LIBERTY STATE PARK
JERSEY CITY, HUDSON COUNTY, NEW JERSEY
SUB-SURFACE SOIL CHARACTERIZATION
AUGUST 2003 – FEBRUARY 2004

In August of 2003, The Army Corps of Engineers, New York District (the District) initiated an extensive sub-surface soil characterization within Liberty State Park. This fieldwork was in collaboration with the New Jersey Department of Environmental Protection (DEP), Division of Parks and Forestry (Parks). The District is partnering with the DEP on the planning and reintroduction of tidal wetlands and the enhancement of fresh water wetlands and upland habitat. The purpose of this fieldwork was to define the vertical and lateral extent of any existing contamination. The entire park is comprises fill placed there over the decades starting back in the late 1800's. The area(s) to be characterized were mostly in the middle third part of the park and further concentrated in an area presently fenced off. Within this 45-acre fenced off area are dredged sediments placed there in the late 1980's by New York District during construction of the bulkhead for the walkway. Information obtained from this sampling will be used to direct the planning, design and construction of tidal wetlands within that central area of the park.

The drilling was conducted by the Corps of Engineers – Baltimore District drill crew with laboratory analyses conducted by the US Army Environmental Lab at Fort Monmouth, NJ. Samples were collected, described and shipped by District personnel. There were two phases of drilling. The first phase took place over 22 days from 11 August through 7 September 2003. The second phase occurred over 4 days from 2 February through 5 February 2004.

Background:

Prior to the start of placing fill in that area that eventually would be come Liberty State Park (LSP) was primarily shallow open water and mud flats. Starting in the late 1800's the shallows/mud flats were covered over by dumping of fill. Over the next several decades the area was completely covered over with debris, excavated soil from other construction projects, demolition debris, blasted stone from construction sites, obsolete wooden barges filled with stone and coal ash and sunk in place. Eventually the filled in area extended outward over one mile from the historic shoreline. The dominant activity on this filled in area was railroad. There were locomotive repair shops, fuel oil storage tanks, rail sidings, docks for rail ferries to New York City and a passenger terminal.

In the early to mid 1900's quantities of chromium laced waste tailings, from nearby chromium (chrome) ore processing plants, was used as fill. This fill was subsequently built on by the railroads. In the mid to late 1960's railroad activity ceased and the site evolved into an abandoned area. By the mid 1970's the NJDEP started buying up the land that eventually became the state park. At the time of this purchase, the characterization of the fill material started. What the early sub-surface soil sampling showed was how extensive the chrom laced back fill was. Further studies over the years determined concentration levels, depths and areal extent of the chrome fill.

In the late 1980's dredged sediment from the area immediately adjacent the present day walkway was placed in the center third of the park and fenced off within a 45 acres parcel from the general public. This dredged sediment is managed as hazardous and signs placed on the fence warn of such. To ensure the containment of this material is was capped with presumably clean sand. This area is isolated from the main areas of public activity within the park. Long

range plans by park management show this area as wetlands and habitat restoration thus turning this area into a focal point for wildlife habitat. The sub-surface soil characterization conducted in August, September 2003 is the first step in bringing that plan to fruition.

In February 2003, AMEC, New York District conducted a Phase One Site Assessment on Liberty State Park. Considering the already extensive files and reports already in existence, the purpose of the Phase One was to physically locate and review those documents. The report concisely summarizes the site's history leading up to it becoming a state park. The Phase One report is part of this document as an attachment.

Field Sampling Methodology:

To conduct the sub-surface characterization a CME drill rig all terrain vehicle (ATV) was utilized. This type drill rig has the capability of drilling through the type of fill anticipated to be within the study area. A total of forty (40) borings were planned and thirty-eight (38) were completed in the first phase. Two of the forty borings were planned for the sediments in North Cove. A barge mounted drill rig from the Baltimore District was used to accomplish that part of the project. Planned boring depths were twenty-eight to thirty feet (28 – 30) below ground surface (bgs). This depth was picked as the proposed new bottom elevation for the proposed tidal channels. Soil samples were collected at two locations within the boring, at the halfway point (13 – 17 feet below ground surface) and bottom. Samples were placed in clear eight-ounce glass jars; there were three jars of soil per set. A total of six sample jars per boring were collected. Samples collected from the bottom were analyzed; samples collected at the midway point of the boring were archived. Once a boring was completed its location was marked with a Global Positioning System (GPS).

In the second phase, seventeen (17) samples were collected at a depth of 12-15 feet below ground surface. Two of the samples were collected from North Cove. The sampling, storage and analysis techniques were identical to that of the first phase.

Samples were collected using a stainless steel two-inch diameter "split spoon". The split spoon was advanced into the ground inside a four-inch hollow stem auger. There was continuous split spoon sampling, in two foot increments, from surface to bottom of boring. After a spoon was pushed down to depth and retrieved, an auger was advanced down to the depth of the previous spoon. Once a spoon was retrieved, it was opened, its contents described and written down into a field log book, with time of day, soil boring number, depth collected from, percent recovery within the spoon (recovery was listed in 10, 20, 30 percent, etc.), color, noticeable odors, grain size/texture, moisture content (saturated, moist, etc.), changes in lithology (clay to sand, loam to sand, etc.), amount of roots, stone and other material. When a sample was collected it was given a unique identifier code, time and date of collection, initials of the person collecting the sample, analyses required, preserving agents added or not and who the sample was collected for, in this case the sample was collected for the New York District Corps of Engineers. All that information would be written on a label fixed onto the sample jar.

Once a split spoon was used it was set aside, washed of loose soil, then put through a decontamination process: washed in an alconox detergent and rinsed off, rinsed again with de-ionized water, air dried, then a final rinse with laboratory grade acetone and air dried.

All samples collected each day were documented on a form called a Chain of Custody (C of C). This form would list the samples collected that day, initials of the person collecting the samples, types of analyses requested, sample type (solid, liquid) and name of the person signing off on the transfer of the samples. All samples were placed in a cooler packed in ice to chill them down to four degrees centigrade. Ice was placed in small zip lock bags to minimize free water in the bottom of the cooler and to further pack the sample jars in place. All samples were placed in zip lock bags as well. The C of C was placed in a zip lock bag and put inside the cooler with the samples. All coolers were sealed for transit with duct tape. Baltimore District personnel delivered all samples to the Fort Monmouth Environmental Lab, Fort Monmouth, NJ.

The lab analyzed for the following constituents: Volatile Organics +15 Library Search (VOA+15), Acid Base Neutrals + 25 Library Search (ABN+25), Pesticide/PCBs, Total Petroleum Hydrocarbons (TPHC), RCRA Metals, Percent Solids. Turn-around time was the standard three weeks. Archived samples will stay at Fort Monmouth until further notice. All samples were soil no water samples were collected.

Laboratory Methodology Summary:

EPA SW-846 Method 8260
Gas Chromatographic Determination of Volatiles in Soil.

EPA SW-846 Method 8270
Gas Chromatographic Determination of Semi-volatiles in Soil

EPA SW-846 Method 8081/8082
Gas Chromatographic Determination of Pesticides and PCB's in Soil

EPA SW-846 Method 3051, 3rd Edition Base Manual with Final Updates I, II, IIA, IIB and III: Digestion of Priority Pollutants Metals

Milestone MLS and 1200 MEGA

EPA SW-846 Method 6010, 3rd Edition Base Manual With Final Updates I, II, IIA, IIB, and III: ICP Priority Pollutant Metals

Perkin Elmer OPTIMA 3000 DV

EPA SW-846 Method 7471A, 3rd Edition Base Manual With Final Updates, I, II, IIA, IIB and III: Mercury

Varian SpectrAA-640, VGA-77

NJDEP Method OQA-QAM-025 10/97
Gas Chromatographic Determination of Total Petroleum Hydrocarbons in Soil.

Data Review:

The following categories of constituents were analyzed by the Fort Monmouth Environmental Laboratory and Lionville Lab, Inc. (hexavalent chromium):

- Volatile Organics plus 15 (VOA + 15)
- Acid Base Neutral plus 25 (ABN + 25)
- Pesticides/PCBs (Pest/PCBs)
- Total Petroleum Hydrocarbons (TPHC)
- Priority Pollutant Metals
- Percent Solids (% solids)
- Total Hexavalent Chromium

Effects Range Criteria for Sediment:

Effects Range (ER) criteria used to gauge potential impact of contaminated sediment. The purpose is to quantify how much contamination is present and it's potential for being released into the food chain, thus ingested by the native fauna and potentially affected by that contamination. The ER criteria has three levels; Low, Medium, Severe. The threshold levels for exceeding ER levels are more conservative than, for example the Non-Residential Direct Contact Soil Cleanup Criteria. Those areas of the park that will excavated and potentially made part of the planned wetlands the ER criteria may be implemented on the now exposed lower layers of sediment

Non-Residential Direct Contact Soil Cleanup Criteria:

Non-Residential Direct Contact Cleanup Criteria (NRDCSCC) is a NJDEP guideline used to manage the cleanup of impacted soils, impacted areas that will not be residential in its final designed use. This guideline would be used to manage the restoration of those areas excavated during construction but not part of the planned wetlands.

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Volatile Organics plus 15:

Of the 38 samples there were no significantly measurable quantities of VOAs found. The parameter of measurement was Part Per Billion (ppb). There were 33 samples with measurable amounts of acetone and 2-butanone. Their presence is explained by the use of acetone in the field as a decon agent and 2-butanone is a solvent very similar to acetone, present in laboratories and it's presence here is not at all surprising. Neither of these VOAs was present in any quantity exceeding threshold limits for the NJDEP's Non Residential Direct Contact Soil Clean Criteria (NRDCSCC), or Impact to Groundwater Soil Cleanup Criteria (IGWSCC). Both VOAs are not on the DEP's Effects Range for Marine/Estuarine Sediment Screening Guidelines.

All 38 samples had VOAs listed as Tentatively Identified Compounds (TICs), they left a distinct mark on the gas chromatograph analysis, but their exact identification could not be determined. Hexane did appear several times on the TIC list, with one sample as high as 220 ppb (or **.**220 ppm). The reason for hexane being listed in the TIC is its presence was suspected but not confirmed. Its presence is explained as lab influence plus it did not exceed any NJDEP criteria and thus a non-issue. Other TICs had readings as high as 276 ppb (or **.**276 ppm) and as low as 10 ppb (.0.010 ppm). The high TIC number, like the 276 ppb is the total of the several TICs present in that one sample.

Acid Base Neutrals plus 25:

All 38 samples had TICs. The number of TICs per sample ranged from two to eleven and ranged from 1990 to 93,300 ppb (1**.**99 to 93**.**3 ppm). Those numbers are the total of all TICs present in that

one sample. Compared to the NRDCSCC the ABN levels are below thresholds in the identified ABNs and the TIC ABNs. When compared to the Effects Range – Low criteria (ERL), the guidelines referred to thresholds established for freshwater sediment screening. Bear in mind the sediment analyzed in this came from a tidal estuary, not a freshwater environment.

There were three ABNs that exceeded the ERL, they are pyrene, fluoranthene and phenanthrene. Pyrene was 3300 ppb (3.300 ppm), the ERL is .490 ppm. Phenanthrene was 2100 ppb (2.100 ppm), ERL is .560 ppm. Fluoranthrene was 3500 ppb (3.500 ppm), ERL is .750 ppm. These three ABNs add up to 8900 ppb or 8.900 ppm. If the total amount of TICs in a sample added together exceed 4.00 ppm (4000 ppb) then these are a flagged sample location. There are over six samples exceeding this threshold. Sample LSP-03-20 which has a TIC number of 93,300 ppb or 93.300 ppm, has the highest exceedence. The next lowest TIC exceedence is 64,800 ppb or 64.800 ppm. The numbers range down from there to 5010 ppb or 5.010 ppm.

Pesticides:

No pesticides exceeded the NRDCSCC, IGWSCC or ERL thresholds. Only one pesticide was detected, Dieldrin at 1.60 ppb (or 0.0016 ppm). The ERL threshold is 0.002 ppm.

PCBs:

There were no PCBs detected.

TPHC:

Only one sample came up positive for TPHC, sample LSP-03-20. The number was 549.31 ppm. There are no threshold limits for TPHC in the NRDCSCC, IGWSCC or ERL.

Metals Priority Pollutant List:

Of the 38 samples, fourteen (14) exceeded the ERL. No samples exceeded the NRDCSCC or IGWSCC. Nickel was the most prevalent (twelve samples) metal exceeding the ERLs. The threshold is 21 ppm, the highest exceedence was 31.9 ppm. Next was cadmium with seven samples exceeding threshold of 1.2 ppm, the highest number was 1.74 ppm. Next was arsenic, with four samples exceeding threshold. ERL threshold is 8.2 ppm, the highest number was 10.0 ppm. Next is mercury with two samples exceeding threshold. ERL limit is 0.15 ppm, the highest sample was 3.22 ppm. The last metal was lead, with one exceedence. The ERL is 47 ppm, the highest number was 74.3 ppm. All of the highest metal numbers came from one sample…LSP-03-20. Other samples with exceedences were generally barely above threshold.

Hexavalent Chromium:

Hexavalent Chromium was detected in only nine samples. The numbers ranged from 0.45 ppm up to 9.4 ppm. Interestingly enough sample LSP-03-20, which had the highest numbers in metals and TPHC did not have the highest number.

Summation for Round 1:

All things considered, the bottom sediment layer (28 – 30 feet) is not as impacted as previously thought. The surprisingly low numbers in hexavalent chrome can lead one to conclude the metal did not leach all that much downward to the depths drilled to (thirty feet). Considering the amount of chromium-laced backfill dumped on what is now Liberty State Park this is unexpected. The rest of the Priority Pollutant metals analyzed for were unexpectedly low considering the history of the site. Even

when there were numbers above threshold, those numbers were not that high. In many samples the exceedences were only a fraction above threshold. Reviewing the TPHC analyses it was equally surprising to see only one sample to come up with detectable limits. For the pesticides and VOAs no new information on what is in the sub-soil came out of this. The level of ABNs was unexpected. Even though only three ABNs exceeded threshold it was still unexpected considering the site's history. What was expected was a series of samples exceeding thresholds for metals, TPHC and hexavalent chromium. That was not the case**.** In fact only sample, LSP-03-20 came up with any significant numbers in the aforementioned categories. The analytical information from LSP-03-20 points to a concentrated pocket of contaminants in that vicinity of the park. This information will be used to plan accordingly on how best to excavate and manage the handling of this material.

Date Review for Round 2:
A second phase was conducted in February 2004, based on results of the August 2003 investigations. This round focused on the route of the proposed tidal creek and collected 17 continuous samples from the surface to 15 feet bgs (Figure 7 in Geotechnical Appendix, Vol. 1). Sampling and analysis procedures for this round were identical to the procedures used in Round 1.

Volatile Organics plus 15:
Of the 17 samples there were no significantly measurable quantities of VOAs found. The results are similar to those of Round 1, which took samples from a depth of 30 feet bgs.

Acid Base Neutrals plus 25:
Over all, the numbers were low across all the samples, except for three: NC04-04 with 52 ppm, NC04-03 with 636 ppm, and CA04-03 with 66 ppm. NC04-4 and NC04-3 are close to LSP-03-20, and CA04-03 is in the center of the containment area.

Pesticides:
No pesticides were detected.

PCBs:
No PCBs were detected.

TPHC:
Three samples came up positive for TPHC: NC04-3 with 600 ppm, NC04-3 with 2896 ppm, and CA04-03 with 2284 ppm. The result for CA04-03 is similar to that of other samples from round one in the same area, and is to be expected given the history of the site. There are no threshold limits for TPHC in the NRDCSCC, IGWSCC or ERL. These are the same samples of concern from the Acid Base Neutrals analysis.

