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LAKE UNION AND SHIP CANAL HISTORICAL USE STUDY

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INTRODUCTION

This report is organized into three major sections. Part I is a brief history of development on Lake Union and the Lake Washington Ship Canal. Part II describes the types of land and water uses that have historically affected water quality in the Lake and Ship Canal and presents specific information about the Seattle Gas Plant, the Steam Plant, and Fishermen's Terminal. Part III contains a list of suggested sources for researching the historic use of a site. Appendix A summarizes the sources of water pollution identified in Lake Union and the Ship Canal in a 1943 report. A separate memorandum describes specific incidences and sources of pollution mentioned by individuals who were interviewed as part of the research for this report.

A set of maps indicating major uses along Lake Union and the Ship Canal has been prepared as part of this report. These maps were compiled from a variety of sources and are not comprehensive because different information was available for each year. The maps indicate uses in 1897, 1917-1919, 1931, 1941-1943, 1951-1952, and 1963. The City of Seattle Land Use and Transportation Project has prepared a 1986 map which shows current land uses, including business names.

In addition, tables have been compiled which list major uses for each time period covered by the maps. The tables are organized into the following categories of uses: 1) shipbuilding and boatbuilding; 2) boat and machine repair; 3) marinas and moorage; 4) petroleum and related industries; 5) chemical companies; 6) lumber and wood products industries; 7) bulk materials handling (sand, gravel, coal, asphalt, clay, cement); 8) metal products industries; 9) seafood products/fisheries; and 10) other industries. Information listings on the tables are organized by Ballard, Fremont/Ship Canal, and Lake Union.

I. BRIEF HISTORY OF DEVELOPMENT ON LAKE UNION AND SHIP CANAL

The original inhabitants of Lake Union and Salmon Bay were Native Americans affiliated with the Duwamish tribal group, which was part of the Puget Sound Salish peoples. The Shilshoh group occupied Shilshole Bay, Salmon Bay, and an area northwest of Lake Union. Another group was located near where the University of Washington is today. An encampment on the south shore of the lake was a potlatch site and gathering place until the 1870s. The local tribes lived in winter villages and seasonal camps and depended upon the abundant fish, plant, and animal life along rivers, lakes, and Puget Sound for their livelihood. The Indian people called Lake Washington hyas chuck or "big water," and Lake Union was known as tenas chuck or "little water."

Originally, the level of Lake Union was about eight feet below Lake Washington. The two lakes were separated by a ridge between Portage Bay and Union Bay, and the waters of Lake Washington flowed through the Black River and the Duwamish River into Elliott Bay. A few small streams fed Lake Union, and its outlet was a small nonnavigable stream which descended through a narrow, steep channel into Salmon Bay. Salmon Bay was originally a saltwater tidal inlet; when the Locks were opened in 1916, it was raised to the level of Lake Union and became freshwater. Lake Washington was lowered to the level of Lake Union, and it drained through the Ship Canal after the digging of the Montlake Cut in 1916.

In the 1890s, Lake Union was estimated to be about 905 acres in size, compared to about 688 acres in the 1920s, and closer to 600 acres today. At its southwest corner, the water extended about two blocks farther south, and there was a peat bog. Both Westlake and Fairview Avenues were initially built on pilings.

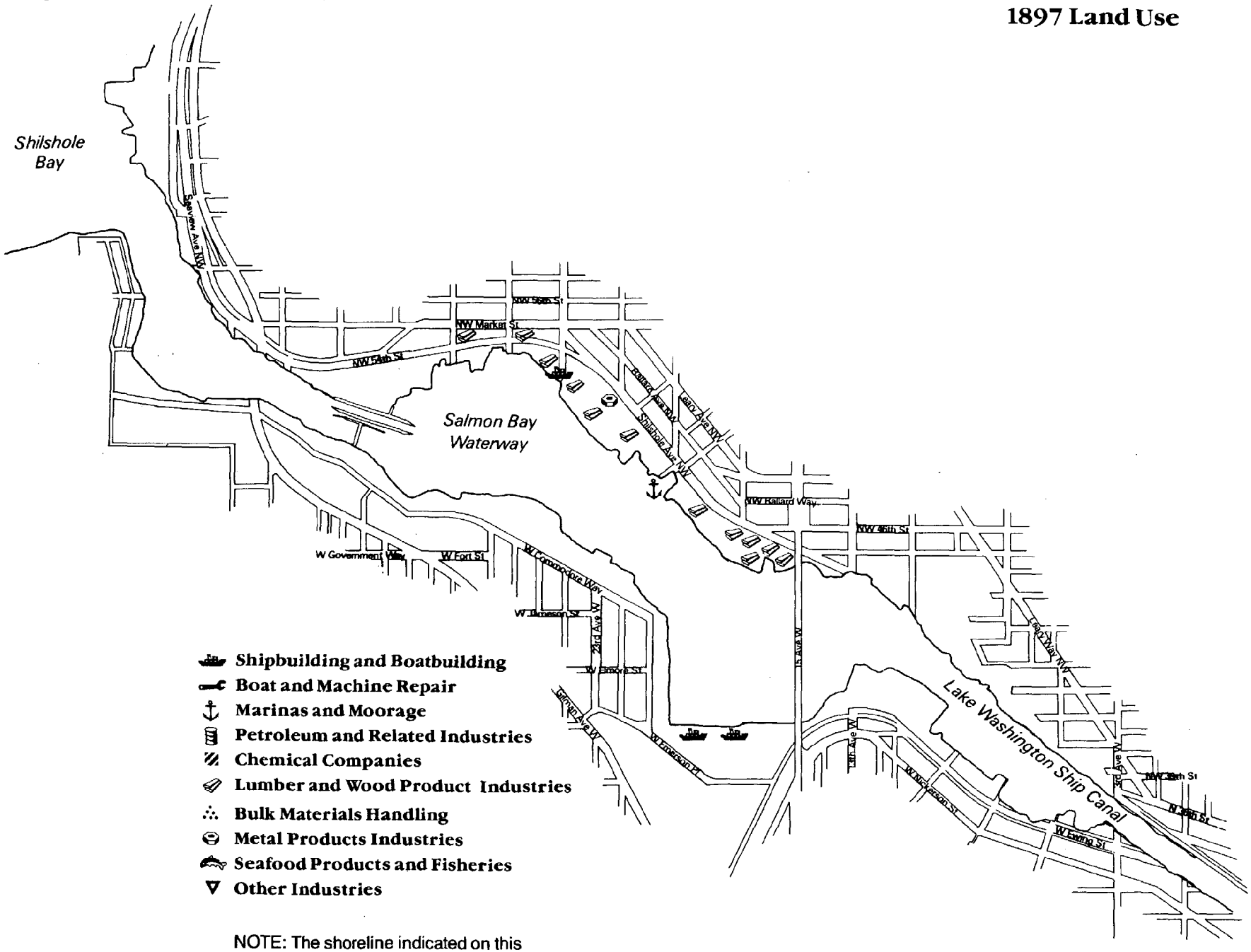
Early Development: 1853-1897

The first claim made by a white settler on Lake Union was staked by David Denny in 1853, but he did not move to the area until 1870. An important early event in Lake Union's history occurred at a Fourth of July picnic in 1854 at Thomas Mercer's homestead on the south shore. Mercer named Lake Washington after our first president, and Lake Union was named in anticipation of the union between Lake Washington and Puget Sound. Its name may also reflect the hoped for union of Washington territory with the United States.

In the 1850s, a sawmill was built at Fremont, but it was burned during the 1855-1856 Indian war. The first major industrial use of Lake Union was the shipment of coal in the 1870s. Coal was moved from the Newcastle mines on the east side of Lake Washington to the lake by a tramway, then carried on a barge to Union Bay. It was moved via another tram across the "portage" down to Portage Bay, where it was again loaded onto a barge. At the south end of Lake Union, it was moved from the barge onto a train bound for the Pike Street coal bunkers. Not surprisingly, this method of transport proved uneconomical and was abandoned in 1877. Brickmaking was another early industry along the lake, and in 1876 two plants produced about 750,000 bricks (Droker, 1977, p.22).

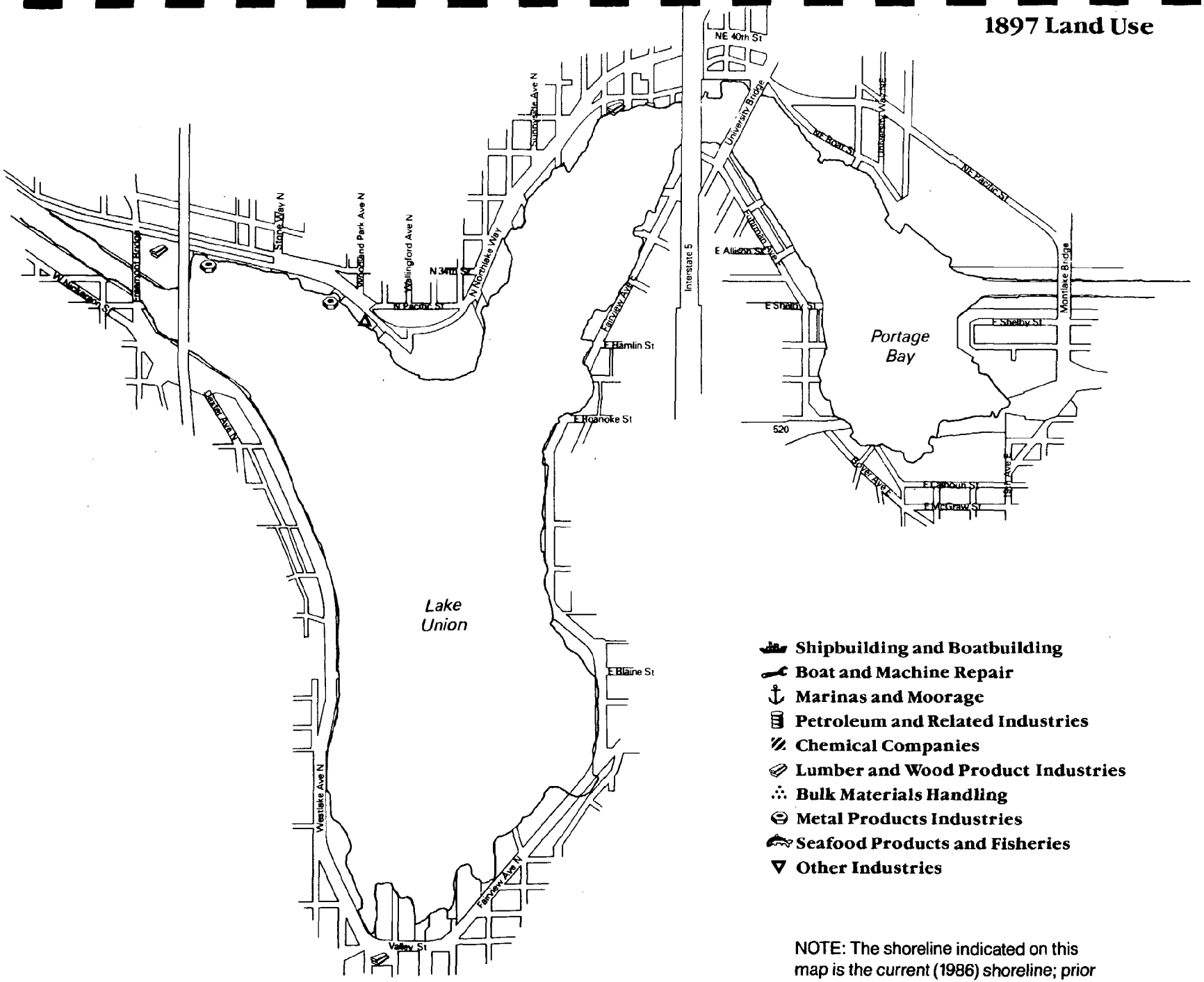
In 1882, the Lake Union Lumber and Manufacturing Company built a mill at the south end of Lake Union. It was purchased by David Denny in 1884, and he operated it as the Western Mill until the mid-1890s when it became the Brace and Hergert Mill. Sawdust from the mill was dumped into the Lake, the beginning of a landfill which eventually covered the small bay at the Lake's southwest corner.

