Petroleum Storage & Transportation Capacities

Volume III • Petroleum Pipeline

National Petroleum Council • December 1979

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Committee on U.S. Petroleum Inventories, and Storage and Transportation Capacities
Robert V. Sellers, Chairman

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The sole purpose of the National Petroleum Council is to advise, inform, and make recommendations to the Secretary of Energy on any matter requested by the Secretary relating to petroleum or the petroleum industry.

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INTRODUCTION AND EXECUTIVE SUMMARY

INTRODUCTION

In June 1978, the Secretary of Energy requested the National Petroleum Council to determine the nation's petroleum and gas storage and transportation capacities as part of the federal government's overall review of emergency preparedness planning (Appendix A). The National Petroleum Council has provided similar studies at the request of the federal government since 1948, most recently the 1967 report entitled U.S. Petroleum and Gas Transportation Capacities and the 1974 report entitled Petroleum Storage Capacity.

To respond to the Secretary's request, the National Petroleum Council established the Committee on U.S. Petroleum Inventories, and Storage and Transportation Capacities, chaired by Robert V. Sellers, Chairman of the Board, Cities Service Company. A Coordinating Subcommittee and five task groups were formed to assist the Committee (Appendix B).

The Petroleum Pipeline Task Group, chaired by Gordon D. Kirk, President, Sun Pipe Line Company, was requested to update and expand the information contained in the petroleum pipeline section of the 1967 National Petroleum Council report, U.S. Petroleum and Gas Transportation Capacities.

In this report, capacity data as of December 31, 1978, are presented for common carrier crude lines, refined petroleum product lines, and liquified petroleum gas/natural gas liquids (LPG/NGL) lines in the form of maps and tables.

The maps include:

- A United States map, including all lines, for crude lines, petroleum product lines, and LPG/NGL lines, each separately
- Petroleum Administration for Defense (PAD) maps (Figure 1) for crude and petroleum product lines, each separately.

Tables presenting more detailed information than contained on the maps and intended to be used as a supplement to them are included in the Appendices.

To develop these data, a questionnaire was distributed by the National Petroleum Council. A copy of this questionnaire is included as Appendix H. A mailing list was prepared with the assistance of the Association of Oil Pipe Lines whose member companies transport more than 95 percent of the petroleum in the United States; the list included members as well as nonmembers of the association.

One hundred sixty-three pipeline companies with more than 50 miles of pipelines received the questionnaire; all of the major

Figure 1. Petroleum Administration for Defense (PAD) Districts.

transporters of petroleum in the United States were among those 163. One hundred sixty of these companies responded to the questionnaire and 131 furnished statistical data. The other respondents noted that their systems are either gathering lines or private lines, neither of which are within the scope of this report.

In an effort to enhance the usefulness of the basic capacity information presented in this report, several items not found in the 1967 report have been included:

- Area maps indicating interconnection of pipelines in the vicinity of major refining and pipeline centers (Appendix F). These maps expand the general location and direction information provided on the general maps by presenting details of interconnections to storage terminals, distribution terminals, refineries, and other pipeline facilities.[1]

- Gravity and viscosity information as it relates to the capacity data presented for crude oil pipelines. This

[1]The National Petroleum Council gratefully acknowledges the assistance of Sun Pipe Line Company in the drafting of these maps.

information may be desirable for future strategic planning to project the capacity of systems handling materials of viscosities and characteristics different from those reported.

- The reporting of the capacity for all refined petroleum product systems on a consistent basis; i.e., the capacity for transporting No. 2 fuel oil. Where it was reported, these tables also list capacity information for these systems when transporting gasoline and the "normal" average product mix.

- An overview of industry structure and operations to aid in a more meaningful application of the data contained within the report.

- A glossary of terms common to the industry and used within the report (Appendix J).

Crude oil gathering lines and private lines are not included in this report. Crude oil gathering lines are briefly described in Appendix C. Gathering systems are complex because they consist of many lines of varying lengths and diameters, generally all within a relatively small geographic area. These systems are readily expandable and generally more than adequately sized due to declining domestic crude oil production in the lower 48 states. Detailed reporting of these systems would, therefore, be of little value in contingency planning.

Private lines in the United States transport crude oils, refined products, and LPG/NGL. Most are considered to be plant facilities which move petroleum between refineries and product distribution terminals or water terminals. Most lines are small in diameter (2-inch through 12-inch) and are usually short in length. The total length of these private lines, including both gathering and trunk lines, has been estimated to be 16,000 miles, or less than seven percent of the total U.S. pipeline network. It is estimated that these lines transport less than 10 percent of the total petroleum transported by pipelines in the United States.

The name, location, and line size of both crude oil gathering and private line systems are available from the American Petroleum Institute and the Petroleum Publishing Company.[2]

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[2] Petroleum Pipeline Maps, American Petroleum Institute, Washington, D.C., 8th Edition, 1977 (a 9th edition is expected to be published January 1980); Crude and Products Pipeline Wall Maps of the United States and Canada, Petroleum Publishing Company, Tulsa, Oklahoma, 1978.

EXECUTIVE SUMMARY

Petroleum pipelines transported approximately 546 billion ton-miles of freight during 1977, which constituted about 24 percent of the total intercity freight in the United States that year.[3] Freight moved by petroleum pipelines includes crude oil, refined products (e.g., gasolines, diesel fuel, jet fuel, and home heating oils), liquified petroleum gases (ethane-propane mixes, propane, and butanes) and natural gas liquids.

This report contains detailed capacity information on specific pipelines that form the common carrier petroleum pipeline network of the United States. Since 1967, more than a dozen major pipeline projects have been completed, with approximately 12,840 miles of crude oil pipelines and 25,230 miles of products pipelines (refined products and LPG/NGL) added to the petroleum pipeline transportation network of the United States. This network now encompasses approximately 145,770 miles of crude oil pipelines; 63,700 miles of refined products pipelines; and 17,590 miles of LPG/NGL pipelines.[4]

The darker lines on Figure 2 indicate the relative size and direction of movements of crude oils through the crude oil pipeline network in 1978. Movements by water are shown in a lighter shade. The majority of the crude oil (both domestic and imported) moves from southwestern and Gulf Coast areas to major refining areas located in the central and upper Midwest.

Figure 3 indicates the relative size and direction of movements of both refined products and LPG/NGL by pipeline and water, from key refining areas to terminals located at the marketplace. The major portion of refined products flows from Gulf Coast refining centers to southeastern and eastern areas of the United States. Significant quantities also flow from Gulf Coast refining centers to the central and upper Midwest.

Several significant trends have developed in the years since the 1967 report was published. The United States has imported increasing amounts of foreign crude oil to supplement its declining domestic production. This foreign crude is imported through water terminals and their associated facilities and distributed through petroleum pipelines to inland refineries. Major amounts of imported crude oil are transported by pipeline from the Gulf Coast to the central and upper Midwest refineries.

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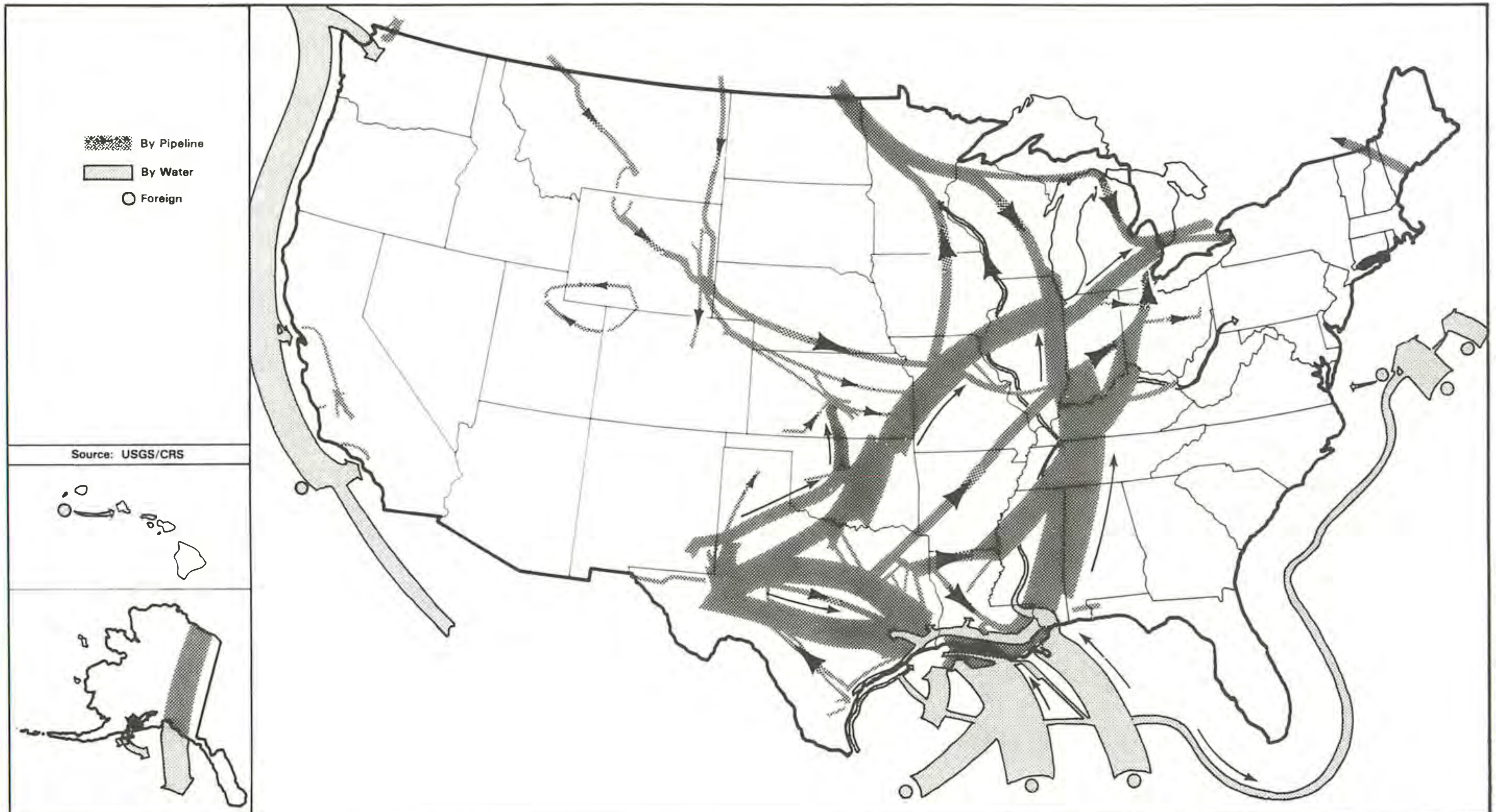
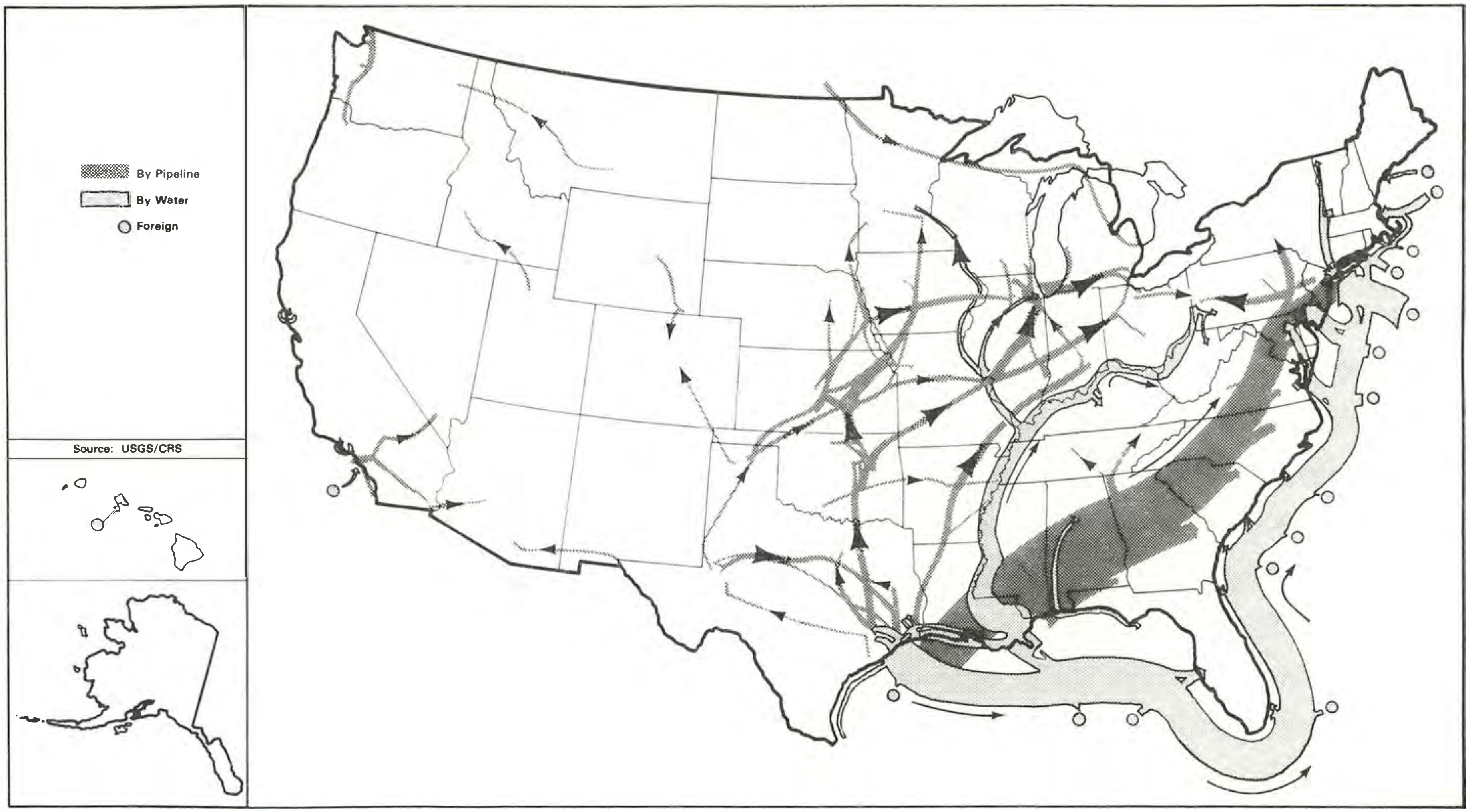
[3] Transportation Facts and Trends, Transportation Association of America, 14th Edition, July 1978, supplemented April 1979, quarterly update.

[4] Crude Oil and Refined Products Pipeline Mileage in the United States, U.S. Department of Energy, January 1, 1977.



SOURCE: *Petroleum Supply Alternatives for the Northern Tier and Inland States Through the Year 2000 (Draft Report)*, U.S. Department of Energy, Assistant Secretary for Policy and Evaluation, Office of Policy Analysis, Volume I, February 1979.

Figure 2. 1978 Crude Oil Movement.



SOURCE: *Petroleum Supply Alternatives for the Northern Tier and Inland States Through the Year 2000 (Draft Report)*, U.S. Department of Energy, Assistant Secretary for Policy and Evaluation, Office of Policy Analysis, Volume I, February 1979.

Figure 3. 1978 Refined Petroleum Products Movement.

These imported foreign crude oils are of varying qualities and characteristics and are received in large batch sizes (approximately 300,000-600,000 barrels). Before the importation of these crudes became such a significant factor, individual crude oils were often shipped in separate batches to refineries. The trend at the present time is to mix individual crude oils having similar qualities and deliver the mixes to the refineries.

Prior to 1967 some effort had been made to ship various petroleum materials through the same pipeline systems. Since 1967, it has become common to batch various combinations of crude oil, refined products, LPG, and petrochemicals through a single pipeline. This ability to ship various petroleum materials in a single pipeline has enhanced the flexibility of the pipeline network.

SIGNIFICANT CHANGES AND TRENDS SINCE 1967

Since 1967, approximately 12,840 miles of crude oil pipelines and 25,230 miles of petroleum products pipelines have been constructed at a cost of about $11 billion.[1] Major pipeline construction projects which have been completed since 1967 are shown in Table 1. Many of the new systems shown in this table, as well as systems existing before 1967, have continued to expand (Appendix G). The 800-mile Trans-Alaska Pipeline System, which cost about $9.3 billion, has expanded its capacity from 1,000 thousand barrels per day (MB/D) to 1,235 MB/D since it was placed in operation in 1977. Since 1968, the Capline System has increased its capacity from 420 MB/D to 1,200 MB/D. The building of Seaway and Texoma in 1975 added a total of 600 MB/D to the pipeline capacity to move crude oil into PAD II from the Gulf Coast. In 1978, Texoma was further expanded by 110 MB/D.

The Arapahoe Pipe Line, a 475-mile crude oil pipeline from Merino, Colorado, to Humboldt, Kansas, has been taken out of crude oil service. The former crude line, which was previously underutilized, will form a portion of a 610-mile natural gas system expected to be in operation by late 1979. This new Cities Service Gas Company system was approved by the Federal Energy Regulation Commission (FERC) only after other arrangements were made to move the oil formerly transported on the Arapahoe Pipe Line.

The refined products pipelines systems have continued to grow. When completed in 1971, Explorer Pipeline Company had an initial capacity of 209 MB/D into the Chicago area; this capacity has been increased to 290 MB/D. Colonial Pipeline Company has expanded its capacity from Atlanta, Georgia, to Greensboro, North Carolina, from 1,152 MB/D in 1968 to about 2,000 MB/D. Texas Eastern Products Pipeline Company will complete the looping of its Houston, Texas, to Seymour, Indiana, system in 1979, which will increase its capacity to 360 MB/D.

The number of LPG and NGL pipelines has increased dramatically since 1967. The Chapparal System was completed in 1971 for moving western Texas gas liquids (NGL) into the Houston area. Both Hydrocarbon Transportation, Inc. and MAPCO Inc. have continued to expand their systems. Also, many small additions to the LPG and NGL lines have been constructed since 1967. The Cochin System was recently completed for importing LPG from Canada into the Toledo, Ohio, area.

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[1]Association of Oil Pipe Lines.

TABLE 1

Major Pipeline Projects Completed 1967-1978

Project	Origin	Destination	Material Transported	Year Completed	Present Capacity (MB/D)
Capline	St. James, LA	Patoka, IL	Crude	1968	1,200
Chicap	Patoka, IL	Chicago, IL	Crude	1968	490
Lakehead	Superior, WI	Chicago, IL	Crude	1968	740
Lakehead	Chicago, IL	Sarnia, Canada	Crude	1969	710
Chapparal	West Texas	Mont Belvieu, TX	NGL	1971	102
Explorer	Lake Charles, LA	Chicago, IL	Refined Products	1971	290
Chase	El Dorado, KS	Denver, CO	Refined Products	1973	40
Amoco	Denver, CO	Bushton, KS	NGL	1975	20
Osage	Cushing, OK	El Dorado, KS	Crude	1975	270
Seaway	Freeport, TX	Cushing, OK	Crude	1975	300
Texoma	Nederland, TX	Cushing, OK	Crude	1975	410
Trans-Alaska	Prudhoe Bay, AK	Valdez, AK	Crude	1977	1,235
Cochin	Edmonton, Canada	Chicago, IL, and Toledo and Green Springs, OH	NGL	1978	75
				TOTAL	5,882

Several significant trends have developed since 1967:

- With the decrease in domestic petroleum supplies from the lower 48 states, more crude oil is being imported through water terminals and transported to inland refineries via pipeline.

- There has been less batching of individual and specific crude oils with a specific quality and increased batching of mixes of crude oils with similar qualities.

- With the advent of higher priced crude oil, refined products, and LPG, more sophisticated methods of measurement are being developed.

- In an effort to optimize the usage of existing petroleum pipeline systems and to minimize pipeline transportation costs, crude oils, LPG, NGL, and refined products are frequently batched through the same lines.

- NGL is transported through pipelines directly from field gas plants to central fractionation facilities. This transportation of NGL has simplified the field gas plants. The centralized fractionation facility provides economies of scale by separating large volumes of NGL into its marketable components (e.g., propane, butane, etc.).

All of the operational trends have been initiated to reduce investment and operating costs, resulting in more efficient pipeline operations.

A PIPELINE INDUSTRY OVERVIEW

HISTORY

After Edwin Drake discovered oil in western Pennsylvania in August 1859, crude oil was carried in barrels loaded on horse-drawn wagons or on barges. In 1862, a railroad line into the western Pennsylvania oilfields was completed and oil was moved to refineries in primitive tank cars consisting of flat cars with two large wooden drums.

The first crude oil pipelines were built during the 1860's using wood, cast iron, and wrought iron. Pipeline companies were formed and rapidly replaced barges, wagons, and railroads as the primary mover of crude oil because the cost of transporting oil by pipeline was substantially less than the cost of other methods of transportation. The first system designed expressly to move oil from wells to pipeline storage was constructed in 1866, and pipeline companies began to provide oil storage for their customers in that year. By 1870, approximately one million barrels of storage existed in the western Pennsylvania oil region.

These early pipelines were small, having diameters of two or three inches. In 1879, a 108-mile, six-inch pipeline was completed in Pennsylvania and was extended to Bayonne, New Jersey, in 1888. Early pipeline activity centered in Pennsylvania, West Virginia, Kentucky, Ohio, and Indiana where crude oil production and the refining centers of Pittsburgh and Cleveland were located. In 1901, the first petroleum products were shipped in batches through a crude oil pipeline. Small diameter cast iron or wrought iron pipelines of the 1860's have given way to the steel pipelines of today which range in diameter up to 48 inches. Construction and operation of the Trans-Alaska Pipeline System, a 48-inch crude oil pipeline, is perhaps the best and most recent example of the technological advances in pipeline materials and construction that have taken place.

PIPELINE DESIGN

The Decision to Build a Pipeline

The decision to build a new pipeline requires a demonstrated need based on its economic feasibility. New pipelines or expansions of existing pipelines are considered when there is a need to connect new crude oil fields or marine terminals, to supply new or expanded markets, or to supplement older, less efficient pipelines. The throughput must be large enough to result in low operating costs per barrel, making it competitive with other transportation systems (other pipeline systems, barges, tank cars, tankers, and trucks) serving the same area. The typical large diameter pipeline requires approximately five years for planning, design, engineering, environmental permits, and construction. Feasibility studies are made to forecast demand over the life of the pipeline -- generally a minimum of 20 years. Factors such as the following are considered:

- The state of the economy
- Product demand growth
- Refinery construction, expansion, and shutdowns
- Changes in domestic crude oil production
- Potential crude oil and petroleum product imports
- Possible construction of competing new pipelines
- Competition from other pipelines or modes of transportation
- Product prices
- State and federal government regulations.

Ultimately, the decision to build or not to build is based on economics. The line will be built only if it can generate enough revenue to repay its costs, taxes, and principal and interest, and provide an acceptable profit to the investor.

Ownership

The initial decision to consider building a pipeline necessarily involves either an existing company or the formation of a new one. There are three basic forms of ownership of petroleum pipelines: single ownership, joint venture stock company, and undivided interest.

Single ownership means that a pipeline is owned by one company. That company may be a crude oil producer, a refiner, a product marketer, or a company that simply owns and operates the pipeline as a business venture. This pipeline can be either a common carrier or a proprietary (private) line. All interstate common carrier pipelines file their tariffs with the FERC.

A joint venture stock company involves two or more companies or individuals which form a new company to build, own, and manage a pipeline. These owners usually ship their petroleum through the pipeline when it is constructed. The stock company files its own tariffs with the FERC.

An undivided interest pipeline also involves a number of companies owning a single pipeline. Each undivided interest owner, however, owns a specific portion of the pipeline's capacity and files tariffs with the FERC as if it were a separate pipeline. Usually one company serves as the operator for the entire system.

Both joint venture stock companies and undivided interest pipelines have made possible the building of larger diameter pipelines. These larger pipelines transport greater volumes at a lower cost per barrel than the smaller diameter, single ownership lines. The investment required to construct a large diameter pipeline prohibits most companies from undertaking such a project individually.

Determining the Size of the New Pipeline

For a stock company or undivided interest pipeline, the initial shipment capacity and line size are determined from future-shipment estimates. The pipeline company or group studying the pipeline's feasibility contacts all prospective shippers to determine their interest in ownership of the pipeline and their long-term shipment forecast through the line. Prospective shippers are requested to provide realistic shipment forecasts even if they are not interested in ownership. After compilation of all shippers' forecasts, an estimate is normally made to account for prospective shippers who do not submit a forecast. The total of forecasted and estimated shipments is used to help determine the size of the facilities. When actual shipments exceed the initial pipeline capacity, larger horsepower motors and pumps and/or more pumping stations may be installed, if economical, to increase the capacity. Beyond this point, if demand for capacity continues to increase, the pipeline may be expanded, if economical, by looping (i.e., construction of a new pipeline parallel to an existing pipeline). When actual shipments remain less than the initial or expanded capacity (i.e., total estimated shipments do not materialize), the pipeline has been oversized and may never operate economically. Because pipelines are capital intensive and have inflexible routes, they are considered to be risky investments by the investment community. Accurate forecasts of total shipment volumes are therefore imperative in the sizing of new pipelines and the expansion of existing pipelines.

Route Selection

A major part of planning a new pipeline is route selection. The key considerations for routing are the origin, destination, and intermediate delivery points. Product pipelines typically have a number of intermediate delivery points because product demand tends to be distributed with population; crude oil pipelines normally have only a few intermediate delivery points which are determined by refinery locations or by pipeline distribution centers.

Another consideration is topography. High terrain generally means higher construction and pumping costs; it takes more power to pump petroleum uphill than it does to pump it along flat terrain. River crossings are more expensive to construct because of burial requirements caused by shifting currents, flood plains, course changes, etc. Where possible, urban areas and river crossings are avoided because of higher construction costs. The pipeline company must obtain right-of-way for the route either by purchase of land or purchase or lease of right-of-way from the land owners.

The next step is to obtain permits from various agencies of federal, state, and local governments. The precise requirements vary, but government permits for most projects now require a minimum of two or three years for processing. The routes of most major pipelines proposed in the last several years have met with some environmental objections. The pipeline company may answer the objections satisfactorily or change construction or routing plans to resolve the objection. If resolution is not possible, the pipeline construction plans may be cancelled or suspended.

Basic Design

Petroleum pipelines normally carry either crude oil or petroleum products, although a few pipelines carry both. The function of both types of pipeline is to move a commodity to market.

In the case of crude oil pipelines, domestic crude is moved from producing oilfields to refineries (often from thousands of oil wells through smaller gathering pipelines and main lines) and imported crude is moved from ports to refineries. In the case of petroleum product pipelines, the product is moved from refineries to terminals from which distributors move it to market.

Crude oil and petroleum products are pumped through pipelines in a continuous flow, pushed by various types of pumping equipment. Pipelines are connected to storage facilities called tank farms at their origin and destination points, and sometimes to tanks at intermediate points. All petroleum entering or leaving the system is measured to account for any differences between receipts into the pipeline and deliveries out of the pipeline.

Pipeline Capacity

Petroleum pipeline capacity is difficult to define, tends to be oversimplified, and is, in general, an elusive concept. It is the maximum volume that a pipeline can move between two points during a given time period using existing equipment, and is dependent on the following factors:

- Pipeline diameter
- Pipeline length
- Pumping equipment
- Intermediate locations
- Pipeline topography
- Petroleum viscosity, temperature, and gravity.

Seasonal variations in viscosity, temperature, and gravity can result in capacity differences between winter and summer. For example, during the winter season, products pipelines must move more heating oils. These heating oils have higher viscosities than gasolines, which means that they will move through the pipeline more slowly, causing a reduction in refined products pipeline capacity. In addition, lower ambient temperatures in the winter will increase the viscosities of both refined products and crude oil, also causing reductions in pipeline capacities.

Pipeline Expansion

When pipelines are constructed, they usually have some built-in capability for expansion, often referred to as "normal expansion capability" or "economic expansion capability." These expansions can be made by adding booster pump stations, or by adding or replacing pumps with more powerful ones at stations. These expansion possibilities are planned when the pipeline is designed, but whether they take place depends upon the increase in the demand for capacity in the pipeline after it begins operating.

Pipelines which have been expanded to their economic limits by adding booster stations and pumping equipment can be expanded further only by "looping," or constructing an additional pipeline along part or all of the original pipeline route. The decision to loop the original line involves the same kind of economic analysis as constructing any new pipeline.

PIPELINE TECHNOLOGY[1]

Construction

Horses were used to haul pipe and equipment during construction of the earliest petroleum pipelines, but most of the work was done manually. Land was cleared, ditches were dug, pipe lengths were screwed together, pipe was lowered into ditches, and ditches were backfilled by hand. Steel pipe became available in 1895 and was the forerunner of several important developments of the early 1900's. Pipeline joints were soon welded, and in 1928 electric arc welding and 40-foot-long seamless pipe sections were developed. These developments represented significant improvements over earlier, less reliable welding techniques and short lengths of pipe.

Today, pipelines are usually constructed by specialized pipeline contractors. First, the pipeline's right-of-way is cleared to accommodate construction equipment. Pipe sections, often 60 to 80 feet in length, are placed (or "strung") along the cleared right-of-way, and the ditch is dug with a ditching machine. Where necessary, the pipe is bent to fit the ditch, welded either manually or

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[1]For further information regarding pipeline technology, see Introduction to the Oil Pipeline Industry, University of Texas Petroleum Extension Service, Austin, Texas, 2nd Edition, 1978.

automatically, and lowered into the ditch. Welded joints are visually inspected and many are examined by X-ray to detect flaws. Any flaw requires either repair or removal of the weld and welding the joint again.

Many improvements have been and are being made in pipeline construction technology. Perhaps the best example of the application of this technology is the Trans-Alaska Pipeline System which now carries almost 1,200 MB/D of crude oil across the Alaskan wilderness.

An additional significant technical development has been the use of drilling equipment to bore horizontal holes under major rivers, canals, and ship channels for pipeline crossings. This method of installing crossings prevents soil erosion, eliminates silting, and permits construction with minimum interference to normal river traffic.

In the past, liquid pipelines and facilities have been constructed in accordance with standards developed and published by the organizations listed below:

- American Petroleum Institute (API)
- American Society of Mechanical Engineers (ASME)
- Manufacturers Standardization Society (MSS)
- American National Standards Institute (ANSI)
- American Society for Testing and Materials (ASTM)
- National Fire Prevention Association (NFPA)
- American Insurance Association (AIA).

Also, state and local building and fire codes were adhered to in designing facilities.

In 1969, the Department of Transportation issued Code 195 which establishes standards governing pipeline construction. This code incorporated many of the standards of the organizations listed above.

The standard known as ANSI B31.4, Liquid Petroleum Transportation Piping Systems, is the most widely used code for pipeline design. In addition, the National Electric Code, which is one of the several NFPA codes, and state and local building and fire codes are utilized.

Materials and Equipment

In the past decade many advances have been made in the materials used in pipelines. In turn, these new materials have caused the development of new construction equipment and techniques. For example, the tensile strength of pipe steel has risen steadily, thus permitting the use of thinner yet stronger pipe walls. Pipe today commonly has a tensile strength of up to 70,000 pounds per square inch, an increase of 25 to 35 percent over steels used 10 years ago. At the same time, new alloys have improved the ductile characteristics and the low temperature properties of the pipe. These developments have improved service over a wide range of conditions, resulting in significantly lower construction costs.

Welding processes have also changed. Automated pipe welding techniques are common today. New welding rods with high tensile strengths and special properties which prevent the cracking of high yield strength weld metal have been developed for use with new steels and alloys. New welding processes have been developed, permitting faster construction and higher quality welding.

New materials and processes for coating both the outside and inside of pipe have been developed. The external coating was previously made of asphalt, coal tar, or enamel with layers of felt, glass, or paper. Recently there has been increased use of plastic tape, extruded plastic, and fusion-bonded epoxy thin-film coatings to coat both the inside and outside of pipelines.

Motors and pumps used on pipelines have not changed drastically in recent years, but improvements are constantly being made. More efficient yet smaller electric motors to drive pipeline pumps result in reduced costs and space savings. Low speed industrial and high speed aircraft turbines are also used to drive pipeline pumps. Where electrical power is inaccessible or very expensive, turbines can be fueled by gas or a small portion of the petroleum being pumped. The Trans-Alaska Pipeline System has several small refineries along its route that take crude oil from the pipeline, refine a fuel product from it to supply the pipeline's turbines, and return the unused portion of the crude to the pipeline where it is mixed with the passing crude oil.

Electronic, pneumatic, and hydraulic equipment for remotely controlling and monitoring pipelines has changed substantially. Computerized supervisory systems and solid state electronics have resulted in more efficient centralized pipeline operations. One or more pipeline systems can now be monitored from a computerized control center, requiring fewer people and providing substantially more data than previous systems.

Operations

A pipeline can be a single line of uniform diameter pumping at a uniform rate from one place to another, or it can be a substantially more complex system. The line can have intermediate entry and exit points, change diameters or pumping capabilities at various points, or be several separate pipelines running side by side with varying diameters -- the combinations are almost limitless. The typical pipeline will have origin and destination points, breakout tankage, and a decreasing or increasing capacity as the line approaches its terminus. All of these factors make scheduling pipeline movements and overseeing pipeline operations a difficult and complex task.

As noted earlier, the volume of liquid a pipeline can carry depends upon the size of the pipeline, the capabilities of its pumps, and the gravity and viscosity of the liquid being pumped. Pipelines publish tariffs that establish the price for shipping through them, and state the conditions and specifications of what may be shipped. A pipeline will normally set specifications on the pour point of the liquid (the minimum temperature at which the liquid will no longer flow) and its viscosity (a measure of the resistance exhibited by the liquid) because the rate of flow of a pipeline is determined by the slowest moving liquid in the pipeline. In addition, crude oil pipelines usually have specifications on the sulfur content, gravity, and other properties of the crude that they will ship; product pipelines also may have limited capability to handle certain products. The reasons for establishing specifications on materials handled in crude and product pipelines are the need to maintain the rate of flow at an optimum level and the desire to avoid downgrading or contaminating the crude or products normally shipped.

Because contamination results in cost penalties to the shipper and/or the pipeline, pipelines protect crude and product qualities by means of careful quality control practices. Separation of different grades of crude oil or petroleum products in a pipeline is called "batching." To minimize contamination, batches are sometimes physically separated by batching devices such as rubber spheres. Even if batching devices are used, some mixing, or "interface," occurs. To minimize this interface and maximize the uncontaminated crude or product, shipments are batched in a continuous, orderly sequence with shipments of similar quality. Crude oil is normally batched by sequencing compatible crudes considering such qualities as specific gravity, viscosity, sulfur content, and whether the crude is asphaltic, paraffinic, or naphthenic based. Products are typically shipped in groups that move from lighter to heavier gravities and then back to lighter again in sequences such as this: gasoline-kerosine-fuel oil-kerosine-gasoline. This sequence of product is normally moved in regular, repetitive cycles that are usually 10 days in length, with three cycles per month and 36 cycles per year. Cycles may be five or seven days in length and vary depending on the pipeline capacity, scheduling of refinery operations, and market demand.

In a "segregated" pipeline, specific shipments are identified as the property of a shipper and are moved through the pipeline in such a way as to maintain the integrity and identity of the specific product. In a "fungible" products pipeline, the pipeline company sets a range of specifications for each grade of fungible product. All volume of that product grade is commingled or mixed into a single batch. When the fungible batch reaches the delivery point, every shipper receives his appropriate volume. The shipper can receive another shipper's original product rather than his own with the realization that the product received meets the specifications required. In a common stream crude pipeline, the crude the shipper receives may vary from that which the shipper put into the pipeline. Sometimes the shipper will pay or receive a price differential based on the quality difference between the oil delivered into the line and the oil received, but usually he will simply take the crude provided it is either all sweet crude (low in sulfur) or all sour crude (high in sulfur). When large differences exist in the quality of crude injected into a pipeline, a gravity-sulfur bank may be established to compensate the shipper for the differences in the quality of crude oil delivered and received.

Efficient pipeline operations depend on large shipments, which result in lower operating costs for the pipeline, and consequently lower transportation costs to shippers. Pipelines normally have minimum batch sizes ranging upward from 25,000 barrels. Minimum batch requirements are often established for operating reasons and for maintaining product integrity. The purpose of establishing minimum batches is to keep the interfaces small in relation to the size of the shipment and thus minimize losses.

Anyone wishing to ship crude or products on a common carrier pipeline has the right to do so provided he meets the requirements of the pipeline's published tariffs and asks for (or "nominates") shipment on the pipeline during the coming month by informing the pipeline what and when he wants to ship. If he meets the published rules and regulations of the pipeline's tariff (which is filed with the FERC), the pipeline confirms the movement and a shipment date. After the batch has been delivered to the shipper or to a connecting pipeline, the shipper is billed for the movement at the rate published in the tariff.

If the requests for shipments during the month are greater than the capacity available, a pipeline may have to apportion (or "prorate") available capacity among all those nominating for it. Because of the increasing demand for pipeline transportation, a few pipelines in the United States have had to prorate capacity among shippers. Pipelines generally have formulas for computing prorations in order to treat shippers on a fair and equitable basis.

The physical characteristics of pipeline operations require a pipeline to be full before any deliveries can be made. This line-fill is normally furnished and owned by all of the shippers on a pipeline but remains in the custody of the pipeline company. It includes pipeline fill, manifolding and tank line fill, and working storage fill. Line fill can be as much as several million barrels.

Scheduling shipments through a pipeline is a complex and exacting job. The pipeline companies must balance all the various nominations of different qualities of crude oil or grades of products, their entry points and destinations, and their shipment and arrival dates. Many pipeline companies use computers to prepare and adjust short- and long-range schedules and update them on a regular basis. Schedule changes often occur on both a short- and a long-range basis, and shipment dates must be shifted from week to week and day to day. These changes are caused by refinery shutdowns, pipeline operating problems, erratic tanker arrivals, and volume changes by shippers. In addition, pipeline schedules vary seasonally as product demand changes.

Pipeline operations are monitored around the clock from a central location by dispatching personnel, many using supervisory control equipment. Dispatchers control operations at remote, unmanned facilities; keep track of the grade, quantity, and ownership of each batch; coordinate with field operation personnel at manned facilities; and monitor flow rates, pressures, and shipments to maintain safe and efficient operations.

Although this view of pipeline operations indicates how complex the operation of a pipeline can be, it has only considered the operation of a single pipeline or pipeline system. In practice, a shipment of crude or product may change systems several times before it is delivered to its final destination. For example, crude oil from southeastern Utah can move through the Texas-New Mexico, Basin, Cushing to Chicago, Lakehead, and Interprovincial Systems to the Buffalo, New York, refineries; or products can move from Lake Charles, Louisiana, to Pittsburgh, Pennsylvania, through either the Colonial and Laurel Systems or the Explorer, Arco, and Buckeye Systems to product distribution terminals. These shipments may be shipped on pipelines with varying quality requirements or may be moved through several different storage facilities between pipelines, but they will meet the shipper's quality specifications at their destination.

Maintenance

Pipeline maintenance is continuous and involves routine maintenance of the pipeline's pump stations and rights-of-way. Equipment, pump stations, and tank farms require repair, replacement, and/or recalibration. Many pipeline companies have maintenance crews to repair leaks, while others have contract personnel available on short notice. Some pipeline companies perform major maintenance with company personnel, such as line lowering or relocation, while others contract out major maintenance. However, all companies use their employees to supervise and inspect the work performed by others.

Pipelines are cleaned internally of dirt, sediment, wax, and other matter by use of scrapers (or "pigs"), which are cylindrically shaped metal or polyurethane devices with wire brushes or a series of protrusions. They are put into and taken out of the pipeline through pipe and valve assemblies called "scraper traps." These scrapers are pushed by the oil in the pipeline at the flow rate and push the dirt or wax into the scraper trap where it is removed.

Problems along the pipeline can be located and identified by computers at the pipeline's control center. Small leaks that might not result in readily identifiable drops in line pressure are typically located by aircraft. All main lines are inspected at least once every two weeks and in many cases more frequently, usually by aerial patrol, to check the pipeline route for abnormal conditions such as washouts, new construction on or near a pipeline, and leaks. When necessary, maintenance crews are dispatched to locate leaks and repair or replace the section of pipe involved. Once a leak is located, the repair crews uncover the line and place a specially designed clamp around the pipe over the leak to stop it. After the flow is stopped, one of several methods may be used to repair the line: for a very small leak a full encirclement sleeve is welded to the pipe; for larger leaks the line is shut down and drained, the damaged section is removed, and a new section welded in place. All new welds are tested and coated to prevent corrosion.

Corrosion control is of great importance, both in the design and the maintenance of pipelines. Soil corrosion is reduced by coating the pipeline and by carefully controlling the flow of electric current between the soil and the pipeline. This work is performed by corrosion engineers who apply a knowledge of chemistry, electricity, and electronics to the job of controlling corrosion.

Safety

According to statistics collected by the National Transportation Safety Board, the petroleum pipeline industry provides the safest mode of liquid petroleum transportation when compared to other modes, such as tank trucks, tank cars, barges, and tankers. Safety training programs are conducted and monitored continuously. Many of the pipeline accidents occur during the digging of ditches or pits, and the grading of roads or land by construction equipment operated by non-industry personnel. To help protect pipelines from external sources of damage, pipelines are clearly marked above ground where they cross roads, highways, railroads, property lines, and rivers. Most pipelines are routed wherever possible and practical so as to avoid congested residential and industrial areas. In these areas, pipelines are provided extra cover to avoid possible damage from construction equipment.

Improvements in controlling corrosion have dramatically reduced the number of pipeline leaks or accidents. These improvements are also a result of many factors, the most important of which are:

- Material quality
- Welding techniques
- Coatings
- Testing

- Inspections
- Cathodic protection.

Of primary importance is the high grade steel used to manufacture the pipe. The most critical job on the construction site is welding the pipe together. Only highly qualified and tested welders are used, and their work is kept under continuous close inspection, both visually and radiographically. Proper welds are actually stronger than the pipe itself. Before the line is lowered into the ditch, the outside of the pipe is covered with the protective coating described earlier. Before the line is put into operation, it is tested by filling every section with liquid (usually water) and raising the pressure to exceed the highest level expected during normal operations. This hydrostatic test is continued for a prescribed time in accordance with Department of Transportation regulations. For continuing protection against external corrosion, a low voltage electric current is applied to the pipe to counteract the natural pipe-to-ground currents that can eventually result in corrosion and leaks. As discussed earlier, scraper programs disperse accumulations of water at low points in the pipeline to minimize internal corrosion. Where necessary, corrosion inhibitors are injected into the stream during operation to protect the pipe against internal corrosion. Corrosion prevention has substantially increased the life of steel pipe.

Many pipelines are kept under continuous surveillance through a complex system of electronic monitoring, detecting, and data reporting devices. This system makes continuous recordings of line pressures and flow rates, which are transmitted to a control operator. When trouble occurs, such as a sudden increase or drop in pressure, alarm systems either alert the operator or stop the pipeline automatically. The industry is working to perfect more sensitive and reliable devices to measure flow into and out of the line. Automatic computer comparison of these measurements which compensate for changes in gravity, viscosity, and temperature will indicate if some oil has been lost along the way.

Regulation

Oil pipelines do not sell energy as do gas transmission and electric utility companies, nor do they buy or sell crude oil or petroleum products as a business; they only provide transportation service. Most pipelines are common carriers and have been subject to regulation by the Interstate Commerce Commission (ICC) since 1906, and more recently, by the FERC.

The FERC is empowered to conduct investigations and hearings upon the complaint of a third party or upon its own initiative. The FERC can review and issue orders establishing just and reasonable local and joint tariff rates, suspend newly filed rates for up to seven months pending investigation of their legality, and order reparations for damages sustained by shippers due to violations of the Interstate Commerce Act. Under this act, a common carrier pipeline's local and joint tariffs and its rules and regulations must be just and reasonable, must be applicable to all shippers on a nondiscriminatory basis, and must be filed with the FERC before transporting petroleum under the tariff. A pipeline is expressly prohibited from giving unreasonable preference or discriminating in any way in furnishing services to different shippers. Unfair or unreasonable tariffs are subject to remedial action or challenge by shippers and by the FERC at any time. Violation of the Interstate Commerce Act can be cause for a proceeding before the FERC, as well as federal court action, and may subject the pipeline company and its personnel to penalties which include fines and imprisonment.

