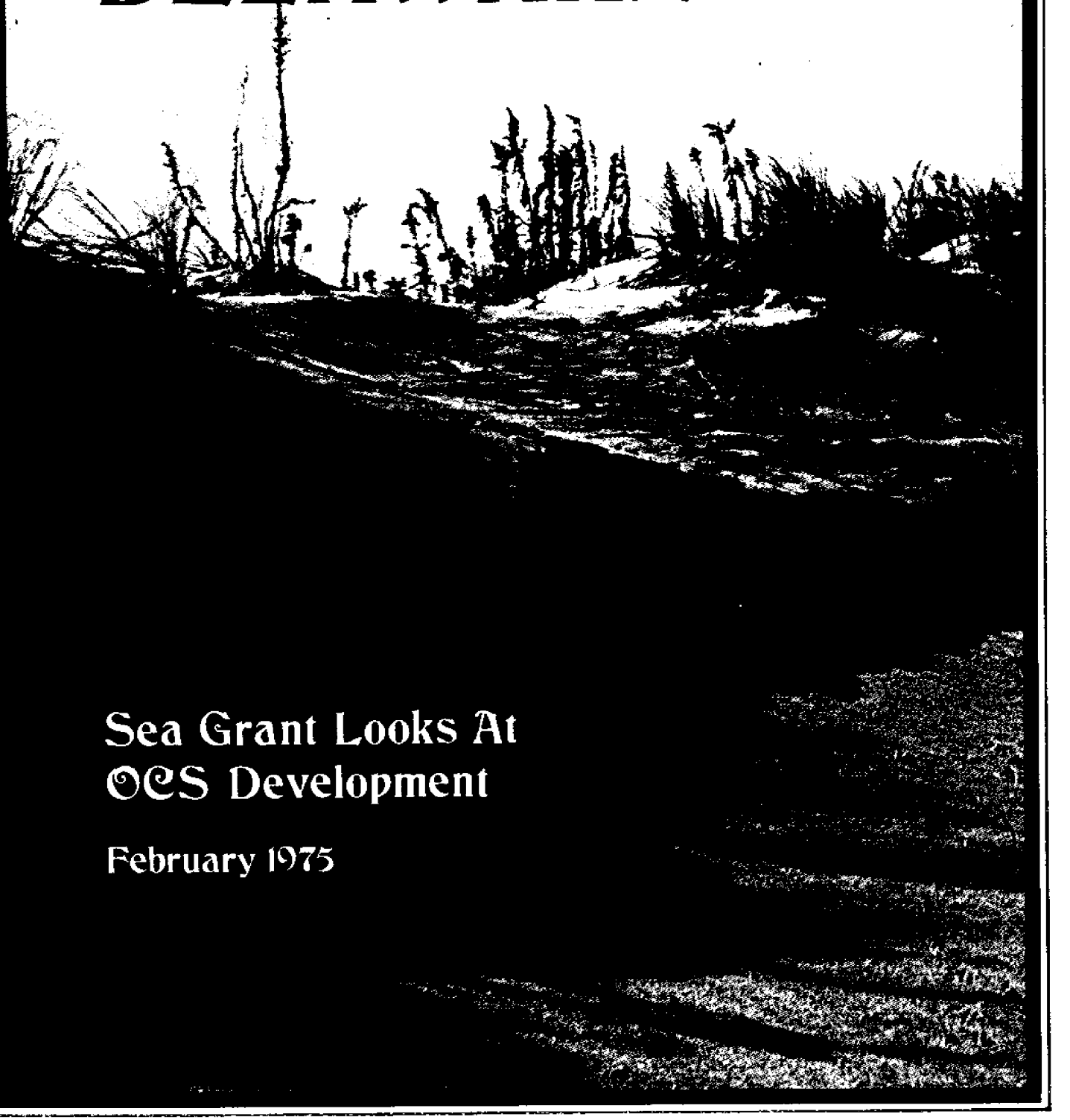
Decisions for DELAWARE



Sea Grant Looks At OCS Development

February 1975

DECISIONS FOR DELAWARE:
Sea Grant Looks At OCS Development

JOEL M. GOODMAN

Director of Coastal Zone Resources Planning

College of Marine Studies

University of Delaware

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This report is one of a University of Delaware Sea Grant series, *Decisions for Delaware*. Each report addresses a major marine resource problem or opportunity facing the state and the region. Topics were identified by the Sea Grant Advisory Council as being of high priority interest to decisionmakers and the public.

Twelve reports will be published during spring 1975 to interpret and summarize the state of knowledge on specific topics (see margin for titles and authors). Each author was asked to: (1) define the problem clearly and concisely; (2) describe what work has been done to solve or illuminate the problem; (3) explain the implications of existing information; (4) assess the risks of relying only on available information; (5) describe the research still needed to reduce these risks or unknowns; and (6) provide the decisionmaker with an assessment of what can be concluded reliably from available information.

Before publication, each report has been reviewed to be sure that it treats important topics clearly and understandably and contains accurate information.

The *Decisions for Delaware* series is designed to provide the legislators (and the people they represent) with alternatives and factual information on which to base their decisions.

William S. Gaither
Sea Grant Program Director

Delaware Sea Grant includes a broad spectrum of research, education and training, and advisory services related to wise development and use of marine resources. The program is a federal/state/university partnership, supported by an institutional grant from the National Oceanic and Atmospheric Administration's Office of Sea Grant; by a direct appropriation in 1974 from the Delaware General Assembly; and by the University of Delaware. Total Delaware Sea Grant investment this year is almost $1.3 million.

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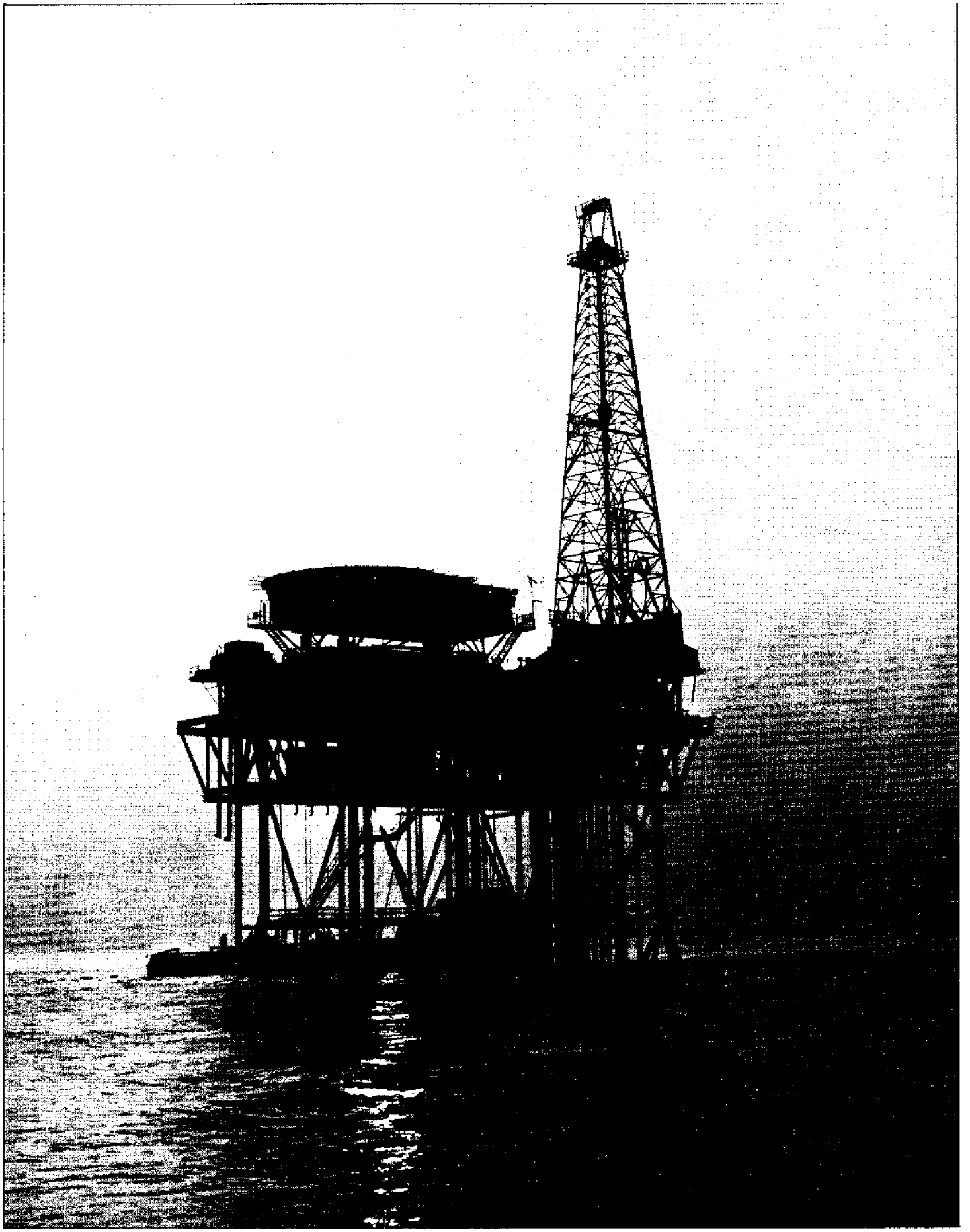


Summary

Assessing Delaware's options in exploiting the oil and gas resources on the outer continental shelf (OCS) is limited by some important unknowns. Only predictions can be made about the timing of activity, the amount of resources that will be discovered, and the limits to onshore activity that affected states may choose to impose. We do know that:

- *Lease sales are expected to be scheduled for late '75 and mid '77.*
- *The total Atlantic resource is expected to be small (contributing only 2.9% of the nation's total gas supply and only 1.8% of the total oil supply).*

The Baltimore Canyon Trough is the geologic feature off the Mid-Atlantic states that is the potential source of oil and gas. It is an area of approximately 5,000 square miles – roughly one-fifth the size of the OCS off Louisiana.

The activities necessary to develop the potential OCS oil and gas include:

1. *Geophysical survey – conducted to reveal sub-surface sediments that might trap oil and gas. Surveys began in the Baltimore Canyon Trough area in 1970*
2. *Exploratory drilling – conducted from very large, mobile, drilling platforms to locate and verify the presence of oil and gas*
3. *Development drilling and production – conducted from fixed platforms if commercially recoverable quantities of resources are found*
4. *Transportation of oil and gas – usually handled by pipelines*

Supporting activities that have onshore impact include transportation and storage of materials and construction and installation of platforms, separators and other similar facilities.

It is important to remember that production does not include processing activities such as refining. It is entirely possible that no new refineries, petrochemical plants, etc. would be sited in Delaware.

Experience in Louisiana, California, and Alaska indicates that the following situations may be encountered:

1. *Government services may be provided in support of OCS-generated activity without an adequate share of income derived from operations.*
2. *Petroleum-induced growth may fundamentally alter areas of a state through changes in population and land use.*

3. Although multiple-use conflicts can develop, these can be resolved by careful planning and localization of activity.

An estimate of Mid-Atlantic onshore activity has been prepared based on an assumed peak production of one million barrels/day and lease sales late in '75 and in mid '77. Under reasonable circumstances, peak OCS development activity would be reached by 1980 and continue through 1985. Production would last from 20 to 40 years.

The level of activity anticipated is significantly less than that now going on in the Louisiana and Texas Gulf areas. Population buildup in direct support of OCS activity would approach 15,000 after five years (if concentrated in one area, this would result in establishment of a community slightly smaller than Dover). The total population increase for all petroleum-based activity could be about 60,000. Rig crews (whose work cycles may require blocks of days on and days off) generally locate within 150 miles of their operations base, which probably would reduce the concentration of population. It is also likely that with the low level of OCS development predicted, specialized services will be provided from other centers of activity rather than duplicated in this area.

It is not likely that the entire 60,000 people would locate in Delaware.

Average income of the OCS work force probably will be higher than the state's current labor force, possibly as much as $2,000 to $3,000/year higher.

Probably the only unsightly facilities would be bulk storage tanks, and the visual impact can be reduced by planned isolation of the facilities.

Approximately 3,800 additional dwelling units would be required. If all were concentrated in Sussex County, this would be roughly the equivalent of a community the size of Rehoboth.

Combined county and municipality per capita expenditures would increase by about 40%, assuming a county-based population of 95,000.

The total land-use requirement to support OCS exploration and drilling activity is quite small, about 500 acres. Less than 100 acres of that need be at the water's edge (about 12,000 feet of shoreline two acres deep). Production facilities would require about another 500 acres. The land-use needs for pipeline corridors would depend on their routing.

From an environmental viewpoint, the greatest potential hazards are the spillage of oil and chemicals, and dredging or landfill activities associated with construction of onshore support facilities. Maps of already-developed OCS areas reveal the need for 12- to 15-foot channels for ship operations. Since these water depths are usually not found close inshore in this area, dredging would be required.

The overwhelming majority of oil spills are caused by human error rather than equipment failure, so the risk of catastrophic spills can never be entirely eliminated. However, strict regulation and training can do much to reduce the potential for occurrence. It is highly unlikely that a spill 40 to 50 miles out would reach Delaware shores. Storms or strong winds blowing onshore, however, could cause complications.

The water quality problems that already exist in the Delaware Bay coastal zone would be aggravated by the new industry and its increased population unless careful planning is done for onshore development.

There is a striking similarity between the lengths of the Louisiana coast and the Mid-Atlantic coast (from Sandy Hook, New Jersey to the border between Virginia and North Carolina). The similarity suggests that support activities in our region might be spread out along the coast in much the same way as they are in the Louisiana area, thereby decreasing the impact on any one area. The comparison also indicates that if additional refineries were required, they could be located well away from the coastal zone – in the second or third tier of counties, or even further. In contrast to the Louisiana situation, however, this would require joint action of the several states involved. With a cooperative plan, offshore logistic support could be offered from two or more sites with shoreline commitments no greater than that of the former Fish Products Co. facility at Lewes (84 acres). The states might also agree on pipeline routing corridors, revenue and cost sharing, and the regulation of OCS direct activity and induced development by region-wide planning and exclusions. Similarly, adverse impact could be minimized by adopting uniform safety standards and enforcement policies, training, and other activities.

It seems to be well within the power of the state governments to achieve this kind of control, but it demands concerted action.

With the ability to disperse activities along the coast, a population buildup of 15,000 in Delaware appears likely.

Frequent mention is made of the need for timely planning as a means for assuring orderly onshore and offshore development. The state government would do well to prepare an action calendar paced to the Bureau of Land Management sales plan, including milestone dates for forming regulatory bodies or authorities, taking legislative action, and publishing guidelines.

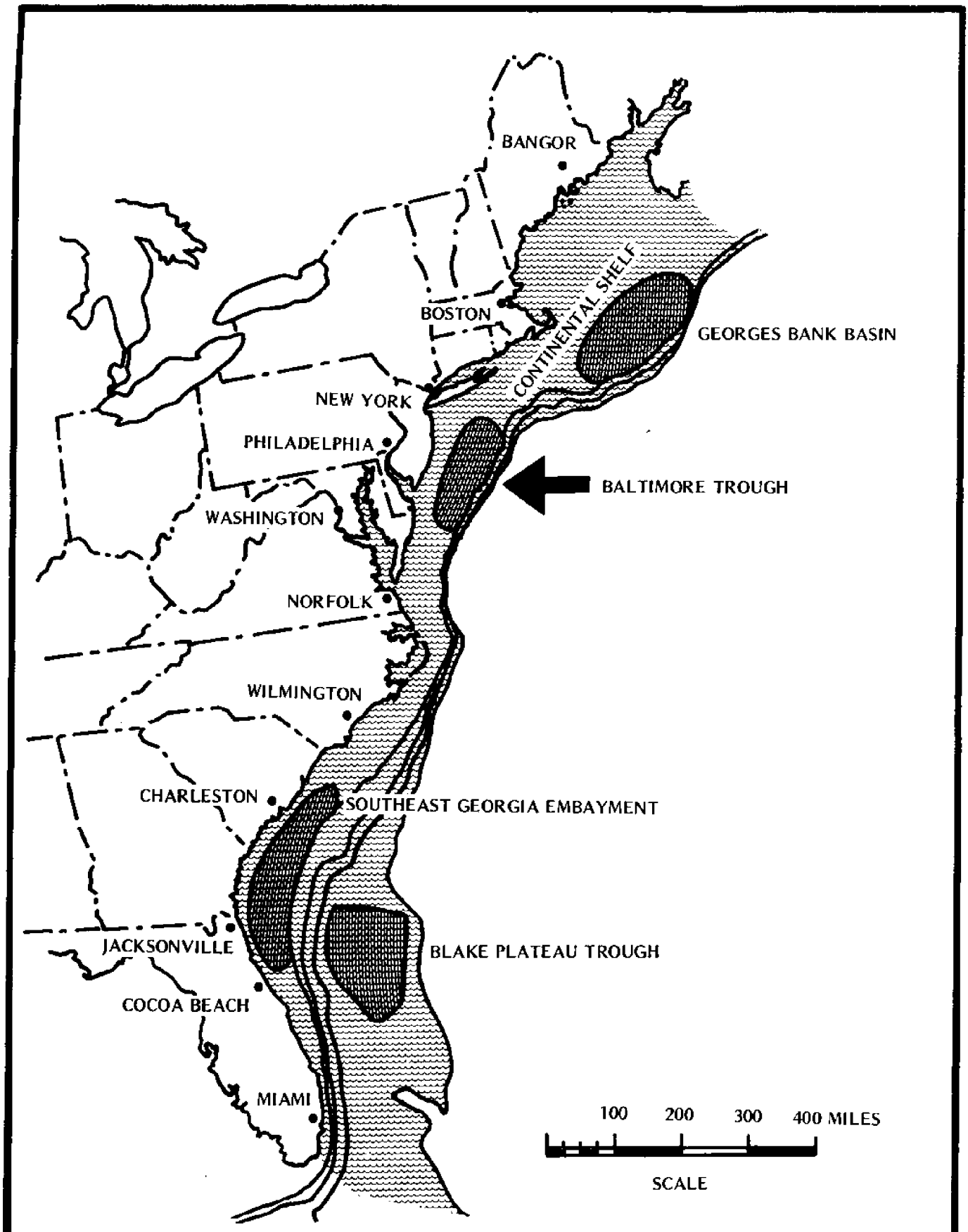


Figure 1. Location of Potential Atlantic Oil and Gas Resources

THE TOTAL ATLANTIC OIL AND GAS RESOURCE (IF ANY IS FOUND) IS EXPECTED TO BE RELATIVELY SMALL, PROVIDING ONLY 2.9% OF THE NATION'S GAS SUPPLY AND 1.8% OF ITS OIL. THE RESOURCES COULD BE DEVELOPED WITHOUT A BUILD-UP ON LAND OF PROCESSING FACILITIES, IF THE STATE SO CHOOSES.