1897 Land Use



NOTE: The shoreline indicated on this map is the current (1986) shoreline; prior to filling, the lake occupied a larger area at the time period depicted.

1897 Land Use



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Streetcar and railroad construction spurred growth along Lake Union. After the streetcar line reached its south end, a fleet of boats served settlements on the north shore. These included the David T. Denny, the Latona, and the Maud Foster. The Seattle, Lake Shore & Eastern railroad was organized in 1886, and by 1888, it linked Ballard and the north shore of Lake Union with downtown.

Sawmills were also established at Fremont and Brooklyn, today's University District, and constituted the lake's most important industry until after World War I. The community of Fremont was named by Luther Griffith, a Seattle real estate developer, after his home town of Fremont, Nebraska. Other communities on the north side of Lake Union included Edgewater, east of Fremont, and Latona, between Edgewater and Brooklyn. These two communities now comprise the Wallingford neighborhood. A settlement known as Ross was on the north side of Queen Anne Hill, along Nickerson Street, where Seattle Pacific University is today.

Even in these early years, the discharge of raw sewage into Lake Union was a pollution issue of local concern. Following the June 6, 1889 fire in downtown Seattle, the Lake apparently became a cesspool. At the same time, a local water company obtained a portion of Seattle's water supply from a point on the Lake's west side. This prompted the City to develop plans for a sewage system in the area (Phelps, 1957-1971, p. 187).

Although sawmills were a major early use on Lake Union, Ballard was the major lumber center of the Seattle area in its heyday. It was named for Captain William Ballard who platted 720 acres on the north shore of Salmon Bay in the 1880s. The Stimson Mill was established in 1888, the first and the largest of Ballard's many sawmills. Much of the rebuilding of downtown Seattle after the 1889 fire was accomplished with lumber from Ballard's mills.

The town of Ballard had about 1,200 residents at the time of its incorporation in 1890. By the turn of the century, Ballard was said to be the largest area of employment north of San Francisco. Its twenty mills constituted the world's largest shingle industry, producing 3 million cedar shingles per day in 1904 (Kreisman, 1985, p. 53). Other early industries along Salmon Bay included fishing and shipbuilding. Fishermen's Terminal was established by the Seattle Port Commission in 1913. Originally an independent town, Ballard was annexed to the City of Seattle in 1907. At that time, Ballard's population was 10,000 making it the seventh largest city in the state.

The 1897 map shows the many shingle mills and sawmills in Salmon Bay. Besides the Stimson Mill, other large operations included the Seattle Cedar Lumber Company and the West Coast Manufacturing and Investment Company Mill. Shipbuilders along the bay included T.W. Lake, T.H. Petersen, and E.S. Sorenson. The Ballard Boiler

Works and City Dock were other important facilities along Ballard's waterfront.

In contrast with Salmon Bay, Lake Union was less industrial in the 1890s. Besides the Western Sawmill, the Fremont Mill, and the Ferguson Mill at Brooklyn, there was a tannery at Edgewater on the north side of the Lake, and Pacific Iron Works was at Fremont.

Industrial Growth and Construction of the Ship Canal: 1898-1918

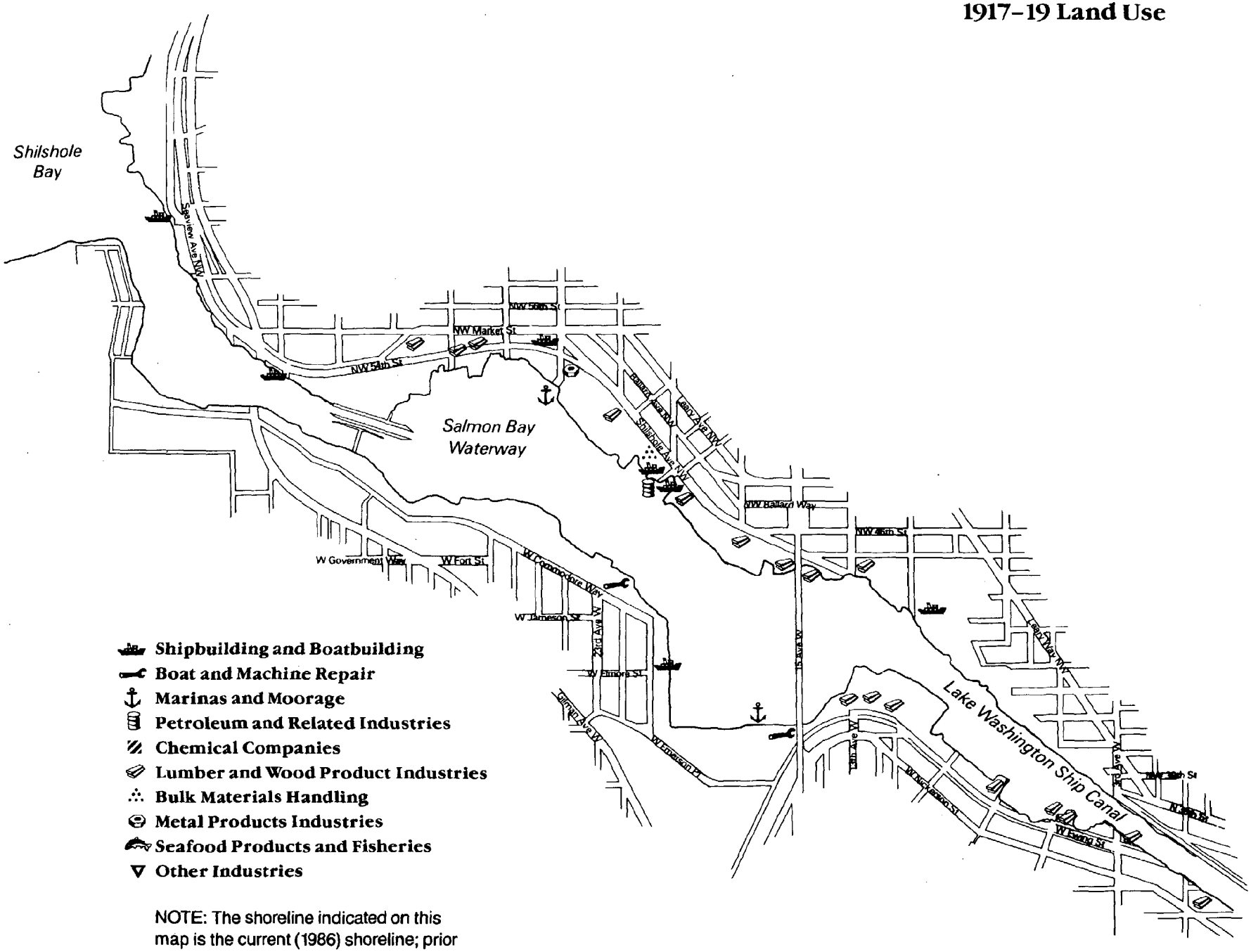
In the early years of the twentieth century, an asbestos factory was located in Fremont, and the Pacific Ammonia and Chemical Plant was established along Northlake Way in Edgewater in 1906. One of the most important early industrial facilities on the Lake was the Gas Plant, built by the Seattle Lighting Company in 1906. The effects of its operation are still being felt today in the contaminated soil and lake sediments at Gas Works Park. In 1914, the Seattle Steam Plant was built on Fairview Avenue, another prominent utility structure that remains to this day. Brief descriptions of the histories of these two facilities are presented in Part II. B, below.

At the turn of the century, ownership of the shore lands on Lake Union was unclear, and most upland owners used the abutting underwater property. In 1907, the Lake Union shore lands were sold by the State, in order to provide funds for the Alaska-Yukon-Pacific (AYP) Exposition. Property owners paid ten dollars per foot of waterfront in anticipation of increased values due to the proposed ship canal construction. The practice of renting moorage space to houseboat owners began at this time. The AYP Exposition was held on the University of Washington campus in 1909, and it celebrated Seattle's important ties with Alaska. During the Klondike Gold Rush of 1897, Seattle had become the chief outfitting port for eager prospectors bound for Alaska.

The idea of a link between Lake Washington and Puget Sound began with the early settlement of the area in the 1850s, many years before the Ship Canal was constructed. There were several early attempts to build a canal. One of the most ambitious was undertaken singlehandedly by Harvey Pike, a resident of Portage Bay. He believed that if there was an outlet for the waters of Lake Washington, the canal would dig itself. In 1860, he spent about a week working with his pick, shovel, and wheelbarrow before he abandoned the project. He apparently made fairly good progress, but construction of a canal was no one man task.

Shallow canals between the two lakes and from Lake Union to Salmon Bay were opened by the Lake Washington Improvement Company in 1885-1886. However, these canals were suitable only for small vessels and floating logs, and the canal and wooden locks between Lake Washington and Lake Union were abandoned by 1886.

1917–19 Land Use



- Shipbuilding and Boatbuilding
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- Marinas and Moorage
- Petroleum and Related Industries
- Chemical Companies
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- Bulk Materials Handling
- Metal Products Industries
- Seafood Products and Fisheries
- Other Industries