Three major regulatory cases are presently before the FERC. They include:

- Williams Pipeline Company (OR79-1)
- Trans-Alaska Pipeline System (TAPS) (OR78-1)
- RM78-2 (Ex Parte 308).

These are anticipated to be landmark cases regarding rate base and rate of return and will form the framework of future regulation. The Williams case has been under consideration since 1971, while the others are more recent. Final decisions are not expected for some time to come. However, in the interim, these cases create an atmosphere of uncertainty, particularly involving both present and future pipeline investments.

INDUSTRY PERSPECTIVE

The pipeline network in the United States in 1976 (the latest data available) encompassed some 145,770 miles of crude oil pipelines carrying domestic and imported crude oil from producing fields and ports to refineries, and some 81,296 miles of product pipelines carrying refined products and LPG/NGL to terminals and industrial customers. In 1977 these pipelines carried over 546 billion ton-miles of petroleum, or about 24 percent of the nation's total intercity freight tonnage, at approximately 1.6 percent of the intercity freight cost. This tonnage generally moves at an economic transportation rate -- for about 1.5 to 2 cents, a gallon of gasoline can be moved from Houston to the New York area or a gallon of crude can be moved from the New Orleans area to Chicago.

HIGHLIGHTS OF THE REPORT

CURRENT SYSTEMS AND CAPACITIES

The maps in the appendices show the direction of flow of the pipeline systems. If needed, some of these pipelines may be reversed; others would require major changes to piping, pump stations, and origin and delivery facilities and would require considerable time before reversal could be accomplished.

The tables included in the appendices reflect the capacities from point to point in the common carrier pipelines. However, it is very important to note that the delivery capacity of petroleum pipelines is not necessarily the same as the capacity of a system. Capacity refers to the volume that can be pumped through a line segment, not actual throughput. Throughput may be equal to capacity or it may be less than the line segment capacity. This difference is generally the result of origin or delivery patterns. A 24-inch line with 300 MB/D capacity may have a midpoint delivery to a smaller line or terminal with a capacity of 100 MB/D. If no new origins occur at the delivery point, as much as 100 MB/D of unused capacity will exist in the 24-inch segment beyond the delivery point. The reverse situation can occur at points of origin which do not fall at the beginning of a line.

Since 1970, domestic crude oil production in the lower 48 states has steadily declined while the demand for petroleum has steadily increased. This has caused a shift in crude oil transportation patterns as well as in some products distribution patterns. Former key domestic crude oil producing areas (primarily Kansas, Louisiana, Oklahoma, and Texas) no longer produce sufficient quantities of crude; thus, many refineries have become dependent on foreign sources or different domestic sources. The discovery of the Prudhoe Bay oil field in Alaska caused the Trans-Alaska Pipeline System to be built, while increased foreign crude oil imports into the Gulf Coast created the need for the Seaway and Texoma Pipelines from the Gulf Coast to the central Midwest. The reduction of Canadian imports has also increased the demand for crude oil pipeline capacity into the upper Midwest. In summary, decreased domestic production and Canadian imports created the need for more pipeline capacity to carry foreign crude oils into the midwestern United States.

Many companies responding to the 1978 National Petroleum Council U.S. Petroleum Pipeline Capacity Questionnaire (Appendix H) noted that movement of high viscosity crude oils would reduce their capacity by five to 30 percent. This decrease in capacity must be considered in any emergency planning situation involving the increased movement of high viscosity crude.

The trend toward electrification of pumping stations affects the petroleum pipeline in two ways. Serious problems could develop if electrical power failures or curtailments should occur over large areas of the nation for long periods of time. In addition, the rising cost of electricity has increased pipeline operating costs, and more importantly, these increases affect the economics of expanding the capacity of existing systems. Due to the high power requirements to move incremental volumes, expansion of existing lines by adding pumping horsepower is becoming less attractive. The alternative to adding pumping horsepower is line loops which offer lower operating costs but are more capital intensive.

Another problem area could be the difficulty in acquiring equipment for new stations and pipelines. The delivery time for large pumps and electric motors is presently 18 to 24 months. Also, the time needed to obtain new permits for pipeline construction has continued to increase and two to three years are now needed for permitting.

FUTURE EXPANSIONS

Tables 2 and 3 reflect the expansions noted by pipeline companies which responded to the NPC questionnaire. Note that most of these expansions will be completed during 1979. Included in these tables are a Northern Pipeline Company crude oil pipeline project from Wood River, Illinois, to Pine Bend, Minnesota, and a Transgulf Pipe Line Company products pipeline project. This project involves the conversion of a natural gas pipeline to product service and would provide for shipment of products from several Louisiana and Texas refineries to product distribution terminals in Florida. Both of these major proposed projects are in various stages of the permitting process and no completion dates are given.

The Northern Tier Pipeline Project, a proposed large diameter crude oil pipeline connecting Port Angeles, Washington, to Clearbrook, Minnesota, has been announced in various trade journals, but is not included in Table 2. This proposed pipeline would deliver Alaskan and foreign crude oils to the upper midwestern refineries. This project was reported to be in various stages of the permitting process.

Information on the Strategic Petroleum Reserve projects consisting of large diameter crude oil pipelines and underground storage facilities is included in Table 2. These projects are being constructed by the Department of Energy. Foreign crude oil being stored in underground facilities can be withdrawn and delivered into connecting pipelines to supplement the domestic crude oil supply in the event of a national emergency. Storage capacity in these five projects will total about 746 million barrels.[1] The delivery capacity to other pipelines will be approximately 3,624 MB/D.[2]

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[1] Federal Register, August 20, 1979, pp. 48696-48707.
[2] Department of Energy Annual Strategic Petroleum Reserve Report, February 1979.

TABLE 2

Principal Crude Oil Expansion Projects Planned or Under Construction - 1979

Pipeline Company	Location	Type of Expansion	Miles	Diameter (Inches)	Present Capacity (MB/D)	Approximate Anticipated Capacity (MB/D)	Completion Date
Arco	Texas City Ship Dock to Arco Refinery (Pasadena)	New Lines	37 5	36 42	-	500	Mid-1980
Ashland	Patoka, IL, to Owensboro, KY	New Stations	-	20	161	219	March 1979
	Owensboro to Catlettsburg, KY	New Station Horsepower	-	24	173	216	April 1979
	Lima to Canton, OH	Horsepower	-	12	76	82	October 1979
Capline	St. James, LA, to Patoka, IL	Horsepower	-	-	1,032*	1,098*	October 1980
Cities Service	Fauna to Sour Lake, TX	New Line	34	12	-	60	Late 1979
Exxon	Clovelly Dome to LaFourche Parish, LA	New Line	7	20	-	170	1980
	Raceland Station to LaFourche Parish, LA	New Line	13	20	-	170	1980
Lakehead	Griffith, IN, to Marysville, MI	Loop Line Horsepower	35	30	-	65 (Additional)	Late 1979
LOCAP	Clovelly to St. James, LA	New Line	52	48	-	1,350	Late 1980
Marathon	St. James to Garyville, LA	New Line	19	30	-	300	January 1, 1980
Mid-Valley/Marathon	Lima, OH, to Samaria, MI	New Stations	-	22	278	338	First Quarter 1980
Northern Pipeline	Wood River, IL, to Pine Bend, MN	New Line	476	24	-	135	Permitting Process

TABLE 2 (continued)

Pipeline Company	Location	Type of Expansion	Miles	Diameter (Inches)	Present Capacity (MB/D)	Approximate Anticipated Capacity (MB/D)	Completion Date
Shamrock	Borger to Dumas, TX	New Line	44	14, 16	-	40	July 1979
Trans-Alaska	Prudhoe Bay to Valdez, AK	Horsepower	-	-	1,230	1,360	January 1, 1980
Williams	Des Moines to Mason City, IA	New Line	-	18	-	-	Permitting Process
Strategic Petroleum Reserve Projects[†]							
	Bryan Mound at Freeport, TX	New Storage and Lines	5	30	-	387	August 1979
	" "	Expansion	NA	NA	387	1,054	January 1980
	West Hackberry, LA, to Nederland, TX	New Storage and Lines	42	42	-	402	September 1979
	" "	Expansion	NA	NA	402	1,400	February 1980
	Bayou Choctaw to St. James, LA	New Storage and Lines	69	36	-	240	September 1979
	" "	Expansion	NA	NA	240	480	May 1980
	Sulphur Mines to West Hackberry, LA	New Storage and Lines	17	16	-	100	November 1979
	Weeks Island, Iberia Parish to St. James, LA	New Storage and Lines	69	36	-	590	March 1980
	St. James Terminal, LA	Dock and Pump Station	NA	-	-	720[§]	September 1979

*Design crude capacity. Annual average capacity will be higher.
[†]Systems are government-owned and capacities shown are drawdown capacities.
[§]Combined pumping capacity to Weeks Island and Bayou Choctaw.

TABLE 3

Principal Products Expansion Projects Planned Or Under Construction - 1979

Pipeline Company	Location	Type of Expansion	Miles	Diameter (Inches)	Present Capacity (MB/D)	Approximate Anticipated Capacity (MB/D)	Completion Date
Badger	System	Horsepower	-	-	90	120	December 1979
Calnev	Hinkle, Umatilla County, OR, to Columbia River Barge Terminal	New Line	10	4	-	6	May 1979
Collins	Meraux, LA, to Collins, MS	New Stations	-	-	100	125	August 1979
Colonial	Houston (Pasadena) to Hebert, TX	Loop Line	80	40	1,920	2,296	1979
	Port Arthur to Hebert, TX	Loop Line	8	36			
	Greensboro, NC, to Mitchell Junction, VA	Loop Line	148	36	960	1,320	1979
	Helena to Birmingham, AL	New Line	12	16	-	127	December 1979
	Atlanta, GA, to Chattanooga, TN	Loop Line	92	16	238	252	1979
	Mitchell Junction to Roanoke, VA	Replace 8"	42	12	34	51	1979
	Dorsey, MD, to Woodbury, NJ	Horsepower	-	-	768	960	1979
	Mitchell Junction to Richmond, VA	Horsepower	-	-	125	240	1979
	Belton Junction, SC, to Augusta, GA	Horsepower	-	-	27	45	1979
	Atlanta to Bainbridge, GA	Horsepower	-	-	60	72	1979
Explorer	Port Neches to Port Arthur, TX	Loop Line	8	14	101	190	October 1, 1979
	Port Arthur and Pasadena, TX, to Tulsa, OK	Horsepower	-	28	380	440	July 1, 1979

TABLE 3 (continued)

Pipeline Company	Location	Type of Expansion	Miles	Diameter (Inches)	Present Capacity (MB/D)	Approximate Anticipated Capacity (MB/D)	Completion Date
Gulf	Mesquite Line - Lucas to Lufkin, TX	Horsepower	-	-	55	63	January 1, 1980
Hydrocarbon Transportation, Inc. (LPG)	Bushton, KS, to Dearborn, MO	New Line	230	10	-	35	Late 1980
Laurel	Extension of existing El Dorado, PA, to Duncanville 12" lateral to connect new terminal in Pennsylvania	Lateral	1	12	-	-	3rd Quarter 1979
Marathon	Garyville to Baton Rouge, LA	Horsepower	-	-	150	280	January 1, 1980
Mid America (LPG)	Sanborn, IA, to Mankato, MN	New Line	93	8	42	54	January 1, 1980
Phillips	Sweeney to Pasadena, TX	New Line	60	18	-	158	April 1980
Plantation	Austell, GA, to Atlanta Airport	Replacement	12	12	-	67	August 1, 1979
	Clanton to Helena to Montgomery, AL	Horsepower	-	-	-	40	December 31, 1979
Shamrock	McKee Refinery near Borger, TX, to Dallas-Fort Worth Area	New Line	363	8	-	15	4th Quarter 1979
Southern Pacific	Norwalk to Colton, CA	New Line	32	20	247	300	January 1, 1980
Sun	Fostoria to Hudson, OH. Addition of pump stations in Seneca and Medina Counties	New Stations	-	-	30	47	4th Quarter 1979
Texas Eastern	Baytown, TX, to Seymour, IN	Loop Line	-	16	-	360	December 1979

TABLE 3 (continued)

Pipeline Company	Location	Type of Expansion	Miles	Diameter (Inches)	Present Capacity (MB/D)	Approximate Anticipated Capacity (MB/D)	Completion Date
Transgulf	Baton Rouge, LA, to Kissimmee, FL	Conversion of Gas Line and Looping	-	24	-	240	Permitting Process
	Kissimmee to Port Everglades, FL	Conversion of Gas Line and Looping	-	20	-	130	Permitting Process
	24" Line to Jacksonville, FL	New Line	-	14	-	70	Permitting Process
Williams	Minneapolis, MN, to Wausau, WI	Horsepower	-	8	26	34	July 1979

APPENDICES

APPENDIX A

Department of Energy
Washington, D.C. 20585

June 20, 1978

Dear Mr. Chandler:

The National Petroleum Council has prepared numerous studies in the past on the Nation's petroleum transportation systems. The last study on this subject was prepared over ten years ago and published on September 15, 1967.

The transportation data collected over the years by the Council has been used by the Federal Government for emergency preparedness planning purposes. The data includes information on major crude oil and petroleum product pipelines, natural gas transmission lines, inland waterway barges, tank cars and tank trucks. Detailed information is also included on the location, capacity and type of pump stations and compressor stations.

As part of the Government's overall review and update of emergency preparedness planning, current data are needed on the Nation's petroleum transportation systems. I, therefore, request the National Petroleum Council to undertake a detailed study to determine current petroleum and gas transportation capacities including natural gas transmission lines, crude oil and petroleum product pipelines, crude oil gathering lines in major producing areas, inland waterway barges, tank cars and tank trucks. With respect to transportation of oil and petroleum products, the study should cover the spatial and transportation relationships--the match ups--among refineries of varying capacities and crude oil sources.

The study should examine the industry's flexibility to meet dislocations of supply and outline the changing supply patterns of the petroleum and natural gas deliverability systems.

For the purpose of this study, I will designate the Deputy Assistant Secretary for Policy and Evaluation to represent me and to provide the necessary coordination between the Department of Energy and the National Petroleum Council.

Sincerely,

James R. Schlesinger
Secretary

Mr. Collis P. Chandler, Jr.
Chairman, National Petroleum Council
1625 K Street, N.W.
Washington, D. C. 20006

Department of Energy
Washington, D.C. 20585

June 20, 1978

Dear Mr. Chandler:

The ability of this Nation to withstand interruptions in normal oil supplies, whether by domestic dislocation or by foreign intervention, is immediately served by recourse to existing inventories of oil stocks. In addition, the United States has embarked on a Strategic Petroleum Reserve program to aid in meeting its commitments abroad and its commitments to consumers at home in case of another interruption of foreign oil supply. For industry and Government to respond appropriately to an emergency, our need for accurate information and understanding of primary petroleum inventories is greater than it has ever been.

Implicit in an understanding of petroleum inventories is the distinction between total stocks and those stocks which would be readily available for use. Such information is essential in evaluating correctly the extent of the contribution our oil stocks would be able to make in times of oil supply emergency and planning the development and use of the Strategic Petroleum Reserve.

Periodically the National Petroleum Council has conducted for the Department of the Interior a survey of the availability of petroleum inventories and storage capacity. The last such report was issued in 1974, the eighth in a series which began in 1948.

Accordingly, the National Petroleum Council is requested to prepare for the Department of Energy a new report on available petroleum inventories and storage capacity. This new report should emphasize the distinction between available stocks and those unavailable. For the purpose of this study, I will designate the Deputy Assistant Secretary for Policy and Evaluation to represent me and to provide the necessary coordination between the Department of Energy and the National Petroleum Council.

Sincerely,

James R. Schlesinger

James R. Schlesinger
Secretary

Mr. Collis P. Chandler, Jr.
Chairman
National Petroleum Council
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*Succeeded J. Donald Durand, June 1979.

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Consulting Engineer

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Union Pacific Corporation

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International Brotherhood
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Chairman of the Board
Exxon Corporation

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Pacific Resources, Inc.

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Guam Oil & Refining Company, Inc.

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Chairman of the Board and
Chairman of Executive Committee
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Hamilton Brothers Oil Company

Armand Hammer
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and Chief Executive Officer
Occidental Petroleum Corporation

Jake L. Hamon
Oil and Gas Producer

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Chief Executive Officer
Halliburton Company

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Chairman and President
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American Association
of Petroleum Geologists

Denis Hayes
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Standard Oil Company
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League of Women Voters
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Director, Center for Energy
Policy Research
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Mesa Petroleum Company

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Pitts Oil Company

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New York State Consumer Protection Board

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Rand Corporation

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Quintana Petroleum Corporation

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Rosapepe, Fuchs & Associates

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Chief Executive Officer
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Cities Service Company

Robert E. Seymour
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Consolidated Natural Gas
Company

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President
Simmons Royalty Company

Theodore Snyder, Jr.
President
Sierra Club

Charles E. Spahr

John E. Swearingen
Chairman of the Board
Standard Oil Company (Indiana)

Robert E. Thomas
Chairman of the Board
MAPCO Inc.

H. A. True, Jr.
Partner
True Oil Company

Martin Ward, President
United Association of Journeymen
and Apprentices of the
Plumbing and Pipe Fitting
Industry of the United States
and Canada

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Consumer Energy Council
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The Williams Companies

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Ashland Oil, Inc.

CRUDE OIL PIPELINE MAPS AND TABLES

Pipelines play a major role in moving crude oils from producing fields and water terminals to refinery centers located throughout the United States. Crude oil pipelines are usually classified as gathering pipelines or trunk pipelines. Crude oil gathering pipelines are found in crude oil producing areas. These pipeline systems consist of smaller diameter lines (2-inch through 8-inch) moving crude oil from small storage tanks (connected to producing wells) to a central facility such as a large storage tank or tank farm. Crude oil is accumulated in this central facility for pumping through larger trunk pipeline systems to other pipeline terminals or to refineries (see Figure 4). Although gathering pipeline systems are complex (many small lines of varying sizes and lengths), these systems are flexible and readily expandable. Presently, most gathering systems are more than adequately sized because domestic crude oil production peaked in 1970. Existing gathering systems in the United States contain approximately 67,800 miles of pipelines.[1] (For further information on crude oil gathering systems including line locations and sizes, see the American Petroleum Institute crude oil pipeline maps of the United States and southern Canada.)

Common carrier pipelines receive substantially all of their crude oil from the central facility located in or near the producing field or at a water terminal where foreign crude oil is imported. They deliver this oil to other pipeline terminals or to one or more refineries.

The maps and tables in this appendix list the annual average capacities of common carrier crude oil pipelines in thousands of barrels per day (MB/D) as of December 31, 1978. The capacity information presented in this section was provided by those companies surveyed by the NPC. The tables indicate "NR" when the data requested was not submitted.

MAPS

The map of the United States (Page C-4) indicates the PAD districts, the origin and destination points, and the annual average capacity of single or multiple lines located between these points. The direction of crude oil flow is indicated with an arrowhead. Pipelines which can flow in both directions have the arrowheads so placed. Small tanker symbols indicate the areas where foreign crude oils are imported for distribution by pipelines.

The PAD district maps indicate the names of the pipelines in each segment in addition to the information given on the United States map. Pipelines crossing PAD district lines are identified and their capacities given. PADs I and III are shown on individual maps (Pages C-5 and C-8). The pipelines in PAD I transport crude oils from Canada to the Buffalo, New York, and Warren, Pennsylvania, refineries, and from Jay, Florida, to Mobile, Alabama (PAD III). Most of the other refineries in PAD I are supplied by tankers carrying

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[1] Crude Oil and Products Pipelines Triannual Report, Energy Information Administration, January 1, 1977.

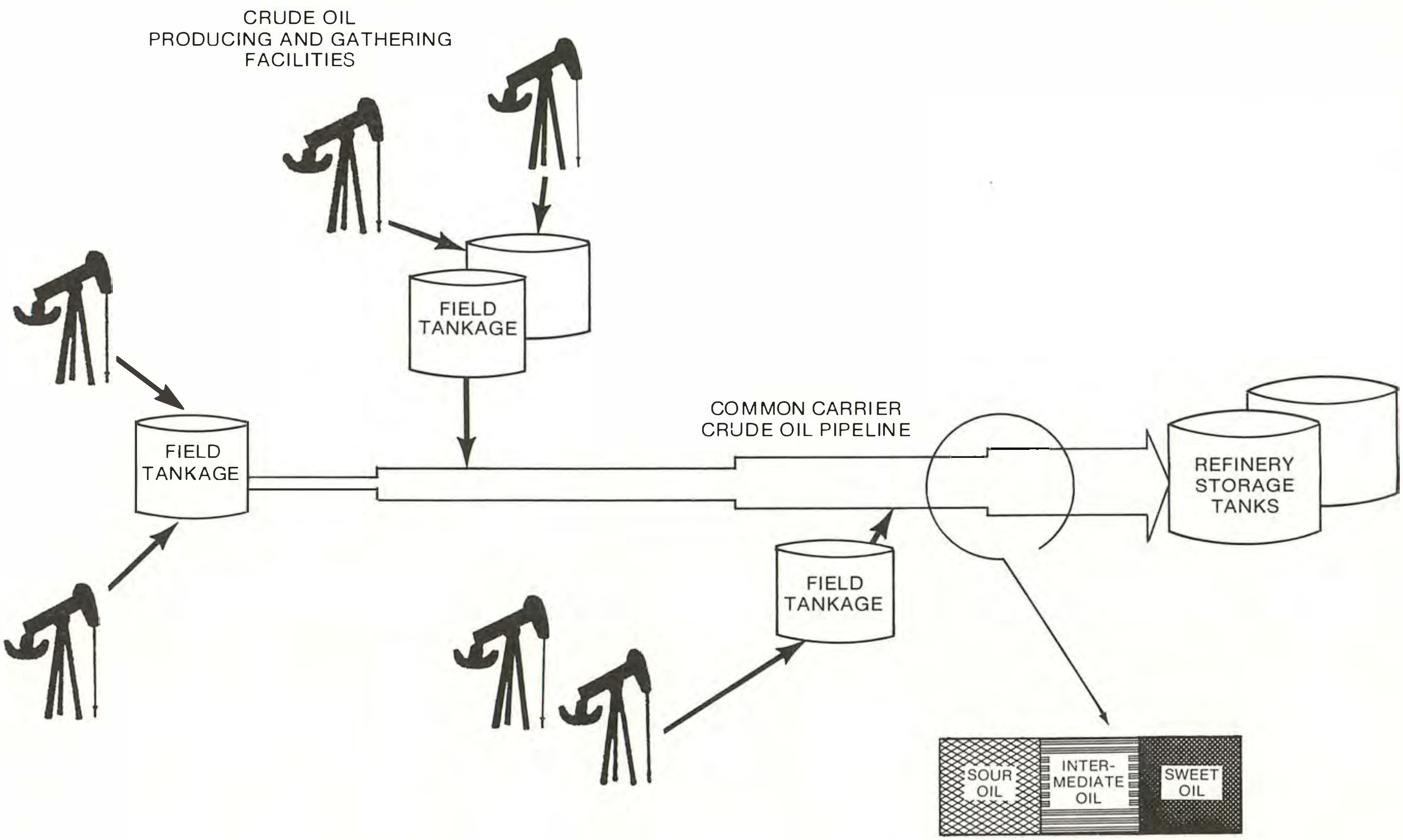


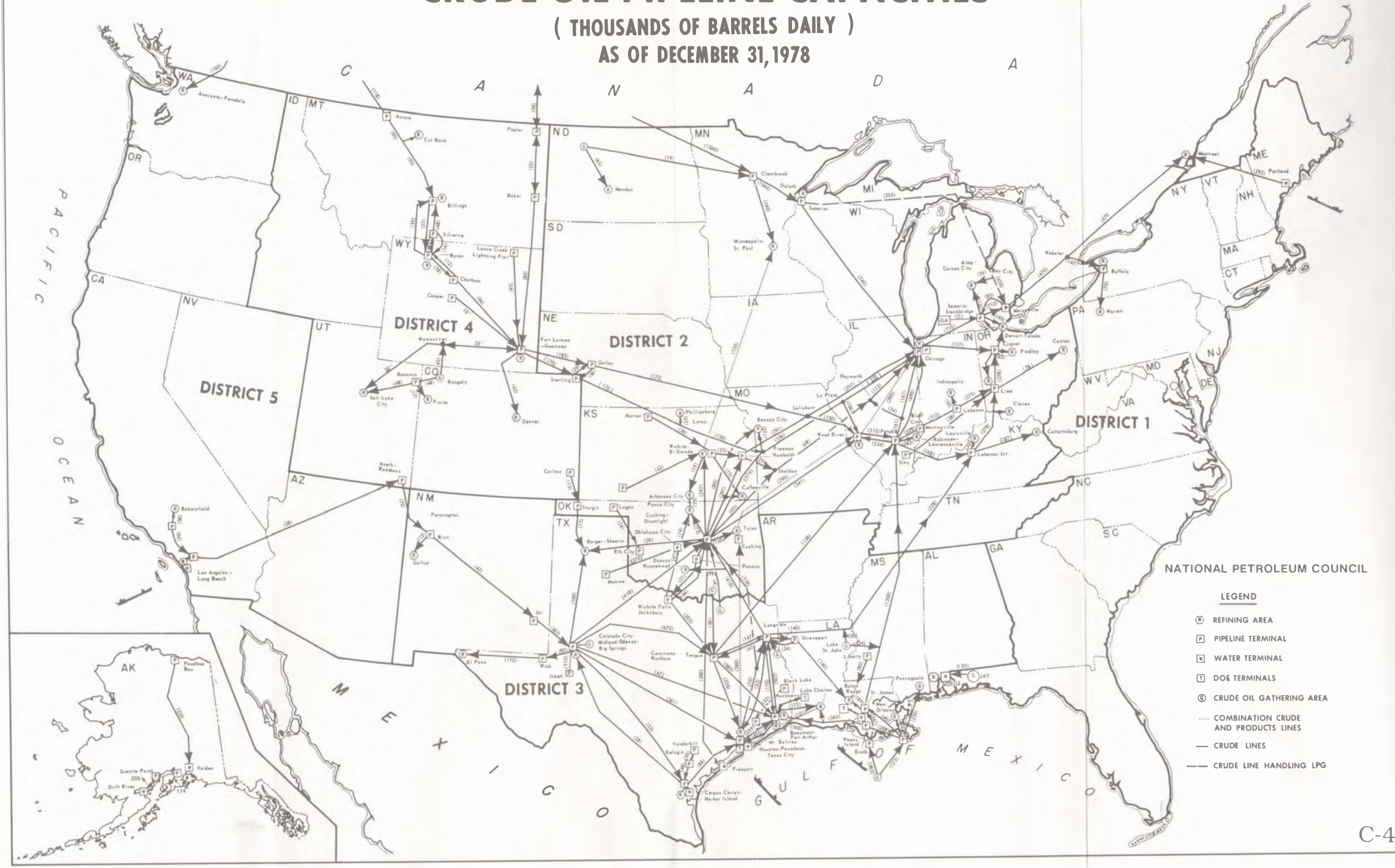
Figure 4. Simplified Crude Oil Pipeline Flow Chart.

domestic and foreign crude oil. PAD III accounts for most of the domestic crude oil production capacity in the lower 48 states. Major pipelines transport this crude oil from the producing areas to the Gulf Coast where refining centers are located. Also, 13 pipelines with an annual average pipeline capacity of 3,579 MB/D transport both domestic and foreign crude oils from PAD III to PAD II. PAD II is divided into two sections (Pages C-6 and C-7). A major portion of the pipelines in this district transport domestic and foreign crude oils from large pipeline terminalling areas at Cushing, Oklahoma, and Petoka, Illinois, to refining centers in Illinois, Indiana, and Ohio. PADs IV and V are combined on a single map. Pipelines in PAD IV transport both domestic and Canadian crude oils to refining centers located in Colorado, Montana, Utah, and Wyoming. Two major pipelines, with a present total annual average capacity of 340 MB/D, transport crude oils from PAD IV to PAD II. Two of the PAD V pipelines transport crude oils from Alaskan water terminals. Crude oil gathered in the San Joaquin Valley of California is transported by pipeline to refining centers at Bakersfield and Los Angeles.

CRUDE OIL PIPELINE CAPACITIES

(THOUSANDS OF BARRELS DAILY)

AS OF DECEMBER 31, 1978



NATIONAL PETROLEUM COUNCIL

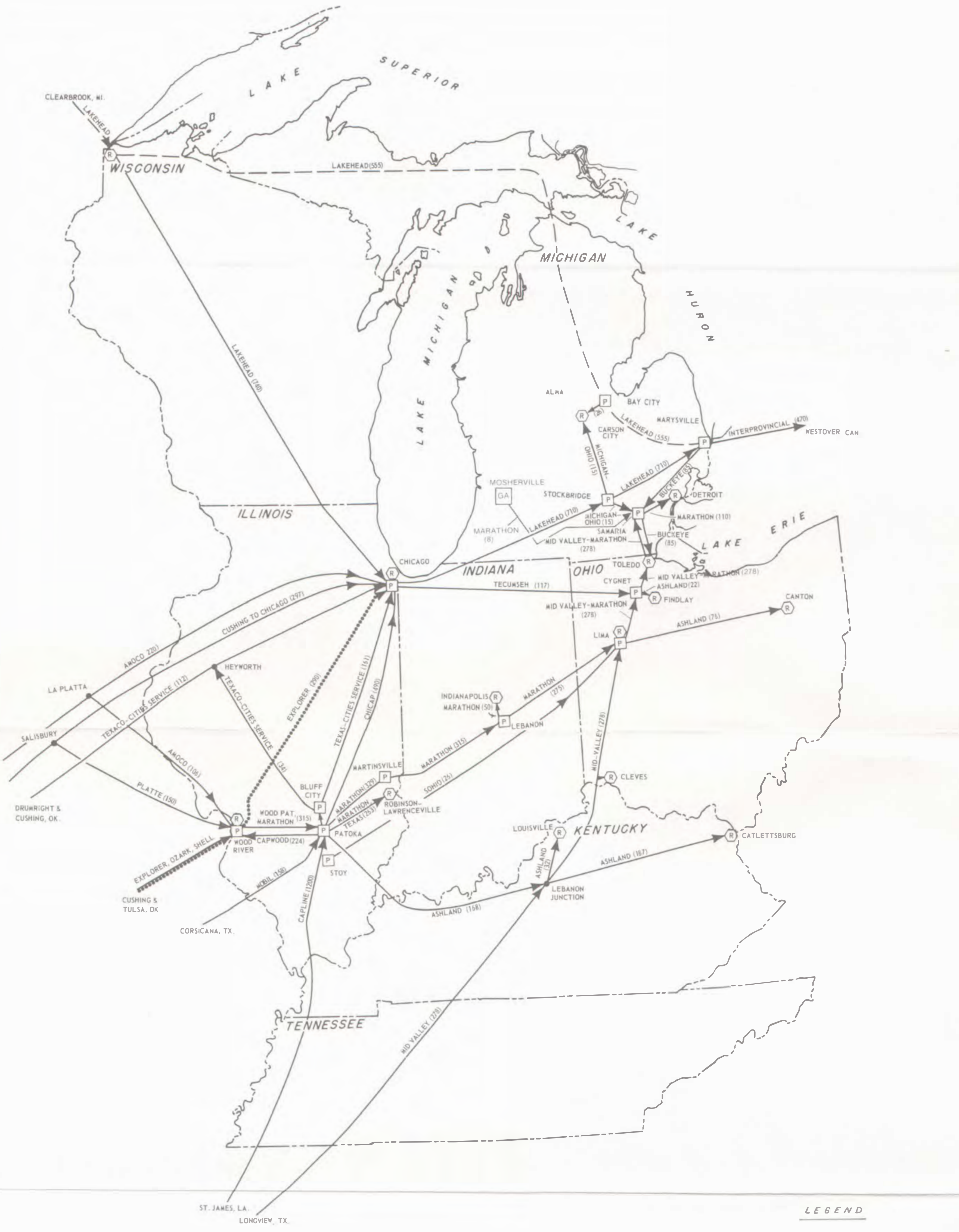
PRINCIPAL COMMON CARRIER CRUDE OIL PIPELINES

PIPELINE CAPACITIES FOR

P A D DISTRICT I

NOTE: FIGURES INDICATE CAPACITY IN THOUSANDS OF BARRELS PER CALENDAR DAY

(E) ESTIMATED



LEGEND

- GA — GATHERING
- P — PIPELINE STATION OR TERMINAL
- R — REFINERY AREA
- ●●●●●●●●●●● PRODUCTS LINE HANDLING CRUDE OIL
- — — — CRUDE LINE HANDLING LPG

DETAILED MAPS OF INTERCONNECTIONS ARE INCLUDED IN APPENDIX F FOR THESE AREAS:

CHICAGO
DETROIT, SAMARIA , SARNIA, TOLEDO
LIMA, CYGNET, TOLEDO
PATOKA
WOOD RIVER

NATIONAL PETROLEUM COUNCIL

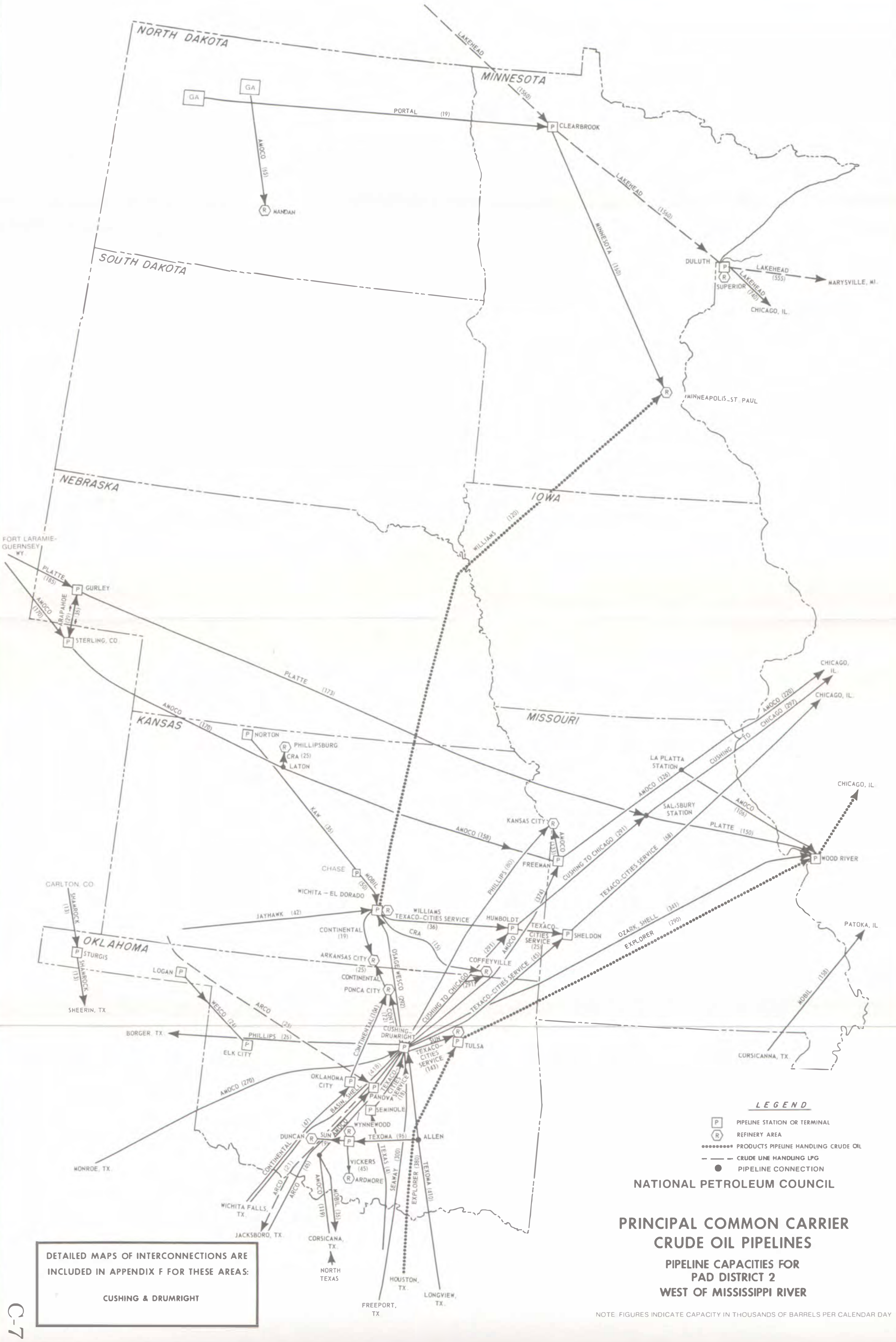
PRINCIPAL COMMON CARRIER CRUDE OIL PIPELINES

PIPELINE CAPACITIES FOR

P A D DISTRICT 2

EAST OF MISSISSIPPI RIVER

NOTE: FIGURES INDICATE CAPACITY IN THOUSANDS OF BARRELS PER CALENDAR DAY



DETAILED MAPS OF INTERCONNECTIONS ARE INCLUDED IN APPENDIX F FOR THESE AREAS:

CUSHING & DRUMRIGHT

LEGEND

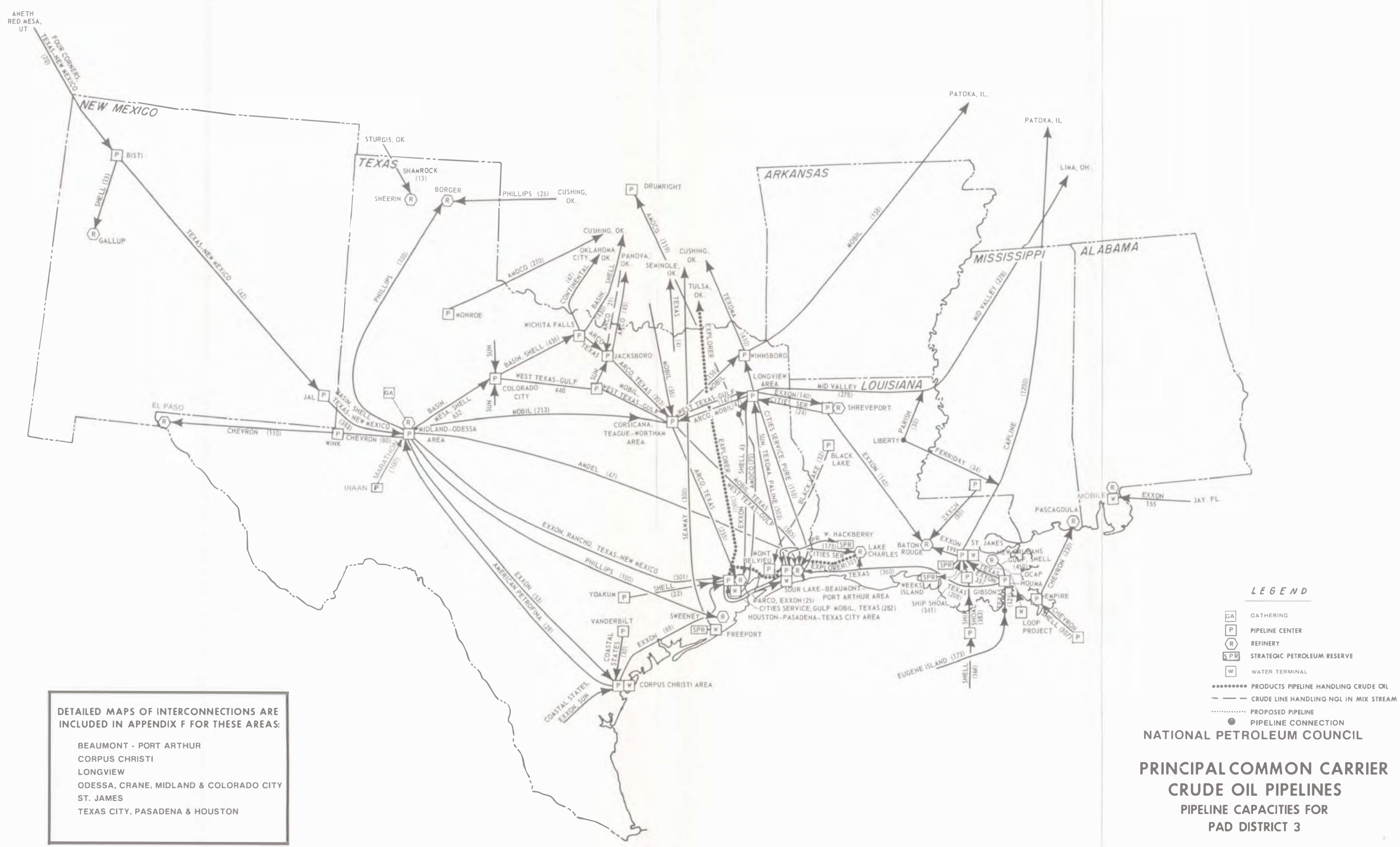
- P — PIPELINE STATION OR TERMINAL
- R — REFINERY AREA
- ••••••• PRODUCTS PIPELINE HANDLING CRUDE OIL
- — — CRUDE LINE HANDLING LPG
- ● PIPELINE CONNECTION

NATIONAL PETROLEUM COUNCIL

PRINCIPAL COMMON CARRIER CRUDE OIL PIPELINES

PIPELINE CAPACITIES FOR PAD DISTRICT 2 WEST OF MISSISSIPPI RIVER

NOTE: FIGURES INDICATE CAPACITY IN THOUSANDS OF BARRELS PER CALENDAR DAY



DETAILED MAPS OF INTERCONNECTIONS ARE INCLUDED IN APPENDIX F FOR THESE AREAS:

- BEAUMONT - PORT ARTHUR
- CORPUS CHRISTI
- LONGVIEW
- ODESSA, CRANE, MIDLAND & COLORADO CITY
- ST. JAMES
- TEXAS CITY, PASADENA & HOUSTON

NATIONAL PETROLEUM COUNCIL

PRINCIPAL COMMON CARRIER CRUDE OIL PIPELINES

PIPELINE CAPACITIES FOR PAD DISTRICT 3

NOTE: FIGURES INDICATE CAPACITY IN THOUSANDS OF BARRELS PER CALENDAR DAY

NATIONAL PETROLEUM COUNCIL

PRINCIPAL COMMON CARRIER CRUDE OIL PIPELINES

PIPELINE CAPACITIES FOR PAD DISTRICT 4 & 5

NOTE: FIGURES INDICATE CAPACITY IN THOUSANDS OF BARRELS PER CALENDAR DAY

TABLES

The pipeline capacity tables are arranged as follows:

- Canadian export and import capacities (Table 4, Page C-12)
- Interdistrict capacities (Table 4, Pages C-12 through C-14)
- Offshore capacities (Table 4, Page C-14)
- PAD I capacities (Table 5, Page C-15)
- PAD II capacities (Table 5, Pages C-15 through C-20)
- PAD III capacities (Table 5, Pages C-20 through C-24)
- PAD IV capacities (Table 5, Pages C-25 and C-26)
- PAD V capacities (Table 5, Page C-26).

Each table exhibits the following information for each pipeline segment:

- The PAD district of origin and destination for each segment
- The name and state of origin and the method of supply (GA for gathering area, PL for pipeline terminal, W for water terminal)
- The name and state of destination and the type of facility (PL for pipeline, R for refinery)
- The name of each common carrier pipeline with a line between those locations
- The annual average capacity (in MB/D) as of December 31, 1978, and the maximum economic capacity (in MB/D) of the pipeline
- The gravity range of the crude oil handled
- The viscosity range of the crude oil handled.

When determining the capacity of a pipeline system consisting of more than one segment and with a different capacity in each segment, the capacity of the segment with the lowest capacity was used to describe the pipeline system capacity.

