, Anderson, and Marion are supplied entirely from ground water. The Indianapolis service area is supplied almost entirely from surface water. Richmond utilizes substantial supplies from both surface and ground-water sources, with surface water being slightly predominant. Terre Haute uses both ground and surface sources, with ground water providing the major share. Speedway uses both ground and surface sources. Oldenburg and Batesville are supplied entirely from surface water, while all others in the region use ground water exclusively.

As would be expected, due to the pattern of reduced ground-water availability from north to south, rural water systems occur in these ground-water poor areas of the southern portion of central Indiana.

Self-Supplied Industrial Water The majority of self-supplied industrial water requirements are centered around the same major areas as those for public water supplies. Most of the supply is from ground water. About 43 percent of the total 1977 withdrawals of 215 mgd occurred in the Indianapolis area. Total withdrawals are expected to increase to about 244 mgd by the year 2000. Consumptive uses are estimated to increase from 35 mgd to 67 mgd.

Rural Water Supply Rural water supplies are generally obtained from individual wells, although ponds and cisterns are important for watering livestock in some areas. Rural water supply use is projected to increase from 63 mgd in 1977 to 95 mgd by the year 2000. Rural water supply withdrawals are considered to be totally consumptive.

Irrigation Central Indiana ranks a distant second among the three general areas in the amount of agricultural lands possessing economic potential for irrigation. The areas with irrigation potential generally lie in long, relatively narrow strips paralleling the major water courses, and total about 261,000 acres.

Approximately 5,900 acres were irrigated in 1977, with a projected increase to 41,000 acres by 2000. Irrigation withdrawals are projected to increase by 16 mgd to about 111 mgd. Approximately 57 percent of the 1977 irrigation withdrawals were from ground water. It is estimated that ground water will supply about 58 percent by the year 2000. In addition to the agricultural irrigation usage, withdrawals for irrigation of golf courses is expected to increase from about 13 mgd in 1977 to 18 mgd by 2000.

Energy There are a total of fourteen electric generating plants in central Indiana, including one in an advanced construction stage. Two are hydroelectric, located on Tippecanoe River, and the remainder are fossil-fueled. Of these, four are municipally owned (Crawfordsville, Logansport, Peru and Richmond). Four large plants located along the Wabash River and four along the West Fork of the White River utilize those streams for cooling water. The fourteen plants have a combined nameplate rating of 5,234 megawatts. Combined withdrawals during 1977 were approximately 2,788 mgd, with an estimated consumptive use of 8 mgd. Withdrawals are projected to decrease to 1,862 mgd, accompanied by an increase in consumptive use to 28 mgd.

Instream Uses Very substantial deficits in supply for boating, waterskiing and fishing currently exist in most of central Indiana. It is expected that these shortages will intensify and extend to all parts of central Indiana by the year 2000.

Overview The ground-water resource in central Indiana is in the transition zone from the generally excellent resource in northern Indiana to the generally poor conditions in southern Indiana. In the central, north-central and easterly portions of the area, ground-water availability is generally in the range of 200 to 400 gpm. Elsewhere, availability decreases very significantly and is in the general range of 50 to 100 gpm, with some extensive areas in the southeast and southwest limited to potential yields on the order of 10 gpm. The potential high yield areas are limited to the alluvial valleys of the Wabash, East and West Forks of the White, and Whitewater Rivers.

Only the Wabash River is an interregional stream. Central Indiana is the headwater area for the East and West Forks of the White River and the East and West Forks of the Whitewater. The Salamonie and Mississinewa Rivers, Sugar Creek, Eel River, and lower Tippecanoe River are the other major streams in the region.

Central Indiana has very few natural lakes, but does have a number of artificial reservoirs, of which the most significant are Lakes Shafer and Freeman, and the Salamonie, Mississinewa, Mansfield, Brookville, Morse, Geist and Eagle Creek Reservoirs.

When considered in light of water resource availability and of the rather concentrated areas of the major demands, it becomes apparent that projected

water requirements will require careful planning. Planning is necessary to determine the source of supply to be utilized in the particular case and to give adequate consideration to impacts on other uses, both withdrawal and instream. In much of the area, even relatively modest ground-water developments can have impacts on ground-water levels over considerable distances. Many communities will find it necessary to go further afield to find new sources of supply. Instream needs, especially for recreation and waste assimilation capacity, are substantial on a number of streams, especially Wildcat Creek and the West Fork of the White River. Particular attention needs to be given to the maintenance of the low flow regimes of significant streams, and to the improvement of low flows in those streams where substantial impacts already exist.

It is noted that, although agricultural irrigation was rather modest in 1977, the projected acreage by the year 2000 is significant. Since the irrigable areas generally lie along stream valleys, irrigation water withdrawals pose the potential for conflicts with instream uses, whether withdrawn from streams or from aquifers located in stream valleys.

There is potential, insofar as water availability is concerned, for new electrical generating plants along the West Fork of the White and Wabash Rivers. Such construction would however, necessitate supplemental storage for use during periods of low flow.

Southern Indiana

Public Water Supply Fifty-five percent of the total public water supply withdrawals in southern Indiana in 1977 were accounted for by Bloomington, Columbus, Bedford, Vincennes, Evansville, Clarksville, and New Albany. Evansville accounted for 50 percent of the combined usage of these seven cities, and about 27.5 percent of the total regional withdrawals for 1977. Of these major cities, Evansville, Bloomington, Bedford, and New Albany are supplied from surface water, while Clarksville, Columbus, and Vincennes utilize ground water.

Southern Indiana has by far the largest number of surface water supply sources of the three statewide areas; a reflection of extensive areas of poor ground-water availability. Southern Indiana is also characterized by very extensive rural water supply systems for the same reason. Only Decatur, Orange, and Posey Counties have limited rural systems. The public water supply withdrawals are projected to increase from 108.8 mgd in 1977 to 160.5 mgd by 2000, with consumptive uses increasing from 19.8 mgd to 30.0 mgd.

Self-Supplied Industrial Water Southern Indiana is not characterized by large water-using industries. The 1977 withdrawals of 52.9 mgd and projections to 65 mgd by the year 2000, are modest in comparison to those in northern and central Indiana. Consumptive uses are expected to increase from 8.8 mgd to 18.1 mgd. Ground water is the principal source of supply for self-supplied industrial water in southern Indiana.

Rural Water Supply Rural water supply withdrawals of 5.6 mgd in 1977 are projected to increase to 44.4 mgd by the year 2000. This is considerably less than

that for northern and central Indiana, although one important factor is the significant rural usage supplied by rural water companies, which is accounted for under public water supply. Sources of supply vary widely, from individual wells where possible, to farm ponds, strip mine lakes, cisterns, and supplies transported by truck.

Irrigation Approximately 7,860 acres were irrigated in 1977, with withdrawals of 20.6 mgd, of which almost all was from surface water. The irrigated acreage is expected to increase to about 16,100 acres by the year 2000, with projected withdrawals of 42.6 mgd. About 80 percent of this usage may be supplied from ground water. The major expansion in irrigation is expected in Green, Knox, Daviess, Bartholomew, and Jackson Counties, along the valleys of the Wabash and the East and West Forks of the White River. There are about 45,300 acres in southern Indiana that have some potential for irrigation. In addition to agricultural irrigation requirements, 1977 withdrawals for golf courses was 3.5 mgd and is expected to increase to 4.6 mgd by the year 2000. All irrigation uses are considered to be totally consumptive.

Energy As might be anticipated because of the availability of water in the Ohio, White and Wabash Rivers, southern Indiana contains a number of large electrical generating plants. There is one hydroelectric and six fossil-fueled plants along the Ohio River in Indiana, with one nuclear and two fossil-fueled plants under construction and one fossil-fueled plant in advanced planning along the same stream. Of the remaining plants, one is on the Wabash River, two are on the White River, one is on the West Fork of the White River, and one is on the Patoka River.

Gross nameplate capacity in 1977 was 6,890 megawatts. It is significant that announced expansion at existing and new sites totals about 10,680 megawatts. These will occur on the White, Wabash, and Ohio Rivers. 1977 withdrawals of 4,800 mgd with a consumptive use of 21 mgd are projected to change to 2,245 mgd and 170 mgd, respectively, by the year 2000.

Instream Uses The supply for boating, waterskiing, and fishing is adequate to meet current demands in all areas of southern Indiana except the general northeastern section. By the year 2000, substantial deficits will extend to the northwestern quarter as well.

Overview Significant ground-water availability is limited to the alluvial valleys of the Ohio, Wabash, White, East Fork of the White, West Fork of the White and Eel Rivers. These same streams, plus the Patoka, Muscatatuck, Driftwood, Flatrock, and Blue Rivers, are the major streams in southern Indiana. The major reservoirs are Cagles Mill, Monroe and Patoka. Both Monroe and Patoka Reservoirs have large water supply storages owned by the state. Each is already supplying substantial amounts of water, either directly to cities in the case of Monroe or to a large regional water district in the case of Patoka. Very substantial reserve capacity is available in both projects.

The major water supply problems of southern Indiana relate to those municipalities and rural areas which are at some distance from the major river valleys and the economic zone of influence of the Monroe, Patoka and Brookville Reservoirs. The rural water systems are generally at or approaching the limits of

reasonable distance from their source of supply and lack the distribution capacity to serve substantial uses. Numerous small communities are struggling with supply developments that are only marginally adequate for present needs and have little or no capacity to serve population growth or economic development. The development of regional sources of supply would appear to be both necessary and desirable in several areas.

It appears that there are substantial rural areas where supplies are extremely limited, but which, due to costs and sparsity of the population, may not be served by rural water companies. The projected growth in irrigation has the potential for conflicts between individual irrigators, other stream withdrawal uses, and instream uses.

General Conclusions

In summary, the current withdrawal and instream uses, and the availability of the water resource, have led to past and present water resource management practices, namely:

- 1) Indiana water users have utilized the most readily available sources of supply. Where available in sufficient supply, ground water is the preferred source because of lower costs of development and treatment.
- 2) Creativity has been employed in a number of cases in the development of supplies. Examples include off-channel storage reservoirs, regional sources of supply, and rural distribution systems.
- 3) Development of supply sources has, in the general case, occurred without consideration to the effects of such development on other users or uses, including instream uses in particular. There are a number of cases where instream uses, including fish and wildlife, recreational uses, and waste assimilative capacity, have been adversely affected.
- 4) The location of a number of the points of need for water is not coincident with local water availability. Hence there already exists the practice of the importation of water from both ground and surface sources which are distant from the point of use.
- 5) Agricultural irrigation, from both ground and surface sources of supply, is a rapidly growing practice in some areas of the state.
- 6) The consumptive use of water, resulting primarily from water recycling efforts by industry, from the thermal limitations on power plant cooling water, and from irrigation, is increasing at substantial rates.
- 7) There are now substantial regional deficits for water-related recreation.

In looking to the future, the following patterns emerge:

- 1) Withdrawal uses of all types, except for electrical energy and self-supplied industrial water, will increase substantially.

- 2) The consumptive use of water is expected to increase by about 22 percent to some 1,400 mgd by the year 2000.
- 3) There will be an intensification of demand for such instream uses as boating, waterskiing, and fish and wildlife, and a much heavier usage of the existing supply. No major new supplies of surface water for boating and waterskiing are expected.
- 4) Withdrawal uses, whether from ground or surface sources, can adversely affect instream uses, both with respect to recreational uses and the waste assimilative capacity of streams. Impairment of waste assimilative capacity can have severe water quality impacts and may impose requirements for additional treatment.
- 5) There will be increasing competition between withdrawal users, both from ground and surface sources.
- 6) The continuing and expanded need for developing supply sources at points distant from the point of use will develop substantial conflicts between those seeking such supplies and actual or potential users in the region of proposed development.
- 7) The as yet unknown, but clearly prospective, development of energy-conversion facilities will present situations which have clear potential for problems in the development of needed water supplies in harmony with other uses and needs.
- 8) The largely untapped flood runoff of Indiana streams has significant potential for development in connection with many supply problems, including instream uses.

CURRENT AND POTENTIAL PROBLEMS

It is concluded that each of the general problem categories previously identified already exists in Indiana in varying degrees. However, with a few exceptions, none of them are presently at an acute stage. When the water use projections are analyzed, a scenario emerges whereby competition for the water resource intensifies and conflicts between water uses and users become inevitable.

This is not to say that either the same types or degrees of conflicts will necessarily occur on a statewide basis. It is safe to say that no part of the state is entirely free of either present or future conflict situations of some type.

In summary, the major focus of the water resource situation is centered around the issue of water rights and management, not that of adapting to a very scarce resource. *The central problem is:*

managing a resource that must serve a diversity of uses and needs that are not usually mutually compatible in such a way as to minimize conflicts, to promote equity as between various uses and users, to provide a reasonable degree of certainty as to rights to use, to promote efficiency in utilization, and to enable water to be supplied to the areas of need while ensuring reasonable protection for areas of origin.

Managing the water resource must be done with full recognition of the variability of the resource in time and space, of the variability in the relative occurrence of ground and surface water, and of the interrelated nature of ground and surface water.

THE EXISTING WATER RESOURCE MANAGEMENT SYSTEM

The major elements of the existing management system (law, policy and programs) have been assembled in a condensed form and are contained in the appendix to this report. The Commission has examined this existing program in the light of its analysis of the present and projected water use situation, and of its conclusions with respect to the basic problem, that of water rights and management. The following general conclusions are drawn from a review of the existing water program outlined in the appendix and treated in expanded fashion in *The Indiana Water Resource: Availability, Uses, and Needs* (pages 91-124 and 493-502).

- 1) The General Assembly over the years has addressed many aspects of the water resource through a substantial number of legislative enactments. Interestingly, although probably not from any conscious recognition of the hydrologic cycle and its interrelated components, it has addressed all of those elements in some measure.
- 2) The vast bulk of the existing program is concentrated in two major areas, enabling acts and regulatory acts. *Enabling acts* are designed to provide the authority and institutions at state and local levels to provide for public water supply, drainage, water quality, recreation, fish and wildlife, and flood control. *Regulatory acts* are designed to protect and promote the public health and safety, primarily in the area of water quality, public water supply and floodplain management.
- 3) Two major program elements, rights to use and management of use, have been addressed by the General Assembly in a very limited degree. The only significant legislation relating to these elements is found in I.C. 13-2-1 and I.C. 13-2-2, dealing with surface water and ground water, respectively. It then remains that, subject to the limited impacts of these two statutes, the matter of water rights rests with the common law of the state. That law essentially vests water rights in the riparian owner in the case of surface water and in the overlying land owner in the case of ground water.
- 4) In summary, the existing water program consists of a substantial body of enabling legislation for implementing many water resource objectives, together with a similar body of law and programs designed to protect the public health, safety and welfare.