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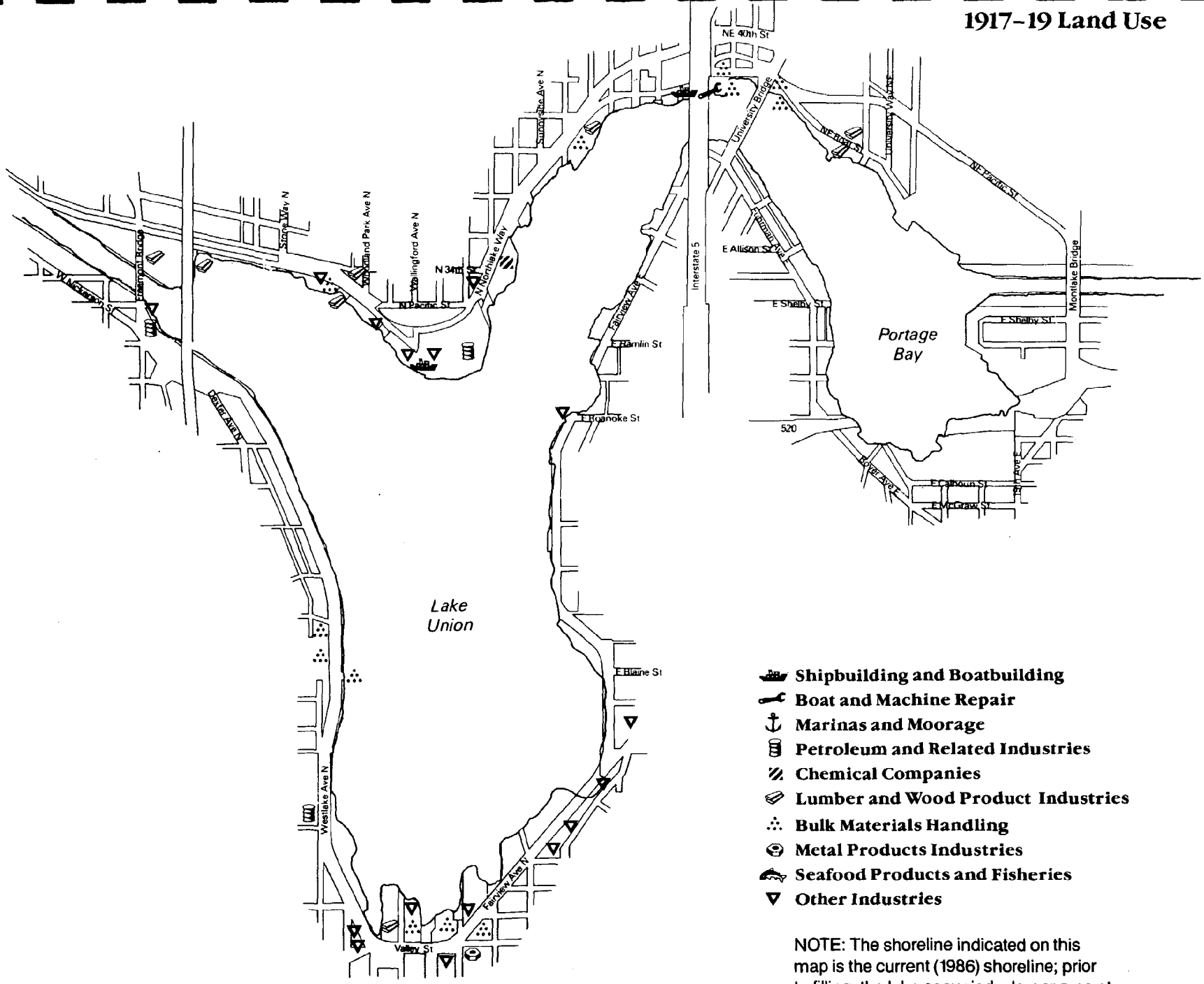
1917–19 Land Use



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The construction of the Lake Washington Ship Canal between 1911 and 1917 was a major stimulus to the industrial growth of Ballard and Lake Union. Many workers who came to the area lived in temporary quarters in houseboats on Lake Union. In 1914, a construction dam at Fremont broke, and Lake Union dropped 10 feet in 24 hours. Saltwater flowed into the lake for about ten days, and the dam was repaired within six weeks (Chrzastowski, 1983, p. 6.)

By July of 1916, the Locks opened at Ballard, and on August 25, 1916, the Canal was dug at the Montlake Cut. Forty-five million gallons of water flowed into Lake Union, and Lake Washington was lowered more than eight feet. The Canal opened for navigation on May 8, 1917 and was dedicated on the Fourth of July. The total cost of construction was about $3.7 million.

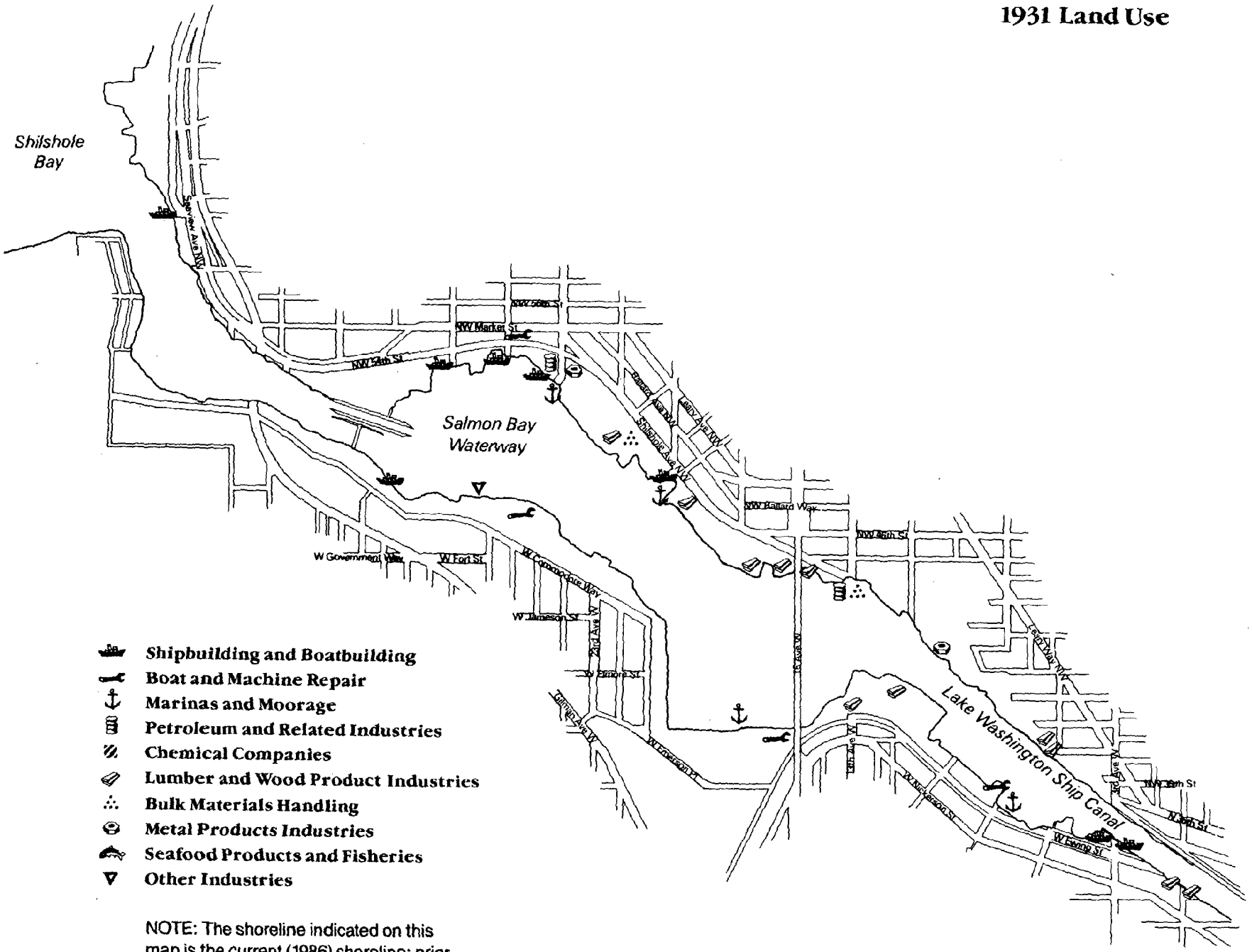
The completion of the Canal combined with the onset of World War I, accelerated the industrial growth of Lake Union and the Ship Canal. In 1915, William E. Boeing built and tested his first seaplanes on Lake Union. The first B & W seaplane was constructed at a small hangar at the foot of Roanoke Street in 1916 (Droker, 1977, p.51). The 1917-1919 map shows a wide variety of industries and businesses on the lake, including four asphalt plants, four coal companies, a Ford Motor Company Automobile Assembly Plant, several mills and lumber companies, wood products companies, a roofing company, a wool company, several laundries, a brick company, and a canning company (Libby, McNeill & Libby).

In 1917-1919, Ballard continued to be a lumber and shipbuilding center. Among its many shingle mills were Sobe, Campbell, Woodland, McLaughlin-Taylor, McDonald, Motor, and Phoenix companies. Other mills included the Stimson Lumber Mill, Seattle Cedar Manufacturing Company, Victoria, Gould, Canal, and Bolcom lumber companies. Shipbuilding and ship repair included Ballard Marine Railway, Allen, Fleming, Vanderwell Melchert, and Meacham & Babcock shipbuilding companies and Gulowsen Grei Engine Company. Fishing activity was centered at the Port Commission's Salmon Bay Terminal. The Salmon Bay Gravel and Standard Oil companies were established in Ballard by this time, two uses that would expand in the coming years.

<u>Diversification and World War II: 1919-1945</u>

During the period from 1919 to 1939, there was a downturn in Seattle's economy. The lumber industry in Ballard and Lake Union began to decline, especially on the Lake. During these years, however, major new industries sprang up along the Ship Canal, including Foss Tug and Northwest Steel Rolling Mills. Increasing numbers of sand and gravel companies and oil storage facilities were located on Lake Union and the Ship Canal. Although coal and asphalt companies were important on Lake Union in 1917, by the 1930s sand and gravel industries were the dominant bulk materials handling activities. These diverse industrial uses along Lake

1931 Land Use



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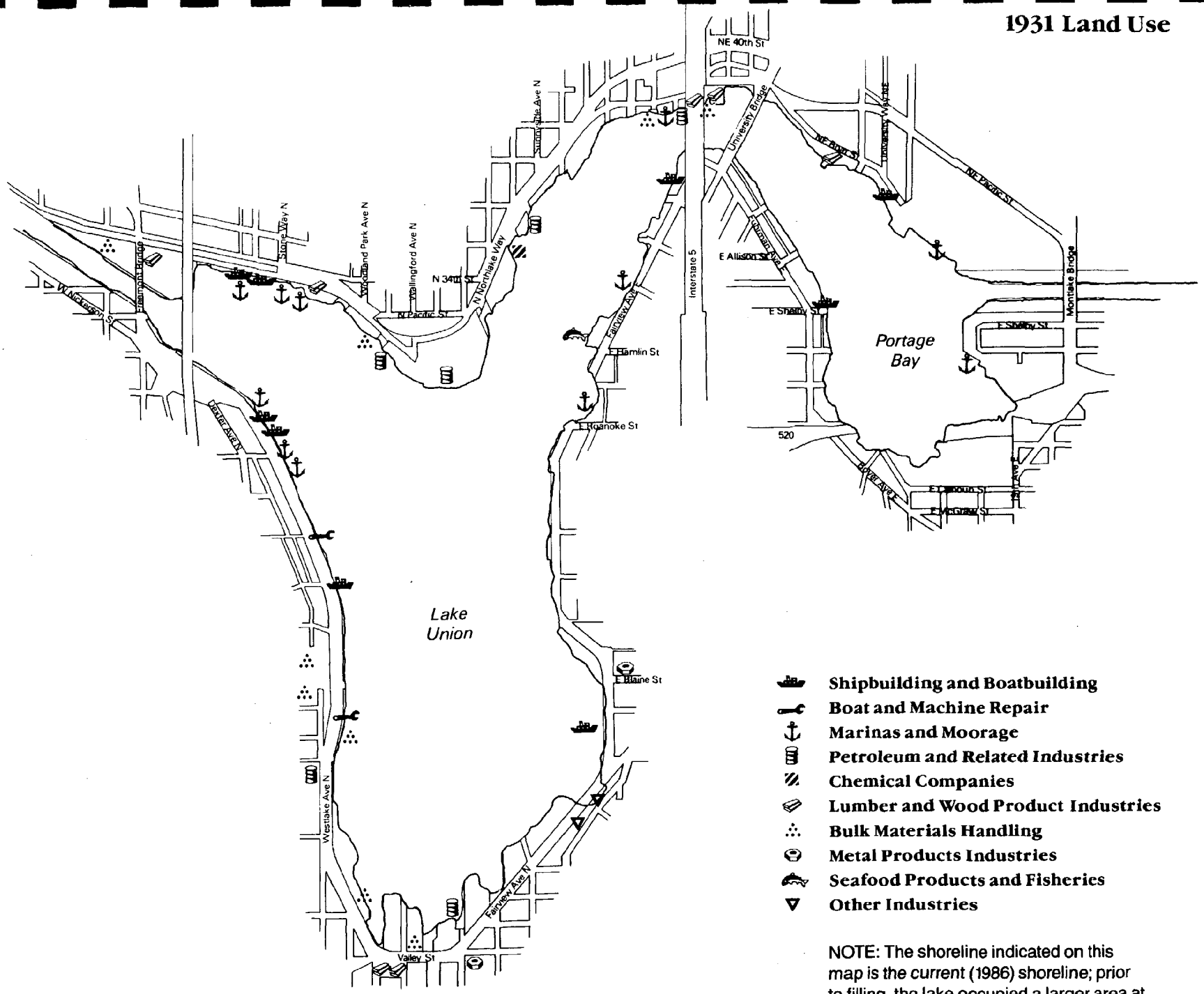

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Union and the Ship Canal are shown on the 1931 map.