Introduction

Delaware faces new and challenging decisions related to development of the adjacent outer continental shelf (OCS) area. The possible onshore impacts of developing OCS oil and gas resources, if they are found in commercial quantities, require prompt and critical examination. Whether or not there will be an impact, and its probable extent, depend partly on the laws of the state, partly on federal laws, and partly on industrial practices.

This report is written to give factual information on the potential effects of OCS development on Delaware. It assumes that existing laws or amended legislation will permit this activity under some set of legislative guidelines.

A number of approaches are available for exploiting OCS oil and gas resources, but assessing the alternatives is limited by some important unknowns:

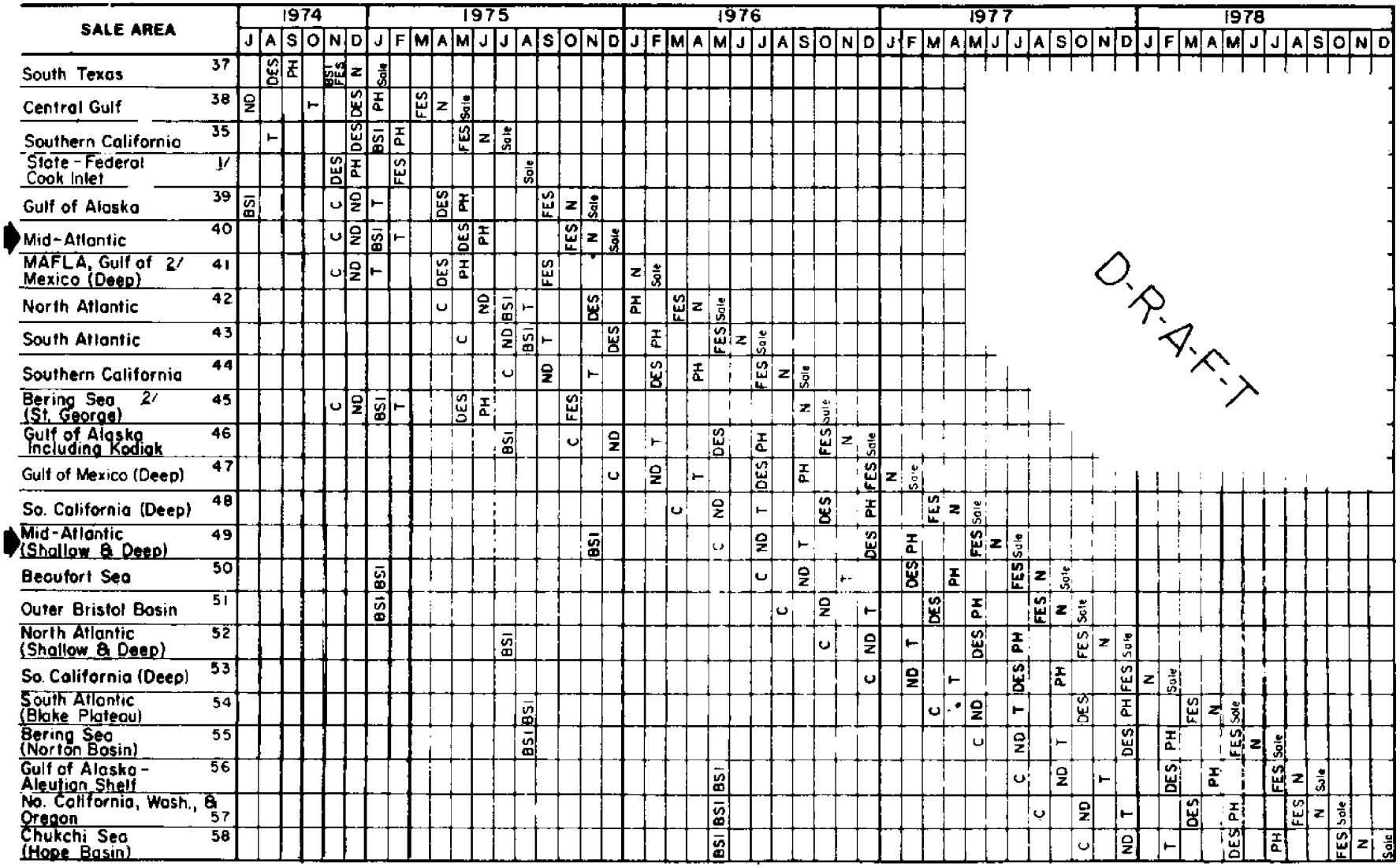
- *When will the adjacent OCS areas be offered for lease?*
- *Where are the resources located in relation to Delaware?*
- *How extensively dispersed are the resources?*
- *How much oil and gas will be found?*
- *At what rate will discovered resources be developed?*
- *What limits on onshore activity (directly related and/or secondarily related) will be imposed by the affected states?*

The first three questions were answered in a general sense by a news release from the Bureau of Land Management (BLM) on November 14, 1974. A revised lease schedule and a series of maps were published to advise the public of the Interior Department's plans. On figures 1 and 2, the information important to Delaware is identified by arrows. Lease sales for the Baltimore Trough of the Mid-Atlantic are scheduled for late '75 and mid '77. Answers to questions of quantity and onshore impact related to activity after leasing will be described in some detail in later sections of this report.

It should be noted that the National Petroleum Council's Committee on U.S. Energy Outlook estimated **total** discoverable oil-in-place resources as of 1972 for the entire Atlantic Ocean area (Georges Bank, Mid-Atlantic, and South-East) to be roughly equal to the resources already extracted from the Gulf of Mexico. So the total Atlantic resource is expected to be relatively small compared to other areas. Also, according to the Council's December 1972 report, the Atlantic resources are expected to provide a larger share of the nation's total gas supply (2.9%) than oil supply (1.8%).

The onshore impact of developing and producing OCS oil and gas should be considered separately from the issues of building new refineries or petrochemical facilities that would process the crude oil or gas. Exploration and production can occur in the Mid-Atlantic with or without a buildup on land of refineries, petrochemical plants, etc. The degree of development and siting of facilities for the latter depend on the answers to a different series of questions that will be described only briefly in another section of this report. This report concentrates on the potential impacts of OCS development and production and does not examine in detail Delaware's options in regard to product processing, which requires additional information and independent decisions.

HERE IS INTERIOR DEPT.'S "LEASE LINE" – showing the proposed OCS planning schedule for '74-'78 from initiation of baseline studies through notice of sale. In CZM,13Nov, we presented dates for calls for nominations and possible sales which we obtained prior to release of this schedule. You may update that CZM breakout by adding the MAFLA, Gulf of Mexico (deep) and Outer Bristol Bay areas, with nominations to be called for in Nov'74 and Aug'76, respectively, and sales seen in Feb'76 and Oct'77, respectively. The '75 lease schedule wasn't available last week, but now can be gleaned from this chart. Look for nominations anytime on MAFLA (deep) and Gulf of Alaska.



BSI Baseline Studies Initiated
C Call for Nominations
ND Nominations Due
T Announcement of Tracts
DES Draft Environmental Statement
PH Public Hearing
FES Final Environmental Statement
N Notice of Sale

Baseline studies scheduled are contingent upon scientific personnel and equipment being available to perform the studies.

The holding of sales in the Atlantic is dependent upon the outcome of pending litigation with the Atlantic States regarding jurisdiction over this area.

Sales are contingent upon technology being available for exploration and development. A decision whether to hold any of the lease sales listed will not be made until completion of all necessary studies of the environmental impact and the holding of public hearings; as a result of the environmental, technical, and economic studies employed in the decision-making process, a decision, may, in fact, be made not to hold any sale on this schedule.

1/ State may conduct sale.

2/ These sales could be contingency sales for either Gulf of Alaska (39) or Mid-Atlantic (40).

Figure 2. Interior Department's "Lease Line" (11/14/74)

THE BALTIMORE CANYON TROUGH IS THOUGHT TO INCLUDE ABOUT THREE MILLION ACRES (40 TO 50 MILES OFFSHORE) THAT COULD HOLD OIL AND GAS. UNTIL HOLES ARE ACTUALLY DRILLED, NO ONE KNOWS FOR SURE.

The Baltimore Canyon Trough

The continental margin of eastern North America is bordered by several troughs. The geologic term *trough* describes a depression of the earth's surface (trough-shaped), usually at least 10 miles long. Troughs often are filled with sedimentary rock, and there may be no surface evidence of their existence.

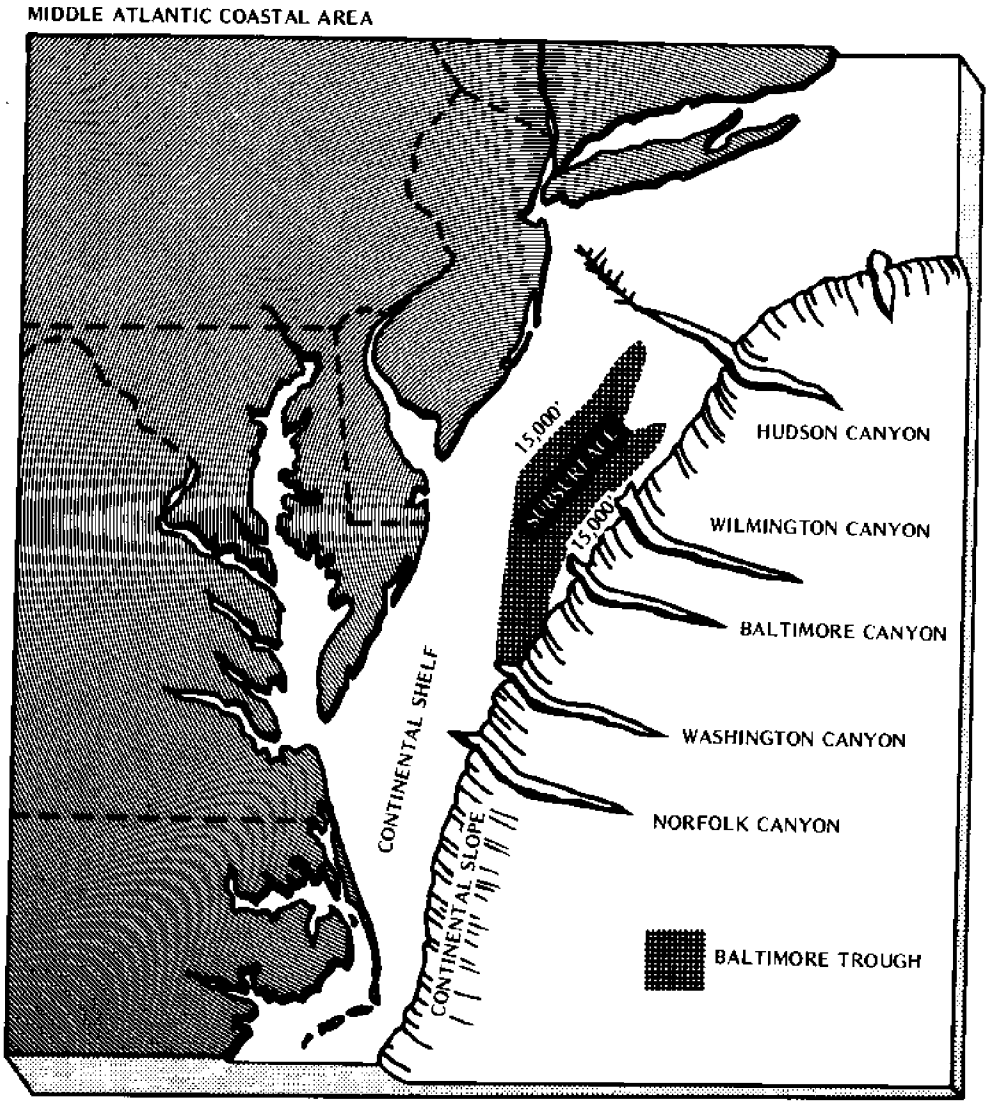


Figure 3. Mid-Atlantic Coastal Area/Baltimore Trough Location

The Baltimore Canyon Trough was identified in 1959 by Drake, et al., and named by Maher (1965). As is common geologic practice, the name was taken from a nearby major feature in the area, the Baltimore Canyon. The Baltimore Canyon, a prominent valley on the edge of the continental shelf, should not be confused with the subsurface Baltimore Canyon Trough (see figure 3).

The Baltimore Canyon Trough is known only from geophysical exploration and much of the data are held confidential by petroleum companies. The geographic extent of the Trough is not precisely defined, and its internal structure and rock composition are poorly known from available information.

The Trough appears to run approximately parallel to the coast for about 200 miles, with its western edge 40 to 50 miles offshore. Maximum width is about 20 to 30 miles. It extends from off the southern Delmarva Peninsula to off northern New Jersey. Thus, it contains approximately 5,000 square miles (25 x 200), or about 3.2 million acres. This compares with more than 16 million acres in the troughs off Louisiana.

The Baltimore Canyon Trough contains a thick mass of sedimentary rock. Again, available geophysical records are scanty and subject to considerable interpretation. Indications are that the Trough contains at least 30,000 feet of sediment, and the maximum thickness may prove to be as much as 50,000 feet. Oil and gas are found in sedimentary rocks, so the area is attractive for exploration because of the great volume of such rock present.

Petroleum or gas will not be found distributed uniformly throughout this large amount of sedimentary rock. These materials accumulate in "traps" in the rocks. Since oil and gas are fluids lighter than water, both tend to seep upward

through the rocks until they reach a trap (figure 4). If no traps exist, then the upward movement continues until the petroleum and gas reach the seafloor and are lost.

If the proper structures are present within the Trough, those sites would probably be prime candidates for drilling. Lacking further information at this time about the structure of the Trough and its relationship to the surrounding region, the entire complex should be considered as a generalized target for exploration. More specific subdivisions will be selected for intensive exploration as additional information becomes available.