TABLE 4

Common Carrier Crude Oil Pipeline Capacities
(MB/D - As of December 31, 1978)

(International and Inter-PAD District Pipelines)

Legend

(GA) - Gathering Area (R) - Refinery
(PL) - Pipeline Terminal (W) - Water Terminal

PAD District From	PAD District To	Origin and Type	Destination and Type	Company	Annual Average Capacity 12/78	Annual Average Capacity Maximum Economic	Crude Oil Handled Gravity Range (°API)	Crude Oil Handled Viscosity Range (SSU)
Export								
1	Intl	Portland, ME - (W)	Montreal, Can. - (R)	Portland	292	550	25-44	550-50
2	Intl	Marysville, MI - (PL)	Sarnia, Can. - (PL)	Interprovincial	470	NR	NR	NR
4	Intl	Poplar, MT - (PL)	Regina, Can. - (PL)	Wascana	30	60	NR	NR
			Total Export Capacity to Canada		792			
Import								
Intl	1	Westover, Can. - (PL)	Buffalo, NY - (PL,R)	Interprovincial	147	150	38-40†	500-38†
Intl	2	Edmonton, Can. - (PL)	Clearbrook, MN - (PL)	Interprovincial	1,560	NR	21-40†	500-38†
Intl	4	Oldman, Can. - (PL)	Aurora, MT - (PL)	Rangeland	118	NR	NR	NR
		Regina, Can. - (PL)	Poplar, MT - (PL)	Wascana	30	60	NR	NR
Intl	5	Sumas, Can. - (PL)	Ferndale, WA - (PL)	Transmountain	160	160	NR	NR
			Total Import Capacity to United States from Canada		2,015			
1	3	Jay, FL - (GA)	Mobile, AL - (R,W)	Exxon	155	NR	52	31
2	3	Sturgis, OK - (PL)	Sheerin, TX - (R)	Shamrock	13	NR	26-49†	NR
		Cushing, OK - (PL)	Borger, TX - (R)	Phillips	26	50	26-34§	179-56§
		Panova, OK - (PL)	Jacksboro, TX - (PL)	Arco	21	NR	44-89	3.4†,**
		Ardmore, OK, Area - (GA)	Corsicana, Teague, and Wortham, TX - (PL)	Mobil	36	36	32-43†	41§
			Total District 2 to 3		96			

TABLE 4 (continued)

PAD District From	PAD District To	Origin and Type	Destination and Type	Company	Annual Average Capacity 12/78	Annual Average Capacity Maximum Economic	Crude Oil Handled Gravity Range (°API)	Crude Oil Handled Viscosity Range (SSU)
3	2	North Texas Area - (PL)	Cushing, OK - (PL)	Amoco	119	119	38¶	46¶
		Monroe, TX - (PL)	Cushing, OK - (PL)	Amoco	270	270	33-41¶	49-39¶
		Wichita Falls and Jacksboro, TX - (PL)	Cushing, OK - (PL)	Arco	46	69	32-42†	30.2-3.6†,**
		Colorado City, TX - (PL)	Cushing, OK - (PL)	Basin§§	384	NR	32.9-40.7††	45.4-34.8††
		" "	" "	Shell	34	34	28.2-50	63-36††
		Freeport, TX - (W)	Cushing, OK - (PL)	Seaway	300	590	25-45§	180-45§
		Longview, TX - (PL)	Cushing, OK - (PL)	Texoma	410	600	23-42†	500-60†
				Total District 3 to Cushing	1,563			
		Wichita Falls and Jacksboro, TX - (PL)	Oklahoma City, OK - (PL)	Continental	47	NR	NR	NR
		Covey, TX - (GA)	Seminole, OK - (PL)	Texas	4	NR	39.1††	39.2††
		Corsicana, Teague, and Wortham, TX - (PL)	Patoka, IL - (PL)	Mobil	158	158	32-43§	70-39§
		St. James, LA - (PL,W)	Patoka, IL - (PL)	Capline§§	1,200	1,300	35.6§	49§
				Total District 3 to Patoka	1,358			
		Longview, TX - (PL)	Cleves and Lima, OH - (PL)	Mid-Valley	278	338	23-42†	600-60†
		Port Arthur and Pasadena, TX - (W)	Tulsa, OK - (PL)	Explorer	380*	677*	30 (Minimum)††	100(Maximum)††
				Total District 3 to 2	3,579			
2	4	Gurley, NE - (PL)	Sterling, CO - (PL)	Arapahoe	36	36	34-44	80-40

TABLE 4 (continued)

PAD District		Origin and Type	Destination and Type	Company	Annual Average Capacity		Crude Oil Handled	
From	To				12/78	Maximum Economic	Gravity Range (°API)	Viscosity Range (SSU)
4	2	Fort Laramie-Guernsey, WY - (PL)	Laton, KS - (PL)	Amoco	170	275	27-35[¶]	182-77[¶]
		Fort Laramie-Guernsey, WY - (PL)	Salisbury, MO - (PL)	Platte	173	185	22-37.5[¶]	750-50[¶]
		Carlton, CO - (GA)	Sturgis, OK - (PL)	Shamrock	13	NR	26-49	NR
		Sterling, CO - (PL)	Gurley, NE - (PL)	Arapahoe	29	29	34-44	80-40
				Total District 4 to 2	385			
4	3	Aneth and Red Mesa, UT - (GA,PL)	Bisti, NM - (PL)	Texas-New Mexico	42	NR	27.8-48.5[††]	89-31.7[††]
		" "	" "	Four Corners	28	NR	26-37	NR
				Total District 4 to 3	70			
5	4	Long Beach and Los Angeles, CA - (W)	Aneth and Red Mesa, UT - (PL)	Four Corners	28	NR	37-26	NR-26
Offshore LA	3	South Marsh Island - (PL)	Caillou Island - (PL)	Eugene Island[§§]	173	173	32.3[§§]	7.35[§§]
3	3	Ship Shoal 188 - (PL)	Ship Shoal 28 - (PL)	Shell	164	164	36	52.2[¶]
		Ship Shoal 28 - (PL)	Gibson, LA - (PL)	Ship Shoal[§§]	383	383	36	52.2[¶]
		Pass Fourchon, LA - (GA)	Empire, LA - (PL,W)	Chevron	67	240	30-30.6	NR
		Southwest Pass, LA - (GA)	" " (PL,W)	Shell	240	240	36	52.2[¶]
				Total to Empire, LA	307			

*No. 2 fuel oil capacity.
†At a temperature of 60° Fahrenheit.
§At a temperature of 70° Fahrenheit.
¶At a temperature of 68° Fahrenheit.

**Measured in centerpoise.
††Measured at a temperature of 100° Fahrenheit.
§§Undivided interest pipeline systems.

NR Not Reported.

TABLE 5

Common Carrier Crude Oil Pipeline Capacities
(MB/D - As of December 31, 1978)

(Intra-PAD District Pipelines)

Legend

(GA) - Gathering Area (R) - Refinery
(PL) - Pipeline Terminal (W) - Water Terminal

PAD District From	PAD District To	Origin and Type	Destination and Type	Company	Annual Average Capacity 12/78	Annual Average Capacity Maximum Economic	Crude Oil Handled Gravity Range (°API)	Crude Oil Handled Viscosity Range (SSU)
1	1	Buffalo, NY - (PL)	Warren, PA - (R)	Kiantone	70*	70*	NR	NR
2	2	Northwestern North Dakota - (GA)	Clearbrook, MN - (PL)	Portal	19	19	31-36	150-80
		Central North Dakota - (GA)	Mandan, ND - (R)	Amoco	65	115	41**	42**
		Clearbrook, MN - (PL)	Minneapolis and St. Paul, MN - (R)	Minnesota	160	170	22-54	600-30
		Clearbrook, MN - (PL)	Superior, WI - (PL,R)	Lakehead	1,560	1,560	21.4-40¶	500-38¶
		Superior, WI - (PL)	Chicago, IL - (PL,R)	Lakehead	720	720	21.4-40¶	500-38¶
		Superior, WI - (PL)	Marysville, MI - (PL)	Lakehead	555	555	38-40¶	500-38¶
		Chicago, IL - (PL)	Stockbridge and Marysville, MI - (PL)	Lakehead	710	710	21.4-40¶	500-38¶
		Bay City, MI - (PL)	Alma, MI - (R)	Michigan-Ohio	26	34	36-45	NR
		Stockbridge, MI - (PL)	Crystal City and Carson City, MI - (R)	Michigan-Ohio	15	NR	36-45	NR
		Marysville, MI - (PL)	Samaria, MI, and Toledo, OH - (R)	Buckeye	85	87	34-45¶	100-50¶
		Mosherville, MI - (GA)	Samaria, MI - (PL)	Marathon	8	32	37-41	50
		Samaria, MI - (PL)	Detroit, MI - (R)	Marathon	110	110	22-44	750-43

TABLE 5 (continued)

PAD District					Annual Average Capacity		Crude Oil Handled	
From	To	Origin and Type	Destination and Type	Company	12/78	Maximum Economic	Gravity Range (°API)	Viscosity Range (SSU)
2	2	Lima and Cygnet, OH - (PL)	Toledo, OH, and Samaria, MI - (R,PL)	Mid-Valley/ Marathon	278	338	23-42[¶]	600-60[¶]
		Lima, OH - (PL)	Canton, OH - (R)	Ashland	76	76	23-41[¶]	550-38[¶]
		Cygnet, OH - (PL)	Findlay, OH - (R)	Ashland	22	50	21-23[¶]	600-325[¶]
		Chicago, IL - (PL)	Cygnet, OH - (PL)	Tecumseh	117	185	22-42	150-3.6[¶,¶¶]
		Patoka, IL - (PL)	Lebanon Junction, KY - (PL)	Ashland	168	220	26-44[¶]	200-38[¶]
		Lebanon Junction, KY - (PL)	Catlettsburg, KY - (R)	Ashland	187	300	26-44[¶]	200-38[¶]
			Total Patoka to Catlettsburg		168	220		
		Lebanon Junction, KY - (PL)	Louisville, KY - (R)	Ashland	32	32	29-38[¶]	70-38[¶]
		Patoka, IL - (PL)	Lawrenceville and Robinson, IL, Area - (R)	Marathon	174	260	30.4-42[¶]	70-43[¶]
		" "	" "	Texas	89	NR	39.2[§§]	38.9[§§]
			Total Patoka to Lawrenceville and Robinson Area		263			
		Patoka, IL - (PL)	Martinsville, IL - (PL)	Marathon	291	291	22.4-42[¶]	745-43[¶]
		" "	" "	Marathon	38	38	22.4-42[¶]	745-43[¶]
			Total Patoka to Martinsville		329	329		

TABLE 5 (continued)

PAD District From	PAD District To	Origin and Type	Destination and Type	Company	Annual Average Capacity 12/78	Annual Average Capacity Maximum Economic	Crude Oil Handled Gravity Range (°API)	Crude Oil Handled Viscosity Range (SSU)
2	2	Martinsville, IL - (PL)	Lebanon, IN - (PL)	Marathon	315	315	22-42[¶]	750-50[¶]
		Lebanon, IN - (PL)	Lima, OH - (PL,R)	Marathon	275	275	22-42[¶]	750-50[¶]
				Total Patoka to Lima	275			
		Lebanon, IN - (PL)	Indianapolis, IN - (R)	Marathon	50	50	22-42[¶]	750-50[¶]
		Stoy, IL - (PL)	Lima, OH - (PL,R)	Sohio	26	70	34-37	NR
		Patoka, IL - (PL)	Chicago, IL - (R)	Chicap	490	490	28-44	70-40
		" "	" "	Texaco-Cities Ser.	161	NR	39.2[§§]	38.9[§§]
				Total Patoka to Chicago	651			
		Bluff City, IL - (PL)	Chicago, IL - (PL,R)	Texaco-Cities Ser.	34	NR	39.2[§§]	38.9[§§]
		Patoka, IL - (PL)	Wood River, IL - (PL,R)	Capwood[¶¶¶]	224	224	36[¶]	55[¶]
		Wood River, IL - (PL)	Patoka, IL - (PL)	Woodpat	315	315	22-42[¶]	750-43[¶]
		Wood River, IL - (PL)	Chicago, IL - (PL,R)	Explorer	290[†]	470[†]	30 (Minimum)[§§]	100 (Maximum)[§§]
		Salisbury, MO - (PL)	Wood River, IL - (PL,R)	Platte	150	185	22-37.5[¶]	750-50[¶]
		Tulsa, OK - (PL)	Wood River, IL - (PL,R)	Explorer	290[†]	470[†]	30 (Minimum)	100 (Maximum)
		Cushing, OK - (PL)	Sheldon, MO - (PL)	Texaco-Cities Ser.	45	NR	39.1[§§]	39.2[§§]
		Wichita and El Dorado, KS - (PL)	Sheldon, MO - (PL)	Texaco-Cities Ser.	25	NR	NR	NR

TABLE 5 (continued)

PAD District From	PAD District To	Origin and Type	Destination and Type	Company	Annual Average Capacity 12/78	Annual Average Capacity Maximum Economic	Crude Oil Handled Gravity Range (°API)	Crude Oil Handled Viscosity Range (SSU)
2	2	Wichita and El Dorado, KS - (PL)	Humboldt, KS - (PL)	Williams	11	11	30[§§]	40[§§]
		Sheldon, MO - (PL)	Heyworth, IL - (PL)	Texaco-Cities Ser.	68	NR	39.1[§§]	39.2[§§]
		Heyworth, IL - (PL)	Chicago, IL - (PL,R)	Texaco-Cities Ser.	112	NR	39.2[§§]	38.9[§§]
		Cushing, OK - (PL)	Freeman, MO - (PL)	Amoco	374	374	32-40	85-47[**]
		Freeman, MO - (PL)	Chicago, IL - (PL,R)	Amoco	220	220	32-40	85-47[**]
		Cushing, OK - (PL)	Chicago, IL - (PL,R)	Cushing-Chicago[¶¶¶]	291	300	32-42[¶]	150-3.6[¶,¶¶]
		" "	" "	Amoco	220	220	32-40	85-47[**]
		" "	" "	Texaco-Cities Ser.	45	45	39.1[§§]	39.2[§§]
				Total Cushing to Chicago	556			
		Cushing, OK - (PL)	Salisbury, MO - (PL)	Cushing-Chicago[¶¶¶]	291	291	32-42[¶]	150-3.6[¶,¶¶]
		Salisbury, MO - (PL)	Chicago, IL - (PL,R)	Cushing-Chicago[¶¶¶]	297	297	32-42[¶]	150-3.6[¶,¶¶]
		Freeman, MO - (PL)	Wood River, IL - (PL,R)	Amoco	106	106	27-35[**]	182-77[**]
		Salisbury, MO - (PL)	Wood River, IL - (PL,R)	Platte	150	185	22-37.5[¶]	750-50[¶]
		Cushing, OK - (PL)	Wood River, IL - (PL,R)	Ozark[¶¶¶]	315	315	28-50	NR
		" "	" "	Shell	26	39	28-50	NR
				Total Cushing to Wood River	597			
		Laton, KS - (PL)	Freeman, MO - (PL)	Amoco	158	275	27-35[¶]	182-77[¶]
		Freeman, MO - (PL)	Kansas City, MO - (R)	Amoco	133	133	32-40	85-47[**]
		Cushing, OK - (PL)	Kansas City, MO - (R)	Phillips	80	80	26-44	179-40
				Total Cushing to Kansas City	213			

TABLE 5 (continued)

PAD District From	PAD District To	Origin and Type	Destination and Type	Company	Annual Average Capacity 12/78	Annual Average Capacity Maximum Economic	Crude Oil Handled Gravity Range (°API)	Crude Oil Handled Viscosity Range (SSU)
2	2	Cushing, OK - (PL)	Wichita and El Dorado, KS - (PL,R)	Osage	270	280	26-42[¶]	185-40[¶]
		" "	" "	Wesco	22	27	37-42	75
			Total Cushing to Wichita and El Dorado		292			
		Cushing, OK - (PL)	Coffeyville, KS - (R)	Cushing to Chicago[¶¶¶]	291	291	32-42[¶]	150-3.6[¶,¶¶]
		Cushing, OK - (PL)	Tulsa, OK - (R)	Sun	59	NR	37-40[**]	60-40[**]
		" "	" "	Texaco-Cities Ser.	61	NR	39.1[§§]	39.2[§§]
		" "	" " (PL)	Continental	23	NR	NR	NR
			Total Cushing to Tulsa		143			
		Cushing, OK -(PL)	Ponca City, OK - (R)	Continental	104	NR	NR	NR
		Ponca City, OK - (PL)	Arkansas City, KS - (R)	Continental	25	NR	NR	NR
		Logan, OK - (PL)	Elk City, OK - (PL)	Wesco	24	24	40-45	70
		Wichita and El Dorado, KS - (PL)	Arkansas City, KS - (R)	Continental	19	NR	NR	NR
		Oklahoma City, OK - (PL)	Ponca City, OK - (R)	Continental	74	NR	NR	NR
		Seminole, OK - (PL)	Cushing, OK - (PL)	Texaco-Cities Ser.	18	NR	39.1[§§]	39.2[§§]
		Wichita and El Dorado, KS - (PL)	Minneapolis and St. Paul, MN - (R)	Williams	120	NR	27.3-39.4[¶]	170-40[¶]
		Wichita and El Dorado, KS - (PL)	Coffeyville, KS - (R)	CRA	15	15	NR	NR
		Southwest Kansas - (GA)	Wichita and El Dorado, KS - (PL,R)	Jayhawk	42	NR	32-40	150-70
		Northwest Kansas - (GA)	Chase, KS - (PL)	KAW	36	NR	36.7	48.8§§

TABLE 5 (continued)

PAD District From	PAD District To	Origin and Type	Destination and Type	Company	Annual Average Capacity 12/78	Annual Average Capacity Maximum Economic	Crude Oil Handled Gravity Range (°API)	Crude Oil Handled Viscosity Range (SSU)
2	2	Chase, KS - (PL)	Wichita and El Dorado, KS - (PL,R)	Mobil	50	50	NR	NR
		Laton, KS - (PL)	Phillipsburg, KS - (R)	CRA	25	25	NR	NR
		Allen, OK - (PL)	Wynnewood, OK - (PL,R)	Texoma	96	NR	23-42[¶]	500-60[¶]
		Wynnewood, OK - (PL)	Ardmore, OK - (R)	Vickers	45	45	26-39.9[¶]	275[¶]
		Wynnewood, OK - (PL)	Duncan, OK - (R)	Sun	9	NR	NR	NR
3	3	Bisti, NM - (PL)	Jal, NM - (PL)	Texas-New Mexico	42	NR	27.8-48.5[§§]	89[§§]-31.7
		Jal, NM - (PL)	Midland and Odessa, TX - (PL)	Texas-New Mexico	78	NR	27.8-48.5[§§]	89[§§]-31.7
		" "	" "	Basin[¶¶¶]	290	NR	32.9-40.7[††]	45.4-34.8[††]
		" "	" "	Shell	15	NR	39-49[¶]	48-39[¶]
			Total Jal to Midland, Odessa, and Big Springs		383			
		Midland and Odessa, TX - (PL)	Colorado City, TX - (PL)	Basin[¶¶¶]	290	NR	32.9-40.7[††]	45.4-34.8[††]
		" "	" "	Mesa[¶¶¶]	316	316	.79-.84[***]	55-37
		" "	" "	Shell	46	46	28.2-50	63-36[§§]
			Total Midland-Odessa to Colorado City		652			
		Crane, TX - (PL)	Ozona, TX - (PL)	Texas-New Mexico	48	NR	27.8-48.5[§§]	89-31.7[§§]
		Midland and Odessa, TX - (PL)	Houston, TX - (PL,R)	Exxon	126	NR	28-45	100-40
		" "	" "	Rancho[¶¶¶]	312	312	31-45	NR
		" " (Ozona)	" "	Texas-New Mexico	63	NR	27.8-48.5[§§]	89-31.7[§§]
			Total Midland-Odessa to Houston		501			

TABLE 5 (continued)

PAD District From	PAD District To	Origin and Type	Destination and Type	Company	Annual Average Capacity 12/78	Annual Average Capacity Maximum Economic	Crude Oil Handled Gravity Range (°API)	Crude Oil Handled Viscosity Range (SSU)
3	3	Colorado City, TX - (PL)	Wichita Falls, Jacksboro, TX - (PL)	Basin[¶¶¶]	390	NR	32.9-40.7[††]	45.4-34.8[††]
		" "	" "	Shell	46	46	28.2-50	63-36[§§]
			Total Colorado City to Wichita Falls - Jacksboro		436			
		Midland and Odessa, TX - (PL)	Beaumont and Port Arthur, TX - (R)	Amdel	47	47	34	NR
		Midland and Odessa, TX - (PL)	Borger, TX - (R)	Phillips	100	100	26-44	179-40
		Colorado City, TX - (PL)	Wink, TX - (PL)	Chevron	80	132	29-41.5	NR
		Wink, TX - (PL)	El Paso, TX - (R)	Chevron	110	238	35-43	NR
		Iraan, TX - (PL)	Midland and Odessa, TX - (PL)	Marathon	100	130	30.4	100
		Midland and Odessa, TX - (PL)	Corpus Christi, TX - (PL)	Exxon	53	NR	28-45	100-50
		Corpus Christi, TX - (PL,W)	Crane, TX - (PL)	American Petrofina	28	46	36	NR
		Corpus Christi, TX - (PL,W)	Houston, TX - (PL,R)	Exxon	88	NR	23-45	52-30
		Vanderbilt, TX - (GA)	Refugio, TX - (PL)	Coastal States	48	48	28-40	NR
		Sealy, TX - (GA,PL)	Houston, TX - (R)	Mobil	60	60	21-43[¶]	126-42[**]
		Yoakum, TX - (GA)	Houston, TX - (R)	Shell	22	22	NR	NR

TABLE 5 (continued)

PAD District From	PAD District To	Origin and Type	Destination and Type	Company	Annual Average Capacity 12/78	Annual Average Capacity Maximum Economic	Crude Oil Handled Gravity Range (°API)	Crude Oil Handled Viscosity Range (SSU)
3	3	Houston, TX - (PL)	Beaumont and Port Arthur, TX - (PL,R)	Cities Service[§]	60	NR	NR	NR
		" "	" "	Gulf	23	23	.82-.90[***]	50-200
		" "	" "	Mobil	60	60	21-43[¶]	126-42[¶]
		" "	" "	Texas	139	NR	23.1-38.9[§§]	45.8-38.9[§§]
			Total Houston to Beaumont-Port Arthur		282			
		Texas City, TX - (PL)	North Texas - (PL)		70	70	NR	NR
		Beaumont and Port Arthur, TX - (GA,PL)	Houston, TX - (PL,R)	Arco	25	25	38	NR
		" "	" "	Explorer	380[†]	380[†]	30 (Minimum)[§§]	100 (Maximum)[§§]
			Total Beaumont-Port Arthur to Houston		405			
		Midland, TX - (PL)	Corsicana, Teague, and Wortham, TX - (PL)	Mobil	213	213	32-43[¶]	55-37[**]
		Colorado City, TX - (PL)	Corsicana, Teague and Wortham - (PL)	West Texas-Gulf	440	440	.79-.84[***]	55-37
		Wichita Falls and Jacksboro, TX - (PL)	Corsicana, Teague, and Wortham, TX - (PL)	Arco	138	138	32-42	3.6-30.2[¶]
		" "	" "	Texas	65	NR	23.1-43.3[§§]	147-102[§§]
			Total Wichita Falls-Jacksboro to Corsicana-Teague-Wortham		203			
		Corsicana, Teague, and Wortham, TX - (PL)	Longview, TX - (PL)	West Texas-Gulf	147	147	.79-.84[***]	55-37
		Longview, TX - (PL)	Corsicana, Teague, and Wortham, TX - (PL)	Arco	36	NR	32-42	30.2-3.6[¶,¶¶]
		" "	" "	Mobil	11	11	43[¶]	35[**]
			Total Longview to Corsicana, Teague, and Wortham		47			

TABLE 5 (continued)

PAD District From	PAD District To	Origin and Type	Destination and Type	Company	Annual Average Capacity 12/78	Annual Average Capacity Maximum Economic	Crude Oil Handled Gravity Range (°API)	Crude Oil Handled Viscosity Range (SSU)
3	3	Corsicana, Teague, and Wortham, TX - (PL)	Houston, TX - (PL,R)	Arco	170	NR	32-42	30.2-3.6¶,¶¶
		" "	" "	Texas	65	NR	23.1-43.3§§	147-102§§
			Total Corsicana, Teague, and Wortham to Houston		235			
		Corsicana, Teague, and Wortham, TX - (PL)	Beaumont and Port Arthur, TX - (R)	Mobil	250	250	32-43¶	55-37**
		" "	" "	West Texas-Gulf	335	335	.79-.84***	55-37
			Total Corsicana-Teague-Wortham to Beaumont-Port Arthur		585			
		Longview, TX - (PL)	Houston, TX - (R)	Exxon	7	NR	35-40	70-45
		" "	" "	Shell	36	45	41-52	48
			Total Longview to Houston		43			
		Longview, TX - (PL)	Sour Lake, TX - (PL)	Cities Service	65	65	NR	NR
		Longview, TX - (PL)	Beaumont and Port Arthur, TX - (R)	Pure	45	45	34-44	80-40
			Total Longview to Sour Lake-Beaumont-Port Arthur		110			
		Beaumont and Port Arthur, TX - (PL, W)	Longview, TX - (PL)	Paline¶¶¶	45	45	36¶	45¶
		" "	" "	Sun	48	48	25-43¶	125-42¶
		" "	" "	Texoma	410	600	23-42¶	500-60¶
			Total Beaumont-Port Arthur to Longview		503			
		Beaumont and Port Arthur, TX - (PL)	Lake Charles, LA - (R)	Cities Service	175	175	33.5-42	NR

TABLE 5 (continued)

PAD District From	PAD District To	Origin and Type	Destination and Type	Company	Annual Average Capacity 12/78	Annual Average Capacity Maximum Economic	Crude Oil Handled Gravity Range (°API)	Crude Oil Handled Viscosity Range (SSU)
3	3	Longview, TX - (PL)	Shreveport, LA - (PL,R)	Exxon	140	NR	21-40	2200-55
		Shreveport, LA - (PL)	Longview, TX - (PL)	Cities Service	24	NR	39-40.5	NR
		Shreveport, LA - (PL)	Baton Rouge, LA - (R)	Exxon	140	NR	21-40	2200-55
		Lake St. John, LA - (GA)	Delhi, LA - (PL)	Parish	30	30	38-39¶	60-55¶
		Lake St. John, LA - (GA)	Liberty, MS - (PL)	Ferriday¶¶¶	34	NR	38-39¶	60-55¶
		Liberty, MS - (GA)	Baton Rouge, LA - (R)	Exxon	80	NR	42-45	46-36
		South Bend, LA - (GA)	Baton Rouge, LA - (R)	Exxon	69	NR	23-50	100-35
		Louisiana Delta, LA - (GA)	St. James, LA - (PL)	Exxon	130	NR	32-40	105-40
		" "	" "	Texas	207	NR	31.7-38.9§§	45.8-38.9§§
			Total Louisiana Delta to St. James		337			
		Louisiana Delta, LA - (GA)	New Orleans, LA - (R)	Gulf	220	220	.86***	55
		" "	" "	Shell	240	240	36¶	52.2¶
			Total Louisiana Delta to New Orleans		460	460	36	52.2¶
		Caillou Island, LA - (PL)	Louisiana Delta - (PL)	Texas	125	173	32.3§§	7.35§§
		Louisiana Delta, LA - (GA)	Erath, LA - (PL)	Texas	208	NR	31.7-38.9§§	45.8-38.9§§
		Erath, LA - (PL)	Beaumont and Port Arthur, TX, and Lake Charles, LA - (R)	Texas	360	NR	31.7-38.9§§	45.8-38.9§§
		St. James, LA - (PL,W)	Baton Rouge, LA - (R)	Exxon	189	NR	32-40	105-40
		Gibson, LA - (GA)	St. James, LA - (PL)	Ship Shoal¶¶¶	341	341	36¶	52.2¶
		Venice, LA - (GA)	Empire, LA - (PL,W)	Chevron	69	238	30.8-33	NR

TABLE 5 (continued)

PAD District From	PAD District To	Origin and Type	Destination and Type	Company	Annual Average Capacity 12/78	Annual Average Capacity Maximum Economic	Crude Oil Handled Gravity Range (°API)	Crude Oil Handled Viscosity Range (SSU)
4	4	Empire, LA - (PL,W)	Pascagoula, MS - (R)	Chevron	230	230	30-30.6	NR
		Lake Charles, LA - (W)	Beaumont and Port Arthur, TX - (PL)	Explorer	101[†]	101[†]	30 (Minimum)[§§]	100 (Maximum)[§§]
		Black Lake, LA - (GA)	Mont Belvieu, TX - (PL)[†††]	Black Lake	32	40	NR	NR
		Rangely, CO - (GA)	Bonanza, UT - (PL)	Chevron	48	48	34-37	NR
		Bonanza, UT - (PL)	Salt Lake City, UT - (R)	Chevron	48	48	34-37	NR
		Wamsutter, WY - (GA)	Salt Lake City, UT - (R)	Amoco	42	42	48[**]	50[**]
		Wamsutter, WY - (PL)	Casper WY - (PL)	Amoco	42	42	48[**]	50[**]
		Aurora, MT - (PL)	Billings, MT - (PL,R)	Continental	95	NR	NR	NR
		Billings, MT - (PL)	Byron, WY - (PL)	Continental	25	NR	NR	NR
		Byron, WY - (PL)	Billings, MT - (R)	Continental	19	NR	NR	NR
		Byron, WY - (PL)	Silvertip, MT - (PL)	Marathon	38	NR	16-44[¶]	43[¶]
		Byron, WY - (PL)	Chatham, WY - (PL)	Platte	78	NR	22-37.5[¶]	750-50[¶]
		Chatham, WY - (PL)	Casper, WY - (PL)	Platte	96	NR	22-37.5[¶]	750-50[¶]
		Chatham, WY - (PL)	Byron, WY - (PL)	Marathon	12	NR	16-44[¶]	43[¶]
		Silvertip, MT - (GA)	Billings, MT - (R)	Exxon	58	NR	27.8-29	280-60
		Silvertip, MT - (PL)	Byron, WY - (PL)	Marathon	16	NR	16-44[¶]	43[¶]
		Casper, WY - (G)	Fort Laramie - Guernsey, WY - (PL)	Amoco	191	275	27-35	182-77[**]
		Chatham, WY - (PL)	Fort Laramie - Guernsey (PL)	Platte	96	NR	22-37.5[¶]	750-50[¶]
		Poplar, MT - (PL)	Baker, MT - (PL)	Wesco	25	NR	36-60	100-70

TABLE 5 (continued)

PAD District From	PAD District To	Origin and Type	Destination and Type	Company	Annual Average Capacity 12/78	Annual Average Capacity Maximum Economic	Crude Oil Handled Gravity Range (°API)	Crude Oil Handled Viscosity Range (SSU)
4	4	Baker, MT - (PL)	Poplar, MT - (PL)	Wesco	25	NR	36-60	100-70
		Baker, MT - (PL)	Ft. Laramie-Guernsey, WY - (PL)	Butte	80	125	NR	NR
		Lance Creek and Lightning Flats, WY - (GA,PL)	Fort Laramie, WY - (PL)	Continental	23	23	NR	NR
		" "	" "	Belle Fourche	72	120	28-38	250[§§§]-55[¶]
			Total Lance Creek-Lightning Flats to Fort Laramie		95			
		Fort Laramie-Guernsey, WY - (PL)	Cheyenne, WY - (PL,R)	Continental	57	57	NR	NR
		Cheyenne, WY - (PL)	Denver, CO - (R)	Continental	43	43	NR	NR
		Bonanza, UT - (PL)	Fruita, CO - (R)	Wesco	12	12	36	120
5	5	San Joaquin Valley, CA - (GA)	Los Angeles, CA - (R)	Four Corners	70	NR	26-37	NR
		Elk Hills, CA - (GA)	Bakersfield, CA - (R)	Four Corners	50	NR	26-37	NR
		Prudhoe Bay, AK - (GA)	Valdez, AK - (W)	Trans-Alaska[¶¶¶]	1,235	2,000	NR	NR
		Granite Point, AK - (GA)	Drift River, AK - (W)	Cook Inlet	205	NR	35	NR
		Kenia Peninsula, AK - (P)	Nikiska, AL - (R,W)	Kenia	174	NR	35-40	NR

*Estimated.
†No. 2 fuel oil capacity.
§Completed by January 1, 1980.
¶Measured at 60° Fahrenheit.
**Measured at 70° Fahrenheit.
††Measured at 68° Fahrenheit.
§§Measured at 100° Fahrenheit.
¶¶Measured in centerpoise.
***Specific Gravity.
†††Crude - LPG Mix.
§§§Measured at 69° Fahrenheit.
¶¶¶Undivided interest pipeline systems.

NR Not Reported.

REFINED PRODUCTS PIPELINES MAPS AND TABLES

Pipelines play a major role in the movement of products from refineries to distribution terminals. The tables and maps in this appendix list the December 31, 1978, average capacity of existing common carrier product pipelines to move No. 2 fuel oil in thousands of barrels per day (MB/D); the capacity for pumping gasoline will usually be higher. If a pipeline company did not provide a capacity figure for pumping No. 2 fuel oil, it was estimated from the other capacity information provided. (These estimates are noted with an "E" in the tables.)

Other capacity information provided by each pipeline company is also listed in the tables. Except for No. 2 fuel oil capacities, the tables indicate "NR" when a company did not respond with capacity information.

MAPS

The map of the United States notes the location of origin and destination, and, where there is space on the map, the capacity for No. 2 fuel oil. The direction of product flow is shown with an arrowhead; lines that can flow in both directions have arrowheads so placed.

The PAD district maps show all of the locations and other information on the U.S. map. In addition, the pipeline company names are shown for each line segment along with the total No. 2 fuel oil capacity for the lines in that segment.

Because the largest concentration of petroleum refining capacity is along the Texas-Louisiana Gulf Coast, the product tends to flow from the Gulf to other areas of the country east of the Rocky Mountains. This product flow supplements that from local refineries and regional refining centers. The sequence of the tables follows this general flow pattern:

(1) Major cross-district pipeline systems with Gulf Coast origins:

The Colonial-Plantation Systems to the east coast and the associated feeder and delivery lines (Table 6, Pages D-12 through D-15)

The Texas Eastern System to Little Rock, Indianapolis, Chicago, Cincinnati, and Lima (Ohio) (Table 7, Page D-16). (See Table 6 for feeder lines in the Houston area.)

The Explorer System to Dallas-Ft. Worth, Tulsa, St. Louis, and Chicago (Table 8, Page D-17). (See Table 6 for feeder lines in the Houston area.)

(2) Pipelines in northern PAD I -- New Jersey, Pennsylvania, New York, and New England (Table 9, Pages D-18 through D-21). Most of these pipelines ship product supplied by either Colonial Pipeline or the refineries in the Philadelphia or New York City areas.

(3) Pipelines in PAD II west -- west of the Mississippi River (Tables 10-12, Pages D-22 through D-28). Most of these pipelines ship product supplied by either Explorer Pipeline or the refineries in Oklahoma and southern Kansas (sometimes called the Group 3 refiners).

(4) Pipelines in PAD II east -- east of the Mississippi River (Tables 13-16, Pages D-29 through D-34). Most of these pipelines ship product supplied by either Explorer or Texas Eastern Pipelines or by refineries in the St. Louis, Chicago, or Toledo areas.

(5) Pipelines in western PAD III -- Texas and New Mexico (Tables 17 and 18, Pages D-35 through D-38). These pipelines ship product from most of the refining areas of Texas.

(6) Pipelines in PAD IV -- Rocky Mountain Area (Table 19, Pages D-39 and D-40). These pipelines ship product from most of the refineries in PAD IV.

(7) Pipelines in PAD V -- West Coast and Arizona (Table 20, Pages D-41 and D-42). These pipelines ship product from refineries in PAD V and El Paso, Texas.

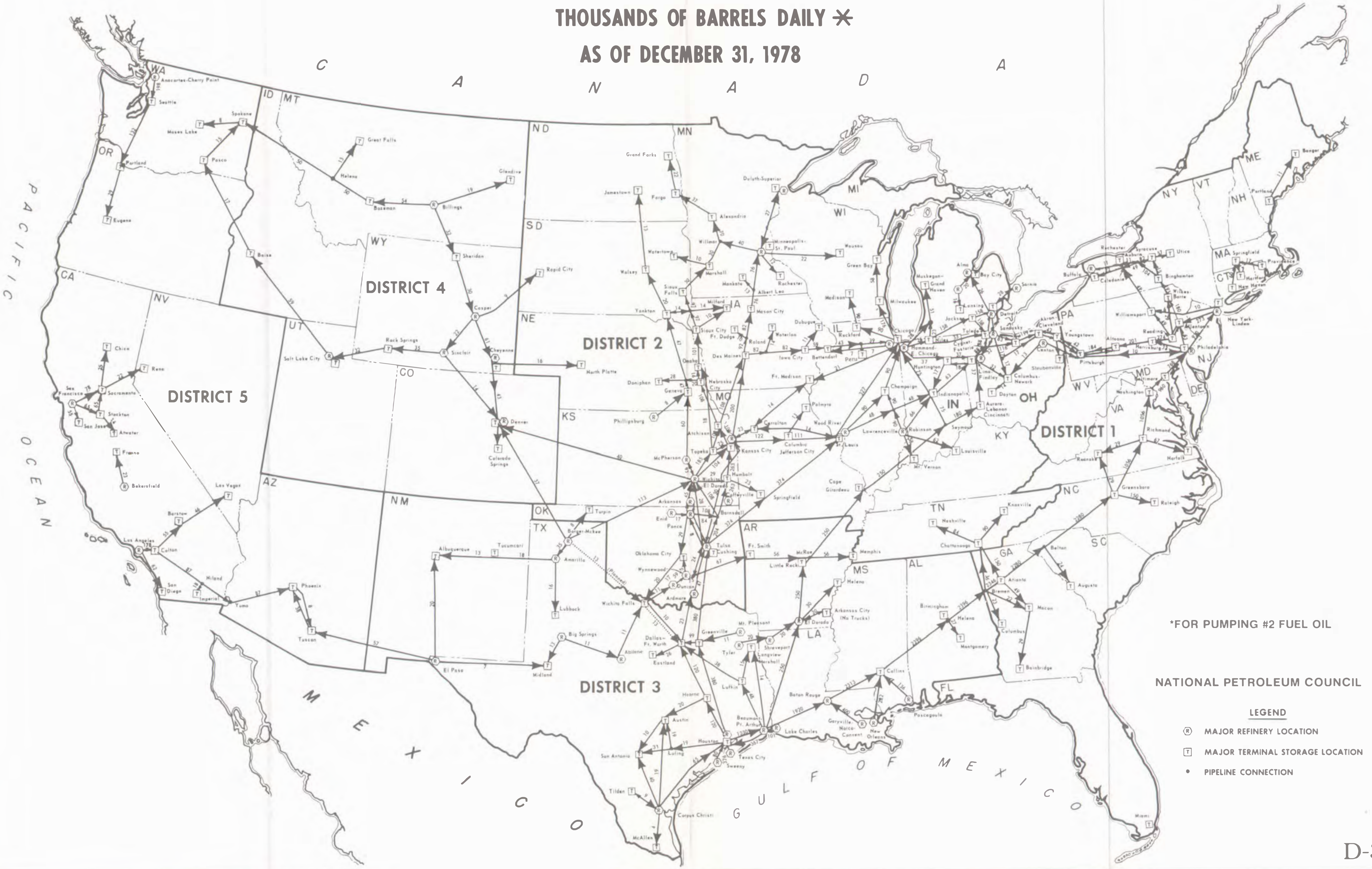
When determining pipeline capacity between two locations, care must be taken to determine the line segment with the lowest capacity. For example, in the case of the capacity between Houston and the New York area, there are 13 line segments on the map with total capacities ranging from 2,396 MB/D to 930 MB/D -- but none of the capacities on the map is exact. Colonial is a refined product pipeline that runs from Houston to the New York area. The Colonial tables show the lowest capacity between Houston and New York as the segment between the Philadelphia area and the New York area at 732 MB/D. The difference between 930 MB/D shown on the map and the correct capacity of 732 MB/D is the capacity of two additional lines that connect the Philadelphia area to the New York area.

It should be noted that many intermediate terminals along a pipeline system were not designed to receive the total capacity of that pipeline system. For example, the Colonial and Plantation pipelines have a combined capacity of 2,280 MB/D into the Belton, South Carolina area. However, the facilities at Belton were not sized to receive that combined capacity. It is beyond the scope of this report to provide intermediate terminal receipt capabilities.