Shipbuilding contined to be a major activity in Ballard, and more small boatyards were established on Lake Union. The Lake Union Dry Dock Company was started in 1919 and continues to operate today. It is touted as the only commercial shipyard for wooden boats on the West Coast. By the 1930s, Jensen Motor Boat, Blanchard Boat Company, Prothero & McDonald, and Franck & McCrary, were in business. All of these operations continued until at least the 1960s.

The headquarters of the Seattle Yacht Club were on Portage Bay, and the Queen City Yacht Club was on the east side of Lake Union at this time. Following the first World War, Lake Union was used for as a storage area for a variety of vessels. Moorage facilities became increasingly important on Lake Union, a use that has grown dramatically since World War II.

In the 1920s, 1,100 houseboats were blamed for polluting Lake Union and Lake Washington (Droker, p. 73). Nonetheless, houseboats were homes for many maritime workers, especially during the Depression in the 1930s. Ballard and Lake Union businesses were adversely affected by the Great Depression. By 1932, Lake Union, Lake Washington, and the Ship Canal were considered polluted according to a Seattle Engineering Department history (Phelps, 1957-1971, p. 194).

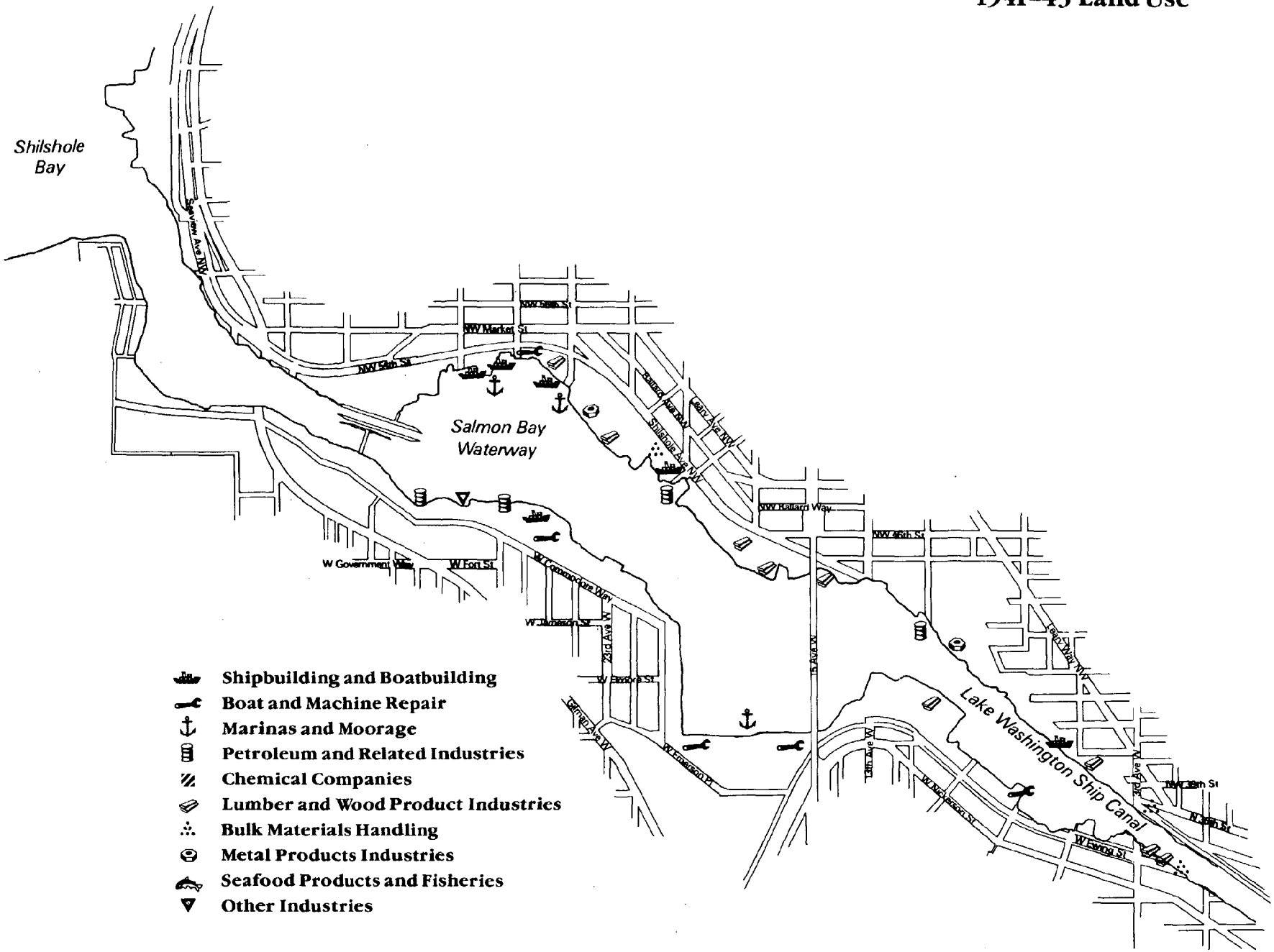
Immediately following the Depression, World War II was a boom period for Seattle's waterfront, including Salmon Bay and Lake Union. The major industrial activities along Lake Union and the Ship Canal during World War II are shown on the 1941-1943 map.

Shipbuilding became especially important on Lake Union and the Ship Canal as vessels were built and outfitted for war service. Major shipyards in Ballard were Ballard Marine Railway Company, Barbee Marine Yards, Sagstad Shipyard, Seattle Shipbuilding & Dry Dock Company, and Maritime Shipyard. Lake Union shipyards and boat builders included Lake Union Dry Dock, Franck's Boat Company, Jensen Motor Boat, Blanchard Boat Company, Prothero & McDonald, Grandy Boat Company, Washington Boat Works, Bryant's, and Shain Manufacturing Company. An increasing number of outfits specialized in marine repair.

Relative to shipbuilding, moorage decreased during the war. Wood products industries continued to decline in the area. The U.S. Coast Guard Wharf was south of the Locks, and the former sawmill site in south Lake Union became the Naval Armory.

A 1943 report entitled Sources of Pollution in Lake Washington Canal and Lake Union, described the existing shoreline as lined with concrete bulkheads, fills, docks, industrial plants, and houseboats. The principal industries were boatbuilding (mostly

1941–43 Land Use



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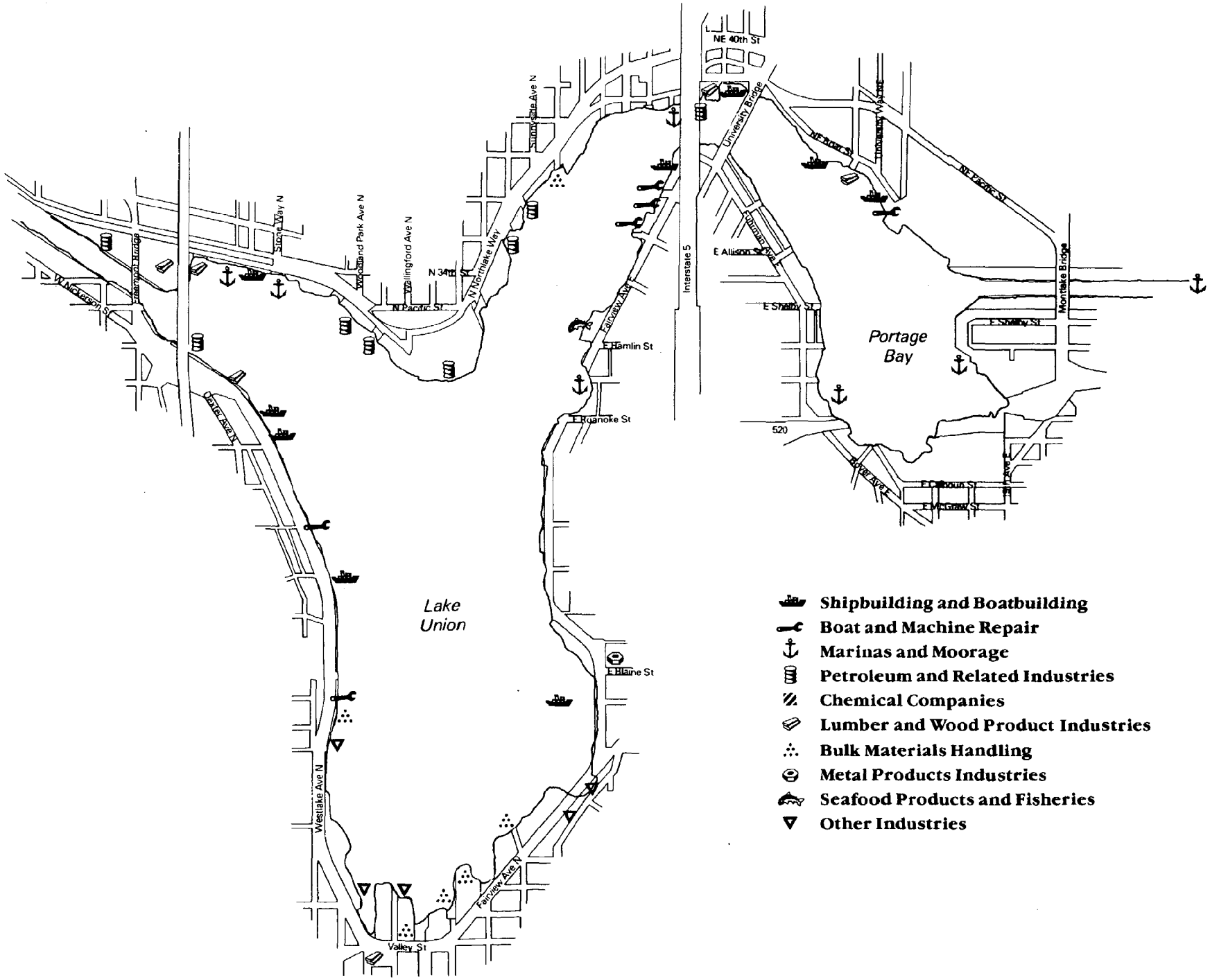

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boats less than 50 feet in length), sawmills and woodworking plants, and small machine shops. Moorings and service stations for small craft were found throughout the area, and storage dumps for water-transported oil and gravel were located in several areas. A considerable amount of raw sewage was dumped directly into the Lake and Canal from houseboats, industries, and some residences near the shores.