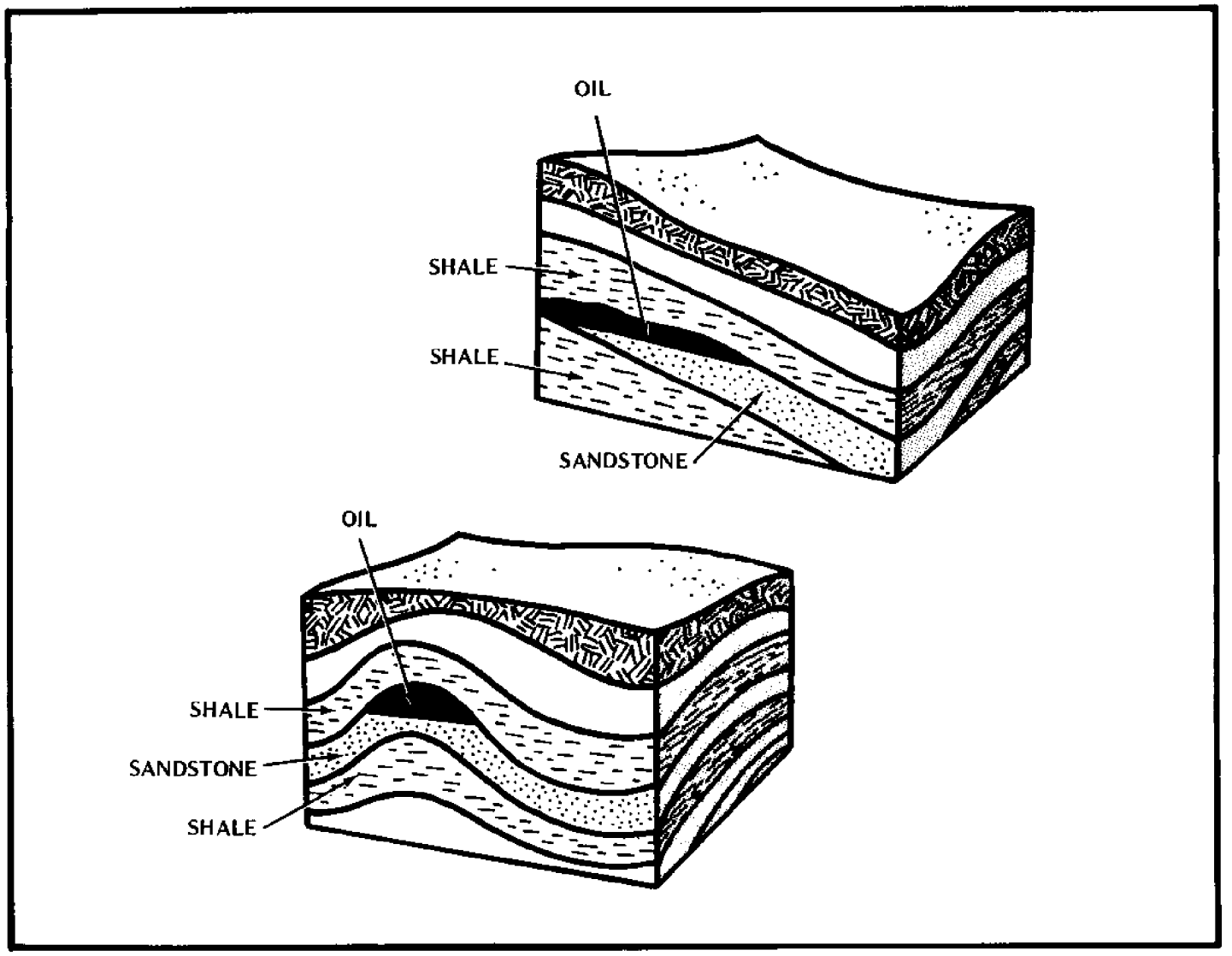


Figure 4. Oil/Gas Traps in Sedimentary Rock

GEOPHYSICAL SURVEYS CONDUCTED SINCE 1970 HAVE LED TO ESTIMATES OF A POTENTIAL ONE MILLION BARRELS A DAY FROM THE BALTIMORE TROUGH. THE NEXT STEPS ARE EXPLORATORY DRILLING AND PRODUCTION.

Steps in Developing Offshore Oil and Gas

Concern about the potential impact of OCS activity in Delaware can be expressed through the following series of questions, which is by no means complete:

- *What do systems look like that are needed to support OCS activity?*
- *How many and what kinds of people will be brought into a support area as a result of OCS activity?*
- *How much land is needed?*
- *What is the relationship between construction phase and operation phase activities?*
- *What options exist for arranging the physical lay-out of OCS-related activities?*
- *How can we protect our recreation and fishing areas from the effects of potential oil spills?*

The next few sections provide a summary of what we know about the subject of OCS development that can help answer these questions. First, as background, a brief descriptive explanation of the types of activities normally associated with OCS development is provided. This is followed by a rough estimate of the level of activity that can be expected if production of one million barrels per day can be sustained from the Baltimore Trough. Finally, the potential population and onshore impact is evaluated based on the experience of others and adjusted for the scale of activities expected in this region.

OCS development begins with geophysical surveys, followed in sequence by exploratory drilling, development drilling and finally, production.

Geophysical surveying uses small shock waves set off near the water surface and sensitive recording devices towed behind small vessels to determine the density of sediments lying thousands of feet beneath the ocean bottom. Geophysicists interpret the results of these surveys to predict where oil and gas deposits are likely to be found. Figure 5 shows a schematic view of the geophysical surveying operation, which is conducted independently by both the federal government and industry.

Unless very extensive oil and gas resources exist in an area, no permanent onshore support facilities are needed by geophysical contractors. Along the Delaware coast, considerable geophysical surveying has been done since 1970 to estimate the extent of the Baltimore Trough formation.

When geophysical surveys reveal oil- and gas-bearing structures, lease sales may follow. Each interested organization uses the geophysical survey information at its disposal upon which to base its call for nominations (selection of blocks to be included in the lease sale) and later, its bids for tracts of ocean bottom. The nominations submitted are confidential information, since they reveal each company's interpretation of geophysical information it has available. Groups of companies frequently bid together, designating one as the operator. Leases are made for five years and remain in effect as long thereafter as production continues.

Exploratory drilling follows lease sales. Seismic surveys only imply that oil and gas are present in sediments beneath the shelf. Holes must be drilled into the promising deposits to determine positively whether petroleum is present. Until this is done and petroleum is found, the Baltimore Canyon Trough off Delaware can only be regarded as a *potential* source of oil and gas.

Sophisticated drill rigs (semisubmersible, jack-up, or floating) are used to drill exploratory holes to locate (or verify the presence of) gas or oil. The rigs are towed to the leaseholdings from any of a

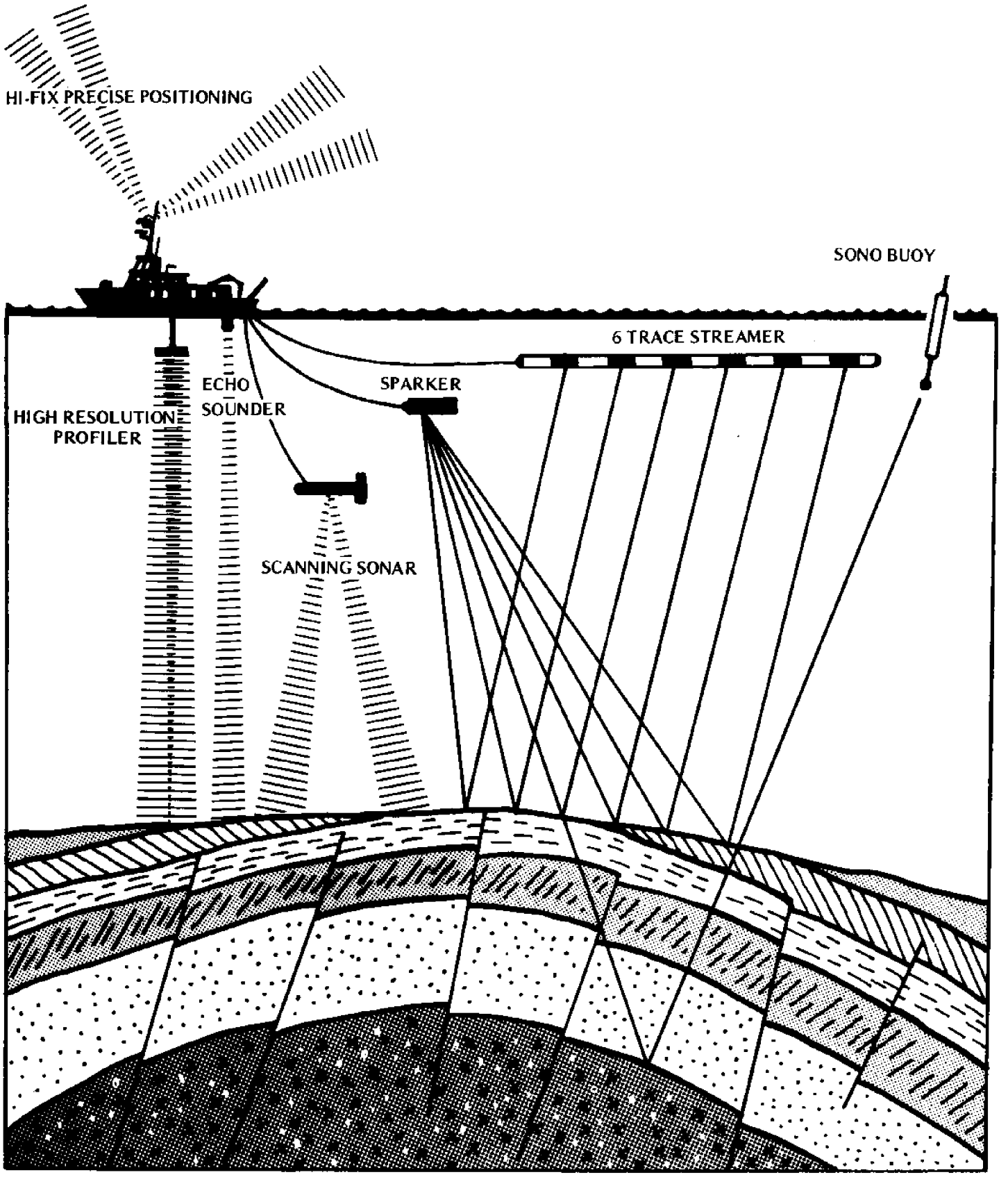
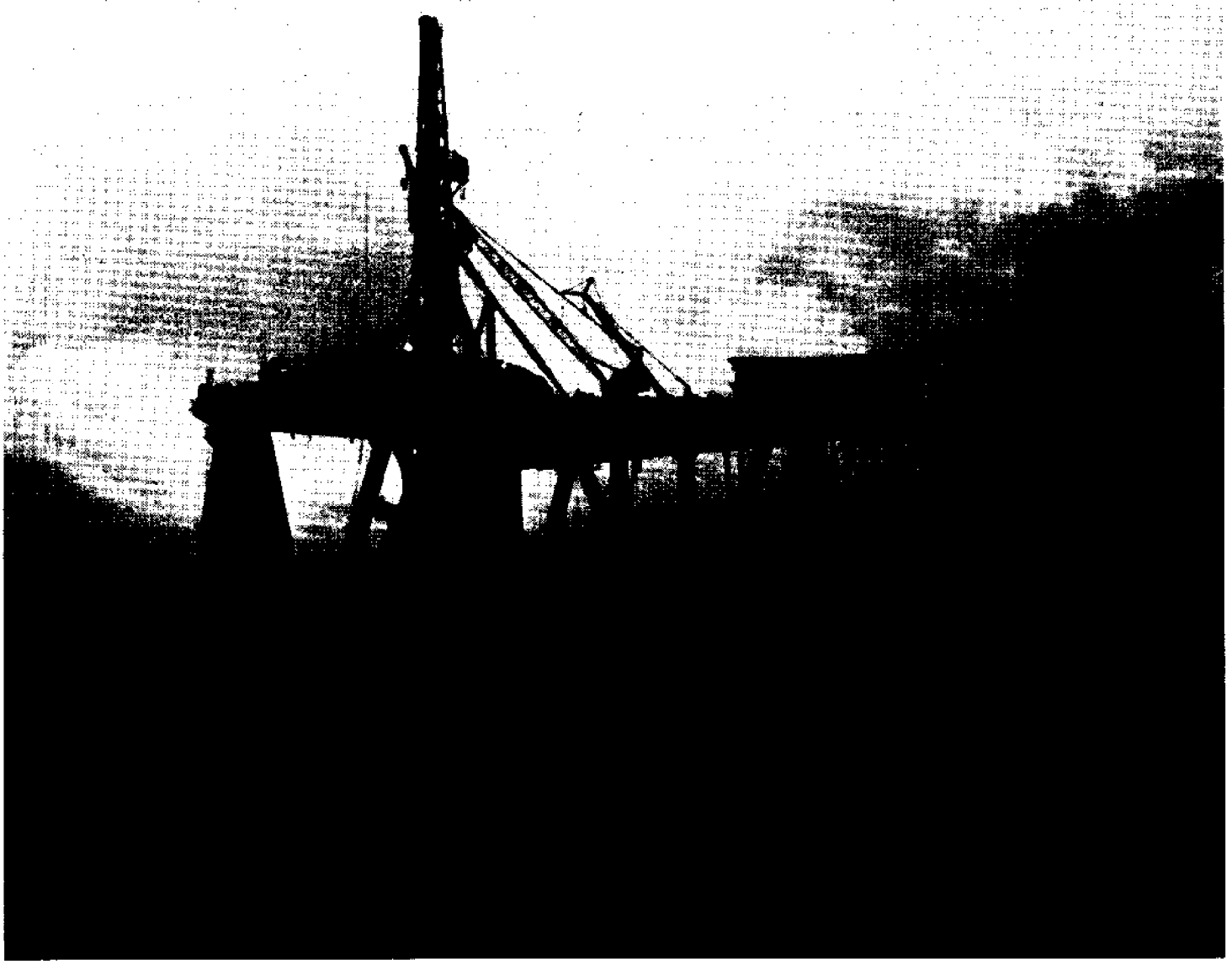


Figure 5. Geophysical Survey Methods



Semisubmersible rig used for exploratory drilling

number of worldwide locations. Support materials are stored onshore: drill pipe, drill bits, drilling mud (powder), cement (powder), casing (pipe), catered foods, crews, tools, etc. Transportation to drilling sites is provided by locally-berthed work boats (up to 200-250 feet), crew boats (up to 85-110 feet) and helicopters. Repair facilities, divers, ship chandlers, welders, mechanics, and other ancillary support usually locate in the immediate area to provide their special services, many of which are common trades.

Exploratory drilling continues until the limits of the total field are defined. The number of exploratory wells required depends on the geological structure. The U.S. Geological Survey of the Department of the Interior regulates the procedures for drilling and for numerous other activities related to completion, platform installation, pipelines and other OCS operations by publishing "OCS Orders" and by conducting inspections of facilities and operations. The index of a typical set of "Orders" is shown in figure 6.

The Office of Pipeline Safety, Department of Transportation, issues rules regarding the design, construction and maintenance of pipelines.

If exploration is successful, development drilling and then production activities begin; exploratory drilling continues in other areas. New exploration and development drilling of leases also usually continue after the first production wells are operating.

Experience in Alaska has shown anywhere from a two- to five-year time lag between the start of exploration and the start of production. Members of the industry have indicated that as much as five to seven years may elapse between those two stages of activity.

The **production phase** includes offshore platform construction and erection; pipeline construction; more extensive development drilling (sometimes more than 40 holes per platform); construction and installation of production equipment, including "Christmas trees" (the complex arrangement of valves that control product flow and facilitate the reworking of a well), and other related devices on the platforms or the bottom; construction of processing units offshore for separating sand, water, and gas from oil, and onshore for stripping heavier fractions from oil; and finally, maintenance operations that keep the wells flowing. The support requirements also grow accordingly – at a rate defined later in this report. It is important to remember that the term *production* does not include processing activities such as refining.

Under normal circumstances, transportation to shore of crude oil from platforms at sea takes place through pipelines. Large diameter pipe (generally greater than 12-inch diameter) is welded together from short sections (40 feet long) on a barge and allowed to sag under its own weight to the sea floor. (In deeper water, a curved pipe support called a "stinger" trails behind the laybarge.) In water depths less than 200 feet, the pipeline is buried. This is accomplished by jets of water forcing sediments away

Figure 6*. Typical set of "OCS Orders" Published by the Interior Department.