PETROLEUM PRODUCTS PIPELINE CAPACITIES

THOUSANDS OF BARRELS DAILY *

AS OF DECEMBER 31, 1978



NATIONAL PETROLEUM COUNCIL

LEGEND

AR	ARCO	PL	PIPELINE TERMINAL OR PUMP STATION
AS	ASHLAND	●	PIPELINE CONNECTION
BE	BUCKEYE	R	REFINERY OR REFINERY AREA
CL	COLONIAL	T	TERMINALLING AREA
LA	LAUREL	TT	TRUCK TERMINAL
MO	MOBIL	WT	WATER TERMINAL

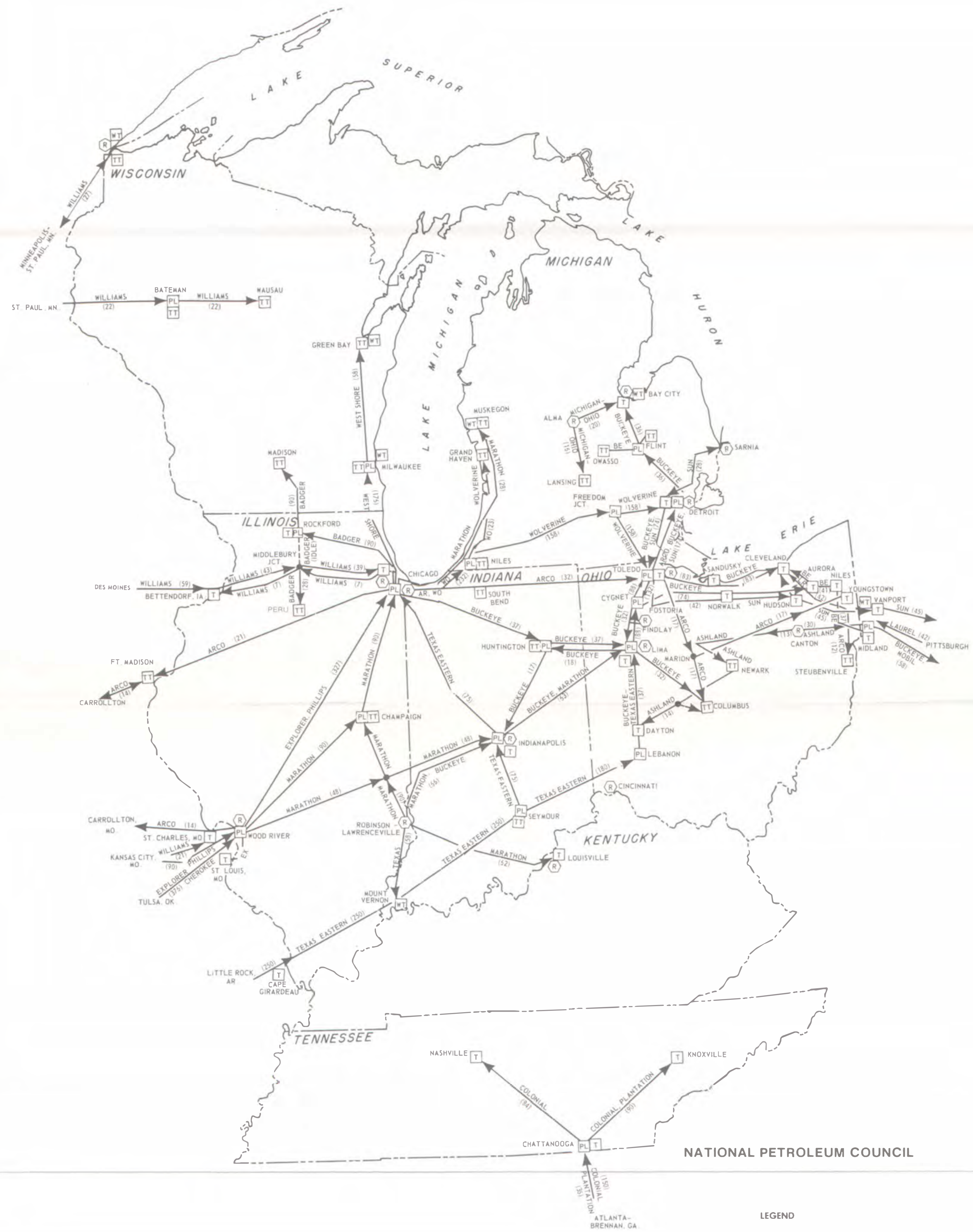
DETAILED MAPS OF INTERCONNECTIONS ARE INCLUDED IN APPENDIX F FOR THESE AREAS:

- NEW YORK CITY (NEWARK, BAYONNE, LINDEN)
- PHILADELPHIA
- PITTSBURGH

PRINCIPAL COMMON CARRIER REFINED PRODUCTS PIPELINES

PIPELINE CAPACITIES FOR PAD DISTRICT 1

NOTE: FIGURES INDICATE CAPACITY IN THOUSANDS OF BARRELS PER CALENDAR DAY FOR PUMPING #2 FUEL OIL



NATIONAL PETROLEUM COUNCIL

LEGEND

- PL PIPELINE TERMINAL OR PUMP STATION
- ● PIPELINE CONNECTION
- R REFINERY OR REFINERY AREA
- T TERMINALLING AREA
- TT TRUCK TERMINAL
- WT WATER TERMINAL

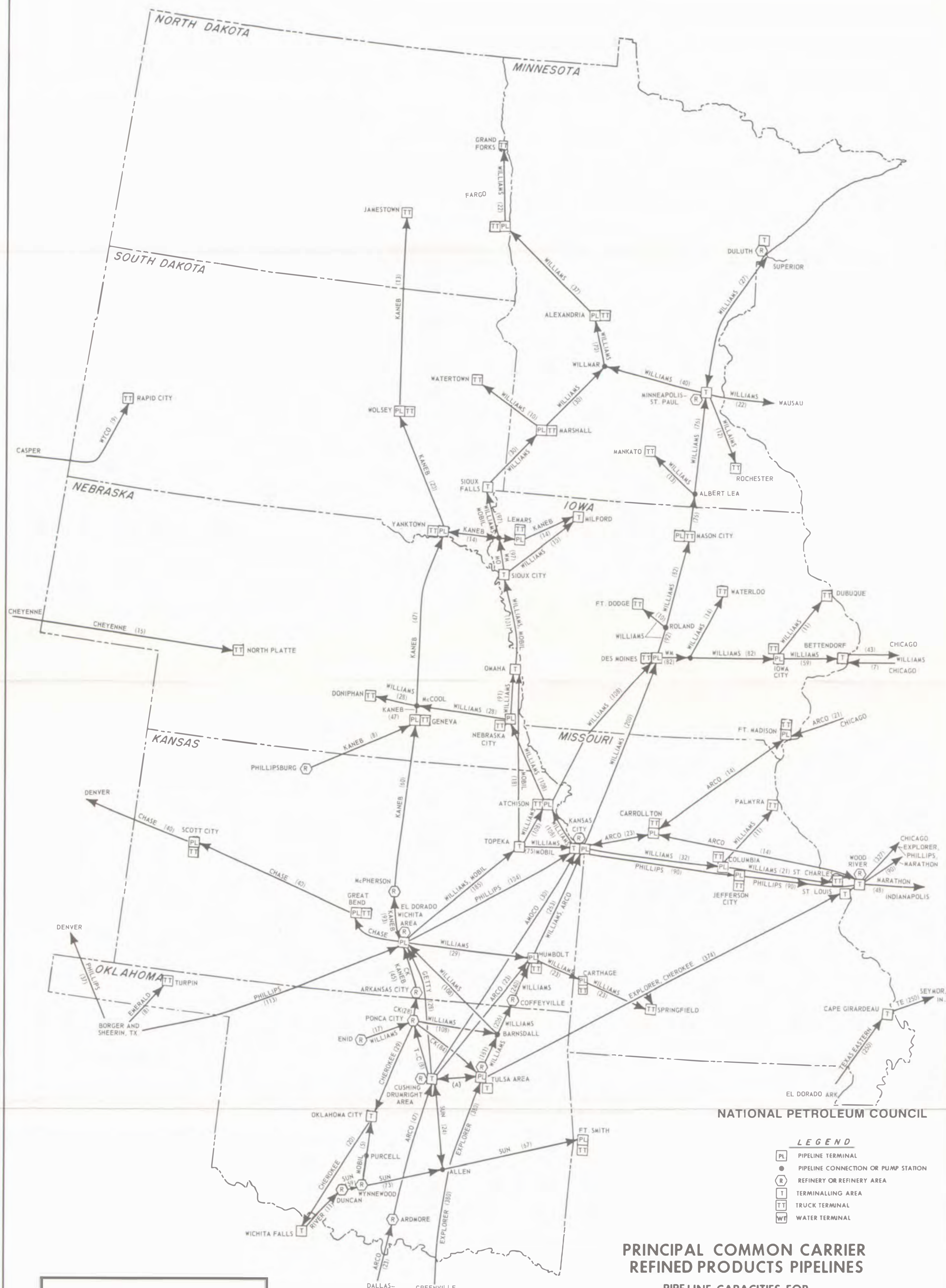
DETAILED MAPS OF INTERCONNECTIONS ARE INCLUDED IN APPENDIX F FOR THESE AREAS:

CHICAGO
DETROIT, SAMARIA, SARNIA, TOLEDO
LIMA, CYGNET, TOLEDO
WOOD RIVER

PRINCIPAL COMMON CARRIER REFINED PRODUCTS PIPELINES

PIPELINE CAPACITIES FOR PAD DISTRICT 2 EAST OF MISSISSIPPI RIVER

NOTE: FIGURES INDICATE CAPACITY IN THOUSANDS OF BARRELS PER CALENDER DAY FOR PUMPING #2 FUEL



NATIONAL PETROLEUM COUNCIL

LEGEND

- PL PIPELINE TERMINAL
- ● PIPELINE CONNECTION OR PUMP STATION
- R REFINERY OR REFINERY AREA
- T TERMINALLING AREA
- TT TRUCK TERMINAL
- WT WATER TERMINAL

PRINCIPAL COMMON CARRIER REFINED PRODUCTS PIPELINES

PIPELINE CAPACITIES FOR

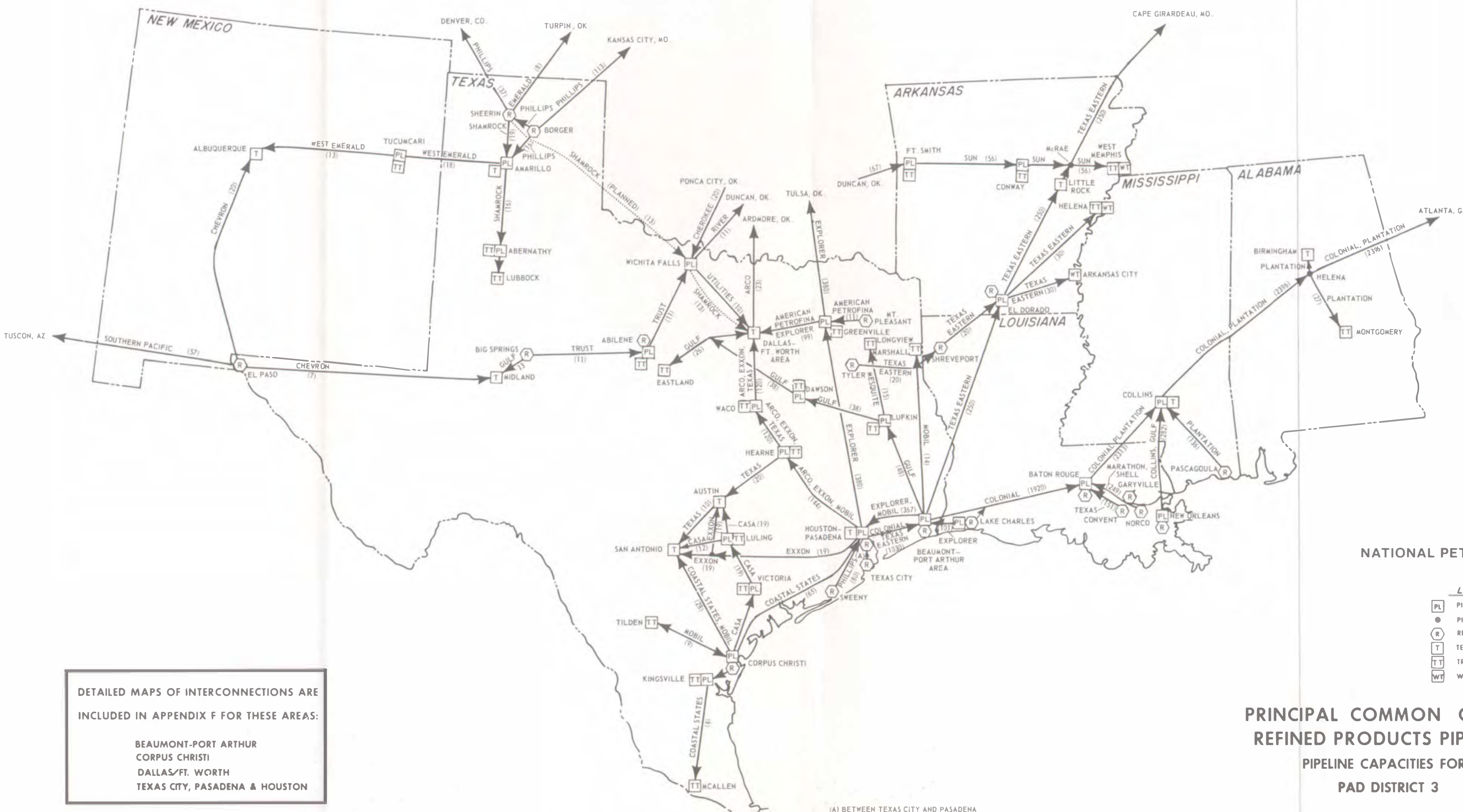
PAD DISTRICT 2

WEST OF MISSISSIPPI RIVER

NOTE: FIGURES INDICATE CAPACITY IN THOUSANDS OF BARRELS PER CALENDAR DAY FOR PUMPING #2 FUEL OIL

A DETAILED MAP OF INTERCONNECTIONS IS INCLUDED IN APPENDIX F FOR THE TULSA AREA

(A) BETWEEN TULSA AND CUSHING-DRUMRIGHT ARE THE FOLLOWING LINES (DIRECTION OF FLOW)
WILLIAMS - [WM] (E & W)
CIMMARON - (W)
TEXACO-CITIES SERVICE - [T-C] (W)
CHEROKEE - [CK] (W)



NATIONAL PETROLEUM COUNCIL

LEGEND

- PL PIPELINE TERMINAL OR PUMP STATION
- • PIPELINE CONNECTION
- R REFINERY OR REFINERY AREA
- T TERMINALLING AREA
- TT TRUCK TERMINAL
- WT WATER TERMINAL

DETAILED MAPS OF INTERCONNECTIONS ARE INCLUDED IN APPENDIX F FOR THESE AREAS:

BEAUMONT-PORT ARTHUR
CORPUS CHRISTI
DALLAS/FT. WORTH
TEXAS CITY, PASADENA & HOUSTON

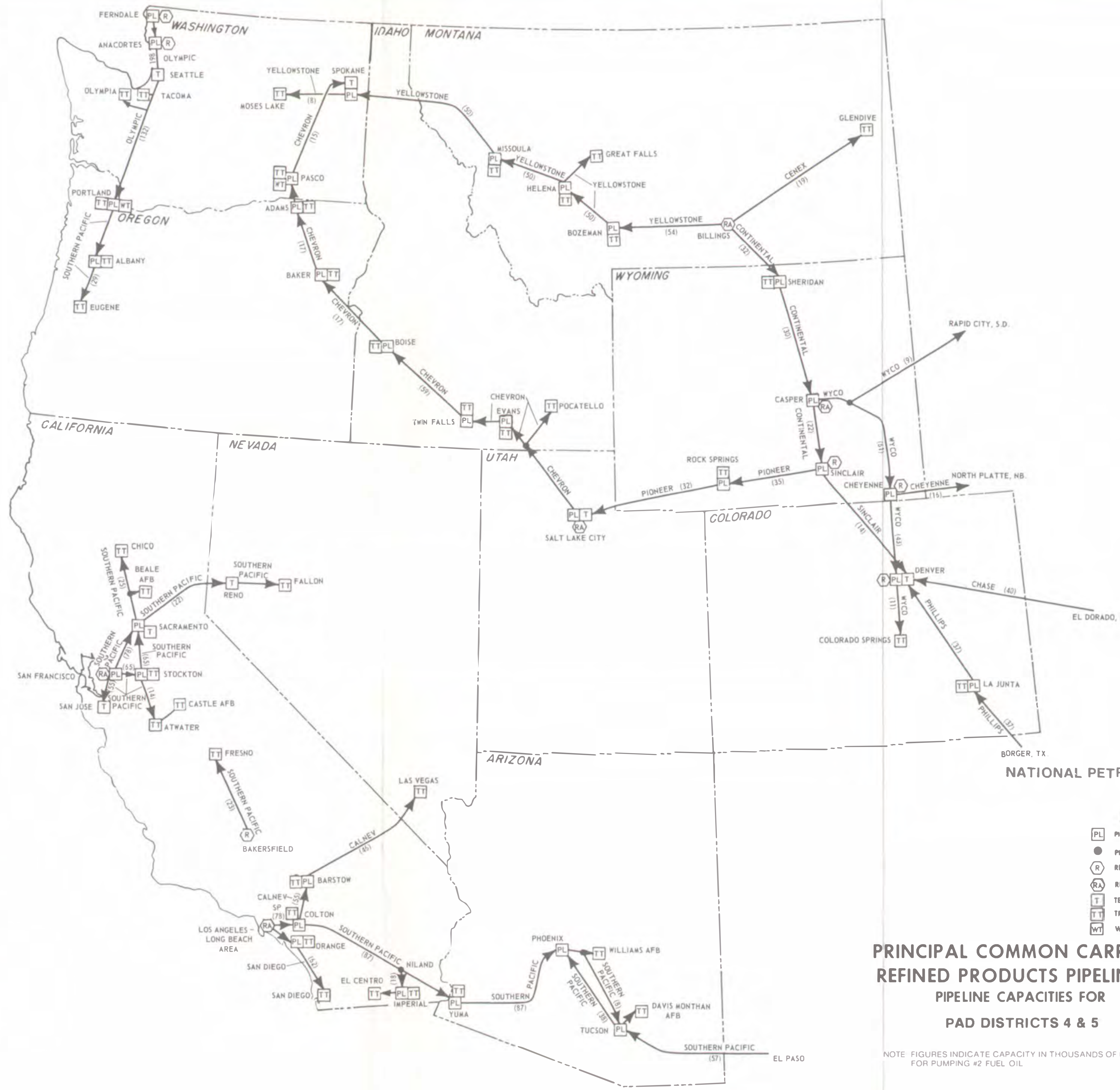
(A) BETWEEN TEXAS CITY AND PASADENA ARE THE FOLLOWING LINES:

AMOCO	(202)
MARATHON	(104)
TEXAS EASTERN	(70)
TOTAL	(375)

PRINCIPAL COMMON CARRIER REFINED PRODUCTS PIPELINES

PIPELINE CAPACITIES FOR PAD DISTRICT 3

NOTE: FIGURES INDICATE CAPACITY IN THOUSANDS OF BARRELS PER CALENDAR DAY FOR PUMPING #2 FUEL OIL



A DETAILED MAP OF INTERCONNECTIONS IS INCLUDED IN APPENDIX F FOR THE LOS ANGELES - LONG BEACH AREA

NATIONAL PETROLEUM COUNCIL

LEGEND

- PL — PIPELINE TERMINAL OR PUMP STATION
- ● — PIPELINE CONNECTION
- R — REFINERY
- RA — REFINERY AREA
- T — TERMINALLING AREA
- TT — TRUCK TERMINAL AREA
- WT — WATER TERMINAL

PRINCIPAL COMMON CARRIER REFINED PRODUCTS PIPELINES

PIPELINE CAPACITIES FOR PAD DISTRICTS 4 & 5

NOTE: FIGURES INDICATE CAPACITY IN THOUSANDS OF BARRELS PER CALENDAR DAY FOR PUMPING #2 FUEL OIL

TABLES

The tables exhibit the following information for each major pipeline segment:

(1) The basic direction of product flow (N for north, E for east, etc.)

(2) The PAD district of origin and the PAD district of destination of each segment

(3) The name and state of the origin location and the type or method of product supply (R for Refinery, PL for Pipeline, and W for Water Terminal)

(4) The name and state of the destination location

(5) The name of each common carrier pipeline company with a line segment between those locations

(6) The average capacity of that line segment in thousands of barrels per day when pumping:

No. 2 fuel oil -- for all segments

Gasoline -- where provided

Average product mix -- where provided

(7) The economic maximum capacity as defined by each pipeline company (this capacity is also noted with an N for No. 2 fuel oil, G for Gasoline, and M for Mixed).

Cross-PAD Pipeline Capacities

Following the same product flow pattern as the tables, the December 31, 1978, cross-PAD common carrier products pipeline capacities for pumping No. 2 fuel oil are as follows:

PAD III to PAD I	MB/D
Colonial (Helena, AL, to Bremen, GA)	1,920
Plantation (Helena, AL, to Bremen, GA)	476
Total No. 2 fuel oil capacity	2,396

PAD III to PAD II West	
Explorer (Greenville, TX, to Tulsa, OK)	380
Texas Eastern (Little Rock, AR, to Cape Girardeau, MO)	250
Arco (Dallas-Ft. Worth, TX, to Ardmore, OK)	23
River (Wichita Falls, TX, to Duncan, OK)	11
Phillips (Borger, TX, to Wichita, KS)	113
Emerald (McKee, TX, to Turpin, OK)	8
Total No. 2 fuel oil capacity	785

PAD III to PAD II East

This capacity is somewhat more difficult to determine. Pipelines marked with an asterisk (*) can move either PAD III or PAD II West product. The capacities shown assume that PAD III product has been maximized.

Colonial (Atlanta to Chattanooga)	150
Plantation (Bremen, GA, to Chattanooga)	36
Texas Eastern (Cape Girardeau, MO, to Seymore, IN)	250
Explorer (Tulsa, OK, to Wood River, IL)*	290
Arco (Carrollton, MO, to Wood River, IL)*	14
Approximate No. 2 fuel oil capacity	740

In addition to the above, PAD III origin product could be moved into PAD II East on the following pipelines:

Laurel (Pittsburgh to Youngstown, OH)	42
Williams (Bettendorf, IA, to Middlebury, IL)	43
Williams (Minneapolis to Wausau, WI)	22
Total No. 2 fuel oil capacity	107

PAD III to PAD II - Net

This capacity is easier to determine: it is the PAD II West capacity of 785 MB/D plus that of Colonial and Plantation, for a net of 971 MB/D. (Laurel could move another 42 MB/D.)

PAD III to PAD IV	MB/D
Phillips (Borger, TX, to Denver, CO)	37
PAD III to PAD V	
So. Pacific (El Paso, TX, to Tucson, AZ)	57
PAD I to PAD II East	
Laurel (Pittsburgh to Youngstown, OH)	42
PAD II East to PAD I	
Ashland (Canton, OH, to Pittsburgh Area)	30
Badger (Niles, OH, to Pittsburgh Area)	
Sun (Youngstown, OH, to Pittsburgh Area)	45
Total No. 2 fuel oil capacity	112
PAD II West to PAD III	
Continental (Oklahoma City to Wichita Falls, TX)	17
Sun (Allen, OK, to Ft. Smith, AR)	67
Total No. 2 fuel oil capacity	84
PAD II West to PAD IV	
Chase (El Dorado, KS, to Denver, CO)	40
PAD IV to PAD II West	
Wyco (Casper, WY, to Rapid City, SD)	9
Cheyenne (Cheyenne, WY, to N. Platte, NE)	16
Total No. 2 fuel oil capacity	25
PAD IV to PAD V	
Yellowstone (Helena, MT, to Spokane, WA)	50
Chevron (Boise, ID, to Pasco, WA)	17
Total No. 2 fuel oil capacity	67

TABLE 6

Common Carrier Products Pipeline Capacities
Colonial and Plantation Pipelines
(MB/D - As of December 31, 1978)

(Gulf Coast to East Coast)

Legend	
(GA) - Gathering Area	(R) - Refinery
(PL) - Pipeline Terminal	(W) - Water Terminal

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity No. 2	Gasoline	Mix	Maximum Economic Capacity
Flow E & N									
3	3	Corpus Christi, TX	R	Houston Area	Coastal States*,†,§	65	78	68	Max
		Sweeny, TX	R	Houston Area	Phillips*,†,§	80E	100	NR	NR
		Texas City, TX	R	Houston Area	Amoco*,†,§	202E	NR	220	Max
		" "	"	" "	Marathon*,†,§	104	114	108	NR
		" "	"	" "	Texas Eastern	70	85	80	NR
					Net Segment	376		408	
		Houston Area	R,PL	Beaumont Area	Colonial	780	1,140	960	¶¶¶
		" "	"	" "	Texas Eastern**	250	305	280	360 M
					Net Segment	1,030	1,445	1,240	
		Beaumont Area	R,PL	Baton Rouge, LA	Colonial	1,920	NR	1,920	2,296 M††
		Garyville, LA	R	Baton Rouge, LA	Marathon*,¶	145	160	150	NR
		Convent, LA	R	" "	Texas*	151E	NR	156	NR
		Norco, LA	R	" "	Shell¶	104	114	110	Max
					Net Segment	400		416	
		Baton Rouge, LA	PL	Collins, MS	Colonial¶	1,920	NR	1,920	2,296 M††
		" "	R,PL	Collins, MS	Plantation	393	NR	437	Max
					Net Segment	2,313		2,357	
		Meraux, LA	R	Collins, MS	Collins*,¶	97E	NR	100	125 M
		Alliance, LA	R	Collins, MS	Gulf*,¶	185	230	200	Max
					Net Segment	282		300	

TABLE 6 (continued)

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity No. 2	Gasoline	Mix	Maximum Economic Capacity
Flow E & N									
3	3	Pascagoula, MS	R	Collins, MS	Plantation	136	NR	158	NR
		Collins, MS	PL	Helena, AL	Colonial[†††]	1,920	NR	1,920	2,296 M[††]
		" "	"	" "	Plantation	476	NR	559	Max
					Net Segment	2,396		2,479	
		Helena, AL	PL	Birmingham, AL	Plantation[§§]	40	NR	NR	NR
		Helena, AL	PL	Montgomery, AL	Plantation	27	NR	32	NR
3	1	Helena, AL	PL	Bremen, GA	Colonial[†††]	1,920	NR	1,920	2,296 M[††]
		" "	"	" "	Plantation	476	NR	559	Max
					Net Segment	2,396		2,479	
1	2	Bremen, GA	PL	Chattanooga, TN	Plantation	36	NR	42	NR
1	1	Bremen, GA	PL	Columbus, GA	Plantation	23	NR	28	NR
		Bremen, GA	PL	Macon, GA	Plantation	22	NR	26	NR
		Bremen, GA	PL	Atlanta, GA	Colonial	1,920	NR	1,920	2,296 M[††]
		" "	"	" "	Plantation	426	NR	482	Max
					Net Segment	2,346		2,402	
		Atlanta, GA	PL	Macon, GA	Colonial	49	NR	60	72 M
1	2	Atlanta, GA	PL	Chattanooga, TN	Colonial	150	NR	197	252 M
2	2	Chattanooga, TN	PL	Nashville, TN	Colonial	84	NR	108	NR
		Chattanooga, TN	PL	Knoxville, TN	Colonial	64	NR	86	NR
		" "	"	" "	Plantation	26	NR	33	NR
					Net Segment	90		119	

TABLE 6 (continued)

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity No. 2	Gasoline	Mix	Maximum Economic Capacity
Flow E & N									
1	1	Macon, GA	PL	Bainbridge, GA	Colonial	29	NR	34	NR
		Atlanta, GA	PL	Belton, SC	Colonial	1,920	NR	1,920	2,296 M[††]
		" "	"	" "	Plantation	360	NR	416	Max
					Net Segment	2,280		2,336	
		Belton, SC	PL	Augusta, GA	Colonial	24	NR	31	45 M
		Belton, SC	PL	Greensboro, NC	Colonial[†††]	1,920	NR	1,920	2,296 M[††]
		" "	"	Greensboro, NC	Plantation[§§§]	360	NR	416	Max
					Net Segment	2,280		2,336	
		Greensboro, NC	PL	Raleigh, NC	Colonial	150	NR	185	NR
		Greensboro, NC	PL	Roanoke, VA	Plantation	29	NR	35	NR
		Greensboro, NC	PL	Richmond, VA	Colonial	960	NR	960	****
		" "	"	" "	Plantation	96	NR	105	Max
					Net Segment	1,056		1,065	
		Richmond, VA	PL	Norfolk, VA	Colonial	67	NR	84	NR
		Richmond, VA	PL	Roanoke, VA	Colonial	29	NR	34	51 M
		Richmond, VA	PL	Washington Area	Colonial	960	NR	960	Max
		" "	"	" "	Plantation	96	NR	105	Max
					Net Segment	1,056		1,065	
		Washington Area	PL	Baltimore, MD	Colonial	960	NR	960	Max
		Baltimore, MD	PL	Philadelphia Area	Colonial[¶¶]	768	NR	768	Max

TABLE 6 (continued)

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity No. 2	Gasoline	Mix	Maximum Economic Capacity
Flow E & N									
1	1	Philadelphia Area	PL	New York Area	Colonial***	732	NR	732	Max
		" "	R	New York Area	Harbor	113	144	NR	Max
		" "	"	" " "	Sun	85E	NR	87	NR
					Net Segment	930			

*Can deliver to Colonial Pipeline.
†Can deliver to Explorer Pipeline.
§Can deliver to Texas Eastern Pipeline.
¶Can deliver to Plantation Pipeline.
**Texas Eastern (TET) System continues on Table 7, Page D-16.
††Scheduled to be available by December 1979.
§§Colonial is building a 16-inch line to Birmingham, AL.
¶¶Can deliver to Laurel Pipeline at Booth, PA (Philadelphia area). See Table 9, Page D-18.
***Can deliver to Buckeye Pipeline at Linden, NJ. See Table 9, Page D-18.
†††Can deliver to Plantation Pipeline at destination.
§§§Can deliver to Colonial Pipeline at Greensboro, NC.
¶¶¶Will be looped during 1979; capacity will be 2,296.
****Will be looped during 1979; capacity will be 1,320.

G Capacity for pumping gasoline.
M Capacity for pumping average mix of products.
N Capacity for pumping No. 2 fuel oil.
NR Not Reported.

TABLE 7

Common Carrier Products Pipeline Capacities
Texas Eastern (TET) Pipeline
(MB/D - As of December 31, 1978)

(Gulf Coast to Upper Midwest)

Legend	
(GA) - Gathering Area	(R) - Refinery
(PL) - Pipeline Terminal	(W) - Water Terminal

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity No. 2	Gasoline	Mix	Maximum Economic Capacity
Flow N & E									
3	3	Houston, TX	R,PL	Beaumont, TX	Texas Eastern	(see Colonial-Plantation, Page D-12)			
		Beaumont, TX	R,PL	El Dorado, AR	Texas Eastern	250	305	300	360 M*
		Tyler, TX	R	Shreveport, LA	Texas Eastern	20	24	21	Max
		Shreveport, LA	R,PL	El Dorado, AR	Texas Eastern	20	24	21	Max
		El Dorado, AR	R,PL	Arkansas City, AR	Texas Eastern†	30	41	35	Max
		" "	"	Helena, AR	Texas Eastern	30	41	35	Max
		" "	"	Little Rock, AR	Texas Eastern	250	305	300	360 M*
3	2W	Little Rock, AR	PL	Cape Girardeau, MO	Texas Eastern	250	305	300	360 M*
2W	2E	Cape Girardeau, MO	PL	Seymour, IN	Texas Eastern	250	305	300	360 M*
2E	2E	Seymour, IN	PL	Indianapolis, IN	Texas Eastern§	75	85	80	120 M
		Seymour, IN	PL	Lebanon-Cincinnati Area	Texas Eastern	180	220	200	360 M*
		Lebanon, OH	PL	Lima, OH	Texas Eastern-Buckeye††	37E	46	NR	Max
		Indianapolis, IN	PL	Hammond-East Chicago Area	Texas Eastern¶	75	85	80	120 M
		" "	"	Chicago Area	Texas Eastern**	75	85	80	120 M

*Scheduled to be available December 1979.

†Pipeline is reversible. The Arkansas City Terminal can only load or unload barges -- no truck facilities.

§Can deliver or receive from Marathon Pipeline at Indianapolis, IN. See Table 13, Page D-29.

¶Can deliver to Marathon Pipeline at Griffith, IN. (Chicago area) See Table 14, Page D-31.

**Can deliver to West Shore Pipeline and Phillips Pipeline, in the Chicago area. See Table 14, Page D-31.

††Undivided interest pipeline system.

M Capacity for pumping average mix of products.

TABLE 8

Common Carrier Products Pipeline Capacities
Explorer and Parallel Lines
(MB/D - As of December 31, 1978)

(Gulf Coast to Chicago, Dallas, St. Louis)

Legend

(GA) - Gathering Area (R) - Refinery
(PL) - Pipeline Terminal (W) - Water Terminal

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity No. 2	Gasoline	Mix	Maximum Economic Capacity
Flow W									
3	3	Lake Charles, LA	R	Beaumont, TX	Explorer	101	NR	NR	NR
		Beaumont, TX	R,PL	Houston, TX	Explorer	380	NR	NR	677 N
		" "	R	Houston, TX	Mobil¶	77E	96	NR	Max
					Net Segment	457			
Flow N									
3	3	Houston, TX	R,PL	Greenville, TX	Explorer§	380	NR	NR	677 N
Flow W									
3	3	Mt. Pleasant, TX	R	Greenville, TX	American Petrofina	11E	NR	12	22 M
		Greenville, TX	PL	Dallas-Ft. Worth	American Petrofina	11E	NR	12	22 M
		" "	"	" "	Explorer	88	NR	NR	NR
					Net Segment	99			
Flow N									
3	2W	Greenville, TX	PL	Tulsa, OK	Explorer*	380	NR	NR	677 N
2W	2W	Tulsa, OK	R,PL	Mt. Vernon-Springfield, MO	Cherokee	86	NR	NR	NR
2W	2E	Tulsa, OK	R,PL	Wood River, IL	Cherokee	86	NR	NR	NR
		" "	"	" "	Explorer	290	NR	NR	470 N
					Net Segment	376			
Flow E & N									
2E	2E	Wood River, IL	R,PL	Chicago Area	Explorer†	290	NR	NR	470 N
		" "	"	" "	Phillips	37E	47	NR	NR
					Net Segment	327			

*Can deliver to Williams (see Table 10, Page D-22) and Cimarron (see Table 11, Page D-26) Pipelines at Tulsa, OK. Can receive from Cherokee at Tulsa, OK (see Table 12, Page D-27).

†Can deliver to Buckeye (see Table 13, Page D-30); also Arco, Badger, Marathon, West Shore, and Wolverine Pipelines (see Table 14, Page D-31) in the Chicago area.

§See Table 6, Page D-12, for feeder lines at Houston, TX.

¶This line continues on Table 18, Page D-37.

M Capacity for pumping average mix of products.
N Capacity for pumping No. 2 fuel oil.

TABLE 9

Common Carrier Products Pipeline Capacities
Northeast Lines
(MB/D - As of December 31, 1978)

(PAD 1)

Legend	
(GA) - Gathering Area	(R) - Refinery
(PL) - Pipeline Terminal	(W) - Water Terminal

Direction of Flow PAD District		Line Segment				12/31/78	Average Capacity		Maximum Economic
		Origin							
From	To	Name	Type	Destination	Pipeline Company	No. 2	Gasoline	Mix	Capacity
Flow E									
1	1	Linden, NJ	R,PL	JFK or La Guardia†††	Buckeye	108	NR	NR	Max
		" "	"	Newark Airport†††	Buckeye	30	NR	NR	90 N
		" "	"	Brooklyn, NY†††	Buckeye	65E	77	NR	120 G
Flow W									
1	1	Linden, NJ	R,PL	Washington, NJ†††	Getty Pipe	10	NR	NR	15 N
		Washington, NJ	PL	Williamsport, PA	Getty Pipe	6	NR	NR	Max
		Linden, NJ	PL	Allentown, PA	Buckeye	273	321	NR	550 G
		Allentown, PA	PL	Reading, PA	Buckeye	61E	72	NR	110 G
		Philadelphia Area	R,PL	Reading, PA	Arco	126	NR	134	Max
		" "	"	Reading, PA	Laurel*	174	210	180	370 M
		" "	"	" "	Sun	15E	NR	16	Max
					Net Segment	315		330	
		Reading, PA	PL	Harrisburg, PA	Buckeye	61E	72	NR	110 G
		" "	"	" "	Arco	39	NR	43	Max
		" "	"	" "	Laurel	174	210	180	370 M
					Net Segment	274			
		Philadelphia Area	R,PL	Harrisburg, PA	Mobil	33	35	34	Max

TABLE 9 (continued)

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity No. 2	Gasoline	Mix	Maximum Economic Capacity
Flow W									
1	1	Harrisburg, PA	PL	Altoona, PA	Buckeye	44E	52	NR	72 G
		" "	"	" "	Arco	23	NR	27	Max
		" "	"	" "	Laurel	117	168	144	288 M
		" "	"	" "	Mobil	17E	19	NR	Max
					Net Segment	201			
		Altoona, PA	PL	Pittsburgh Area	Buckeye	44E	52	NR	72 G
		" "	"	Pittsburgh Area	Arco[§]	23	NR	27	Max
		" "	"	Pittsburgh Area	Laurel	117	156	144	216 M
					Net Segment	184			
		Philadelphia Area	R,PL	Pittsburgh, PA	Sun[†]	10E	12	NR	Max
1	2E	Pittsburgh Area	PL	Youngstown, OH	Laurel[¶]	42	60	47	117 M
2E	2E	Youngstown, OH	PL	Cleveland, OH	Laurel	42	60	47	117 M
Flow E									
1	1	Pittsburgh Area	PL	Altoona, PA	Mobil[**]	21	24	22	Max
		Pittsburgh Area	PL	Philadelphia Area	Sun[††]	10E	12	NR	Max
Flow N									
1	1	Philadelphia Area	R,PL	Allentown, PA	Arco[§§]	29E	NR	29	Max
		" "	"	" "	Mobil	24	28	26	Max
					Net Segment	53		55	
1	1	Reading, PA	PL	Wilkes-Barre, PA	Arco	14E	NR	15	Max
		" "	"	" "	Sun	15E	NR	16	Max
					Net Segment	19		21	

TABLE 9 (continued)

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity No. 2	Gasoline	Mix	Maximum Economic Capacity
Flow N									
1	1	Reading, PA	PL	Allentown, PA	Buckeye	71E	84	NR	NR
		Allentown, PA	PL	Wilkes-Barre, PA	Buckeye	166E	195	NR	250 G
		" "	"	" "	Mobil	14E	NR	15	Max
					Net Segment	180			
		Wilkes-Barre, PA	PL	Binghamton, NY	Buckeye	166E	195	NR	250 G
		" "	"	" "	Mobil	12E	NR	13	Max
		" "	"	" "	Sun	15E	NR	16	Max
					Net Segment	193			
		Binghamton, NY	PL	Syracuse, NY	Sun	15E	NR	16	Max
		Binghamton, NY	PL	Auburn, NY	Buckeye	98E	115	NR	135 G
		" "	"	Waterloo, NY	Mobil	6E	NR	7	Max
					Net Segment	104			
		Reading, PA	PL	Williamsport, PA	Arco	49E	NR	55	Max
		Williamsport, PA	PL	Caledonia, NY	Arco	49E	NR	55	Max
Flow W									
1	1	Auburn, NY	PL	Caledonia, NY	Buckeye§§	49E	58	NR	68 G
		Caledonia, NY	PL	Rochester, NY	Buckeye	49E	58	NR	68 G
		" "	"	" "	Arco	27E	NR	30	Max
					Net Segment	76			
		Caledonia, NY	PL	Buffalo, NY	Arco	22E	NR	24	Max

TABLE 9 (continued)

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity No. 2	Gasoline	Mix	Maximum Economic Capacity
Flow E									
1	1	Buffalo, NY	R	Rochester, NY	Mobil¶¶	11	11	11	Max
		Rochester, NY	PL	Waterloo, NY	Mobil¶¶	11	11	11	Max
		Waterloo, NY	PL	Syracuse, NY	Mobil***	11	11	11	Max
		Auburn, NY	PL	Syracuse, NY	Buckeye	71E	84	NR	NR
					Net Segment	82	95		
		Syracuse, NY	PL	Utica, NY	Buckeye	57E	67	NR	77 G
Flow W & S									
1	1	Providence, RI	W	Springfield, MA	Mobil	17	18	18	Max
		Springfield, MA	PL	Hartford, CT	Mobil	7E	NR	8	NR
Flow N									
1	1	Portland, ME	W	Bangor, ME	Mobil	11	12	11	Max
		New Haven, CT	W	Springfield, MA	Jet (Buckeye)	60	NR	NR	70 N

*Can deliver to the Buckeye line at Reading, PA, that pumps north. See below on Page D-18.

†This line is reversible; normal flow is from west to east. See below on Page D-19.

§Can deliver to or receive from Laurel Pipeline in the Pittsburgh, PA, area.

¶Can deliver to Arco's line at Youngstown, OH, that pumps to Steubenville, OH. See Table 16, Page D-34.

**Can receive from Buckeye and Ashland Pipeline in the Pittsburgh, PA, area. See Table 16, Page D-34.

††This line is reversible (see above on Page D-19). Normal flow is from west to east.

§§Can deliver to the Buckeye line at Allentown, PA, that pumps to Auburn, NY.

¶¶This line is reversible. Normal flow is from east. Flowing west, the No. 2 capacity is 14.

***Can deliver to Buckeye Pipeline at Syracuse, NY.

†††Not shown on maps due to space limitations.

G Capacity for pumping gasoline.
M Capacity for pumping average mix of products.
N Capacity for pumping No. 2 fuel oil.
NR Not Reported.

TABLE 10

Common Carrier Products Pipeline Capacities
Williams and Parallel Lines
(MB/D - As of December 31, 1978)

(PAD 2W)

Legend	
(GA) - Gathering Area	(R) - Refinery
(PL) - Pipeline Terminal	(W) - Water Terminal

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity No. 2	Gasoline	Mix	Maximum Economic Capacity
Flow N & E									
2W	2W	Tulsa, OK	R,PL	Barnsdall, OK	Williams	181E	NR	201	NR
		Cushing, OK	R,PL	Barnsdall, OK	Arco***	23E	NR	25	Max
					Net Segment	204		226	
		Cushing, OK	PL	Kansas City Area	Amoco	30	NR	NR	Max
		Enid, OK	R	Ponca City, OK	Williams	17E	NR	19	NR
		Arkansas City, KS	R	Ponca City, OK	Williams	29E	NR	32	NR
		Ponca City, OK	R,PL	Barnsdall, OK	Williams	108E	NR	120	NR
(Central Lines)		Barnsdall, OK	PL	Coffeyville, KS	Williams	206E	NR	229	NR
		" "	"	Coffeyville, KS	Arco	23E	NR	25	Max
					Net Segment	229		254	
		Barnsdall, OK	PL	El Dorado, KS	Williams*	108E	NR	120	NR
		Coffeyville, KS	R,PL	Humboldt, KS	Williams	240E	NR	267	NR
		" "	"	Humboldt, KS	Arco	23E	NR	25	Max
					Net Segment	263		292	
		El Dorado, KS	R,PL	Humboldt, KS	Williams	29E	NR	32	NR
		Humboldt, KS	PL	Springfield, MO	Williams	23E	NR	25	NR
		Humboldt, KS	PL	Kansas City Area	Williams	240E	NR	267	NR
		" "	"	" "	Arco	23E	NR	25	Max
					Net Segment	263		292	
		Kansas City Area	R,PL	Des Moines, IA	Williams	200E	NR	221	NR
		Kansas City Area	R,PL	Atchison, KS	Williams*	108E	NR	120	NR
		Atchison, KS*	PL	Des Moines, IA	Williams	108E	NR	120	NR

TABLE 10 (continued)

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity No. 2	Gasoline	Mix	Maximum Economic Capacity
Flow N & E									
2W	2W	Des Moines, IA	PL	Roland, IA	Williams	92E	NR	102	NR
		Roland, IA	PL	Ft. Dodge, IA	Williams	10E	NR	11	NR
		Roland, IA	PL	Mason City, IA	Williams	82E	NR	91	NR
		Mason City, IA	PL	Albert Lee, MN	Williams	76E	NR	84	NR
		Albert Lee, MN	PL	Mankato, MN	Williams	13E	NR	14	NR
		Albert Lee, MN	PL	Minneapolis, MN	Williams	76E	NR	84	NR
		Minneapolis, MN	R,PL	Duluth-Superior Area	Williams†	27E	NR	34	NR
		Minneapolis, MN	R,PL	Willmar, MN	Williams*	40E	NR	44	NR
(Western Lines)		El Dorado-Wichita Area	R,PL	Topeka, KS	Williams	161E	NR	179	NR
			"	" "	Mobil	24E	NR	27	NR
					Net Segment	185		206	
		El Dorado-Wichita Area	R,PL	Kansas City Area	Phillips	104	130	NR	Max
		Topeka, KS	PL	Kansas City Area	Williams§	53E	NR	59	NR
		" "	"	Kansas City Area	Mobil	22E	NR	25	NR
					Net Segment	75		84	
Flow N									
2W	2W	Topeka, KS	PL	Omaha, NE	Mobil	18E	NR	20	NR
		Topeka, KS	PL	Atchison, KS	Williams	108E	NR	120	NR
		Atchison, KS	PL	Nebraska City, NE	Williams	108E	NR	120	NR
		Nebraska City, NE	PL	Doniphan, NE	Williams¶	28E	NR	31	NR
		Nebraska City, NE	PL	Omaha, NE	Williams	91E	NR	101	NR
		Omaha, NE	PL	Sioux City, IA	Williams	88E	NR	98	NR
		" "	"	" "	Mobil	13E	NR	14	NR
					Net Segment	101		112	

TABLE 10 (continued)

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity No. 2	Gasoline	Mix	Maximum Economic Capacity
Flow N									
2W	2W	Sioux City, IA	PL	Milford, IA	Williams	10E	NR	11	NR
		Sioux City, IA	PL	Sioux Falls, SD	Williams	84E	NR	93	NR
		" "	"	" "	Mobil**	13E	NR	14	NR
					Net Segment	97		107	
		Sioux Falls, SD	PL	Marshall, MN	Williams	30E	NR	34	NR
		Marshall, MN	PL	Watertown, SD	Williams	10E	NR	11	NR
		Marshall, MN	PL	Willmar, MN	Williams§	30E	NR	34	NR
		Willmar, MN	PL	Alexandria, MN	Williams	70E	NR	78	NR
		Alexandria, MN	PL	Fargo, ND	Williams	37E	NR	41	NR
		Fargo, ND	PL	Grand Fork, ND	Williams	22E	NR	24	NR
Flow E (Lines to East)									
2W	2E	Minneapolis, MN	R,PL	Wausau, WI	Williams	22E	NR	24	NR
2W	2W	Minneapolis, MN	R,PL	Rochester, MN	Williams	12E	NR	15	NR
		Des Moines, IA	PL	Waterloo, IA	Williams	14E	NR	15	NR
		Des Moines, IA	PL	Iowa City, IA	Williams	82E	NR	91	NR
		Iowa City, IA	PL	Dubuque, IA	Williams	11E	NR	12	NR
		Iowa City, IA	PL	Bettendorf, IA	Williams	59E	NR	65	NR

TABLE 10 (continued)

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity No. 2	Gasoline	Mix	Maximum Economic Capacity
Flow E (Lines to East)									
2W	2E	Bettendorf, IA	PL	Middlebury, IL	Williams[††]	43E	NR	48	NR
2E	2E	Middlebury, IL	PL	Chicago, IL	Williams	39E	NR	43	NR
2W	2W	Kansas City Area	R,PL	Carrollton, MO	Arco[†]	23E	NR	25	NR
2W	2E	Carrollton, MO	PL	Wood River, IL	Arco[†]	14E	NR	15	Max
2W	2W	Carrollton, MO	PL	Ft. Madison, IA	Arco[†,§§]	14E	NR	15	NR
		Kansas City Area	R,PL	Columbia, MO	Williams	32E	NR	36	NR
		" "	"	Jefferson City, MO	Phillips[¶¶]	90E	113	NR	NR
					Net Segment	122			
		Columbia, MO	PL	Palmyra, MO	Williams	11E	NR	12	NR
		Columbia, MO	PL	St. Louis, MO	Williams	21E	NR	23	NR
		Jefferson City, MO	PL	Wood River, IL	Phillips[¶¶]	90E	113	NR	NR
					Net Segment	111			

[*] Connects to Williams' western lines.
[†] Line segment is reversible.
[§] Connects to Williams' central lines.
[¶] Connects with Kaneb Pipeline at McCool, NE.
[**] Connects with Kaneb Pipeline at Hawarden, IA.
[††] Connects with Badger Pipeline at Middlebury, IL.
[§§] Connects with Arco line from E. Chicago, IN. See Table 14, Page D-31.
[¶¶] Phillips System begins on Table 11, Page D-26 and continues on Table 8, Page D-17.
[***] This Arco line continues from Table 12, Page D-27.
NR Not Reported.