The report listed 15 boatbuilding operations; 10 machine shops and metal products industries; 12 fuel companies, storage and service stations; 8 sand, gravel, concrete, and asphalt companies; 10 lumber and wood products operations; the Seattle Gas Plant; the City Light Power Plant; Fishermen's Terminal; Libby, McNeill & Libby; Foss Tug Company; two yacht clubs; and four other industries along the Ship Canal and Lake Union. Other sources of pollution included 759 houseboats, direct sewer outfalls, and combined sewer overflows (CSOs). The sources of pollution enumerated in the report are summarized in Appendix A.

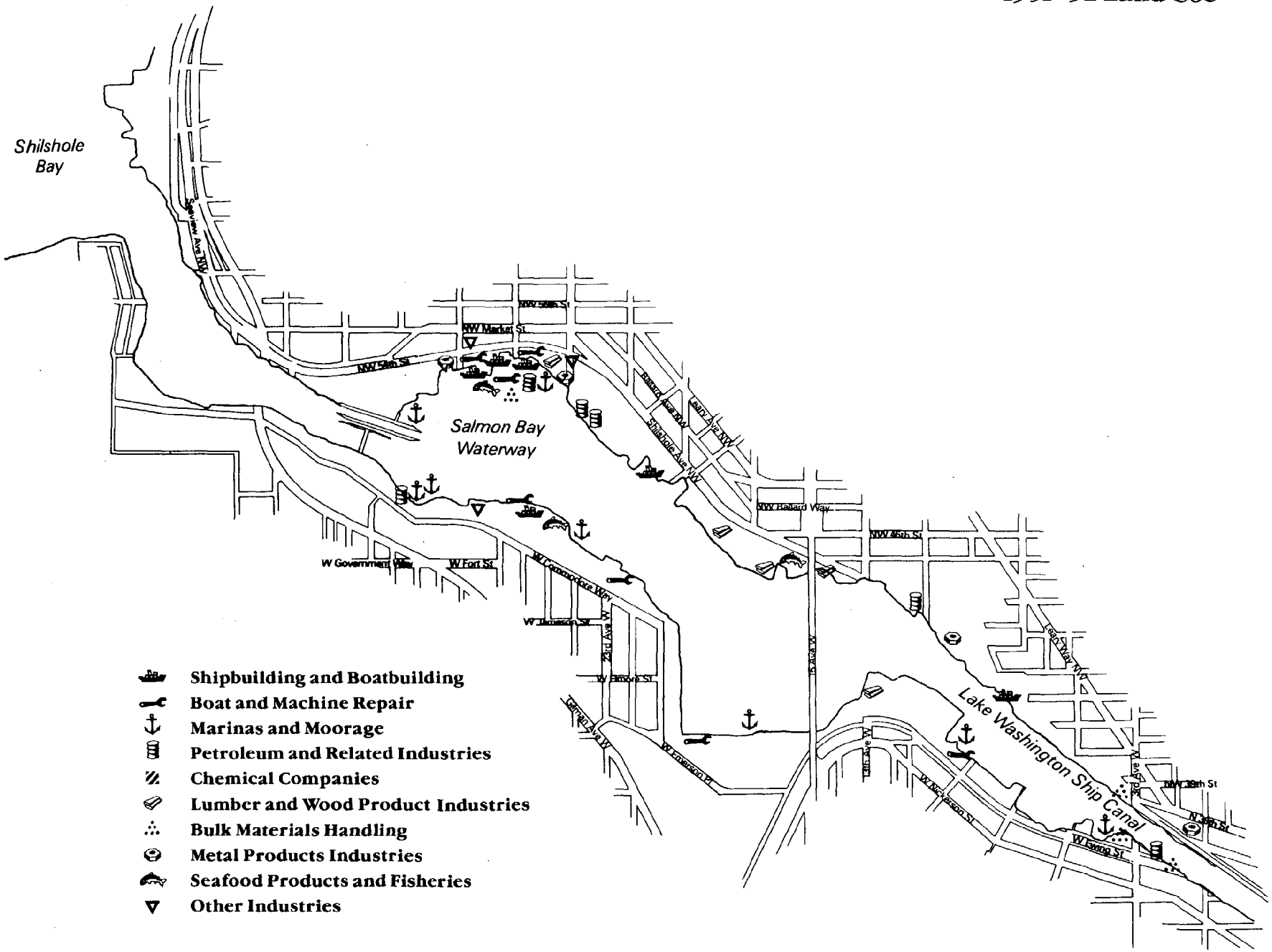
The most significant sources of pollution were the Seattle Gas Plant and the fishing boats at Fishermen's Terminal. At the Gas Plant, there were six outlets discharging wastes into the Lake which included a considerable amount of oil, and deposits of tar and other waste materials. Fish kills were reported in the vicinity of the operation, attributed to the large quantity of oil in the water. At Fishermen's Terminal, the primary sources of pollution were wood scraps, oil, bilge sludge, and metal trimmings. The Gas Plant, Fishermen's Terminal and the City Light Steam Plant are discussed separately in Section II. B, below. Clearly, by the 1940s, water pollution was becoming a problem in Lake Union and the Ship Canal.

Post World War II Development: 1946-1963

Immediately following World War II, some of the shipbuilders and boatyards on Lake Union and the Ship Canal became involved in ship breaking (demolition) or marine repair. During the postwar years, the Ballard waterfront remained primarily industrial, with shipbuilding and repair, fishing moorage, fish processing, plywood, and metal products industries.

On Lake Union, however, industrial activities began to give way to other uses. Offices, restaurants, and apartments were built along its shores, and the number of marinas and small boat sales operations mushroomed. Fishing boat moorage and marine repair were common. By the 1950s and 1960s, many lakeside businesses were involved in several activities, such as moorage, boat sales, and marine repair and service. Other businesses included marine transportation including floatplane and cruise services, a floating restaurant (Four Winds), Belknap Glass, paint companies, warehouse facilities, and other miscellaneous businesses. The 1952-1953 and 1963 maps illustrate postwar trends on the Lake and Ship Canal.

1951–52 Land Use



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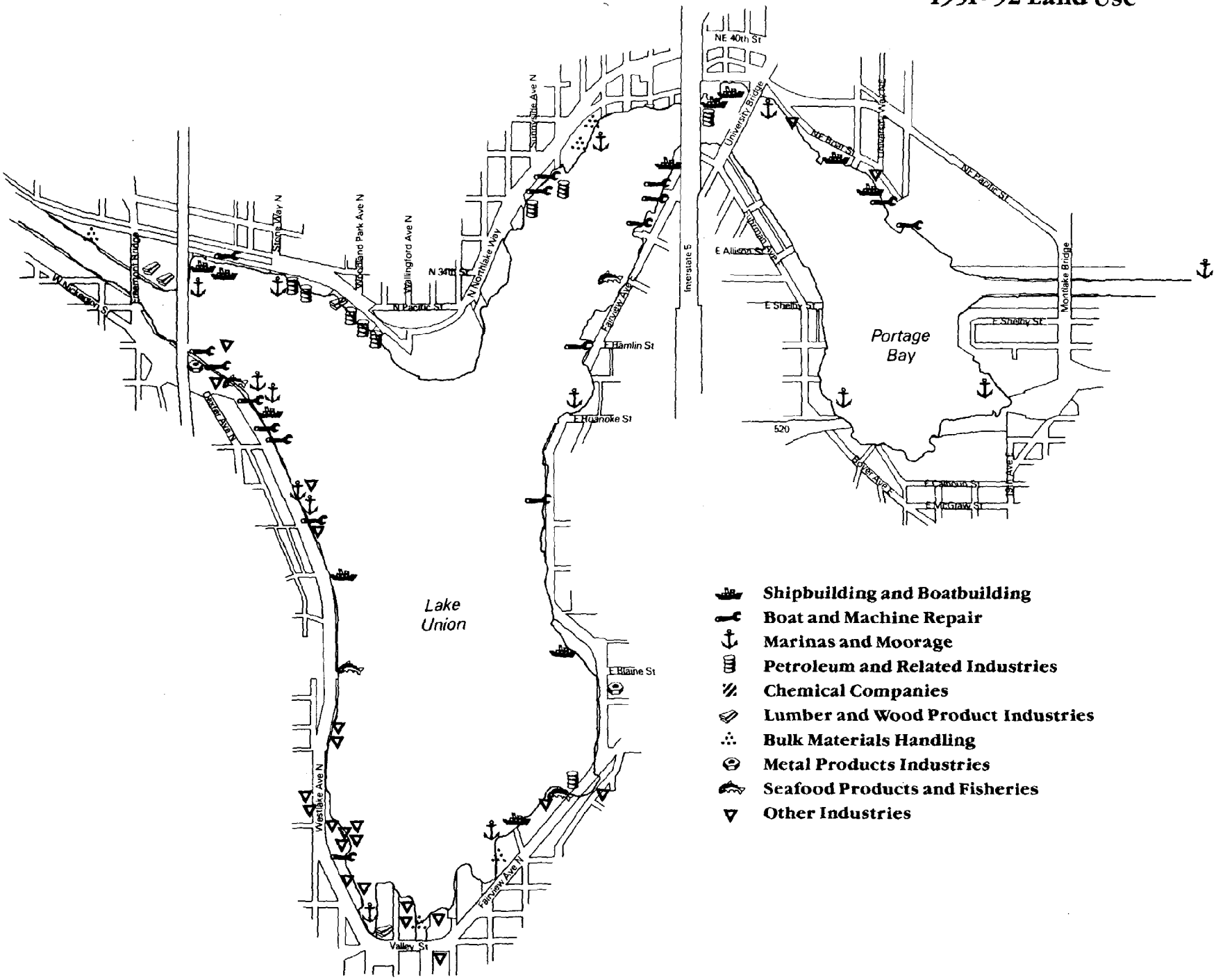
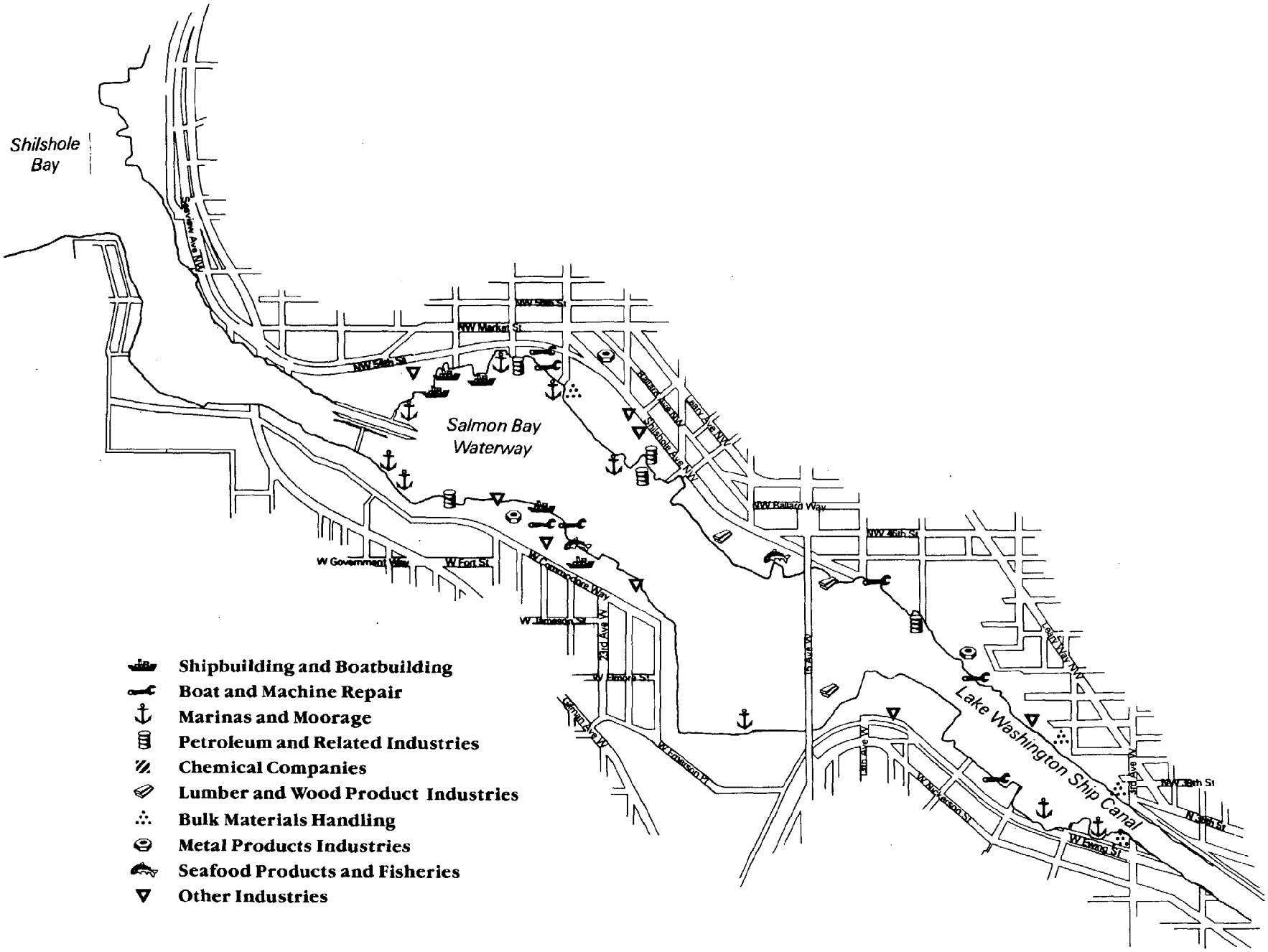