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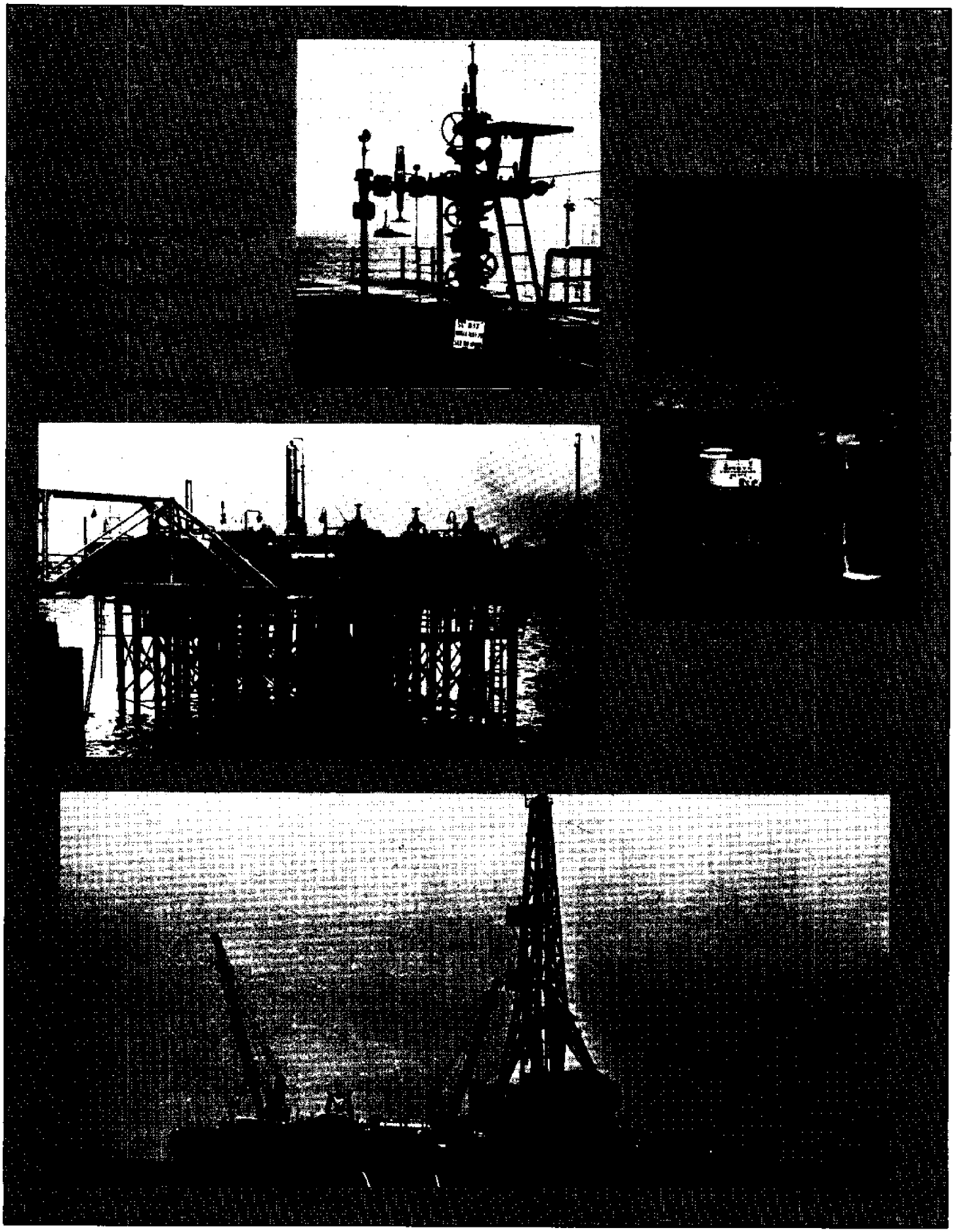
*From Notice to Lessees and Operations of Federal Oil and Gas Leases in the Outer Continental Shelf.

from the pipe, allowing the pipe to settle in the resulting trench. The disturbed sediments, after they settle, partly cover the pipe, but complete burial requires additional time (usually more than a year in deep waters). Complete burial may be achieved in certain bottom materials by making several passes with the jetting equipment.

To prevent corrosion, pipelines are coated with materials such as epoxy compounds or thick, asphalt-like mastic. If extra weight is needed to keep the line in place or mechanical protection is needed, the pipe also is covered with a layer of dense concrete. As the pipeline comes ashore, it is buried deeply enough to avoid its being exposed by storm-associated beach erosion. Onshore pipelines are buried in trenches (either on upland or marsh). Pipelines are monitored continuously for leaks. Very small leaks that do not decrease line pressure go undetected unless observed, so visual inspections by pipeline patrols are conducted at least once every two weeks.

The only other principal method used for transporting crude oil from platform to shore is by barge. This operation is very similar to the lightering that now takes place in Delaware Bay, but probably would be limited to operating in seas up to five feet offshore.

Laying a gas pipeline



WE CAN LEARN MUCH FROM OCS DEVELOPMENT IN OTHER AREAS, BUT THE MID-ATLANTIC HAS UNIQUE BOUNDARY AND THEREFORE JURISDICTION PROBLEMS.

Experience in the Gulf and Pacific

Analysis of what might happen in Delaware depends to a great extent on the study of similar OCS developments in other parts of the United States. Each comparable location suffers from certain short comings, though, because geographic, economic and demographic conditions vary.

The OCS off **Louisiana** is the most extensively developed area of its type in the nation. Isolating the impact of OCS development alone is difficult because the area also has experienced extensive onshore and nearshore (bayou) development for product processing. However, the Gulf coast of Louisiana (extending from Venice in the delta region to the border of Texas on the west) is roughly equal in length to the coast of the Mid-Atlantic region (from Sandy Hook, New Jersey to the border of Virginia and North Carolina), as shown in figure 7. The similar length of that coastline provides clues as to where development might occur along the Mid-Atlantic coast, but the fact that the latter is a multi-state area complicates the comparison.

Cook Inlet, Alaska, though probably a better analog for Delaware than Louisiana with respect to scale of offshore activity, has severe climatic constraints not present in the Mid-Atlantic region. Another difference is that activity in the Cook Inlet area is limited to state-controlled waters. The area does, however, demonstrate that remote centers may be used for supporting exploration activity until development warrants local construction.

The third area, **Santa Barbara, California,** also is a better analog than Louisiana with respect to scale of activity. This area illustrates an operation developing under strict environmental constraints, including restrictions on onshore development. However, the proximity of extensive support activities at Long Beach tends to cloud the picture of total support requirements.

None of the analog areas illustrates the boundary problems present in Delaware. A facility located inland and still easily accessible to the Delaware coast, for instance, may well be within the state of Maryland, and thus be beyond Delaware's control.

A number of documents have been produced recently by representatives of industry, state government and academia on OCS impact in the analog areas. Certain issues appear regularly. Particularly significant with respect to economic impact are:

The problem faced by a state called on to provide governmental services to support OCS-generated activities without an adequate share of the income derived from the operations. (This is similar to the "bedroom community" problem of suburbia.) Studies in Alaska and Louisiana indicate the need for government expenditures ranging from $295 to $1280 per capita for services to support OCS-generated population and onshore activity. In Alaska, this represented an increase in per capita expenditures of 60-80% and of 126-172% in operating budgets. As a further complication, Louisiana estimates $183 million of tax revenue foregone in 1972 because of the inability to tax activity conducted on the OCS beyond the three-mile limit. The figure includes $127 million in severance taxes (based on unit output at the wellhead). The impact of taxes foregone in Louisiana is compared to a net deficit in state budgets (i.e., the cost of state services required to support onshore activity exceeds the tax revenue derived from the OCS development). The deficit is made up by non-OCS-related activity carrying more than its fair share of the burden.

U.S. Senate Bills 2398, 2672, 2922, and 3221 introduced in the 93rd Congress are draft legislation aimed at this problem. But none is law (all died in Senate or House committees), and more important, NONE PROVIDES FUNDS

BEFORE DEVELOPMENT OCCURS (in the words of Governor Egan of Alaska, "front-end costs").

The problem that petroleum-induced growth may fundamentally alter areas of a state through changes in population and land use. In the Kenai area of Alaska, for example, the population almost doubled in five years (8,000 to 14,000). Public investment in the area increased from $6 million to $24 million.

Delaware, like Alaska, lacks both labor pool and the proper type of industry to effectively support OCS activity. Therefore, the potential exists for an influx of population and development in some respects similar to that in the Kenai region.

OCS exploration and production probably would have little impact on unemployment in the area (given "normal" unemployment) because of the highly skilled nature of most of the jobs associated with exploration and production. Major exceptions could be stevedoring, the work of roustabouts, catering services, boat repair, local housekeeping functions and hardware supply. In refining, however, it has been estimated that as much as 60% of the refinery work force can be drawn from relatively low-skilled workers if they are properly trained. Thus, in a "normal" period of unemployment, only the processing stage of petroleum activity could be reasonably sure of having a significant effect on unemployment. Given an abnormally high rate of unemployment, the potential impacts of both exploration/production and processing are higher, depending on the available skills of the unemployed.

The problem of reconciling what appear to be multiple-use conflicts of marine and coastal zone resources indicates that not all potential employment impacts from OCS activity are positive. The shellfishing and recreation industries in the Mid-Atlantic are the most important ones that could lose employment because of OCS activity. On the other hand, lack of energy also has a significant negative impact on these industries. With adequate planning, potential conflict between these industries and OCS activity could be minimal, as seen in the recreation industry in Santa Barbara and the fishing industry in the Gulf of Mexico. Santa Barbara experience indicates that demands for coastal recreation and OCS activity both can be accommodated by geographically separating the activities. Aesthetic impacts of OCS development can be limited to localized areas – no undue hardships have been experienced in Santa Barbara. In the Gulf, only about 0.3% of the acreage of developed tracts has been lost to commercial fishing activities.

The effect of petroleum-related development on land values seems to strongly depend on the previous uses of the land and on use of surrounding land. Most sources indicate that where previous uses are (or have been) agriculture, petroleum-related activity tends to increase land values. Where recreation is involved, petroleum-related activity on the land or nearby tends to lower values.

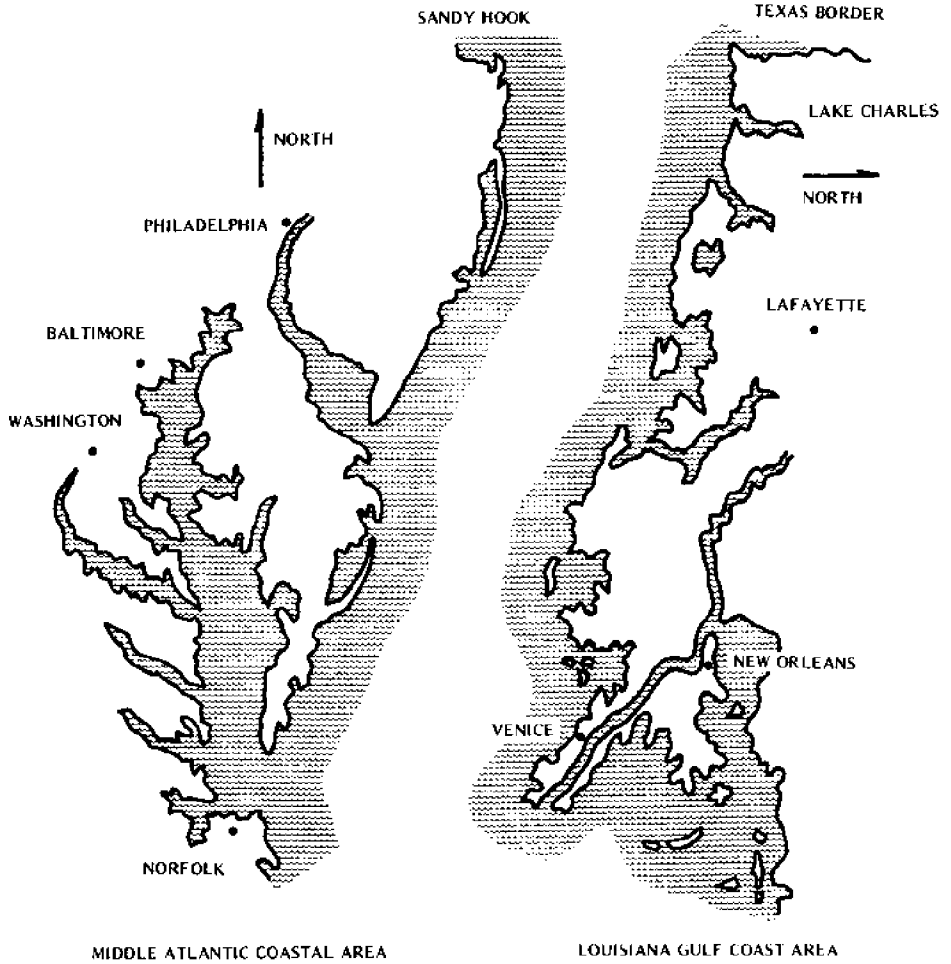


Figure 7. Relative Sizes of the Louisiana Gulf and Mid-Atlantic Coasts

WE ESTIMATE THE PEAK OF OCS ACTIVITY TO OCCUR IN 1980, WITH 21 ACTIVE RIGS OFFSHORE.

Quantifying Mid-Atlantic Development

It is difficult to visualize the onshore economic and land-use impact of OCS development without a quantitative estimate of the related activity, but generalized quantifications have little value for the decisionmaker. For that reason, little analytical work on land-use impact has been completed. On the basis of what has been done, however, it appears that some of the OCS-related onshore activities require large amounts of land, much of which does not need direct access to water.

The major land commitments for direct support activities are needed for steel fabrication (platforms, etc.), storage (tanks, warehousing, etc.) and transportation (helicopters, supply ship wharfage, crewboat docks, ship repair). Pipeline corridors to transport oil or gas, however, are not great land users, nor do they permanently deface the landscape. When the pipeline is buried in the right-of-way, the land is restored and quickly revegetated, just as are existing lines that distribute gas and other materials and services.

For ship operations and platform construction, there would be pressure for land near navigable water. If all facilities were concentrated in the vicinity of Delaware Bay, it is possible that this pressure could lead to the filling or dredging of several thousand acres of wetlands. (The Brown and Root site acquisition in the Cape Charles area of Virginia over 100 miles away seems to preclude that type of concentration.)

To gain a better understanding of OCS development, an analysis has been conducted to quantify possible impacts. For this analysis, certain assumptions were made. These premises are:

1. Two lease sales will be held roughly two years apart; one late in 1975 and one in mid-1977 (see figure 2, BLM Lease Sale Schedule).
2. In each sale, four million acres will be offered and two million acres will actually be leased (compared with about 5.6 million acres leased off Louisiana in the period 1954-72).
3. Each sale will result in production of 500,000 barrels per day; a total of 1,000,000 bbl/day from the entire Mid-Atlantic region. (Other estimates have varied from 750,000 bbl/day to 3,500,000 bbl/day.)
4. Because the Baltimore Trough is a group of relatively simple geologic structures, it is estimated that only 150 exploratory wells will be required to verify the production from each lease sale.
5. It is estimated that one platform will be required for every four lease blocks (one block contains more than 5,000 acres) and that an average of 36 wells will be drilled per platform. Each will produce 1,000 bbls/day.
6. It is estimated that from 45 to 60 days will be required to drill a well to reach the hydrocarbon-bearing geologic structures (although estimates of drilling times vary widely due to drilling depth, type of formation, type of rig and other factors). BLM, for example, in the draft impact statement for the Northeast Gulf, cites 10 to 14 days for a 10,000-foot development well. For this

analysis, 50 days per well is assumed because of the geology of the area. If this is incorrect, it will be on the conservative side (i.e., fewer drill rigs will be required if the drill time is shorter).

7. The fundamental unit for estimating population and economic impact is the number of drill rigs and from that, the size of the mining labor force. An average of 60 men per rig is assumed. To determine the size of the directly and indirectly associated labor force, two multipliers are applied to mining manpower. A third multiplier then is used to convert the size of the labor force to a total population. In a like manner, the unit for estimating transportation and supply support requirements (and thus land-use impact) is the combination of drill rig and platform.

As will be seen in the calculation details, the multipliers applied to the mining manpower in this study are 2.0 to determine the directly associated labor force; 3.0 to determine the number of the indirectly associated labor force; and 4.0 to arrive at an estimated total population.[1]

The values selected account for the likelihood of supporting Mid-Atlantic operations from other established areas (such as the Gulf or Pennsylvania), and account for the fact that the Mid-Atlantic is a market-oriented production center, rather than an exporter of raw materials.