The existing program does not provide in any substantial degree for the mitigation or resolution of conflicts over the actual taking of water from its source, over impacts of such takings on other uses and interests, or over competing or conflicting uses, save only to the courts.

CONCLUSIONS

The Commission therefore concludes that:

- 1) The primary issue is management of the water resource to achieve the following objectives:
 - a) minimize conflicts between a diversity of uses and needs;
 - b) promote equity between various uses and users;
 - c) preserve and protect the public interest;
 - d) provide a reasonable degree of certainty as to rights of use;
 - e) ensure reasonable provision for present and future uses in the watershed of origin, before water is transferred out of the basin for other uses;
 - f) promote economic and efficient utilization; and,
 - g) provide a procedure whereby questions of use may be resolved on a timely basis, while giving adequate recognition to all interests involved and the characteristics of the resource itself.
- 2) The existing law of water rights in Indiana is inadequate to provide that legal basis and management framework within which human, social and economic water needs may be satisfied in a timely and equitable manner. This conclusion is based upon the finding that:
 - a) The existing common law is directly concerned only with withdrawal uses by riparian owners in the case of surface water and by overlying land owners in the case of ground water;
 - b) It provides no basis in law for uses on non-riparian and non-overlying lands, which in many cases is the major use and need and is a widely prevalent practice throughout the state;
 - c) It provides no certainty of rights to use, regardless of the type of use or the investments made to take and utilize the water;
 - d) It provides no recognition for legitimate and necessary instream uses and needs;
 - e) It provides no basis for recognition of the interrelated nature of the various components of the water resource and of the relative impacts of uses of the various components;
 - f) The only recourse for conflict resolution is to the courts, where the constraints of the present law and the narrow issues of a particular case preclude consideration of the full range of relevant factors.

- 3) There is need for legislation to create a water rights and use management statute for Indiana.
- 4) The General Assembly has established certain public policy that provides a substantial basis for the development of a water rights and use management statute, to wit:

I.C. 13-2-1. "Water in any natural stream, natural lake or other natural body of water in the State of Indiana which may be applied to any useful and beneficial purpose is hereby declared to be a natural resource and public water of the State of Indiana and subject to control and/or regulation for the public welfare as hereinafter determined by the General Assembly of the State of Indiana."

I.C. 13-2-2. "It is hereby declared a public policy of this state in the interest of the economy, health, and welfare of the state and its citizens, to conserve and protect the ground-water resources of the state, and for that purpose to provide reasonable regulations for its most beneficial use and disposition."

ALTERNATE MANAGEMENT STRATEGIES

The Commission has considered possible alternatives to its conclusion as to the need for a water rights and use management statute. The management alternatives included: 1) maintaining the status quo; 2) legislative clarification of vague terms in the existing common law; 3) providing the courts with *amicus curiae* technical advisors from qualified state agencies, while retaining the existing law; and 4) providing administrative mediation of water rights disputes and conflicts by a qualified state agency, with opportunity for final recourse to the courts, while retaining the existing law.

While some one, or a combination, of these possible causes of action might be helpful to a degree, none of them offers any substantial assistance to the solution of the basic problem. These management strategies are rejected because the fundamental problem has its basis in the law itself. No modification of strategy based upon these laws would be adequate. Current Indiana water law was developed primarily during or before the eighteenth century in an era that bears little or no resemblance to modern uses and needs for the water resource. Furthermore, the current body of law is inadequate in its concepts and doctrines to serve the needs of the future.

RECOMMENDATIONS

- 1) The Commission recommends the creation of a water rights and use management statute that incorporates the following major principles and elements:
 - a) A determination and declaration that, based upon sound and accepted principles of natural laws and hydrology, the water resource of Indiana is in fact, and shall henceforth be regarded as, a single resource composed of the major interrelated elements of atmospheric moisture, precipitation, soil moisture, evapotranspiration, diffused surface water, water in lakes and water courses (surface water), and ground water; and that the said resource is both renewable and finite.
 - b) Recognition that the water resource of the state must serve a multiplicity of human, social and economic uses and needs; that specific uses and needs may, from time to time, either wax or wane; and that new uses and needs may vary both as to human, social and economic utility and their compatibility with one another.
 - c) Recognition that while short-term water resource availability is highly variable in both time and space as a result of natural factors, the overall long-term resource is adequate to meet the general spectrum of perceived human, social and economic uses and needs, *given proper planning and management*.
 - d) Assertion that the economy and the general health, safety, and welfare of the people of Indiana require that the water resource of the state be utilized for beneficial purposes; that waste, non-beneficial use and degradation of the resource be prevented; and that the resource be utilized so as to provide the best possible accommodation and balance as among beneficial uses and needs, including multi-purpose use where feasible.
 - e) An express declaration that the public policy of the State of Indiana is to manage, regulate, and control the water resource because: a) water is a natural and public resource; b) water plays an essential and pervasive role in the human, social and economic well-being of the people of Indiana; and c) it is of vital importance to the general health, safety and welfare of the people of Indiana.
 - f) An assertion that the State of Indiana does not forfeit any responsibility for water rights and the management and regulation of the water resource within the boundaries of the state.
 - g) Establish a state system of water use permits with the following major features:
 - 1- Full recognition of the rights of riparian owners and of the owners of overlying lands for domestic household uses and of the rights of capture and use of diffused surface water by land owners without a permit.

- 2- Riparian owners and owners of overlying lands may, but shall not be required to, obtain a permit for non-domestic use on riparian or overlying land not to exceed 100,000 gallons-per-day.
- 3- Any withdrawal, diversion, impoundment, or consumptive use of water of more than 100,000 gallons-per-day must have a prior water use permit from the state.
- 4- The proposed use of water must be such as is necessary for economic and efficient utilization, not interfere with any existing legal use of water, and be consistent with the public interest.
- 5- Define essential terms, including "watershed", "watercourse", "domestic use", "riparian lands", "overlying lands", and "beneficial use".
- 6- That the state may permit the holder of a water use permit to take, transport, and use surface water beyond riparian land and beyond the watershed from which it is taken; and to take, transport and use ground water beyond overlying land and beyond the watershed in which the aquifer is located.
- 7- That the issuance of a water use permit will be based upon full consideration of the overall public interest, including protection for the basin of origin and for instream flows and uses.
- 8- That a water use permit and rights thereby granted may be assigned or transferred and may not be revoked or suspended for any reason other than termination of use or non-compliance with reasonable conditions imposed at the time of issuance.
- 9- That all existing withdrawals, diversions, impoundments or consumptive uses of more than 100,000 gallons-per-day may be continued with a water use permit for which application must be made within, say, three years. Such permits will be granted provided that the use is reasonable and beneficial. Failure to so apply will create a rebuttable presumption of abandonment.
- 10- That non-domestic ground-water users whose withdrawals create substantial adverse effects upon the domestic household wells of others shall, as a condition precedent to a water use permit, either restore such wells to their former relative capability, provide a reasonable alternative source of supply, or pay proper damages.
- 11- Provide by law for the protection of a reasonable level of low streamflow in the interest of instream uses; for consideration of such protection as one element of the public interest in consideration of water use permits; and for recognition of the policy that the impoundment of water for the purpose of low flow augmentation for instream uses is a legitimate public purpose.

- h) Provide a clear definition of public rights for such instream uses as boating and fishing, based upon consideration of the navigation servitude and/or the public water concept, and of the rights of riparian owners.
- 2) It is the view of the Commission that the development of a water rights and management statute should be accomplished under the guidance and direction of a representative group conversant with the water resource and the uses and needs of the people of Indiana. The Commission has developed a broad base of such knowledge and insight during the past three years. It is therefore recommended that the Commission be continued and assigned the task of developing a statute on water rights and management for consideration by the General Assembly.
- 3) The necessary resources should be provided to the Department of Natural Resources for the development of a comprehensive plan for the development and utilization of the water resource of the state to serve the goal of meeting the needs of the people of Indiana in timely fashion by both public and private efforts.
- 4) Accepted technical procedures should be developed by the Department of Natural Resources for consistent assessment of the yield capability of the several sources of public water supply as an aid to water utilities in the planning and development of additional supplies in timely fashion.
- 5) The Department of Natural Resources should be provided with the necessary resources to conduct and report upon continuing periodic inventories of water use in the state as an aid in assessing the further demands upon the water resource, and in determining any further public policy actions with respect thereto.



Flooding

All streams in Indiana react to excessive precipitation within their watershed. Heavy precipitation and the resulting rapid diffused surface water contribution to streamflow will occasionally cause all stream levels to rise, spill out of their banks, and occupy adjacent lands. On frequent occasions, runoff may be so intense that the stream spreads out and flows across an entire valley floor.

There are a wide variety of flooding conditions encountered in Indiana. In areas of high relief, the smaller streams are characterized by narrow valleys, rapid rates of rise, and high floodwater velocity. Streams exhibiting these characteristics are found in south-central Indiana. In areas of low relief, floodplains are generally wide and shallow, rates of stream rise are slow, and floodwater velocities are low. There are several areas in Indiana where major streams are confined to deep narrow valleys. Examples of these areas include the region north of the White River in Martin County and the Ohio River upstream from Tell City.

The most extensive floodplains are located along the Wabash River below Terre Haute, along the East Fork of the White River above Bedford, the West Fork of the White River below Muncie, the Kankakee River, and the Ohio River below Tell City. Most of these floodplains are used as cropland.

The damages resulting from flooding are segregated into urban and rural categories. Rural damages consist of loss of crops, erosion or deposition of soils, and damage to fences, livestock, agricultural buildings, equipment and roads. Average annual-rural flood damages, in 1978 dollars, are estimated at \$83.5 million (IWR: AUN, p. 68). Urban damages include losses in commercial, industrial, and residential areas. Average annual urban damages, in 1978 dollars, are estimated at \$43.2 million (IWR: AUN, p. 68). There are some 238 cities and towns in Indiana that are exposed to some degree of flooding. The most serious urban flooding potential occurs along the Little Calumet River in northwestern Indiana and in the cities of Indianapolis and Fort Wayne. A number of other cities, such as Anderson, Kokomo, Noblesville, Shelbyville, Columbus, Evansville, Rushville, Plymouth, and Marion also contain significant risk areas.

Flooding problems are aggravated by sediment carried into streams from soil erosion. The resulting deposits may significantly reduce stream capacity to discharge floodwaters, cause urban flood losses and reduce the fertility of the floodplain. While soil erosion is a natural and continuing process, it can be greatly accelerated by poor land use practices. There are certain soils, associated with areas of moderate to high relief, that are subject to particularly severe erosion if not properly managed. In Indiana, these soils are generally found on the rolling to hilly lands south of a line extending from Warren County to Bartholomew County to Union County.

FLOODPLAIN MANAGEMENT

Floodplain management in Indiana is composed of a variety of structural and non-structural methods to minimize the damage caused by flooding. Both the state and federal governments participate in floodplain management in Indiana, as the following discussion indicates.

Structural Methods

Structural methods involve the construction of some type of facility designed to exclude flood waters from lands that are of economic concern. These methods include the construction of small dams or detention structures, the construction of large dams for flood water storage, the construction of levees or flood walls, and the construction of channel modifications intended to reduce flood heights. With rare exceptions, these projects do not provide for complete and total protection against all possible levels of flooding but instead are designed to strike a balance between project costs and level of damage prevented. Another structural approach is to relocate the property subject to flooding. Both the federal and state governments have supported structural methods as a way to alleviate flooding.

The Federal Program The Federal government has spent in excess of \$260 million for structural flood control facilities in Indiana. The largest single source funds has been the flood control programs of the U.S. Army Corps of Engineers. Although there are a large number of Corps programs available, they are generally divided into two broad categories, the so-called "local protection" projects and the "national interest" projects. A local protection project is designed to benefit one specific locality, such as a levee around the city. The Corps of Engineers requires some financial contribution by the area to be benefitted. The benefits of a national interest project exceeds any one local geographic area. The federal government bears all costs of national interest flood projects. Examples include the large reservoirs in Indiana that have control benefits not only on Indiana streams but also on the Ohio River.

During the 1950's, the U.S. Department of Agriculture commenced a flood control program under Public Law 566. Among other objectives, this program was to provide flood control benefits for small agricultural watersheds. A typical project might consist of a series of small dams, channel modifications and levees.

Many flood control projects are actually multiple purpose projects. The Monroe Reservoir, for example, provides not only a high degree of flood protection on the East Fork of the White River, but also provides a regional water supply and a significant recreational facility attracting more than one million visitors annually.

The public usually expects flood control projects to solve the regional flood control problem. However, this is not usually the case. Most of these projects are designed to decrease both the severity and the frequency of flooding, not to eliminate it. Only urban levees and flood walls are designed to provide a high degree of total protection from floods. The federal projects constructed in Indiana are well maintained and have generally performed as expected.

The State Program The Indiana General Assembly enacted a number of statutes related to structural flood control methods. These statutes authorize state agencies, local governments and a series of special districts, to construct flood control works. Some of the special districts are simply intended to overlay existing political units of government. Other districts, such as the Conservancy District, can constitute special multi-county taxing units for flood control purposes.

The 1945 session of the Indiana General Assembly enacted a statute known as the Indiana Flood Control Act (I.C. 13-2-22). This act has two purposes, the first of which is to promote structural solutions to flooding problems in the state. The second purpose is to provide a mechanism for the control of encroachments (construction in floodways which would aggravate flooding problems by impeding the passage of flood water). This act has since been broadened to include consideration of non-structural methods.

The Flood Control Revolving Fund was created in 1959 (I.C. 13-2-23) for the purpose of providing low interest loans to cities, towns, counties and special taxing districts for the implementation of flood control projects. The amount of any outstanding loan to any one municipality is limited to \$100,000. By virtue of the amount of the fund (\$2 million) and the maximum loan limitation, the program is oriented toward small projects. This is exacerbated by the substantial increases in project costs since the program was initiated in 1959.