Metals Priority Pollutant List:
Of the 17 samples, three (3) exceeded the NRDCSCC. Lead was the most prevalent (three samples) metal exceeding the NRDCSCC. The threshold is 600 ppm, and the highest exceedence was 2400 ppm. One sample, NC04-03 in North Cove, had the highest concentration of metals exceeding the NRDCSCC. Below is a table listing the metals, NRDCSCC limits, and NC04-03 results for that metal:

Metal	NRDCSCC(ppm)	NC04-03(ppm)
Arsenic	40	68
Copper	600	1600
Lead	600	2400
Zinc	1500	5760

It is worth noting sample NC04-03 is in close proximity to Sample LSP-03-20, which yielded the highest concentrations of metals in round one, reinforcing the need to implement precautionary measures in working with this material.

Hexavalent Chromium:

Hexavalent Chromium was detected in only three samples. The numbers ranged from 0.36 ppm up to 2.0 ppm. Two of the samples were from the containment area (CA04-06 AND CA04-01). The highest concentration of hexavalent chromium came from sample NC04-03 in the North Cove at 2.0 ppm. As the NJDEP guideline for hexavalent chromium is 20 ppm, levels of this metal will not be a major concern in any work done within the project area.

Recommendations:

In two rounds of sampling, only 2 sample points, LSP-03-20 and CA-04-03 came up with significant levels of contaminants. As these two samples are in close proximity to each other, it would be reasonable to assume that the sub-soil in the vicinity would be equally impacted with decreasing levels as one moves outward from these two points. When time comes for excavation of areas adjacent to this, additional engineering controls will have to be implemented. Estimates can be prepared on potential volume of material to be excavated. Exact controls can be specified at a later time but at a minimum there will be strict segregation of excavated material and placement of that same material in the park's designated disposal area. It may be this sub-soil is too impacted to be secured within the park's area and must be hauled off site for final disposal. Plans to manage this should be drawn up and funds dedicated to that task. When plans for construction are drawn up, there must be protocols and procedures written out on how to address pockets of concentrated chrome impacted waste, drums, remnants of drums, pockets of oil. These plans will include health and safety protocols, procedures for isolating the area(s), collecting soil/sediment/water samples, personal protective equipment to wear, level of air quality monitoring to maintain, decon procedures to follow, chain of command in notification and managing the impacted soils, debris, etc. These health and safety plans will be fully detailed and presented to the NJDEP for review and comment before actual construction starts.

As for the remaining sample locations it appears the extent of impacted sub-soil is not as pervasive as previously thought. It looks entirely feasible that only simple dust suppression procedures may be adequate, that straightforward excavation methods be employed and equally straightforward placement/containment of the excavated sub-soil in the park's southwest corner.

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Phase I Environmental Site Assessment of Priority Sites

PART I
LIBERTY STATE PARK, JERSEY CITY, HUDSON COUNTY, NEW JERSEY

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Prepared for:

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EXECUTIVE SUMMARY

The U.S. Army Corps of Engineers, New York District (USACE-NYD) is working in partnership with several state and local agencies to assess the feasibility of restoring selected wetlands within the New York-New Jersey Harbor Complex (also known as the Hudson-Raritan Estuary). The USACE-NYD has identified three priority sites (Project Areas) for wetland restoration within the Hudson-Raritan Estuary. These are: (1) Liberty State Park, located in Jersey City, New Jersey; (2) Newtown Creek, located in the Boroughs of Brooklyn and Queens, New York; and (3) Sherman Creek, located in Manhattan Borough, New York.

Prior to implementation of the proposed wetland restoration projects, the USACE-NYD requires that a Phase I Environmental Site Assessment (ESA) of the three Project Areas be performed. The purpose of the ESA was to collect background data and review existing information concerning recognized environmental conditions at three Project Areas. The principal objectives of the ESA were to develop information about environmental conditions at the three sites, in the specific context of the planned wetland restoration projects; identify any information gaps regarding existing environmental studies; and make recommendations concerning any additional investigations that may be needed to address those gaps.

Under contract No. DACW51-01-D-0017 between Northern Ecological Associates, Inc. (NEA) and the USACE-NYD, AMEC Earth & Environmental, Inc. (AMEC) was assigned to conduct an ESA of the three priority wetland sites. The results are presented in this ESA Report, which is being submitted under Delivery Order 0012 of the referenced contract. The ESA report is comprised of three parts, of which Part I (this part) pertains specifically to the Liberty State Park (LSP) Project Area. Parts II and III concern the Sherman Creek and Newtown Creek Project Areas, respectively.

This ESA was prepared in accordance with the Scope of Work (SOW) prepared by the USACE-NYD (USACE-NYD, 2002). The SOW incorporates by reference the guidance document by the American Society for Testing and Materials (ASTM) entitled Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process (ASTM E1527-00) (ASTM, 2000). The geographic limits of each Project Area and the specific types of environmental record sources to be reviewed were determined on a site-specific basis, in consultation with the USACE-NYD Point of Contact (POC).

The limits of the LSP Project Area were defined as the park boundaries. The environmental records sources that were reviewed included those standard federal and state records listed under Section 7.2.1.1 of ASTM E1527-00. Additionally, a review was conducted of publicly accessible files at the New Jersey Department of Environmental Protection (NJDEP). Sources reviewed with respect to the physical setting (*e.g.*, topography, hydrology, geology) of the LSP Project Area included U.S. Geological Survey (USGS) Topographic Quadrangle maps, as well as site-specific information obtained from existing environmental reports. Historical land-use information was obtained from a review of Sanborn Fire Insurance Maps and historic aerial photography. Studies of historical land use and cultural resources of the LSP Project Area were also reviewed, along with historic maps and site plans obtained from state regulatory files. Information concerning historic land ownership within the LSP Project Area was provided by State of New Jersey.

Site reconnaissance of the LSP Project Area was performed on 9 December 2002 with the assistance of the POC. Site reconnaissance was restricted to the LSP Project Area (i.e., none of the adjoining properties were examined). Because the site has already been extensively investigated by the NJDEP, reconnaissance activities were limited to a general examination of major areas of interest and photographs of current site conditions.

LSP is currently owned and operated by the State of New Jersey, and is utilized as a public park and educational facility. The park is comprised of a series of irregularly shaped parcels, which were acquired by the State of New Jersey during the period from 1965 to 1993. Public facilities at LSP currently include the Liberty Science Center and Hall of Technology, Visitors Center, Interpretive Center, the railroad terminal (with ferry service to the Statue of Liberty and Ellis Island) formerly operated by the Central Railroad of New Jersey (CRRNJ), a swimming pool, hiking trails, picnic area, playground, food concession, and associated parking areas and roads. Waterfront facilities include the Liberty Landing Marina, a trailer launch, canoeing and boating facilities, and boat storage facilities. Additionally, there are park maintenance facilities and offices for park personnel. The Liberty Landing Marina and associated parking and boat storage facilities occupy most of the northern shore of the park. The eastern shore is bounded by a concrete seawall reinforced by an exterior apron of stone riprap. The southern shore of the property is bounded by wooden and steel bulkheads. Most of the interior of the property is currently undeveloped.

The ground elevation within LSP typically ranges from 0 to 10 feet above Mean Sea Level (MSL). Drainage is generally toward the waterfront (north, east, and south). There are currently no surface-water bodies in the interior of the site (although freshwater wetlands are present in some areas). The Hudson River Estuary and the Morris Canal Basin are the principal surface-water receptors. The site is underlain by a sequence of fill ranging in thickness from 10-40 feet, which consists principally of disturbed soils, dredge spoils, domestic refuse, coal ash, construction debris, and metal production waste. The fill material is underlain by recent (Holocene) shallow-marine deposits and partially consolidated Pleistocene-age glacial deposits which, in turn, overlay the Lower Paleozoic-age Manhattan Schist. The approximate elevation of the bedrock surface ranges from -43 to -134 feet MSL.

Based on a review of water-level data and ground water contour maps contained in NJDEP regulatory files, shallow (unconfined) ground water typically occurs at depths of 5 to 10 feet below grade, and hydraulic gradients are generally oriented toward the shoreline (i.e., toward the north, east, and south). Previous hydrogeological studies have shown that shallow ground water flow adjacent to the shoreline is tidally influenced.

Soils examined during the site reconnaissance visit typically contained common fill materials such as coal-ash, glass, and construction debris. The undeveloped portions of the site were heavily overgrown with trees and brush. No obvious evidence of environmental contamination was observed, other than the presence of the common fill materials described above. During the site reconnaissance visit, the Assistant Superintendent of LSP noted that an oil sheen has been observed sporadically along the eastern shore of the park, the source of which is currently under investigation by the NJDEP.

Nearly all LSP Project Area is underlain by fill. Prior to about 1860, the site consisted mostly of open water and tidal flats. In the 1860s, the CRRNJ placed over 20 million cubic yards of fill into the former Communipaw Cove to create a rail terminal complex. The fill consisted principally of domestic solid waste obtained from the City of New York. From the 1870s until approximately 1960, the CRRNJ and the Lehigh Valley Railroad (LVRR) operated shipping terminals, freight yards, railroad repair facilities, and stockyards at the site. During that period, the site was systematically filled to produce the present-day shoreline of LSP. Large-scale filling activities at the site were completed by about 1928. However, evidence from historic maps and aerial photographs suggests that localized filling may have occurred as recently as the 1960s.

Historic Sanborn Fire Insurance Maps and aerial photographs document the expansion of the CRRNJ and LVRR terminal facilities over time. The CRRNJ Terminal Building, an attached railroad depot, and an extensive network of rail facilities and piers were present by 1895. By 1911, the Terminal Building and the railroad depot were expanded to their present size, and new rail facilities were added, which included additional freight yards, coal loading facilities, a coal-fired power plant, a machine shop, a railroad turntable, cattle pens, and cement storage facilities. During this period, a brass foundry was operated within the area now occupied by the Liberty Science Center Parking Lot. A 1943 aerial photograph shows an active rail facility with numerous steam-powered engines in use. The 1950-51 Sanborn Maps show two railroad "roundhouses" operated by the CRRNJ at the site of the present-day Liberty Science Center, along with a coal-fired power-house, two 100,000-gallon above-ground oil tanks, coal pockets, conveyors, cinder pits, and a diesel locomotive servicing area. A tugboat repair facility was also present near the current site of the Interpretive Center, which included a machine shop, sheet metal shop, storage facilities, and floating dry docks. The 1966 aerial coverage shows evidence of active railroad operations. However, partial demolition of the roundhouse facilities is also evident.

The railroad operations by the CRRNJ and LVRR ceased by 1970, by which time both companies had filed for bankruptcy. Some of the properties owned by CRRNJ and LVRR were subsequently sold, while others remained vacant. In its review of historic aerial photography, the NJDEP noted evidence of dumping or filling activities at several areas during the 1970s. A 1976 aerial photograph reviewed during this investigation shows evidence of what appears to be an open burial site. In 1978, shortly after their acquisition by the State of New Jersey, two facilities formerly operated near the present site of Liberty Landing Marina area were found to have engaged in illegal dumping of hazardous materials. Approximately 250 abandoned drums were discovered at the two facilities, some of which were found to contain organic solvents. The NJDEP contracted for removal of the drums in 1980. Two other incidents involving abandoned drums at the property were identified in state environmental records, one in 1992 and another in 2000. Additionally, at least ten underground storage tanks (USTs) were formerly present at the site, which were used to store either leaded gasoline or diesel.

Coal combustion residues are widespread in soils at the site, both as a consequence of historic railroad operations and as a constituent of historic fill materials. Arsenic and heavy metals (principally lead, zinc, and copper) and polynuclear aromatic hydrocarbons (PAHs) are nearly ubiquitous in the fill, and typically occur at concentrations above the applicable NJDEP Soil Cleanup Criteria (SCC). Metals and PAHs have also been detected in ground water at concentrations above the New Jersey Ground water Quality Criteria. Various volatile organic compounds (VOCs) have also been detected locally in the soil and (or)

ground water, including, ethylbenzene, toluene, chloroform, trichloroethene, tetrachloroethene, and 1,1,1-trichloroethane. Additionally, traces of polychlorinated biphenyls (PCBs) and organochlorine pesticides (*e.g.,* dieldrin and DDT) have been detected in the soils at concentrations slightly above the NJDEP SCC.

Petroleum free-product is known to be present in subsurface soils at two different locations within the LSP Project Area. One site, known as the Middle Cove, has been extensively investigated by the NJDEP, and product-recovery efforts are currently underway. The other site, which is located beneath the Liberty Science Center parking lot, has not yet been completely characterized. Known sources of petroleum at LSP have historically included former locomotive repair and fueling facilities, the former tug and barge repair facility, and various USTs.

During the early 20th century, chromate chemical production waste (CCPW) derived from off-site chemical manufacturing facilities was used as a structural fill at several locations within the LSP Project Area. Three CCPW sites have been identified within the LSP Project Area to date, all of which have been investigated by the NJDEP. Hexavalent chromium is the principal environmental contaminant of concern at these sites. One issue of particular concern is the historic use of CCPW as backfill in the construction of underground utilities. In 1994, the NJDEP found that CCPW had been used as backfill during the construction of an 84-inch-wide brick sewer main (now abandoned), which bisects the LSP Project Area. It is has not been determined whether CCPW is associated with other underground utilities at LSP.

In 1916, a series of large explosions occurred at a munitions depot located adjacent to Black Tom Channel along what is today the southern shore of LSP (formerly Black Tom Island). Approximately 1,000 tons of explosives were detonated, which resulted in the deposition of unexploded ordnance (UXO) on the floor of the adjacent Black Tom Channel. During the course of hydraulic dredging operations 1981, it was discovered that several rounds of ordnance had been transferred into a dredge-spoil storage area located within the interior of LSP. The rounds were found to be completely saturated with water, and attempts to detonate them under controlled conditions were unsuccessful. However, the risks associated with any additional rounds that may be present in the dredge-spoils have not been evaluated.

Since its purchase by the state of New Jersey, the NJDEP has conducted numerous soil and ground water investigations within LSP, and most of the environmental concerns identified above have been thoroughly characterized. However, in the opinion of this investigator, there remains a risk of encountering previously unidentified soil and (or) groundwater contaminants during the construction of the proposed wetlands. The concentrations of PAHs and metals in common fill materials at the site are generally within the ranges listed in the NJDEP Historic Fill Database and meet the general definition of "historic fill" under Technical Rules for Site Remediation (N.J.A.C. 7:26E App. D). Thus, the common fill materials found at the site are amenable to on-site management (e.g., capping with a layer of clean soil and establishing a vegetative cover). However, in the event that heavily contaminated soils (*e.g.,* petroleum saturated soils or CCPW) are, on-site management of the contaminated soil may not be feasible, and off-site disposal could be prohibitively expensive.

Therefore, prior to initiating the proposed wetland restoration project, it is recommended that further compilation and analysis be performed of existing subsurface information (*e.g.*, soil-boring logs, test-pit logs; laboratory analytical results) pertaining specifically to the areas to be disturbed. The purpose of this analysis would be to assess the adequacy of existing environmental studies, evaluate the impact of any recognized environmental conditions, and identify specific targets for any additional subsurface characterization studies that may be required. It is also recommended that the NJDEP be consulted to determine whether any of the suspected dumping or filling sites identified in their review of historic aerial photography are located within the footprint of the proposed wetlands, and if so whether all of those sites have been adequately investigated. Further, it is recommended that historic utility plans be reviewed to identify any underground facilities that may have been installed using CCPW as backfill. Additionally, it is recommended that the potential risks associated with any UXO remaining in the dredge spoils storage area be assessed, if soils are to be disturbed in that area. Once these analysis have been completed, a determination can be made as to whether environmental conditions in the areas to be disturbed have been sufficiently well characterized and, if so, whether any environmental conditions are present that may hinder implementation of the proposed wetland restoration project. If necessary, a targeted, subsurface investigation can be implemented to supplement existing environmental studies.