The combination of premises, legal constraints on time to develop leases, proposed lease sale schedule, and operating experience leads to the following estimate of activity. **These calculations are based on a set of assumptions and should not be taken as firm predictions. Changes in any of the numerous variables could alter the calculations significantly.**

- *150 exploratory wells will be drilled over a seven year period, with development virtually completed in a little more than a decade, but production lasting from 20 to 40 years.*
- *Approximately 42 platforms will be required to develop the entire Baltimore Trough (1 million bbls/day divided by 36,000 bbl/day/platform then multiplied by a factor of 1.5 to account for the inefficiency of locating platforms that is necessitated by oil field geologic structures).*
- *Considering the time needed to mobilize a work force, exploratory rig availability, drilling time, platform construction time and capacity and lease sale schedule, the development plan in table 1 seems reasonable and provides for a peak of 12 exploratory rigs on station and the erection of 6 platforms per year. Production from the field likely would not begin until the period 1980-82.*
- *As a rule of thumb, it is estimated that half the platforms will have 2 drill rigs each. In a worst-case situation, this would mean 21 drill rigs operating simultaneously (1980 – when there would be 12 exploratory rigs and 9 platform rigs).*
- *The logistic support capability required to haul drilling equipment, drilling mud, cement, water, etc., and to haul drilling crews, requires 1 work boat and 1 crew boat per drill rig and 2 helicopters for the first 3 drill rigs and 1 for 3 thereafter (see table 2). Some economies of scale are realized on boat use as the number of rigs increases so that 21 rigs, for example, might need only 18 boats.*

Table 1. *Exploratory Rigs on Station* & Platforms Erected

	1976	77	78	79	80	81	82	83	84	85	86
1st Lease Sale	*3*	*6*	*9*	*4*	*3*						
				5	6	3	3	3	1		
2nd Lease Sale			*3*	*8*	*8*	*9*	*3*	*2*			
							3	3	5	6	1
Total Active Rigs	3	6	12	19	21	12	11	9	9	9	1

Table 2.
Boat and Helicopter Requirements

	1976	77	78	79	80
Work Boats	3	6	11	17	18
Crew Boats	3	6	11	17	18
Helicopters	1	2	4	6	7

[1] *These compare with multipliers used in other studies which range from 1.687 to 3.7 for the first, about 1.86-2.08 for the second, and 3.14 to 4.2 for the last.*

Two separate aspects of production activity must be considered, one related to the maintenance of production (which is oriented toward marine operations) and the other related to product delivery (including pipeline corridors, pipeline terminals, storage facilities, separator facilities, etc.).

Maintenance of production (called workover) requires work on wells to correct mechanical problems, to change production zones, to remove sands and other substances that may enter the well bore from oil-bearing strata. This is accomplished by special drill rigs, usually considerably smaller than the rigs that drill exploratory or development wells. No separate provision is made for these activities in the activity model since they are part of the multiplier described earlier.

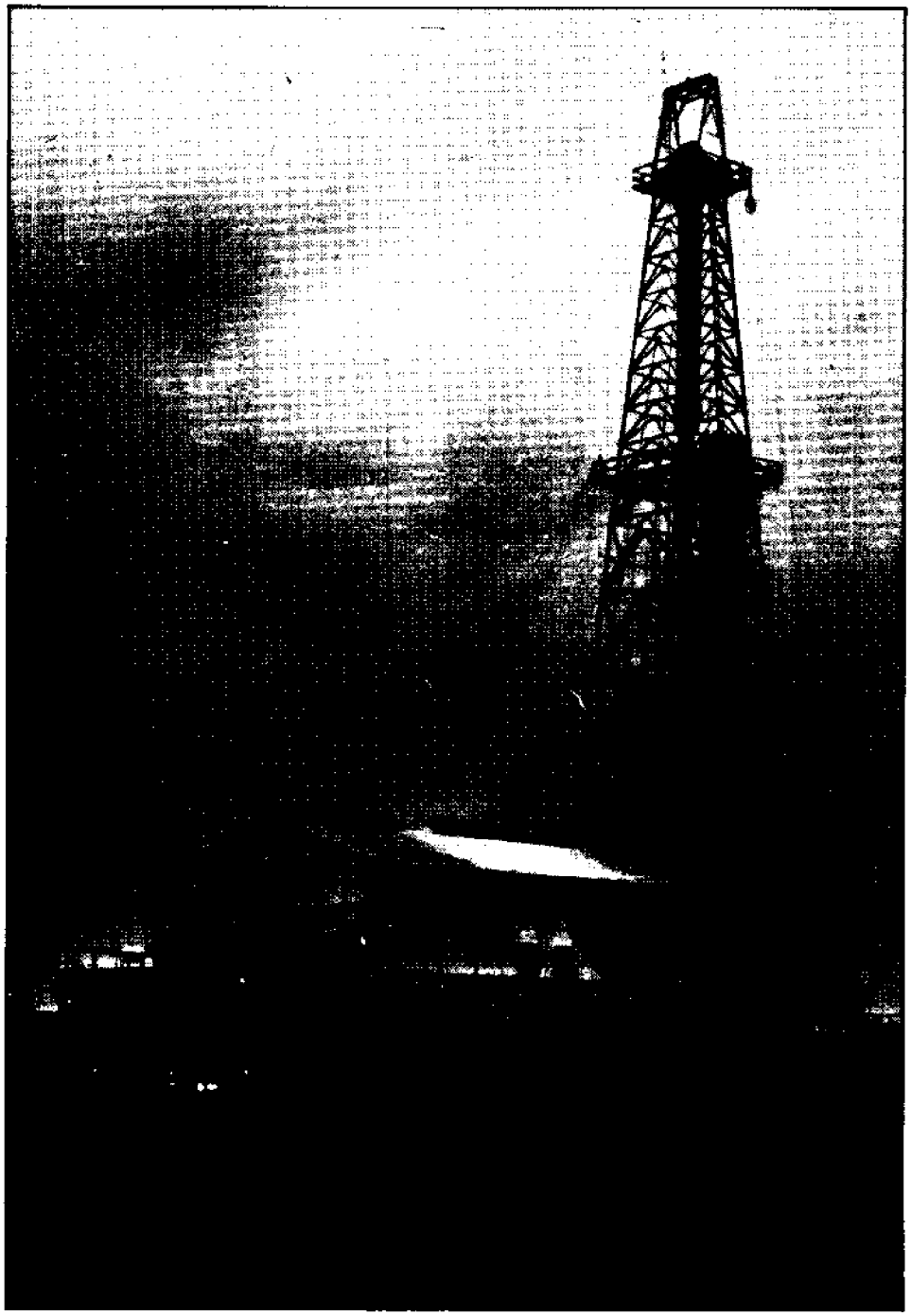
Separator facilities (also used in the production phase) separate gas from oil, and water and sediment from oil. Location of the facilities is flexible, some being installed on production platforms, others being located ashore. As with the previously mentioned maintenance operations, manpower provisions for this activity are included in the multipliers; land-use impact will be described in the next section.

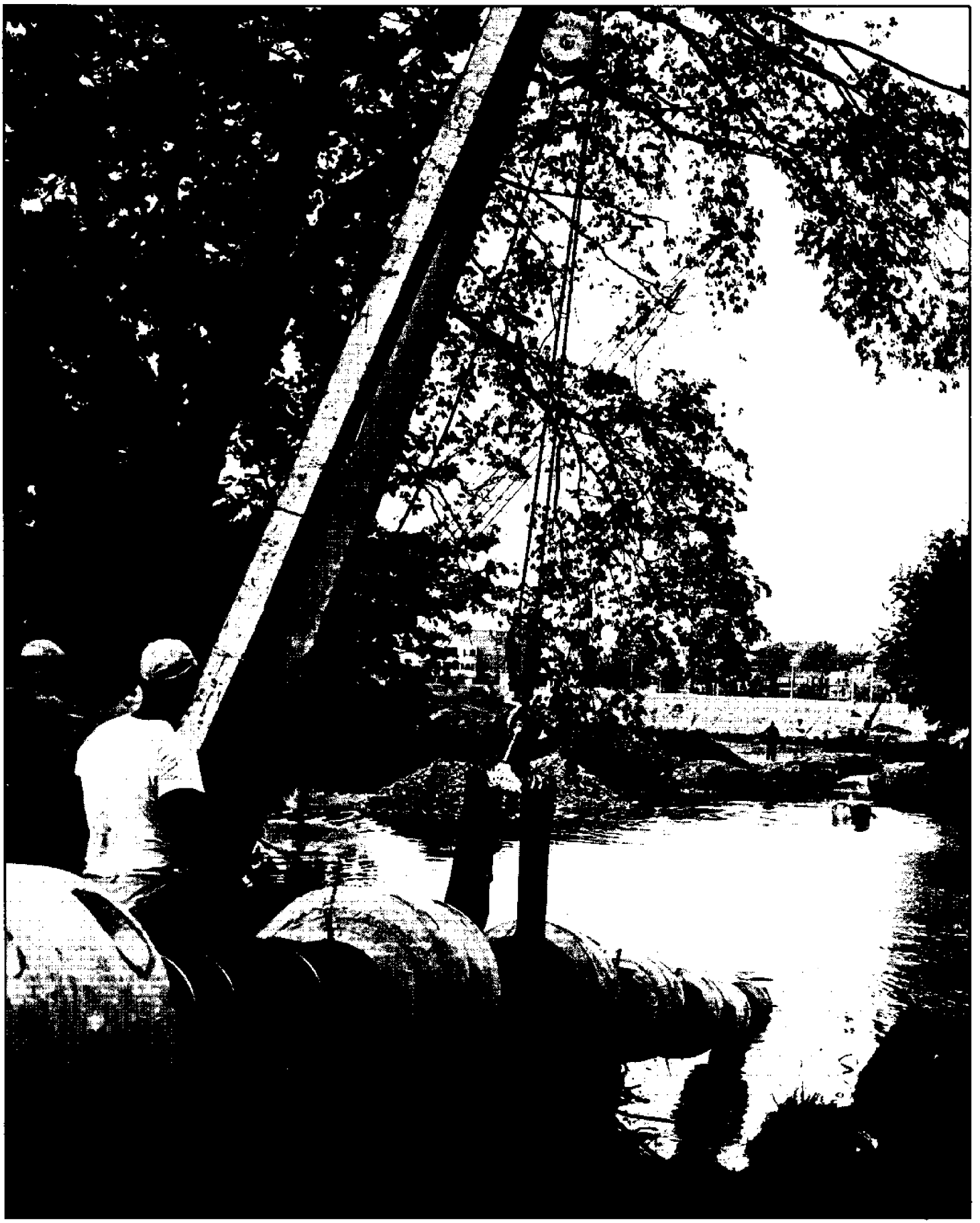
With respect to product delivery, very little buffer storage is needed for OCS activity if direct runs are made to refineries because of the high wellhead pressures usually attainable. Pipeline diameters can be expected to be only 16 inches to 36 inches for the same reason. Storage in the amount of 150,000 to 200,000 bbls may be provided at the pipeline terminal.

Pipeline length is not a critical factor for routing decisions until supplementary pumping costs for pipeline transportation become large; therefore, it will probably be economically feasible for process plants to be market-oriented. In the opinion of one oil company, it is not necessary to have numerous crude pipelines crossing the shore zone if pipeline systems are properly designed. This attitude is upheld by BLM appraisals of few pipeline crossings needed for the Northeast Gulf area.

In addition to numbers of facilities required to support this projected level of production, there are two key points that become evident as a result of this preliminary quantification. First, it seems likely that **approximately five years could elapse between the start of OCS activity and its peak.** Second, **the level of activity anticipated is significantly less than that encountered in the Louisiana and Texas Gulf areas.**

Stationary drilling platform





Pipeline laid in water is weighted to assure settling.

THE TOTAL POPULATION INCREASE DUE TO EXPLORATION, DRILLING AND PRODUCTION WILL PROBABLY BE ABOUT 60,000 FOR THE ENTIRE MID-ATLANTIC REGION. ABOUT 1,000 ACRES OF LAND WOULD BE NEEDED, WITH LESS THAN 100 OF THAT AT THE WATER'S EDGE.

Economic and Land-Use Impact

Determining the onshore economic impact depends on knowing the size of the peak population. Assuming an average of 60 people per rig, and using the multipliers described in the previous section and the estimated rig activity schedule, a total petroleum-based employment of 15,000 by about 1980 is estimated. This estimate compares favorably with an independent estimate of between 15,400 and 20,900 for all Atlantic operations. The latter was derived from Louisiana experience by the Gulf South Research Institute, Baton Rouge, Louisiana.

This 15,000 total labor force would mean a population increase of 60,000 people because of OCS activity. However, many of the 15,000 employment base need not be located in Delaware because: (1) state and county governments can make management decisions about the activities they will allow; (2) since the amount of the resource is estimated to be relatively low, many supporting services can be provided from already-established OCS areas; (3) activity can be distributed along the Mid-Atlantic seaboard; and (4) crews that work 7-days on/7-days off generally live within a 150-mile radius of their operations base, so they could live in Washington, Baltimore or Philadelphia, as well as anywhere in Delaware.

To account for these factors, this analysis is based on a total OCS operations labor force of 3,780, which would result in a total population increase in the state of 15,000 in about five years. This increase would create the equivalent of a community a little smaller than Dover.

As noted earlier, conflicts may arise among several economic uses of the coastal environment – fishing, recreation and support of OCS activity. Employment in the marine-related recreation industry in Delaware is not known with any reasonable certainty; employment in the fishing and fish processing industry probably totals about 1,000 full-time jobs, so this gives a rough idea of potential effects. Also noted earlier was the fact that both the Santa Barbara and Louisiana areas have been able to minimize the adverse effects of OCS activity where conflicts exist.

In California, exploratory rigs and platforms are easily visible from the shore, but in Delaware rigs and platforms are expected to be farther over the hori-

Table 3. Possible Employment/Population Impact

	1976	77	78	79	80
Rig build-up	3	6	12	19	21
(60 men/rig)	180	360	720	1,140	1,260
Direct support (multiplier of 2)	360	720	1,440	2,280	2,520
Total Offshore Operations	540	1,080	2,160	3,420	3,780
Indirect Support (multiplier of 3.0)	1,620	3,240	6,480	10,260	11,340
Total petroleum-based employment	*2,160*	*4,320*	*8,640*	*13,680*	*15,120*
Total population (multiplier of 4)	**8,640**	**17,280**	**34,560**	**54,720**	**60,480**

zon, and at worst, no larger to the naked eye than the tankers that currently ply these waters. The only undesirable onshore impact on recreation might relate to unsightly liquid bulk storage tanks; in this area of coastal plains, it is difficult (if not impossible) to camoflauge that type of installation.

By carefully planning for OCS activity and separating facilities, however, it is not likely that installations will adversely affect employment in either fisheries or recreation.

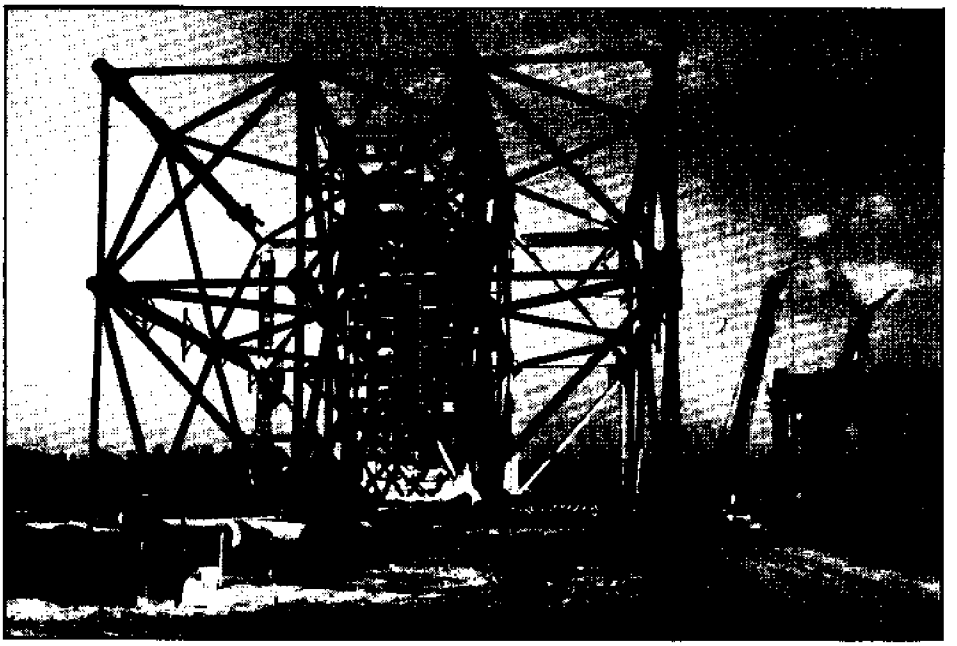
The potential does exist for interference between increased offshore support vessel traffic and recreational boating, particularly sport fishing. It is also likely that improved navigation aids will be required to minimize interference between OCS vessels and incoming tankers.

Other potential economic impacts will be reflected in income, housing demands and the demands for government services.

Based on an August 1972 wage survey,[1] a weighted-average of straight-time hourly earnings for all types of workers in the crude petroleum and natural gas production industry was $4.77/hour including offshore bonuses. Industry estimates place this figure closer to $6.00/hour in 1974. On the basis of a 40-hour work week for 50 weeks per year, and the 1972 wage rate, the average annual income would be $9540. This compares to a median income of approximately $6700 in 1970 for craftsmen, foremen and kindred operations, $5700 for operatives and approximately $4000 for laborers in Sussex County – a significant increase (even after inflating by some 20% for 1972 levels) if the present labor force can be used.

With respect to housing, approximately 3,800 additional family dwelling units would be required as a result of a population increase of 15,000 (the number directly related to OCS activity). This is predicted on the same multiplier (4) used to convert labor force to total population. If all were concentrated in Sussex County, this would be roughly equivalent to a community the size of Rehoboth, and would have comparable demands for land.