1963 Land Use



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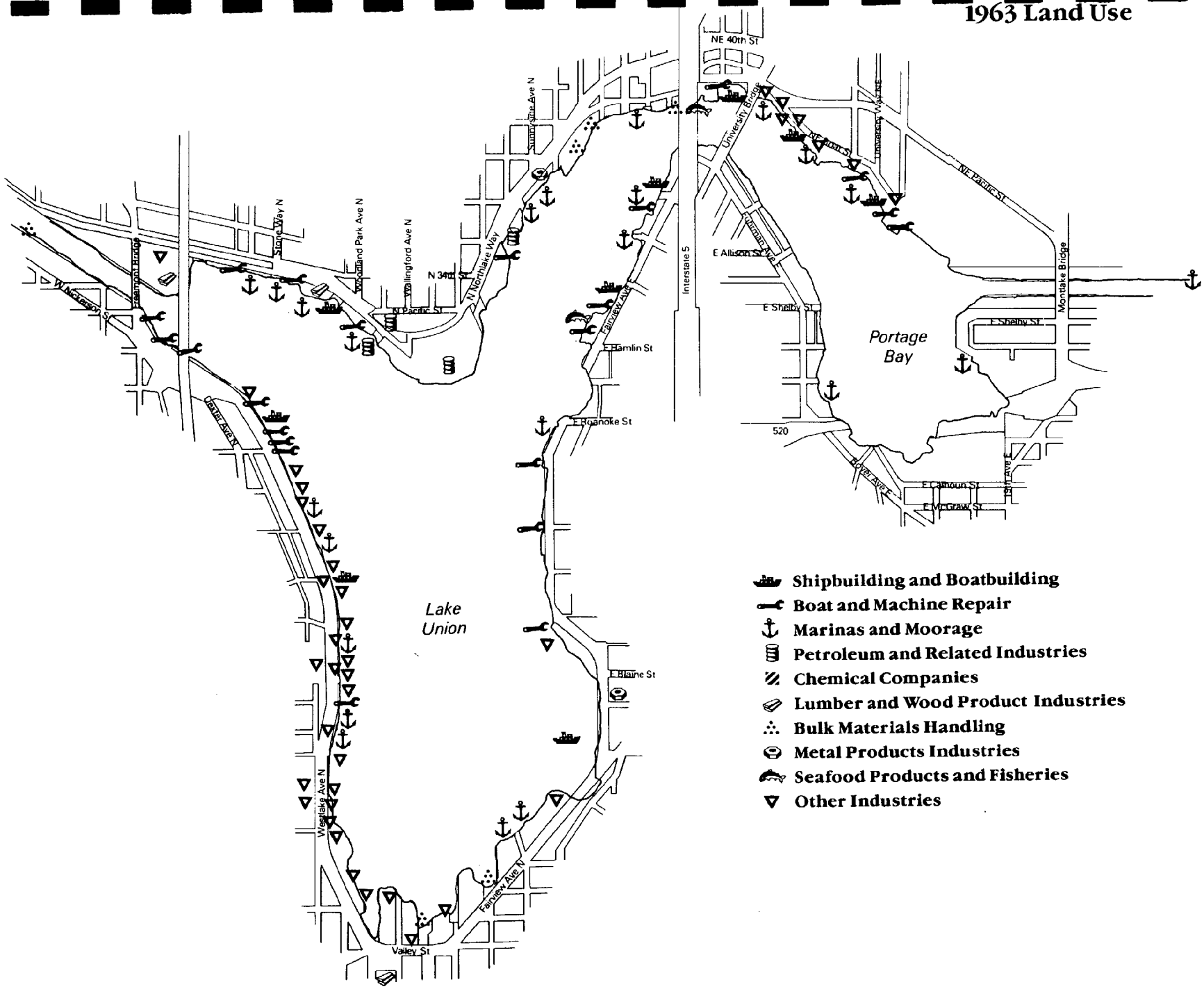

Two large shipyards were established during this time. By 1963, the Marine Design and Construction Company was operating on the south side of Salmon Bay, and Marine Power and Equipment had its facility on Northlake Way.

During the construction of Interstate 5 in the early sixties, fill material was placed on the south shore of Lake Union in several locations. This included in Waterway 7, along Fairview Avenue, and along Westlake Avenue. Islands created of lake-bottom mud and clay were apparently forced to the surface by pressure from the fill dirt (Seattle Times, May 17, 1962 and July 30, 1962). This led to an outcry for cleaning up Lake Union, similar to the concern about Lake Washington in the late 1950s. Filling was halted, and the Lake remained the basic shape we know today. Lake Union was probably at its most polluted before all houseboats were finally hooked up to sewers in the 1960s, as part of the METRO sewage improvements. This predated the enactment of major environmental legislation, including the State Shoreline Management Act and strict federal water quality regulations in the 1970s.

Recent Trends: 1964-1986

Since the 1960s, the amount of industrial land on Lake Union has continued to decrease. In Ballard/Salmon Bay, however, the majority of the waterfront has remained industrial and water dependent.* Several studies of past uses of Lake Union are available, and the changing patterns of land use on Lake Union between 1920 and 1982 are shown on Table 1. This shows the dramatic decrease in industrial and manufacturing land, lesser decrease in residential land, and strong increases in business-commercial and public lands.

A study of Seattle's commercial and industrial shorelines was undertaken in 1982 by the Department of Construction and Land Use, and the results are presented in Seattle's Commercial and Industrial Shorelines: Inventory Background Report. The report acknowledges that Lake Union has evolved from a "working lake" to a mixture of marine-oriented commercial and industrial uses with marinas, houseboats, restaurants, offices, and residences along its shores. Portage Bay has remained less developed with businesses and the University of Washington on its north shore, and two yacht clubs, houseboats, and residences on its other shores.

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*Water-dependent uses are those which are dependent on a waterfront location due to the basic nature of their operations and cannot exist in any other place. Water- or marine-related uses are those which are not by nature dependent on the water but which cannot operate economically without a waterfront location.

TABLE 1: LAKE UNION LAKESHORE TRENDS

Use	1920	1948-1950	1954-1958	1962	1982
	Percent of Total Shoreline Acreage				
Residential	27.6	26.4	21.0	13.6	12.3
Single Family					
Houseboats					
Duplexes					
Apartments					
Business-Commercial*	9.3	23.4	31.7	39.4	48.8
Neighborhood Business					
Community Business					
Covered Moorage					
Open Moorage					
Commercial					
Manufacturing & Industry	55.9	42.5	37.1	33.6	7.2
Manufacturing					
General Industry					
Heavy Industry					
Public & Semi-Public	0.0	3.7	7.0	7.3	30.4
Utilities					
Institutional					
Recreational					
Vacant Land	7.2	4.0	3.2	6.1	1.3
Total	100.0	100.0	100.0	100.0	100.0

* In the original sources, business and commercial are listed separately. Following are the more specific breakdowns:

	1920	1948-50	1954-58	1962	1982
Business	1.3	8.3	18.0	19.1	25.2
Neighborhood Business					
Community Business					
Covered Moorage					
Open Moorage					
Commercial	8.0	15.1	13.7	20.3	23.6

Source: City of Seattle Planning Commission. September 1963. Lake Union Study; and Jacobson, Phillip. 1983. Lake Union 1983.

The Ballard industrial area is characterized by a variety of water dependent and marine-related industries on both sides of Salmon Bay. Fishermen's Terminal is a major activity center on the south side. Although Ballard has remained primarily industrial, its limited transportation access may hamper its future development. The old Ballard Mill site is vacant, and Honeywell is leaving its facility at the former Stimson Mill site. Champion International Corporation, a plywood manufacturer, has closed its operation near the southeast corner of the Ballard Bridge, the site of lumber activities since the early 20th century.

A summary of the findings of the Commercial and Industrial Shorelines Inventory for the Ship Canal, Lake Union, and Portage Bay is presented in Table 2. Categories in Table 2 are based on water dependency and do not relate directly to the land and water use categories for Lake Union in Table 1. Total waterfrontage for each area listed in Table 2 is: Ship Canal - 26,045 feet; Lake Union - 25,830 feet; and Portage Bay - 8,816 feet.

TABLE 2: WATER DEPENDENT USES ON WATERFRONT LOTS, 1982

	Percentage of Waterfrontage in Each Area		
Category	Ship Canal	Lake Union	Portage Bay
WD-Industrial/Commercial	57.8	27.7	9.7
WD-Recreation	18.0	24.2	46.9
WD-Both	3.1	13.0	--
Water-Related	12.0	1.5	--
Multi-including WD	7.5	15.0	13.4
Marine-Related	0.5	0.5	--
Floating Home	--	11.1	24.9
Not WD or Water-Related	0.1	5.1	5.1
Vacant	1.0	1.9	--
TOTALS	100.0	100.0	100.0

WD = Water Dependent

Source: City of Seattle, Department of Construction and Land Use. September 1983. Seattle's Commercial and Industrial Shorelines: Inventory Background Report.

The inventory percentages show a marked contrast in the amount of water dependent industrial/commercial use in the Ship Canal in comparison to Lake Union and Portage Bay. Also, there is a significant amount of recreational waterfront area in Portage Bay and Lake Union. Water-related industry and commerce is more common on the Ship Canal than on Lake Union, and multiple use activities occupy more land on Lake Union and Portage Bay than on

the Canal. Floating homes are limited to Lake Union and Portage Bay. The Commercial and Industrial Shorelines Inventory is the most recent report which provides a comprehensive overview of the current shoreline use patterns on Lake Union and the Ship Canal.