Part I

TABLE OF CONTENTS

Page

TABLE OF CONTENTS

Page

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ACRONYMS AND ABBREVIATIONS

AMEC	AMEC Earth & Environmental, Inc.
AST	Above-ground storage tank
ASTM	American Society for Testing and Materials
BCM	BCM Engineers/ ATC Group Services, Inc.
BUST	New Jersey Department of Environmental Protection Bureau of Underground Storage Tanks
CCPW	Chromate Chemical Production Waste
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System database
CERC-NFRAP	CERCLIS No Further Remedial Action Planned database
CONSENT	Superfund (CERCLA) Consent Decrees database
CORRACTS	RCRA Corrective Action Activity database
CRRNJ	Central Jersey Railroad
DAF	Dilution attenuation factor
DRPSR	NJDEP Division of Responsible Party Site Remediation
EDR	Environmental Data Resources, Inc.
ERNS	Emergency Response Notification System
ESA	Phase I Environmental Site Assessment
FIFRA	Federal Insecticide Fungicide and Rodenticide Act
FINDS	Federal Facility Index System database
FTTS	Federal database of pesticide enforcement and compliance activities
GIS	Geographic Information System
HMIRS	Hazardous Materials Information Reporting System
KCSL	New Jersey Know Contaminated Site List
LQG	Large Quantity Generator of hazardous waste
LSP	Liberty State Park
LUST	New Jersey Department of Environmental Protection Leaking Underground Storage Tanks incident report database
LVRR	Lehigh Valley Railroad
MINES	Mine Master Index File database
MLTS	Material Licensing Tracking System database
MSL	
NAD83	North American Datum of 1983
NEA	Northern Ecological Associates
NJDEP	New Jersey Department of Environmental Protection
NJPDES	New Jersey Pollutant Discharge Elimination System
NJPF	Publicly Funded Cleanup Site Status Report database
NPL	National Priority List
PADS	PCB Activity Database
PAH	Polynuclear aromatic hydrocarbons
PCB	Polychlorinated biphenyl
POC	U.S. Army Corps of Engineers Point of Contact
PPM	Parts Per Million
RAATS	RCRA Administration Action Tracking System
RCRA	Resource Conservation and Recovery Act

RCRIS	Resource Conservation and Recovery Act Information System database
RCRIS-LQG	Resource Conservation and Recovery Act Information System Large Quantity Generator database
RCRIS-SQG	Resource Conservation and Recovery Act Information System Small Quantity Generator database
RCRIS-TSD	Resource Conservation and Recovery Act Information System Treatment Storage and Disposal facilities database
ROD	Record of Decision
SARA	Superfund Amendment and Reauthorization Act
SCC	Soil Cleanup Criteria
SHWS	EDR database complied from New Jersey Known Contaminated Site List
SOW	Scope of Work
SPLP	Synthetic Precipitation Leaching Procedure
SQG	Small Quantity Generator of hazardous waste
SSTS	Federal Pesticide registration database
SVOC	Semi-Volatile Organic Compound
SWF/LS	New Jersey Solid Waste Facilities / Landfill Sites database
TCL	USEPA Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TOC	Total Organic Carbon
TPHC	Total Petroleum Hydrocarbons
TRIS	Toxic Chemical Release Inventory
TSCA	Toxic Substance Control Act
TSD	Hazardous waste Treatment Storage and Disposal facility
USACE	U.S. Army Corps of Engineers
USACE-NYD	U.S. Army Corps of Engineers, New York District
USCG	U.S. Coast Guard
USGS	U.S. Geological Survey
UST	Underground Storage Tank
UXO	Unexploded Ordnance
VOC	Volatile Organic Compound

1.0 INTRODUCTION

The U.S. Army Corps of Engineers, New York District (USACE-NYD) is working in partnership with several state and local agencies to assess the feasibility of restoring selected wetlands within the New York-New Jersey Harbor Complex (also known as the Hudson-Raritan Estuary). The USACE-NYD has identified three priority sites (Project Areas) for wetland restoration within the Hudson-Raritan Estuary. These are: (1) Liberty State Park, located in Jersey City, New Jersey; (2) Newtown Creek located in the Boroughs of Brooklyn and Queens, New York; and (3) Sherman Creek, located in Manhattan Borough, New York. Prior to implementation of the proposed wetland restoration projects, the USACE-NYD requires that a Phase I Environmental Site Assessment (ESA) be performed of the three Project Areas.

Under contract No. DACW51-01-D-0017 between Northern Ecological Associates, Inc. (NEA) and the USACE-NYD, AMEC Earth & Environmental, Inc. (AMEC) was assigned to conduct an ESA of the three priority wetland sites. The results are presented in this ESA Report, which is being submitted under Delivery Order 0012 of the referenced contract. The report is comprised of three parts, of which Part I (this part) pertains to the Liberty State Park (LSP) Project Area. Parts II and III pertain to the Sherman Creek and Newtown Creek Project Areas, respectively.

1.1 Purpose and Objectives

The purpose of the ESA was to collect background data and review existing information concerning recognized environmental conditions at three Project Areas. The principal objectives of the ESA were to develop information about environmental conditions at the three sites, in the specific context of the planned wetland restoration projects; identify any information gaps regarding existing environmental studies; and make recommendations concerning any additional investigations that may be needed to address those gaps.

1.2 Scope of Services

This ESA was prepared in accordance with the Scope of Work (SOW) provided to AMEC by NEA on August 5, 2002 (USACE-NYD, 2002). The SOW incorporates by reference the guidance document by the American Society for Testing and Materials (ASTM) entitled Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process (ASTM E1527-00) (ASTM, 2000). The geographic limits of each Project Area and the specific types of environmental record sources to be reviewed were determined on a site-specific basis, in consultation with the USACE-NYD Point of Contact (POC).

The geographic limits of the LSP Project Area were defined as the park boundaries (Figure 1). The environmental records sources that were reviewed included those standard federal and state records listed under Section 7.2.1.1 of ASTM E1527-00, and publicly accessible files available at the New Jersey Department of Environmental Protection (NJDEP). Sources reviewed with respect to the physical setting (*e.g.*, topography, hydrology, geology) of the LSP Project Area included U.S. Geological Survey (USGS)

Topographic Quadrangle maps, as well as site-specific information obtained from existing environmental reports. Historical land-use information was obtained from a review of Sanborn Fire Insurance Maps and historic aerial photography. Existing reports on historical land use and cultural resources of the LSP Project Area were also reviewed, along with historic maps and site plans obtained from state regulatory files.

Site reconnaissance of the LSP Project Area was performed with the assistance of the POC and Assistant Superintendent of LSP. Site reconnaissance was limited to exterior observations concerning major areas of interest within the LSP Project Area.

1.3 Significant Assumptions

An important assumption underlying this ESA is that the LSP Project Area has already been sufficiently well characterized through previous environmental investigations by the State of New Jersey that an exhaustive review of local government records (*e.g.*, tax, fire and police records) was not warranted. This assumption was supported by the results of the NJDEP file review, which produced extensive background information on the site.

1.4 Limitations and Exceptions

Environmental impairment of a property may result from activities such as illegal or unreported dumping, or the spilling of hazardous substances or materials. It should be noted that the presence of contaminants at a particular property may not always be apparent, and the completion of a Phase I ESA in accordance with ASTM-E-1527-00 cannot provide a guarantee that hazardous substances or materials do not exist. The scope of services executed for this project does not constitute an audit for any of the following: regulatory compliance, cultural and historic resources, industrial hygiene, health and safety, ecological resources, endangered species, indoor air quality, or high voltage power lines. Nor does it comprise a detailed condition survey for: radon, naturally occurring hazardous materials, lead-based paint, lead in drinking water, asbestos-containing materials, or other conditions of potential hazard. The above-mentioned conditions are as outlined in Section 12.1.4 (Non-Scope Considerations) of the ASTM E1527-00.

1.5 Special Terms and Conditions

AMEC has prepared this report for the exclusive use of NEA and the USACE-NYD. AMEC will not be responsible for the use of this report by any other party, or reliance on or any decision to be made based on it without the prior written consent of AMEC. AMEC accepts no responsibility for damages, if any, by any other party as a result of decisions or actions based on this report.

This report presents an overview of issues of environmental concern, reflecting AMEC's best judgement using information reasonably available at the time of AMEC's site visit. AMEC has prepared this report using information understood to be factual and correct and shall not be responsible for conditions arising from information or facts that were concealed or not fully disclosed to AMEC at the time of the site visit.

In completing the scope of work, AMEC did not conduct any intrusive investigations such as sampling, testing or monitoring. Detailed cost estimates associated with environmental

issues discussed in this report, or activities required to bring the site into environmental compliance, were not required in the SOW.

2.0 SITE DESCRIPTION

2.1 Local and Legal Description

The park is comprised of a series of 24 land parcels, which were acquired by the State of New Jersey during the period from 1965 to 1993 (Figures 1 and 2). The LSP Project Area is located entirely within Jersey City, New Jersey, and includes the following tax Blocks and Lots[1] :

Block 60 (Lot 38A); Block 1497 (Lots 1C, 3F, 3N, 3Q, and 8-10);

Block 2048 (Lots S1, S2, J, H3, 6, 10A&B, 11, 16, and 44B);

Block 2145 (Lots 22M, 40D, 44D, 45D-F, 48J, 48L&M, 48P, 49J, 50J, 50L-Z, 51B&C, and 52); and

Block 2154 (Lots 33, 22D, 22G, 22H, 22J, 22M, 22S, 24, 40F, 40H, 47A, 49K, 48H, 48J, 48L, and 50H).

The LSP Project Area boundaries shown in Figures 1 and 2 are based on a geographic information system (GIS) layer provided by the NJDEP (1999), and a compilation of land acquisitions at LSP by the NJDEP Division of Parks and Forestry (NJDEP, 1984).

2.2 Site and Vicinity General Characteristics

The LSP Project Area occupies an area of approximately 1,200 acres, and is bounded to the north by the Morris Canal Basin and to the east and south by the Hudson River Estuary (Figure 1). Land use in the immediate vicinity of the LSP Project Area is predominantly industrial, but also includes some commercial and residential use. The land areas within the LSP Project Area consists mostly of fill material deposited within former tidal flats and wetlands. Approximately 70% of the land area within the LSP Project Area is currently undeveloped and unpaved.

2.3 Current Use of the Property

Liberty State Park is owned by the State of New Jersey, and is used principally as a public park and educational facility. Public facilities at LSP include the Liberty Science Center and Hall of Technology, Visitors Center, Interpretive Center, the former CRRNJ Terminal (with ferry service to the Statue of Liberty and Ellis Island), a swimming pool, hiking trails, picnic area, playground, food concession, and associated parking areas and roads (Figure 2). Waterfront facilities include the Liberty Landing Marina, a trailer launch, canoeing and boating facilities, and boat storage facilities. Additionally, there are temporary offices (trailers) for park personnel (a permanent office building is currently under construction).

[1] The NJDEP has advised that the City of Jersey City has revised its lot and block system since the Acquisition Map was prepared and that some of these lot and block designations may have been changed.

2.4 Structures, Roads and Other Improvements on the Site

The park is served by a network of paved roads (Figure 2). A utility plan of LSP produced by the Port Authority of New York and New Jersey (1975) shows subsurface sanitary sewer, electrical, water, and telephone service throughout the LSP Project Area. Three sewer mains operated by the Jersey City Sewerage Authority are shown passing through the site and discharging to the Hudson River: (1) a steel, 96-inch diameter, combined sewer, (2) an 84-inch brick combined sewer (now abandoned), and (3) an 80" x 80" reinforced concrete sanitary sewer.

2.5 Current Uses of Adjoining Properties

The New Jersey Turnpike is located immediately northwest of the LSP Project Area. As shown in Figure 2, the southwestern portion of the LSP Project Area consists of a series of irregularly shaped parcels enclosing a privately owned industrial park. The Jersey City Sewerage Authority operates a treatment facility (East Side Treatment Plant) immediately to the west of LSP.

As noted in Section 1.2 above, the LSP Project Area is defined on the basis of the park boundaries. Therefore, the current uses of adjoining properties were not reviewed further in connection with this ESA.

3.0 USER PROVIDED INFORMATION

3.1 Reason for Performing Phase I

The reason for performing this ESA, as stated in the SOW, was to "establish a base line" of environmental data for each Project Area so that "a more focused study can go forward in determining what level of effort would be required to implement restoration at the site" (USACE-NYD, 2002).

3.2 Other Information

The USACE-NYD POC provided guidance concerning the geographic limits of the LSP Project Area, the types of environmental record sources to be reviewed, and the level of detail required in the ESA report. Additionally, the POC provided AMEC with the names of contacts within the NJDEP for the purpose of arranging file reviews and/or interviews concerning environmental conditions within the LSP Project Area.

4.0 RECORDS REVIEW

4.1 Standard Environmental Record Sources

The standard environmental records sources specified under Section 7.1.1 of ASTM E1527-00 were searched for records that were "reasonably ascertainable", as defined under Section 3.3.30 of the Standard, using computerized database searches. The database searches were performed on behalf of AMEC by Environmental Data Resources, Inc. (EDR) of Southport Connecticut. The standard environmental record sources that were searched in connection with this ESA are described in Sections 4.1.1 and 4.1.2 of this report, and the results are discussed in Section 7.3.

The database queries were performed using the "Area Study" service available from EDR, in which records are searched relative to a geographic "corridor" specified by the client. The database searches included federal and state databases as well as EDR proprietary databases. As specified by the POC, a geographic search corridor based on the LSP Project Area boundaries was used for all of the databases queried except the Federal NPL Site List and RCRA TSD database. The geographic search limits for the Federal NPL Site List and RCRA TSD were extended 1 mile outward from the LSP Project Area boundaries, in accordance with Section 7.2.1.1 of ASTM E1527-00.

Due to the irregular shape of the LSP Project Area (Figure 2) and limitations imposed by EDR's geographic information system, it was not possible to exactly replicate the LSP Project Area boundaries in the computerized records search. Therefore, a simplified search corridor was defined which included all of the LSP Project Area, as well as some regions located outside of the Project Area boundaries. As per the scope of this ESA (Section 1.2), only the environmental records pertaining to sites located within the LSP Project Area are discussed in this report.

4.1.1 Federal Environmental Records Sources

The following federal databases (maintained by the USEPA) were searched in connection with this investigation:

CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System – listing of federally regulated sites under CERCLA.
CERC-NFRAP	Listing of CERCLIS sites where No Further Remedial Action is Planned.
CONSENT	Superfund (CERCLA) Consent Decrees.
CORRACTS	RCRA Corrective Action Activity database.
ERNS	Emergency Response Notification System database.

FINDS	Federal Index System – listing of USEPA regulated facilities and references to listings in other federal databases.
FTTS	Listing of federal administrative/enforcement actions against pesticide-producing establishments.
HMIRS	Hazardous Materials Information Reporting System.
MINES	Mine Master Index File.
MLTS	Material Licensing Tracking System.
NPL[2]	National Priority List.
Proposed NPL	Proposed National Priority List.
Delisted NPL	National Priority List Deletions database.
NPL Liens	Listing of federal Superfund Liens.
PADS	PCB Activity Database.
RAATS	RCRA Administration Action Tracking System database.
RCRIS-LQG	Provides information on facilities that are Large Quantity Generators (LQGs) of hazardous waste.
RCRIS-SQG	Provides information on facilities that are Small Quantity Generators (SQGs) of hazardous waste.
RCRIS-TSD[2]	Provides information on hazardous-waste treatment, storage, and disposal facilities (TSDs) regulated under the Resource Conservation and Recovery Act (RCRA).
ROD	Records of Decision database.
SSTS	Federally registered pesticide-producing establishments.
TRIS	Toxic Chemical Release Inventory.
TSCA	Records maintained under the Toxic Substance Control Act.

The relevant findings are reviewed in Section 7.3 of this report.

4.1.2 State Environmental Records Sources

The following state databases (maintained by the NJDEP) were searched in connection with this investigation:

LUST	Leaking Underground Storage Tank Incident Reports database.
NJ Brownfields	Listing of brownfields sites in New Jersey.
NJ Chrome	Known chromate waste contaminated sites.
NJ Major Facilities	List of Major Facilities in New Jersey.

[2] Geographic search corridor extended 1 mile outward from Project Area boundaries, as per ASTM E1527-00 Section 7.2.1.1.