The need for government services to support population growth has been the subject of several studies in areas of comparable OCS activity. The range of costs cited varied from $295 to over $1,000 per capita, depending on the level of previous development in the area. Louisiana's experience of about $700/capita appears more like the Delaware situation, in which case about $10 million per year in government expenditures would be required, including debt service and amortization of new capital expenditures. This would be roughly equivalent to total Sussex County expenditures for 1974 (including revenue sharing), and would increase the combined county and municipality per capita expenditures by about 40%, assuming a county-based population of 95,000.



Production platform fabricating yard

Land-use implications of logistic support are determined by the number of boats, requirements for boat and rig fuel, low chloride-content water, dry bulk storage, and dockside lifting capacity. Logistic support facilities would require a 50-ton traveling crane, about 6,000 bbls of fuel storage (say, two 40-foot diameter tanks 15-feet high), about 10,000 bbls of water storage (say, two 42-foot diameter tanks about 20-feet high), some dry bulk storage sheds, pipe storage area (for various pipe diameters up to about 18-inches in diameter and 30-feet long), movable dry bulk loading hoppers, and about 4,000 linear feet of wharves or piers with a control depth alongside of at least 15 feet. Roughly 40 to 60 acres probably would be required for the various other logistic support facilities close to a center of boat operations. Based on estimates made by BLM for the Northeast Gulf area, four to five times that acreage might be required in the general vicinity (several mile radius) of the onshore logistic support site as exploratory operations proceed. Barge, rail, and road access would be required. Barge access is particularly important to reduce the cost of transporting material from inland and Gulf suppliers.

The acreage necessary to provide maintenance services for production would add only slightly to the 240-300 acres per site described earlier – perhaps an additional 40-60 acres. The land-use impact of product delivery facilities has been estimated by BLM as being 40 acres for a tanker terminal with 500,000 bbls of storage and 40 acres per pipeline terminal including 120,000-200,000 bbls of storage. The number of such sites will depend on the number and location of pipelines.

Certain large, specialized land-use activities already have been committed for (i.e., Brown & Root's 2,000-acre land acquisition in Northampton County, Va., probably for platform and pipeline fabrication). Others may follow but only at the invitation of the local area. The extent of these additional large commitments will depend in part on answers to the following questions that are not directly associated with OCS activity.

- *Will existing refineries and refinery sites satisfy production demands or will new centers of refinery activity be required?*
- *If new refinery centers are*

[1] *Industry Wage Survey: Crude Petroleum and Natural Gas Production Bulletin, 1797, U.S. Department of Labor.*

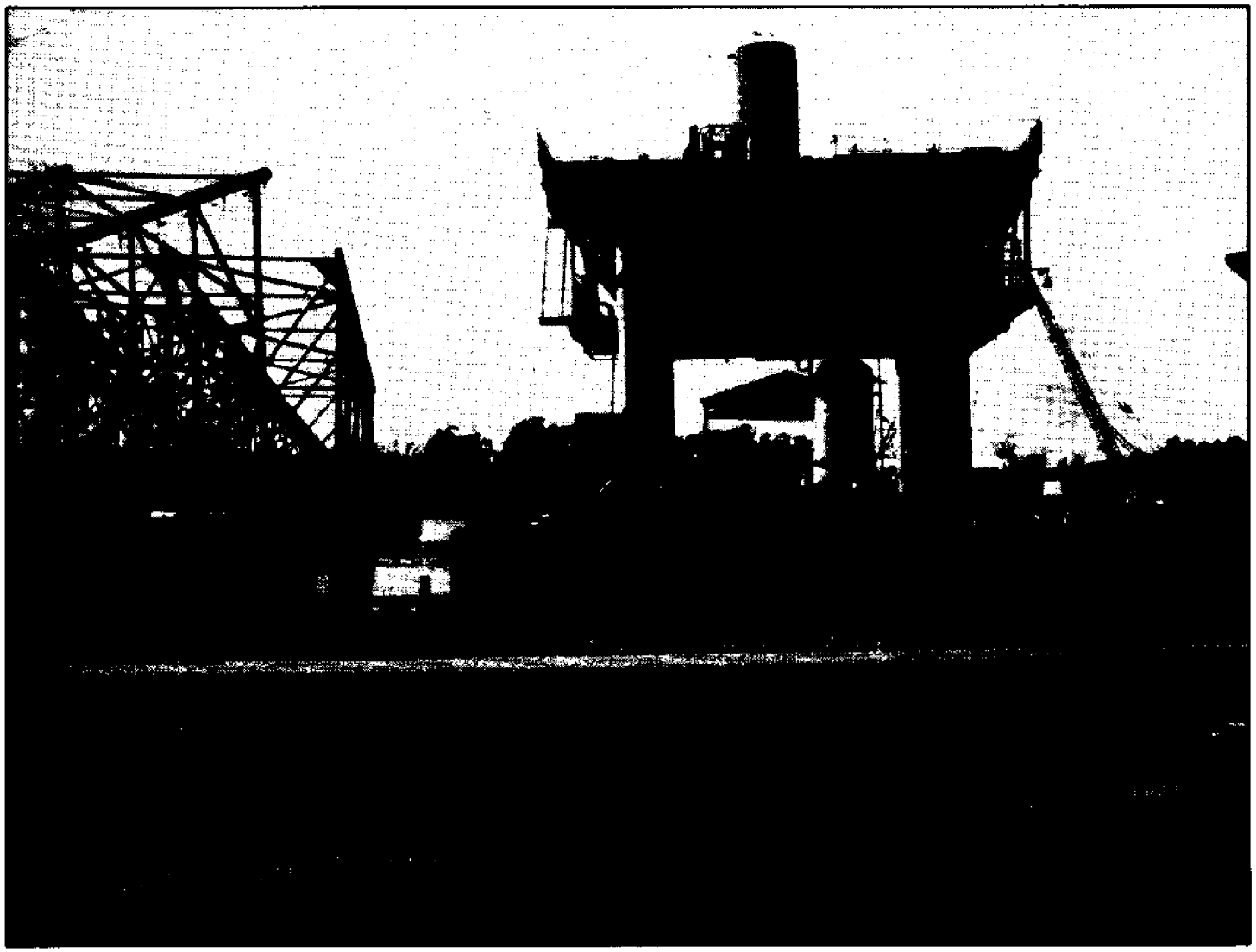
needed, will they be developed close to markets or raw materials?

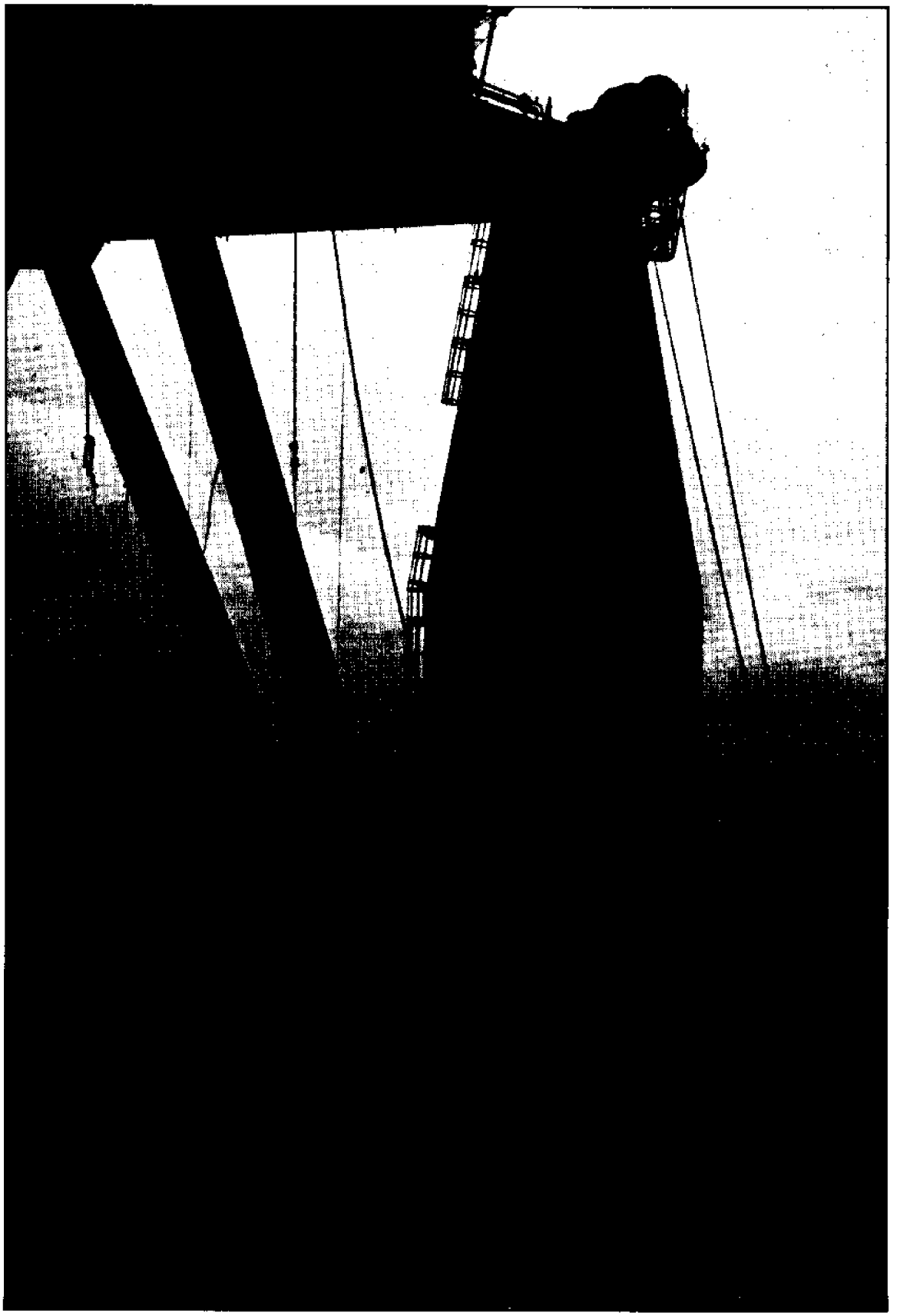
- *If gas is found on the OCS, is it likely that new industries using gas as a fuel or raw material would try to locate in close proximity to a pipeline downstate?*

As noted earlier, pipeline costs are not high enough to mean that user industries must locate in the coastal zone (in Louisiana, for example, many refineries are in the second- and third-tier counties). As far as committing coastal lands for processing and/or allowing pipelines to cross submerged lands, the states have considerable flexibility and control.

In summary, there are two key points which derive from this brief look at economic and land use impact. First, based on the estimated level of resource recovery, the **total population increase due to exploration, drilling, and production activity will probably be about 60,000 people for the entire Mid-Atlantic region.** Second, the **total land use requirement in support of OCS exploration and drilling activity is quite small, about 500 acres; less than 100 acres need be at the water's edge. The requirements for production facilities also would be about 500 acres of land.** The estimated land-use needs for pipeline corridors would depend on their routing.

Equipping a production platform





DELAWARE IS EXPERIENCING ACUTE ENVIRONMENTAL PROBLEMS THAT WILL BE INTENSIFIED BY THE NEW INDUSTRY AND POPULATION UNLESS CAREFUL PLANNING IS DONE FOR ONSHORE DEVELOPMENT.

Environmental Impact

Ecological impact of OCS activity continues to be a major unresolved issue with three primary components – onshore, inshore, and offshore. Some aspects of the latter two already have been the subject of extensive debate which will not be resolved by this document. However, the views of those familiar with the Delaware area will be reiterated in their appropriate place.

The potential environmental impacts of exploration/production and processing (refinery and petrochemical activity) are quite different, and as has been stated in other sections, are independent of each other; refining and petrochemical activity may or may not follow the discovery and production of petroleum on the mid-Atlantic outer continental shelf.

Offshore, the primary source of damage would be oil or chemical spills. Thus, according to the BLM, outer continental shelf exploration and production of petroleum results in the following environmental interactions:

Release of cleaned drilling fluids, drill cuttings, and sand: A typical 10,000-ft. offshore exploration well generates approximately 2,100 barrels of cuttings weighing about 1,840,000 lbs. The total weight of cuttings and drill mud discharged overboard is some 1,200 tons per well. In California, experience has shown that communities of bottom-dwelling organisms establish in these materials where none existed before.

Release of produced formation water: Water found in contact with formations in southern Louisiana averaged 112,513 milligrams of solids per liter of water (ocean salt water is about 35,000 mg/l). An average volume of 420,000 bbl of formation waters is produced daily; 240,000 bbl are transported to shore for treatment and released; the remaining 180,000 bbl are treated and discharged near the platforms.

Generation and disposal of solid waste: All solid waste from drilling and production on the platform is collected in large containers. Combustible wastes generally are incinerated on the platform; noncombustibles are loaded onto service boats and sent ashore.

Disruption of seafloor and resuspension of sediments: Disruption occurs especially during pipeline-laying; impact would be minimal and local.

Dredging of trenches: Destruction of the seabed occurs in local areas near platforms and rigs (2 acres per jack-up rig).

Construction of direct support facilities: Dredging and/or landfill activities are associated with the construction of onshore support facilities.

These potential impacts probably would be limited in both extent and importance, with the possible exception of the last one.

Dredging and landfill could occur on the shoreline and inshore to support service boats and yards. Maps of the three analog areas reveal a prevalence of 12- to 15-foot channels to most logistic support areas – often with adjacent warehousing on fast lands. The potential exists for

Table 4.
Sources of Oil Pollution in the Oceans

Automobile Crankcase Oil Disposal	29.4%
Tankers	28.4%
Tank Barges	1.4%
Other Vessels	17.3%
Industrial Machinery Waste Oil	15.3%
Refinery/Petroleum, Plant Disposal	6.5%
Offshore Production	2.1%

Table 5. Trends in Gulf of Mexico Spills

Year	Number of Incidents	Total Production (bbl)	Total Spilled (bbl)	% of Production Spilled
1964	5	122,500,126	14,928	0.0122
1965	2	144,986,615	2,188	0.0015
1966	0	188,714,070	0	0
1967	2	121,861,614	160,704	0.072
1968	2	266,936,001	6,085	0.0023
1969	8	302,919,143	10,924	0.0036
1970	7	335,658,540	84,323	0.0251
1971	11	387,445,398	1,285	0.0003
1972	2	389,323,680	150	0.00004

damaging marsh, tidal river, and shallow water environments by indiscriminate filling, dredging and widening to support work boat and crew boat operations. Modified water tables and salinity regimes would probably result, along with habitat destruction. The degree of concentration of these facilities would indicate the propensity for causing ecological damage.

These day-to-day operating impacts, however, are not considered by some to be as serious as the potential for accidents occurring on the rigs and platforms, although this is the subject of growing debate.

Natural Gas Leaks

Natural gas releases from production platforms usually are caused by blowouts. The Geological Survey listed 36 such gas leaks in the Gulf of Mexico from 1956 to 1972. These leaks may last from a few hours to several months. The Bureau of Land Management reported "no environmental damage" from these accidents.

Oil Spills

A substantial amount of work has been done concerning environmental impact from oil spills. The following information is in no way exhaustive, but does allow for the better understanding of the problem.

Oil spills are the result of both "catastrophic" accidents (i.e. Santa Barbara Channel in 1969) and chronic accidents from day-to-day operations. Because the major spills are catastrophic, their occurrence cannot be predicted reliably. Major oil spills have occurred due to pipeline accidents, blowouts, platform fires, accidents during maintenance and repair work, and tanker and barge accidents. **The overwhelming majority of oil spills are caused by human error rather than equipment failure.**

It is more difficult to trace the origin of small oil spills. Transfer operations and cargo handling during exploration and production will surely cause some spillage; factors unrelated to exploration and production include oil introduced into the environment by tanker and barge accidents, cleaning, bunkering, ballasting and pumping, leaks in these vessels and natural seeps.

With so many possible spill factors, it is quite difficult to determine actual spillage or predict the volume of potential oil spillage due to OCS operations. One frequently quoted estimate is that used by the Bureau of Land Management. They have estimated that approximately 0.011% of the overall (2.36 billion barrels) OCS production of oil and condensate in the Gulf of Mexico from 1964 to 1972 was spilled. However, the amount of oil introduced into the oceans by offshore production is quite small in relation to other sources, as seen in table 4, derived by Porricelli and Keith. Trends in Gulf of Mexico spills are shown in table 5 (as stated in recent BLM impact statements).