TABLE 11

Common Carrier Products Pipeline Capacities
Phillips-Kaneb-Chase and Parallel Cherokee Lines
(MB/D - As of December 31, 1978)

(PAD 2W)

Legend	
(GA) - Gathering Area	(R) - Refinery
(PL) - Pipeline Terminal	(W) - Water Terminal

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity No. 2	Gasoline	Mix	Maximum Economic Capacity
Flow N & E									
3	2W	Borger, TX	R	Wichita, KS	Phillips	113E	141	NR	Max
2W	2W	Wichita, KS	PL	Kansas City Area	Phillips*	104E	130	NR	NR
Flow N									
2W	2W	Tulsa, OK	PL	Cushing, OK	Cimarron	28E	30	NR	Max
		Cushing, OK	PL	El Dorado, KS	Getty	28E	30	NR	Max
		Ponca City, OK	R	Arkansas City, KS	Cherokee†	28E	NR	NR	NR
		Arkansas City, KS	R,PL	Wichita, KS	Cherokee†	16E	NR	19	Max
		" "	"	El Dorado, KS	Kaneb§	29E	36	NR	Max
					Net Segment	45			
		El Dorado, KS	R,PL	McPherson, KS	Kaneb¶	93E	116	NR	Max
		McPherson, KS	R,PL	Geneva, NE	Kaneb¶	60E	74	NR	Max
		Phillipsburg, KS	R	Geneva, NE	Kaneb¶	8E	10	NR	Max
		Geneva, NE	PL	Yankton, SD	Kaneb¶,**	47E	59	NR	Max
		Yankton, SD	PL	Milford, IA	Kaneb¶,††	14E	17	NR	Max
		Yankton, SD	PL	Wolsey, SD	Kaneb¶	20E	25	NR	Max
		Wolsey, SD	PL	Jamestown, ND	Kaneb¶	13E	16	NR	Max
Flow W									
2W	4	El Dorado, KS	R,PL	Denver, CO	Chase§§	40	51	49	65 G

*Phillips System continues on Table 10, Page D-25.
†Can deliver to Kaneb at Arkansas City or Wichita, KS.
§Can receive from Phillips Pipeline at El Dorado, KS.
¶Line segment is reversible.
**Can receive from Williams Pipeline at McCool, NE.
††Can deliver and receive from Mobil Pipeline at Hawarden, IA; this line is reversible.
§§Can receive from Cimarron and Williams Pipelines at El Dorado, KS.
G Capacity for pumping gasoline.
NR Not Reported.

TABLE 12

Common Carrier Products Pipeline Capacities
Arco, Cherokee, Sun and Short Oklahoma Lines
(MB/D - As of December 31, 1978)

(PAD 2W)

Legend

(GA) - Gathering Area (R) - Refinery
(PL) - Pipeline Terminal (W) - Water Terminal

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity No. 2	Gasoline	Mix	Maximum Economic Capacity
Flow N									
3	2W	Dallas-Ft. Worth Area	PL	Ardmore, OK	Arco*	23E	NR	25	NR
2W	2W	Ardmore, OK	R,PL	Cushing, OK	Arco*	47E	NR	51	NR
Flow S									
2W	2W	Ponca City, OK	R	Tulsa, OK	Cherokee†	84E	NR	99	NR
		Ponca City, OK	R	Oklahoma City, OK	Cherokee	29	NR	34	NR
2W	3	Oklahoma City, OK	PL	Wichita Falls, TX	Cherokee§	20	NR	24	NR
Flow E									
3	2W	Wichita Falls, TX	PL	Duncan, OK	River¶	11E	NR	12	24 M
2W	2W	Duncan, OK	R,PL	Wynnewood, OK	Sun	59	68	66	84 G
		Wynnewood, OK	R,PL	Allen, OK	Sun	73E	84	NR	Max
2W	3	Allen, OK	PL	Ft. Smith, AR	Sun	67E	75	NR	84 G
3	3	Ft. Smith, AR	PL	Conway-Little Rock Area	Sun**	56E	63	NR	84 G
		Conway, AR	PL	W. Memphis, AR	Sun	56E	63	NR	84 G

TABLE 12 (continued)

Direction of Flow PAD District		Line Segment							
		Origin				12/31/78 Average Capacity			Maximum Economic Capacity
From	To	Name	Type	Destination	Pipeline Company	No. 2	Gasoline	Mix	
Flow N									
2W	2W	Wynnewood, OK	R	Oklahoma City	Mobil	5E	6	NR	NR
		Allen, OK	PL	Cushing, OK	Sun[††,¶¶]	24E	27	NR	NR
		Tulsa, OK	R	Ponca City, OK	Texaco-Cities Service[§§]	8E	10	NR	NR

*Arco System begins on Table 18, Page D-37, D-38, and continues on Table, Page D-22.
†Cherokee System to the east is continued on Table 8, Page D-17. Can deliver to Sun and Explorer Pipelines at Tulsa, OK.
§Can deliver to Utilities Pipeline at Wichita Falls, TX. See Table 17, Page D-36.
¶Can receive from Trust Pipeline at Wichita Falls, TX, and deliver to Sun Pipeline at Duncan, OK.
**Can deliver to TET at McRae, AR.
††Connected to Williams and Arco Pipelines at Cushing, OK.
§§Can deliver to Cherokee Pipeline at Ponca City, OK.
¶¶Line segment is reversible.

G Capacity for pumping gasoline.
M Capacity for pumping average mix of products.
NR Not Reported.

TABLE 13

Common Carrier Products Pipeline Capacities
Marathon and Buckeye Lines
in Indiana and Illinois
(MB/D - As of December 31, 1978)

(PAD 2E)

Legend	
(GA) - Gathering Area	(R) - Refinery
(PL) - Pipeline Terminal	(W) - Water Terminal

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity No. 2	Gasoline	Mix	Maximum Economic Capacity
Flow N & E									
2E	2E	Wood River, IL	R,PL	Champaign, IL	Marathon*	90	102	94	Max
		Wood River, IL	R,PL	Indianapolis, IN	Marathon†	48	54	50	Max
		Robinson, IL	R	Indianapolis, IN	Marathon	48	54	50	Max
		" "	R	" "	Buckeye	18E	22	NR	Max
					Net Segment	66	76		
		Robinson, IL	R	Champaign, IL	Marathon§	90	102	94	Max
		Champaign, IL	PL	Chicago Area	Marathon¶	90	102	94	Max
Flow S & E									
2E	2E	Robinson-Lawrenceville Area	R	Louisville, KY	Marathon	62	70	66	130 M
		Robinson-Lawrenceville Area		Mt. Vernon, IN	Texas	58E	72	NR	NR
Flow E									
2E	2E	Indianapolis, IN	PL	Lima, OH	Marathon	48	54	50	Max
		" "	"	" "	Buckeye	15E	19	NR	Max
					Net Segment	63	73		

TABLE 13 (continued)

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity No. 2	Gasoline	Mix	Maximum Economic Capacity
Flow E									
2E	2E	Chicago Area	R,PL	Huntington, IN	Buckeye	37E	46	NR	Max
		Huntington, IN	PL	Lima, OH	Buckeye	37E	46	NR	Max
Flow W									
2E	2E	Lima, OH	R,PL	Huntington, IN	Buckeye	18E	23	NR	NR
		Huntington, IN	PL	Indianapolis, IN	Buckeye	17E	21	NR	NR

*Can receive from Cherokee and Explorer Pipelines at Wood River, IL.
†Can receive from Phillips and Explorer Pipelines at Wood River, IL; can deliver to TET and Buckeye at Indianapolis.
§Interconnects with Marathon Pipeline's Wood River to Indianapolis Line at Martinsville, IL.
¶Can deliver to Arco, Badger, Buckeye, Marathon, West Shore, and Wolverine Pipelines in the Chicago, IL, area.

M Capacity for pumping average mix of products.
NR Not Reported.

TABLE 14

Common Carrier Products Pipeline Capacities
Chicago Area Origin Lines
(MB/D - As of December 31, 1978)

(PAD 2E)

Legend	
(GA) - Gathering Area	(R) - Refinery
(PL) - Pipeline Terminal	(W) - Water Terminal

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity No. 2	Gasoline	Mix	Maximum Economic Capacity
Flow N & W									
2E	2E	Chicago Area	R,PL	Milwaukee, WI	West Shore	176	NR	NR	Max
		Milwaukee, WI	PL	Green Bay, WI	West Shore	58	NR	NR	108 N
		Chicago Area	R,PL	Rockford, IL	Badger	90	NR	103	120 N*
		Rockford, IL	PL	Madison, WI	Badger	90	NR	103	120 N*
		Middlebury, IL	PL	Peru, IL	Badger†	28E	NR	31	NR
2E	2W	Chicago Area	R,PL	Bettendorf, IO	Williams	7E	NR	8	NR
		Chicago Area	R,PL	Ft. Madison, IO	Arco§	21E	NR	22	NR
Flow N & E									
2E	2E	Chicago Area	R, PL	South Bend, IN	Arco	32	NR	NR	Max
		" "	" "	Niles, MI	Wolverine	232E	NR	252	Max
					Net Segment	264			
		Chicago Area	R,PL	Muskegon, MI	Marathon	28	34	32	50 M
		Niles, MI	PL	Grand Haven, MI	Wolverine	23E	NR	25	NR
					Net Segment	51		57	
		South Bend, IN	PL	Toledo, OH	Arco	32	NR	NR	Max
		Niles, MI	PL	Freedom Junction, MI	Wolverine	158E	NR	172	Max
		Freedom Junction, MI	PL	Toledo, OH	Wolverine	158E¶	NR	172	Max
		Freedom Junction, MI	PL	Detroit, MI	Wolverine	158E¶	NR	172	Max

*Scheduled expansion by December 1979.
†Receives from Williams Pipeline at Middlebury, IL. See Williams line below and on Table 10, Page D-25.
§Connects at Ft. Madison with Arco Line from Carrollton, MO. See Table 10, Page D-25.
¶Figures represent full line capacity to either Toledo, OH, or Detroit, MI.

M Capacity for pumping average mix of product.
N Capacity for pumping No. 2 Fuel Oil.
NR Not Reported.

TABLE 15

Common Carrier Products Pipeline Capacities
Eastern Michigan Lines
(MB/D - As of December 31, 1978)

(PAD 2E)

Legend	
(GA) - Gathering Area	(R) - Refinery
(PL) - Pipeline Terminal	(W) - Water Terminal

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity No. 2	Gasoline	Mix	Maximum Economic Capacity
Flow N									
2E	2E	Toledo, OH	R,PL	Detroit, MI	Arco	17	NR		NR
					Buckeye	97E	121	NR	Max
					Sun*	60E	NR	62	Max
					Net Segment	174			
		Detroit, MI	R,PL	Bay City, MI	Buckeye	36E	45	NR	Max
		Alma, MI	R	Bay City, MI	Mich-Ohio	20	24	23	30 G
Flow S									
2E	2E	Alma, MI	R	Lansing, MI	Mich-Ohio	16	20	19	Max
International		Sarnia, Canada	R	Detroit, MI	Sun†	28E	NR	30	Max
2E	2E	Detroit, MI	PL	Toledo, OH	Sun†	28E	NR	30	Max
		" "	R,PL	Toledo, OH	Buckeye	46E	57	NR	Max
					Net Segment	74			

*Line Segment is reversible. Normal flow is from south to north.
†Line segment is reversible. Normal flow is from north to south.

G Capacity for pumping gasoline.
NR Not Reported.

TABLE 16

Common Carrier Products Pipeline Capacities
Buckeye and Other Ohio Lines
(MB/D - As of December 31, 1978)

(PAD 2E)

Legend

(GA) - Gathering Area
(PL) - Pipeline Terminal
(R) - Refinery
(W) - Water Terminal

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity No. 2	Gasoline	Mix	Maximum Economic Capacity
Flow S									
2E	2E	Toledo, OH	R,PL	Cygnet, OH	Buckeye	90E	112	NR	Max
		" "	"	Fostoria, OH	Sun	42E	NR	45	Max
					Net Segment	132			
		Toledo, OH	R,PL	Marion, OH	Arco	17	NR	NR	NR
		Marion, OH	PL	Columbus, OH	Arco	17	NR	NR	NR
		Cygnet, OH	PL	Lima, OH	Buckeye	32E	40	NR	Max
		Lima, OH	R,PL	Columbus, OH	Buckeye¶	32E	40	NR	Max
Flow N									
2E	2E	Lima, OH	R,PL	Cygnet, OH	Buckeye¶	88E	110	NR	137 G
		Cygnet, OH	PL	Toledo, OH	Buckeye	88E	110	NR	137 G
Flow E									
2E	2E	Toledo, OH	R, PL	Sandusky, OH	Buckeye	83E	104	NR	Max
		Cygnet, OH	PL	Norwalk, OH	Buckeye	74E	92	NR	114 G
		Fostoria, OH	PL	Norwalk, OH	Sun	42E	NR	45	Max
					Net Segment	116			
		Sandusky, OH	PL	Cleveland, OH	Buckeye	83E	104	NR	Max
		Norwalk, OH	PL	Aurora, OH	Buckeye	74E	92	NR	114 G
		" "	"	Hudson, OH	Sun	42E	NR	45	Max
					Net Segment	199			

TABLE 16 (continued)

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity No. 2	Gasoline	Mix	Maximum Economic Capacity
Flow E									
2E	2E	Marion, OH	PL	Akron, OH	Arco	17	NR	NR	NR
		Akron, OH	PL	Youngstown, OH	Arco	17	NR	NR	NR
		Aurora, OH	PL	Niles, OH	Buckeye	41E	51	NR	NR
		Hudson, OH	PL	Youngstown, OH	Sun	45E	NR	47	65 M
					Net Segment	103			
2E	1	Niles, OH	PL	Pittsburgh Area	Buckeye†	37E	46	NR	NR
		Youngstown, OH	PL	Pittsburgh Area	Sun	45E	NR	47	65 M
					Net Segment	82			
		Canton, OH	R	Pittsburgh Area	Ashland†,§	30E	37	NR	Max
Flow S									
2E	2E	Youngstown, OH	PL	Steubenville, OH	Arco*	12	NR	NR	NR
		Canton, OH	R	Newark, OH	Ashland	13E	16	NR	Max
		Newark, OH	PL	Dayton, OH	Ashland	14E	17	NR	23 G

*Can receive from Laurel Pipeline at Youngstown, OH.

†Can deliver to Mobil Pipeline in the Pittsburgh, PA, area.

§Connects to Buckeye Pipeline at Rogers, OH. Line is reversible. Normal flow is west to east.

¶Can receive at Lima, OH, from Texas Eastern-Buckeye line (Table 7, Page D-16) and Buckeye lines from Indianapolis and Huntington, IN.

G Capacity for pumping gasoline.
M Capacity for pumping average mix of products.
NR Not Reported.

TABLE 17

Common Carrier Products Pipeline Capacities
West Texas - New Mexico Lines
(MB/D - As of December 31, 1978)

(PAD 3)

Legend	
(GA) - Gathering Area	(R) - Refinery
(PL) - Pipeline Terminal	(W) - Water Terminal

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity No. 2	Gasoline	Mix	Maximum Economic Capacity
Flow N									
3	2W	Borger, TX	R	Wichita, KS	Phillips	113E	(see Table 11, Page D-29)		
		Sheerin (McKee), TX	R	Turpin, OK	Emerald	8E	NR	11	17 M
3	4	Borger-Sheerin Area	R	Denver, CO	Phillips	37	NR	NR	Max
Flow W & S									
3	3	Borger, TX	R	Amarillo, TX	Phillips*	16E	20	NR	Max
		Sheerin (McKee), TX	R	Amarillo, TX	Shamrock†	19E	NR	23	27 M
					Net Segment	35			
		Amarillo, TX	R,PL	Lubbock, TX	Shamrock	16E	NR	19	NR
		Amarillo, TX	R,PL	Tucumcari, NM	W. Emerald	18E	NR	19	25 M
		Tucumcari, NM	PL	Albuquerque, NM	W. Emerald	13E	NR	14	25 M
3	4	El Paso, TX	R	Tucson, AZ	So. Pacific§	57	68	59	178 M
Flow N									
3	3	El Paso, TX	R	Albuquerque, NM	Chevron	20E	NR	22	Max
Flow E									
3	3	El Paso, TX	R	Midland, TX	Chevron	7E	NR	8	40 M
		Big Spring, TX	R	Abilene, TX	Trust	11E	NR	12	Max

TABLE 17 (continued)

Direction of Flow PAD District		Line Segment				12/31/78 Average Capacity			Maximum Economic Capacity
		Origin							
From	To	Name	Type	Destination	Pipeline Company	No. 2	Gasoline	Mix	
Flow E									
3	3	Abilene, TX	R,PL	Wichita Falls, TX	Trust[¶]	11E	NR	12	Max
		Wichita Falls, TX	PL	Dallas-Ft. Worth Area	Utilities[**]	10	NR	15	20N
Flow W									
3	3	Big Spring, TX	R	Midland, TX	Gulf	13E	NR	15	Max

[*] Can deliver to Shamrock and W. Emerald Pipelines at Amarillo, TX.
[†] Can deliver to W. Emerald Pipeline at Amarillo, TX.
[§] Continued on Table 20, Page D-42.
[¶] Can deliver to River (see Table 12, Page D-27) and Utilities Pipelines.
[**] Can receive from Cherokee Pipeline (see Table 12, Page D-27) and Trust Pipeline at Wichita Falls, TX.

M Capacity for pumping average mix of products.
N Capacity for pumping No. 2 fuel oil.
NR Not Reported.

TABLE 18

Common Carrier Products Pipeline Capacities
South and Central Texas Lines
(MB/D - As of December 31, 1978)

(PAD 3)

Legend

(GA) - Gathering Area (R) - Refinery
(PL) - Pipeline Terminal (W) - Water Terminal

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity No. 2	Gasoline	Mix	Maximum Economic Capacity
Flow S									
3	3	Corpus Christi, TX	R	McAllen, TX	Coastal States	4E	6	5	Max
Flow N & W									
3	3	Corpus Christi, TX	R	Tilden, TX	Mobil*	9	NR	NR	NR
		Corpus Christi, TX	R	San Antonio, TX	Casa¶	12	15	14	Max
					Coastal States	23	28	26	Max
					Mobil	5E	6	NR	Max
					Net Segment	40	49		
		Corpus Christi, TX	R	Austin, TX	Casa¶	19	25	22	Max
		Corpus Christi, TX	R	Houston Area	Coastal States	65	(see Table 6, Page D-12)		
		Houston Area	R	Luling, TX	Exxon	19E	23	NR	NR
		Luling, TX	PL	Austin, TX	Exxon	19E	23	NR	NR
		Luling, TX	PL	San Antonio, TX	Exxon	19E	23	NR	NR
		Houston Area	R	Hearne, TX	Arco	44E	NR	47	Max
		" "	R	Hearne, TX	Exxon	23E	34	NR	NR
		" "	PL	Hearne, TX	Mobil†	53E	NR	71	Max
					Net Segment	120			

TABLE 18 (continued)

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity No. 2	Gasoline	Mix	Maximum Economic Capacity
Flow N & W									
3	3	Hearne, TX	PL	Dallas-Ft. Worth Area	Arco§	44E	NR	47	Max
					Exxon	23E	28	NR	NR
					Texas	53E	66	NR	NR
					Net Segment	120			
		Hearne, TX	PL	Austin, TX	Texas	20E	24	NR	NR
		Austin, TX	PL	San Antonio, TX	Texas	10E	12	NR	NR
		Beaumont, TX	R	Marshall, TX	Mobil	14E	NR	17	Max
		Beaumont, TX	R	Lufkin, TX	Gulf	48	55	52	63 G
		Lufkin, TX	PL	Longview, TX	Gulf	15E	19	NR	NR
		Lufkin, TX	PL	Dallas-Ft. Worth Area	Gulf	38E	44	NR	NR
		Dallas-Ft. Worth Area	PL	Eastland, TX	Gulf	26E	30	NR	NR

*This line is reversible. Capacity east is 13.
†Can deliver to Texas Pipeline at Hearne, TX.
§This line continues on Table 12, Page D-27.
¶Undivided interest pipeline system.

G Capacity for pumping gasoline.
NR Not Reported.

TABLE 19

Common Carrier Products Pipeline Capacities
Rocky Mountain Lines
(MB/D - As of December 31, 1978)

(PAD 4)

Legend

(GA) - Gathering Area (R) - Refinery
(PL) - Pipeline Terminal (W) - Water Terminal

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity No. 2	Gasoline	Mix	Maximum Economic Capacity
Flow E									
4	4	Billings, MT	R	Glendive, MT	Cenex	19	24	22	30 M
Flow W									
4	4	Billings, MT	R	Bozeman, MT	Yellowstone	54E	NR	60	Max
		Bozeman, MT	PL	Helena, MT	Yellowstone	50E	NR	56	Max
		Helena, MT	PL	Great Falls, MT	Yellowstone	13E	NR	14	Max
4	5	Helena, MT	PL	Spokane, WA	Yellowstone	50E	NR	56	Max
5	5	Spokane, WA	PL	Moses Lake, WA	Yellowstone*	8E	NR	9	NR
Flow S									
4	4	Billings, MT	R	Sheridan, WY	Continental	32E	NR	35	NR
		Sheridan, WY	PL	Casper, WY	Continental†	30E	NR	34	NR
		Casper, WY	R,PL	Sinclair, WY	Continental§	22E	NR	24	NR
		Casper, WY	R,PL	Cheyenne, WY	Wyco¶	61	NR	NR	96 N

TABLE 19 (continued)

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity No. 2	Gasoline	Mix	Maximum Economic Capacity
Flow E									
4	3W	Casper, WY	R,PL	Rapid City, SD	Wyco	9	NR	NR	15 N
		Cheyenne, WY	R,PL	North Platte, NE	Cheyenne	16	21	17	Max
Flow S									
4	4	Cheyenne, WY	R,PL	Denver, CO	Wyco	43	NR	NR	Max
		Denver, CO	R,PL	Colorado Springs, CO	Wyco	11	NR	NR	15 N
		Sinclair, WY	R,PL	Denver, CO	Sinclair	14	20	NR	24 G
Flow W & N									
4	4	Sinclair, WY	R,PL	Rock Springs, WY	Pioneer	35E	NR	38	NR
		Rock Springs, WY	PL	Salt Lake City, UT	Pioneer**	32E	NR	35	NR
		Salt Lake City, UT	R,PL	Boise, ID	Chevron	59E	NR	64	80 M
4	5	Boise, ID	PL	Pasco, WA	Chevron	17E	NR	18	23 M
5	5	Pasco, WA	PL	Spokane, WA	Chevron††	15E	NR	16	18 M

*Can receive from Chevron Pipeline at Spokane, WA. See below.
†Can deliver to Wyco Pipeline at Casper, WY.
§Can deliver to Pioneer and Sinclair Pipelines at Sinclair, WY.
¶Can deliver to Cheyenne Pipeline at Cheyenne, WY.
**Can deliver to Chevron Pipeline at Salt Lake City, UT.
††Can deliver to Yellowstone Pipeline at Spokane, WA. See above.

G Capacity for pumping gasoline.
M Capacity for pumping average mix of products.
N Capacity for pumping No. 2 fuel oil.
NR Not Reported.

TABLE 20

Common Carrier Products Pipeline Capacities
West Coast and Arizona Lines
(MB/D - As of December 31, 1978)

(PAD 5)

Legend

(GA) - Gathering Area (R) - Refinery
(PL) - Pipeline Terminal (W) - Water Terminal

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity No. 2	Gasoline	Mix	Maximum Economic Capacity
Flow S									
5	5	Anacortes Cherry Pt, WA	R	Seattle, WA	Olympic	198E	NR	220	NR
		Seattle, WA	PL	Portland, OR	Olympic*	132E	NR	144	164 M
		Portland, OR	PL	Eugene, OR	Southern Pacific	29	39	34	55 M
		San Francisco Area	R	San Jose, CA	Southern Pacific	55	72	68	90 M
		San Francisco Area	R	Stockton, CA	Southern Pacific	65	74	71	88 M
		Stockton, CA	PL	Atwater, CA	Southern Pacific	14	NR	14	NR
Flow E & N									
5	5	San Francisco Area	R	Sacramento, CA	Southern Pacific	78	93	90	154 M
		Stockton, CA	PL	Sacramento, CA	Southern Pacific	65	74	71	88 M
		Sacramento, CA	PL	Chico, CA	Southern Pacific	25	30	28	57 M
		Sacramento, CA	PL	Reno, NV	Southern Pacific	22	30	25	Max
		Bakersfield, CA	R	Fresno, CA	Southern Pacific	23	30	28	57 M

TABLE 20 (continued)

Direction of Flow PAD District		Line Segment				12/31/78 Average Capacity			Maximum Economic Capacity
		Origin							
From	To	Name	Type	Destination	Pipeline Company	No. 2	Gasoline	Mix	
Flow S									
5	5	Los Angeles Area	R	San Diego, CA	San Diego	62	79	75	90 M
Flow E									
5	5	Los Angeles Area	R	Colton, CA	Southern Pacific	178	246	194	Max
		Colton, CA	PL	Barstow, CA	Calnev	55	70	60	90 M
		Barstow, CA	PL	Las Vegas, NV	Calnev	46E	NR	50	NR
		Colton, CA	PL	Niland, CA	Southern Pacific	87	110	96	123 M
		Niland, CA	PL	Imperial, CA	Southern Pacific	18	21	20	32 M
		Niland, CA	PL	Phoenix, AZ	Southern Pacific	87	110	96	123 M
		Phoenix, AZ	PL	Tuscon, AZ	Southern Pacific	8	11	9	32 M
Flow W									
5	5	Tucson, AZ	PL	Phoenix, AZ	Southern Pacific†	38	NR	40	NR

*Can deliver to Southern Pacific Pipeline at Portland, OR.
†Can receive from Southern Pacific Line from El Paso, TX. See Table 17, Page D-35.

M Capacity for pumping average mix of product.
NR Not Reported.

LPG AND NGL PIPELINE MAP

LPG and NGL pipelines play a very important role in moving natural gas products from field gas plants or fractionation facilities to refineries or distribution terminals. LPG pipelines batch ethanes, propanes, butanes, and natural gasolines to distribution terminals or refineries where these products are used as fuel or blending materials to make gasolines or petrochemicals. NGL pipelines transport a commingled natural gas liquids stream from gas or oil field separation plants to a central fractionation plant where ethanes, propanes, butanes, and natural gasolines are separated for movement to market.

MAP

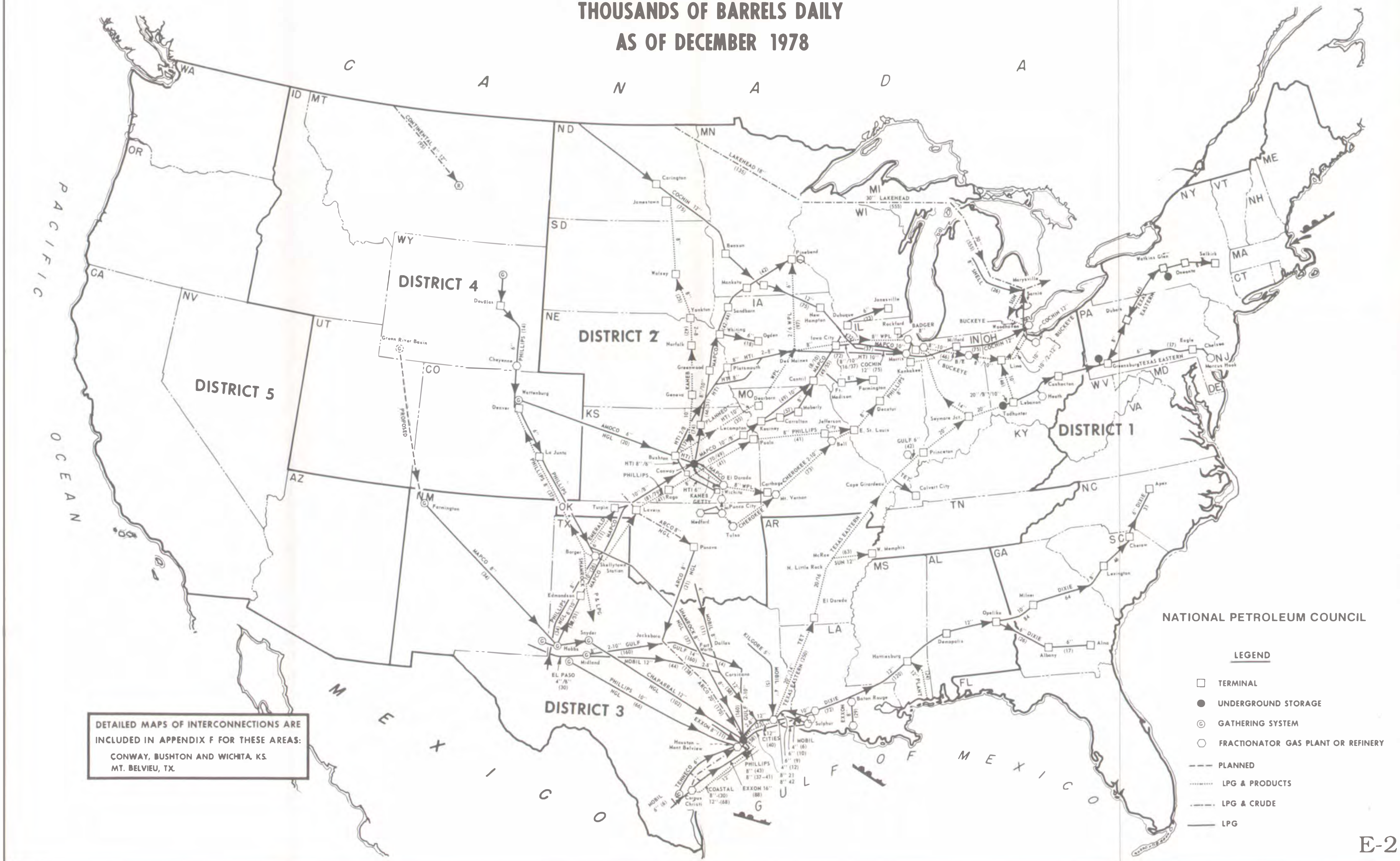
The common carrier LPG and NGL pipelines indicated on the map of the United States (Page E-2) contain the name, capacity, direction of flow, line size, and origin and destination for each line. Also, underground storage points are indicated. Some LPG and NGL is being imported and those ports are indicated by small tanker symbols.

All capacities indicated are annual average capacities as of December 31, 1978.

LPG AND NGL PIPELINE CAPACITIES

THOUSANDS OF BARRELS DAILY

AS OF DECEMBER 1978



TABLES

Tables 21-28 exhibit the following information for each pipeline system:

- Direction of flow
- PAD district of origin and destination by segment
- Name and state of origin and delivery location. Origin supply is indicated by GA for gathering area, R for refinery, PL for pipeline, W for water terminal, US for underground storage
- Name of pipeline company
- Basis for capacity data:

  - Products for products moving LPG/NGL
  - Crude for crude lines moving LPG/NGL
  - LPG/NGL for lines moving only these liquids

  Details for products and crude capacities can be found in the respective tables.

- The economic maximum capacity for each segment.

Cross-PAD Pipeline Capacities

The December 31, 1978, cross-PAD capacities for LPG/NGL are as follows:

PAD III to PAD I	MB/D
Dixie (Opelika, AL, to Milner, GA)	120
(Opelika, AL, to Albany, GA)	26
	146

PAD III to PAD II	
Texas Eastern (El Dorado, AR, to Cape Gerardeau, MO)	240[1]
Phillips (Borger, TX, to Rago, KS)	41[1]
MAPCO (Mocane, OK, to Conway, KS)	168
Emerald (Sheerin, TX, to Liberal, KS)	11[1]
	829

PAD III to PAD IV	
Phillips (Borger, TX, to Denver, CO)	37[1]

PAD II to PAD I	
Texas Eastern (Lebanon, OH, to Greensburg, PA)	44

PAD II to PAD III	
Mobil (Lone Grove, OK, to Corsicana, TX)	11
Arco (Panova, OK, to Jacksboro, TX)	21
	32

PAD IV TO PAD III	
Phillips (Denver, CO, to Borger, TX)	20

PAD IV to PAD II	
Amoco (Wattenberg, CO, to Bushton, KS)	20

Imports by Pipeline

Canada to PAD II	MB/D
Lakehead (Edmonton, Canada, to Superior, WI)	135[2]
Cochin (Edmonton, Canada, to Toledo, OH)	75
Sun (Sarnia, Canada, to Toledo, OH)	30[1]
Amoco-Dome (Sarnia, Canada, to Marysville, MI)	35
Amoco-Dome (Sarnia, Canada, to St. Claire, MI)	35

[1]Combined product, LPG/NGL capacity.
[2]Combined crude, LPG/NGL capacity.

TABLE 21

Common Carrier LPG and NGL Pipeline Capacities
Dixie, Texas Eastern, MAPCO
(MB/D - As of December 31, 1978)

Legend

(GA) - Gathering Area
(PL) - Pipeline Terminal
(R) - Refinery
(US) - Underground Storage
(W) - Water Terminal

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity Products*	Crude†	LPG/NGL	Maximum Economic Capacity
Flow E & N									
3	3	Mont Belvieu, TX	US	Sulphur, LA	Dixie	-	-	58	Max
		Sulphur, LA	PL	Egan, LA	Dixie	-	-	72	Max
		Egan, LA	PL	Breaux Bridge, LA	Dixie	-	-	82	Max
		Breaux Bridge, LA	PL	Opelika, AL	Dixie	-	-	120	Max
3	1	Opelika, AL	PL	Milner, GA	Dixie	-	-	120	Max
		Milner, GA	PL	Lexington, SC	Dixie	-	-	NR	Max
		Lexington, SC	PL	Apex	Dixie	-	-	NR	Max
		Opelika, AL	PL	Albany, GA	Dixie	-	-	26	Max
		Albany, GA	PL	Alma, GA	Dixie	-	-	17	Max
Flow N & E									
3	3	Mont Belvieu, TX	US	Baytown, TX§	Texas Eastern	-	-	828	Max
		Houston, TX	PL	Baytown, TX	Texas Eastern	-	-	215	Max
		Baytown, TX	PL	Beaumont, TX	Texas Eastern	250-305	-	240	360¶
		Beaumont, TX	PL	El Dorado, AR	Texas Eastern	250-305	-	240	360¶
3	2	El Dorado, AR	PL	Cape Girardeau, MO	Texas Eastern	250-305	-	240	360¶

TABLE 21 (continued)

Direction of Flow PAD District		Line Segment							
		Origin				12/31/78 Average Capacity			Maximum Economic
From	To	Name	Type	Destination	Pipeline Company	Products[^]	Crude[†]	LPG/NGL	Capacity
Flow N & E									
2	2	Cape Girardeau, MO	PL	Lick Creek, IL	Texas Eastern	250-305	-	240	360[¶]
		Lick Creek, IL	PL	Calvert City, KY	Texas Eastern	-	-	50	-
		Lick Creek, IL	PL	Seymour, IN	Texas Eastern	250-305	-	240	360[¶]
		Seymour, IN	PL	Indianapolis, IN	Texas Eastern	75-85	-	96	120
		Indianapolis, IN	PL	Chicago, IL	Texas Eastern	75-85	-	80	120
		Seymour, IN	PL	Todhunter, OH	Texas Eastern	180-220	-	NR	-
		Todhunter, OH	US	Lebanon, OH	Texas Eastern	-	-	44	Max
		Lebanon, OH	PL	Lima, OH	Texas Eastern/ Buckeye	-	-	45	NR
2	1	Lebanon, OH	PL	Greensburg, PA	Texas Eastern	-	-	44	Max
2	2	Lebanon, OH	PL	Heath, OH	Texas Eastern	-	-	12	Max
1	1	Greensburg, PA	US	Watkins Glen, NY	Texas Eastern	-	-	44	Max
		Watkins Glen, NY	US	Selkirk, NY	Texas Eastern	-	-	44	Max
		Greensburg, PA	US	Marcus Hook, PA	Texas Eastern	-	-	17	Max
Flow NW to SE									
3	3	Farmington, NM	GA	Hobbs, TX	MAPCO	-	-	34	51

TABLE 21 (continued)

Direction of Flow		Line Segment							
PAD District		Origin				12/31/78 Average Capacity			Maximum Economic Capacity
From	To	Name	Type	Destination	Pipeline Company	Products*	Crude†	LPG/NGL	
Flow N & E									
3	3	Hobbs, TX	US,GA	Skellytown, TX	MAPCO	-	-	109	Max
3	2	Skellytown, TX	PL,US	Mocane, OK	MAPCO	-	-	129	Max
2	2	Mocane, OK	PL	Conway, KN	MAPCO	-	-	168	Max
Flow N									
2	2	Conway, KS	US	Greenwood, NE**	MAPCO	-	-	97	106††
		Greenwood, NE	PL	Whiting, IA**	MAPCO	-	-	98	106††
		Whiting, IA	PL	Sanborn, IA**	MAPCO	-	-	87	96††
		Whiting, IA	PL	Ogden, IA	MAPCO	-	-	NR	-
		Sanborn, IA	PL	Pine Bend, MN**	MAPCO	-	-	42	46††
Flow E & N									
2	2	Conway, KS	US	Kearney, MO	MAPCO	-	-	119	131
		Kearney, MO	PL	Moberly, MO	MAPCO	-	-	57	63
		Kearney, MO	PL	Cantril, IA	MAPCO	-	-	49	54
		Moberly, MO	PL	Cantril, IA	MAPCO	-	-	NR	-
		Cantril, IA	PL	Iowa City, IA	MAPCO	-	-	104	114
		Iowa City	PL	Farmington, IL	MAPCO	-	-	NR	-

TABLE 21 (continued)

Direction of Flow PAD District		Line Segment							
		Origin				12/31/78 Average Capacity			Maximum Economic
From	To	Name	Type	Destination	Pipeline Company	Products*	Crude†	LPG/NGL	Capacity
Flow E & N									
		Iowa City, IA	US	Clinton, IA	MAPCO	-	-	53	58
		Iowa City, IA	US	Dubuque, IA	MAPCO	-	-	32	35
		Clinton, IA	PL	Morris, IL	MAPCO	-	-	37	41
		Dubuque, IA	PL	Janesville, WI	MAPCO	-	-	23	25
Flow N & S									
2	2	Conway, KS	US	El Dorado, KS§	MAPCO	-	-	25	Max

*See products tables for capacity details.
†See crude tables for capacity details.
§Segment is reversible.
¶Expansion to 360 MB/D to be completed in late 1979.
**The 8" line is reversible.
††Expansion to maximum to be completed June 1979.

TABLE 22

Common Carrier LPG and NGL Pipeline Capacities
Phillips and Chapparal
(MB/D - As of December 31, 1978)

Legend

(GA) - Gathering Area
(PL) - Pipeline Terminal
(R) - Refinery
(US) - Underground Storage
(W) - Water Terminal

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity Products*	Crude†	LPG/NGL	Maximum Economic Capacity
Flow N & E									
3	2	Borger, TX	R,US	Rago, KS	Phillips	41§	-	-	Max
2	2	Rago, KS	PL	Paola, KS	Phillips	41§	-	-	Max
		Paola, KS	PL	E. St. Louis, IL	Phillips	41§	-	-	Max
		E. St. Louis, IL	PL	Chicago, IL	Phillips	41§	-	-	Max
3	4	Borger, TX	R,US	Denver, CO	Phillips	37	-	-	Max
3	3	Goldsmith, TX	GA	Borger, TX	Phillips	-	-	34	Max
3	3	Benedum, TX	GA	Sweeney, TX	Phillips	-	-	66	Max
3	3	Clemons, TX	US	Pasadena, TX¶	Phillips	-	-	37/41	Max
Flow E									
3	3	Borger, TX	R,US	Skellytown, TX	Phillips	-	-	26	55
Flow S & W									
3	3	Mont Belvieu, TX	US	Sweeney, TX	Phillips	-	-	43	Max

TABLE 22 (continued)

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity Products*	Crude†	LPG/NGL	Maximum Economic Capacity
Flow S									
4	4	McCulloch, WY	GA	Denver, CO	Phillips (Powder River)	-	-	14	Max
4	3	Denver, CO	PL	Borger, TX	Phillips	-	-	20	Max
Flow S & E									
3	3	Hobbs & Snyder, TX	GA,US, PL	Mont Belvieu, TX	Chapparal	-	-	102	NR

*See products tables for capacity details.
†See crude tables for capacity details.
§This is for the 8" line only.
¶Segment is reversible.

TABLE 23

Common Carrier LPG and NGL Pipeline Capacities
HTI, Kaneb, Williams, and Cherokee
(MB/D - As of December 31, 1978)

Legend

(GA) - Gathering Area
(PL) - Pipeline Terminal
(R) - Refinery
(US) - Underground Storage
(W) - Water Terminal

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity Products*	Crude†	LPG/NGL	Maximum Economic Capacity
Flow N & E									
2	2	Bushton, KS	US	Platsmouth, NE	HTI	-	-	117	Max
		Platsmouth, NE	PL	Des Moines, IA	HTI	-	-	117	Max
		Des Moines, IA	PL	Chicago, IL	HTI	-	-	72	Max
		Wichita, KS	R,PL	Bushton, KS	HTI	-	-		
		Bushton, KS	US	Conway, KS	HTI	-	-	107	Max
		Conway, KS	US,PL	Wichita, KS	HTI§	-	-		
Flow N									
2	2	Arkansas City, KS	PL	Wichita, KS	Kaneb	29-36	-	-	Max
		Wichita, KS	PL,R	Conway, KS	Kaneb	93-116	-	-	Max
		Conway, KS	PL,US	Norfolk, NE	Kaneb	60-74	-	-	Max
		Norfolk, NE	PL	Yankton, SD	Kaneb	47-59	-	-	Max
		Yankton, SD	PL	Wolsey, SD	Kaneb	20-25	-	-	Max
Flow N & E									
2	2	Des Moines, IA	PL	Pine Bend, MN	Williams	-	-	14	NR
		Des Moines, IA	PL	Chicago, IL	Williams	-	-	31	NR

TABLE 23 (continued)

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity Products*	Crude†	LPG/NGL	Maximum Economic Capacity
Flow S & E									
2	2	Wichita, KS	PL	Carthage, MO	Williams	31	-	31	NR
Flow E & N									
2	2	Medford, OK	GA	Ponca City, OK	Cherokee			90	NR
		Ponca City, OK	R	Medford, OK	Cherokee		-	9	NR
		Ponca City, OK	R	Tulsa, OK	Cherokee	96	-		Max
		Tulsa, OK	PL	E. St. Louis, IL (Wood River)	Cherokee	86	-		Max
		Ponca City, OK	R	Arkansas City, KS	Cherokee	33	-		Max

*See products tables for capacity details.
†See crude tables for capacity details.
§Segment is reversible.