NJ Release	Lists initial notification information provided to the NJDEP 24-hour Spill Hotline.
NJ Spills	Contains records of hazardous materials discharges reported to the NJDEP 24-hour Spill Hotline.
NJPDES	Permits issued New Jersey Pollution Discharge Elimination System.
NJPF	Publicly Funded Cleanup Site Status Report.
SHWS	Contains records from the NJDEP Known Contaminated Site List, excluding those regulated under the NJDEP Bureau of Underground Storage Tanks (BUST).
SWF/LS	Solid Waste Facilities / Landfill Sites List – contains an inventory of solid waste disposal facilities and landfills in New Jersey.
UST	Underground Storage Tank database – contains a list of registered USTs.

The relevant findings are reviewed in Section 7.3 of this report.

4.2 Additional Environmental Record Sources

4.2.1 NJDEP File Review

Additional information regarding recognized environmental conditions at LSP was obtained from a manual review of publicly accessible files maintained by NJDEP. These files provided a detailed record of past environmental investigations and remedial action at LSP, as well as information concerning the historic development and use of the property. The NJDEP file review was conducted during the period from October 22-29, 2002 at the NJDEP offices located at 401 and 501 East State Street, Trenton New Jersey. File review requests were directed to two divisions of the NJDEP: (1) the Site Remediation Program, which is responsible for oversight of environmental investigations and remedial work at LSP; and (2) the Division of Parks and Forestry, which has primary administrative responsibility for the operation, management, and development of the park. The principal contacts within the NJDEP were Edward Putnam, Assistant Director of the Remedial Planning & Design Element, Site Remediation Program, and Frank Gallagher, Administrator of Interpretive & Education Services, Division of Parks and Forestry. The results of the NJDEP file review are presented in Section 7.4 of this report.

4.2.2 Proprietary Databases

The database search performed by EDR included a search of a proprietary historical database of former manufactured gas (coal-gas) facilities. The information contained in the database consists of records compiled by EDR during the course of past investigations.

4.3 Physical Setting Sources

Information concerning the topography of the LSP Project Area, and its relationship to surrounding surface-water bodies, was obtained from the U.S. Geological Survey Jersey City Quadrangle (photorevised 1981). Site-specific information concerning the subsurface geology was obtained principally from: (1) a report prepared for the NJDEP by TAMS (1989b); (2) a report of geophysical investigations by the New Jersey Geological Survey (NJDEP 1988), and (3) soil-boring logs contained in NJDEP regulatory files. Information pertaining to shallow (*i.e.* unconfined) ground water conditions within the LSP Project Area was obtained from reports by the NJDEP (1994b, 2000b, 2001a, 2001b) and TAMS (1989a, 1989b).

4.4 Historical Use Information on the Property

Information concerning the historic uses of the properties within the LSP Project Area was obtained from the following sources:

1. Sanborn Fire Insurance Maps for the years 1885, 1887, 1911, 1912, 1950, 1951, and 1979;
2. Historic topographic map coverage provided by the EDR Historic Topographic Map service for the years 1955, 1967, and 1981;
3. Historic aerial photography provided through the EDR Aerial Photography Print Service for the years 1943, 1953, 1966, 1976, 1985, and 1995;
4. A report on the historic and cultural resources within the LSP Project Area by Historic Conservation and Interpretation Inc. (1977);
5. Historic maps obtained from NJDEP files;
6. An NJDEP memorandum (NJDEP, 1994a) summarizing the results of a previous aerial photographic review of the property; and
7. The 1984 Liberty State Park Acquisition Map compiled by the NJDEP.

4.5 Historical Use Information on Adjoining Properties

As described in Section 1.2, the scope of this ESA was limited to the region within the LSP Project Area boundaries. Therefore, no historical use information concerning the adjoining properties was reviewed.

5.0 SITE RECONNAISSANCE

Reconnaissance of the site was performed by AMEC on 9 December 2002, with the assistance of the POC. The Assistance Superintendent of LSP provided a guided tour of the facility and provided information about the development and operation of the park facilities.

5.1 Methodology and Limiting Conditions

Because of the size of the LSP Project Area, and the fact that it has already been extensively investigated by the NJDEP, reconnaissance activities were limited to an examination of major areas of interest and photographs of current site conditions. Site photographs are provided in Appendix A.

Limiting conditions encountered during the site reconnaissance included the presence of heavy vegetative overgrowth in undeveloped areas and the presence of approximately 5 inches of snow on the ground. The presence of landscaping, paved areas, and recently constructed buildings further limited examination of the underlying soils. Exposures of surficial materials were limited, and the ground was frozen at the time of the visit.

5.2 General Site Setting

Current usage of the property includes park facilities (*e.g.*, Liberty Science Center, Interpretive Center, Maintenance Office, and Ferry Terminal), paved roads, and privately operated concessions such as the Liberty Landing Marina. The Liberty Landing Marina and associated parking and boat storage facilities occupy most of the northern shore of the park. The eastern shore is bounded by a concrete seawall reinforced by an exterior apron of stone (riprap). The southern shore of the property is bounded by wood and steel bulkheads. Most of the interior of LSP is currently undeveloped and is enclosed by chain-link fencing.

5.3 Exterior Observations

Exterior observations included a walking tour through the center of the former Freight Yard (Figure 2), visits to the Liberty Landing Marina, Ferry Terminal, and Liberty Walk, and driving tours of the park perimeter, interior roads, and roads enclosing the privately owned industrial park.

Exposed fill materials were examined at a construction site located at the western margin of the Liberty Landing Marina (Appendix A). The soils consisted of dark-gray to black fill materials (evidently coal ash and (or) other burned material) and construction debris (brick, concrete and metal). Within the Freight Yard, piles of soil were present in which similar anthropogenic materials were observed, along with tires and other refuse. As noted above, the Dredge Spoils Storage Area was heavily overgrown with trees and brush, as was the Freight Yard. No obvious evidence of environmental contamination was observed during the site reconnaissance, other than the common fill materials historically deposited at the site.

During the reconnaissance visit, the Assistant Superintendent of LSP noted that an oil sheen has been observed sporadically along the eastern shore of the park, the source of which is currently being investigated by the NJDEP. This condition is apparently related to the presence of petroleum free-product in the subsurface within an area known as Waterfront Development Area (refer to Section 7.4.2.6 below). No oil sheen was observed during the site visit.

5.4 Interior Observations

This ESA pertains specifically to areas in which wetlands restoration is proposed, which do not include the areas underlying existing park buildings. Further, all of the buildings at the park are located in areas that have already undergone environmental investigation and/or remedial action by the NJDEP. Therefore, other than a cursory examination of the former CRRNJ Terminal Building, no interior observations were made during the reconnaissance visit.

6.0 INTERVIEWS

Liberty State Park is owned, operated, and managed by the State of New Jersey, and the operating history and environmental conditions within the LSP Project Area have been extensively documented by the NJDEP. Therefore, publicly accessible files maintained by the NJDEP Site Remediation Program and the NJDEP Division of Parks and Forestry were the principal sources of information concerning recognized environmental conditions at LSP. The information developed through the NJDEP file reviews was supplemented with specific details provided by NJDEP personnel familiar with the site. The principal contacts within the NJDEP were those listed in Section 4.2.1 above and the Assistant Superintendent of LSP. Information developed from discussions with NJDEP personnel is included in the narrative in Section 7.0 of this report, and citations are provided, where appropriate.

All of the concessions currently operated at LSP (Liberty Landing Marina, Liberty Science Center, food concessions) are located in areas that have already undergone environmental investigation and/or remedial action (where required) during the course of their redevelopment. Because detailed records are available through the NJDEP concerning environmental conditions at these sites, formal interviews with concession operators were not conducted during this ESA.

7.0 FINDINGS

7.1 Physical Setting

7.1.1 Topography and Drainage

The topography of the site, as represented by the U.S. Geological Survey Jersey City Quadrangle is shown in Figure 1. The ground elevation within the LSP Project Area typically ranges from 0 to 10 feet above Mean Sea Level (MSL). Drainage is generally toward the waterfront (north, east, and south). There are currently no surface-water bodies in the interior of the site (a freshwater wetland is present immediately north of the Liberty Science Center). Thus, the Hudson River Estuary and the Morris Canal Basin are the principal surface-water receptors.

7.1.2 Geology and Hydrogeology

The unconsolidated deposits underlying the site consist principally of fill (*e.g.*, domestic refuse, coal ash, dredge spoils, construction debris, and chromate production waste). According to the results of a seismic reflection survey by the New Jersey Geological Survey the total fill thickness within the LSP Project Area ranges from 10-40 feet (NJDEP, 1988). The fill is underlain by Holocene-age shallow-marine deposits (organic-rich silt, clay, sand, and shells), which are in turn underlain by partially consolidated Pleistocene deposits consisting of "varved" lacustrine deposits and glacial till (TAMS, 1989b). The Pleistocene deposits overlay the Lower Paleozoic Manhattan Schist (Lovegreen, 1974). The elevation of the bedrock surface, as determined by geophysical surveys ranges from -43 to -134 feet MSL (NJDEP, 1988).

During previous ground water investigations at LSP, ground water was typically encountered at depths of 5 to 10 feet below grade (NJDEP 1994b, 2000b, 2001a, 2001b; TAMS 1989a, 1989b). As shown by TAMS (1989b), ground water in the vicinity of the Northern Marina (and probably elsewhere on site) is tidally influenced. The results of synoptic water-level measurements contained in NJDEP regulatory files suggest that hydraulic gradients within the shallow ground water are generally oriented toward the shoreline (*i.e.*, toward the north, east, and south). No information was found concerning the hydrogeology of deeper water-bearing units (*e.g.* fractured bedrock).

7.2 Historical Use Information

7.2.1 Filling History

Prior to about 1860, nearly all of the LSP Project Area consisted of open water and tidal flats (NJDEP 1989) (refer to Figures II and III of Appendix F). Filling of the LSP Project Area occurred in several stages, from north to south, beginning in 1860 and continuing until at least 1928. During the 1860s, the CRRNJ placed over 20 million cubic yards of fill into Communipaw Cove to create a rail terminal complex at the present site of CRRNJ Terminal

Building, thus forming the northern margin of LSP (Historic Conservation and Interpretation Inc. 1977). The fill consisted principally of garbage from the City of New York, which was transported to the site on scows. During the 1870s, the CRRNJ and the LVRR operated a railroad repair facility, stockyards, and various commercial shipping facilities at the site. A series of piers were also created by filling areas adjacent to the former Black Tom Island (now known as "Black Tom"). Over time, the region lying between Black Tom Island and the CRRNJ Terminal was systematically filled to produce the present-day shoreline of LSP.

Much of the filling of the central part of Communipaw Cove occurred during the period from 1900 to 1920, in order to create land for a new CRRNJ Freight Terminal (the region known today as the "Freight Yard"). Initially, a series of wood-cribbed bulkheads were constructed at the location of the present-day Waterfront Development Area (Figure 2). The area immediately outside (east) of the bulkhead line was then dredged, and the area behind the bulkhead was filled with a combination of dredge spoils (hydraulic fill) and domestic refuse. The following account of the filling methods used is taken from an article appearing in the Engineering News (1914):

> Back in 1900, when the work was started, under permission granted by the War Department in 1898, the first operation was to float in a large number of old canal boats, fill them with stone, and sink them from 400 to 500 feet back of the bulkhead line. Just back of the canal boats, an earthen dike was made by unloading (by hand) cellar dirt from scows. The dike formed by the earth-backed canal boats prevented the new fill from being washed away by the tides. At various points back of this dike, transverse dikes were built. Then general filling operations began.

Large-scale filling activities within the LSP Project Area was completed by about 1928 (NJDEP, 1995b). However, evidence form historic maps and aerial photographs suggests that localized filling may have occurred as recently as the 1960s.

7.2.2 Sanborn Maps

Copies of the Sanborn Fire Insurance Maps reviewed in connection with this investigation are provided in electronic (.pdf) file format in Appendix B.

The Sanborn Fire Insurance Maps for the years 1895-1897 shows the CRRNJ Ferry House (Terminal Building), an attached railroad depot, and an extensive network of rail facilities and piers. An "oil waste shed" and a "retort house" are shown approximately 200 feet east of the intersection of Johnson Avenue with Washington Avenue, along with a circular structure which appears to be a storage tank[3]. The area known today as "Black Tom" is shown as a narrow peninsula ("Black Tom Island"). A rail terminal and a series of warehouses are shown (National Storage Co.). Filling of the northern portion of the site (*i.e.* along the Morris Canal Basin) has been completed. Filling of the region lying between Black Tom and the CRRNJ terminal has not yet been completed.

The 1911-1912 Sanborn Map coverage shows the "H. Snooks Brass Foundry" and the "Neptune Mildew and Waterproofing Co." located approximately 600 feet north of the intersection of Communipaw Avenue and Phillip Street (within the northernmost portion of the current Liberty Science Center Parking Lot). The CRRNJ Ferry Concourse (Terminal

[3] The label shown on the Sanborn Map was only partially legible, beginning with the words "GAS..".

Building) and railroad depot have been expanded to their present size, and the rail facilities within the Freight Yard have also been expanded. The LVRR occupies the northernmost portion of the site, along the banks of the Morris Canal Basin, and has also established a coal loading facility immediately north of the CRRNJ Terminal Building. A coal-fired power and heating plant operated by CRRNJ is shown adjacent to the eastern terminus of Johnston Avenue. The Central Union Stockyard is shown in the approximate center of the Freight Yard. Associated facilities include a machine shop, coal pockets, a railroad turntable, cattle pens, and cement storage facilities. Within the area immediately east of the former Middle Cove, railroad tracks and piers are shown belonging to CRRNJ. The rail and loading facilities on Black Tom Island are shown as having expanded southward, and the shoreline along the southwestern margin of the property is shown in its current configuration. At this time, the region located immediately to the north of Black Tom Island (currently the site of the industrial park) has not yet been filled.

The 1950-51 Sanborn Maps show few changes in the area of the Terminal Building. The LVRR freight depot and loading facilities are still present. The Burns Bros. Coal Yard is shown immediately west of the intersection of Johnston Avenue and Washington Street. A "filling station" and an oil tank are shown at the east end of Johnston Avenue, which are apparently part of the CRRNJ rail complex. Within the region now occupied by the Liberty Science Center (east of Communipaw Avenue and south of Wilson Street) are railroad "roundhouses" operated by the CRRNJ (Communipaw Avenue engine terminal). Associated facilities include a coal-fired power house, two 100,000-gallon above-ground oil tanks, coal pockets, conveyors, cinder pits, storage buildings, offices, a diesel locomotive servicing area, and diesel storage facilities. The "Tug & Barge Supply Co." (a.k.a. McAllister Tug and Repair) is shown immediately to the east of the former Middle Cove, which includes a machine shop, sheet-metal shop, storage facilities, and floating dry docks. Immediately east of the Tug & Barge facility is another CRRNJ power house. The region immediately southeast of Black Tom Island (currently the site of Dog Show Field) is shown as being partially filled.

The 1979 Sanborn maps show no new railroad related facilities within the LSP Project Area. The Bond Adhesive Co. occupies a building on the north side of Johnston Avenue (approximately 600 feet west of Washington Street), which was formerly the site of a coal pocket operated by CRRNJ (shown on the 1951 Sanborn Map). The one of the railroad roundhouses at the Communipaw Avenue engine terminal has been partially demolished and one of the 100,000-gallon oil tanks shown in the 1951 Sanborn map is no longer present. The region immediately southeast of Black Tom Island has been filled. Black Tom Drive (now known as Wolf Drive), Edward Hart Drive, and Statue of Liberty Drive have been established. A bleach factory (the former Clorox facility) is shown immediately south of Edward Hart Drive. Immediately to the north of Edward Hart Drive there are warehouses and an electrical appliance repair business.

7.2.3 Historic Topographic Maps

Copies of the historic USGS Topographic Quadrangle maps reviewed in connection with this investigation are provided in Appendix C.

The 1955 topographic map shows an extensive network of rails, piers, and loading facilities within the LSP Project Area, along with the CRRNJ Terminal Building and the Communipaw Avenue engine terminal. The region lying immediately northeast of Black Tom Island has

been partially filled, and a road is shown along the present alignment of Thomas McGovern Drive. The 1967 revision shows additional roads in this area (Theodore Conrad Drive and Edward Hart Drive), along with several new buildings. In the 1981 (current) photorevision, the railroad tracks have been removed. Additional buildings are shown adjacent to Theodore Conrad Drive and Edward Hart Drive, within what is now the privately owned industrial park (Figure 2).