The following assumptions concerning oil spills thus can be made:

- *Overall, offshore production is a relatively minor cause of general oil pollution.*
- *However, major oil spills related to offshore production can and do occur.*
- *These spills are characterized by "catastrophic" events of major proportions (including those attributable to natural events like storms), and by chronic, smaller spills.*
- *Location, strict regulation, and adherance to regulations can reduce the potential for catastrophic spills, but the chance for error (and thus, major spills) can never be entirely eliminated.*

In *Impacts of a Deepwater Terminal*, a "model" spill developed by Maurer and Wang showed that close to the Jersey-Delmarva coast "there is a greater probability that spilled oil would move north-northeast toward the New Jersey coast in the summer, and south-southwest toward the Delaware/Maryland coast in the winter." If the source of the spill were farther out to sea (eight miles), it is concluded that it would be "highly unlikely" that the oil would reach Delaware shores. However, this situation could be complicated if a storm or strong wind were blowing onshore.

Although the trajectory of a major spill 40 or more miles offshore has not been determined, it is likely that its effects would be further diminished. If oil did reach Delaware's coast, it would

spread quickly over the beaches, possibly into the Delaware River and Indian River Bay. The careful location of permanently-installed control equipment could probably avoid introduction of the oil into these areas.

What would be the impact of an oil spill on the marine life in Delaware? Maurer believes that inshore populations would be affected more than offshore populations. An important exception could be benthic species (such as clams). These species have commercial importance – 40 million pounds of surf clams were collected in 1971 from Atlantic City, N.J. to Ocean City, Md. As noted earlier, beds off New Jersey could be affected in the summer, and those off Delmarva in the winter. Because of long resident times, oil would remain indefinitely in the clam beds. Generally, it is believed by Maurer that, for beach and estuarine environments, "regular low level spills may ultimately prove more degrading to New Jersey-Delmarva . . . than a single massive spill." Table 6 summarizes potential impacts on the marine environment.

Table 6. Probable Effect of Oil Spills On Selected Biota and Habitats at Proposed Terminal Sites

	Bay Sites		8 Mile Site		20 Mile Site	
	Acute	*Chronic*	*Acute*	*Chronic*	*Acute*	*Chronic*
Oyster	3.0	3.5	1.0	1.5	0	0
Oyster Community	3.0	3.5	1.0	1.5	0	0
Benthos	3.0	3.5	2.0	2.5	1.5	2.0
Phytoplankton	1.0	1.5	0.5	1.0	0.5	1.0
Zooplankton	2.0	2.5	1.0	1.5	1.0	1.0
Nekton	1.0	2.0	0.5	0.5	0.5	0.5
Beach-Bay	2.5	3.0	1.5	2.0	0.5	0.5
Beach-Ocean	2.0	2.0	2.0	2.5	0.5	1.0
Marsh	3.5	4.0	1.0	1.5	0.	0
Dune	1.0	2.0	1.5	2.0	0.5	1.0
Small Bays	0.0	0.0	1.5	2.0	0.5	0.5
Surf Clam	0.0	0.0	2.5	3.0	1.0	2.0
Surf Clam Community	0.0	0.0	2.5	3.0	1.0	2.0

0 = non-applicable
1
2 (increasing
3 relative
4 magnitude)

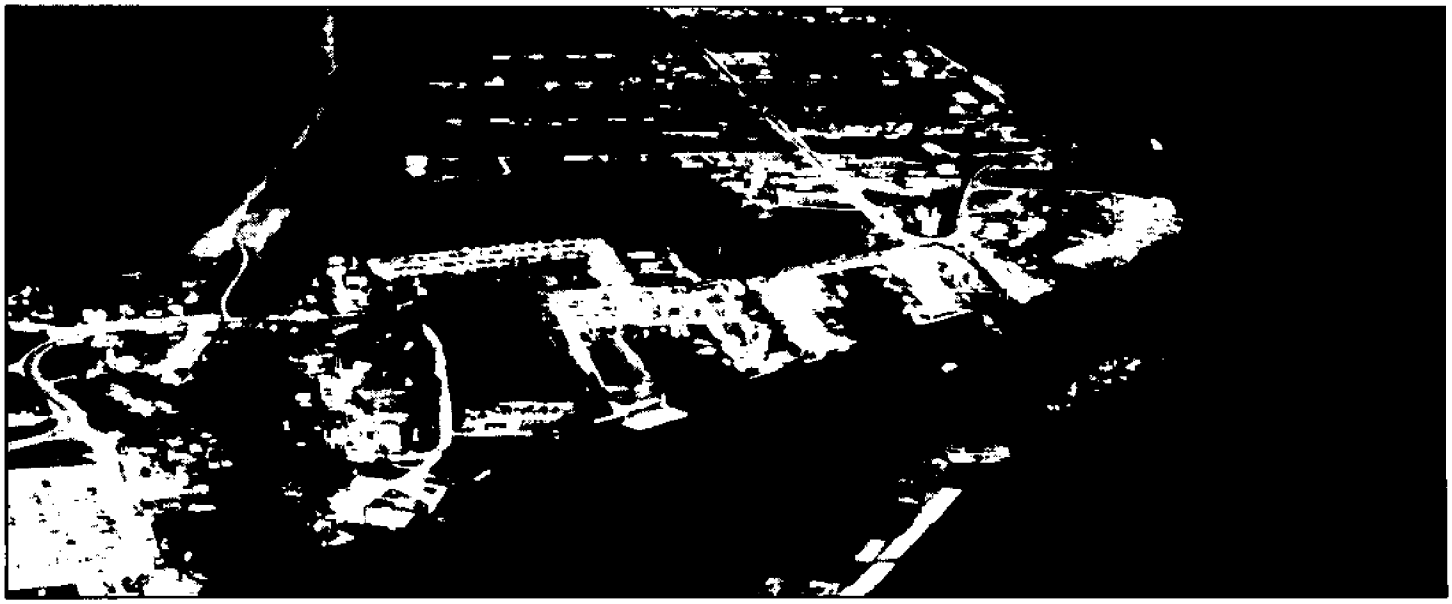
Maurer concludes by stating, "after 25 years experience along the Louisiana Coast, St. Amant (1972) concluded that petroleum activities in offshore waters did not create serious ecological problems, although some restraints must be applied. However, in unstable marshlands and shallow water embayments, industrial activity and particularly mineral exploration and production can be quite destructive."

Aside from these impacts, offshore exploration and production would place temporary and permanent obstacles (platforms, pipelines, rigs) in conflict with commercial fishing. However, experience in the Gulf of Mexico demonstrates that this impact is minimal; approximately 0.3% of the acreage of a tract becomes unavailable for trawling.

Finally, as noted earlier, offshore-related activity may degrade the scenic value of the shoreline if located in the nearshore aquatic or upland zone. This is particularly true for the coastal plain of Delaware, which has no natural topographic features useful for camouflaging storage tanks and other similar man-made devices.

Apart from the potential water quality impacts described earlier, OCS production and exploration would directly affect air quality with exhaust emissions from power units and service vessels, but the impact would be minimal. In the event of a major oil spill, some evaporation of oil would occur; a fire also would cause some air quality degradation if the well were producing oil, and less if

Onshore, OCS-related development near Venice, Louisiana



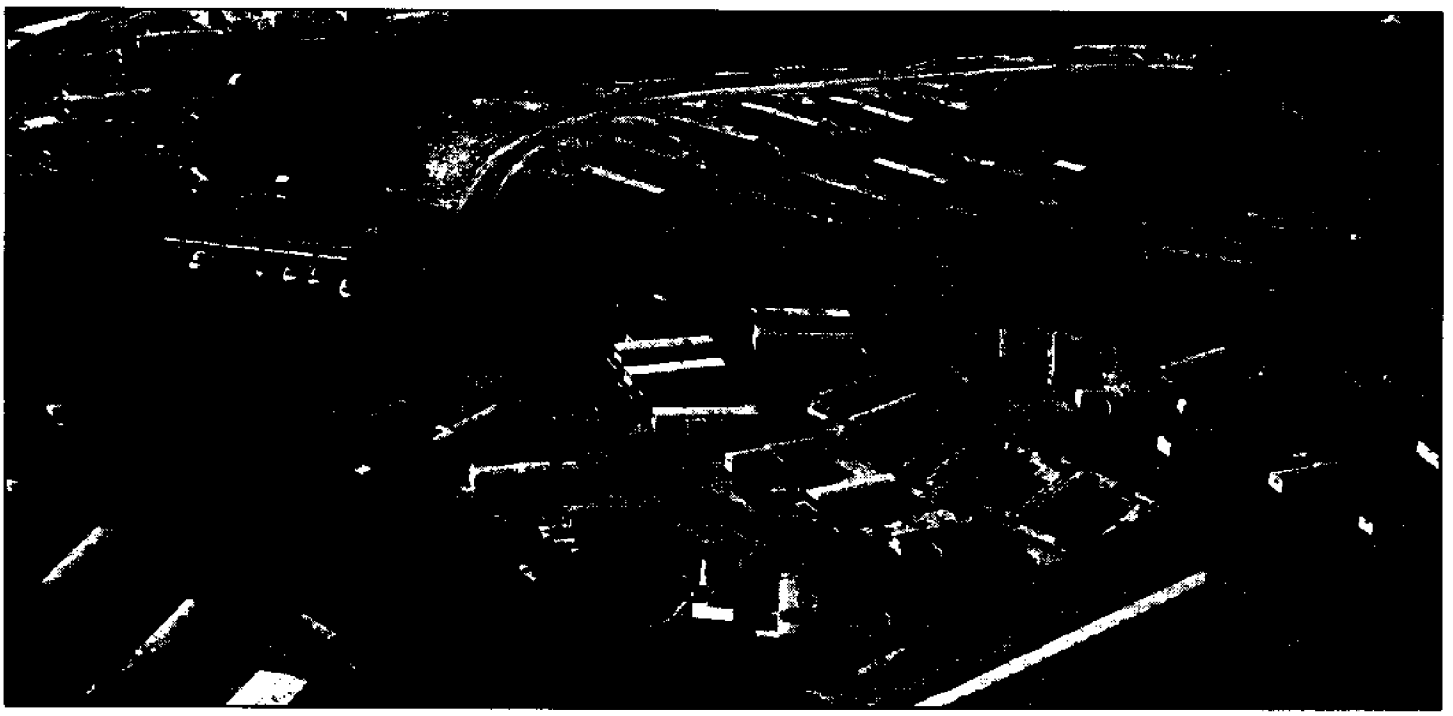
it were producing gas.

It is induced industrialization, population growth, and possible processing that create the greatest demands on air, water, electricity, and sewage disposal. Production and exploration by themselves appear to have minimal impacts on these services and utilities.

Estimates of potential impact on these areas are difficult to make without knowledge of the number and concentration of population and industry. It has been noted that a 100,000 bbl/day refinery will require at least 4 million gallons per day of fresh water and 210 million KWH of electricity per year; at presently accepted treatment levels, almost 60,000 lbs/day of pollutants would be released into water, and approximately 85,000 lbs/day of pollutants are released into the atmosphere. These quantities may be reduced to less than 10,000 lbs/day of wastewater effluents and between 48 and 76,000 lbs/day of air pollutants if guidelines in the Federal Register of May 9, 1974 are supported by current legislation. The "typical[1] petrochemical complex" involved in the manufacture of organic chemicals and cyclic intermediates would require 20 million gallons per day of water, and would produce an approximate load of 125,000 lbs/day of air pollution and approximately 120,000 lbs/day of water pollutants. Equivalent estimates of the electrical load, water demand, and waste load generated by the induced population can be derived from planning estimates of state and county agencies.

In meeting the demands of induced population, industry and/or processing activity, shortfalls (especially in fresh water) could occur. New Castle County is presently experiencing water problems with respect to both quality and quantity. Water quality problems exist in the Bay coastal zone extending along Kent and Sussex Counties. Solid waste disposal, traditionally landfill, currently is causing strains on available land in more developed areas of the state, and is suspected of polluting wells, the major sources of fresh water in the state. Thus, even without OCS exploration, production and processing, Delaware is experiencing acute environmental problems that will be intensified by the new industry and population unless careful planning is done for onshore development.

With planning, recreation and OCS development can co-exist.



[1] *A complex producing $350 million in sales per year.*

THE MULTI-STATE, COMMON RESOURCE ASPECT OF THE MID-ATLANTIC COASTAL REGION DEMANDS CONCERTED ACTION BY THE STATES.

Conclusions

The information presented so far provides a basis for examining some options for Delaware (and in one case, also for the other Mid-Atlantic coastal states) with respect to Outer Continental Shelf development. The following major points extracted from the body of this report provide the framework for identifying alternative actions.

First, a preliminary quantification study has estimated that OCS exploration and production activity in the Mid-Atlantic region would require at least 1,000 acres of shoreline and nearshore upland (in addition to that already acquired by Brown & Root in Northhampton County, Virginia). An associated population growth of some 15,000 people could be expected over a five-year period, reaching its peak in the early 1980s.

Second, for a one-million barrel/day field, the estimates indicate the potential for a petroleum-based population growth of 45,000 or more for indirect support functions. The acreage required will depend on location decisions that are independent of the presence of the OCS resource, because pipeline routing and costs offer a substantial degree of flexibility of siting.

Third, the estimates depend on assumptions, so it is necessary to examine extremes. One extreme, of course, is reached if no hydrocarbons are found. This would probably lead to a tapering of activity after the first three years. The other extreme would be an unexpectedly large find that probably would lead to accelerated activity and possibly a two- to three-fold increase in its level. If little or no oil or gas is found, states that prematurely committed to providing services could be left "holding the bag." A pay-as-you-go policy and regional participation to spread the risk are hedges against this happening. If the find is large, intensive pressures for land-use commitments should be expected. Adequate planning on a state and regional basis is a hedge against the latter.

Fourth, the similarity between the length of the Louisiana shoreline and that of the Mid-Atlantic coastal states suggests the ability to spread out shoreside activity and hence impact. Figure 8 (page 37) shows the location of roads, ports and airports that service OCS activity throughout the Louisiana coastal area. Many of the refineries are located in the second and third tiers of counties. Comparable distribution of activities seems possible along the Mid-Atlantic coastline, and discussions with a major oil company indicate that this is feasible. But the Mid-Atlantic seaboard has a unique problem – a multiplicity of affected, small states with common socioeconomic interests and environmental and political boundaries closely intertwined.

The fifth and last point indicates that per capita public expenditures increase substantially faster than revenues during the buildup phase of OCS activity. The potential exists for substantially increasing the tax burden on the resident population. Using a figure of $700/per capita (slightly more than that experienced in Louisiana), the annual increase in operating budget for a 15,000-person increase in population would be more than $10 million. That is more than present Sussex County expenditures, including income from revenue sharing.

The five points suggest that, as one approach to the OCS development problem, careful consideration might be given to creating a four-state regional authority. By so doing, it could be possible for the states to agree to provide offshore logistic support from two or more sites, each with shoreline commitments less than that of the former Fish Products Co. facility at Lewes (about 20 to 30 acres). The states might also agree on pipeline routing corridors, revenue and cost sharing, and the regulation of OCS direct and induced development by regional planning and

exclusions. Adverse impact could be minimized by adopting and enforcing uniform safety standards, training programs and similar activities.

If a regional authority were ruled out, other options for Delaware include:

- **No activity.** This option means intentional exclusion on the part of the state or industry. This does not, however, preclude Delaware from being a "bedroom community" for activity centered in other states.
- **An invited portion of logistic support activity (from some to all).** This requires careful planning and the establishment of acceptable zones of activity based on state and local regulations. Missing is the ability to exercise control over the actions of neighboring states.
- **Provision of a pipeline corridor to existing and/or neighboring state facilities.** It is not clear whether any benefit would accrue to the state through product taxes on material carried in the pipelines.
- **Any combination of the first three options.**

Beyond this point, participation could go up to any degree of product processing that the state might desire or allow.

With respect to environmental impact, the risk of catastrophic, offshore spills appears to be lower statistically than for other types of petroleum-related activity, but no less lethal if one were to occur in near-shore waters. As with most accidents with catastrophic consequences, human error is the likely culprit. Adequate contingency planning and regulation could do much to reduce the risks. This seems to be well within the power of state governments to accomplish, but the multi-state, common resource aspect of the Mid-Atlantic coastal region demands concerted action by the coastal states.

Finally, table 7 summarizes for directly related OCS operations the facilities required, which in turn govern the impact on population, housing, income, required government operations expenditures and land use. It assumes that all OCS-related development activity will be concentrated in Delaware. As stated earlier, that need not be the case. The level of capital expenditures has not been included because the rate with which improvements are made (such as the addition of schools, roads, sewers, etc.) is highly variable. Total earning and government expenditure estimates are probably somewhat lower than they might be in reality because of indirect effects that cannot be foreseen, but the figures are of the correct order of magnitude. Table 7 makes no provision for processing oil or gas in Delaware.

