

GEOLOGIC RESOURCES

The earth provides all the natural resources for our economic well-being and security. Therefore, a thorough understanding of our earth, its geological resources and their useful capabilities is essential for effective resource and environmental planning in our modern society — now and in the future.

MINERALS

Michigan produces substantial amounts of mineral raw materials. In 1970, value of production amounted to \$684 million. By 1988, value had increased to \$2.3 billion. Mineral fuels increased from \$51 million to \$728 million and non-fuel minerals from \$684 million to nearly \$1.6 billion. In 1988, Michigan ranked fourth in the nation in the value of non-fuel mineral production. The State ranked first in calcium chloride, magnesium compounds and peat; second in bromine, sand and gravel, industrial sand and iron ore; and third in gypsum.

Trends in iron and copper production are indicated in figures 7 and 8. It is anticipated that non-fuel mineral production trends will continue as in the past. Demand for some minerals may decrease as they are impacted by the use of advanced composite materials.

The Geological Survey Division has been actively collecting earth resource information for more than 150 years and has amassed a very large and significant data base. Even though our data base is large, when considering Michigan's large land area (58,200 square miles), and resource potential, coverage density is less than desirable considering the need to resolve problems that require more and more detailed information. It is thus important to recognize deficiencies in our earth resource data base if we are to cope with present and future earth resource issues.

Program continuity is a necessity in fact-finding organizations. Among the casualties of Geological Survey Division's programs during the past 20 years are mine reclamation regulation, mineral wells regulation, general geology, mineral statistics and geological investigations. Cooperative programs with the U. S. Geological Survey Geologic Division and Topographic Division have been terminated. The absence of such programs creates a vacuum in the management of nonrenewable natural resources, and of the natural environment. Before we can manage our natural resources we must have defined what natural resources we have to manage.

OIL AND GAS

Earth Day 1970 found the United States on the brink of an energy crisis. Until the 1970's, energy was relatively inexpensive and abundant. The subsequent twenty years have seen major fluctuations in the price and quantity of energy available. The Mid-East oil embargo and subsequent increase in oil prices brought about a dramatic increase in oil and gas exploration and production in the State.

In part, the mandate of the Geological Survey, under the Michigan Oil and Gas Act, 1939 PA 61, as amended, is to ensure and encourage the proper development of the resources of the State, including fossil fuels. This includes monitoring the drilling, and production of oil and gas in the State to conserve our natural resource and to protect the environment.

Between 1970 and 1980 the annual production of oil and gas from Michigan tripled. Oil production peaked in 1980 at 34 million barrels, only 21 million barrels is projected for 1989. Since 1980, gas production has fluctuated but remains above 150 billion cubic feet per year (Figure 1).

The value of Michigan's oil and gas production, negligible in 1970, rose dramatically through the 1970's and early 1980's to become an important part of Michigan's economy (Figure 2). Since 1982, the annual value of oil has dropped by 60%. The value of gas has dropped 20% since 1985. The drop in gas value is wholly attributable to price decreases, while the plunge in the value in oil is due to the softening of world oil markets.

In Michigan, the total number of oil and gas discovery wells peaked in 1974. The number of discoveries remained more or less constant at approximately 70 per year from 1975 through 1985. The discovery rate has declined steadily since 1985. In 1987 and 1988, the number of natural gas discoveries exceeded the number of oil discoveries for the first time since 1977. These trends are indicative of the decline in oil prices in conjunction with more stable gas price levels. A steep drop in Michigan oil production, greater than 30%, through 1988 contrasts sharply with an overall drop of less than 5% in gas production.

Natural gas is now seen as a valuable, inexpensive, and environmentally clean fuel. Flaring, or the burning off of natural gas produced by oil wells, has not been permitted since 1973, except when permission is granted in special cases. Michigan's gas production as a percentage of consumption was at a tiny 5% in 1970 compared to 21% in 1988 (Figure 3). This trend is expected to continue through the 1990's.

During the late 1980's there were two significant exploration targets, first deep gas (6,000 - 12,000 feet), in the Prairie du Chien formation, and second shallow Antrim Formation gas. Although the Prairie du Chien drilling did not raise the number of permits issued significantly, in 1988 alone, the 68 producing Prairie du

Chien wells contributed 31 billion cubic feet, or about 20% of the State's total gas output. From 1984 through 1988, natural gas production rebounded to stabilize at near 1979-80 record levels. The number of permits issued for the shallower depth, (1,200 - 1,500 feet) Antrim Formation gas has greatly increased since 1987 (Figure 4). These shallow gas wells have been largely responsible for the increase in the number of permits issued since 1986.