7.2.4 Historic Aerial Photography

Copies of the historic aerial photography provided by the EDR Aerial Photography Print Service are provided in Appendix D.

The 1943 aerial photographs shows an active rail facility with numerous steam-powered engines in use (rising plumes of steam are visible at several locations). Ships and barges are visible adjacent to the piers and loading areas. The presence of disturbed areas along the shoreline immediately north of Black Tom suggest that filling is taking place. The roundhouses associated with the Communipaw Avenue engine terminal are clearly visible and steam plumes visible over the tracks show that these facilities are active.

Numerous railroad cars are visible in the 1953 aerial photographs, suggesting that the rail facility is still active. However, the steam plumes seen in the earlier photographs are absent (suggesting a change to diesel and/or electric-powered engines). Boats and barges are visible adjacent to the McAllister Tug and Barge facility, suggesting that it is also active. Trains are visible within three distinct clusters of tracks, each leading to a major loading facility. Filling of the region southeast of Black Tom appears to have been mostly completed. However, no buildings are shown in the area now occupied by the industrial park. A narrow stream channel is visible passing though the area.

The 1966 aerial coverage shows evidence of several important changes. The railroad operations are still active. However, one of the railroad roundhouses at the Communipaw Avenue engine terminal has been partially demolished (apparently to make way for the New Jersey Turnpike). Several buildings are present in the area of the industrial park. Soils in the southeastern portion of the industrial park appear to be disturbed, suggesting recent construction and (or) filling in the area. The stream channel noted in the 1953 aerial photographs is no longer visible. Additionally, a new building complex is visible immediately to the northwest of the former Middle Cove, within the Freight Yard. This building complex is identified in the underground utilities plan by Port Authority of New York and New Jersey (1975) as a drug treatment center. The East Side Sewage Treatment Plant and an auto impoundment yard are also visible immediately west of Communipaw Avenue.

No evidence of active railroad operations was noted in the 1976 aerial coverage, nor were any changes noted concerning new buildings or construction. However, approximately 2,000 feet west of the Terminal Building and 700 feet south of the present-day marina, an elliptical feature is visible which appears to be an excavation filled with standing water. Its dimensions are approximately 200 feet in the east-west direction by 100 feet north-south. Immediately east of this feature is an area where the soil appears to have been disturbed. These features suggest the possibility of filling and/or burial activity at this location, and warrant further investigation.

The 1985 aerial photographs, the tracks, piers, loading facilities, McAllister Tug and Barge facility, and the Communipaw Avenue engine terminal are no longer visible (apparently removed). The Dredge Spoils Storage Area is clearly visible, as is an area of recent filling at the southeastern corner of the park (adjacent to South Cove). The elliptical excavation noted in the 1976 aerial photographs is no longer visible.

The 1995 image shows the site after construction of the seawall but before construction of the Liberty Landing Marina. The Middle Cove has been filled, along with some areas immediately west of the seawall. The site shows evidence of landscaping and several of the roads have been widened and/or otherwise improved.

Additionally, the NJDEP has reviewed historic aerial photography for the years 1930-32, 1940, 1951, 1953, 1961, 1972, 1974, 1978, 1979, and 1986. In a memorandum by the NJDEP (1994a), the reviewer noted that:

> The 1930-32 photo-mosaic shows the Freight Yard area to be completely filled and covered by railroad tracks with no areas of concern for biased sampling. There are no real changes to this area until the 1970's aerials when the railroads declined and removal of the tracks began. From the 1970's onward to the 1986 aerials there are a few areas where additional dumping/filling activities occurred and where some unusual features are indicated. These areas may warrant some biased sampling in future sampling events.

The memorandum stated that several of the features noted in the aerial photographic review were to be investigated, but did not identify the specific features that were to be investigated. Therefore, it is not known whether the NJDEP has identified or investigated the possible burial site noted in the 1976 aerial photograph reviewed during this ESA[4].

7.3 Standard Environmental Records Sources

A copy of the EDR Area Study Report is provided in Appendix E, which includes a map of the facility locations identified in the database search. As noted in Section 4.1, the search corridor defined for the EDR Area Study was a polygon that included some areas outside of the LSP Project Area (refer to the Area Study Map in Appendix E). Consequently, approximately 80% of sites listed in the EDR Area Study report are located outside of the LSP Project Area, and are therefore not within the scope of this ESA. Additionally, several of the facilities shown on the EDR Area Study Map as being within the LSP Project Area were determined to be outside of the Project Area boundaries, based on a review of the corresponding street addresses and (or) facility descriptions listed in Area Study Report[5]. Thus, a total of six facilities were identified within the LSP Project Area, which are shown at map location numbers 5, 6, 11, 13, 15, and 16 in the EDR Area Study Report (Appendix E). The environmental records in the Area Study Report pertaining to each of these facilities are discussed individually in Sections 7.3.1 through 7.3.9 below:

[4] The images reviewed by the NJDEP included coverage for 1974 and 1978, but not for 1976; it is not known whether this feature was visible in either the 1974 or 1978 coverage.

[5] Several privately owned facilities located on streets bordering the LSP Project Area were shown on the side of the street opposite their actual location.

7.3.1 RCRIS-TSD Database

A total of five TSDs were identified within a 1-mile radius of the LSP Project Area, which are shown at locations 1 through 4 on the EDR Area Study map (Appendix E). All of these facilities are located outside of the LSP Project Area, and are hydraulically isolated from it by the Morris Canal Basin (Figure 1 and Appendix E). Therefore, these sites are unlikely to have had a direct impact on soil or ground water conditions within the LSP Project Area.

7.3.2 RCRIS-SQG Database

The EDR Area Study Report shows two SQG facilities within the LSP Project Area (listed as NJDEP Sites 015 and 178) at map locations 13 and 15 (Appendix E, pages 49 and 66). These sites, which are also known as McAllister Tug and Barge Products and the Cabana Club, respectively, have been investigated by the NJDEP as part of a regional investigation of Chromate Chemical Production Waste (CCPW) sites in Hudson County. The results of these investigations are summarized in Section 7.4.2.5 below. There are currently no industrial facilities operating at either location, and their SQG status is apparently related to past investigative and remedial activities by the NJDEP.

7.3.3 FINDS Database

Listings were identified in the FINDS databases pertaining to the two sites described in Section 7.3.2 above (NJDEP Sites 015 and 178). No additional information was found in the FINDS records beyond that provided in the RCRIS-SQG database. As noted above, both of these sites have been the subject of investigations by the NJDEP, the results of which are summarized in Section 7.4 of this report.

7.3.4 Known Contaminated Site List

Two entries listed in the EDR Area Study Report are within the LSP Project Area boundaries. The sites are listed as “Hudson County Chromate Occidental” and “Hudson County Chromate 15” and are both shown at map location 13 (Appendix E, p. 51). Both entries appear to refer to the same site, and few details are provided in the database records. As noted above, Chromate Site 15 (a.k.a., McAllister Tug and Barge Products) has been investigated by the NJDEP and the results are summarized in Section 7.4.2.5 of this report.

7.3.5 Solid Waste Facilities / Landfill Sites

Two solid waste facilities are shown within the LSP Project Area boundaries, which are designated as “Liberty State Park Maintenance Area” and the “DEP Liberty Park SLF” (Appendix E, p. 68 and 74). The solid waste facility at the Liberty State Park Maintenance Area is a leaf composting facility operated by the NJDEP. The DEP Liberty Park SLF is a closed sanitary landfill (also operated by the NJDEP) which was formerly used for disposal of “bulky waste”. No details were provided in the database records regarding the specific types of materials placed in the landfill.

7.3.6 Leaking Underground Storage Tank Incident Reports

Two LUST sites were identified in the EDR Area Study report at locations within LSP Project Area, one on Audrey Zapp Drive (site 5) and another at the Liberty State Park Maintenance Area located on Wolf Drive (site 16) (Appendix E, p. 22 and 68). The records show that a fuel-oil discharge was reported on September 7, 1994 at a construction site located on Audrey Zapp Drive, based on the discovery of a previously unknown, 10,000-gallon UST. Soil contamination was suspected and the tank was scheduled for removal. A no-further-action letter was issued by the NJDEP regarding this LUST on November 17, 1995.

The records pertaining to the Liberty State Park Maintenance Area indicate that four USTs with a total capacity of 4,000 gallons were scheduled for removal at the former landfill site described in Section 7.3.5 above. The USTs were formerly used to store leaded gasoline, and were reportedly installed in 1987. The tank construction was described as" fiberglass-reinforced plastic". The incident was initially reported on August 30, 1994. The available records to date do not show evidence of a no-further-action decision by the NJDEP with regard to this case. The current status of this case is therefore unknown.

7.3.7 Underground Storage Tank Database

Two USTs were identified in the EDR report at locations within the LSP Project Area, one adjacent to Freedom Way[6] (site 13) and another at the Liberty State Park Maintenance Area located on Wolf Drive (site 16) (Appendix E, p. 49 and 68). Four, bare-steel, single-wall, fuel-oil USTs were reportedly registered at the site on Freedom Way site in 1995, immediately prior to being removed. The records concerning the Liberty State Park Maintenance Area pertain to the same gasoline tanks described in Section 7.3.6 above.

7.3.8 NJ Spills List

Five discharges were identified at locations within the LSP Project Area, at site locations 5, 6, 11, 13, and 16 on the EDR Area Study map (Appendix E, pages 22, 34, 44, 49, and 68). Two of the sites are shown adjacent to Audrey Zapp Drive[7] (sites 5 and 6). One incident involved the same fuel-oil UST described in Sections 7.3.6 and 7.3.7 above, for which a no-further-action decision has been issued by the NJDEP. The other record concerned a report filed on December 17, 1992 regarding thirteen 55-gallon drums which were reportedly washed up along the shoreline, some of which were observed to be leaking (NJDEP Case No. 92-12-17-1047-24). The contents of the containers were not identified in the report. The incident responders included the Jersey City Fire Department and the NJDEP Division of Responsible Party Site Remediation (DRPSR). No further information was provided in the records regarding the outcome of this incident.

[6] The records list the site address as "Audrey Zapp Drive", but the location shown on the EDR Area Study Map is approximate ½ mile southwest of Audrey Zapp Drive, adjacent to Freedom Way. The address listed in the database is the business address of the responsible party, which apparently does not correspond to the location of the tanks.

[7] The second record incorrectly lists the street as "Audrey Zapp Blvd".

The records shown on page 44 of Appendix E (site 11) pertain to a fuel spill from a commercial bus in March 2000, which involved approximately 30 gallons of diesel [8]. The specific measures taken to contain or remediate the spill are not described in the report. However, based on the circumstances and the relatively small quantity of fuel involved, this incident does not appear to warrant further investigation.

The records pertaining to site 13 (Liberty State Park) and site 16 (Liberty State Park Maintenance Area) refer to incidents previously described in Section 7.3.6 and 7.3.7 above.

7.3.9 NJ Release

Three releases are listed in the EDR Area Study Report at locations within the LSP Project Area, all of which reportedly occurred at map location 6 (Appendix E, pages 24, 29, and 34). Two incidents are described as occurring at the Liberty Landing ("Liberty Park") Marina located at 80 Audrey Zapp Drive. The earliest record (dated December 17, 1992) pertains to the 13 abandoned drums described in Section 7.3.8 above. The incident was reported by an employee of the NJDEP on July 1, 2000 (Appendix E, p. 29). Under the heading "status at spill", the incident report states that eighty-seven 55-gallon drums were found in a trailer. The report provides no further details on the circumstances surrounding the release. The two other incidents both involved observations of an "oil sheen" on the water adjacent to the Liberty Landing Marina, one of which was reported by an officer of the U.S. Coast Guard (USCG). The source of the sheen is not described in the report. However, the type of release is described as "continuous".

7.4 NJDEP File Review

The NJDEP has conducted numerous environmental investigations within the LSP Project Area during the period from 1978 to the present, and additional investigations are planned. The results of environmental investigations performed during the period from 1981 to 1995 are summarized in reports by the NJDEP (1989; 1995a), copies of which are included in Appendices F and G respectively. A summary of site-wide soil and ground water conditions is provided in Section 7.4.1 below.

Several specific areas of environmental concern have been identified by the NJDEP, which are labeled in Figure 2. These areas of concern are: the Freight Yard, the Dredge Spoils Storage Area, Black Tom Channel / Dog Show Field, the Liberty Science Center, Chromate Sites 15 and 178, the Waterfront Development / Middle Cove area, the Northern Marina, and the Terminal Parking Lot. Details concerning the environmental investigations performed to date at these areas of concern is provided in Section 7.4.2.

7.4.1 Site-Wide Summary

The results of past environmental investigations within the LSP Project Area have shown evidence of relatively widespread soil contamination, but generally at levels below applicable hazardous-waste thresholds. Heavy metals (*e.g.*, arsenic, lead, zinc, and copper) and polynuclear aromatic hydrocarbons (PAHs) are nearly ubiquitous in fill materials

[8] The incident reportedly occurred in the vicinity of 251 Phillips Street (adjacent to the Liberty Science Center), however the location shown on the EDR map is within the former Freight Yard.

at the site, and commonly occur at concentrations above the applicable NJDEP Soil Cleanup Criteria (SCC). Petroleum hydrocarbons are commonly present in surface soils, probably as a result of incidental spillage during historic railroad operations, and petroleum free-product has been observed in subsurface soils at two different locations. Traces of Polychlorinated biphenyls (PCBs) and organochlorine pesticides (*e.g.,* dieldrin and DDT) have also been detected locally at concentrations above the SCC (but generally below applicable hazardous waste thresholds). Additionally, fill materials containing chromate chemical production waste (CCPW) have been identified at three sites within the LSP Project Area, in which hexavalent chromium (CrVI) was detected at concentrations above the NJDEP SCC.

Ground water quality at the site is generally reflective of the soil conditions described above. In 1994, the NJDEP Site Remediation Program conducted a site-wide reconnaissance investigation of ground water conditions at the site, during which 50 ground water samples were collected for laboratory analysis at the locations shown in Figure 3, using a Hydropunch® direct-push sampling rig. The sampling locations were targeted to specific features that were previously identified by the NJDEP during a review of historic aerial photography (NJDEP 1994b). The samples were analyzed for TCL VOCs, Metals and SVOCs. No VOCs were detected in the samples. However, metals and PAHs were detected locally at concentrations above the NJDEP Ground water Quality Criteria.

7.4.2 Specific Areas of Environmental Concern

7.4.2.1 Freight Yard

The Freight Yard is comprised of approximately 205 acres of undeveloped land within the center of LSP. It is bounded to the east by Freedom Way, to the west by Phillips Drive, to the north by Audrey Zapp Drive, and to the south by James Hamill Drive (Figure 2)[9]. The Freight Yard was created entirely from fill, which was deposited during the period from 1860 to about 1928 (refer to Section 7.2.1 above). From the time of its creation until the late 1960s, it was the site of a freight switching yard operated by the CRRNJ, which also contained stockyards and coal transportation facilities.

On February 28 and March 1 of 1990, a total of 57 soil samples were collected from 28 sample locations within the Freight Yard (NJDEP, 1990). Two samples were collected from each location, at depth intervals of 0-0.5 feet and 2-3 feet below grade. The samples were analyzed for the TCL VOC+30, TCL SVOCs, pesticides, PCBs, and metals. Trace of several VOCs were detected including, chloroform, ethylbenzene, trichloroethene, and toluene. Total PAH concentrations ranged from 8.0 to 276.2 parts per million (ppm). Traces of organochlorine insecticides were also detected including dieldrin (0.790 ppm), 4-4' DDE (0.580-0.70 ppm), and 4-4'-DDT (0.160-2.0 ppm). PCBs were detected in two samples (Aroclor 1248 at 5.9 ppm; Aroclor 1260 at 0.650 ppm).

[9] The Dredge Spoils Storage Area is geographically a part of the Freight Yard, but is addressed separately in Section 7.4.2.2 of this report.