TABLE 24

Common Carrier LPG and NGL Pipeline Capacities
Exxon, Mobil
(MB/D - As of December 31, 1978)

Legend	
(GA) - Gathering Area	(US) - Underground Storage
(PL) - Pipeline Terminal	(W) - Water Terminal
(R) - Refinery	

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity Products*	Crude†	LPG/NGL	Maximum Economic Capacity
3	3	Ingelside, TX	PL,W	Houston, TX	Exxon	-	99	-	NR
		Conroe, TX	R	Baytown, TX	Exxon	-	-	11-24	NR
		Garden City, LA	R	Baton Rouge, LA	Exxon	-	-	29	NR
		Midland, TX	GA	Corsicana, TX	Mobil	-	-	44	Max
		Lone Grove, TX	GA	Corsicana, TX	Mobil	-	-	11	Max
		Corsicana, TX	PL	Beaumont, TX	Mobil	-	-	75	Max
		Hull, TX	US	Mont Belvieu, TX	Mobil	-	-	50	Max
		Cameron, LA	R	Orange, TX	Mobil	-	-	6	Max
		Cameron, LA	R	Beaumont, TX	Mobil	-	-	10	Max
		Iowa, LA	R	Beaumont, TX	Mobil	-	-	9	Max
		Beaumont, TX	R	Orange, TX	Mobil	-	-	12	Max
		Kilgore, TX	GA	Beaumont, TX	Mobil	-	-	5	Max

*See products tables for capacity details.
†See crude tables for capacity details.

TABLE 25

Common Carrier LPG and NGL Pipeline Capacities
Amoco, Arco, Diamond Shamrock, Gulf, Coastal
(MB/D - As of December 31, 1978)

Legend

(GA) - Gathering Area
(PL) - Pipeline Terminal
(R) - Refinery
(US) - Underground Storage
(W) - Water Terminal

Direction of Flow PAD District		Line Segment Origin				12/31/78 Average Capacity			Maximum Economic Capacity
From	To	Name	Type	Destination	Pipeline Company	Products*	Crude†	LPG/NGL	
4	2	Wattenberg, CO	GA	Bushton, KS	Amoco	-	-	20	25
3	3	Hastings, TX	PL,GA	Chocalate Bayou, TX	Amoco	-	-	35	Max
		Texas City, TX	R	Bayport, TX	Amoco	-	-	33	Max
		Texas City, TX	R	Chocalate Bayou, TX	Amoco	-	-	126	Max
		Texas City, TX	R	Dickinson, TX	Amoco	-	-	5	Max
2	2	Harpers Ranch, KS							
		Lavern, OK	PL,GA	Panova, OK	Arco	-	-	25	40
2	3	Panova, OK	GA,PL	Jacksboro, TX	Arco	-	-	21	35
3	3	Jacksboro, TX	PL	Teague, TX	Arco	-	138	-	NR
		Teague, TX	PL	Houston, TX	Arco	-	170	-	NR
		Black Lake, LA	GA	Mont Belvieu, TX	Arco	-	32	-	40
		Sheerin, TX	GA, PL	Mont Belvieu, TX	Diamond Shamrock	-	-	37	50
		Sheerin, TX	R	Lubbock, TX	Diamond Shamrock	23	-	-	27
		West Texas	GA	Mont Belvieu, TX	Gulf	-	-	160	Max
		Galena Park, TX	W	Mont Belvieu, TX	Gulf§	-	-	360	480

TABLE 25 (continued)

Direction of Flow PAD District From	To	Line Segment Origin Name	Type	Destination	Pipeline Company	12/31/78 Average Capacity Products*	Crude†	LPG/NGL	Maximum Economic Capacity
2	2	Texas Eastern	PL	Crossville, IL	Gulf	-	-	42	Max
3	3	Corpus Christi, TX	W	Houston, TX	Coastal	65-78	-	-	Max
		Corpus Christi, TX	GA,R,PL	Houston, TX	Coastal	-	-	30	Max
		King Ranch-McAllen, TX	GA	Corpus Christi, TX	Coastal	-	-	12	Max

*See products tables for capacity details.
†See crude tables for capacity details.
§Segment is reversible.

TABLE 26

Common Carrier LPG and NGL Pipeline Capacities
Cities Service, El Paso, Plantation, Tenneco, Emerald
(MB/D - As of December 31, 1978)

Legend

(GA) - Gathering Area
(PL) - Pipeline Terminal
(R) - Refinery
(US) - Underground Storage
(W) - Water Terminal

Direction of Flow PAD District		Line Segment Origin				12/31/78 Average Capacity			Maximum Economic
From	To	Name	Type	Destination	Pipeline Company	Products*	Crude†	LPG/NGL	Capacity
3	3	Mont Belvieu, TX	US	Lake Charles, LA	Cities Service	-	-	40	Max
		West Texas, New Mexico	GA	Midland, TX	El Paso	-	-	21	NR
		Pascagoula, MS	R	Hattiesburg, MS	Plantation	24	-	-	90
		Kingsville and Corpus Christi, TX	GA	Houston, TX	Tenneco	-	-	19	Max
2	3	Sheerin, TX	R	Turpin, OK, and Liberal, KS	Emerald	11	-	-	17

*See products tables for capacity details.
†See crude tables for capacity details.

TABLE 27

Common Carrier LPG and NGL Pipeline Capacities
Badger, Buckeye, Sun, Shell, Getty
(MB/D - As of December 31, 1978)

Legend	
(GA) - Gathering Area	(US) - Underground Storage
(PL) - Pipeline Terminal	(W) - Water Terminal
(R) - Refinery	

Direction of Flow PAD District		Line Segment Origin				12/31/78 Average Capacity			Maximum Economic Capacity
From	To	Name	Type	Destination	Pipeline Company	Products*	Crude†	LPG/NGL	
2	2	Middlebury, IL	PL	Rockford, IL	Badger	-	-	46	Max
		Griffith, IN	US,PL	Huntington, IN, and Limo, OH	Buckeye	46	-	-	Max
		Lima, OH	PL	Toledo, OH	Buckeye	110	-	-	137
		Toledo, OH	PL	Detroit, MI	Buckeye	68	-	-	Max
		Wayne, MI	PL	Wood Haven, MI¶	Buckeye	68	-	-	Max
Import	2	Sarnia, Canada	R	Toledo, OH	Sun	30	-	-	Max
3	3	McRae Junction, AR	PL	West Memphis	Sun	56	-	-	84
2	2	Kalkaska, MI	GA	Marysville, MI	Shell	-	-	26	34
		El Dorado, KS	R	Conway, KS§	Getty	-	-	17/15	25/25

*See products tables for capacity details.
†See crude tables for capacity details.
§6" line is reversible.
¶Segment is reversible.

TABLE 28

Common Carrier LGP and NGL Pipeline Capacities
Import Lines - Cochin, Lakehead, Sun
(MB/D - As of December 31, 1978)

Legend

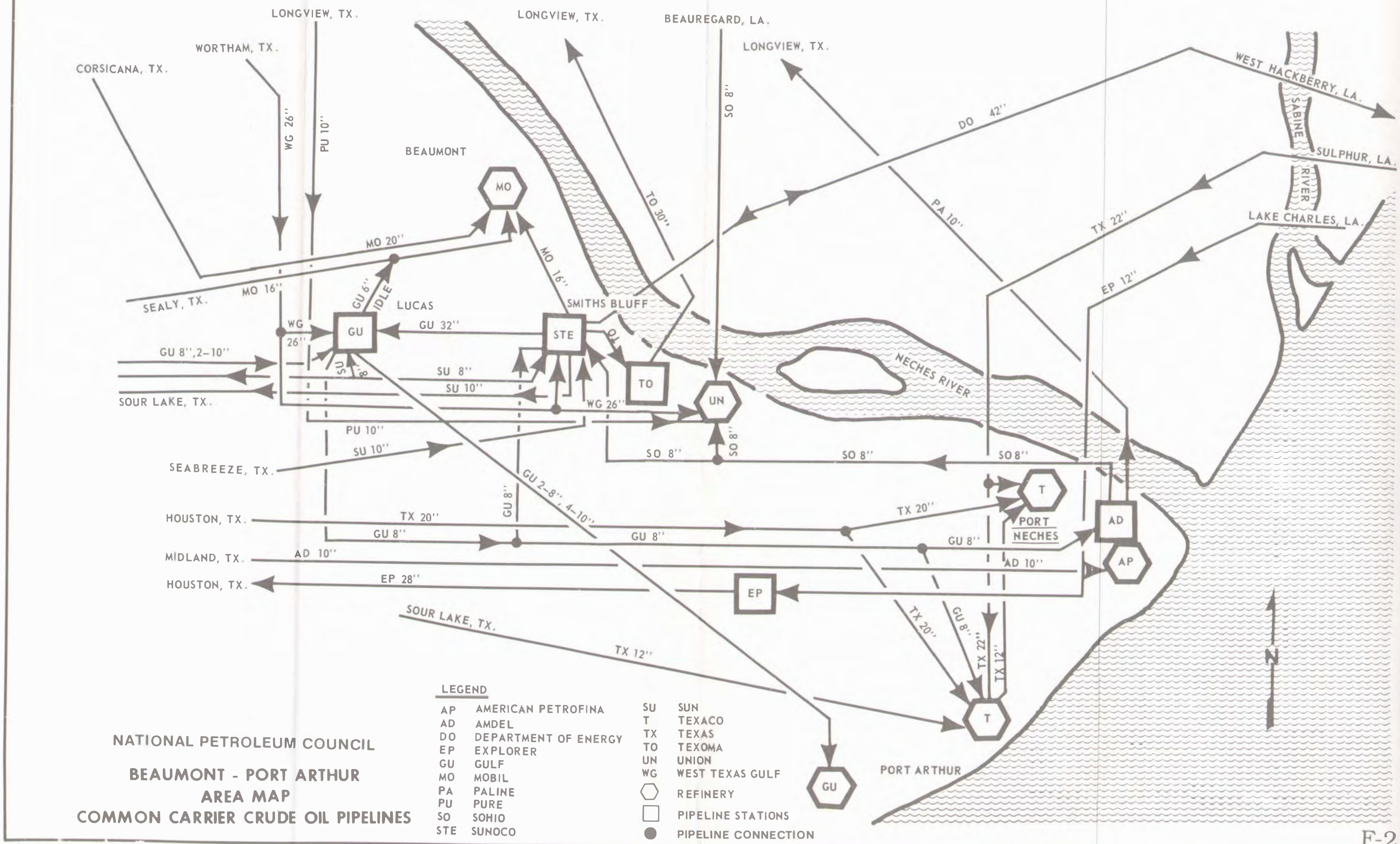
(GA) - Gathering Area
(PL) - Pipeline Terminal
(R) - Refinery
(US) - Underground Storage
(W) - Water Terminal

Direction of Flow PAD District		Line Segment Origin				12/31/78 Average Capacity			Maximum Economic Capacity
From	To	Name	Type	Destination	Pipeline Company	Products*	Crude†	LPG/NGL	
Import	2	Edmonton, Canada	GA,R	Superior, WI	Lakehead	-	135	-	NR
		Superior, WI		Marysville, MI	Lakehead	-	520-540	-	Max
Import	2	Edmonton, Canada	GA	Toledo-Detroit	Cochin	-	-	75	Max
Import	2	Sarnia, Canada	R	Toledo-Detroit	Sun	30	-	-	Max

*See products tables for capacity details.
†See crude tables for capacity details.

PIPELINE AND REFINERY CENTER AREA MAPS

The following are area maps of major refinery and pipeline centers. Included are storage terminals, distribution terminals, refineries, and junctions. The maps show schematically the relative location of facilities and lines, direction of flow, pipe size, and ownership. The maps are not drawn to scale and do not attempt to reflect all operational considerations for various movements.

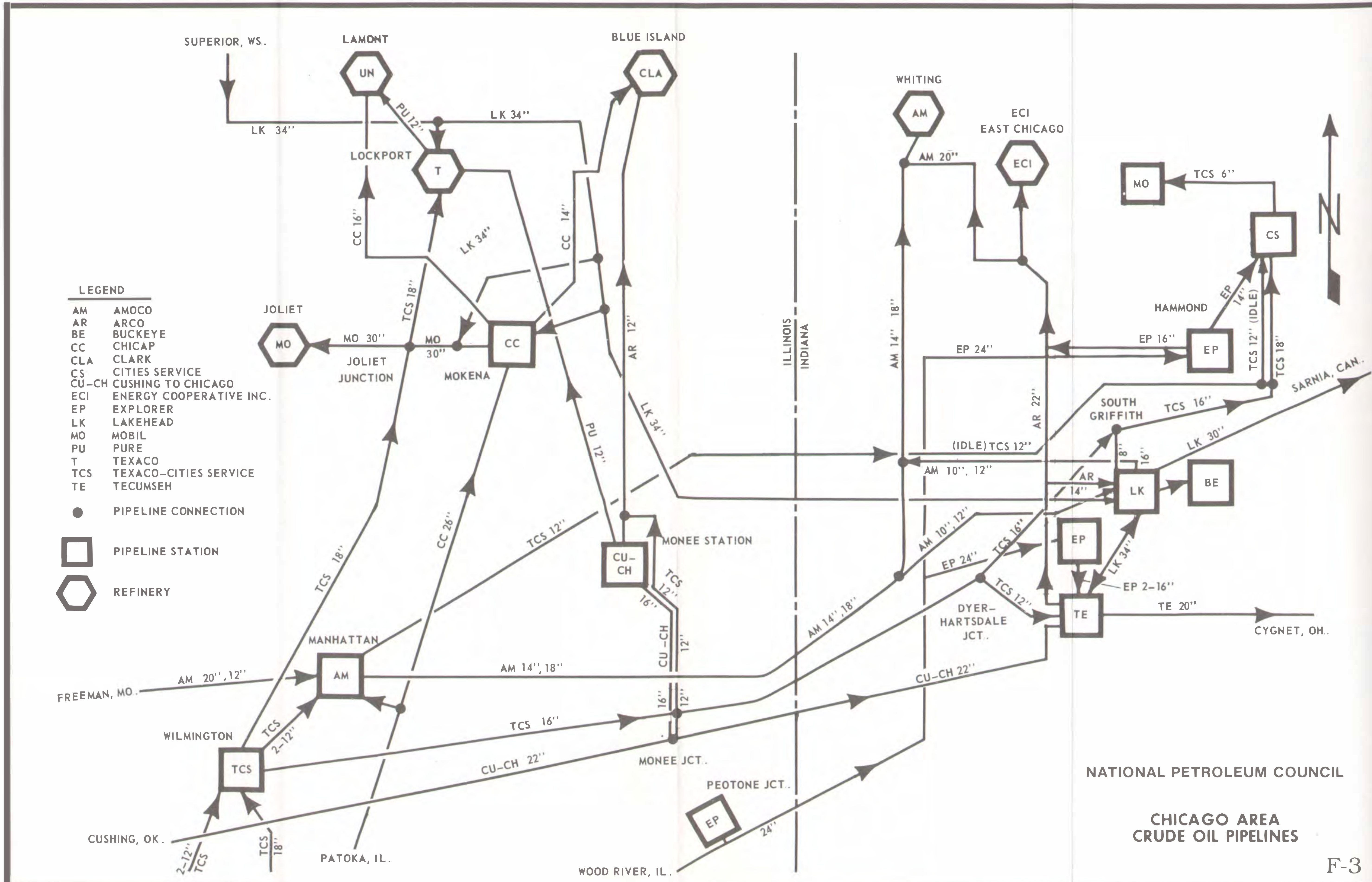


NATIONAL PETROLEUM COUNCIL

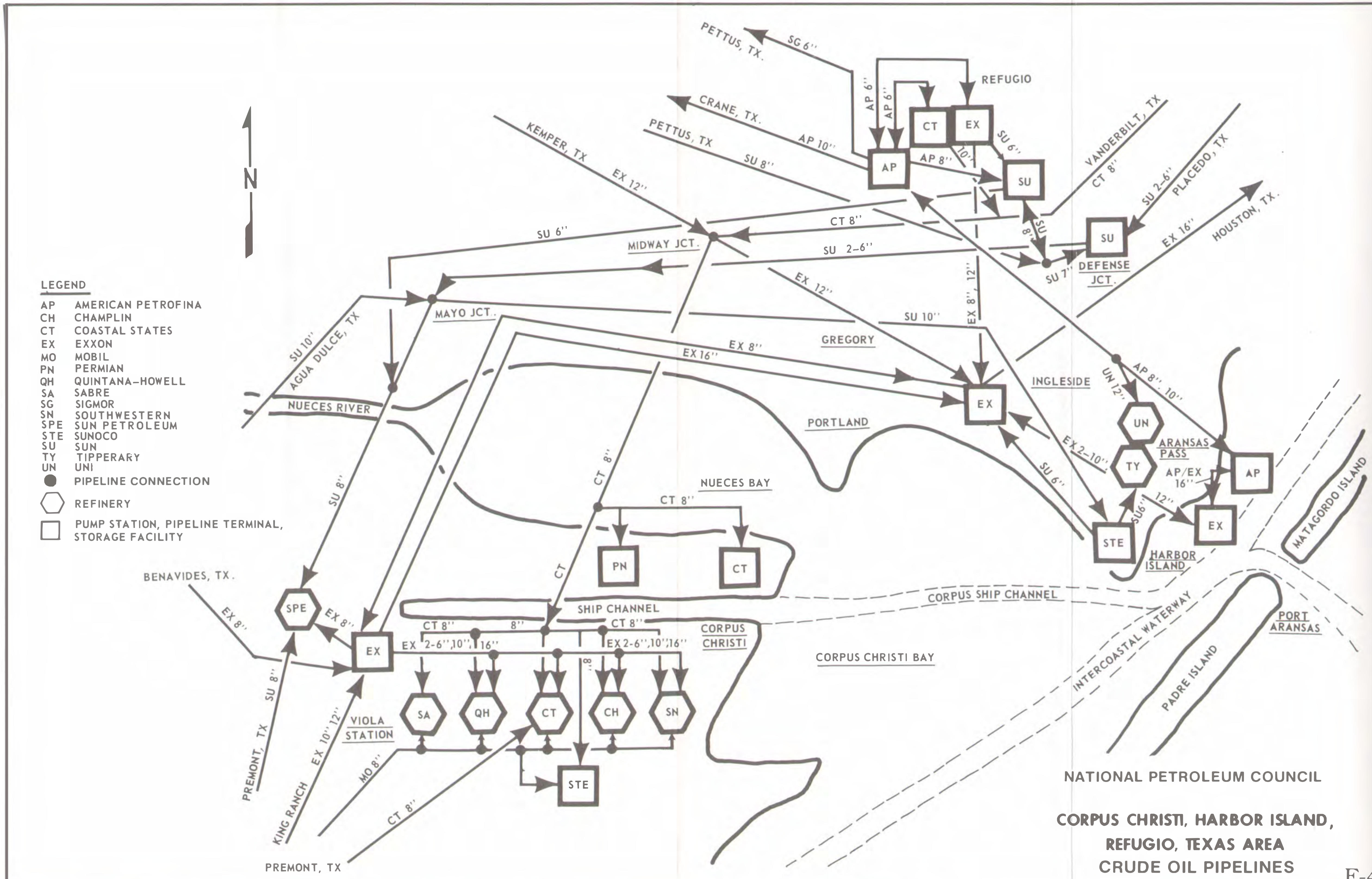
BEAUMONT - PORT ARTHUR
AREA MAP
COMMON CARRIER CRUDE OIL PIPELINES

LEGEND

AP	AMERICAN PETROFINA
AD	AMDEL
DO	DEPARTMENT OF ENERGY
EP	EXPLORER
GU	GULF
MO	MOBIL
PA	PALINE
PU	PURE
SO	SOHIO
STE	SUNOCO
SU	SUN
T	TEXACO
TX	TEXAS
TO	TEXOMA
UN	UNION
WG	WEST TEXAS GULF
⬡	REFINERY
□	PIPELINE STATIONS
●	PIPELINE CONNECTION



CHICAGO AREA
CRUDE OIL PIPELINES



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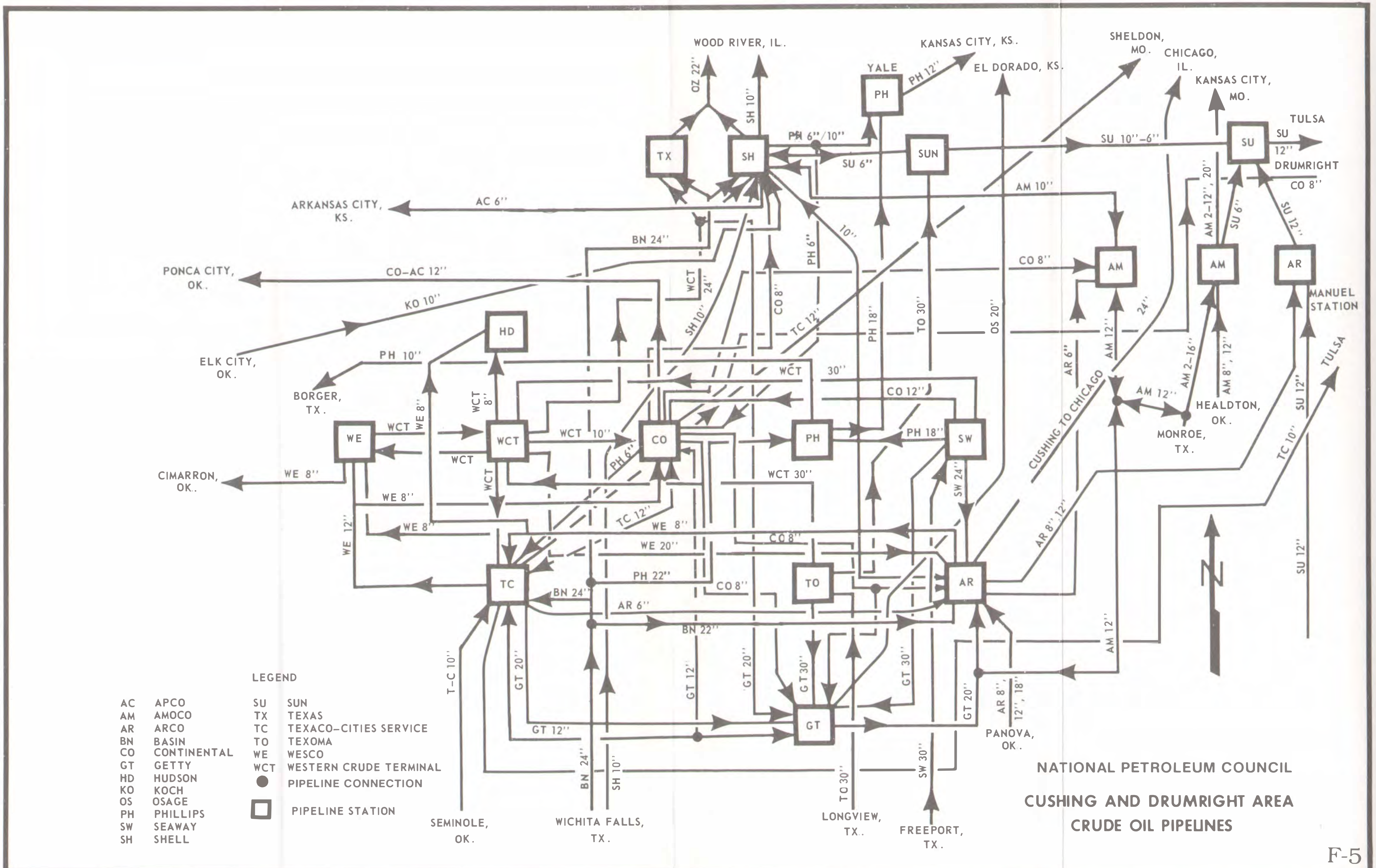
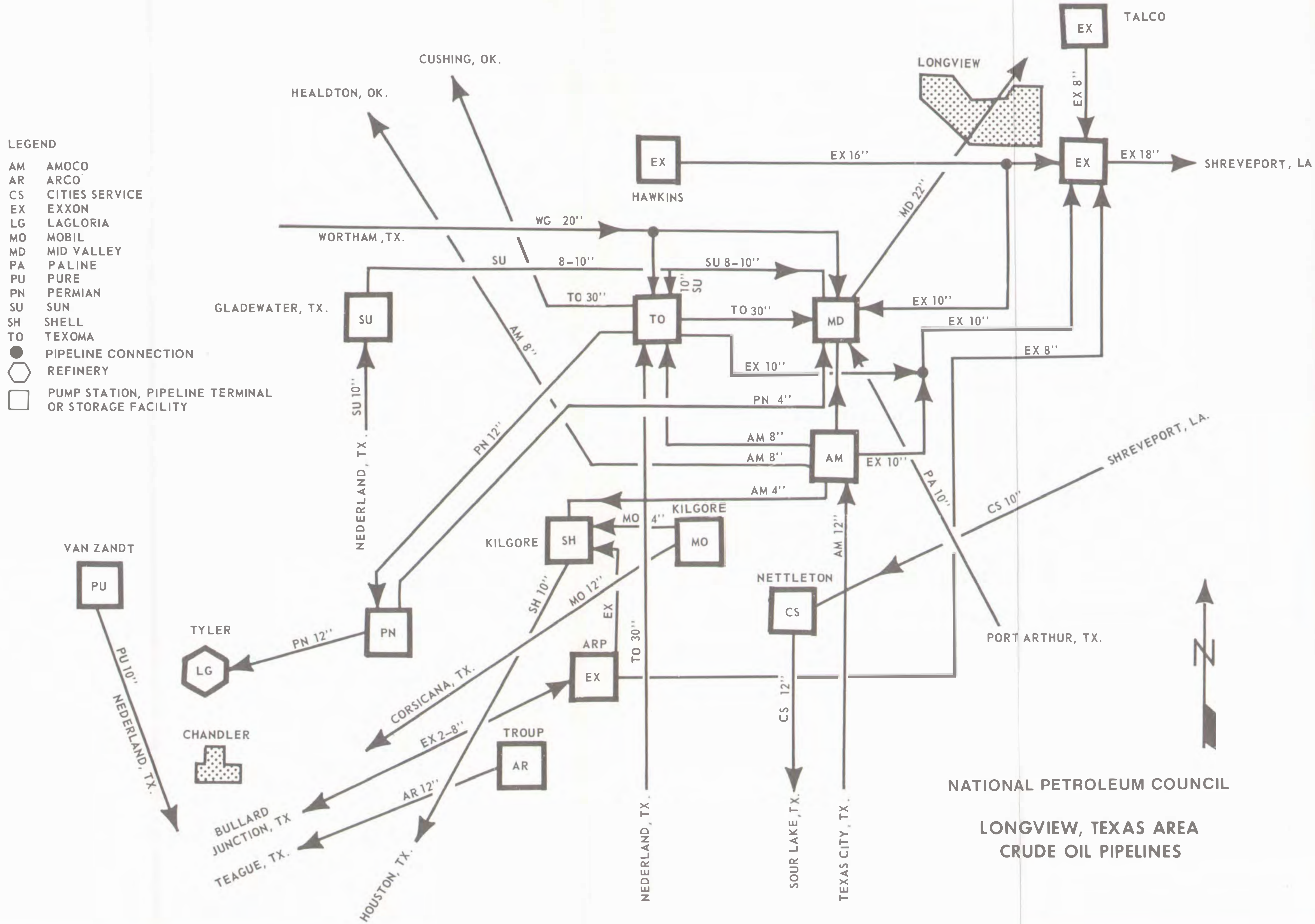
CORPUS CHRISTI, HARBOR ISLAND, REFUGIO, TEXAS AREA CRUDE OIL PIPELINES



NATIONAL PETROLEUM COUNCIL

CUSHING AND DRUMRIGHT AREA CRUDE OIL PIPELINES



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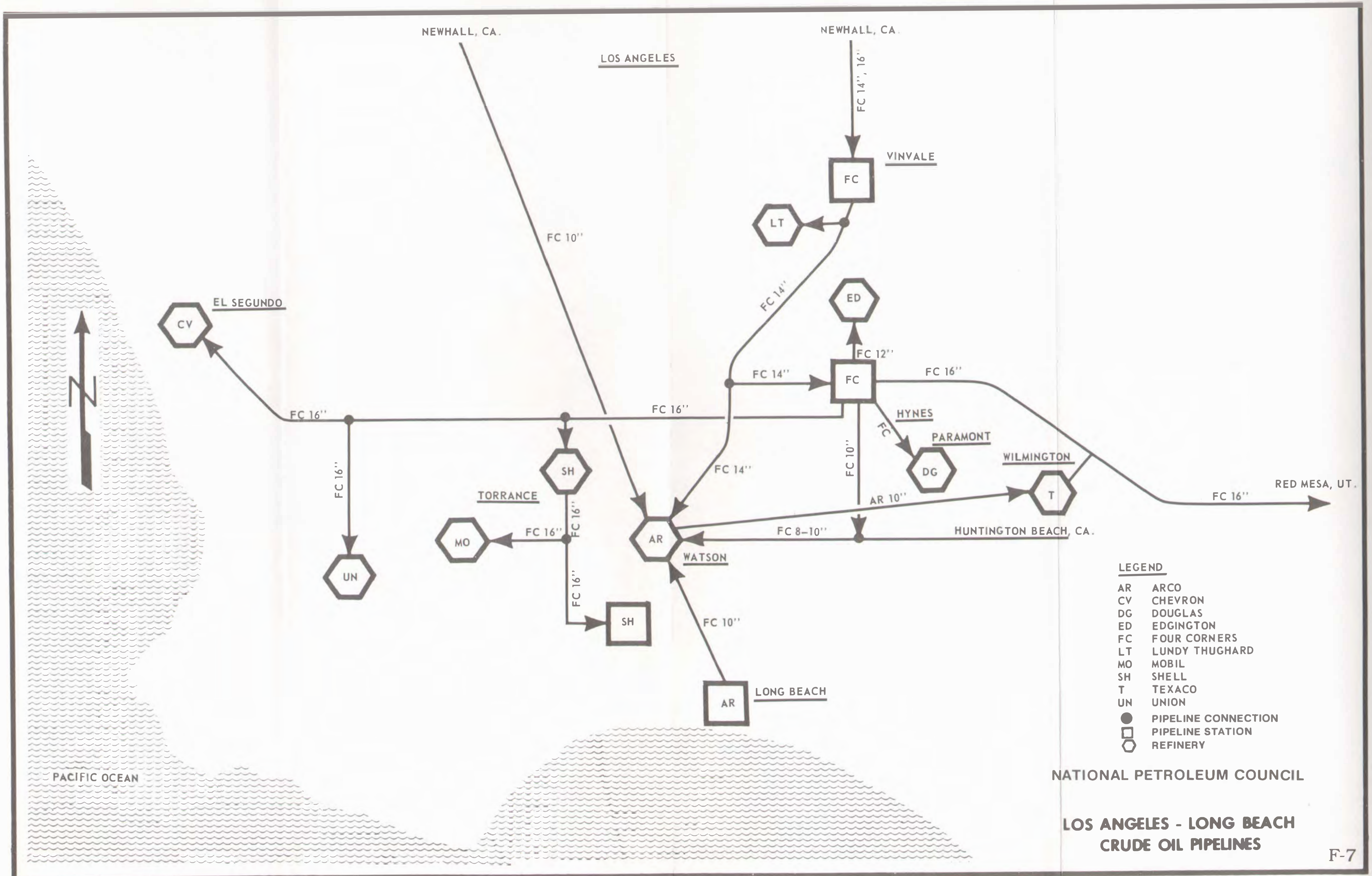
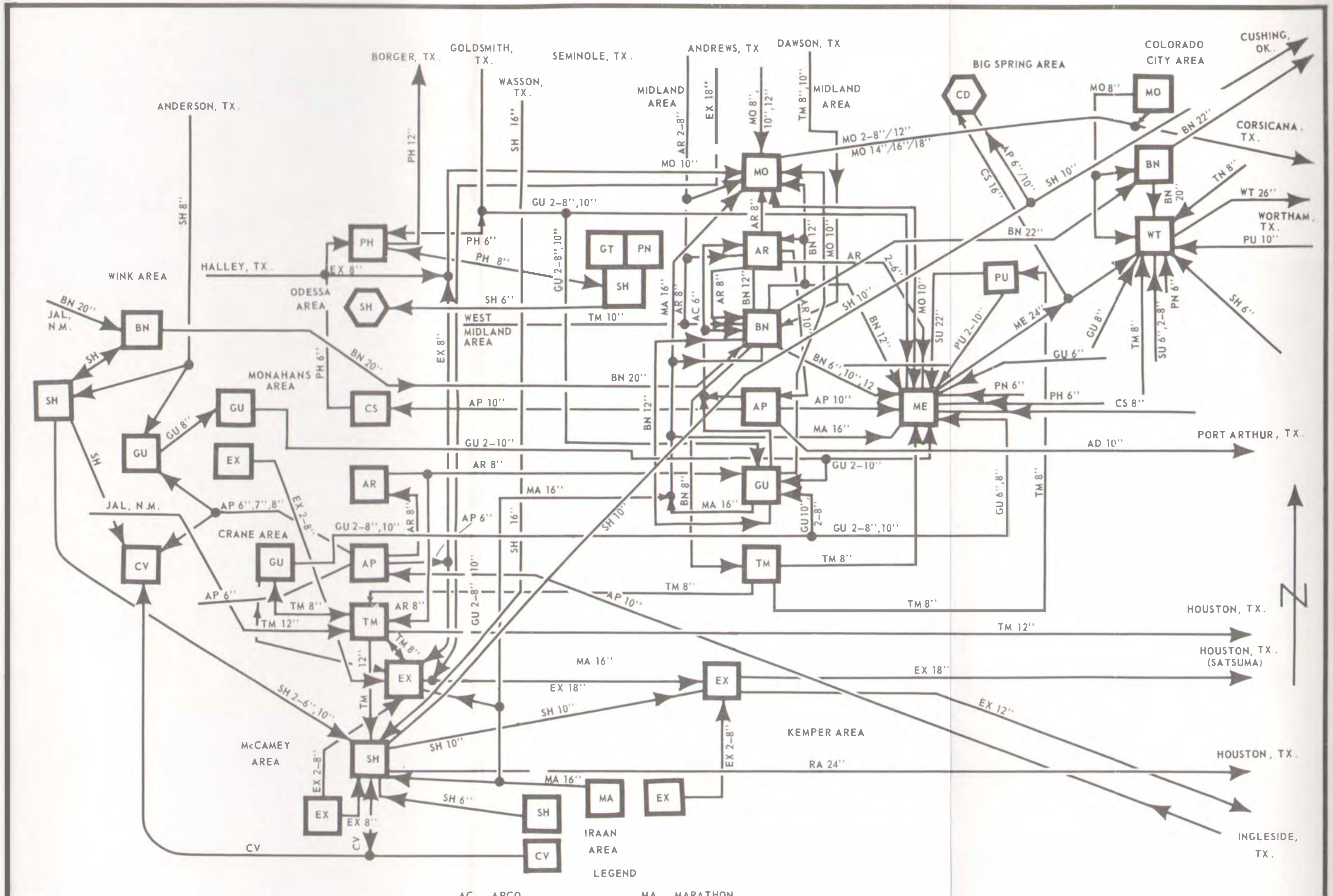
LONGVIEW, TEXAS AREA
CRUDE OIL PIPELINES



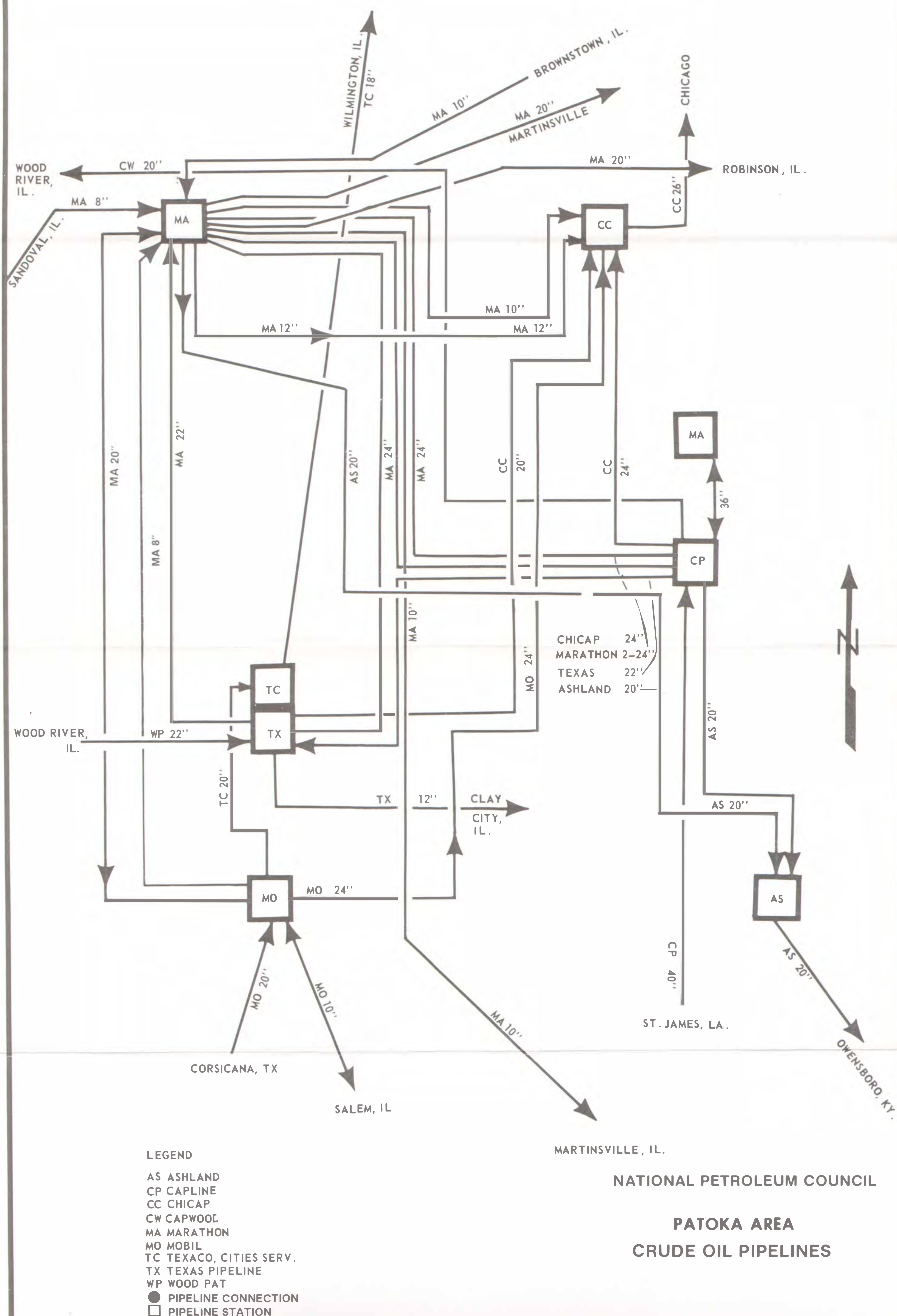
NATIONAL PETROLEUM COUNCIL

LOS ANGELES - LONG BEACH CRUDE OIL PIPELINES



NATIONAL PETROLEUM COUNCIL

ODESSA, CRANE, MIDLAND & COLORADO CITY, TEXAS AREA
CRUDE OIL PIPELINES



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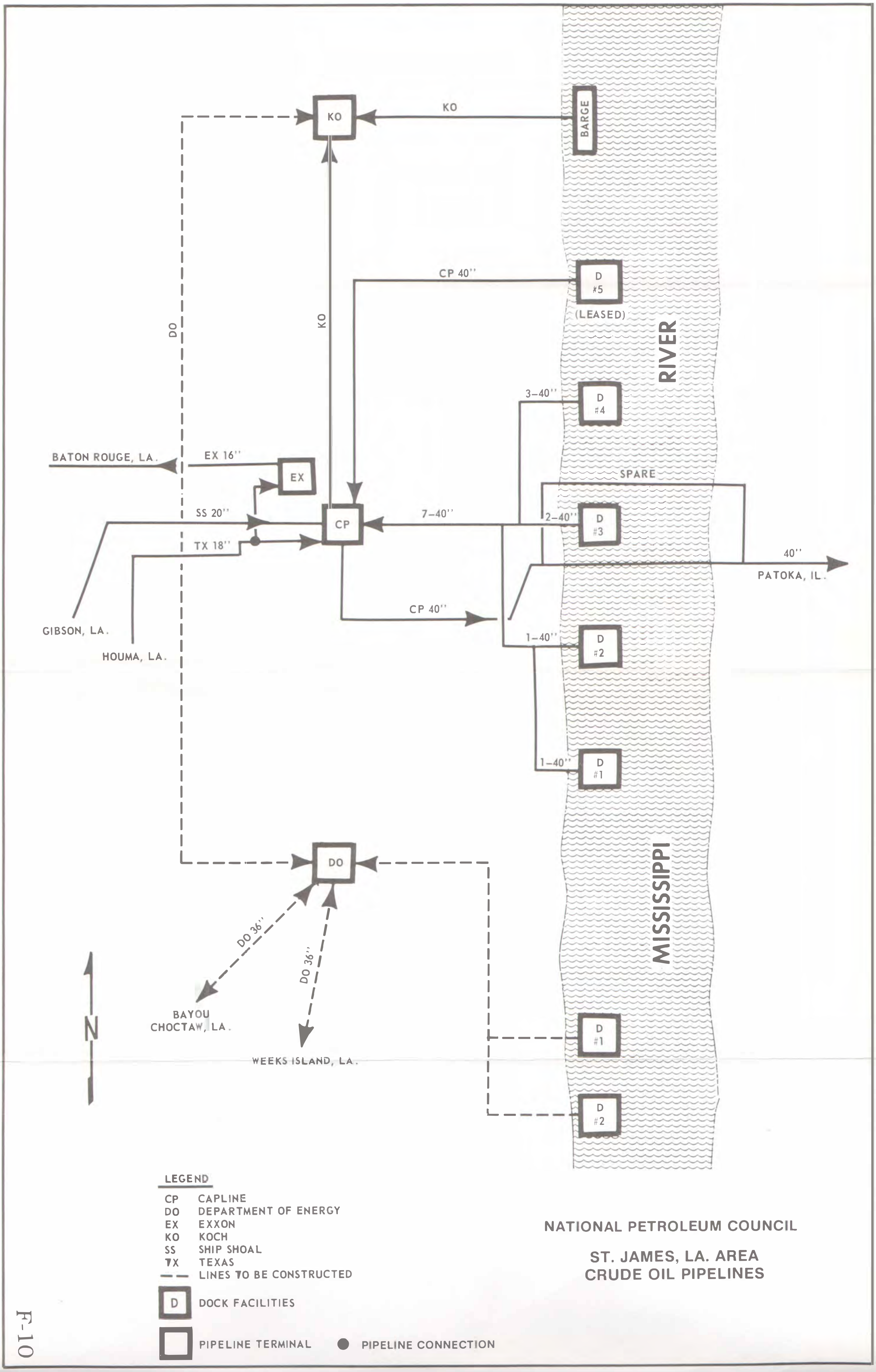
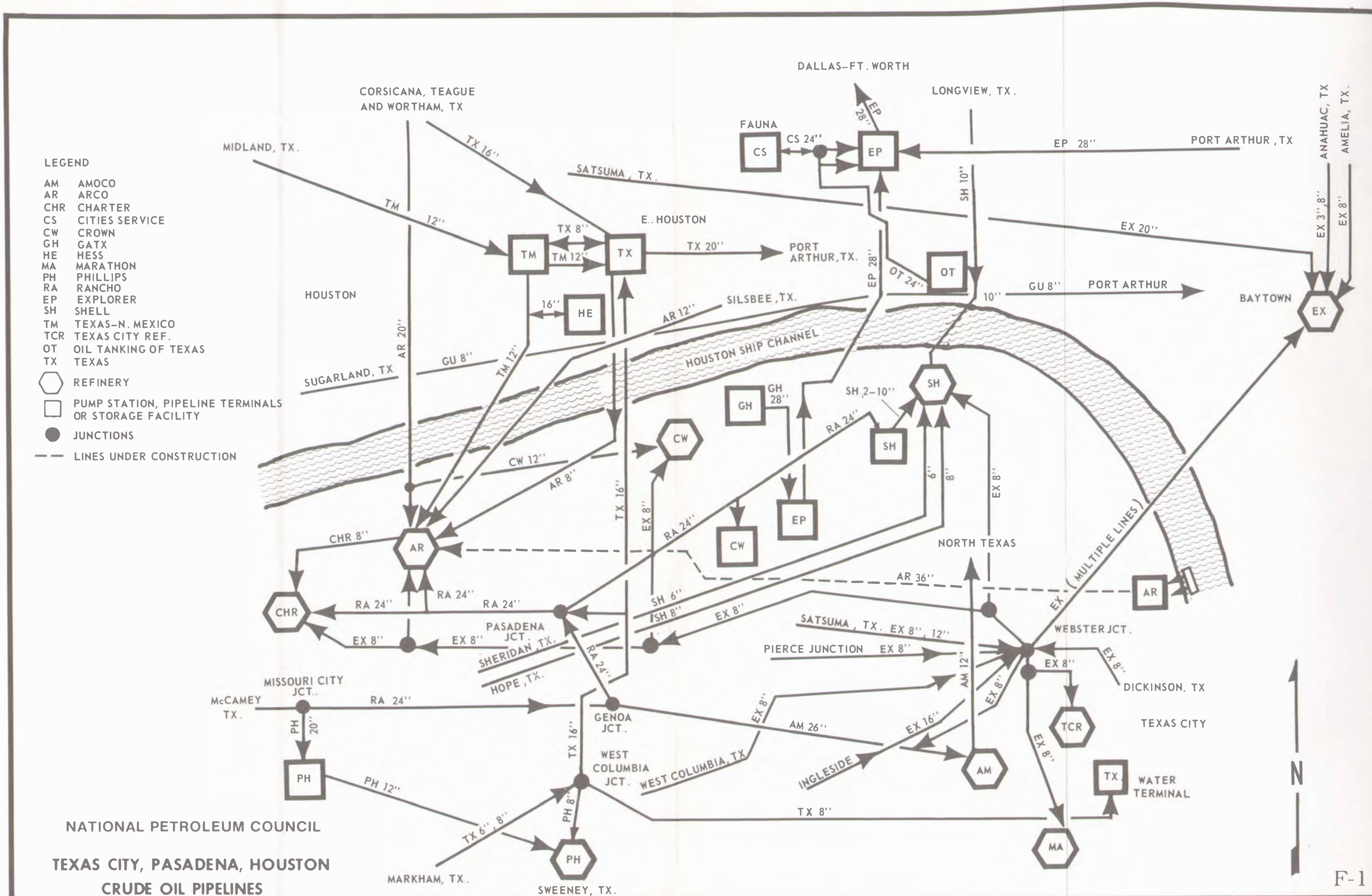
PATOKA AREA
CRUDE OIL PIPELINES