Along with the development of oil and gas resources in the State came the rise of environmental awareness. Conducting a thorough on-site field review became mandatory before a permit could be issued. Permit applications were required to include environmental impact assessments and appraisals. In 1973, a subsurface natural gas blow-out incident, in Williamsburg, Michigan, spurred the enactment of more stringent casing programs for oil and gas wells.

The Michigan Oil and Gas Act, 1939 PA 61, has been amended four times since 1970. The administration of the Act requires the use of an extensive set of administrative rules which have been developed over the fifty years since the law was originally passed. One of the most significant amendments to the Administrative Rules was the promulgation of the hydrogen sulfide management rules in 1987. Hydrogen sulfide, a highly toxic gas is produced in conjunction with oil and gas operations in certain locations within the state. The enactment of administrative rules provides safety for workers involved with hydrogen sulfide producing operations, and the general public living near these operations.

In order to conserve resources, innovative methods have been employed to increase oil production. Secondary recovery projects were instituted in order to recover a higher percentage of the oil in place. While a few secondary recovery projects were instituted in the 1950's, the number of these projects peaked in the early 1980's (Figure 5). The remarkable increase in permits issued and successful oil well completions in the early 1980's can in large part be attributed to drilling in secondary recovery projects. This practice is expected to increase in the future as more oil fields become depleted, and the price of oil increases sufficiently to make it economical.

Without new oil and gas discovery wells being drilled and placed on production, the hydrocarbon reserves available to the nation will continue to be depleted. Unless efficient and reliable alternate energy sources can be found for fossil fuels, there will be an increased reliance on foreign supplies of hydrocarbons. An increased reliance on imported energy will contribute to instability of both the price and supply of oil and gas. Therefore, the monitoring of discovery rates and the evaluation of newly discovered domestic oil and gas reserves is an important element to be considered in planning our energy policies (Figure 6). Such policies may be developed or modified to encourage oil and gas exploration in Michigan.

MINERAL WELLS

The regulation of mineral wells - natural brine, solution mining, waste disposal and storage wells - commenced in 1969 with the passage of Act 315 of the P. A. of 1969 as amended, and consequently, the celebration of the 20th anniversary of EARTH DAY marks the 21st anniversary of the Mineral Wells Program.

Prior to 1969, this group of wells went completely unregulated in spite of the fact that they represented an extreme hazard in terms of potential for pollution. In the years which have ensued since the passage of the above noted legislation, this entire well universe has been brought into compliance with the law, though times of meager funding, hiring freezes, and personnel shortages, have often made the task difficult. At present all active mineral wells are under permit and operating in an environmentally sound manner, and a great many unused wells, formerly dormant or ignored, have been securely plugged and abandoned. The program still suffers from underfunding though efforts are underway, to amend the law making it more self supporting, and also to obtain additional general fund support.

As we celebrate EARTH DAY II we look forward with hope and anticipation to the possibility that new resources will be made available to continue effective surveillance and regulation in this economically significant and environmentally sensitive area.

GROUNDWATER

Prior to 1970, resource quantity and quality were the principal issues of Division groundwater programs. With increasing identification of groundwater contamination, programs to preserve, protect and restore evolved and became dominant. Groundwater is the source of 17 percent of public water supplies in Michigan, and approximately 43 percent of Michigan's 19 million residents rely on it for their needs. So, it is a most vital resource, which must be protected.

Division staff has provided support and services to other agencies such as Fisheries Management Division in locating and testing large supplies of groundwater for State Fish Hatcheries. They have assisted the Department of Public Health in the location of water supplies and sewage disposal areas for trailer parks and subdivisions. Other services provided to agencies include evaluating dredging in or around lakes, proposed impoundments, and the measurement of lake water levels.

More than 400,000 water well records are on file in the Division, and more than 40,000 copies are supplied each year to consultants, water well drillers, other professionals and the public. These records are in constant use by staff of the Geological Survey since they are essential to effectively evaluate hydrologic conditions in the subsurface.

There is a continuing cooperative program with the Water Resources Division of the United States Geological Survey. This program measures streams and lakes and monitors groundwater quality. This program may or may not be continued depending on budgetary constraints. Studies of local, county and regional areas respond to resource or environmental problems which when concluded, are distributed as maps and reports. Examples include groundwater investigation reports for Clinton, Eaton, Ingham, Kalamazoo, Keweenaw, Oakland and VanBuren Counties. Hydrologic Atlases have been published for several river basins as well as annual water resources and groundwater data for Michigan.

In recent years, groundwater investigation efforts have turned toward evaluation of potential contamination resulting from oil and gas operations. As a result, it has been determined that parties responsible for degradation of groundwater quality are responsible for remedial actions. Additionally, to cope more effectively with the expanding information base, a computerized groundwater data base system has been initiated.