During December 1994 and February 1995, the NJDEP collected additional soil samples within the southwest corner[10] and central portion of the Freight Yard. A total of 34 test pits were excavated within the southwest corner of the Freight Yard, from which 11 soil samples were collected for laboratory analysis. Within the central portion of the Freight Yard, 82 test pits were excavated, from which 52 samples were collected. The results are summarized in the August 1995 Liberty Park Soil Sampling Report (NJDEP 1995a; Appendix E). Arsenic, lead, and PAHs were detected at concentrations above the NJDEP Residential SCC. The NJDEP concluded that the contaminant concentrations in the central Freight Yard were "similar to those found in historic fill" and considered that capping with a 1-foot layer of clean cover would be a suitable remedy for the site (NJDEP,1995a). With respect to the southwest corner of the Freight Yard, the NJDEP concluded that arsenic, which had been detected at concentrations of up to 429 ppm, required further delineation.

Additional sampling was conducted during August 1996 to delineate the distribution of arsenic. A total of 23 test pits were excavated from which 54 samples were collected at depth intervals of 0-6 and 18-24 inches below grade. Further delineation of arsenic was performed during August and November 1996 (NJDEP 1996, 1997), during which 44 samples were collected for total arsenic analysis, four for Toxicity Characteristic Leaching Procedure (TCLP) analysis, and eight samples were collected for analysis using the Synthetic Precipitation Leaching Procedure (SPLP). The analytical results of these investigations were not reviewed during this ESA. However, an undated, draft NJDEP memorandum noted that arsenic concentrations as high as 1150 ppm have been detected locally within fill materials in the freight yard.

7.4.2.2 Dredge Spoils Storage Area

The Dredge Material Storage Area is located within the Freight Yard and consists of approximately 42 acres of dredge spoils and associated containment structures (NJDEP 2000a). The containment structure, which consisted of a series of 8-foot-high earthen berms, was constructed by the Port Authority of New York and New Jersey (Port Authority) during 1980-81 (NJDEP, 1989), using existing fill material excavated on-site (NJDEP 2000a). In 1981, approximately 93,000 cubic yards of dredge spoils were placed into the containment structure, in connection with the construction of the southern section of the seawall (Figure 2). On the basis of laboratory analyses performed in 1981, the dredged material was determined to be non-hazardous (NJDEP 2000a). However, runoff samples collected during October 1981 reportedly yielded results for oil & grease, cadmium, and lead above applicable regulatory thresholds. The NJDEP had previously stipulated that the Port Authority cover the dredge material with 2 feet of clean soil after dewatering of the material was complete (NJDEP 1987). However, no records were found of this work having been performed.

During the spring of 1987, an additional 255,000 cubic yards of dredge spoils were placed into the impoundment, which were obtained from an area between the South Cove and the Middle Cove during the completion of the Liberty Walk seawall project. Waste-classification sampling of this material during 1987 yielded results above the applicable regulatory thresholds for EP Toxicity (selenium) and reactive sulfide. However, The USEPA subsequently made a determination that the material was non-hazardous, citing

[10] Also known as the "Soil Staging Area".

inconclusive results for EP Toxicity and attributing the sulfide reactivity to naturally occurring, anaerobic biological activity (USEPA, 1984).

During the winter of 1991-92, a combination of high winds and dry weather resulted in erosion of the material. In August of 1993, the NJDEP hired a contractor to excavate and re-grade the berms surrounding the impoundment over the dredge spoils to form a cap over the material, and vegetative cover was subsequently established (NJDEP, 2000a).

The NJDEP conducted additional soil sampling within the Dredge Spoils Area in 1995, in order to confirm previous analytical results (NJDEP, 1995a) (Appendix E, pages 6-7). A total of 46 soil samples were collected along a regularly-spaced grid pattern, which were submitted for laboratory analysis. Relatively low concentrations of polychlorinated biphenyls (PCBs) and dieldrin, an organochlorine insecticide, were detected (maximum concentrations of 1.31 ppm and 0.72 ppm, respectively). Arsenic was detected at concentrations above the NJDEP Residential SCC of 20 ppm on 31 out of 46 samples, and lead was detected in six samples above the residential SCC of 400 ppm (maximum of 3,380 ppm). The NJDEP concluded that soil contaminants detected in the Dredge Spoils Area were generally similar to those found elsewhere in LSP, except for the presence of PCBs and dieldrin (NJDEP, 1995a). The NJDEP has suggested that an appropriate remedy for this area would be to maintain the current vegetative cover, possibly with the addition of a 1-foot layer of clean soil. It was concluded that additional investigation may be required to delineate PCBs and pesticides in this area, depending on the future use of the site (NJDEP, 1995a).

7.4.2.3 Black Tom Channel / Dog Show Field

The Black Tom Channel Area, which includes the Dog Show Field, occupies an area of approximately 150 acres at the southern end of Liberty State Park (Figure 3). A 35-acre portion of the site, which includes the Administration Building and the Liberation Monument, was the first area in the park to be redeveloped for public use. Prior to the turn of the century, Black Tom Channel was the site of a shallow oyster reef, which was partly filled with municipal refuse to create piers and a railroad terminal (refer to Sections 7.2.1 and 7.2.2 above). During the initial development of LSP, clean fill was used to cover debris located in the southern area, and asphalt parking lots were constructed.

In September 1992, the NJDEP tested surface soils within the Dog Show Field in response to a proposal to use the field for high-school football practice. Heavy metals and coal combustion residues (PAHs) were detected at concentrations above the NJDEP Residential SCC. On the basis of these results, the NJDEP determined that the site was not suitable for use as a football field but could safely be used for passive recreation and parking (NJDEP, 1995b).

Prior to the United States' entry into World War I, the terminal facilities at Black Tom were used to ship munitions to the Allied forces in Europe (NJDEP, 1989). In 1916, a series of explosions occurred at Black Tom, during which approximately 1,000 tons of munitions were detonated[11]. The explosions caused extensive damage to the surrounding area, and several barges containing unexploded ordnance (UXO) reportedly sank to the bottom of the adjacent Black Tom Channel (NJDEP, 1989).

[11] Allegedly as a result of sabotage by German agents.

During March of 1981, while hydraulic dredging operations were underway at the south end of the seawall (Figure 2), several rounds of "live" ordnance were reportedly discovered within the Dredge Spoils Storage Area (refer to Section 7.4.2.2 above). The rounds, which consisted of two 4-inch shrapnel rounds, two 3.25-inch shrapnel rounds, and two 35-mm cartridges, were sent to U.S. Navy Weapons Station Earle in Colts Neck, New Jersey for examination. The officer in charge noted that the powder and propellant charges in the rounds were "completely soaked with water", and that attempts to detonate them using explosives had failed (U.S. Navy, 1981). The report stated further that: "The conditions of the rounds examined to date indicates that the possibility of a detonation is remote." However, at the recommendation of the U.S. Coast Guard, a 100-yard-radius exclusionary zone was established around the dredging site and a screen was installed on the dredge-spoil line to prevent any additional ordnance from reaching the Dredge Spoils Storage Area. No further investigations have been performed to assess the possible presence of UXO within the LSP Project Area.

7.4.2.4 Liberty Science Center / Former Roundhouse

This site occupies an area of approximately 23.4 acres, of which 8 acres are currently leased to the Liberty Science Center, 10 acres are used as a parking lot, and the remainder is currently undeveloped (Figure 2). A freshwater wetland exists in the northern portion of the site.

The CRRNJ formerly operated its Communipaw Avenue engine terminal at this site, which was the main servicing and repair facility for over 300 railroad engines per day (refer to Section 7.2.2 above). The facility included a large double roundhouse, a coal-fired electric generating plant, and associated coal loading and fuel handling facilities. The facility was active from 1914 until 1967, when its operations were curtailed by the construction of the New Jersey Turnpike (NJDEP, 1989). The H. Snooks Brass Foundry and the Neptune Mildew and Waterproofing Co. facilities occupied the site prior to its acquisition by CRRNJ. The State of New Jersey purchased the property in 1978, and completed demolition of the buildings in 1980. During a site inspection by the NJDEP in 1980, petroleum product was observed within a manhole, which was subsequently removed. A USEPA Preliminary Assessment Report of the site noted that "the site was observed to be highly contaminated with an oil and grease sludge" an that due to the nature of operations at the site "PCBs may also exist" (USEPA, 1986a).

In February of 1991, during trenching activity associated with the construction of the Liberty Science Center, an unidentified "green goo" was reportedly encountered in the subsurface (NJDEP, 1991). The NJDEP sent a sampling team to the site, which found a petroleum product in the subsurface. The area was further excavated in an attempt to locate the source of the material, at which time an 18-inch-diameter "brick" pipe was encountered. The pipe was accidentally ruptured, at which time an estimated 100-450 gallons of oil leaked into the excavation. The material was sampled, and subsequent laboratory analysis showed it to consist of 62-76% petroleum hydrocarbons. PCBs were not detected in the sample. The NJDEP recommended no further action with respect to spill, providing that the area remains undisturbed. However, the NJDEP noted that if further excavation was to be performed in the area, removal of the grossly contaminated soils would be required.

During a preliminary soil investigation of the site performed by the NJDEP in 1987, arsenic, metals (antimony, cadmium, chromium, copper, lead, mercury, nickel, and selenium), PAHs,

and volatile organic compounds (VOCs) were detected in soils above the applicable NJDEP SCCs (NJDEP, 1998b). A remedial investigation was subsequently performed, during which soil samples were collected at 48 locations and three monitoring wells were installed. Sediment and surface-water samples were also collected at 13 locations within the adjacent Morris Canal Basin. The soils were analyzed for the USEPA Target Compound List (TCL) metals, TCL semi-volatile organic compounds (SVOCs), total petroleum hydrocarbons (TPHC) and total organic carbon (TOC), and randomly selected samples were analyzed for TCL Organics +30. The analytical results for soils confirmed earlier findings with respect to the presence of metals, PAHs, and petroleum hydrocarbons at the site. Additionally, lead, cadmium, petroleum hydrocarbons and semi-volatile organic compounds were detected in one of the monitoring wells, at concentrations exceeding the applicable NJDEP Ground water Quality Criteria. Unspecified "pesticides" were detected in all three of the monitoring wells (NJDEP 1998b).

The incident reports by the USEPA (1986a) and the NJDEP (1991) suggest that petroleum free-product may remain within subsurface piping, which has not been fully characterized. An NJDEP memorandum refers to anecdotal information provided by a previous site manager, who indicated that "free petroleum product may exist at a location beneath the parking lot" and recommended that a well be installed to investigate it (NJEP, 1998b). To date, no additional investigations are known to have been performed in this area.

Prior to redevelopment of the site, two subsurface geotechnical investigations were performed at the site of the area parking area, one by Langan Engineering Associates (Langan, 1991) and another by Warren George, Inc. of Jersey City, New Jersey (date unknown). Although the borings were performed for geotechnical rather than environmental sampling purposes, the associated boring logs may contain useful information concerning the distribution of petroleum product in subsurface soils.

7.4.2.5 Chromate Waste Sites

During the early 1900s, three chromate chemical production facilities were operated in Hudson County which produced an estimated two to three million tons of CCPW (NJDEP 1985). The CCPW was widely used as structural fill in Hudson County, and the majority of the CCPW sites identified to date are located in Jersey City. Three CCPW sites are currently known within the LSP Project Area. Two sites were identified during the course of regional remedial investigation performed in Hudson County between 1986 and 1989. These sites are known as Chromate Waste Site 15 (former McAllister Tug and Barge Products) and Chromate Waste Site 178 (Cabana Club). Additionally, in 1993, the NJDEP discovered CCPW in association with an abandoned brick sewer located adjacent to Thomas McGovern Drive (Figure 2). The results of the environmental investigations to date at these sites are described below:

Chromate Waste Site 15

Chromate Waste Site 15, which covers an area of approximately 12 acres, is bounded to the west by the Interpretive Center, to the east by Liberty Walk (Figure 2). The NJDEP initially reported the presence of "visually distinctive nodular chromate waste" on the ground surface, the identity of which was subsequently confirmed by soil and ground water sampling (BCM, 2001). The site is surrounded by a fence, to restrict public access. However, there is a paved road through the site to provide access to the Jersey City Sewer

Authority, as required for maintenance of the tide gates associated with their Combined Sewer Overflow System.

In 1994, the NJDEP engaged a private contractor, BCM Engineers/ATC Group Services Inc. (BCM), to perform a remedial investigation at the site. During the period from September 12, 1995 to April 10, 1996, BCM completed a total of 86 soil borings, 12 monitoring wells, and 8 test pits at the site. The soil borings ranged in overall depth from approximately 7 feet to 32 feet below grade. Additionally, surface-water and sediment samples were reportedly collected from an on-site "tidal pond".

Hexavalent chromium was detected in 62 of the soil borings and in one of the test pits. The analytical results for hexavalent chromium ranged from non-detectable to 1,877 mg/kg. The concentrations detected in 21 of the soil borings exceeded the NJDEP Site-Specific, Non-Residential Direct Contact Soil Cleanup Criterion of 20 mg/kg. Most of the results also exceeded the USEPA migration-to-ground water criterion of 38 mg/kg, which is based on a dilution attenuation factor (DAF) of 20. The highest total and hexavalent chromium concentrations were generally detected within 5 feet of the ground surface. However, hexavalent chromium was also detected in soils at depths of up to 25 feet below grade. Antimony, arsenic, beryllium, cadmium, lead, nickel, thallium, vanadium, and zinc were also detected locally at concentrations exceeding their respective Residential and/or Non-residential SCC. Chromate waste was identified in 37 out of the 86 soil borings. Hexavalent chromium was detected in one of the 12 monitoring wells sampled, at a maximum estimated concentration of 3,500 µg/L. No ground water quality criteria were then established by the NJDEP for hexavalent chromium. However, the results for hexavalent chromium exceeded the criterion of 100 µg/L established for total chromium. Hexavalent chromium was not detected in any of the nine surface water samples, nor in any of the 15 sediment samples analyzed. Total chromium concentrations detected in surface water were also below the human-health-based surface-water criterion of 160 µg/L. However, arsenic, copper, lead, mercury, selenium, and thallium were detected in surface water at concentrations exceeding the applicable surface-water criteria. Hexavalent chromium was not detected in any of the chip samples.

The investigators recommended that additional soil, ground water, surface-water, sediment, and chip sampling be performed to more precisely delineate the extent of contaminants associated with the CCPW at Site 15 (BCM, 2001). Specifically, 5 additional soil borings, 2 sediment sample locations, 8 surface-water sampling locations, and 5 additional monitoring wells were proposed.

Chromate Waste Site 178 (Cabana Club)

Chromate Waste Site 178 occupies an area of approximately 14.5 acres and is located in the southwest corner of Liberty State Park, between the Theodore Conrad Drive, Morris Pesin Drive, Burma Road, and Hart Drive (Figures 2 and 3). This site contains a public swimming pool, the Liberty State Park maintenance yard, an on-site residence for the Liberty State Park maintenance supervisor, and a summer camp for Jersey City Children (Camp Liberty). In 1992 the NJDEP received information from a confidential informant that CCPW might be present at the site. The NJDEP subsequently collected a series of surface-soil samples for analysis of chromium, to determine whether a potential exposure hazard existed at the site. None of the results were above the NJDEP SCC, nor was any CCPW observed at the site (NJDEP, 1995b). Further investigation of the site was proposed as of

October 1995. However, no information concerning subsequent investigations was found during the NJDEP file review.

Brick Sewer

The Underground Utility Plan prepared by the Port Authority (1975) shows an 84-inch brick sewer (now abandoned) passing through the LSP Project Area and discharging from an outfall located between South Cove and Middle Cove (Figure 2). Suspecting that CCPW might have been used as a structural fill during construction of the sewer, the NJDEP performed subsurface investigation of the adjacent soil during 1994-95. Initially, the NJDEP performed a geophysical investigation to determine the alignment of the sewer, and subsequently collected three samples of fill material at 100-foot intervals along its length (NJDEP 1995a) (Appendix E, pages 7-8). Laboratory analysis of the samples yielded results of up to 26,800 ppm total chromium and 42 ppm hexavalent chromium. All three samples yielded results above the NJDEP Residential Soil Cleanup Criterion of 10 ppm for hexavalent chromium. These results suggest that CCPW is present adjacent to the entire length of the brick sewer. The NJDEP has concluded that, due to the depth of the chromium contamination, "the risk to human health and the environment is minimal" (NJDEP 1995a). However, the presence of CCPW could be a significant factor in planning any wetland restoration projects at LSP, if chromium contaminated soils are disturbed.