II. EFFECTS OF HISTORIC USES ON WATER QUALITY IN LAKE UNION AND THE SHIP CANAL

The types of industrial and commercial uses and their potential impacts on water quality in Lake Union and the Ship Canal are discussed in this section. Because few historical data are available about specific water quality effects, this discussion is general. Appendix A lists the sources of pollution that were identified in a 1943 report about water quality in Lake Union and the Ship Canal. A separate memorandum notes specific incidences of pollution described by METRO, Department of Ecology, Puget Sound Water Quality Authority, Seattle Harbor Patrol, and City Department of Construction and Land Use staff. Because this information is not documented, it is presented separately from the rest of this report.

A. Types of Uses and Potential Water Quality Effects

Shipyards and Boat Building

Shipyards and small boat builders have been common on Salmon Bay since the turn of the century and on Lake Union since World War I. Of all the uses, shipbuilding presents some of the most severe hazards to water quality. Ship construction and ship breaking is far more significant than small boatyards in terms of potential water quality impacts. Sandblasting removes bottom paint which contains toxic substances including metals such as tin and copper. In addition to bottom paint, shipbuilding wastes typically include arsenic, rust, marine growth, paint thinner and other solvents, fuel, and lubricating oil. Slag materials from the ASARCO smelter in Tacoma were apparently used in sandblasting, contributing lead and other metals that have been deposited in Lake and Ship Canal sediments.

The impacts of smaller boat building operations are similar to those associated with shipbuilding, but of a lesser magnitude. However, the cumulative impacts of boat builders may be considerable, especially on Lake Union. Heavy metals are deposited in sediments in the Lake and Ship Canal. Dredging and other activities can stir up these sediments, thereby releasing toxic heavy metals into the water column. However, ship and boat building are water-dependent uses, and if operations are carefully carried out, water pollution is minimal. It is likely that past activities were more polluting than present shipbuilding, especially prior to the mid-1970s when major environmental and water quality regulations took effect.

Boat Repair and Machine Repair
Boat and machine repair have occurred along Lake Union and the Ship Canal since before the turn of the century. Wherever there are boats, there is a demand for repair and service. The impacts of boat and machine repair on water quality are similar to those associated with ship and boat building, but usually of a lesser magnitude. Oil spills may result from these activities, especially around marine service stations. Paint and some metals could also enter the water. Sandblasting dislodges bottom paint which contains toxic substances that may enter the water.

Marinas and Moorage
The proliferation of marinas is a relatively recent phenomenon, with a dramatic increase since World War II. Recreational marinas and commercial moorage have similar water quality impacts. Potential pollution from moorage and marinas includes bilge waste, lubricating oil, oil spill from fuel docks, paint, metals, cleaning solvents, and polycyclic aromatic hydrocarbons (PAHs, produced by incomplete combustion of fossil fuels). Liveaboards may increase the pollution associated with marinas, especially coliforms from sewage discharged from holding tanks.

Petroleum Storage and Related Industries
The most likely adverse impacts of petroleum storage on water quality are associated with oil spills when loading and unloading, spills from overwater storage tanks, and leakage from nearshore tanks that may leach into the water. Contaminated wastewater may also be discharged from refining operations. The most significant pollution source on Lake Union was the Gas Plant, and its effects will continue to be felt in the coming years. The history and operation of the Gas Plant is discussed briefly in II. B, below.

Chemical Companies
Chemical companies may discharge wastes which can enter storm drains and contribute contaminants to the water and sediments. Only one chemical company is shown on the maps, the Pacific Ammonia and Chemical Company which was located on Northlake Way between 1906 and the 1930s.

Lumber and Wood Products Industries
In the late 19th and early 20th century, Ballard was a community dominated by sawmills and shingle mills. Lake Union, too, had several sawmills and an assortment of wood products industries. Log storage was common on the Lake and Ship Canal, and leaching from wood chips and bark may have contributed organic wastes to the water and sediments. By the 1920s and 1930s, the local sawmills and wood products industries had begun to decline. Recently, Champion International Corporation closed its plywood operation on the Ship Canal, signalling the end of the lumber industry in the area.

Pollution associated with sawmills and wood products industries includes the dumping of sawdust, wood chips, and other wood wastes. Decaying sawdust uses up the oxygen in the water, increasing biological oxygen demand (BOD). It is likely that the first filling around the early sawmills was sawdust and wood wastes. Nonetheless, the impacts of sawmills were much less deleterious than the effluent discharged by pulp mills. Early pulp operations in Shelton, Tacoma, and Everett had severe effects on shellfish in nearby areas.

Bulk Materials Handling (sand, gravel, coal, asphalt, clay, cement)

Bulk materials movement is another common industry along Lake Union and the Ship Canal. In the early years, coal from mines in Newcastle was shipped on Lake Union, and several coal bunkers and operations were on the Lake in 1917. Asphalt plants were another industry found on the Lake in 1917, and the City's Asphalt Plant remained until the 1960s. The Washington Asphalt Company continues to operate on the Ship Canal today. The impacts of coal and asphalt include oils, chemicals, and PAHs, similar to the effects produced by the Gas Plant.

More recently, there have been sand and gravel operations on the Lake and Ship Canal, although these have diminished in recent years. Impacts of these industries on water quality include increased sedimentation and temporarily increased turbidity. These sediments may contain metals that could adversely affect water quality.

More significant, however, are the effects of cement operations. Cement plants on the Duwamish River, and possibly on Lake Union and the Ship Canal, used slag materials from the ASARCO smelter in Tacoma, contributing toxic heavy metals that have been deposited in bottom sediments. Also, cement wastes dumped into the water have congealed into structures beneath the surface which constitute navigational hazards as well as affecting water quality.

Metal Products Industries

Metal products industries in the area include the Salmon Bay Foundry (later Ballard Foundry), Northwest Steel Rolling Mills, a Ford Motor Company Automobile Assembly Plant near Lake Union, Coolidge Propeller Company, Fentron Steel Works, and others. The pollutants discharged by these industries include metals, PAHs, and process wastewater. The Pacific Iron Works and Asbestos Factory was located in Fremont at the turn of the century, and contributed iron, asbestos, and other pollutants to the water and bottom sediments in the area. These toxicants, similar to those contributed by shipbuilding, could persist for many years in bottom sediments. However, metal products industries have been fairly limited in the Lake Union/Ship Canal area.

Seafood Products and Fisheries
Seafood products and fisheries industries have been associated with Fishermen's Terminal in Ballard and on Lake Union at the Libby, McNeill & Libby facility. Although Ballard developed as a fishing port early on, there is minimal information about historical fish processing activities. More recently, there have been several fish and seafood operations on the Ship Canal and Lake Union, but they have primarily provided moorage and boat repair facilities.

Pollution sources from seafood products industries would include waste scraps, paints, solvents, and process wastewater. Historically, waste products do not constitute a major problem because these materials would naturally decompose over time. Seafood products and fisheries activities do not appear to be a major cause of water quality degradation in the Ship Canal and Lake Union.

Sewage
Although not an industry, raw sewage from houseboats, industries, and residents along the Lake and Ship Canal was a water quality problem in the past. This collectively contributed to a high biological oxygen demand in the water, causing adverse effects on fish and plant life. However, the construction of the METRO sewage system in the 1960s significantly improved water quality. Nonethless, combined sewer overflows are a major problem today, and on a lesser scale, the discharge of raw sewage from holding tanks of liveaboards at marinas is a continuing concern.

Filling
Another special category, filling, has contributed to water quality degradation in the past because of the kinds of materials dumped into the water. Originally, Lake Union and Salmon Bay were used as dumping grounds for a variety of waste materials. Sawdust and wood wastes were dumped into the water as was other refuse. Lake Union has decreased in area from 905 acres to about 600 acres due to filling. Major filling had taken place by 1912 in the south end bay, along Westlake Avenue, and on the north shore (Droker, 1977, p. 51). Fill was dumped along the south shore of Lake Union during the construction of Interstate 5 in the early 1960s, and it pushed up the islands discussed above. Filling in Lake Union has been halted since about 1962.

Railroads
Major railroad lines were constructed along Lake Union and the Ship Canal in the 1880s. Coal slag was introduced into the water, soil, and sediments, increasing biological oxygen demand, and PAHs may have entered the water as well. These impacts are primarily historic, because most railroads along the Lake and Ship Canal are no longer used, and the old Seattle Lake Shore and Eastern route has become the Burke Gilman bicycle and pedestrian trail.

Other Industries and Activities
A major use on Lake Union is the City Light Lake Union Steam Plant, discussed briefly in B. below. In the early 20th century there were several laundries along or near Lake Union which probably dumped wastewater containing detergents into the Lake. Gasoline service stations on nearby streets may have contributed to pollution of the Lake and Ship Canal because of stormwater runoff. Glass operations, paint sales, restaurants, seaplane flying services, and a range of other commercial and industrial uses may have added contaminants to the water and sediments.

Creosote and wood preservatives used on wooden pilings and docks on Lake Union and the Ship Canal would have introduced toxic organic chemicals into the water.

Urban stormwater also contributes to water quality problems, especially street and highway runoff which contains metals from tire wear particles and brake fluid, oil, grease, and other contaminants. Air pollution and a variety of urban non-point pollution sources affect water quality in Lake Union and the Ship Canal. Parking lots and other impervious surfaces near the shoreline contribute pollutants to stormwater runoff that enters the water. Although this report focuses on uses along the shoreline, upland uses also significantly affect water quality in the Lake and Ship Canal, primarily through stormwater runoff.

B. Brief History of the Gas Plant, Steam Plant, and Fishermen's Terminal

Seattle Gas Plant
In 1906, the Seattle Lighting Company built the Gas Plant on the north shore of Lake Union. Originally, the facility was a coal-compressing plant, and gas was generated from the high temperature cooking of coal. The Gas Plant was Seattle's largest private utility in its time, and it was operated by the Seattle Lighting Company until 1930, when the name was changed to the Seattle Gas Company. Originally, manufactured gas was distributed through 137 miles of main (Haag, 1971, p. 1). The plant spewed smoke, soot, and cinders, and little attention was given to maintaining environmental quality in the face of progress associated with the industrial facility.

During the mid-1930s, the gas production facilities included six water gas generating sets with a total capacity of 6,600,000 cubic feet of gas, based on the use of heavy oil and coal briquets as solid fuel (Haag, 1971, p. 22). Because of the high cost of operating the coke oven and the water gas manufacturing sets, oil gas generators were installed in 1937. The company had 1,071 miles of main in 1954, and its service areas included Seattle, Renton, Tukwila, and Kent. The number of customers

served decreased from about 43,198 in 1940, to 36,200 in 1954. During the 1940s, the plant also produced Gasco briquets, toluene, solvent naptha, xylene, and resin tar. The peak production day occurred in 1950, when 148,000 therms of gas (equivalent to 29,600,000 cubic feet of gas at 500 BTU's per cubic foot) were produced (Haag, 1971, p. 22).

The plant emitted steam and oily wastes, and tar and sludge accumulated as waste by-products. Production ended in 1956, when natural gas piped from the southwest was available. The City of Seattle began to acquire the property in 1962, and the transaction was completed in 1973. Gas Works Park, designed by landscape architect Richard Haag, opened in 1975. The park occupies a 20.5 acre tract, with about 1900 feet of waterfront.