Table 7. Summary of Facilities Required and Onshore Impact

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Drill Rigs	3	6	12	19	21	12	11	9	9	9	1
Cumulative Number of Platforms				5	11	14	20	26	32	38	39
Supply and Crew Boat	6	12	22	34	36			decreasing			
Helicopters	1	2	4	6	7			decreasing			
Cumulative OCS Opns. Labor Force	540	1080	2160	3420	3780			probably decreasing			
Cumulative OCS Opns. Total Population	2160	4320	8640	13680	15120			probably decreasing			
Cumulative OCS Opns. Based Housing	540	1080	2160	3420	2780			no change if population stays same or decreases			
Cumulative OCS-Related Earnings/Year (Millions of $)*	5.152	10.303	20.606	32.627	30.061			probably decreasing			
OCS Related Gov't. Expend. (Millions of $)*	1.512	3.024	6.048	9.576	10.584			probably decreasing at slower rate than population decrease			

**1972 Dollars*

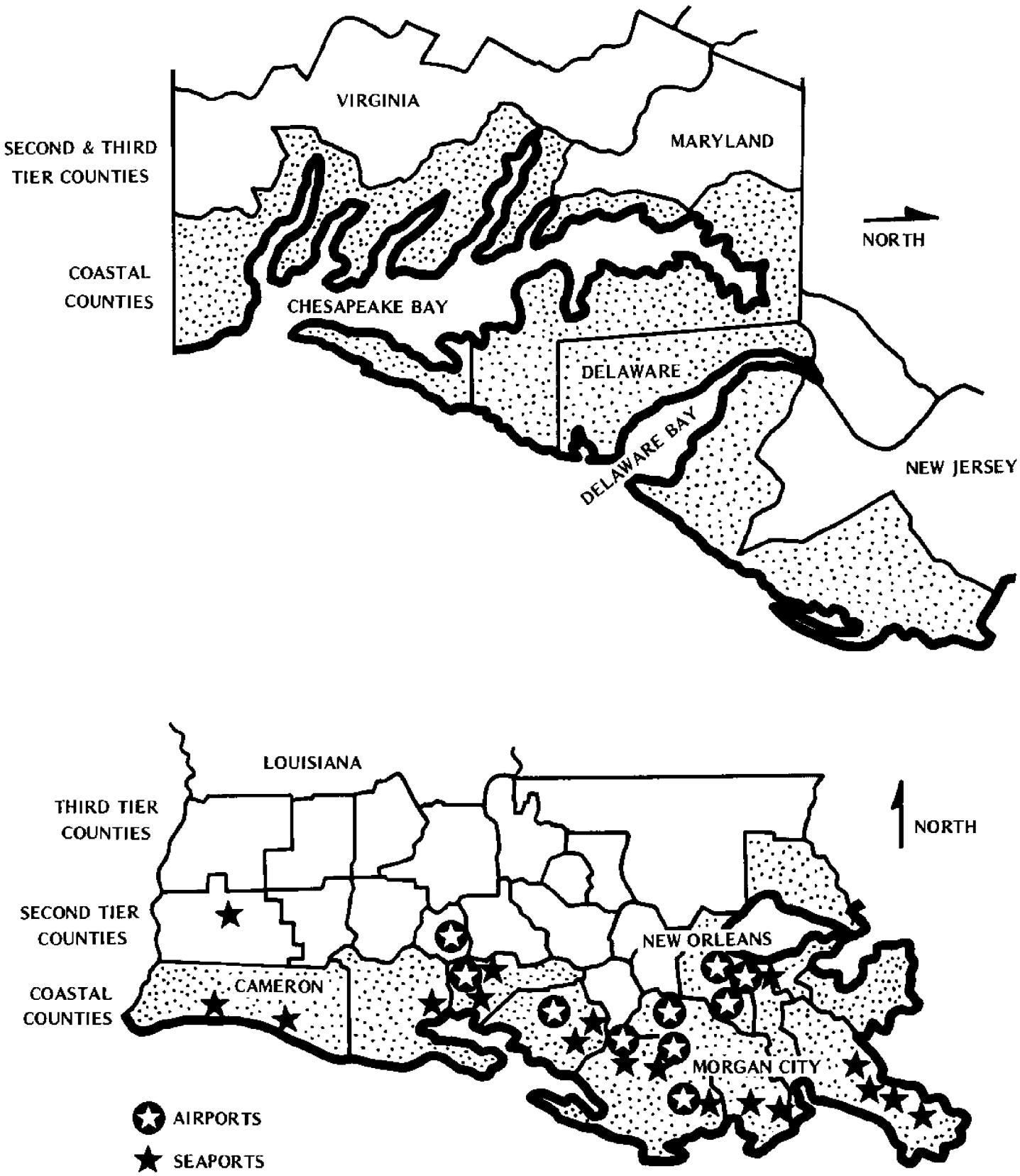


Figure 8. Distribution of OCS Activity Along the Louisiana Gulf Coast

Questions and Answers

OCS development implications for Delaware have been discussed so far in narrative form. Facts have been stated where known and inferences for Delaware made from consideration of comparable developments in other areas of the nation. Also, a number of issues have been identified and examined from a variety of perspectives.

But the questions posed in the early sections of this report have not been specifically answered. This section will answer them as well as a number of other questions relevant to the OCS problem.

• **When will the adjacent OCS areas be offered for lease?**
Late '75 and mid '77, according to present plans of the Bureau of Land Management.

• **Where are the resources located in relation to Delaware?**
The southernmost portion of the region is between 50 and 100 miles east of Cape Henlopen. The area then extends north to a line roughly east of Sandy Hook, N.J. (See figure 1, page 10).

• **How close to shore are the closest sites? Most of the sites? The most remote tracts nominated?**
The answer is unknown to the public at this time.

• **Is there a map of tracts nominated in December by the oil companies for this upcoming lease sale? Who could release the map? This would be a preview of where the richest sites are likely to be found, given the state of the oil-hunting art.**
Nominations have been made, but they are held confidential. BLM has the information, but it is unlikely that they can be pressured into making the information public until the final environmental impact statement is released. If the current court suit (Maine vs. U.S.) were settled in favor of the states, this could change that situation.

• **The oil companies seem to be far along in their planning for oil development in all worldwide locations; they have far more information about Atlantic oil than do the agencies that will eventually regulate development and production – is this true? If so, this is the often-repeated situation leading to haphazard regulation, and lack of regional control.**
Since information developed by oil companies through survey activities is proprietary data, they should, by definition, have more information than is available to the public. One cannot assume, however, that they have more information than the U.S. Geological Survey. Whatever their level of information, they tip their hand when they respond to the call for recommended lease blocks. NO ONE KNOWS HOW MUCH OIL THERE WILL BE UNTIL HOLES ARE DRILLED.

• **Which agencies (with names if possible) are responsible for offshore-related activities:**
(a) Social services for new population (who needs to plan)
(b) Creation of a regional authority for oil development
(c) Interaction with the Department of Interior
(d) Land-use permits, Delaware and region
(e) Coastal Zone, Delaware and neighboring states
(f) Delaware Bay transport
(g) Pipelines to Delaware Valley refineries, N.Y. and Va. refineries
(h) Geological information, offshore and Delaware
These are the responsible state agencies:
(a) Department of Health and Social Services, Department of Education.
(b) Legislature, Attorney General, Office of the Governor.
(c) State Planner, State Dept. of Natural Resources, State Geologist. The last is the primary contact with BLM.
(d) State Planning Office, State Department of Natural Resources, comparable county agencies.
(e) State Planning Office (DE), Department of Natural Resources (NJ & MD).
(f) Delaware River and Bay Authority.
(g) Department of Natural Resources and Environmental Control in Delaware; comparable agencies in other states.
(h) State Geological Survey.

• **What limits on onshore activity will be imposed by the affected states?**
The answer to this question is unknown, but the conclusions section of this report examines some options.

• **In spite of all the experience that the U.S. has had in offshore drilling in the Gulf and Pacific, it appears that a classic error in resource management may be repeated in the Mid-Atlantic – development before planning. There is, for example, a draft timetable for lease sales in the Mid-Atlantic. But are there parallel timetables in Delaware and other states for government preparation? Is there unpublicized but well-organized planning?**
There is no evidence of plans "in being" but there is considerable planning activity and considerably more planning time than heretofore. This is prompted by several factors, including the environmental movement of the past five years, passage of the Coastal Zone Management Act of 1972, and Coastal Zone legislation of many of the coastal

states. The increased planning time available is a result of the requirement to file environmental impact statements before a program may be approved (provisions of NEPA), as well as increased interest in the situation evidenced during the past several years. It does not appear as if the local and state governments have taken full advantages of the planning time available to them, but the recent formation of a Governor's Council to deal with OCS questions indicates the start of joint action.

- **Could you sketch the sequence and time required for events projected for OCS oil development lease sales, baseline studies, presentation of reports to agencies and lawmakers, arrival of noticeable numbers of new residents in Delaware, exploratory drilling, shore-to-rig services needed? And if developable quantities of oil and gas are found, how long from discovery to production? When could pipelines or other fixed installations be completed? When would permits be needed to build onshore access and additional refining capacity?**

See pages 27-29 of this report. Exploratory drill rigs would probably be on station within six months, (i.e., '76). A reasonable early estimate of possible full impact probably would not be available until two or three years after lease sales unless formations prove to be exceptionally productive. Criteria used to determine if the Mid-Atlantic has enough oil to build permanent wells include estimates of field size determined by drilling exploratory wells, well rate of flow, and quality of crude.

- **How much oil and gas will be found?**

No one really knows, but a variety of estimates have been made for both oil and gas. A National Petroleum Council estimate of ultimate discoverable resources in the Atlantic region that was published in 1972 estimated that 14.4 billion barrels of oil were present and also 54.4 trillion cubic feet of gas.

- **How extensively dispersed are the resources?**

No one can say until exploratory drilling is conducted.

- **Assuming that Delaware were as cooperative as other states, how many acres of the nominated tract appear to need to be connected to Delaware for logistic support (onshore storage, housing, vessel moorage, pipeline-right of way (eventually), and so forth)?**

This question can be answered only on a gross statistical basis – possibly one-half to one-third of the total logistic support acreage – so that would be 500 to 333, if the 1,000 total acreage estimate is correct. Delaware could accommodate all of the pipeline right-of-way, although there are many optional routings possible (i.e., up the bay and river, along the New Jersey side if that state were to so choose).

- **Is it correct to assume that the same options for oil transport in the Delaware Bay and adjoining lands will be considered for offshore drillings as were described in the study on deepwater ports, "Energy, Oil, and the State of Delaware"? If some options do not apply to OCS oil, please say which and why.**

It is not known whether an offshore terminal would be needed in conjunction with OCS development. However, all of the pipeline transport options would most certainly apply. Until sufficient production was proved to make a pipeline economically feasible, it is possible that producers might wish to barge from platforms to shore. This would not be too different from transporting lightered fuel. It is within the power of the state to determine if and where pipelines will go, according to an opinion of the Office of the Solicitor of the Department of the Interior.

- **If the OCS is developed, will there still be a need for an offshore terminal near Delaware?**

The Gaither report identified a number of demand forecasts for oil and selected as most likely the one which forecast a demand for two million barrels per day for the Delaware area. If the OCS were to produce one million barrels per day as assumed for this report, then tanker imports might remain at their present levels, and thus in the long run lightering might continue at its present level. But the question cannot be answered quite that simply because:

1. *There is no certainty that oil will be found, and it may take as much as two to three years to determine if it is present in economic quantities. This means that increased lightering (and congestion) would be a certainty for at least that period.*
2. *If oil were not found, then possibly a terminal could be built.*
3. *If oil were found, it would take a total of five to seven years to produce it, which, without a terminal, would mean further congestion and lightering to keep up with demand. Also, until the quality of the oil has been established, it is not possible to determine whether the refineries (or which of them) can accept it without process changes. If a particular mix were required, then Mid-Atlantic crude conceivably might be exported and other, more compatible crudes imported, in which case some form of terminal probably would be desired to support OCS activity.*

There is no simple answer to this question. A decrease in demand would probably make the risks of increased lightering more acceptable, while an increase in demand would probably make a terminal more appealing.

- **Will existing refineries and refinery sites satisfy production demands or will new centers of refinery activity be required?**

This is a different issue and should be considered independently of OCS development. It can be answered only in a separate analysis because it is entirely possible to have OCS development without new refineries or petrochemical plants.

- **If new refineries are needed, will they be developed close to markets or raw materials?**

(Same as above.)

- **If gas is found on the OCS, is it likely that new industries based on gas as a fuel or raw material would try to locate in**

close proximity to the pipeline downstate?
Experience indicates:

1. *That gas is generally reserved for its highest-valued use – that is, as a home heating fuel rather than as an industry fuel.*
2. *Industrial development will take place only where it is allowed to take place. If gas as a fuel were critical, it could be pipelined to industries in inland areas. The cost of pipelining is not sufficient to mean new industries would be forced to locate in coastal areas.*
3. *If one examines existing major gas pipelines, there is little evidence that they encourage industrial siting along their paths.*

• **Would Mid-Atlantic petroleum production make gasoline more available in the Mid-Atlantic states, compared to availability in other regions?**
It is not likely to benefit the Mid-Atlantic states to the exclusion of other areas.

• **Would oil development employ people laid off from other jobs, or would the oil operation hire mostly experienced oil field workers? Would local construction workers get business?**
There will probably be some of both, as noted on page 28 of the report.

• **Would there be any increase in the Delaware tax base as a result of oil exploration? Development?**
There would be an increase of the tax base if the labor force increases and/or new businesses locate in the state.

• **How is the bill for state services and regulation likely to be paid? Higher taxes? Which taxes? Have there been any proposals?**
There are many possibilities. At one extreme is revenue sharing by the Federal Government, at the other is the prospect for increased local and state taxes. It's likely that a combination of the two will result.

• **How can we protect our beaches and small bays from oil pollution if we have OCS activity?**
Studies must be done to determine the drift of oil slicks so that proper contingency plans can be made and equipment deployed to prevent oil from penetrating critical areas.

• **Please summarize advances in technology of offshore drilling that make catastrophic oil spills such as those at Santa Barbara not a threat during Atlantic drilling. Why can't it happen here?**
There were a number of factors that jointly contributed to the Santa Barbara oil spill – a geologically unusual area, human error, equipment failure, and poor judgment, to mention a few. A number of documents have been published that related the incident from different perspectives. It is impossible to say that "it can't happen here." It is possible to say that the risk of such an event happening here is less than it was in the Santa Barbara channel, if for no other reason than learning has occurred, resulting in improved decisionmaking, more rigorous regulations, and a more cautious attitude toward offshore operations.

• **Is not the Atlantic coast, with its predominance of marshes, more difficult to clean up after a spill than the mainly rocky, high-bluff coastline of the Pacific?**
This is a complex issue, and studies sponsored by the Environmental Protection Agency are now underway in search of answers.

• **Who are some University of Delaware experts on topics relevant to OCS development and production?**
Ecology of the shelf and coastal zone: Dr. Frank Daiber, Dr. Donald Maurer, Dr. Kent Price
Geology: Dr. John Kraft, Dr. Robert Sheridan, Dr. Robert Jordan
Current and ocean conditions affecting drilling: Dr. Stuart Kupferman, Dr. Hsiang Wang, Dr. John Ditmars

The need for timely planning has been mentioned frequently as a means for assuring orderly onshore and offshore development. There is not, at this time, a calendar outlining state government or regional actions that parallels the BLM lease sale schedule. Such a calendar could, for example, include milestone dates for:

- formation of a regional regulatory body
- legislative sanction of a regional authority
- completion of regional authority impact assessment and recommendations for state legislation
- legislative action for satisfying regulatory and financial needs for managing OCS development
- publishing guidelines by the Authority to oil companies who intend to participate in offshore activity, and to federal government agencies, outlining regulations, procedures and other pertinent information that must be followed for development to proceed.

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Jon Duggar
Louisiana State Planning Office

Myron Elliott
Sun Oil Company

Donald Gartman
Columbia Gas System Service Corporation

David Hugg
Delaware State Planning Office

James Jones
Florida Division of State Planning

Robert Jordan
University of Delaware

Leon Kazmierczak
Sun Oil Company

Andrew Knox
Delaware Senate

Walter J. Mead
University of California at Santa Barbara

Henry Muschenheim
Sun Pipeline Company

Harry Morrison
Western Oil and Gas Association

Joseph Moseley
Texas Coastal and Marine Council

Patricia Paske
Western Oil and Gas Association

Robert Roberts
Midwest Research Institute

Judith Roales
Delaware State News

Shirley Solomon
Seashore Environmental Alliance

Philip E. Sorensen
Florida State University

Paul Stang
U.S. Office of Coastal Zone Management

Marian Stewart
American Association of University Women

Les Strand
Columbia Gas System Service Corporation

Ernest Watson
Sun Oil Company

Robert Welsh
Columbia Gas System Service Corporation

Sandra D. Worthen
Delaware House of Representatives