The most common structural flood control facility in the state is the private agricultural levee. These levees are constructed by individual farmers or by groups of farmers acting in concert. They are quite common along the wide, productive floodplains of the Wabash River, the East and the West Forks of the White River, the Eel River in Clay County and the Blue River in Shelby County. The most extensive system of private levees lies along the Kankakee and Yellow Rivers in northwestern Indiana. These levees were originally built as spoil banks when these rivers were dredged in the period between 1890 and 1916. Some of these spoil banks have been properly maintained while others have been allowed to deteriorate to the point of ineffectiveness. Private levees range in effectiveness from very well designed, well maintained structures to ineffective spoil banks. Usually, these projects are capable of providing protection only from smaller floods.

A number of cities and towns in Indiana have constructed some type of works for flood control within their borders. The Eagle Creek project in Indianapolis is the outstanding example of such a facility. In some cases, cities have taken over the maintenance of old levees built under the Works Progress Administration or other depression era agencies. The protective works constructed by cities and towns range in effectiveness from very good and well maintained to poorly maintained and dangerous structures. Again, one of the most serious problems associated with these structures is the public perception that they prevent all flooding.

Problems With Structural Programs Public support for structural flood control projects is usually in the form of reaction to disaster, at which time "instant" solutions are preferred. The public is generally apathetic to predisaster planning and development of flood control projects.

An examination of the current status of federal structural flood control programs in the state reveals that, by and large, they no longer receive general public support. Thus, the major structural programs of both the U.S. Corps of Engineers and the Soil Conservation Service of the U.S. Department of Agriculture are at a virtual standstill for the indefinite future. This situation stems from a number of causes, including the extensive "red tape" and long planning times involved, rapidly increasing costs, the general aversion to the acquisition of large amounts of land, and either real or supposed environmental impacts.

Another problem in Indiana is the lack of a coordinated comprehensive plan for flood control works and programs. While there were a number of regional planning efforts in the past two decades, they have largely been conducted by federal agencies and usually consist of a list of projects that might be built under then-existing federal authorities, criteria, rules and regulations. The state has never developed a plan which would focus on relative needs and priorities from the state's perspective, even though such a plan was authorized in the 1945 Flood Control Act. The lack of such a plan has also inhibited the coordination of the construction of flood control facilities.

Probably the most serious problem affecting the construction of flood control facilities in Indiana is the lack of funds. This is undoubtedly due in substantial measure to the perceived priority for such projects in comparison to other funding needs. Structural flood control projects have also been plagued by rapidly escalating construction costs, as well as those for lands and rights of way. Long extended planning periods tend to aggravate these cost pressures.

Non-Structural Methods

The non-structural approaches to flood control all involve the imposition of some form of restrictive land use controls intended to prevent urbanization of floodplains. By implication, the use of these methods implies that society is unwilling to accept the levels of economic and social damage resulting from the urbanization of floodplains. Examples of restrictive ordinances include floodway encroachment statutes, building codes, subdivision ordinances, zoning ordinances, and the restrictive land use controls built into the National Flood Insurance Program.

The National Flood Insurance Program has, for all practical purposes, a basic requirement which forces communities to engage in some form of floodplain zoning. Perhaps ten percent of the floodplains in Indiana are now regulated by ordinances passed as a result of this national program. The National Flood Insurance Program has created a situation where local officials can no longer ignore flooding problems in their zoning ordinances. The program also represents a public classification of flood prone lands.

Indiana planning and zoning legislation dates back to 1947. Local communities are permitted, but not required, to place restrictions on developments within their boundaries if they so choose. These communities may give special consideration to floodplains but are not required to do so.

The 1973 Flood Plain Management Act (I.C. 13-2-22.5) established minimum standards for all local floodplain zoning ordinances in Indiana. All communities adopting such ordinances after July 1, 1974, must meet the minimum standards promulgated by the Natural Resources Commission. This law assures that floodplain land use restrictions will be consistent from community to community.

The state encroachment control program under the 1945 Flood Control Act is generally considered to be successful in regulating potential encroachments caused by construction of major public and private works, largely because of the fact that the sponsors of such works are familiar and generally supportive of the law. The program has been much less successful in regulating encroachments by private individuals on private property. This is probably due to widespread public ignorance of the law and a lack of precise delineation of the land subject to regulation.

Problems With Non-Structural Methods The effectiveness of local land use restrictions varies from effective tightly run programs to "paper only" programs. In many smaller communities, floodplains are not under development pressures. In some of the larger communities, many flood prone areas are already highly developed, and the zoning ordinances have little practical effect.

The Indiana Flood Control Act contains some awkward and almost unworkable conditions with regard to the public identification of floodways and also has some severe restrictions on habitation in such areas. Local resistance to land use regulations has kept some local ordinances very weak or poorly enforced. In some cases, this local resistance has prevented the adoption of ordinances altogether. The National Insurance Program also has a tendency to present itself as an insurance program and hence to deemphasize effective land use regulations.

CONTROL OF SEDIMENT

Erosion is a process whereby minute particles of soil are carried from their original position by either wind or water. Runoff from land carries these small particles into streams. This is a natural and continuous process.

Because excessive erosion is caused by poor land use, it follows that the solution to excessive erosion is proper land management. Such practices as contour plowing, grassed terraces, minimal tillage and the control of erosion at construction sites can all be used to reduce erosion to reasonable levels.

Problems With Current Sediment Control Programs A limited amount of federal assistance is currently available through the state and federal Agricultural Conservation Practices Program for farmers to undertake land use practices to help control erosion. These funds are available on a first come-first served basis and are not concentrated in areas where excessive erosion problems can occur.

A limited number of urban areas have adopted and enforced ordinances which regulate erosion control practices at construction sites, but most construction takes place in areas not covered by such ordinances.

POST-DISASTER ASSISTANCE

Post-disaster assistance usually involves two distinct stages. The first stage consists of emergency action to provide food, shelter and clothing to flood victims and assistance to restore essential public services such as utilities, hospitals and transportation facilities. The second stage involves a series of loans and grants used to restore the impacted area to its former economic viability.

Under current conditions, post-disaster assistance usually involves the expenditure of a certain amount of federal funds in an area which has been stricken by disaster. Ample amounts of money are usually available to provide emergency food and shelter for disaster victims, and to quickly restore essential public services such as streets and utilities. In the longer term, disaster assistance takes the place of individual grants and loans to affected businesses and homeowners. The object is to make the victim "whole", or restore him to his original pre-disaster condition. The problem with the federal assistance program is the tendency to make the victim "whole" again in the floodplain that caused the problem in the first place. However, this does not apply to the restoration of the agricultural productivity of farm land.

DISCUSSION AND CONCLUSIONS

The Commission examined information on the extent of productive floodplain lands subject to periodic flooding, the approximate 238 Indiana communities subject to some degree of flood hazard, and the very substantial level of average annual flood damages sustained in the state, together with the hazard of the loss of life during flood events. The Commission concludes that Indiana does have flood problems of substantial magnitude that impact upon the state and its economy, public health and welfare. It is further concluded that these problems warrant the continued and expanded involvement of both the public and private sectors.

The Commission recognizes that it is neither physically, technically nor financially possible to eliminate all flooding in the state. It further recognizes that there is no universal panacea or ready made solution for those problem areas where

action is warranted. Thus, while there are advocates of reservoirs, levees and channelization on the one hand, and equally fervent advocates of non-structural methods on the other, the appropriate solutions are highly site specific and will most often be found to be some mix of structural and non-structural methods. It is deemed essential that the public policy maintain the various options that may be needed in specific cases.

It is desirable to consider the flood situation from two major perspectives, namely: 1) from the standpoint of actions designed to prevent the creation of new flood problems; and 2) from the standpoint of actions designed to alleviate flood damages in existing problem areas, where feasible. With respect to the first of these perspectives, the Commission finds that, in general, the public policy, the institutional mechanisms and the technical information needed to accomplish this objective are available. The major element for concern is the lack of public support necessary to execute the programs on a long term continuing basis.

This objective can and will only be attained through the implementation and continued administration of land use controls in areas subject to flooding. Under the present system, floodplains and floodways are delineated by the state (or by others subject to state approval). The state retains primary jurisdiction over all construction within the designated floodway with respect to the impacts of such construction on the efficiency and capacity of the floodway and on fish, wildlife and botanical resources. The jurisdiction is retained because the effects of construction may well extend beyond the boundaries of local zoning authorities and because of the high level of technical resources and expertise required for analysis of proposed projects. The local zoning authority exercises total jurisdiction in the floodplain area outside the floodway, while its jurisdiction within the floodway is also total except with the respect to the state's jurisdiction in the specific aspects outlined above. It is concluded that this system is appropriate and should be continued.

The Commission does find that the "due notice" provisions of that section of the Flood Control Act which authorizes the Natural Resources Commission to establish Commission Floodways (I.C. 13-2-22-14), as now interpreted, are so unwieldy as to seriously inhibit that provision of the Act. Implementation of this section of the Act would be particularly useful in that the public would have an effective means of knowing precisely what areas are deemed to be floodways and thereby subject to regulation.

The second perspective on floods relates to actions designed to alleviate existing problems, where feasible. The Commission finds that the development of a master plan for the control of floods, authorized in the Flood Control Act, would serve a useful function in providing a comprehensive overview of the several flood problem areas in the state; a general analysis of the nature and causes of the problems; an evaluation of their relative severity and hazard; and an indication of the most probable feasible and cost-effective solutions, considering both structural and non-structural alternatives. Such a plan would serve both to define in detail the nature and extent of the flood problem, and to provide guidance as to priority of effort. The plan should be developed generally without regard to who or what agency should construct a project, but should provide that overall priority and guidance that would enable a variety of construction-agency options for specific projects which would fit within the overall plan.

The Commission has examined the Flood Control Revolving Fund loan program and concludes that it is a useful tool in providing assistance to local communities in solving local problems. The program suffers from a lack of having been kept current with the cost trends since its inception in 1959. There is need to substantially increase both the capital amount of the fund and the limitation on the maximum loan amount, together with the clarification of whether the loans may be used to pay project planning costs.

The remaining basic question is that of direct state construction of, or direct state grants for, flood control projects. In general, it might be stated that direct state construction of flood control projects should be limited to those which contribute to the solution of regional flood problems, with generally wide-spread benefits, and to those where state properties or direct state interests in other aspects of water resources are involved.

In general, it is concluded that opportunities for those projects that contribute to the solution of regional flood problems are somewhat limited and, in some cases (i.e., major reservoirs), are neither acceptable to the public nor within the reasonable financial capability of the state. Nevertheless, this possibility should not be totally excluded, especially pending completion of the master plan discussed previously.

With respect to the matter of direct state grants for local flood control projects, there have been, in recent years, some cases of direct legislative appropriations in response to local initiatives to the Department of Natural Resources for pass-through to designated local agencies for implementation of specific projects. To date, such projects have included levee repair, clearing and snagging, and the upgrading of urban levees. The pass-through agreement between the Department of Natural Resources and the local sponsor provides for state review and approval of the projects.

This process appears to be one which is satisfactory in its operation. First, the local initiative for financial assistance generally assures that sufficient local interest exists to assure that local costs and leadership to implement the project will be forthcoming. Secondly, the requisite action by the General Assembly assures that the project is in accordance with public policy and commands a degree of priority with available funds. Thirdly, the utilization of the Department of Natural Resources as the grant agency assures that the project will be coordinated with other water resources concerns, will not have unreasonable adverse impacts on other public interests, and will be environmentally acceptable.

This process would be enhanced by development of the master plan for flood control referred to earlier, in that it would provide the Administration and the General Assembly with better information as to overall needs and priorities.

RECOMMENDATIONS

Based upon the foregoing discussion and conclusions the Commission recommends:

- 1) That the existing policy of Indiana with respect to flood control, as expressed in the Indiana Flood Control Act (I.C. 13-2-22) and related statutes, continue to constitute the official public policy of the state.
- 2) That legislation be submitted to the General Assembly which would provide a more workable procedure for the "due notice" provisions of that portion of the Indiana Flood Control Act (I.C. 13-2-22-14) relating to the establishment of Commission floodways. It is proposed that "due notice" be patterned after that in existing zoning legislation; that is, by published legal notice, opportunity for public inspection of maps and other pertinent information, and public hearings.
- 3) That local zoning authorities should enact and maintain effective floodplain zoning ordinances.
- 4) That necessary financial resources be provided to the Department of Natural Resources for the development of a master plan for flood control in the state, to serve not only as a source of guidance and information for local efforts but, importantly, to provide information on relative priorities and needs for use in state and other programs for alleviation of flood hazards.
- 5) That the General Assembly amend the Flood Control Revolving Fund Act (I.C. 13-2-23) so as to increase the amount of the loan fund to approximately \$5 million; to raise the maximum loan amount to \$500,000; and to make planning costs an eligible item for loans.
- 6) That the direct construction of flood control projects by the state be handled on an individual case basis, being limited generally to those projects which either afford relief on a regional basis, provide protection to state properties, or in which flood control can be incorporated in other state water resource projects. It is suggested further that this policy be reexamined upon completion of the master flood control plan, when the relative scope, urgency and need for solutions to the problem on a statewide basis are more clearly apparent.

- 7) The relatively new practice of line-item appropriations by the General Assembly for specific local flood control projects through the Department of Natural Resources should be recognized and encouraged. The Department should be the overall coordinating agency to ensure that such projects are technically and environmentally sound. Completion of the previously recommended master plan for flood control would provide valuable guidance to the Administration and the General Assembly in acting upon such local funding requests.

- 8) That priority be given to those areas having high erosion potential in the disbursement of: a) any available state funds, b) the federal Agricultural Conservation Practices Program, and c) agricultural non-point pollution control programs.



Drainage



Drainage is defined as the removal of diffused surface water and excess ground water. The process of removing diffused surface water is known as *surface drainage*, while the removal of excess ground water from soils (most generally, from the root zone) is known as *subsurface drainage*. Many drainage systems are made up of both surface and subsurface drains.