In the long term, programs must return to providing more exhaustive definition of groundwater resources in both quantity and quality. When quality sources are identified, measures can be taken for their protection. An expanded groundwater data base program will be a key element in this effort.

DATA PROCESSING

The Geological Survey Division began using computers in 1978. Many changes and advancements have been made. Workstations are more numerous and powerful. Effective use of graphics is one key to the continued success of minerals resource management. If computer based systems were not used, many more people would be needed to provide the existing quantity and quality of service. As technology advances the GSD will continue to use appropriate tools. This will help maintain or increase the contributions from a decreasing reservoir of personnel and financial resources made available for mineral resource management efforts.

COASTAL SAND DUNE MANAGEMENT

In 1970, Michigan's coastal sand dunes were being stripped of their vegetation, leveled for development and literally mined away for industrial purposes without regard for proper management of the resource. In 1976, the legislature enacted the Sand Dune Protection and Management Act, 1976 PA 222, as amended; to provide a mechanism to regulate "mining" of the sand dunes. The law provided for the effective regulation of mining of the dunes by requiring permits from the DNR. The permit process requires the industry to prepare mining and reclamation plans, to pay a surveillance fee to fund administration, and to post reclamation bonds to guarantee that reclamation will be conducted. The law regulates 275,000 acres of Designated Sand Dune Areas along the Coastal zone area of Michigan. There are currently 22 active mining sites producing 2.5 million tons of sand per year. Michigan sand dunes are mined primarily for two purposes — to provide sand for the foundry industry for the casting of metals, and as construction fill. At the present time much of Michigan's heavy industry is dependent on these sand deposits.

The mining away of Michigan's sand dunes eliminates an irreplaceable natural resource that has environmental, recreational and aesthetic value for all the people of Michigan. In the future, we should strive to eliminate the mining of coastal sand dunes. This could be accomplished by finding and developing inland deposits and by developing new methods of metal casting that do not use sand.

COMPLIANCE

In 1981 the Division's Compliance Unit was initiated to insure that the Michigan Oil and Gas Act, 1939 PA 61 and other environmental laws administered by the Department of Natural Resources were applied consistently across the State. An encouraging outcome of the Division's enforcement efforts has been the development, in cooperation with the Oil and Gas Industry, of measures designed to help assure that the development of the State's oil and gas resources is carried out in an environmentally sound manner. It is expected that for the foreseeable future that the Division's compliance activity will continue to expand.

MINE RECLAMATION

Prior to 1970, surface mining activities in Michigan had disturbed over 40,000 acres of land in the effort to recover various minerals. The mining operations were unregulated, resulting in very little reclamation and restoration of the disturbed areas. In an effort to address this problem, the Michigan Legislature enacted the Michigan Mine Reclamation Act, 1970 PA 92, as amended. The purpose of this Act is to provide for reclamation of lands subjected to the mining of minerals, to control possible adverse environmental effects of mining, to preserve the natural resources, to encourage the planning of future land use, and to promote orderly development in mining.

The program, initially funded in fiscal year 1973-74, carried out the mandate of the Act continuously until 1982. In 1982, because of a severe shortage in available funds, the program was discontinued and has not since been reestablished.

Surface mining activities continue in Michigan, with only local controls established through zoning ordinances or special use permits providing for regulatory control. Because there is a law, the general public assumes that the State regulates these activities. They are unaware that the program is not being administered. The law should be amended to establish a reclamation fee, paid by the operators, which would fund the program. The law should be expanded to include all minerals mined by surface mining techniques, which are not specifically regulated by other statutes.