7.4.2.6 Waterfront Development Area / Middle Cove

The Waterfront Development Area includes the area bounded by Liberty Walk to the east, Freedom Way to the west, and to the north and south by North Cove and Chromate Waste Site 15, respectively. The Middle Cove (Figure 2) is a former tidewater basin, which was originally created through filling and bulkhead construction (refer to Section 7.2.1). It is located within the Waterfront Development Area, immediately to the east of Chromate Waste Site 15 (Figure 2). Middle Cove was filled by the State of New Jersey during 1985, during the construction of the sea wall (Figure 2). Initially, the north eastern portion was filled using material from a bulkhead that had existed in front of the McAllister Tug and Barge Property. The remainder was subsequently filled with clean sand (NJDEP, undated).

In 1987, concerns were voiced by the public that the CCPW was present in the material used to fill Middle Cove, despite previous sampling results which did not shown any evidence of CCPW at this site (NJDEP 1995b)[12]. Accordingly, the NJDEP performed a subsurface soil investigation of the site during January 1995. The results did not show any evidence of the presence of CCPW. However, petroleum product was encountered in several of the subsurface soil borings, and TPHC concentrations of up to 6,400 ppm were detected in the soil. Noting that the contaminated soil was overlain by 6 to 8 feet of clean sand, the NJDEP concluded that "the threat to human health through exposure to the contamination is unlikely" and determined that no further action was necessary. However, the NJDEP also stated that "any future development of Middle Cove which would disturb the clean soil cover would require further remedial investigation and a remedial alternative analysis" (NJDEP, 1995b).

A report prepared by the NJDEP (2000b) presents the results of subsequent work to delineate and characterize free and residual product in the subsurface. The Handex Corp.,

[12] A lawsuit was brought against the NJDEP in connection with this matter [Interfaith Community Organization v. Shinn, *et al*., D.N.J., Civ. Action Nos. 93-4774, 94-3434, 94-3793]

working under contract with the NJDEP, performed 31 cone-penetrometer borings, 4 test pits, 132 soil borings, 4 monitoring well installations, a free-product laboratory analysis, product bail-down tests, and a series of enhanced recovery evaluation tests. Based on the horizontal and vertical distribution of the free and residual product, it was estimated that 20,000 cubic yards of contaminated soil were present which contained approximately 35,000 to 70,000 gallons of oil. Appendix 3 of the NJDEP (2000b) report contains the result of laboratory "petroleum fingerprint" analysis of free product. The results show that the material is most likely derived from #2 heating oil.

The remedy selected by the NJDEP was "In place containment and exposure controls with periodic free product removal" (NJDEP, 1998a). Specifically, this consisted of: (1) placement of 1 foot of clean cover over the site and (2) periodic free-product extraction (via recovery wells). Placement of the clean cover and re-vegetation of the site was completed in 1999. Additionally, 5 sentinel wells were installed outside of the horizontal limits of the residual product in February 2000, with the goal of preventing any potential discharges into nearby ecosystems.

An additional investigation of the residual and free petroleum product at Middle Cove was performed on May 15, 2001, which included the drilling of 6 continuous cores to depth of 10-12 feet below grade using a Geoprobe® direct-push rig. Indications of free product were noted in 4 out of the 6 borings at depths ranging from 5 to 11 feet below grade (NJDEP, 2001a). Additionally, a "strong odor of creosote from buried wood pilings" was noted in two borings in which free-product was not observed.

In 2001, the NJDEP proposed to continue a program of "product bailing, ground water sampling, and contaminant migration assessment", but concluded that bailing "will not prove to be an effective long-term remedial option (NJDEP 2001b). Therefore the NJDEP has considered two other remedial options for product recovery: (1) multi-well pumping and collection systems with off-site disposal, and (2) trench collection with off-site disposal. The NJDEP subsequently determined that a multi-well pumping system "will best meet the long-term remedial goals" (NJDEP, 2001b).

7.4.2.7 Northern Marina

The Northern Marina area occupies a total area of approximately 72 acres (Figure 2) and is currently operated as a public concession (Liberty Landing Marina). Prior to its acquisition by the State of New Jersey, the CRRNJ owned the southern half of the site, and the LVRR owned the portion located along the northern waterfront (refer to Section 7.2.2). The LVRR developed docking facilities along the shore of the Morris Canal Basin, and the CRRNJ operated stockyards and a major coal distribution facility for the New York City market (TAMS, 1989a).

In 1978, shortly after the Northern Marina area was acquired by the State of New Jersey, two facilities formerly located on Johnston Avenue[13], known as the Bond Adhesive Company and the Globe Trucking Company, were found to have engaged in illegal dumping of hazardous materials (USEPA, 1986b). As noted in Section 7.2.2, the 1979 Sanborn Map coverage shows the Bond Adhesive Company occupying a building located on the north side of Johnston Avenue, which was formerly the site of "coal pocket" operated by CRRNJ

[13] Now known as Audrey Zapp Drive.

(refer to Appendix B). The Globe Trucking Company operated a facility approximately 1,200 feet west of the Bond Adhesive Co. (about 2,400 feet west of the Terminal Building[14] (NJDEP 1980a). During a site inspection by the NJDEP on March 17, 1980, 20 drums containing solvents were found inside of the abandoned Globe Trucking Building, and an estimated 75 to 100 drums were present outside of the building (NJDEP, 1980b). At the former Bond Adhesives Company, approximately 20 drums were found inside of the building and approximately 100 drums were observed at an outdoor loading dock, approximately 50 of which were empty (NJDEP, 1980b). The NJDEP subsequently contracted with Mid-Atlantic Refinery Services to perform a cleanup of the drums, and the work was completed in May 1980.

In 1987, the NJDEP Division of Hazardous Site Mitigation conducted a "Pre-RI Study" of the Northern Marina for the purpose of assessing off-site contaminant migration pathways that could pose a threat to human health or the environment (TAMS, 1989a). The study included a search of existing regulatory files, a soil-gas survey for VOCs, radiation monitoring, and sampling of surface-water, sediments and soils.

A remedial investigation of the Northern Marina was performed in 1989, the results of which are presented in a report by TAMS (1989b). The investigation included subsurface soil borings, installation and sampling of monitoring wells, determination of aquifer characteristics (*e.g.*, grain-size, permeability), tidal studies, and a benthic survey. The sampling points were located based on the results of the 1987 NJDEP Pre-RI Study, and a review of historic maps of the site. A total of 159 soil samples were collected from 76 locations, and a additional 38 samples were collected in connection with the installation of 11 monitoring wells. The soil samples were collected from fill materials as well as the underlying shallow marine deposits, and were analyzed for TCL Metals, TCL SVOCs, TPHC, and TOC. Samples from five randomly selected borings were analyzed for TCL organics + 30.

The organic compounds detected in soils included 1,1,1-TCA (5 ppb); TCE (1 ppb); PCE (9 ppb); PAHs (up to 288 ppm total); dieldrin (14-86 ppb), and 4,4'-DDE (35 ppm). Petroleum hydrocarbons were widely distributed at the site (TPHC >100 ppm in 63% of the samples), as metals (*e.g.*, lead, cadmium and copper) were widely detected at concentrations above the NJDEP SCC. The investigators concluded that the distribution of PAHs and metals in the fill materials at the site is essentially "random", and the TPHC results are related to incidental discharges associated with refueling, fuel spillage, etc. (TAMS 1989b).

The results of the 1989 study were used to develop a baseline public health evaluation for the Northern Marina site, the results of which are presented in a report by TAMS (1990). The carcinogenic and non carcinogenic risks were calculated in relation to 16 contaminants of concern. Exposure routes included ingestion of contaminated fish, as well as dermal contact and ingestion of soils. The estimated cancer risk to park workers and adult visitors was estimated at 9.4×10^{-3}, and the corresponding risk to children was estimated at 8.3×10^{-4}.

[14] Both buildings are visible in the 1966 and 1976 aerial photographs found in (Appendix D).

7.4.2.8 Terminal Parking Lot

The Terminal Parking Lot , which includes the area known as the “south lawn”, is located west of the CRRNJ Terminal Building and occupies an area of approximately 12 acres (Figure 2). In July of 1992, soil samples were collected at 21 locations within the Terminal Parking Lot. The sampling results showed that PAHs and metals were present at concentrations above the NJDEP Residential SCC. In 1993, the NJDEP implemented a remedial action plan for the site, consisting of an asphalt cap over the parking lot and a 1-foot layer of clean fill over the south lawn area with a stable vegetative cover (grass). No further remedial action is planned by the NJDEP in this area (NJDEP, 1995b).

8.0 OPINION

In the opinion of this investigator, the environmental hazards within the LSP Project Area have been systematically characterized by the NJDEP through the environmental investigations conducted to date. However, there remains a risk of encountering previously unidentified environmental contaminants within areas designated for wetland restoration. Soils that are found to be moderately contaminated with arsenic, metals, PAHs, pesticides, or PCBs could probably be managed on-site by capping with a layer of clean soil and establishing a stable vegetative cover. However, if heavily contaminated soils (*e.g.*, petroleum-saturated soil or CCPW) were to be encountered, on-site management of the soil might not be feasible, and off-site disposal could be prohibitively expensive.

The environmental risks and uncertainties associated with the proposed wetland restoration project could be further constrained through further compilation and analysis of existing subsurface data (*e.g.*, soil-boring logs, test-pit logs, and laboratory analyses) pertaining specifically to the areas to be disturbed (*i.e.*, using information from the studies referenced in this ESA). This would require that the boundaries of the proposed wetland restoration project(s) and the relevant sample location maps be registered in a common coordinate system (*i.e.,* using a geographic information system). The environmental studies could then be analyzed to determine: (1) whether sufficient information is available concerning environmental conditions within the areas to be disturbed, and (2) whether there are any recognized environmental conditions that are likely to hinder implementation of the project. Should further characterization of the site conditions be required, a targeted subsurface investigation can then be implemented, focusing only on those areas that have not already been investigated.

9.0 CONCLUSIONS

The conclusions of this ESA regarding the LSP Project Area are as follows:

1. The soil, ground water conditions within the LSP Project Area have been extensively investigated by the NJDEP, and it is possible that sufficient information is already available with which to characterize environmental conditions in areas designated for wetland restoration. However, this cannot be verified without further review of the specific environmental sampling results pertaining to each area designated for restoration.
2. The typical soil contaminants associated with fill materials at the LSP Project Area consist of arsenic, metals, PAHs, and petroleum hydrocarbons. Hexavalent chromium is also present in association with CCPW.
3. The concentrations of PAHs and metals in common fill materials are generally within the ranges listed in the NJDEP Historic Fill Database[15], and appear to meet the general definition of "historic fill" under Technical Rules for Site Remediation (N.J.A.C. 7:26E App. D). Therefore, soils other than those containing CCPW or petroleum free-product can probably be managed on site (*e.g.*, by capping with a layer of clean soil and establishing a vegetative cover). However, soils that are saturated with petroleum or which contain CCPW would probably require either off-site disposal or on-site stabilization.
4. The petroleum free-product present beneath the site of the former Liberty Science Center parking lot (former Roundhouse) has not been fully delineated. Therefore, its potential implications on future wetland restoration projects cannot be assessed at this time. The fact that free-product was observed within an abandoned underground pipe suggests subsurface structures are serving as conduits for oil migration. An additional subsurface investigation may be required if wetland restoration projects are planned in this area.
5. The petroleum free-product present beneath the Waterfront Development Area has been delineated horizontally and vertically by the NJDEP, and product recovery efforts are underway. The additional costs associated with managing petroleum-saturated soils may preclude the implementation of wetland restoration projects in areas that contain free-product.
6. The presence of CCPW adjacent to the abandoned Brick Sewer could be an impediment to wetland restoration efforts, as it bisects the entire LSP Project Area. The question of whether CCPW is present in association with other underground utilities within the LSP Project Area has not been fully investigated.

[15] Technical Rules for Site Remediation N.J.A.C. 7:26E App. D

7. Some uncertainty remains as to whether all of the areas of concern identified by the NJDEP during its review of historic aerial photography have been investigated. Additional interviews with the NJDEP may be necessary to verify the exact nature and location of each area of concern, and to confirm whether all of the areas of concern have been investigated.
8. It is not known whether the possible burial site identified in the 1976 aerial photograph (refer to Section 7.2.4) has been identified or investigated by the NJDEP. Given the proximity of the excavation to two known illegal dumping sites (Globe Trucking Co. and Bond Adhesive Co.), it is possible that hazardous materials were disposed of in this area.
9. UXO may be present within the Dredge Spoils Storage Area as a consequence of the 1981 dredging operations. In the event that soils in this area are to be disturbed, further investigation of the associated risks will be necessary.
10. The geographic limits of the closed, sanitary landfill formerly operated by the NJDEP for disposal of "bulky waste" were not determined during this investigation. Therefore, it is not known whether it constitutes an impediment to the planned wetland restoration efforts.

10.0 RECOMMENDATIONS

Prior to implementation of the proposed wetland restoration project within the LSP Project Area, the following additional work is recommended:

1. It is recommended that the associated environmental risks be further constrained through additional review and analysis of the environmental studies identified in this ESA. A comprehensive compilation and analysis of existing subsurface information is recommended, in which the relevant environmental sampling results and the proposed wetland boundaries are registered in a common coordinate system. It is recommended the results be analyzed (a) to determine the adequacy of existing studies, (b) to assess the impact of any recognized environmental conditions, and (c) to identify specific targets for additional subsurface characterization studies (should they be required).
2. If soils in the vicinity of the Brick Sewer are to be disturbed, it is recommended that further delineation and characterization of associated CCPW be performed in this area. Historic maps and site plans should also be reviewed to identify any other subsurface structures within the proposed wetland restoration area (*e.g.*, water lines, culverts) where CCPW is likely to be present.
3. If soils in the vicinity of the Liberty Science Center parking lot (former Roundhouse), are to be disturbed, it is recommended that subsurface soil sampling be performed to determine whether free-product is present.
4. It is recommended that the USACE-NYD obtain a GIS-compatible map from the NJDEP showing the current limits of free-product in the Waterfront Development Area, and incorporate it into the project planning process.
5. It is recommended that records pertaining to the closed, sanitary landfill formerly operated by the NJDEP for disposal of “bulky waste” be reviewed to determine whether it constitutes an impediment to the wetland restoration projects under consideration.
6. It is recommended that the NJDEP be consulted to confirm whether all of the areas of concern identified in their 1994 review of historic aerial photography have been investigated, and additionally whether the excavation identified in the 1976 aerial photography during this ESA has been investigated.
7. If soils in the vicinity of the Dredge Spoils Storage Area are to be disturbed, it is recommended that the risks associated with the possible presence of UXO be further evaluated.

11.0 DEVIATIONS

This report was prepared in general accordance with the ASTM Standard E1527-00, subject to the limitations/deviations listed below:

- A land title search on the property was not performed.
- Building interiors were not inspected.
- Interviews were not conducted with tenants operating within the LSP Project Area, nor with local (*i.e.*, municipal or county) officials.