The two fundamental types of drainage systems in Indiana are classified as *agricultural* and *urban*. As the name implies, the primary function of an agricultural drainage system is to remove excess water from both the surface and the soil itself so as to create and maintain favorable soil moisture conditions for plant growth. The urban drainage system is directed primarily toward the rapid and efficient removal of surface water to provide favorable conditions for residential, commercial, industrial and transportation activities. The three general categories of drainage problems are those relating to agricultural drainage, those relating to urban drainage, and those involving the agricultural and urban drainage interface.

AGRICULTURAL DRAINAGE

The general soil associations found in Indiana have been classified as to their soil wetness characteristics, as shown in Table 5.

TABLE 5
The wetness characteristics of Indiana soil associations.

Wetness Characteristics	Criteria	Number of Acres
Slight	Less than 30 out of every 100 acres need drainage	9,128,000
Moderate	30 to 69 out of every 100 acres need drainage	6,372,000
Severe	More than 70 out of every 100 acres need drainage	7,326,000

Approximately 60 percent of the soil associations possess moderate to severe wetness characteristics, and hence have a rather extensive need for drainage to maximize crop yields.

The legal authority for agricultural drainage works is the Indiana Drainage Code (I.C. 19-4-1), enacted in 1965. The Code provides for county drainage boards to be created in each county of the state to have jurisdiction over all *legal drains*.

A legal drain is a natural or artificial open channel or subsurface drain, or a combination of the two, that has been constructed or modified under the Indiana drainage statute. The county drainage board (county commissioners or appointed board) is responsible for construction, reconstruction, and maintenance of legal drains. More than 500 miles of legal drains have been constructed in each of thirty-five Indiana counties.

In addition to the drainage board, each county has an elected County Surveyor whose duties are to investigate, evaluate, and survey all legal drains and prepare reports, plans, and profiles necessary for proposed improvements. Furthermore, it is the duty of the county surveyor to classify all legal drains in the county as to whether they are in need of reconstruction or maintenance, or should be vacated. The drainage code also provides for the establishment of new legal drains.

If it is necessary to construct a legal drain in such a way that an owner of land is deprived of ingress or egress, the board will award damages to the owner in an amount equal to the cost of constructing a proper crossing. Private drains may be connected with legal drains if permission is granted by the county surveyor.

The Commission concludes that an adequate system of drainage is essential to maintain a high level of productivity on extensive areas of agricultural land in Indiana. It further concludes that the system of legal open drains, which are the major outlets for the mutual and tile drainage sub-systems, is essentially in place. That is to say that, on an overall basis, no major additions to the system in the way of new legal open drains is anticipated.

The Commission also concludes that the Indiana Drainage Code provides a reasonable institutional basis to accomplish drainage work at the local level *in an agricultural drainage area*. At the same time, the general public interest is recognized and considered through the review and approval process of the Stream Pollution Control Board (where appropriate) and of the Department of Natural Resources pursuant to the provisions of the Flood Control Act and the several laws relating to the public fresh water lakes.

However, the Commission recognizes the following problems related to agricultural drainage, namely:

- 1) The lack of general public recognition and acceptance of the essential role of adequate drainage;
- 2) The lack of adequate maintenance of the drainage system;

- 3) The lack of general recognition and acceptance of the fact that drainage is only one of a number of instream uses, and of consequent need for accomplishing the drainage function in a manner reasonably consistent with other uses and values, and;
- 4) The issue of who bears the additional financial costs of supporting the multiple uses of a drainage system.

These problems and issues and the conclusions of the Commission are discussed separately as follows:

Public Recognition

The Commission senses a wide disparity of public viewpoint as to the need for drainage works. These views seem to range from the idea on the one hand that drainage work, particularly stream "channelization", is so disruptive of other instream uses that it should be prohibited. At the other extreme, there is the view that drainage should be provided without regard to impacts on other uses and values.

As noted previously, the Commission concludes that the installation and proper maintenance of an adequate system of drainage is essential in vast areas of highly productive agricultural lands in Indiana. The value of agricultural production in human, social and economic terms is beyond debate, and it is clearly apparent that a very large proportion of Indiana's agricultural output is dependent upon adequate drainage.

The Commission therefore concludes that there is a need for all sectors of the public and of government to recognize and accept the role of drainage as essential to Indiana's well being.

Adequate Maintenance

The major components of Indiana's drainage systems, principally the legal open drains, are in place and relatively little expansion of that portion of the system may be reasonably anticipated. However, it is apparent that these existing systems are generally characterized by a lack of adequate maintenance. Cases where no significant maintenance has been done for long periods of time, ranging upward from twenty to fifty years, are by no means uncommon. When remedial work is finally undertaken, it is often of the nature of "major surgery", very costly, and possessing the potential for major conflicts with other instream uses. There is also, of course, the progressive deterioration and impairment of the drainage function over these long periods of time.

The Commission maintains that regular and continuing maintenance of drainage works, once installed, is in the best interest not only of the benefited lands, but of other instream uses as well. Moreover, such a program would serve

to greatly alleviate the magnitude and severity of environmental conflicts, as opposed to the past practice of major rehabilitation after long time intervals of little or no maintenance.

Multiple Uses for the Agricultural Drainage System

Given the necessity for drainage systems and for adequate and timely maintenance, there remains the goal of accomplishing the drainage function with due recognition of other instream uses. Many streams or legal drains (which in most cases were originally natural water courses) must serve multiple uses or functions, including drainage, water quality, fish and wildlife habitat and, in some cases, recreational uses such as boating.

The Commission recognizes that most of the major drainage systems were constructed in the latter 1800's and the early 1900's, when these other instream uses were a matter of little or no public interest or concern. Such is no longer the case. The Commission further recognizes that in cases of multiple uses, no single use, whatever its nature, can be ideally served. There must be some sacrifice or adjustment between all uses in order that all may be reasonably served. The Commission concludes that the drainage function can be provided and maintained, as appropriate to the particular case, in a reasonable manner through utilization of a number of practices. These include: 1) the practice of one-sided construction in the interest of providing cover for wildlife and shade to hold down water temperatures; 2) early and adequate revegetation of disturbed banks to reduce erosion and consequent sedimentation and provide wildlife cover; 3) the use of pipes or other erosion control structures to drop surface water into the drain; 4) provision of at least some minimum vegetated buffer strip along the disturbed bank in the interest of erosion control and wildlife cover; 5) the installation and periodic cleaning of sediment traps; and 6) where appropriate, the provision of fish pools for maintenance of the fishery during periods of low flow. It should be noted that some of these practices, notably those related to erosion and sediment control, accrue benefits directly to the drainage interests.

Cost Sharing for Multiple Uses of Agricultural Drains

The Commission, in concluding that maintenance and reconstruction of legal open drains should be accomplished with due regard for other instream uses, recognizes that additional costs will be incurred in implementing the necessary practices. It is to be noted that the fish and wildlife of Indiana have been declared a public resource by the Indiana General Assembly, and that recreational uses such as boating, fishing and swimming are public uses.

The Commission therefore concludes that, with respect to those legal open drains where the protection or enhancement of these public uses and resources are involved, the public should participate in the determination of the measures to be employed and in the costs of implementation.

URBAN DRAINAGE

The major objective in urban drainage is to remove diffused surface water rapidly and efficiently in the interest of preventing damage to, or disruption of, residential, commercial, industrial and transportation activities. Several characteristics of urban drainage are noteworthy. These are:

- 1) The large amount of impervious surfaces in urban areas results in a higher volume and rate of runoff from a given precipitation event than in rural areas.
- 2) Again, because of the presence of large amounts of impervious surfaces, surface runoff occurs more frequently than in rural areas. That is, precipitation events that are within the infiltration capacity of soils in rural areas will produce runoff from impervious urban areas.
- 3) The higher rates of runoff and the greater potential for economic loss require a higher drainage capacity in urban areas.

Physically, urban drainage systems vary widely as to type and degree of sophistication. The drainage system in a typical rural village may consist only of a network of ditches along the streets and roads, discharging into the nearest surface stream. At the other extreme, metropolitan areas may be characterized by several major storm drainage systems, comprised of a network of combined storm and sanitary sewers (as is almost universally the case for older areas) or of an independent system of storm sewers in more recently developed areas. A few of the newer installations include provisions for temporary detention storage in order to reduce the sewer capacity requirements and to reduce the load on the outlet system. Due to the frequent overloading and by-passing of wastewater treatment plants, combined sewer systems are no longer being constructed. In some areas, the old combined systems are being separated into component units.

The Commission concludes that the major problems of urban drainage are:

- 1) The older systems are generally of the combined sanitary sewer and storm water sewer type, resulting in frequent overloading and by-passing of the wastewater treatment plants and thereby causing water quality problems in the receiving streams;
- 2) The older systems (and, indeed, perhaps many of the new ones) do not have excess water removal capacities commensurate with the expectations of the public;
- 3) The capacity problems of the older systems are intensified by the continuing addition of storm drainage from newly developed areas;
- 4) Inadequate maintenance of the drainage systems, and;
- 5) Storm-sewer separation and the rehabilitation and enlargement of old systems is both disruptive and very expensive.

AGRICULTURAL - URBAN DRAINAGE INTERFACE

The agricultural and urban drainage systems interface in three general areas, namely: an agricultural drainage system may pass through an urban or urbanizing area; an urban drainage system may have an outlet into an agricultural drainage system, and in areas converted from rural to urban land use.

When an agricultural drain enters into or flows through an unincorporated urban area, the Drainage Code requires that all land owners who benefit from a legal drain pay the costs for its construction, reconstruction or maintenance. People in the developing area, who are generally non-farm land owners, perceive no benefit to themselves from the agricultural drain and, in addition, most generally feel that such costs to themselves, if paid at all, should be borne by some unit of government rather than by individual assessment. The Drainage Code provides for cities and towns to pay legal drain costs on behalf of all assessed owners.

When an agricultural drain serves as the outlet for an urban drainage system, the urban drain imposes a greater capacity requirement than that for which the agricultural drain was designed. In this case, it is the agricultural sector that objects to paying assessments for the costs of enlarging the drain capacity to accommodate urban drainage from which they derive no perceived benefit. The Drainage Code makes provision for a city or town to pay the costs of enlarging a legal drain to render it suitable as an outlet for urban drainage.

The third general interface occurs in those areas where a watershed is undergoing a conversion from agricultural to urban uses. The Drainage Code does provide for the special designation of *urban drain* in those cases where the watershed has been, or is being converted from rural to urban land use or where it is found that such a change is pending. In these cases, all the land within the watershed is considered to be benefited, although the question of whether a given tract is rural or urban is a factor in assessing benefits, and hence costs.

The Commission concludes that the Indiana Drainage Code recognizes the various agricultural-urban drainage interface problems and provides procedures in law for dealing with them.

RECOMMENDATIONS

Based upon the foregoing discussion, the Commission makes the following recommendations:

- 1) The policy of recognizing and accepting the vital role and value of adequate drainage systems, both agricultural and urban, should be the continuing policy of the State of Indiana and of its citizens and institutions of government.
- 2) The drainage systems should be properly maintained on a regular and continuing basis and the duty and responsibility for such maintenance should be recognized and implemented by those responsible.

- 3) The policy of the State of Indiana should include recognition of the value of both multiple instream uses and the drainage function. The construction, reconstruction, and maintenance of drainage systems should include suitable practices that promote compatibility with other instream uses.
- 4) The State of Indiana should establish and implement an information and education program designed to assist all interests in a better understanding of the problems and needs of both agricultural and urban drainage, to promote understanding and acceptance of the multiple instream uses of major drainage systems, and to promote regular and continuing maintenance of drainage systems while adopting and utilizing drainage practices and procedures that recognize and protect other instream uses.
- 5) There should be established in law the policy that those practices and procedures in the construction, reconstruction and maintenance of legal open drains necessary for the preservation or enhancement of the public interest for recreation and fish and wildlife, be paid for by the state. A continuing source of state funds and a suitable mechanism for implementation of that policy should be established.



Administration

In addition to analyzing the capability of the water resource to supply projected demands, and evaluating the effectiveness of the current management system to deal with current and potential problems associated with those demands, the Commission also evaluated the administration of the management system.

Based upon an analysis of the administrative structure and authorized personnel levels of both the Indiana State Board of Health and Department of Natural Resources, the Commission makes the following conclusions.


The existing administrative structure is generally adequate to carry out the Indiana water resource programs provided that the staff is maintained at the authorized levels. It is however, necessary to continually review and update these personnel requirements and perhaps shift existing personnel to more productive areas. Further, it will also be necessary from time to time to make certain adjustments in legislation to reflect changes in economic and social conditions, and, in some cases, to respond to federal mandates and programs.

Although the authorized staff levels are generally adequate to administer the programs at existing levels of activity, there are very substantial problems in recruiting and retaining the technical personnel necessary to maintain these staff levels.

These problems stem first and foremost from the lack of competitive salary scales. Secondly, there is a lack of opportunity for further education and training, a perceived lack of career advancement opportunities, and last but not least, a lack of an organized, vigorous and sustained recruitment effort on the part of the State's Personnel Division.

The Commission has collected and published a considerable body of data on the availability and current use patterns of the water resources of the state. This information provides an invaluable source of data for political and civic leaders, engineers, planners, farmers and others. There remains a large body of significant and useful water resource data that has not been compiled and made available for general use. There is definite need for systematic programs to compile and periodically publish data on such aspects of the water resource as surface and ground-water quality, surface and ground-water quantity, and flooding and drainage problems. The Commission therefore recommends that:

- 1) The proper authorities give priority attention to the problem of recruitment and retention of professional and technical staff through improvements in salaries, educational and career opportunities and in recruitment programs;
- 2) Adequate resources should be made available to the agencies for the collection, analysis, interpretation, and periodic publication of basic water resource data and information. Existing legislation that permits this collection and publication activity should be amended so that such activity is mandatory.



*Recommendations
For The Future:
A Summary*



Recommendations

The several recommendations of the Commission with respect to withdrawal and instream uses of water, flooding, drainage, and administration have been presented in the chapters of this report dealing with those subjects. They are reiterated here to present an overall view of their nature and scope for ease of reference.