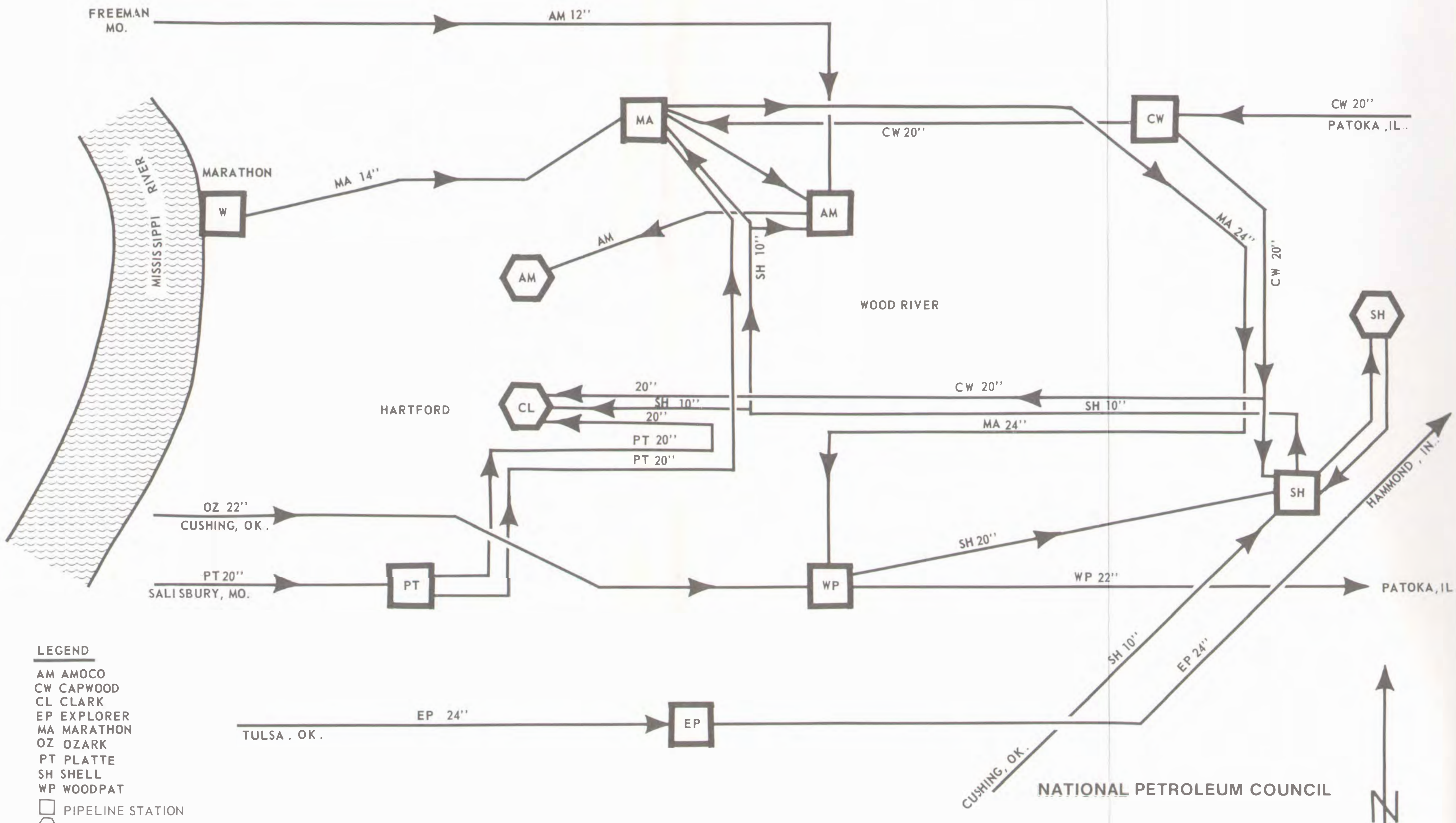
NATIONAL PETROLEUM COUNCIL

ST. JAMES, LA. AREA
CRUDE OIL PIPELINES

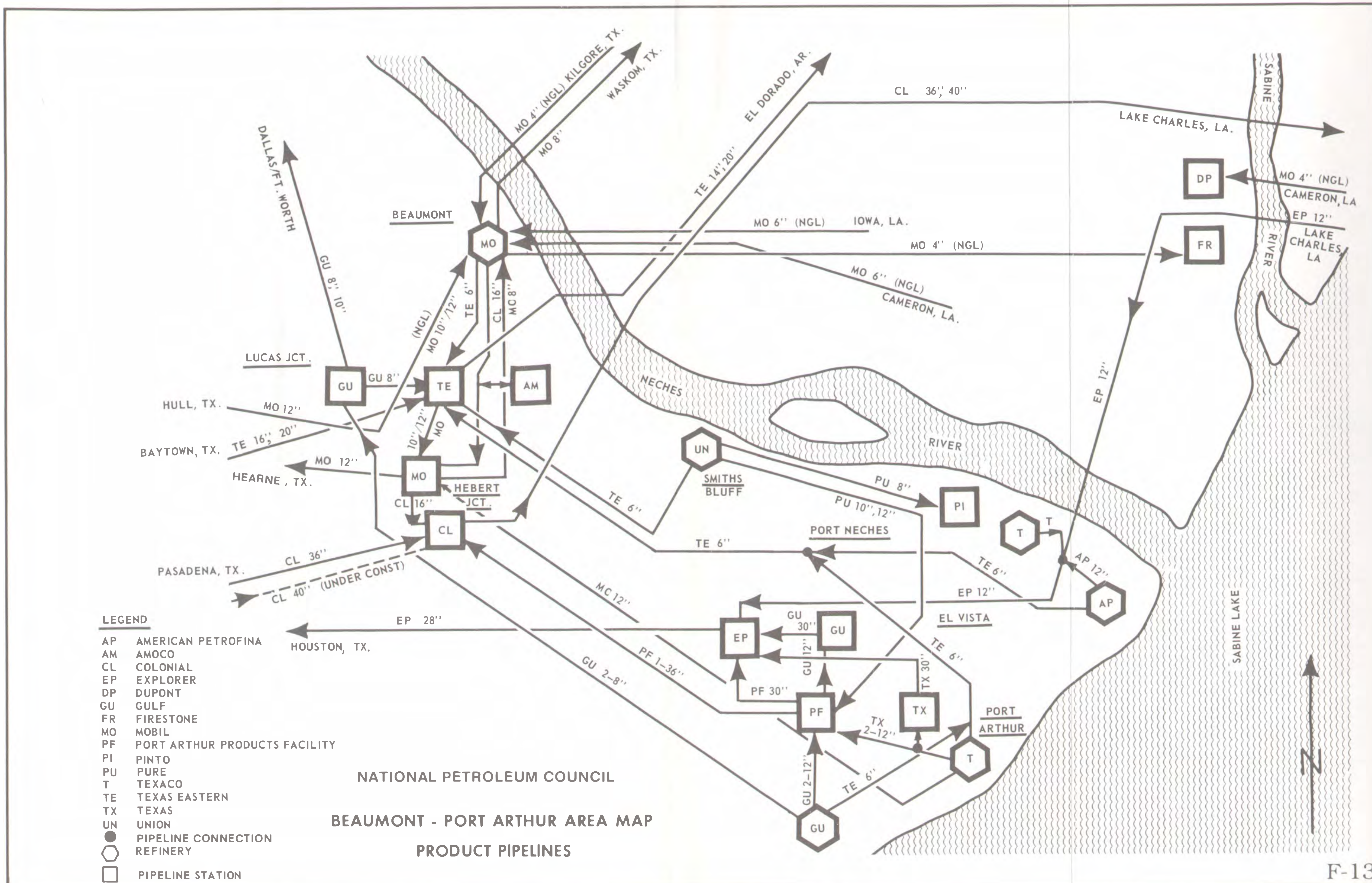


NATIONAL PETROLEUM COUNCIL

TEXAS CITY, PASADENA, HOUSTON CRUDE OIL PIPELINES



WOOD RIVER AREA CRUDE OIL PIPELINES



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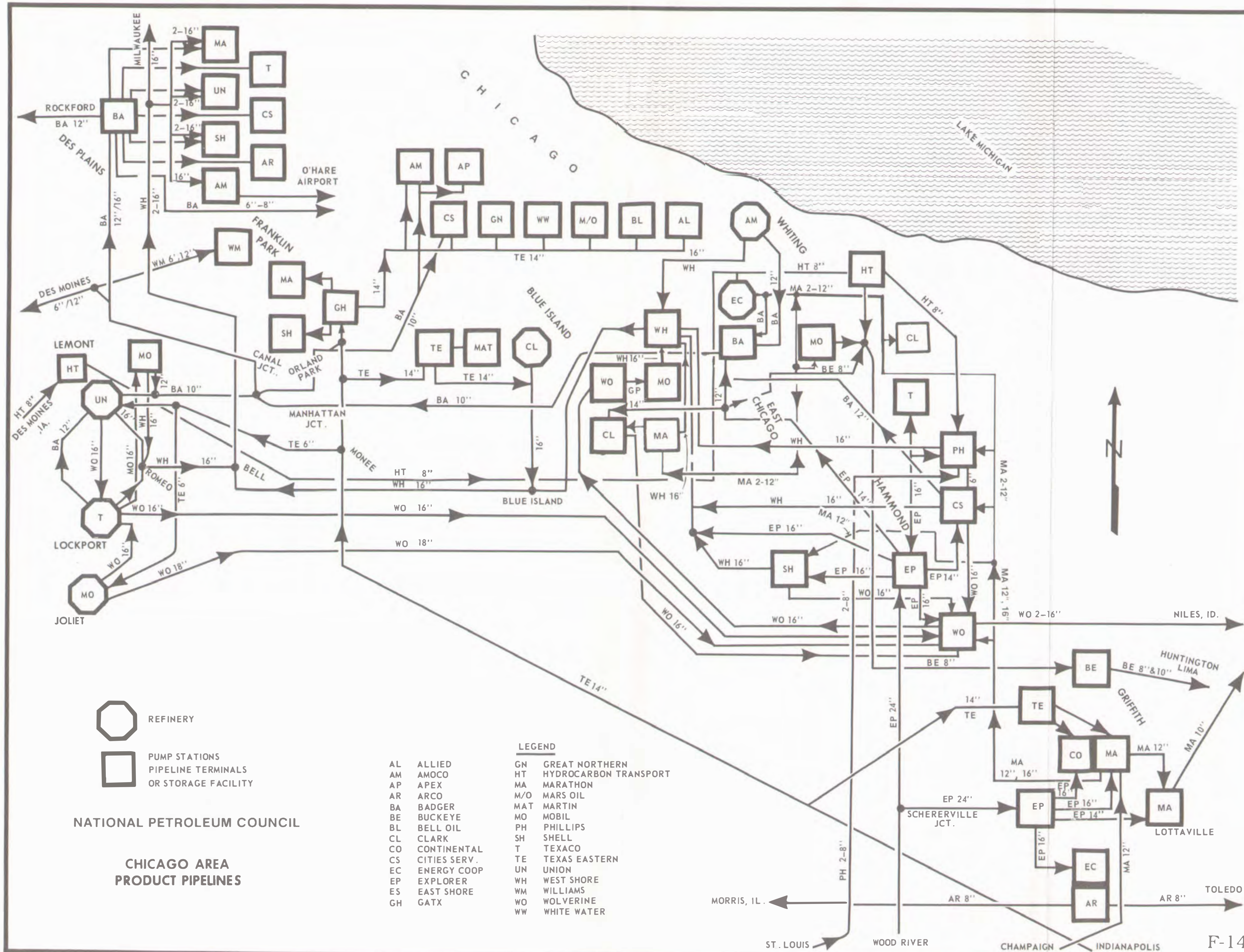
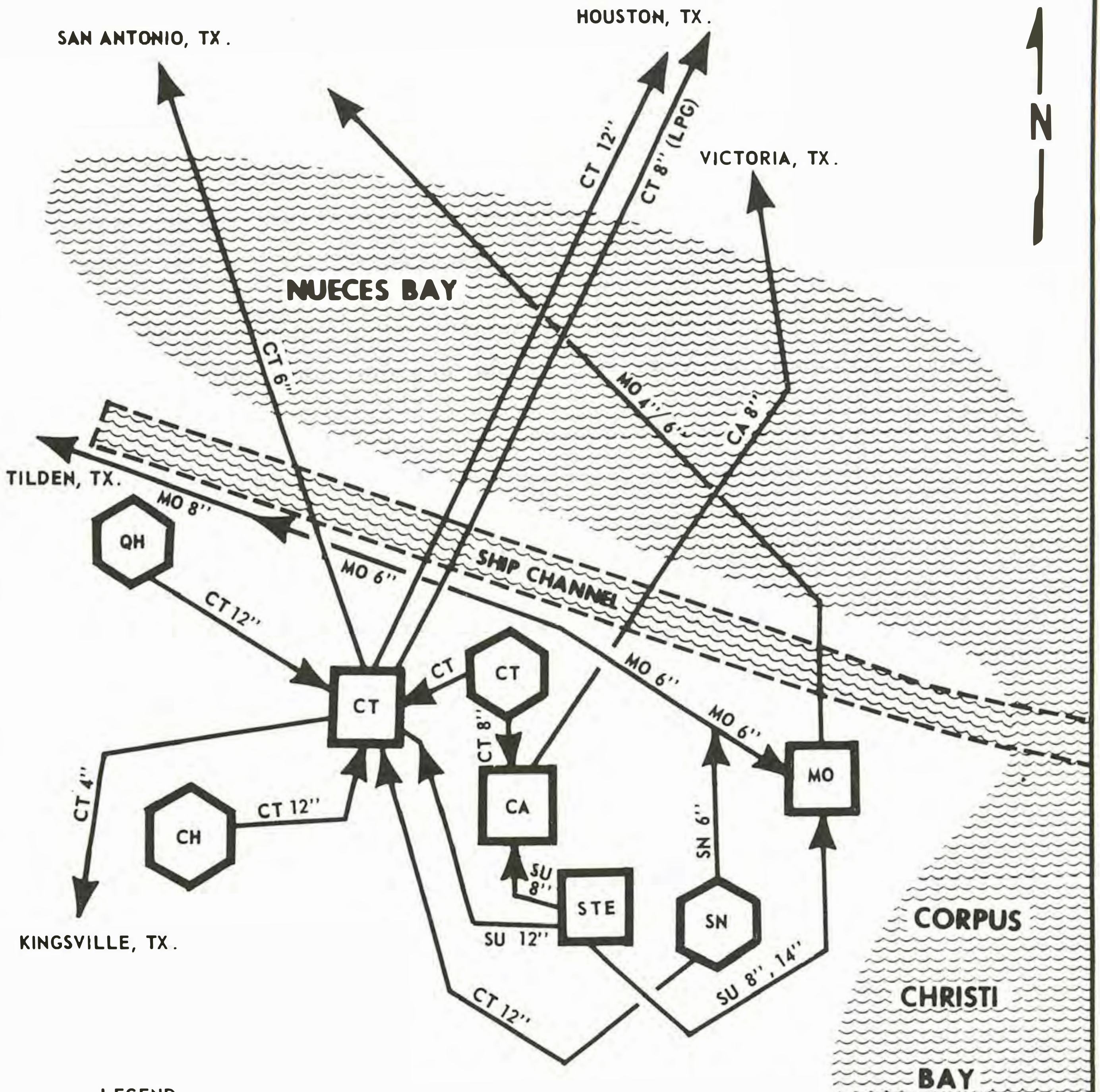
BEAUMONT - PORT ARTHUR AREA MAP

PRODUCT PIPELINES


NATIONAL PETROLEUM COUNCIL
CHICAGO AREA
PRODUCT PIPELINES
REFINERY
PUMP STATIONS
PIPELINE TERMINALS
OR STORAGE FACILITY
LEGEND
AL ALLIED
AM AMOCO
AP APEX
AR ARCO
BA BADGER
BE BUCKEYE
BL BELL OIL
CL CLARK
CO CONTINENTAL
CS CITIES SERV.
EC ENERGY COOP
EP EXPLORER
ES EAST SHORE
GH GATX
GN GREAT NORTHERN
HT HYDROCARBON TRANSPORT
MA MARATHON
M/O MARS OIL
MAT MARTIN
MO MOBIL
PH PHILLIPS
SH SHELL
T TEXACO
TE TEXAS EASTERN
UN UNION
WH WEST SHORE
WM WILLIAMS
WO WOLVERINE
WW WHITE WATER
CHICAGO
LAKE MICHIGAN
MILWAUKEE
ROCKFORD
DES PLAINS
O'HARE AIRPORT
FRANKLIN PARK
DES MOINES
LEMONT
DES MOINES JA.
CANAL JCT.
ORLAND PARK
MANHATTAN JCT.
MONEE
BELL
ROMEO
LOCKPORT
JOLIET
BLUE ISLAND
WHITING
EAST CHICAGO
HAMMOND
GRIFFITH
NILES, ID.
HUNTINGTON LIMA
SCHERERVILLE JCT.
LOTTAVILLE
TOLEDO
MORRIS, IL.
ST. LOUIS
WOOD RIVER
CHAMPAIGN
INDIANAPOLIS



LEGEND
CA CASA
CH CHAMPLIN
CT COASTAL STATES
MO MOBIL
QH QUINTANA-HOWELL
STE SUNOCO
SN SOUTHWESTERN
REFINERY
PUMP STATION, PIPELINE TERMINAL OR STORAGE FACILITY

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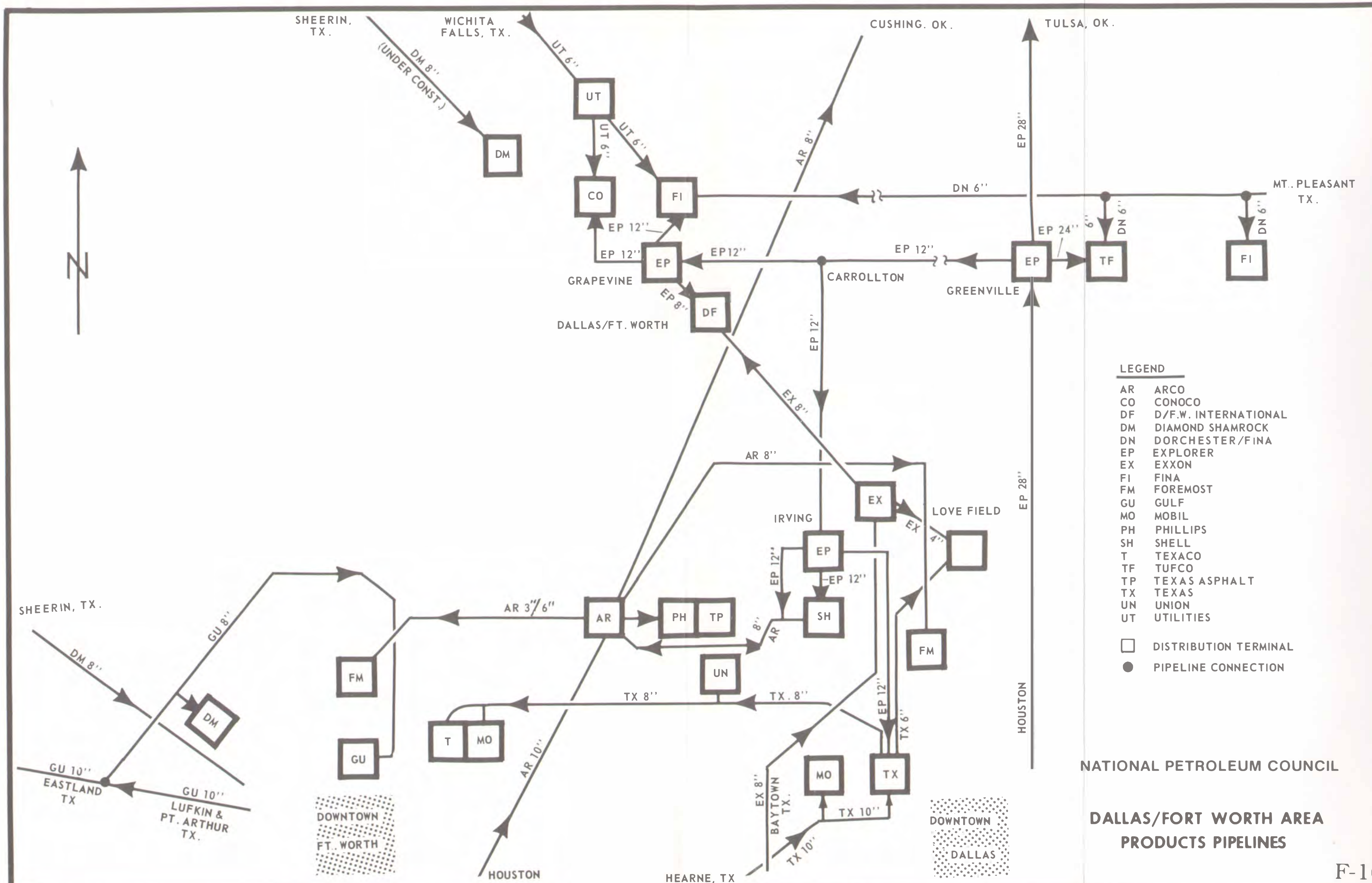
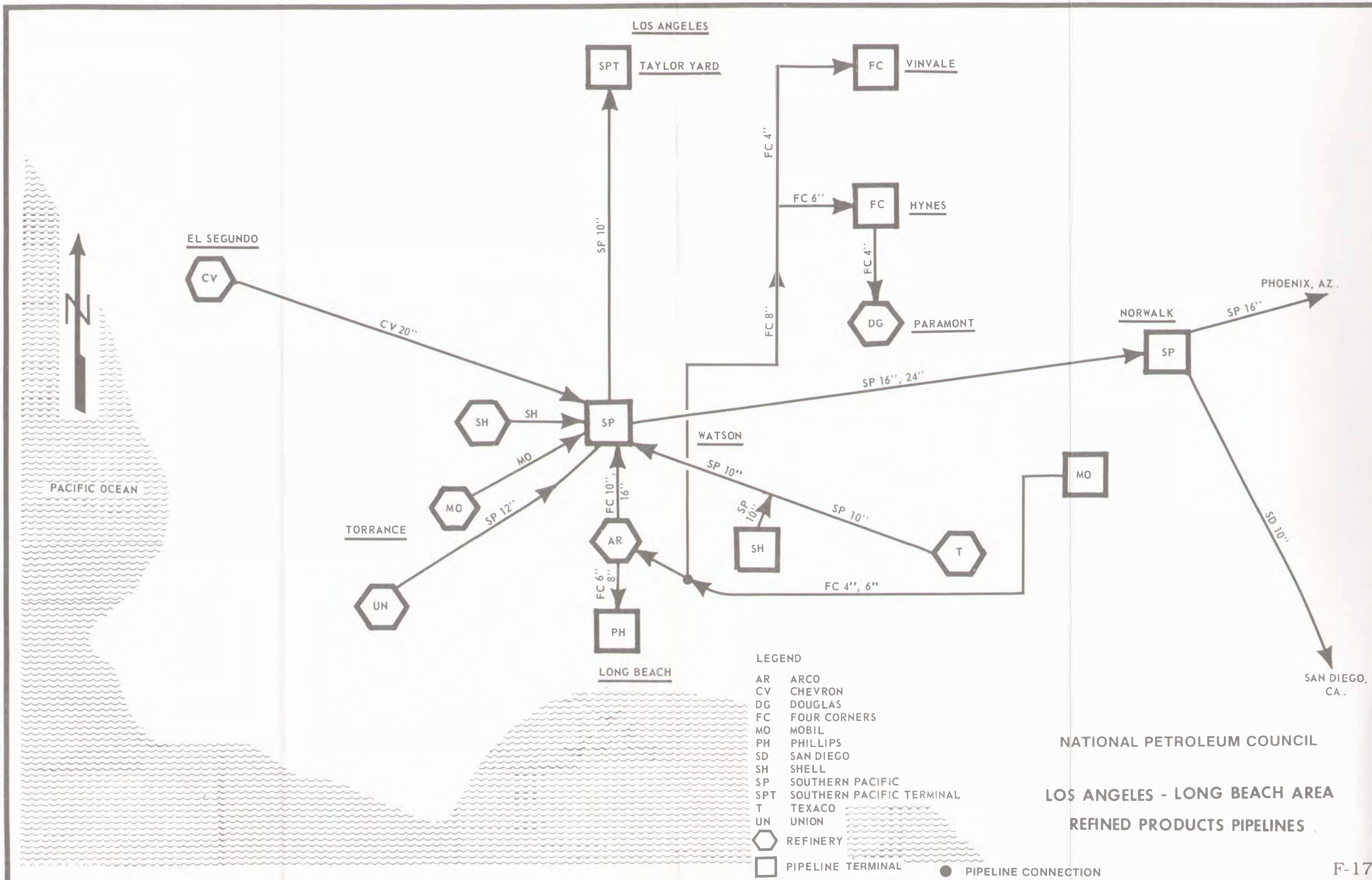
CORPUS CHRISTI AREA MAP
REFINED PRODUCTS
PIPELINES

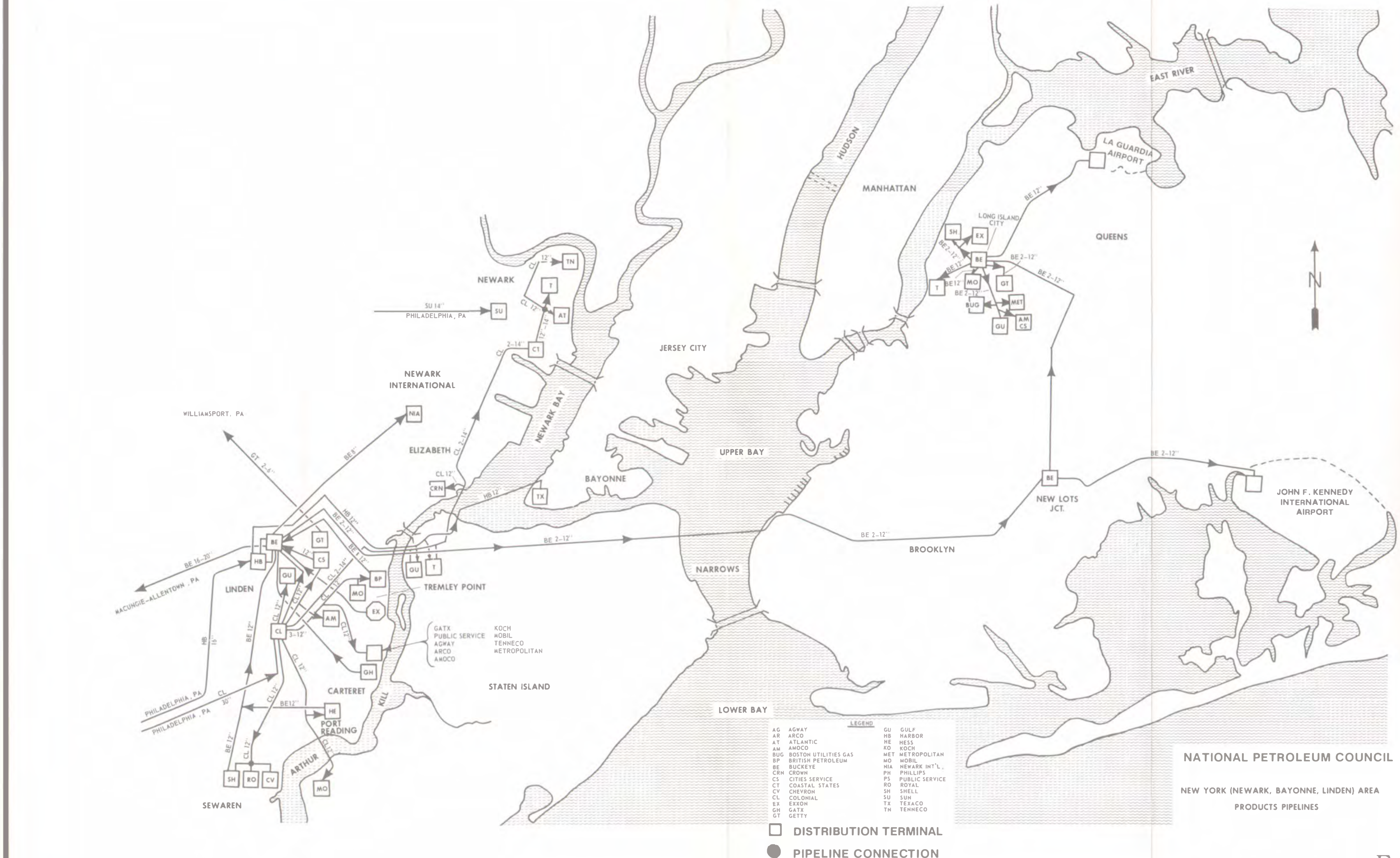

SHEERIN, TX.
WICHITA FALLS, TX.
CUSHING, OK.
TULSA, OK.
DM 8''
(UNDER CONST.)
UT 6''
UT
DM
UT 6''
UT 6''
AR 8''
EP 28''
CO
FI
DN 6''
MT. PLEASANT TX.
EP 12''
EP 12''
EP 12''
EP
EP 12''
CARROLLTON
EP 24''
6''
DN 6''
DN 6''
EP
TF
FI
GRAPEVINE
GREENVILLE
EP 8''
DF
DALLAS/FT. WORTH
EP 12''
EX 8''
AR 8''
EX
LOVE FIELD
EP 28''
IRVING
EP
EX 4''
EP 12''
EP 12''
SHEERIN, TX.
GU 8''
AR 3''/6''
AR
PH
TP
8''
AR
SH
DM 8''
FM
FM
UN
TX 8''
TX. 8''
DM
T
MO
EP 12''
TX 6''
HOUSTON
GU
GU 10''
EASTLAND TX
GU 10''
LUFKIN & PT. ARTHUR TX.
AR 10''
EX 8''
BAYTOWN TX.
MO
TX
TX 10''
DOWNTOWN FT. WORTH
DOWNTOWN DALLAS
HOUSTON
HEARNE, TX
TX 10''
N
LEGEND
AR ARCO
CO CONOCO
DF D/F.W. INTERNATIONAL
DM DIAMOND SHAMROCK
DN DORCHESTER/FINA
EP EXPLORER
EX EXXON
FI FINA
FM FOREMOST
GU GULF
MO MOBIL
PH PHILLIPS
SH SHELL
T TEXACO
TF TUFCO
TP TEXAS ASPHALT
TX TEXAS
UN UNION
UT UTILITIES
DISTRIBUTION TERMINAL
PIPELINE CONNECTION
NATIONAL PETROLEUM COUNCIL
DALLAS/FORT WORTH AREA PRODUCTS PIPELINES



NATIONAL PETROLEUM COUNCIL

LOS ANGELES - LONG BEACH AREA

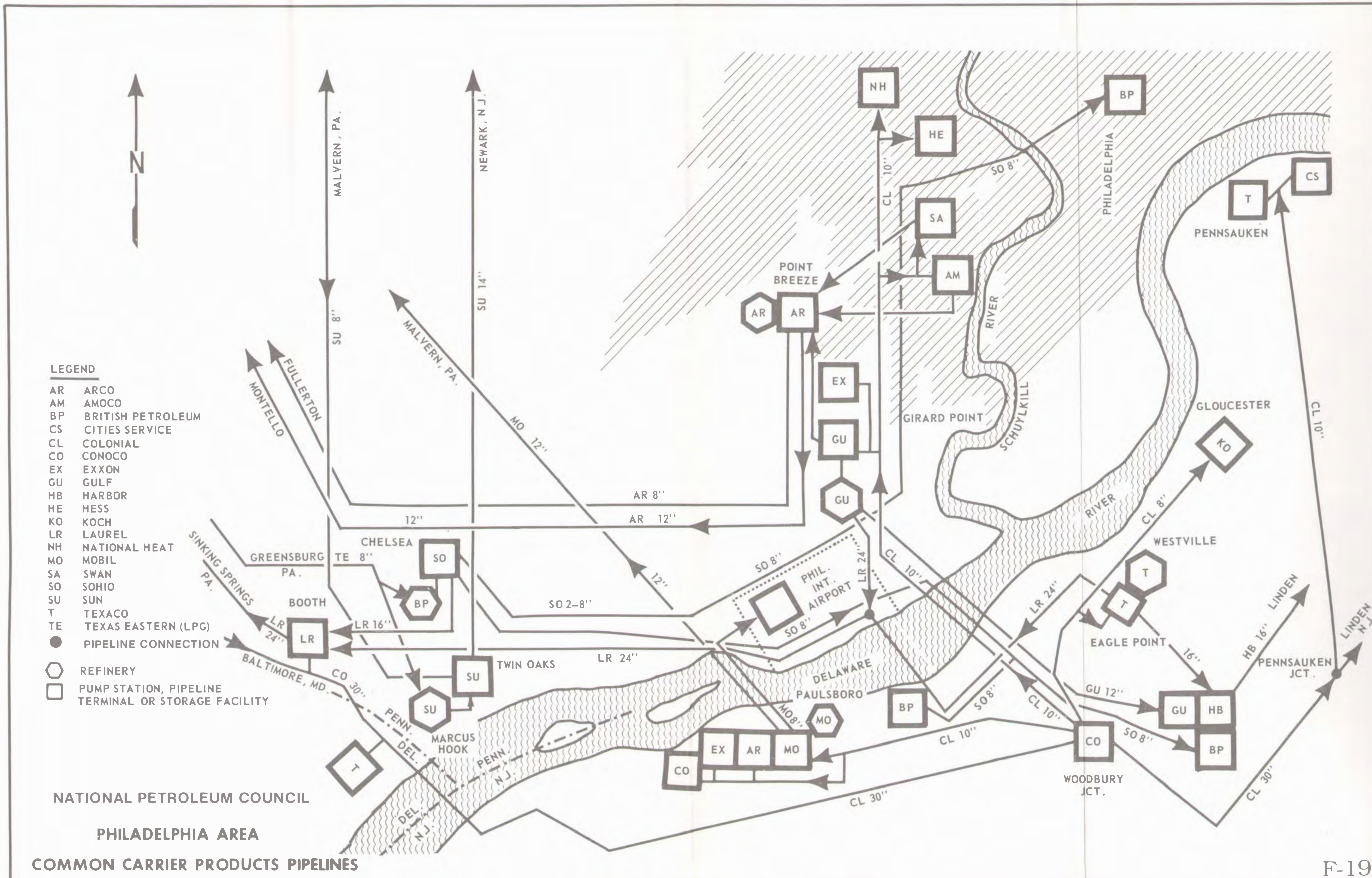
REFINED PRODUCTS PIPELINES



NATIONAL PETROLEUM COUNCIL

NEW YORK (NEWARK, BAYONNE, LINDEN) AREA

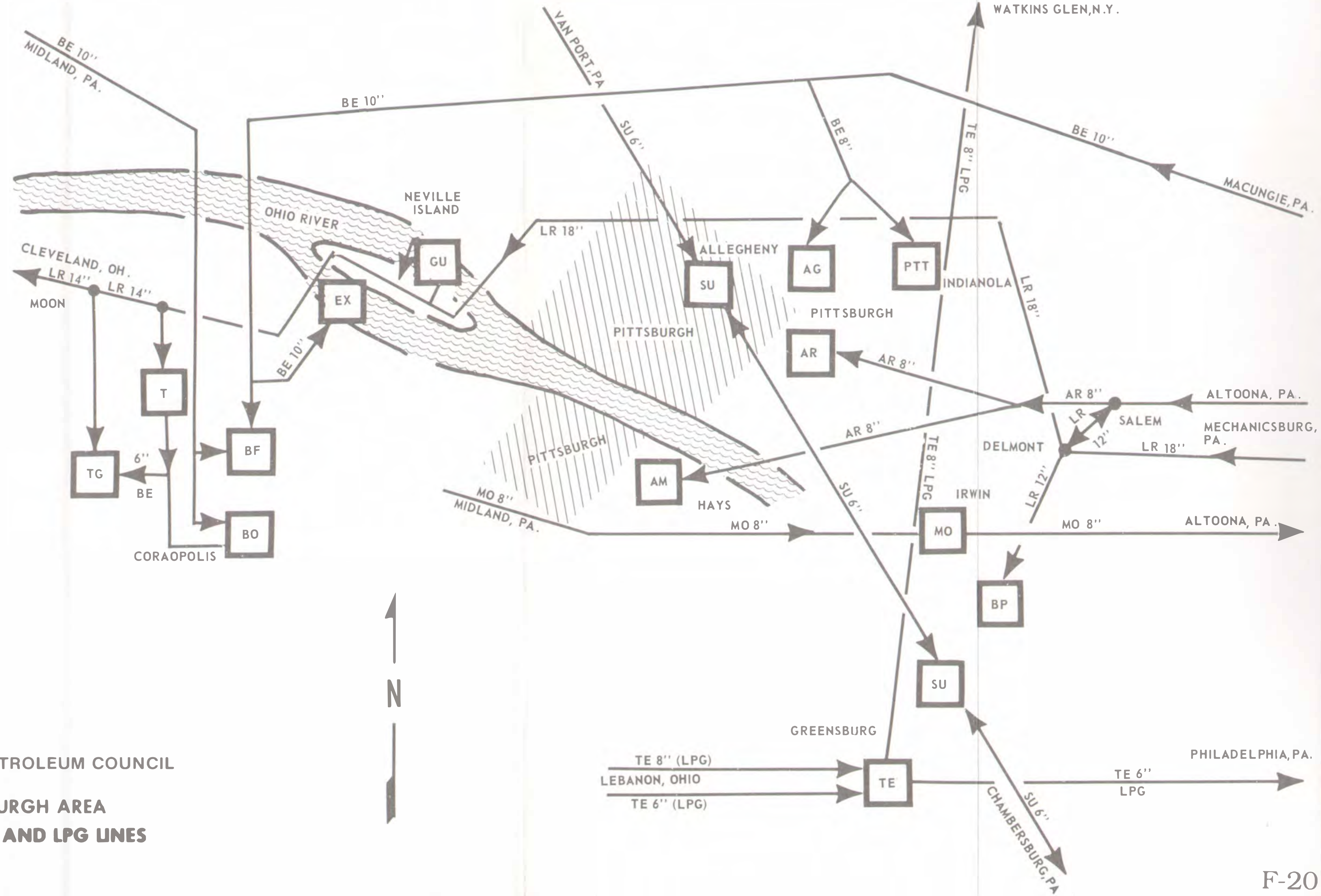
PRODUCTS PIPELINES



NATIONAL PETROLEUM COUNCIL

PHILADELPHIA AREA

COMMON CARRIER PRODUCTS PIPELINES



LEGEND

AG	AGWAY
AM	AMOCO
AR	ARCO
BP	BRITISH PETROLEUM
BE	BUCKEYE
BF	BUCKEYE PETROFUELS
BO	BORON
EX	EXXON
GU	GULF
LR	LAUREL
MO	MOBIL
PTT	PITT OIL
SU	SUN
TE	TEXAS EASTERN
T	TEXACO
TG	TIOGA