Most of the shoreline in the area of the park is rubble fill. Much of the southwest area has been capped by a 50-foot mound of soil. The central area of the park was saturated with oil, tar, and other industrial wastes. The northern edge of the property, where the plant's largest holding tank was located, was also saturated with tar and oil (Haag, 1971, p. 12).

Historically, the Gas Plant was one of the worst polluters on Lake Union. It discharged carcinogenic PAHs into the Lake which were taken up by bottom sediments. The soils near the plant also contain high PAH levels.

A 1943 report on Sources of Pollution of Lake Washington Canal and Lake Union, singled out the gas generating plant as one of the greatest sources of pollution in the Lake. Six outlets discharged wastes into Lake Union including cooling water from the oil spray of a gas machine, two outlets discharging blow down from steam boilers which contained chemicals used to soften and treat the water, condensed steam, yard drain through a filter box, and cooling water. Several of these outlets allowed oily wastewater to reach the Lake (Foster, 1943, pp. 5-6).

In addition, drain water containing some oil entered the plant's circulation system, and water from "scrubbers" which washed the gas discharged into a sump where tar and other materials collected on the surface. Tar was removed and burned in the boilers. Surplus water from the plant flowed into the City sewer, and eventually into Puget Sound. Apparently, at an earlier time oil had accumulated at a siphon in the sewer line; subsequently improvements were made in the plant's oil separation device. Fish kills were reported in the vicinity caused by substantial amounts of oil in the water. Accidental spills had resulted from breakage of a jacket which enclosed an oil spray. In these instances, a large quantity of oil was discharged into the water cooling system and drained into the Lake (Foster, 1943, pp. 6-7). It is likely that the Gas Plant was even more polluting in its early years, when it was coal-fired.

City Light Lake Union Steam Plant
The Steam Plant was built by Seattle City Light in 1914, with additions in 1918 and 1921. The generation of electricity was extremely important to Seattle, and its completion was widely celebrated. The 10,000 kilowatt coal-fired plant first generated electricity in 1916 (Droker, 1977, p.51). As a result of the two additions, its capacity was increased to 40,000 kilowatts produced from three coal-powered generators (Boyle and Deines, 1979, p.253).

Today, the Steam Plant is rarely operated but is used for emergency stand-by, and occasionally for peaking when additional capacity is necessary. Its primary effect on water pollution has been the polychlorinated biphenyls (PCBs) in oil used in its electrical transformers. PCBs are considered carcinogenic and teratogenic. Until the 1970s, transformer oil commonly contained PCBs. Recently, a batch of fuel oil stored at the site has been found to be contaminated with PCBs. Safe disposal of this fuel oil has become an environmental issue of local concern.

Fishermen's Terminal
The Seattle Port Commission established the Salmon Bay fishing terminal in 1913, when the Ship Canal and Locks were under construction. Several docks and a machine shop were built in 1913. The terminal's oldest tenant, the Fishing Vessels Owner Marine Ways, has been at the facility since 1916. When the Locks were completed in 1916, the level of Salmon Bay was raised, and the existing docks had to be built up about six feet. The terminal was originally built to handle small boats about 27 feet long, compared to today's 200-foot fishing boats (Silkworth, personal communication, 1986).

Use of the terminal was relatively low until the late 1940s. The 1943 report on Sources of Pollution of Lake Washington Canal and Lake Union identified the area as one of the most polluted on the Ship Canal. Marine repair resulted in the discharge of wood scraps, oil wastes, bilge sludge, and metal trimmings. The problem was exacerbated by the cumulative effects of many individual activities within a small area (Foster, 1943, pp. 18-19).

Because of increased use of Fishermen's Terminal, $1 million from a port bond issue approved in 1948 was allocated to the expansion of the facility. Major improvements were made between 1948 and 1950, primarily to serve the Northwest fishing fleet. Twenty acres were purchased on the west side, where the West Wall is today. An improved roadway and interchange were constructed. Net sheds were built, and the Wharf Restaurant opened in 1952. An office building was constructed in 1956. Today, there are plans to expand the Fishermen's Terminal, including a possible new office-retail complex, a fish market, and a large dock for

catcher processing ships (Silkworth, personal communication, 1986).

III. SUGGESTED PROCEDURE FOR DETERMINING THE HISTORIC USE OF A SITE

The final section of this report lists sources to be consulted in determining the historic use of a site. Although the focus of this research was not specific sites, the suggested procedure is based on the research undertaken for this project.

The following sources are suggested for determining the historic use of a site: 1) assessor's records, 2) Polk and other city directories, 3) building permits and drawings, and 4) maps and atlases. It is recommended that several sources of information be consulted because historical records are sometimes incomplete and may be difficult to use or interpret. No one source contains a great deal of information about property use. As a starting point for research, it is useful to know the property address and names of current or recent property owners.

- **Assessor's Records.** The Regional Branch of the State Archives (764-4276) has real property record cards from 1937-1973. In order to use these records, the Assessor's Account Number and Block Number (if applicable) must be obtained from the King County Department of Assessments (344-7304). The cards include building data, legal description, construction and remodeling dates, photographs, and appraisal history for all parcels of real property in King County.

  Current computer listings of Assessor's Accounts at the King County Department of Assessments include such data as: owner, property name, current land use, zoning, year built (not always available), assessed value history from 1981, recent sales history, and legal description.

- **Polk and Other City Directories.** These directories are available at the Seattle Public Library, University of Washington Libraries, and the Department of Community Development, Office of Urban Conservation. Polk directories have been published almost every year since 1889. Early directories include alphabetical listings by business or resident's name, and classified listings by type of business, similar to the Yellow Pages but do not list occupants by street address. Since 1938, there are street address listings in addition to alphabetical and classified listings. For businesses, the type of activity is usually noted.

- **Building Permits and Drawings.** The City of Seattle

Department of Construction and Land Use (625-2303) has cards for building permits issued since the 1890s. These cards are arranged by address and include permit numbers, date of application, brief description of structure to be built or type of alteration, number of stories, construction type, and occupancy (use).

Commercial building plans since about 1920 are available on microfilm from the Department of Construction and Land Use (625-5699). These drawings are filed by street address and include permit numbers. Building permits since about 1894 are also available on microfilm. However, most permits prior to 1915 are not indexed.

- **Maps and Atlases.** Historical maps include Sanborn Insurance, Kroll, Polk, and other maps. These can be found at the University of Washington Libraries Special Collections, Seattle Public Library, Government Research Assistance Branch of Seattle Public Library, Seattle Department of Community Development (land use maps from 1948 to present), Seattle Department of Construction and Land Use, Seattle Engineering Department, and Kroll Map Company. The Museum of History and Industry also has a collection of historic maps, including Sanborn Insurance Maps, but these are uncatalogued and not available for review by the public at this time.

In addition to these sources, interviews with past property owners and people who lived or worked at the site may be invaluable. Also, present and past owners, workers, or residents of adjacent property may be helpful in describing the historic uses of a particular site.

APPENDIX A: SOURCES OF POLLUTION IN LAKE UNION AND THE SHIP CANAL IN 1943

The following information is summarized from a 1943 report entitled Sources of Pollution of Lake Washington Canal and Lake Union.

Business	Description of Sources of Pollution
Major Sources	
Seattle Gas Plant	Six outlets including oily wastewater, boiler blow down, yard drain, etc. See separate discussion of Gas Plant in II., B. above.
U.S. Plywood Corporation	Extensive sawdust fill at water's edge; about 60 gallons of glue per day into Salmon Bay; sawdust in water under mill.
Fishermen's Terminal	Boat repair including wood scraps, oil wastes, bilge sludge, metal trimmings, etc. in water. Significant overall effect.
Washington Asphalt Co.	Spilled oil draining into Canal; recommended that a sump be installed.
Fish boat moorings in N. Salmon Bay	Considerable amount of debris, oil and grease from bilge water.
Pioneer and Glacier Sand & Gravel	Spillage of sand and gravel; washings from concrete mixing plants entered Lake; layer of concrete in water; increased turbidity.
Shain Mfg. Co. and Grandy Boat Co.	Appreciable amount of wood wastes entered Lake.
759 Houseboats	Discharge of raw sewage into water.
Minor Sources	
Stimson Mill Company	Pile of sawdust which extended into Canal.
Lake Union Dry Dock	Oil spills, some bilge wastes, and discharge of raw sewage into Lake.
Wayland Mill Company	Small amount of sawdust, bark, etc. entered water.
Lake Union Fuel Company	Past spillage of sawdust.
Wellington Fuel Company	Slight amount of coal spillage.
Woodyard east of NPRR Bridge	Sawdust disposed in water.
Olson & Winge Boatbldg.	Sewage dumped into Canal.
NW Steel Rolling Mills	Waste cooling/wash water and sanitary sewage into Canal; small amount of metal waste.
Phoenix Shingle Co.	Wastewater from water circulating system in sawdust burner.
Spar Manufacturers	Past dumping of sawdust at edge of Canal.
Salmon Bay Sand & Gravel	Slight spillage of sand and gravel.
Frank's Marine Repair	Occasionally grease entered water.
Coolidge Propeller Co.	Sanitary sewage.
City Light Steam Plant	Condenser water from boilers.
Model Washington Laundry	Small amount of cooling water.

Business	Description of Sources of Pollution
Minor Sources continued	
Kreitel's Cabinet Works	Some wood scraps and sawdust dumped on bank of Canal entered water.
Nicholson Concrete Pipe Company	Waste mixture and washings dumped on bank of Canal.
Foss Company	Slight contamination from service and repair.
Fishing Vessel Owners Marine Ways, Inc.	Past dumping of lathe turnings and other metal scraps into Canal.
Houseboat Machine Shop of Akervick Bros.	Some metal scraps entered water.
Petrich Machine Works	Some metal scraps dumped behind bulkhead reached Canal.
Minimal Sources	
U. of Wash. Shellhouse	Minimal sawdust waste.
Jerry Bryant's Marina	Minimal petroleum spillage.
Small boat moorings at Portage Bay	Bilge wastes; impacts associated with general upkeep and repair.
Petroleum Navigation Co.	Minimal oil spillage.
Standard Oil Marine Service Station	Negligible petroleum wastes.
General Petroleum Co.	Negligible spillage.
Standard Oil Dock	No appreciable wastes.
Associated Oil Dock	No appreciable wastes.
Ballard Marine Rwy Co.	Minimal debris-- wood scraps, shavings, etc.
Seattle Yacht Club	Minimal contamination from boats.
Queen City Yacht Club	Minimal contamination from boats.
Stewart's Marine Serv.	Negligible quantities of waste.
McCarty's Repair Shop	Negligible wastes.
Seattle Asphalt Company	Negligible spillage.
Signal Gas Marine Serv.	Few oil and gas drippings.
Graystone Concrete Products Company	Washings dumped on bank of Canal (minimal pollution).
Maritime Marine Ways	No appreciable amount of waste entered water.
Union Oil Company	Negligible spillage.

Note: Most wood and sawdust wastes were burned. This was not considered a pollution source in 1943, even though it probably resulted in PAHs which entered the water and were taken up by bottom sediments.

In addition to the sources of pollution listed above, there were six direct sewer outfalls, four of which discharged into Portage Bay. There were also 21 combined sewer overflows along the Lake and Ship Canal in 1943.

Source: Foster, Richard F. March 1943. Sources of Pollution of Lake Washington Canal and Lake Union. State Pollution Commission, Bulletin No. 28.

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