INSTREAM AND WITHDRAWAL USES

- 1) The Commission recommends the creation of a water rights and use management statute that incorporates the following major principles and elements:
 - a) A determination and declaration that, based upon sound and accepted principles of natural laws and hydrology, the water resource of Indiana is in fact, and shall henceforth be regarded as, a single resource composed of the major interrelated elements of atmospheric moisture, precipitation, soil moisture, evapotranspiration, diffused surface water, water in lakes and water courses (surface water), and ground water; and that the said resource is both renewable and finite.
 - b) Recognition that the water resource of the state must serve a multiplicity of human, social and economic uses and needs; that specific uses and needs may, from time to time, either wax or wane; and that new uses and needs may vary both as to human, social and economic utility and their compatibility with one another.
 - c) Recognition that while short-term water resource availability is highly variable in both time and space as a result of natural factors, the overall long-term resource is adequate to meet the general spectrum of perceived human, social and economic uses and needs, *given proper planning and management.*

- d) Assertion that the economy and the general health, safety, and welfare of the people of Indiana require that the water resource of the state be utilized for beneficial purposes; that waste, non-beneficial use and degradation of the resource be prevented; and that the resource be utilized so as to provide the best possible accommodation and balance as among beneficial uses and needs, including multi-purpose use where feasible.
- e) An express declaration that the public policy of the State of Indiana is to manage, regulate, and control the water resource because: a) water is a natural and public resource; b) water plays an essential and pervasive role in the human, social and economic well-being of the people of Indiana; and c) it is of vital importance to the general health, safety and welfare of the people of Indiana.
- f) An assertion that the State of Indiana does not forfeit any responsibility for water rights and the management and regulation of the water resource within the boundaries of the state.
- g) Establish a state system of water use permits with the following major features:
 - 1- Full recognition of the rights of riparian owners and of the owners of overlying lands for domestic household uses and of the rights of capture and use of diffused surface water by land owners without a permit.
 - 2- Riparian owners and owners of overlying lands may, but shall not be required to, obtain a permit for non-domestic use on riparian or overlying land not to exceed 100,000 gallons-per-day.
 - 3- Any withdrawal, diversion, impoundment, or consumptive use of water of more than 100,000 gallons-per-day must have a prior water use permit from the state.
 - 4- The proposed use of water must be such as is necessary for economic and efficient utilization, not interfere with any existing legal use of water, and be consistent with the public interest.
 - 5- Define essential terms, including "watershed", "watercourse", "domestic use", "riparian lands", "overlying lands", and "beneficial use".
 - 6- That the state may permit the holder of a water use permit to take, transport, and use surface water beyond riparian land and beyond the watershed from which it is taken; and to take, transport and use ground water beyond overlying land and beyond the watershed in which the aquifer is located.
 - 7- That the issuance of a water use permit will be based upon full consideration of the overall public interest, including protection for the basin of origin and for instream flows and uses.

- 8- That a water use permit and rights thereby granted may be assigned or transferred and may not be revoked or suspended for any reason other than termination of use or non-compliance with reasonable conditions imposed at the time of issuance.
 - 9- That all existing withdrawals, diversions, impoundments or consumptive uses of more than 100,000 gallons-per-day may be continued with a water use permit for which application must be made within, say, three years. Such permits will be granted provided that the use is reasonable and beneficial. Failure to so apply will create a rebuttable presumption of abandonment.
 - 10- That non-domestic ground-water users whose withdrawals create substantial adverse effects upon the domestic household wells of others shall, as a condition precedent to a water use permit, either restore such wells to their former relative capability, provide a reasonable alternative source of supply, or pay proper damages.
 - 11- Provide by law for the protection of a reasonable level of low streamflow in the interest of instream uses; for consideration of such protection as one element of the public interest in consideration of water use permits; and for recognition of the policy that the impoundment of water for the purpose of low flow augmentation for instream uses is a legitimate public purpose.
- h) Provide a clear definition of public rights for such instream uses as boating and fishing, based upon consideration of the navigational servitude and/or the public waters concept, and of the rights of riparian owners.
- 2) It is the view of the Commission that the development of a water rights and management statute should be accomplished under the guidance and direction of a representative group conversant with the water resource and the uses and needs of the people of Indiana. The Commission has developed a broad base of such knowledge and insight during the past three years. It is therefore recommended that the Commission be continued and assigned the task of developing a statute on water rights and management for consideration by the General Assembly.
 - 3) The necessary resources should be provided to the Department of Natural Resources for the development of a comprehensive plan for the development and utilization of the water resource of the state to serve the goal of meeting the needs of the people of Indiana in timely fashion by both public and private efforts.
 - 4) Accepted technical procedures should be developed by the Department of Natural Resources for consistent assessment of the yield capability of the several sources of public water supply as an aid to water utilities in the planning and development of additional supplies in timely fashion.

- 5) The Department of Natural Resources should be provided with the necessary resources to conduct and report upon continuing periodic inventories of water use in the state as an aid in assessing the further demands upon the water resource, and in determining any further public policy actions with respect thereto.

FLOODING

- 6) That the existing policy of Indiana with respect to flood control, as expressed in the Indiana Flood Control Act (I.C. 13-2-22) and related statutes, continue to constitute the official public policy of the state.
- 7) That legislation be submitted to the General Assembly which would provide a more workable procedure for the "due notice" provisions of that portion of the Indiana Flood Control Act (I.C. 13-2-22-14) relating to the establishment of Commission floodways. It is proposed that "due notice" be patterned after that in existing zoning legislation; that is, by published legal notice, opportunity for public inspection of maps and other pertinent information, and public hearings.
- 8) That local zoning authorities should enact and maintain effective floodplain zoning ordinances.
- 9) That necessary financial resources be provided to the Department of Natural Resources for the development of a master plan for flood control in the state to serve not only as a source of guidance and information for local efforts but, importantly, to provide information on relative priorities and needs for use in state and other programs for alleviation of flood hazards.
- 10) That the General Assembly amend the Flood Control Revolving Fund Act (I.C. 13-2-23) so as to increase the amount of the loan fund to approximately \$5 million, to raise the maximum loan amount to \$500,000, and to make planning costs an eligible item for loans.
- 11) That the direct construction of flood control projects by the state be handled on an individual case basis, being limited generally to those projects that either afford relief on a regional basis, provide protection to state properties, or in which flood control can be incorporated in other state water resource projects. It is suggested further that this policy be reexamined upon completion of the master flood control plan, when the relative scope, urgency and need for solutions to the problem on a statewide basis are more clearly apparent.
- 12) The relatively new practice of line-item appropriations by the General Assembly for specific local flood control projects through the Department of Natural Resources should be recognized and encouraged. The Department should be the overall coordinating agency to ensure that such projects are technically and environmentally sound. Completion of the previously recommended master plan for flood control would provide valuable guidance to the Administration and the General Assembly in acting upon such local funding requests.

- 13) That priority be given to those areas having high erosion potential in the disbursement of: a) any available state funds, b) the federal Agricultural Conservation Practices Program, and c) agricultural non-point pollution control programs.

DRAINAGE

- 14) The policy of recognizing and accepting the vital role and value of adequate drainage systems, both agricultural and urban, should be the continuing policy of the State of Indiana and of its citizens and institutions of government.
- 15) The drainage systems should be properly maintained on a regular and continuing basis and the duty and responsibility for such maintenance should be recognized and implemented by those responsible.
- 16) The policy of the State of Indiana should include recognition of the value of both multiple instream uses and the drainage function. The construction, reconstruction, and maintenance of drainage systems should include suitable practices that promote compatibility with other instream uses.
- 17) The State of Indiana should establish and implement an information and education program designed to assist all interests in a better understanding of the problems and needs of both agricultural and urban drainage, to promote understanding and acceptance of the multiple instream uses of major drainage systems, and to promote regular and continuing maintenance of drainage systems while adopting and utilizing drainage practices and procedures that recognize and protect other instream uses.
- 18) There should be established in law the policy that those practices and procedures in the construction, reconstruction and maintenance of legal open drains necessary for the preservation or enhancement of the public interest for recreation and fish and wildlife, be paid for by the state. A continuing source of state funds and a suitable mechanism for impementation of that policy should be established.

ADMINISTRATION

- 19) The proper authorities should give priority attention to the problem of recruitment and retention of professional and technical staff through improvements in salaries, educational and career opportunities and in recruitment programs;
- 20) Adequate resources should be made available to the agencies for the collection, analysis, interpretation, and periodic publication of basic water resource data and information. Existing legislation that permits this collection and publication activity should be amended so that such activity is mandatory.

It is the unanimous view of the Commission that implementation of these recommendations would, in conjunction with existing authorities and programs, provide that framework of policy, law, and management within which the water needs of the future may be satisfied in a timely and equitable manner.

Appendix

THE EXISTING INDIANA WATER PROGRAM

The existing Indiana water program is comprised of a combination of statutory laws created by the General Assembly and certain precepts from the common law that have been modified from time to time by the courts. The following discussion is a summary of this program.

THE STATUTORY PROGRAM

In the following summary tabulation of statutory law, the laws are cited in the same order as that in which water moves through the hydrologic cycle. An exception is made in the case of excess water, where the excess water program is presented as it pertains to flooding, drainage, erosion, and sedimentation. The program concerning each phase of the hydrologic cycle has been subdivided into six major elements. These are:

- 1) All legislative expressions of state policy on the subject;
- 2) Any statutory guidelines which might exist as to who has the right to use water, for what purposes, and on what lands;
- 3) The laws which have established the various legal bodies which actually manage water, which are divided into:
 - a) Those governmental mechanisms governing the regulation of water use,
 - b) Laws concerning water storage and distribution facilities, etc.,
 - c) Laws concerning the maintenance of water quality;
- 4) Authority for collecting basic data and conducting research;
- 5) Authority for planning; and
- 6) A summary of the various governmental units and others authorized to deal with water in the particular phase of the hydrologic cycle.

Citations are made in the following format: (I.C. 13-2-22-2), denoting Indiana Code, title 13, article 2, chapter 22, section 2. It is possible that in time the citation may change; therefore, the reader should consult the cumulative supplements of the 1976 edition of the Indiana Code, if the citation made in this report does not correspond to a later edition of the Indiana Code. The symbol N/A is an abbreviation of not-applicable.

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Precipitation

General Policies

By enactment of implementing legislation, the General Assembly has established the policy that the placing or attempting to place any substance into the atmosphere with the intention of inducing, increasing, decreasing, or preventing hail, precipitation, or tornados is subject to regulation to protect the public safety and welfare and the environment of the state (I.C. 13-1-1.5).

Rights to Use

- (1) Not addressed by statute or common law.
- (2) Presumably, the owner(s) of land has the right to the direct capture and use of precipitation.
- (3) The enactment of I.C. 13-1-1.5 regulating efforts to induce, increase, decrease, or prevent hail, precipitation, or tornados may constitute implied recognition of the rights of an owner or owners of lands to modify natural precipitation in their interest.

Management

Use N/A

Facilities

- (1) Persons engaged in weather modification operations must be licensed by the state (I.C. 13-1-1.5).

Quality

- (2) Specific weather modification operations must be conducted under prior permit.
- (1) No management of quality of precipitation per se.
- (2) Indirectly, through the air pollution control program (I.C. 13-1) (I.C. 13-7-2-10)

Research and Basic Data

- (1) Certain state agencies are authorized to conduct applied research for the purpose of securing the scientific and technical data information necessary for the solution of problems involving the wise beneficial development, use and management of the water resources of Indiana (I.C. 13-2-7).
- (2) The federal government, through the National Oceanic and Atmospheric Administration, maintains an extensive nation-wide network of precipitation gaging stations, and compiles and publishes the data therefrom.
- (3) Research is conducted by a number of colleges and universities, and notably through the Water Resources Research Centers at Purdue and Indiana Universities.

Planning

N/A

Institutional Arrangements

- (1) Power and duty to license persons engaged in weather modification activities and to regulate specific weather modification operations by permit is vested in the Department of Natural Resources (I.C. 13-1-1.5).
- (2) Power to conduct applied water resources research in their respective areas of jurisdiction is vested in the State Board of Health and the Department of Natural Resources (I.C. 13-2-7).

Evapotranspiration

General Policies	N/A
Rights to Use	N/A
Management	
Use	Not applicable in general sense of the term.
Facilities	Evapotranspiration can be reduced by land use and treatment measures and by evaporation suppression techniques on surface water bodies.
Quality	N/A
Research and Basic Data	Research on Indiana climatic factors affecting evaporation losses from impoundments authorized by Water Resources Research Act (I.C. 13-2-7). Also, Water Resources Research Centers at Purdue and Indiana Universities.
Planning	N/A
Institutional Arrangements	Power to conduct applied water resources research is vested in State Board of Health and Department of Natural Resources (I.C. 13-2-7).