☐ PIPELINE TERMINAL

● PIPELINE CONNECTION

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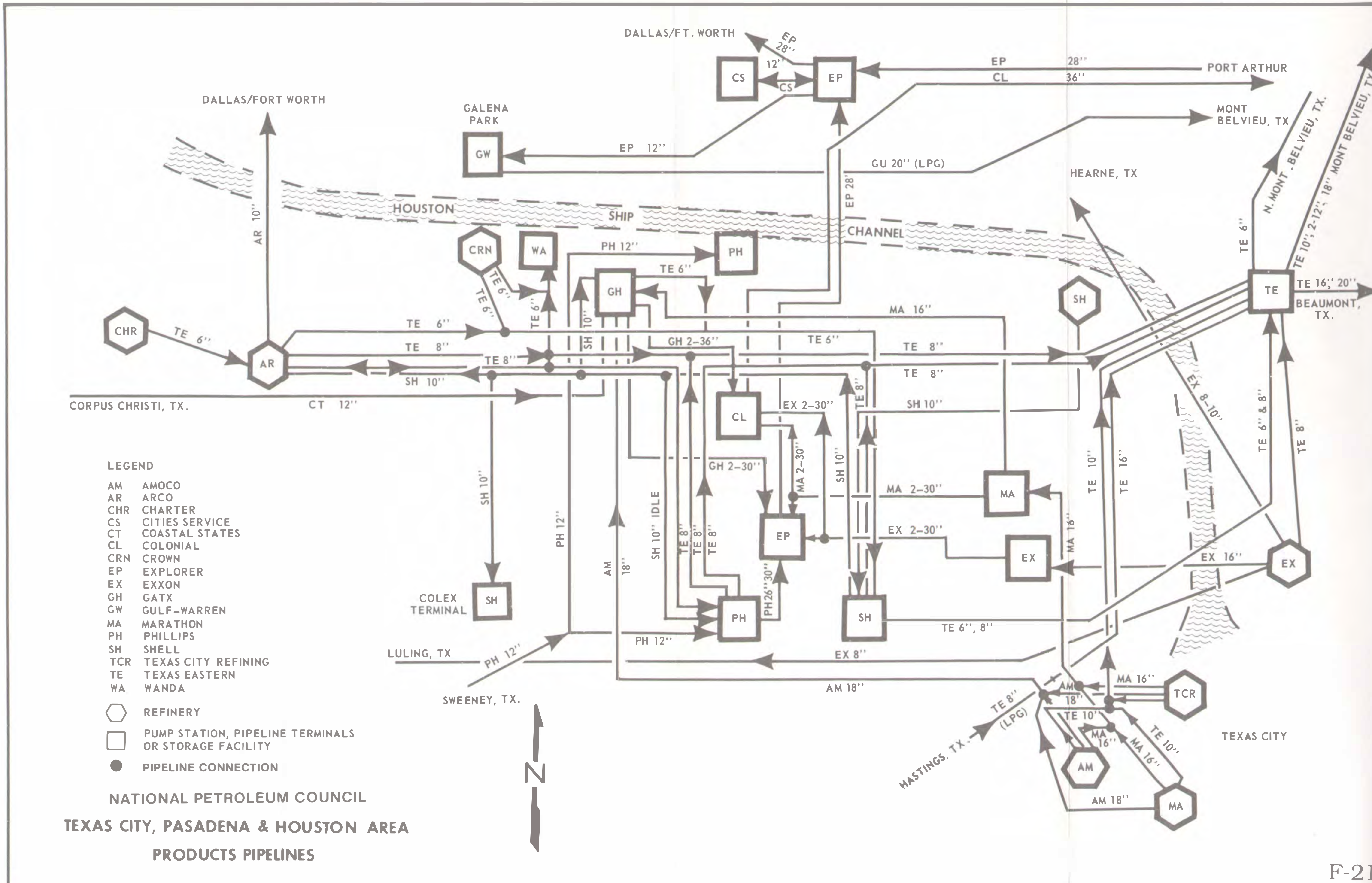
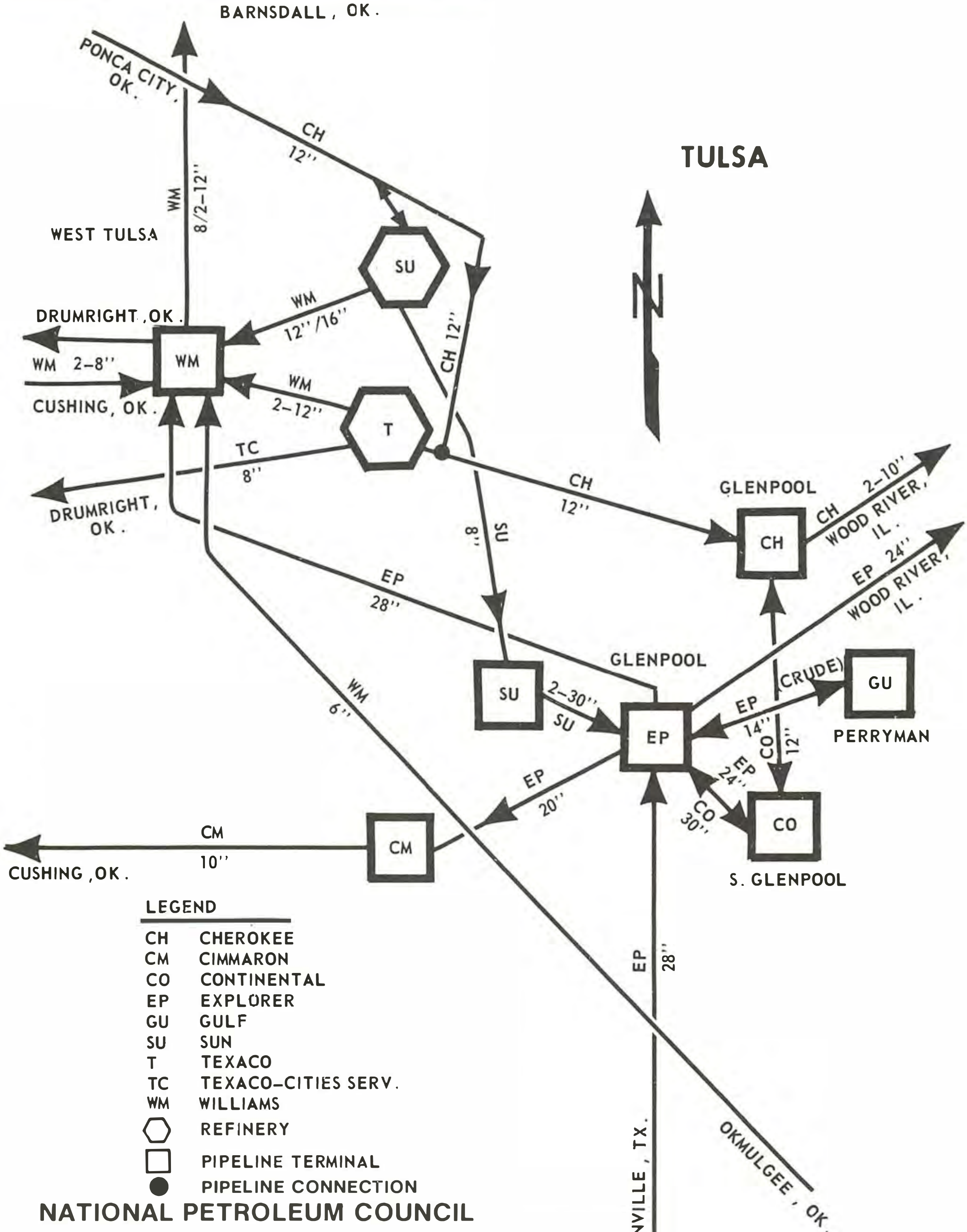
PITTSBURGH AREA

PRODUCTS AND LPG LINES



NATIONAL PETROLEUM COUNCIL

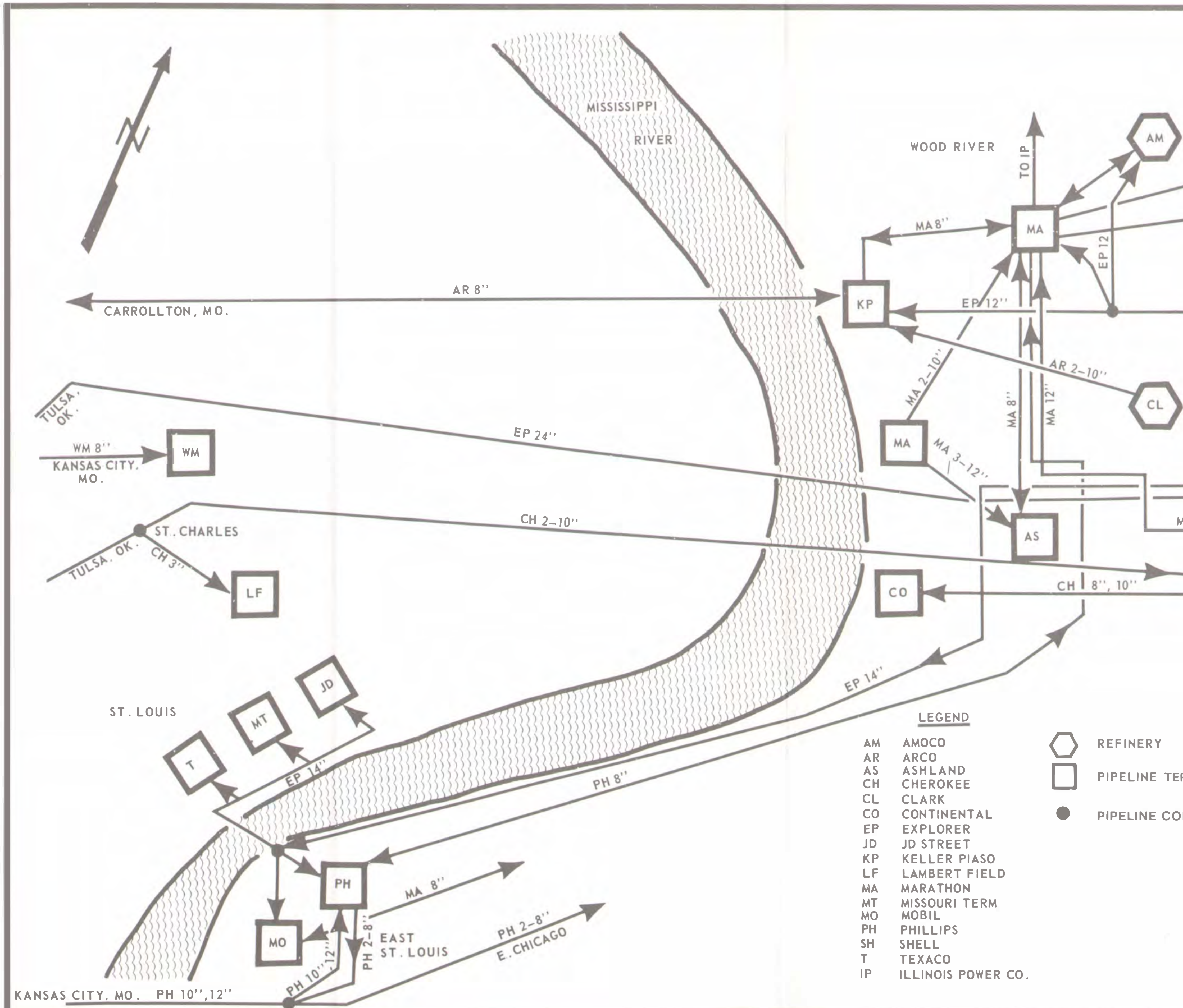
TEXAS CITY, PASADENA & HOUSTON AREA PRODUCTS PIPELINES



NATIONAL PETROLEUM COUNCIL

TULSA AREA

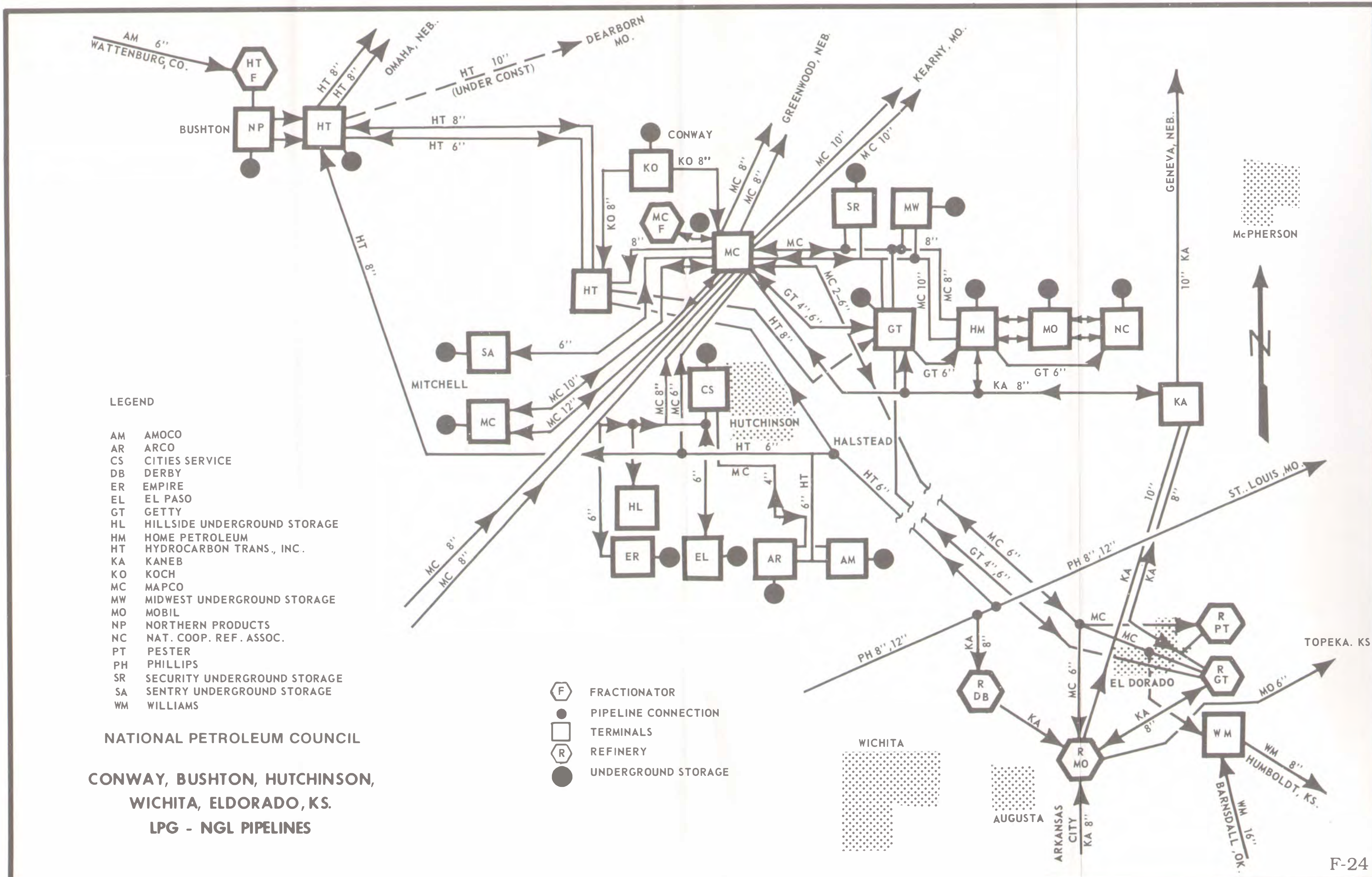
PRODUCTS PIPELINES



NATIONAL PETROLEUM COUNCIL

WOOD RIVER AREA MAP

PRODUCT PIPELINES



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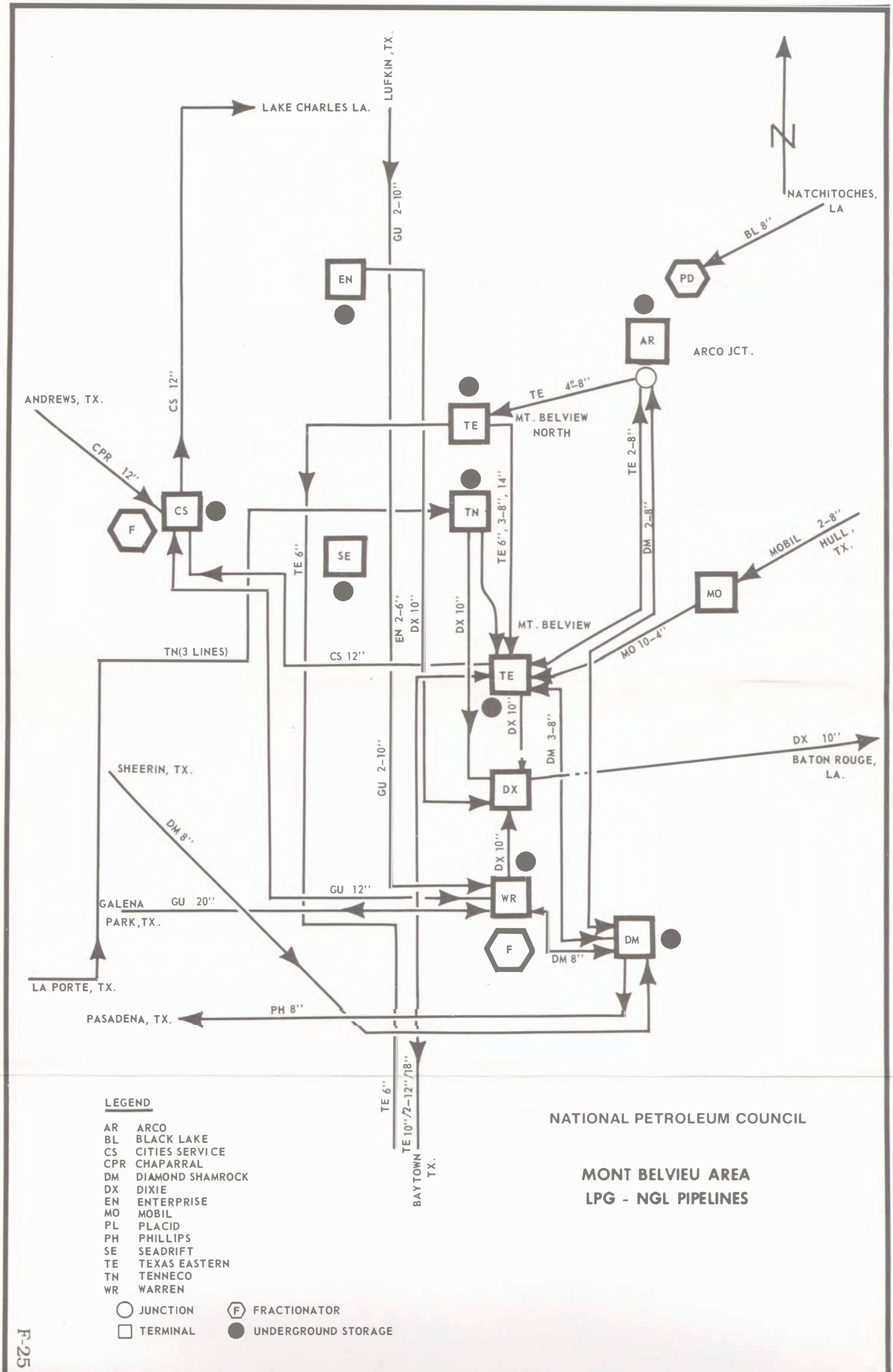
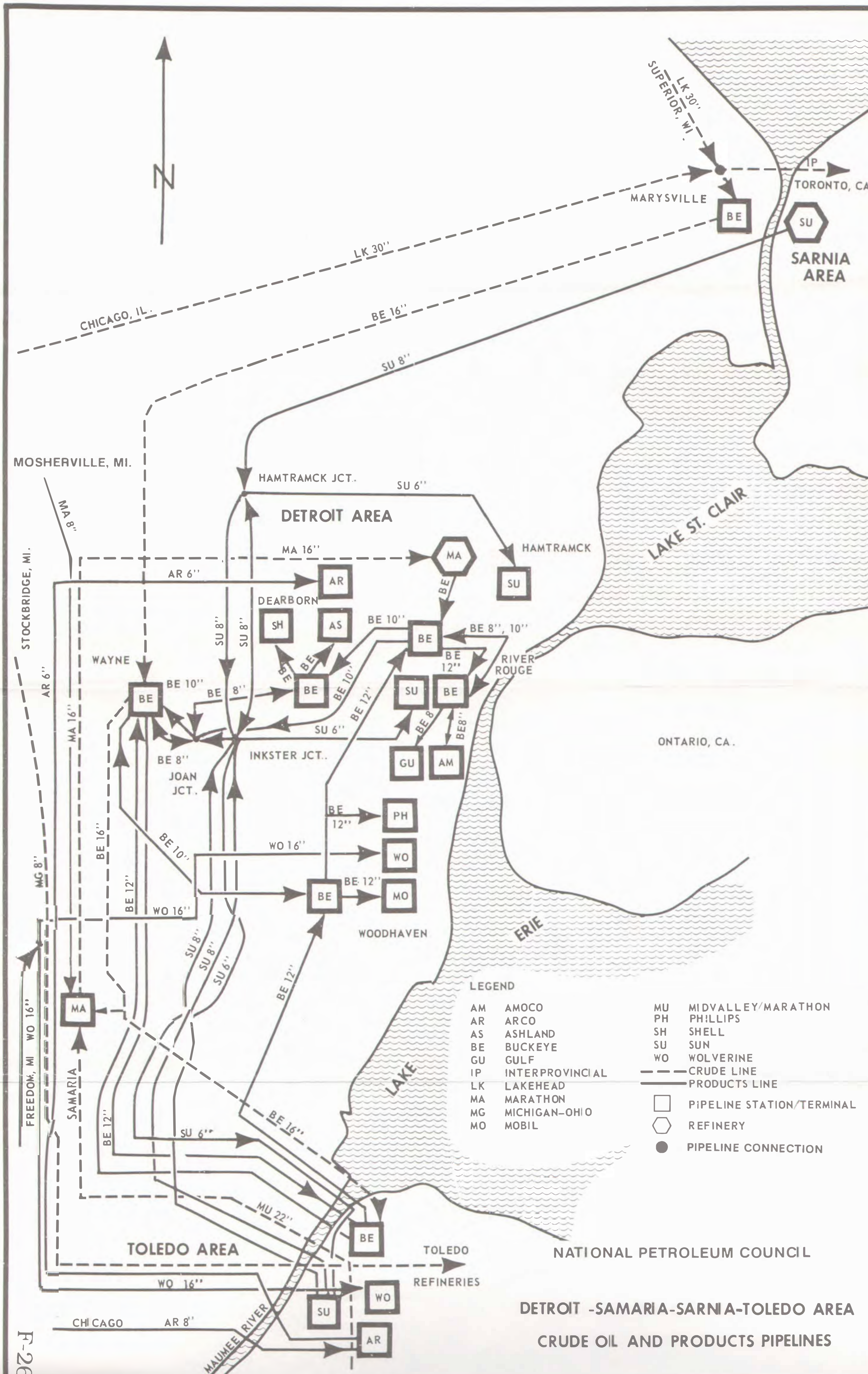
CONWAY, BUSHTON, HUTCHINSON, WICHITA, ELDORADO, KS. LPG - NGL PIPELINES



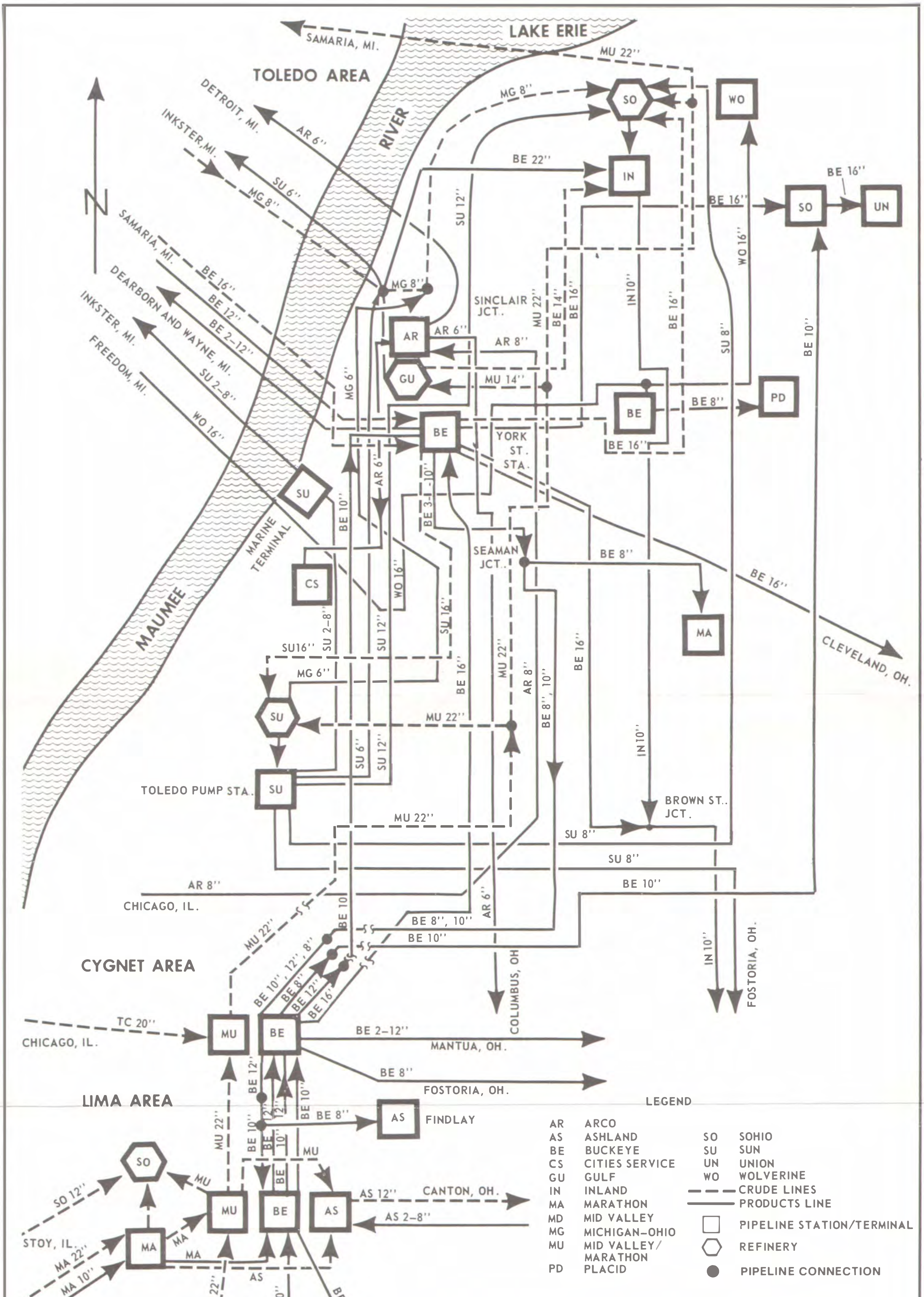
NATIONAL PETROLEUM COUNCIL

MONT BELVIEU AREA
LPG - NGL PIPELINES



NATIONAL PETROLEUM COUNCIL

DETROIT -SAMARIA-SARNIA-TOLEDO AREA
CRUDE OIL AND PRODUCTS PIPELINES



NATIONAL PETROLEUM COUNCIL

LIMA-CYGNET-TOLEDO AREA

CRUDE OIL AND PRODUCTS PIPELINES

MAJOR SYSTEM EXPANSIONS SINCE 1967

The following tables show the major pipeline system expansions which have occurred since 1967. Systems existing in 1967 as well as new systems completed since that time are listed.

The increases shown represent expansions of main segments of a system. Total system expansions may be greater than the increase shown in the tables. Some smaller expansions may not be shown due to variations in the method of reporting in the 1967 NPC survey as compared to the 1978 NPC survey.

Crude Petroleum	MB/D Increase
Amoco (to Chicago)	122
Arco-Pure	65
Capline	780
Chicap	322
Lakehead	1,070
Marathon (from Patoka)	91
Minnesota	74
Phillips (from Cushing)	27
Platte	19
Rancho	46
Texoma	110

Refined Products	MB/D Increase
Badger	28
Buckeye	Numerous
Calnev	30
Chevron	7
Cheyenne	7
Colonial	960
Explorer	108
Gulf	9
Kaneb	18
Marathon	Numerous
Olympic	66
Pioneer	18
Plantation	127
San Diego	25
Seminole	9
Southern Pacific	94
Texas Eastern	115

Refined Products (Continued)	MB/D Increase
West Shore	115
Williams	Numerous
Wolverine	28
Wyco	17
Yellowstone	22

LPG and NGL	
Chapparal	37
Dixie	31
Gulf	120
Hydrocarbon Transportation, Inc.	75
MAPCO Inc.	54
Mobil	27
Texas Eastern (Greenburg-Watkins Glen)	16

EIA-150A
(4-79)

Form Approved
OMB No. 038-R0404

NATIONAL PETROLEUM COUNCIL
U.S. PETROLEUM PIPELINE CAPACITY QUESTIONNAIRE

Cover Page

Reporting Company: ______________________________

Address: ______________________________

____

Employee of Reporting Company to be
Contacted if Questions Arise: ______________________________

Telephone Number: (_______)______________________

Number of Sections Described: __________

Please return by May 18, 1979 to: Mrs. Joan Walsh Cassedy
Committee Coordinator
National Petroleum Council
1625 K Street, N.W.
Washington, D.C. 20006
(202) 393-6100

4/79

GENERAL INSTRUCTIONS

In **Part I** you are asked to furnish information about your company's overall pipeline system. Requested on these pages are:

- Trunk line system maps similar to those now supplied to the DOE on a biannual basis, and

- A general description of any planned new pipeline systems and plans for extension and expansion of existing systems.

Because pipeline companies may own numerous separate systems which are not interdependent, in **Part II** you are asked to divide your various systems into suitable sections. Such sections may be from the origin to termination point or may be divided by breakout tankage. **Part II** concerns each of these sections individually. Please number the pages relating to each pipeline section consecutively.

If a question does not apply to the pipeline section being reported, please enter "NA" where appropriate.

A sample completed questionnaire has been provided for your information. If additional blank questionnaires are required, they may be obtained from the National Petroleum Council office, or they may be copied from these originals.

PART I

Pipeline Company: ______________________________

SYSTEM MAPS

Please supply trunk line system maps similar to those now supplied to the DOE on a biannual basis. Such maps should not, however, include any daily average throughput information. Map information should include locations, capacities of the various line sections, and type of service.

If your pipeline system originates, connects, or terminates at any of the locations listed below, please place an "X" before the appropriate location. Supply detailed area schematics if such are available, including explanatory narrative. Place an "M" before each location for which a map is enclosed.

Houston—Pasadena—Texas City	Corpus Christi
Cushing	Dallas—Fort Worth
St. Louis—Wood River	Tulsa
Chicago	Toledo—Detroit
St. James	Cleveland—Akron
Patoka	Pittsburgh
Lima	Philadelphia
Marysville (Michigan)	New York (Newark, Bayonne, Linden)
Longview (Texas)	Los Angeles—Long Beach
Midland	San Francisco
Port Arthur—Beaumont	Conway—Hutchinson (Kansas)
Lake Charles	Mont Belvieu

Pipeline Company: ____________________

FUTURE NEW SYSTEMS OR EXPANSION PLANS

Provide a general description of any planned new pipeline systems or sections thereof and plans for extension and expansion of existing systems by location, pipe size, added capacity, and status. Such expansions should be firm (announced) proposals with anticipated start-of-construction and completion schedules. If possible, the above should be shown and designated on the trunk line system maps called for on page 1.

Description of New Systems or Expansion Plans:

PART II

Section No. ______
Page ______

Pipeline Company: ____________________

GENERAL DESCRIPTION OF SECTION

This description should be very general, indicating crude, products, or LPG service, location of the beginning and end of the section, major origin points, other pipeline connections, and refinery receipt or delivery points. The description should also include direction of line flow and the capability of the section to pump in the reverse direction. If the reversal of flow would require major modifications (such as existing pump station piping changes and installation of an originating station), please include a statement to that effect. All data reported should be as of December 31, 1978.

General Description of Section:

Pipeline Company: ______________________________

PIPELINE SERVICE

If more than one of the indicated hydrocarbon liquids is being batched through the section, please indicate by checking where appropriate:

Refined Product ______ LPG ______ Crude ______

CAPACITY

Provide the normal attainable capacity of the section in thousand barrels per day (MB/D) based on the company's operating experience. Capacities may differ within line sections due to differing line sizes and other factors. In this case, indicate the minimum/maximum range.

Capacity—(Indicate Basis for Determination)	**(MB/D)**
a. **Products Lines**	
Based on No. 2 Fuel Oil	______
Based on Gasoline	______
Based on "Normal" Mix (describe in Explanation section, page 5)	______
Average Summer Capacity	______
Average Winter Capacity	______
b. **Crude Systems**	
Winter	______
Summer	______
c. **LPG Systems**	
Average	______
d. **Potential for Expansion of System (excluding looping)**	
Is pipeline at maximum economic capacity? (Yes/No)	______
If "No" give approximate maximum economic capacity.	______

Section No. ______
Page ______

Pipeline Company: ____

EXPLANATION

Should include the following where applicable:

a. Effect on capacity of actual crude batch movements in a predominantly product pipeline system.

b. Seasonal variations in capacity in excess of 5% due to temperature effects on crude viscosities.

c. Effect on capacity of actual increased movements of heavier and higher viscosity crude such as Alaskan Prudhoe Bay crude.

d. Range of gravities and viscosities of crudes normally handled.

e. Other.

ORIGIN INFORMATION

The following table requests a more detailed description of the origin points of the previously described line section. The name or place of origin may be either a place or company-named facility. The type of facility should be specified in the Type column by one of the following symbols:

(G) Gathering
(R) Refinery
(WT) Water Terminal
(TS) Tank Storage
(P/L) Connecting Pipeline
(U/S) Underground Storage
(PDT) Products Distribution Terminal
(O) Other (explain in Comments column)

Additional comments concerning connecting pipelines, sources of production, sources of volumes, or any portion of the system may be placed in the Comments column or on the back of this page.

Name or Place of Origin	Type	Place and State	Size (inches)	Origin Capacity (MB/D)	Comments

Pipeline Company: ____

Section No. ____
Page ____

DELIVERY FACILITIES INFORMATION

The following table requests a more detailed description of the delivery facility points of the previously described line section. The name or place of delivery may be either a place or company-named facility. The type of facility should be specified in the Type column by one of the symbols listed on page 6.

Additional comments concerning connecting pipelines, sources of production, sources of volumes, or any portion of the system may be placed in the Comments column or on the back of this page.

Name or Place of Delivery	Type	Place and State	Size (inches)	Delivery Capacity (MB/D)	Comments

Pipeline Company: ______

Section No. ______

Page ______

PETROLEUM PIPELINE COMPANIES WHICH PROVIDED INFORMATION FOR THIS REPORT

Allegheny Pipeline Company
Alyeska Pipeline Service Company
Amdel Pipeline Inc.
American Petrofina Pipe Line Company
Amoco Pipeline Company
Arapahoe Pipeline Company
ARCO Pipe Line Company
Ashland Petroleum Company
Ashland Pipe Line Company
Atlantic Richfield Company
ATA Products System
Badger Pipe Line Company
Basin Pipe Line System
Belle Fourche Pipeline Company
Black Lake Pipe Line Company
BP Pipelines, Inc.
Buckeye Pipe Line Company
Butte Pipe Line Company
Calnev Pipe Line Company
Capline Pipeline System
Capwood Pipeline System
Casa Products System
Cenex Pipeline Company
Chase Pipe Line Company
Cherokee Pipe Line Company
Chevron U.S.A.
Cheyenne Pipeline Company
Chicap Pipe Line Company
Cities Service Pipe Line Company
Coastal States Gas Corporation
Cochin Pipe Line Company
Collins Pipeline Company
Colonial Pipeline Company
Continental Pipe Line Company
Cook Inlet Pipe Line Company
Cosden Pipe Line Company
CRA, Inc.
Cushing-Chicago Pipe Line System
Diamond Shamrock Corporation
Dixie Pipeline Company
El Paso Products Company
Emerald Pipe Line Corporation
Eugene Island Pipe Line System
Eureka Pipe Line Company
Everglades Pipe Line Company
Explorer Pipeline Company
Exxon Pipeline Company
Ferriday System
Four Corners Pipe Line Company

Getty Pipe Company
Getty Pipeline, Inc.
Gulf Central Pipeline Company
Gulf Refining Company
Harbor Pipeline System
Hydrocarbon Transportation, Inc.
Jayhawk Pipeline Corporation
Jet Lines, Inc.
Kaneb Pipe Line Company
KAW Pipe Line Company
Koch Industries, Inc.
Lake Charles Pipe Line Company
Lakehead Pipe Line Co., Inc.
Laurel Pipe Line Company
Leonard Crude Oil Company
L & L Pipe Line System
MAPCO Inc.
Marathon Oil Company
Marathon Pipe Line Company
Mesa Pipeline System
Michigan-Ohio Pipeline Corporation
Mid-Valley/Marathon Pipeline System
Mid-Valley Pipeline Company
Minnesota Pipe Line Company
Mobil Oil Corporation
Mobil Pipe Line Company
Neale Pipeline System
Ohio River Pipeline Company
Olympic Pipe Line Company
Osage Pipeline Company
Owensboro-Ashland Company
Ozark Pipeline System
Paline Pipeline System
Panotex Pipeline Company
Parish Pipeline System
Phillips Pipe Line Company
Pioneer Pipe Line Corporation
Plantation Pipe Line Company
Plains Pipeline
Platte Pipe Line Company
Portal Pipe Line Company
Portland Pipe Line Corporation
Powder River Corporation
Pure Transportation Company
Rancho Pipeline System
River Pipeline Company
SAAL Products Pipeline System
San Diego Pipeline Company
Sante Fe Pipeline Company
Seaway Pipeline, Inc.
Shamrock Pipe Line Corporation
Shell Pipe Line Corporation
Ship Shoal Pipeline System

Sinclair Pipeline Company
Sohio Pipe Line Company
Southern Pacific Pipe Lines, Inc.
Sun Pipe Line Company
Tecumseh Pipe Line Company
Tenneco Oil Company
Texaco - Cities Service Pipe Line Company
Texas Eastern Products Pipeline Company
Texas - New Mexico Pipe Line Company
The Texas Pipe Line Company
Texoma Pipe Line Company
Trans Mountain Oil Pipe Line Corporation
Trust Pipe Line Company
Vickers Petroleum Corporation
Wascana Pipe Line, Inc.
Wesco Pipe Line Company
West Emerald Pipe Line Corporation
West Shore Pipe Line Company
West Texas Gulf Pipe Line Company
Williams Pipe Line Company
Wolverine Pipe Line Company
Woodpat Pipeline System
Wyco Pipe Line Company
Yellowstone Pipe Line Company

GLOSSARY

aerial patrol -- the use of an aircraft at low altitude and speed to observe the pipeline right-of-way.

asphaltic -- a crude oil having a predominant base of asphalt, with very little paraffin wax, but often relatively high in sulfur, oxygen, and nitrogen content. This type of crude is particularly suitable for making high quality gasoline, lubricating oil, and asphalt.

backfill -- soil replaced in the ditch to cover the pipe. Also, the act of covering the pipe in the ditch.

batches -- homogeneous quantities of petroleum shipped through a pipeline usually having a specified minimum acceptable size.

B/D -- Liquid volumes in barrels per day, (e.g., MB/D -- thousands of barrels per day).

booster pump station -- a pumping facility at an intermediate location which will increase the flow rate of a pipeline.

breakout tankage -- a storage facility consisting of one or more tanks used to accommodate petroleum between pipelines or pipeline segments having different pumping rates.

capacity -- the maximum volume that a pipeline can move between two points during a given time period using existing equipment. Is dependent on pipeline diameter; pipeline length; pumping equipment; intermediate locations; pipeline topography; and petroleum viscosity, temperature, and gravity.

cathodic protection -- method of preventing corrosion of pipelines, tanks, and other metal objects by applying weak DC current to counteract the currents associated with ion exchange of corrosion.

common carrier pipeline -- a pipeline with the authority and responsibility (state or federal) to provide public transportation for hire.

common stream -- movement of similar types of petroleum with a common range.

contamination -- mixing of small amounts of petroleum into a larger batch, adversely affecting the quality of the larger batch.

corrosion -- the exchange of ions of a metal object; commonly referred to as "rusting."

crude oil -- raw, unrefined petroleum or hydrocarbon liquid.

custody -- taking possession of and responsibility for (but not title or ownership of) a petroleum shipment.

cycle -- a sequence of pipeline movements (for example, gasoline-kerosine-jet fuel-No.2 fuel oil-kerosine-gasoline) which is repeated on a consistent basis; usually five, seven, or ten days in length.

dispatchers -- pipeline personnel who control the system from a central location.

distillate -- petroleum products such as kerosine, jet fuel, diesel fuel, and No. 2 fuel oil.

ditching machine -- mechanical equipment used to dig the ditch.

ductile -- characteristic of steel which refers to its bendability.

feeder lines -- a pipeline delivering petroleum into a common carrier pipeline.

fractionator -- a processing plant which separates natural gas liquids into the marketable components ethane, propane, butane, and natural gasolines.

fungible -- products or crude oils of like characteristics which can be mixed without downgrading.

gathering system -- the network of small lines used to collect crude oil and gas liquids from individual production units or facilities.

gravity -- the weight per unit measure of petroleum liquid, usually expressed in either degrees API or related to water as a specific gravity. API gravity is a measure of density in degrees API; specific gravity is the weight per unit of a liquid as related to water.

gravity-sulfur bank -- a system of accounting used on common stream pipelines where a shipper is compensated or penalized for shipping crude oils of better quality (high gravity, low sulfur) or lesser quality (low gravity, high sulfur) than the quality of the common stream.

hydraulic -- the use of flowing pressurized fluid in cylinders to operate valves and other controls.

hydrostatic test -- the test of a pipeline prior to operation during which it is filled with water and pressurized to a level which will subject pipe, welds, and other components to a stress of not more than 100 per cent of specified minimum yield strength (SMYS) of the pipe or less than 90 per cent of the SMYS. The system is sealed off from external pressure sources and the pressure is maintained and recorded for up to 24 hours.

inhibitors -- small amounts of special chemicals injected into the pipeline as required to eliminate internal corrosion in pipelines and storage tanks.

interface -- the point or area at which two dissimilar products or grades of crude oil meet in a pipeline as they are pumped, one behind the other.

intermediate crude oil -- a crude oil having a sulfur content greater than 0.5 percent and less than one percent (by weight).

joint rate -- a tariff associated with the movement of petroleum through two or more pipelines, from an original point on one pipeline to a different destination point on a different delivering pipeline, where the tariff may be equal to or lower than the sum of the individual local tariffs.

joint venture pipeline -- either: (1) the corporate joint venture in which two or more companies own stock in a pipeline company; or less frequently (2) the undivided interest system. The corporate joint venture is normally financed by use of throughput agreements and private placement loans; contracts for construction of pipeline facilities, publishes tariffs under its corporate name, and arranges for the performance of all operation, maintenance, and recordkeeping. The Board of Directors of the company exercises full control by establishing the financing program, tariff rates, and the capital and operating budget.

line fill -- the petroleum contained in all pipes, manifolds, pump and valve bodies, and the bottoms of tanks used by pipelines.

local rate -- a tariff associated with movement from a pipeline origin point to a destination point on the same pipeline.

loop -- the construction of a pipeline parallel to an existing line, usually in the same right-of-way, to increase the capacity of the system.

LPG (liquified petroleum gases) -- butane, propane, and ethane which are separated from natural and refinery gases and transported in liquid form.

manifold -- an array of piping and valves which connects the tanks, pumps, and pipelines.

maximum economic capacity -- the maximum volume that a fully expanded pipeline can move economically between two points without constructing a loop.

naphthenic crude -- a crude oil having a predominant base liquid which, when separated by a distillation process, is used as a solvent in the manufacture of paint, as a dry cleaning fluid, and for blending with casinghead gasoline in producing motor gasoline.

NGL (natural gas liquids) -- high vapor pressure, hydrocarbon liquids separated from wet natural gas and moved by pipeline to a fractionation facility where the components are separated into ethanes, propanes, butanes, and natural gasoline.

nominate -- the process by which a shipper notifies a pipeline of the amount of petroleum he wishes to ship during the next month. Notification is usually done by letter or telegram.

paraffinic crude -- a crude oil having a predominant base liquid which, when separated by a distillation process, is used in the manufacture of waxes and lubricating oils.

petroleum product -- broad definition of gasolines, distillates, and heating oils--the ouput of a petroleum refinery.

pipeline contractor -- one who specializes in building pipeline facilities.

pneumatic -- use of high pressure air to operate valves or other controls.

pour point -- the temperature at which a liquid will not readily flow or at which it congeals.

private line -- a pipeline owned and operated to move only the owner company's crude, LPG/NGL, or products.

product distribution terminal -- a facility consisting of storage tanks, pumping equipment, meters, and loading docks where the product is pumped into trucks or tank cars for delivery to bulk plants or service stations. Terminals normally receive products from pipelines, barges, and tankers.

proration -- a method of apportioning pipeline capacity when nominated shippers' volumes exceed the pipeline capacity.

radiographic inspection -- use of X-rays to determine the quality of pipeline welds.

recalibration -- a maintenance task used in pipelines to check pressure, volume, and temperature measuring or compensating devices and safety devices.

right-of-way markers -- signs used to physically mark pipeline crossings and routes.

sediment -- a sludge which accumulates in pipelines and tanks and consists of wax, mill scale, dirt, and other debris. It is periodically cleaned out of the facilities.

segregated -- moving products or crude oil in a manner which maintains the identity and specifications of each individual batch.

sour crude oil -- a crude oil having a sulfur content greater than one percent (by weight).

sulfur content -- the amount of sulfur in crude, expressed as a percentage by weight. This sulfur can be in the form of elemental sulfur, mercaptan sulfur, and/or hydrogen sulfide.

supervisory equipment -- computers, graphic panels, cathode ray tubes, remote telemetry units, and other components used in the remote control and monitoring of a pipeline.

sweet crude oil -- a crude oil having a sulfur content of less than 0.5 percent (by weight).

tank farm -- a group of tanks manifolded together to provide origin, destination, or operational storage for pipeline movements.

tariff -- the document published by the common carrier pipeline owner setting rates charged and rules and regulations under which these services will be performed. Interstate common carriers must file tariffs with the Federal Energy Regulatory Commission.

tariff rate -- the charge in cents/barrel set out in the published tariff which a shipper must pay for transportation services.

tensile strength -- the measure of any material's ability to withstand tensile stress or being pulled apart. Some pipe steels will withstand 70,000 pounds per square inch.

trunk line -- a large diameter pipeline most usually delivering petroleum into a refinery or production distribution terminal.

undivided interest -- a form of pipeline ownership in which the investors share in the pipeline capacity according to their percentage of ownership in the system. Each publishes a tariff and collects its own revenues. One investor is usually employed to manage, schedule, operate, and maintain the facilities.

viscosity -- the internal resistance to flow of a fluid. This characteristic is usually measured in Saybolt Seconds Universal (SSU) for petroleum liquids. This is the time required for a standard quantity of a liquid to flow through a standard orifice at a set temperature.

wax -- a component of crude oil which will generally solidify at normal ambient temperatures and have a tendency to collect on pipe walls and on the sides and bottoms of tanks.