ANNUAL VALUE of Oil & Gas from Michigan

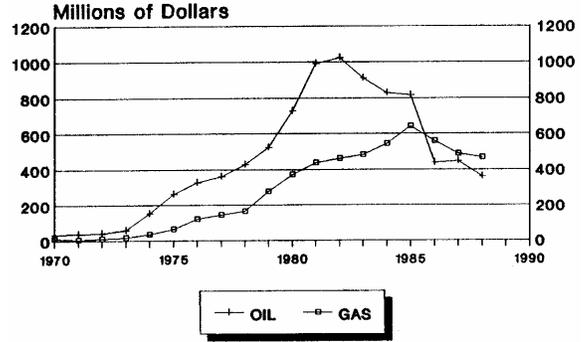


Figure 2

Imported vs In-State Gas used in Michigan

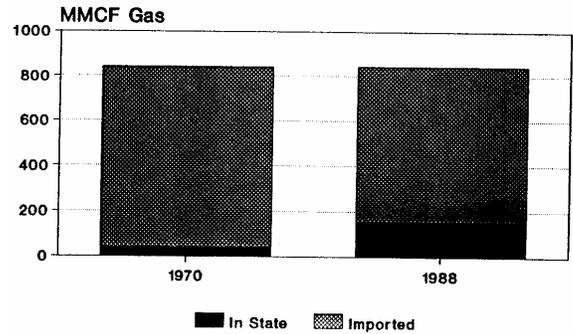


Figure 3

ANNUAL PRODUCTION of Oil & Gas in Michigan

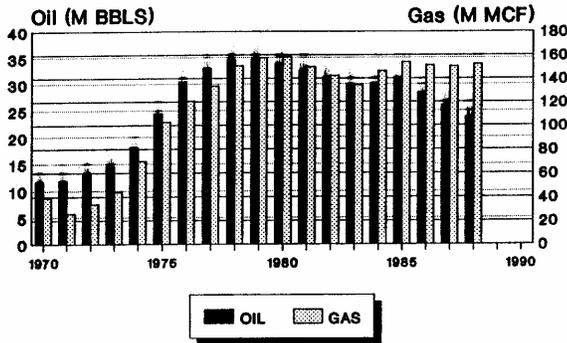


Figure 1

OIL & GAS PERMITS Issued in Michigan

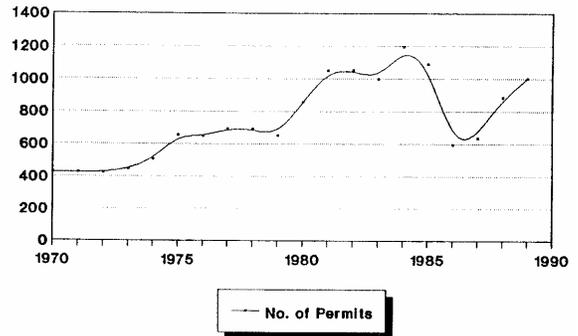


Figure 4

Successful Completions for Oil & Gas in Michigan

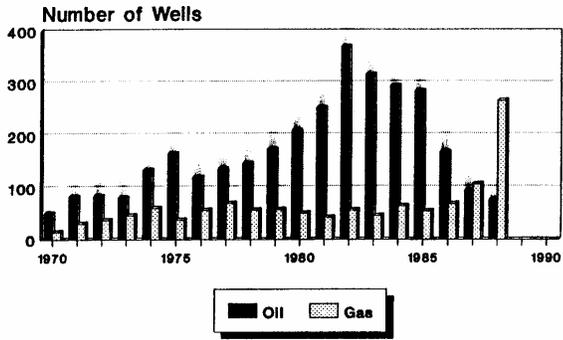


Figure 5

Oil & Gas Discoveries in Michigan

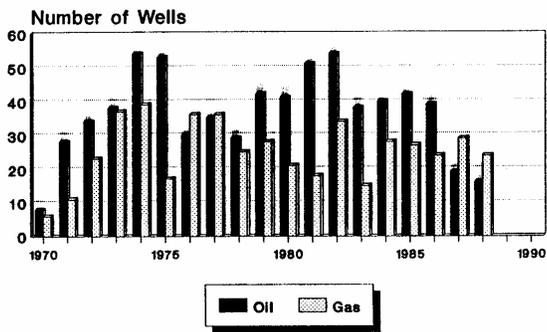


Figure 6

COPPER Produced in Michigan

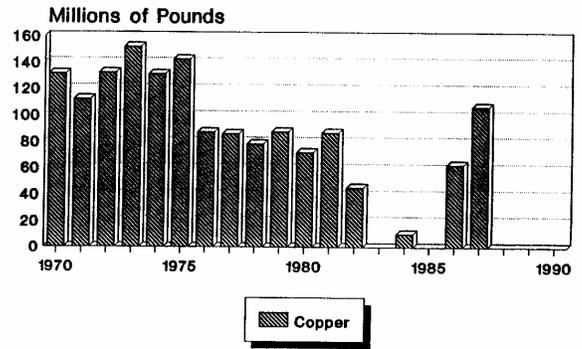


Figure 7

IRON Produced in Michigan

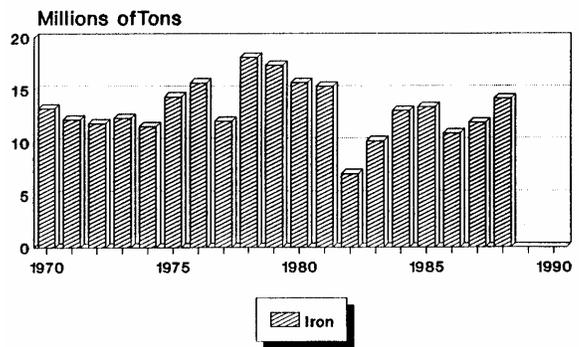


Figure 8