Soil Moisture

General Policies	<p>(1) It is declared, as a matter of legislative determination, that---to conserve soil and water resources---it is necessary that---appropriate soil and water conserving land use practices---be adopted and carried out---and that among such practices are---retardation of runoff by increasing absorption of rainfall (I.C. 13-3-1-2).</p> <p>(2) See Page 87, General Policy Nos. 6 and 7, and Page 90, General Policy No. 2, with respect to Excess Water (floods and drainage).</p>
Rights to Use	Not addressed in law. Soil moisture is the natural source of supply of water for most vegetation and its utilization for such natural functions is an incident of land ownership.
Management	
Use	N/A
Facilities	<p>(1) Weather modification activities, designed to induce, increase, decrease, or prevent hail and precipitation (and hence affect the supply of soil moisture) are regulated by permit (I.C. 13-1-1.5).</p> <p>(2) See Page 78, Facilities No. 1, with respect to the artificial supplying of soil moisture (irrigation).</p>
Quality	<p>(1) No management of the quality of soil moisture per se.</p> <p>(2) Indirectly, the water pollution control programs are of significance.</p>
Research and Basic Data	A program to implement an accelerated program of modern soil surveys for the state is authorized. Such surveys provide, among other things, information and data on the moisture and drainage characteristics of the various soils in the state (I.C. 13-4-3-5).
Planning	N/A
Institutional Arrangements	<p>(1) The accelerated soil survey program is administered through the State Soil and Water Conservation Committee, Department of Natural Resources, in cooperation with the U.S. Soil Conservation Service, Purdue Extension Service and the several counties and county soil and water conservation districts.</p> <p>(2) The general soil and water conservation program is administered by the State Soil and Water Conservation Committee, Department of Natural Resources, in cooperation with the 92 county soil and water conservation districts.</p>

Diffused Surface Water

General Policies	No express policies relative to diffused surface water per se.
Rights to Use	<p>(1) Diffused surface water flowing vagrantly over the surface of the ground shall not be regarded as public water and the owner of the land on which such water falls, pools, or flows, shall have the right to its use (I.C. 13-2-1-2).</p> <p>(2) The general common law rule is that diffused surface water belongs to anyone who captures and collects it on his land.</p>
Management	
Use	As noted above, the owner of the land has the right to capture and use diffused surface water. Thus, management of the use of such water rests solely with the landowner.
Facilities	The common method of capture of diffused surface water for use is the farm pond. Management of such facilities rests with the landowner.
Quality	None
Research and Basic Data	No special research programs per se. Diffused surface water is a factor involved in research related to drainage and erosion control.
Planning	None
Institutional Arrangements	None

Surface Water

- (1) The general welfare of the people of the State of Indiana requires that the surface water resources of the state be put to beneficial uses to the fullest extent and that the use of water for non-beneficial uses be prevented (I.C. 13-2-1-1).
 - (2) Water in any natural stream, natural lake or other natural body of water in the State of Indiana which may be applied to any useful and beneficial purpose is a natural resource and public water of the state and subject to the control and/or regulation for the public welfare as determined by the General Assembly (I.C. 13-2-1-2). The policy that surface waters of Indiana are declared to be public waters and subject to regulations by the Indiana General Assembly shall be the accepted policy of the State of Indiana (I.C. 13-2-11-1).
 - (3) The natural resources and the natural scenic beauty of Indiana are declared to be a public right, and the public of Indiana is hereby declared to have a vested right in the preservation, protection, and enjoyment of all the public fresh water lakes of Indiana in their present state, and the use of such waters for recreational purposes (I.C. 13-2-14-1).
 - (4) The State of Indiana is hereby vested with full power and control of all of the public fresh water lakes in the state both meandered and unmeandered and the State of Indiana shall hold and control all of such lakes in trust for all of its citizens for fishing, boating, swimming, the storage of water to maintain water levels, and for any purposes for which said lakes are ordinarily used and adapted, and no person owning lands bordering any such lakes shall have exclusive right to the use of the waters of any such lake or any part thereof (I.C. 13-2-11-1).
 - (5) The water resources of the state should be accumulated, preserved and protected to prevent any loss or waste beyond the reasonable and necessary use thereof (I.C. 13-2-22-2).
 - (6) It is the public policy of the State of Indiana that a natural, scenic and recreational river system be established and maintained (I.C. 13-2-26-2).
 - (7) It is hereby declared to be the policy of the General Assembly to provide for--the conservation, development, utilization and disposal of water in the watersheds of the state (I.C. 13-1-3-2).
 - (8) The Department of Natural Resources shall have general charge and supervision of the navigable waters of the state (I.C. 14-3-1-14).
 - (9) All lands now owned by the State of Indiana which border upon or lie adjacent to any lake or stream and which are not otherwise used or occupied or intended for use or occupation by any institution, department or office of the state government, shall be under the management, control and supervision of the Department of Natural Resources (I.C. 14-3-10-1).
 - (10) The General Assembly has recognized the need for reservoirs to meet the increasing demand for water supply storage to be used for thirteen enumerated purposes, and has provided the means by which the State of Indiana, municipalities, special taxing districts, and public utilities may secure needed reservoir sites (I.C. 13-2-9-1).
 - (11) It is the declared public policy of this state to protect and conserve the timber, water resources, wildlife and top soil in the state forests (I.C. 14-3-4-1).
- (1) Rights to use the surface water resources of the state are generally governed by the riparian doctrine of reasonable use.

(2) Land owners contiguous to a public water course have the right at all times to use water therefrom in the quantity necessary to satisfy domestic needs and the use of water for domestic purposes shall have priority and be superior to any and all other uses. The owner or group of owners of land contiguous to or encompassing a public water course may impound water behind a dam in the natural stream bed or on its land or by pumping or diverting such water from a stream or lake to a reservoir when the flow of the stream or the level of the lake is in excess of existing reasonable uses at the time of such impoundments. Finally, any person who creates additional stream volumes by releases from impoundments built and financed by them, shall have the right to use of such increased flowage at all times and riparian owners shall have no rights in such increased flowage beyond normal stream flow (I.C. 13-2-1-3).

(3) Any person whether or not a riparian owner, may divert flood waters of any water course for any useful purpose provided that such diversion shall not cause any injury to landowners or the users of water in the watershed of the water course from which the flood flow is diverted (I.C. 13-2-1-6).

Management

Use

(1) Under the riparian doctrine, management of the use of surface water is generally vested in the riparian owner and the recourse for disputes is to the courts.

(2) The Natural Resources Commission is authorized to contract to provide minimum quantities of stream flow or to sell water for supply purposes from impoundments financed by the state (I.C. 13-2-1-7).

(3) Whenever a dispute arises between the users of surface water in any watershed area, any party to the dispute may request that the Department of Natural Resources mediate the dispute. Any recommendations of the Department in any such mediation proceeding shall not be binding upon the parties to the dispute (I.C. 13-2-1-6).

(4) A permit must be acquired from the Natural Resources Commission in order to withdraw water from a navigable stream in the state (I.C. 14-3-1-14).

(5) Cities may regulate the withdrawal of water from water courses within a distance of 10 miles from their corporate limits, but not into a county other than the one which the city hall is located (I.C. 18-1-1.5-9).

(6) Any municipal corporation, county or any combination or municipal corporations, county or counties may create a port authority (I.C. 8-10-5-1).

(7) County commissioners are authorized, upon petition of 24 freeholders of the county in the vicinity of the stream, to declare any stream or water course in the county navigable (I.C. 13-2-4-1).

Facilities

(1) The General Assembly has provided the means by which the State of Indiana, municipalities, special taxing districts, and public utilities may secure needed reservoir sites to meet present and future needs for storage of water, even though there may be no present, immediate need (I.C. 13-2-9-1).

(2) Owners of land contiguous to or encompassing a public water course may impound water behind a dam in the natural stream bed or on its land or by pumping or diverting such water from a stream or lake to a reservoir when the flow of the stream or level of lake is in excess of existing reasonable uses at the time of such impoundments. These actions must be approved by the Natural Resources Commission (I.C. 13-2-1-3).

(3) Any structure, obstruction, deposit, or excavation in the floodway of any stream in the state must first be approved by the Natural Resources Commission (I.C. 13-2-22-13).

- (4) The Natural Resources Commission is authorized to purchase or condemn easements or fee simple interests in land necessary for reservoirs for storage of water, and to construct and otherwise develop necessary structures for impoundments of water on such sites (I.C. 13-2-9-2).
 - (5) Sites for water supply storage must be approved by the Natural Resources Commission and the Board of Health before condemnation can be used (I.C. 13-2-9-7).
 - (6) The Environmental Management Board is authorized to classify all water and waste water treatment plants as to qualifications for their operation (I.C. 13-1-6-1), establish requirements for permits for the construction of public water supply facilities (I.C. 13-7-10-1), and approve the plans and specifications prior to the construction of a public water supply facility (I.C. 13-7-14-1).
 - (7) Any dam which meets certain criteria must be inspected annually by representatives of the Natural Resources Commission (I.C. 13-2-20-4).
 - (8) Pursuant to numerous provisions of the Indiana Code (I.C. 19-3-6.5 thru 35), cities and towns have authority to construct, operate and maintain public water supply systems.
 - (9) Rural water companies may be organized pursuant to the Indiana Not-For-Profit Corporation Act (I.C. 23-7-1.1) for the purpose of providing water supply, including treatment and distribution for public use.
 - (10) Investor owned public water utilities, organized pursuant to the corporation laws of the state and operating under an indeterminate license, permit or franchise issued by the Public Service Commission (I.C. 8-1-2-9) thru 93) may construct, operate and maintain public water supply systems.
 - (11) Regional Water Districts may provide a water supply, including treatment and distribution for domestic, industrial and public use (I.C. 19-3-2-3).
 - (12) Conservancy Districts may provide water supply, including treatment and distribution for domestic, industrial and public use (I.C. 19-3-2-3)
 - (13) The Indiana Port Commission is authorized and empowered to construct, maintain, and operate, in cooperation with the federal government, modern ports on Lake Michigan and/or the Ohio River and/or the Wabash River (I.C. 8-10-1-1).
 - (14) The Indiana Port Commission, in cooperation with the federal government or otherwise, is authorized to construct a new canal or canals or to improve any existing canal or canals, river or other waterway in such manner as to accommodate water-borne transportation and to construct the necessary facilities in connection therewith, subject to the conditions and limitations set forth in the Act (I.C. 8-10-2-1).
- Quality
- (1) The Environmental Management Board has a general charge to preserve, protect, and enhance the quality of the state's environment and to develop programs that provide for most beneficial use of its resources (I.C. 13-7-1-1).
 - (2) Although its authority would appear to be largely superseded by I.C. 13-7, I.C. 13-1-3, and I.C. 16-1-26-1, the Natural Resources Commission is empowered to protect the lakes, streams, and springs of the state against impurities or pollution by industrial, municipal or other sewage waste (I.C. 14-3-1-14).
 - (3) The Environmental Management Board is given the specific duty, among others, to evolve standards and develop regulations to preserve, protect, and enhance the quality of the environment (I.C. 13-7-3-1).

(4) The Stream Pollution Control Board, operating under the general overview of the Environmental Management Board, has been granted the jurisdiction to control and prevent pollution in the waters of the state (I.C. 13-1-3-4). This involves the determination of qualities or properties which indicate pollution and developing regulations and orders which restrict the discharge of polluting substances into the waters of the state (I.C. 13-1-3-7).

(5) It is unlawful to deposit any substance into the waters of the state which is deleterious to public health, the prosecution of any industry or lawful occupation, agriculture, floriculture or horticulture, the livestock industry or use for domestic animals, or which lessens, impairs or materially interferes with the use of the water by the state or any political division of it, or which destroys or jeopardizes any beneficial animal, fish, or vegetable life in the waters (I.C. 16-1-26-1 and I.C. 13-1-3-8).

(6) The proper reclamation of lands subjected to surface mining is required to protect lakes and streams from pollution (I.C. 13-4-6-1).

Research and Basic Data

(1) The Natural Resources Commission is authorized to conduct investigations and measurements of the water resources of the state (I.C. 13-2-8-1).

(2) The Natural Resources Commission is authorized to investigate, compile, and disseminate information and make recommendations concerning the state's Natural Resources (I.C. 14-3-1-3), and make research data and reports available to public or private institutions or individuals (I.C. 14-3-1-3, 4)

(3) The Board of Health and Natural Resources Commission are to conduct research necessary for beneficial development, use, and management of the state's water resources (I.C. 13-2-7-2).

(4) The Water Resource Research Centers, Purdue and Indiana Universities, are engaged in research into numerous aspects of water resources.

Planning

(1) The Natural Resources Commission shall make surveys and investigations of the water resources of this state, giving consideration to the need for, and appropriate sources of, suitable water supplies for domestic, agricultural, municipal, industrial, power, transportation, recreation, stream pollution, health and other beneficial purposes and shall make and formulate plans and recommendations for the further development, protection and preservation of the water resources of the state for such purposes (I.C. 13-2-22-11).

(2) The Stream Pollution Control Board, pursuant to Section 208, PL 92-500, is engaged in the development of a state-wide water quality management plan.

Institutional Arrangements

(1) The Natural Resources Commission must approve any structure, obstruction, deposit, or excavation in the floodway of any stream in the state prior to construction (I.C. 13-2-22-13).

(2) The Natural Resources Commission is authorized to acquire reservoir sites for the storage of water (I.C. 13-2-9-2).

(3) The Environmental Management Board has a general charge to preserve, protect, and enhance the quality of the state's environment and to develop programs which provide for the most beneficial use of its resources (I.C. 13-1-3-4).

(4) The Stream Pollution Control Board, operating under the general overview of the Environmental Management Board, has been granted the jurisdiction to control and prevent pollution in the waters of the state (I.C. 13-1-3-4).

(5) Cities may regulate the withdrawal of water from water courses within a distance of 10 miles from their corporate limits (I.C. 18-1-1.5-9).

- (6) Organized Conservancy Districts may provide water supply, including treatment and distribution for domestic, industrial and public use (I.C. 19-3-2-2).
- (7) Regional water districts may provide water supply for domestic, industrial and public use (I.C. 19-3-1-1).
- (8) Cities and towns may provide public water supplies, including treatment and distribution (I.C. 19-3-6.5 thru 35).
- (9) Rural water companies may provide water supply for public use.
- (10) Investor-owned public utilities may construct, operate and maintain public water supply systems under license, permit or franchise from the Public Service Commission (I.C. 8-1-2-91 thru 93).
- (11) The Indiana Port Commission is authorized to construct, maintain, and operate modern ports on Lake Michigan, and/or the Ohio River and/or the Wabash River (I.C. 8-10-1-1).
- (12) The County Commissioners are authorized, upon petition of 24 freeholders of the county in the vicinity of the stream, to declare any stream or water course in the county navigable (I.C. 13-2-4-1).
- (13) Any municipal corporation, county or any combination of municipal corporations, county or counties may create a port authority (I.C. 8-10-5-1).

Ground Water

General Policies

- (1) It is the policy of the state to conserve and protect the ground-water resource and to provide regulations for its most beneficial use and disposition (I.C. 13-2-2-2).
- (2) The Natural Resources Commission is authorized to require the reduction of flow from flowing wells in order to prevent the loss or waste of potable water not being put to beneficial use (I.C. 13-2-3-1).
- (3) It is unlawful to accelerate the natural flow or the production of an unnatural flow of certain mineral waters (I.C. 13-2-6-1).
- (4) It is the policy of the state to provide for the comprehensive environmental development and control on a state-wide basis in order to preserve, protect, and enhance the quality of the environment and to assure, to the extent possible, clean air, clean water and a healthful environment for future generations (I.C. 13-7-1-1).
- (5) The Stream Pollution Control Board shall have jurisdiction to control and prevent pollution in waters of this state (I.C. 13-1-3-4).
- (6) It is the policy of the state to protect waters and lands in the state against pollution and the loss of impairment of water resources, and to that end to provide additional means whereby abandoned or leaking oil and/or gas, or salt water injection wells may be plugged, replugged or repaired by or under authority and direction of the Department of Natural Resources (I.C. 13-4-4-1).
- (7) It is hereby declared that it is in the public interest for the state to provide the means whereby test holes for or in connection with fluid disposal investigation, mineral resources investigation, engineering projects investigation or geologic investigations are drilled, utilized and plugged in such manner as to prevent pollution, impairment and/or waste of natural resources (I.C. 13-4-5-1).
- (8) Oil and gas operators must file bonds to ensure the proper plugging of oil and gas wells, dry holes and test holes to confine permanently all oil, gas, and water in the separate strata originally confining them (I.C. 13-4-7).

Rights to Use

- (1) A modified absolute ownership doctrine which does not restrict the use of ground water by the owner of the land above it except when it is used in a malicious or wasteful manner.

Management

Use

- (1) It is the policy of the state to conserve and protect the ground water resources and provide regulations for its most beneficial use and disposition (I.C. 13-2-2-2), thus the Natural Resources Commission is authorized to designate restricted use areas, so withdrawal of ground water does not exceed the natural replenishment of the source (I.C. 13-2-2-3).
- (2) The Natural Resources Commission is authorized to require reduced flow from flowing wells to prevent loss or waste of water not being put to beneficial use (I.C. 13-2-3-1). Also, the Commission requires one to obtain a permit before injecting potable water in underground formations which contain nonpotable water (I.C. 13-2-3-2).

Facilities

- (1) All well-drilling contractors are required to obtain a permit from the Natural Resources Commission (I.C. 25-39-1-1).
- (2) County Commissioners may enact ordinances and regulations to control the location, construction, or repair of all wells located within the county. Cities and towns may do the same within their jurisdiction (I.C. 17-2-22-4.5).

Quality

- (1) The Stream Pollution Control Board is authorized to control and prevent pollution in waters of the state with any substance deleterious to public health or to the prosecution of any industry or lawful occupation, or destructive or injurious to fish life or to any beneficial animal or vegetable life (I.C. 13-1-3-4).
- (2) The Environmental Management Board is to develop policies to provide for the comprehensive environmental development and control on a state wide basis in order to preserve, protect, and enhance the quality of the environment and to assure, to the extent possible, clean air, clean water and a healthful environment for future generations (I.C. 13-7-1-1).
- (3) Oil and gas operators must file bonds to ensure the proper plugging of oil and gas wells (I.C. 13-4-7).
- (4) It is the policy of the state to protect waters and lands in the state against pollution and the loss or impairment of water resources, and to that end to provide additional means whereby abandoned or leaking oil and/or gas, or salt water injection wells may be plugged, replugged or repaired by or under authority and direction of the Department or Natural Resources (I.C. 13-4-4-1).
- (5) Permits are required for test holes for fluid disposal, mineral resources, engineering projects and geologic investigations, including provisions for the proper plugging thereof (I.C. 13-4-4-1).

Research and Basic Data

- (1) The Department of Natural Resources may designate an area as a restricted use area for ground water. Such designation is subject to prior surveys of ground water in the area and a determination of safe annual yield (I.C. 13-2-2-3).
- (2) The Water Resources Research Act of 1965 provides for necessary water resources research programs and studies; and the administration and execution of those programs (I.C. 13-2-7-1 thru 4).
- (3) This Act authorizes the investigation and measurement of water resources by the Department of Natural Resources either directly or in cooperation with appropriate federal agencies (I.C. 13-2-8-1).

Planning

- (1) The Flood Control Act calls for overall water resources planning which would include ground water since it is considered a water resource (I.C. 13-2-22-1 thru 12).

Institutional Arrangements

- (1) A permit must be acquired from the Natural Resources Commission in order to inject, pump, or otherwise induce potable water into underground formations which contain non-potable water (I.C. 13-2-3-2).
- (2) The Environmental Management Board (EMB) has a general charge to preserve, protect, and enhance the quality of the state's beneficial use of its resources. Therefore, the EMB is authorized to classify all water and wastewater systems (I.C. 13-1-6-1), adopt rules, regulations and standards at least as stringent as applicable standards and any contaminants into state waters (I.C. 13-7-10-3).
- (3) The EMB is to encourage, assist, and advise local governmental units in developing facilities or establishing standards for, among other things, water pollution control, including waste treatment (I.C. 13-7-15-2).
- (4) The Stream Pollution Control Board (SPCB), operating under the general overview of the Environmental Management Board, has been granted the jurisdiction to control and prevent pollution in the waters of the state (I.C. 13-1-3-4).
- (5) The Natural Resources Commission is empowered to protect the lakes, streams and springs of the state against impurities or pollution by industrial, municipal or other sewage waste (I.C. 14-3-1-14).

- (6) The Natural Resources Commission is authorized to require reduced flow from flowing water wells to prevent loss or waste of potable water not being put to beneficial use (I.C. 13-2-3-1).
- (7) A contractor is required to obtain a renewable annual license from the Department of Natural Resources for drilling water wells (I.C. 25-39-1-1).
- (8) County Commissioners may enact ordinances and regulations to control the location, construction, or repair of all wells located within the county. Cities and towns may do the same within their jurisdiction (I.C. 17-2-22-4.5).

Erosion and Sedimentation

General Policies

- (1) The State has declared, as a matter of legislative determination, that the state's land and water resources are basic assets which must be preserved to protect and promote the health, safety, and general welfare of the people (I.C. 13-1-3-2).
- (2) It is hereby declared to be the policy of the General Assembly to provide for the conservation of the soil and water resources of this state, and for the control and prevention of soil erosion, and for the prevention of flood water and sediment damages--(I.C. 13-3-1-2). By enactment of enabling legislation, the General Assembly has established the policy that lands subjected to surface mining should be reclaimed to prevent or minimize injurious effects to the people and natural resources of the state, including (among other objectives) the need to protect lakes and streams from pollution and to decrease soil erosion (I.C. 13-4-6-1; I.C. 14-4-2-1).
- (3) The State recognizes the need for water management in the form of new drainage projects to make land suitable for agriculture, homes, or industry; new facilities to dispose of sewage and other liquid wastes in order to prevent the pollution of rivers and streams or the overtaxing of the soil's natural filtering process; the reestablishment of ground cover to protect top soil, to prevent siltation of rivers and lakes, or to provide a natural habitat for wildlife; and the reestablishment of the natural recreational facilities associated with water so that more of the public may enjoy it (I.C. 19-3-2-1).

Rights to Use

N/A

Management

Use

N/A

Prevention and Control

- (1) The Natural Resources Commission is empowered to grant, suspend, revoke, modify, or release permits for surface mining (I.C. 13-4-6-3).
- (2) Police powers are used to provide for conservation and improvement of strip mine areas (I.C. 13-2-25-1)
- (3) State agencies with duties of public highway construction and maintenance are authorized to protect such highways against the waters of streams, watercourses, ditches, and drains when the stream is causing or threatening to cause damage by erosion, wash, slides, change of course or overflow (I.C. 13-2-25-1).
- (4) County soil and water conservation districts are authorized to carry out preventive and control measures on specified lands and to otherwise cooperate with, support and encourage soil and water conservation, erosion control, flood prevention, and outdoor recreation measures and projects on private lands within the district (I.C. 13-3-1).
- (5) Conservancy districts can pursue flood prevention and control, drainage improvements, forest development, wildlife areas and parks and recreational facilities where feasible in connection with beneficial water management, prevention of loss of top soil from injurious water erosion, storage of water for augmentation of stream flow, and operation, maintenance, and improvement of any existing work of improvement for water based recreational activities among other activities (I.C. 19-3-2).

Quality

- (1) Erosion and sedimentation do impact upon land and water quality. Sediment is regarded as a pollutant in water. Management tools used to prevent erosion and sedimentation from occurring, and thus affecting quality, are listed above. The development of non-point pollution control plans (including erosion and sedimentation) pursuant to Section 208 of P.L. 92-500 is in progress.

Research

Basic Data and Planning

- (1) The State Soil and Water Conservation Committee is authorized to provide support and assistance to the local soil and water conservation districts by granting funds and by coordination and consultative services (I.C. 13-4-3-8).
- (2) The DNR is directed to utilize appropriated funds to expand the small watershed program, which includes land treatment measures (I.C. 13-4-3-9).
- (3) Soil and water conservation districts are charged to cooperate with the state or its agencies in conducting surveys, investigations, and research relating to the character of soil erosion and water losses and the preventive and control (measures) needed, in publishing the results of such research, and in disseminating information concerning such preventive and control measures; and to cooperate with the state or its agencies in conducting demonstrational projects to show by example the means, methods, and measures by which soil and water resources may be conserved, floods prevented, and soil erosion prevented and controlled (I.C. 13-3-1-8).

Institutional Arrangements

- (1) The DNR, through the State Soil and Water Conservation Committee, provides assistance and support to local soil and water conservation districts through appropriated funds (I.C. 13-4-3-8).
- (2) The DNR, through the State Soil and Water Conservation Committee, assists the small watershed planning program through use of appropriated funds (I.C. 13-4-3-10).
- (3) The Natural Resources Commission is empowered to grant, suspend, revoke, modify, or release permits for surface mining (I.C. 13-4-6-3).
- (4) The State Soil and Water Committee was established to assist supervisors of soil and water conservation districts and conduct other functions (I.C. 13-3-1-4).
- (5) Soil and Water Conservation Districts are governmental subdivisions of the State and carry out the functions assigned them (I.C. 13-3-1-8).
- (6) Conservancy districts are established to conduct activities as outlined in (I.C. 19-3-2-1) and in "Prevention and Control" above (I.C. 19-3-2-3).

Drainage

General Policy

- (1) By enactment of enabling legislation, the General Assembly has established policy for the construction, reconstruction, and maintenance of all legal drains.
- (2) It is illegal to undertake any drainage activities which might cause the lowering of the water level in public fresh water lakes (I.C. 13-2-17-1).
- (3) It is unlawful to conduct any activity in the floodway of any watercourse of the state which will adversely affect efficiency or restrict the capacity of the floodway, constitute a hazard to the safety of life or property, or have detrimental effects upon fish, wildlife and botanical resources. Therefore, any person wishing to undertake any construction activities on any floodway must first obtain approval from the Natural Resources Commission; however, approval is not needed for projects on those streams or legal drains in agricultural areas where the total length of the specific stream or legal drain is ten miles or less (I.C. 13-2-22-13).
- (4) Cities have been granted the power to establish, maintain and control watercourses within a distance of ten miles from the corporate limits but not beyond the county line in which the city hall is located. These powers include the ability to dam, widen, straighten, dredge, change the channels of or remove an obstruction in any watercourse (I.C. 13-1-1.5-9).
- (5) Fifty-one percent of the frontage land owners bordering on any non-navigable stream may petition their county commissioners requesting that a portion of the stream between two designated points be cleaned out or improved to provide adequate capacity (I.C. 17-2-29-1).
- (6) Conservancy Districts can be established to undertake activities for improving drainage (I.C. 19-3-2-1).
- (7) Soil and Water Conservation Districts have been established in Indiana to promote wise and efficient use of the state's land and water resources, including measures such as flood preventing reservoirs and channels, terraces, terrace outlets, check dams, dikes, ponds, ditches and the like (I.C. 13-3-1-2).

Rights to Use

- (1) The use of diffused surface water, frequently the reason for drainage work, shall not be regarded as public water and the owner of the land on which such water falls, pools, or flows, shall have the right to its use (I.C. 13-2-1-2). This is also the common law rule in Indiana.
- (2) High ground water levels are also a reason for drainage work. The rule in Indiana appears to be that the use of ground water by the overlying owner is not restricted except when it is used in a malicious or wasteful manner.
- (3) Once either diffused surface water and/or ground water is collected in a watercourse, its use is governed by the riparian doctrine of reasonable use.

Management

Use

- (1) Management of the use of diffused surface water is by the land owner.
- (2) Management of the use of ground water is by the land owner.
- (3) Management of the use of water in streams and watercourses is by the riparian owner and recourse for settlement of questions of reasonable use is to the courts.

Construction and Maintenance

- (1) Each county has a county drainage board which has primary responsibility for the construction, reconstruction, and maintenance of all legal drains except in areas where they have relinquished this responsibility to cities, towns, sanitary districts, conservancy districts, and any legal entity responsible for flood control and drainage (I.C. 19-4-1-1 thru (I.C. 19-4-1-5).
- (2) Each county has a County Surveyor whose duties are to investigate, evaluate, and survey all legal drains and prepare reports, plans and profiles necessary for proposed improvements (I.C. 19-4-1-9).
- (3) The County Surveyor is responsible for removing any obstructions from legal drains and repairing damage (I.C. 19-4-6-2).
- (4) If obstruction or damage is caused by an owner of land affected by the land, the owner will be required to remove the obstruction and repair the damage (I.C. 19-4-6-3).
- (5) If the connection of a private drain would cause or add to pollution of the receiving waters, written approval must be obtained from the Stream Pollution Control Board and filed with the county drainage board (I.C. 19-4-6-7).
- (6) Any person wishing to undertake any construction activities on any floodway must first obtain approval from the Natural Resources Commission; however, approval is not needed for projects on those streams or legal drains in agricultural areas where the total length of the specific stream or legal drain is 10 miles or less (I.C. 19-4-6-7).
- (7) Fifty-one percent of the frontage land owners bordering on any non-navigable stream may petition their county commissioners requesting that a portion of the stream between two designated points be cleaned out or improved to provide adequate capacity (I.C. 17-2-29-1).

Quality

- (1) If the connection of a private drain would cause or add to pollution of the receiving waters, written approval must be obtained from the Stream Pollution Control Board and filed with the county drainage board (I.C. 19-4-6-7).
- (2) If the Board of Sanitary Commissioners finds that a river, stream or other watercourse is being polluted, it may study the feasibility of building a sewage treatment plant and adopt a resolution stating the necessity for such a plant (I.C. 19-2-14-9).
- (3) Water in surface drains is surface water subject to the water pollution control jurisdiction of the Stream Pollution Control Board.

Planning

- (1) Each county has a County Surveyor whose duties are to investigate, evaluate, and survey all legal drains and prepare reports, plans, and profiles necessary for proposed improvements (I.C. 19-4-1-9).
- (2) In the drainage code, the General Assembly has provided a statutory framework for the construction and regulation of sewers and drains in first and second class cities.
- (3) The Board of Sanitary Commissioners has concurrent power with the Board of Public Works to construct and maintain main sewers and submain sewers and to construct and maintain storm sewers (I.C. 19-2-21-1 and 19-2-22-1).

Institutional Arrangements

- (1) The Drainage Code provides for county drainage boards to be created in each county of the state to have jurisdiction over all "legal drains" (I.C. 19-4-5-1).
- (2) In addition to the drainage board, each county has a County Surveyor whose duties are to investigate, evaluate, and survey all legal drains and prepare reports, plans, and profiles necessary for proposed improvements (I.C. 19-4-1-9).

- (3) Private drains may be connected with legal drains if permission is granted by the County Surveyor. But, if the connection would cause or add to pollution of receiving waters, written approval must be obtained from the Stream Pollution Control Board and filed with the county drainage board (I.C. 19-4-6-8 and 19-4-6-7).
- (4) Any owner of land affected by a final order or determination of a drainage board is entitled to judicial review (I.C. 19-4-8-1 to 7).
- (5) The Boards of Public Works of such cities have the power to construct, reconstruct, maintain, repair and regulate use of sewers and drains within their territorial limits (I.C. 19-2-11-1).
- (6) Insofar as the Department of Sanitation of a first or second-class city has power over sewers and drains, its power is not exclusive, but concurrent with the Board of Public Works (I.C. 19-2-11-3).
- (7) The Board of Sanitary Commissioners has concurrent power with the Board of Public Works to construct and maintain main sewer and submain sewers and to construct and maintain storm sewers (I.C. 19-2-21-1 and I.C. 19-2-22-1).

Floods

General Policy

- (1) It is hereby declared (a) that the loss of lives and property caused by floods, and the damage resulting therefrom, is a matter of deep concern to the state affecting the life, health and convenience of the people and the protection of property; that to prevent and limit floods all flood control works and structures, the alteration of natural or present water courses of all rivers and streams in the state should be regulated, supervised and coordinated in design, construction and operation according to sound and accepted engineering practices so as to best control and minimize the extent of floods and reduce the height and violence thereof; (b) that the channels and that portion of the flood plains of rivers and streams, which are the floodways, should not be inhabited and should be kept free and clear of interference or obstructions which will cause any undue restriction of the capacity of the floodways;---(d) that a master plan or comprehensive plan for the entire state, to control floods, and to accumulate, preserve and protect the water resources, should be investigated, studied and prepared; policy and practices established, and the necessary works constructed and placed in operation (I.C. 13-2-22-2).
- (2) It is hereby declared to be the policy of the general assembly to provide for the conservation of the soil and water resources of this state, and for the control and prevention of soil erosion, and for the prevention of flood water and sediment damage and for the conservation, development, utilization and disposal of water in the watersheds of the state, thereby to preserve natural resources, control floods, prevent impairment of dams and reservoirs, assist in maintaining the navigability of rivers and harbors, preserve wildlife, protect and promote the health, safety, and general welfare of the people of this state (I.C. 13-3-1-2).
- (3) The management of water being necessary to the welfare of Indiana, it is the policy of this act (Conservancy District Act)---to provide in one act a general procedure through which each of the various legitimate purposes, authorized in section 3 (includes flood prevention and control) may be attained where they are needed (I.C. 19-3-2-1).
- (4) The enactment of a number of acts enabling the construction of flood control works by state agencies, counties, cities and towns, and special districts is indicative of general state policy in support of flood prevention and control in the interest of the public health, safety and welfare.

Rights to Use

- (1) In the general case, flood water is a part of surface water (water in lakes and watercourses) and rights to its use are governed by the riparian doctrine of reasonable use.
- (2) If flood water from a watercourse escapes its natural channel never to return, but instead spreads over adjacent land, running in different directions or settling in pools or flats, it ceases to be a part of the watercourse and is considered diffused surface water. As such, the owner of the land has the right to its use. (I.C. 13-2-1-2).
- (3) Subject to prior state approval, any person, whether or not the owner of lands contiguous to or encompassing any watercourse, may divert the flood water of any watercourse for any useful purpose, including the purpose of storage (I.C. 13-2-1-6(1)).

Management

Use

- (1) Management of riparian uses is by the individual riparian. Recourse for questions as to use and reasonableness thereof is directly to the courts.
- (2) If flood water subsequently becomes diffused surface water, its management is by the land owner.
- (3) The diversion of the flood water of a watercourse is subject to prior approval by the state (I.C. 13-2-1-6).

NOTE: The major public concern with floods has been historically, and yet remains, in the area of the elimination or mitigation of flood damages arising from occupation and use of the flood plains. This concern has been expressed in a number of statutory enactments providing the basis for both regulatory and management measures for flood prevention and control at both state and local levels. These measures are classified generally as structural and non-structural (flood plain management), and are so treated herein.

Prevention and Control

Structural Measures - State

- (1) The NRC may construct flood control works or any part thereof and may do so in cooperation with agencies of this state, other states or the United States (I.C. 13-2-22-11).
- (2) The NRC shall procure and obtain flood control works from and through or by cooperation with agencies of the United States, by cooperation with and action of the cities and towns under the laws of the state relating to flood control, and by cooperation with and action of landowners in rural areas affected thereby, under the laws of the state related to levees (I.C. 13-2-22-11) (I.C. 13-2-22-12).
- (3) The Natural Resources Commission is authorized and empowered to represent and act for and in behalf of the State of Indiana, subject to the approval of the governor, in all matters of flood control and water resources of the state with the United States or any agency thereof, and with any other state or agency thereof; to cooperate with and obtain, approve and/or accept any flood control works from and through the Corps of Engineers; and to cooperate with and obtain, approve and/or accept any works or grants of any character or description from or through any agency of the United States relating to flood control and water resources, and to administer the expenditures of funds in connection therewith (I.C. 2-22-12).
- (4) The state or any agency thereof may, with the approval of the governor, give, grant or convey to any person, easements, rights of way and right and privilege to construct, maintain and operate any works or structures in connection with flood control or water resources on lands in which the state has any right, title or interest (I.C. 13-2-22-12).
- (5) No person shall construct or install any works of any nature for flood control and no court shall enter the final order establishing and ordering such works constructed, unless and until the proposed works and the plans and specifications therefor are approved by the Natural Resources Commission (I.C. 13-2-22-5) (I.C. 13-2-24-1).

Non-structural Measures (Flood Plain Management) - State

- (1) The Natural Resources Commission shall make studies of the area of the state affected by floods -- determine the best method and manner of establishing flood control, giving consideration to --- the flood plain regulation method (I.C. 13-2-22-11).
- (2) It shall be unlawful to erect, use or maintain in or on any floodway, a permanent abode or place of residence (I.C. 13-2-22-13).
- (3) Any person desiring to erect, make, use or maintain, suffer or permit, a structure, obstruction, deposit or excavation to be erected, made used or maintained in or on any floodway shall first file a verified written application with the (Natural Resources) commission---and such person must receive the written authorization of the commission therefor prior to construction (I.C. 13-2-22-13).
- (4) The (Natural Resources) commission may by order establish a floodway as a commission floodway and alter, change, or revoke and terminate the same (I.C. 13-2-22-14).
- (5) The (Natural Resources) commission is authorized and directed to promulgate---appropriate rules and regulations, including consideration of non-conforming uses, as minimum standards for the delineation and regulation of all flood hazard areas within the state of Indiana (I.C. 13-2-22-5-2).
- (6) On and after July 1, 1974, local flood plain ordinances, rules and regulations are subject to review and approval by the (Natural Resources) commission for compliance with the state-established minimum standards for the delineation and regulation of flood hazard areas (I.C. 13-2-22-5-3).

- (7) The (Natural Resources) commission is authorized to provide technical data and information and otherwise assist any local unit in the identification and delineation of all flood hazard areas within the jurisdiction of that local unit, and in the preparation of all necessary ordinances, rules and regulations (I.C. 13-2-22.5-4).
- (8) Loans from the flood control revolving fund may be made to local units of government for the purpose of the establishment of floodways (I.C. 13-2-23).

General Measures - State

- (1) The (Natural Resources) commission shall encourage and promote local initiative and effort in providing flood control---and shall cooperate with, advise, disseminate information to, assist any person or agency in this state in matters relating to flood control (I.C. 13-2-22-11).
- (2) The Department of Conservation (Natural Resources) shall have power to investigate, compile and disseminate information and make recommendations concerning the natural resources of the state and their conservation; including---flood prevention (I.C. 14-3-1-3).
- (3) The (Natural Resources) commission shall have jurisdiction over the private and public waters in the state and the lands adjacent thereto necessary for flood control purposes or for the prevention of flood damage (I.C. 13-2-22-11).
- (4) The (Natural Resources) commission, its agents, engineers, surveyors and other employees may enter upon any lands or waters in the state for the purpose of making any investigation, examination, or survey contemplated hereby (flood control and water resources) (I.C. 13-2-22-7).
- (5) The (Natural Resources) commission shall make a comprehensive study and investigation---of the areas of the state affected by floods---determine the best method and manner of establishing flood control---adopt and establish a comprehensive plan or master plan for flood control---determine the best and most practical manner of establishing and constructing the necessary flood control works; and adopt appropriate measures for the prevention of flood damage (I.C. 13-2-22-11).
- (6) The (Natural Resources) commission shall have the right to exercise the power of eminent domain for its purposes (I.C. 13-2-22-10), and for acquisition of lands for reservoirs for storage of water for flood prevention and control (I.C. 13-2-9).
- (7) The (Natural Resources) commission, on behalf of the state, or any municipality, special taxing district, or public utility, which by other provisions of law has the right or duty to supply or store water for certain stated purposes (including flood prevention and control) may acquire by purchase (including condemnation) lands necessary for such water storage (I.C. 13-2-9.3).
- (8) The administration of the Flood Control Revolving Fund is vested jointly in the State Board of Finance and the (Natural Resources) commission (I.C. 13-2-23.2).

Structural Measures - Local

- (1) The State of Indiana, municipalities, special taxing districts, and public utilities may secure reservoir sites for purposes which include flood prevention and control (I.C. 13-2-9.1). Further, the Natural Resources Commission (NRC) is directed to encourage and promote local initiative in providing flood control and the development of water resources and to assist any person or agency in doing so (I.C. 13-2-22-11).

- (2) Subject to the approval of the NRC and the State Board of Finance any municipality may borrow funds up to \$100,000 from the Flood Control Revolving Fund for the purpose of instituting, accomplishing and administering any flood control program (I.C. 13-2-23-1).
- (3) Cities of the 2nd, 3rd, 4th, and 5th class may, by petition to the circuit court of the county, establish flood control districts for the purpose of undertaking flood control and relief projects (I.C. 19-4-18-2). Cities of the 1st class (Indianapolis) may create a department of flood control (I.C. 19-4-21-1). Also, cities of the 2nd, 3rd, 4th, and 5th class may construct levees when the Board of Public Works or the common council determine that this action is necessary for the protection of the city (I.C. 18-1-10-1). Any person lawfully authorized to maintain, protect, or repair any levee shall have the right to purchase for the use of the levee, whatever ground may be necessary to protect, maintain, or repair the levee (I.C. 13-2-19-1).
- (4) Conservancy Districts may be established for purposes which include undertaking actions for the prevention and control of flooding (I.C. 19-3-2-1), and Soil and Water Conservation Districts have been established in the state to promote the policy of conserving the state's soil and water resources and for the prevention of, among other things, damages due to flood water (I.C. 13-3-1-1).

Non-Structural Measures (flood plain management)-Local

- (1) Any person desiring to erect, make, use or maintain, suffer or permit, a structure, obstruction, deposit or excavation to be erected, made, used or maintained in or on any floodway must first seek and obtain authorization from the Natural Resources Commission prior to construction (I.C. 13-2-22-13).
- (2) The state has established minimum standards for the delineation and regulation of all flood hazard areas within the state and provided the means by which local units of government, based on minimum standards, can regulate the flood hazard areas within their jurisdiction (I.C. 13-2-22.5-1 et. seq.). Similarly, local units of government have been authorized to establish flood plain commissions which may regulate land uses within identified flood hazard areas (I.C. 18-7-4.5-1).

General Measures - Local

- (1) Cities and towns may petition in the circuit court of the county for specific or general relief for the purpose of lessening or preventing the inundation by flood water (I.C. 19-4-17-1).
- (2) No individual, partnership, association, corporation, municipal corporation, or political subdivision of the state may do any work designed to regulate or control state waters for flood control purposes without the approval of the Natural Resources Commission (I.C. 13-2-24-1 and I.C. 13-2-22-15).
- (3) Any municipality may borrow up to \$100,000 from the Flood Control Revolving Fund for flood control purposes, upon the approval of the Natural Resources Commission and the State Board of Finance (I.C. 13-2-23-3).

Quality

- (1) As a part of surface waters, flood water is subject to the water pollution laws of the state (I.C. 13-1-3; 13-1-4; 13-7-2-10).

Research and Basic Data

- (1) The Natural Resource Commission (NRC) is authorized to conduct investigations and measurements of water resources (I.C. 13-2-8-1).

- (2) The State Board of Health and the Department of Natural Resources are authorized to conduct applied research for the purpose of securing the scientific and technical data and information necessary for the solution of problems involving the wise beneficial development, use and management of the water resources of Indiana (I.C. 12-2-7).
- (3) The NRC is empowered to investigate, compile, and disseminate information and make recommendations concerning the state's natural resources and their conservation (I.C. 14-3-1-3).
- (4) The NRC shall cooperate with, advise, disseminate information to, assist any person or agency in this state in matters relating to flood control (I.C. 13-2-22-11).
- (1) The NRC is authorized to make a comprehensive study and investigation of all pertinent conditions of the areas in the state affected by floods and to adopt and establish a comprehensive plan for flood control (I.C. 13-2-22-11).

Planning

Institutional Arrangements

- (1) The accelerated soil survey program is administered through the State Soil and Water Conservation Committee, Department of Natural Resources, in cooperation with the U.S. Soil Conservation Service, Purdue Extension Service and the several counties and county soil and water conservation districts.
- (2) The general soil and water conservation program is administered by the State Soil and Water Conservation Committee, Department of Natural Resources, in cooperation with the 92 county soil and water conservation districts.