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Figures

Appendix A

Site Photographs

Appendix B

Sanborn Historic Maps

Appendix C

EDR Historical Topographic Map Report

Appendix D

EDR Aerial Photography Print Service Report

Appendix E

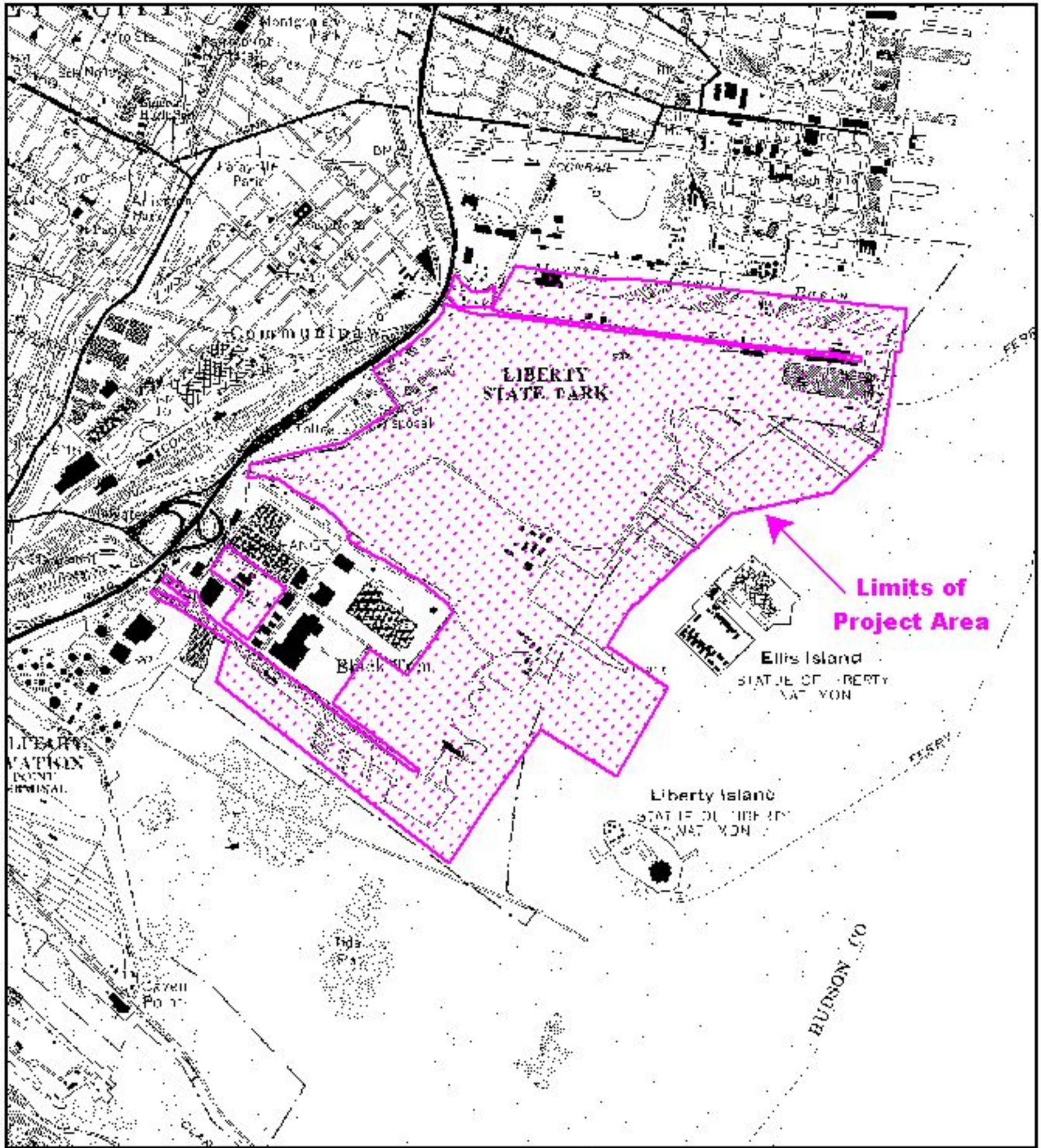
EDR Area Study Report

Appendix F

NJDEP Executive Summary on the History of Environmental Investigations at Liberty State Park dated April 1989

Appendix G

Liberty State Park
Soil Sampling Report – August 1995



N
W E
S

1000 0 1000 Feet

SCALE 1:24,000

LEGEND:

limits of project area

Image Source:

USGS Jersey City Quadrangle, 1967
photorevised 1981

amec Earth & Environmental

Figure 1

Project Site Location
Phase I ESA Liberty State Park
Army Corps of Engineers, NY District
Jersey City, New Jersey

N

W E

S

LEGEND:

limits of project area

Image Sources:

NJDEP 1995 / 1997 color infrared digital imagery

500 0 500 Feet

SCALE 1 : 12,000

amec Earth & Environmental

Figure 2

Project Area Site Plan
Phase I ESA Liberty State Park
Army Corps of Engineers, NY District
Jersey City, New Jersey

N
W E
S

LEGEND:

- shallow hydropunch borings
- deep hydropunch borings
- limits of project area

Image Source:

NJDEP 1995 / 1997 color infrared digital imagery

500 0 500 Feet

SCALE 1 : 12,000

amec Earth & Environmental

Figure 3

NJDEP Groundwater
Sampling Locations 1993-1994
Phase I ESA Liberty State Park
Army Corps of Engineers, NY District
Jersey City, New Jersey

"Linking Technology with Tradition"

Sanborn™ Map Transmittal

Ship to: David Mackie
AMEC Earth & Environmental
285 Davidson Street
Somerset, NJ 08873

1052441DJV 732-302-9500

Order Date: 12/4/2002 **Completion Date:** 12/04/2002
Inquiry #: 891877.1S
P.O. #: na
Site Name: Liberty State Park
Address: Liberty State Park
City/State: Jersey City, NJ 07097
Cross Streets:

Environmental Data Resources, Inc. has been instructed by AMEC Earth & Environmental to print ONLY the Sanborn Maps for the years listed below:

1885 - 4 maps
1887 - 4 maps
1911 - 8 - maps
1912 - 3 - maps
1950 - 11 - maps
1951 - 8 - maps
1979 - 18 - maps

Total Maps: 56

Limited Permission to Photocopy

AMEC Earth & Environmental (the client) is permitted to make up to THREE photocopies of this Sanborn Map Transmittal and each fire insurance map accompanying this transmittal solely for the limited use of its customer. No one other than the client is authorized to make copies. Upon request made directly to an EDR Account Executive, the client may be permitted to make a limited number of additional photocopies. This permission is conditioned upon compliance by the client, its customer and their agents with Environmental Data Resources, Inc.'s copyright policy; a copy of which is available upon request.

Electronic Sanborn Map Images
USER'S GUIDE

Thank you for your interest in electronic Sanborn Map images. The following are guidelines for accessing the images and for transferring them to your system. If you have any questions about the use of electronic Sanborn Map images, contact your EDR Account Executive at 1-800-352-0050.

Organization of Electronic Sanborn Image File

- First Page — Sanborn Map Report, listing years of coverage
- Second Page — Electronic Sanborn Map Images USER'S GUIDE
- Third Page — Oldest Sanborn Map Image
- Last Page — Most recent Sanborn Map Image

Navigating the Electronic Sanborn Image File

- Open file on screen.
- Identify TP (Target Property) on the most recent map.
- Find TP on older printed images.
- Using Acrobat, zoom to 250% in order to view more clearly.
  - 200-250% is the approximate equivalent scale of hardcopy Sanborn Maps.
- Zooming in on an image:
  - On the menu bar, click "View" and then zoom.
  - Use the magnifying tool and drag a box around the TP area.

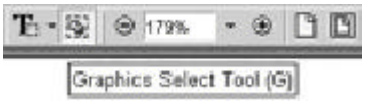
Printing a Sanborn Map from the Electronic File

- EDR recommends printing all images at 300 dpi (300 dpi prints faster than 600 dpi).
- To print only the TP area, cut and paste the area from Adobe Acrobat to your word processor.

<u>Acrobat Version 4</u>

  - Go to the Menu bar
  - Press and hold the "T" button
  - Choose the Graphics Select Tool
  - Draw a box around the area selected
  - Go to "Menu"
  - Highlight "Edit"
  - Highlight "Copy"
  - Go to a word processor such as Microsoft Word, paste and print.

<u>Acrobat Version 5</u>



  - Go to the Menu Bar.
  - Click the "Graphics Select Tool"
  - Draw a box around the area selected
  - Go to "Menu"
  - Highlight "Edit"
  - Highlight "Copy"
  - Go to a word processor such as Microsoft Word, paste and print.

Important Information about Email Delivery of Electronic Sanborn Map Images

- Images are grouped into one file, up to 2MB.
- In cases where in excess of 6-7 map years are available, the file size typically exceeds 2MB. In these cases, you will receive multiple files, labeled as 1 of 3, 2 of 3, etc. including all available map years.
- Due to file size limitations, certain ISPs, including AOL, may occasionally delay or decline to deliver files. Please contact your ISP to identify their specific file size limitations.

18

33

14

62

60

32

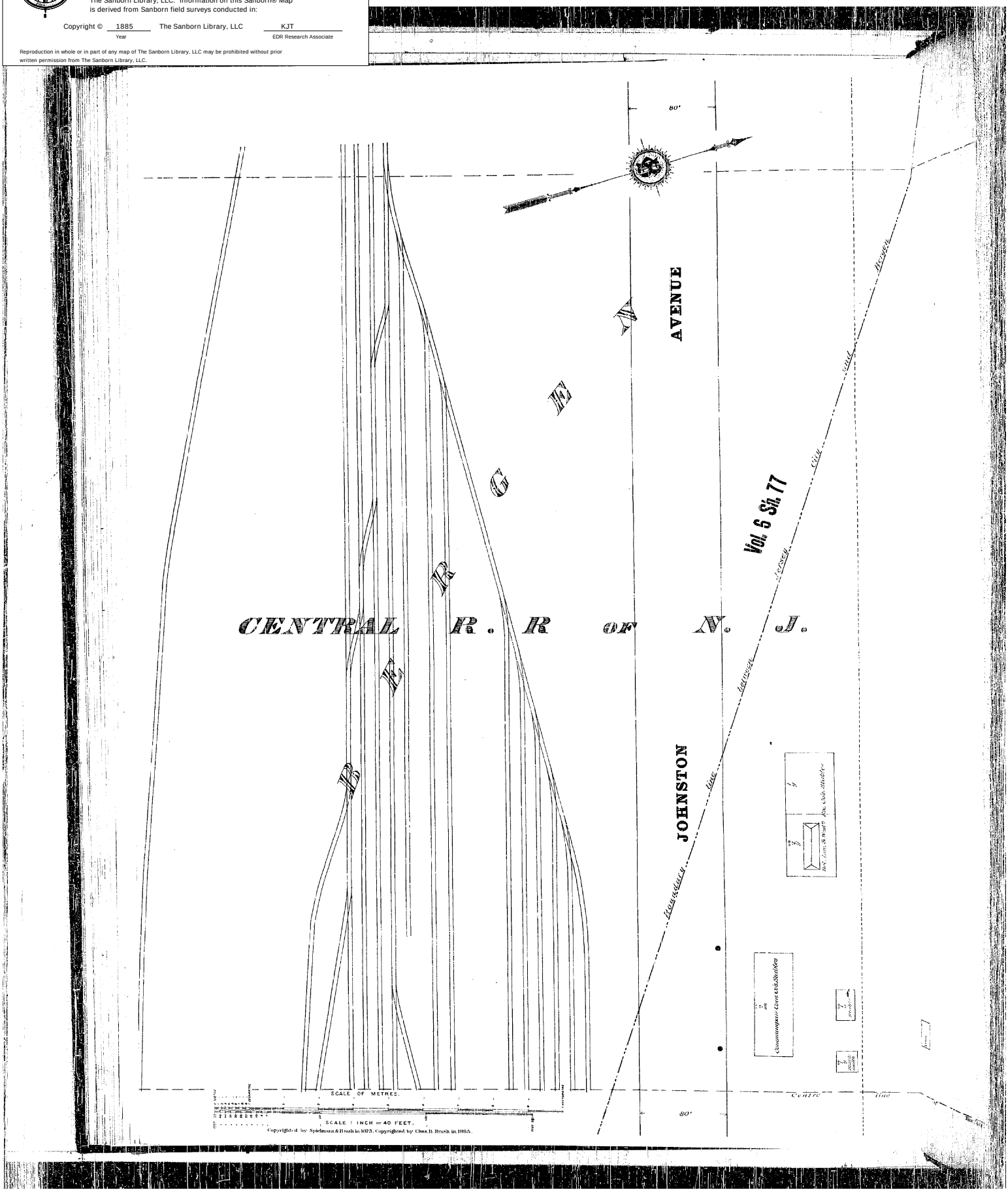
NEW JERSEY WEST SHORE RAILROAD CO.

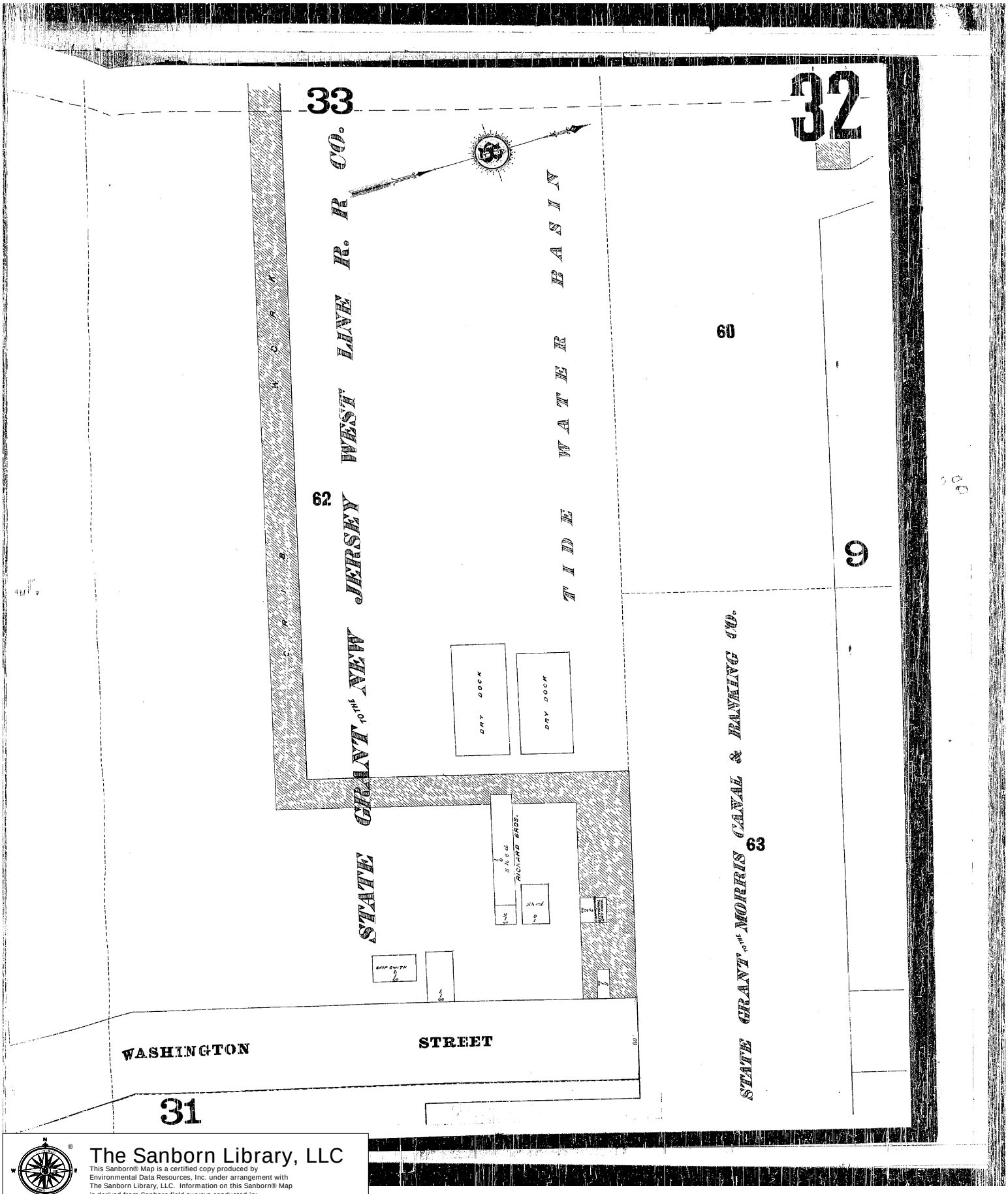
STATEN ISLAND TO WAYNE

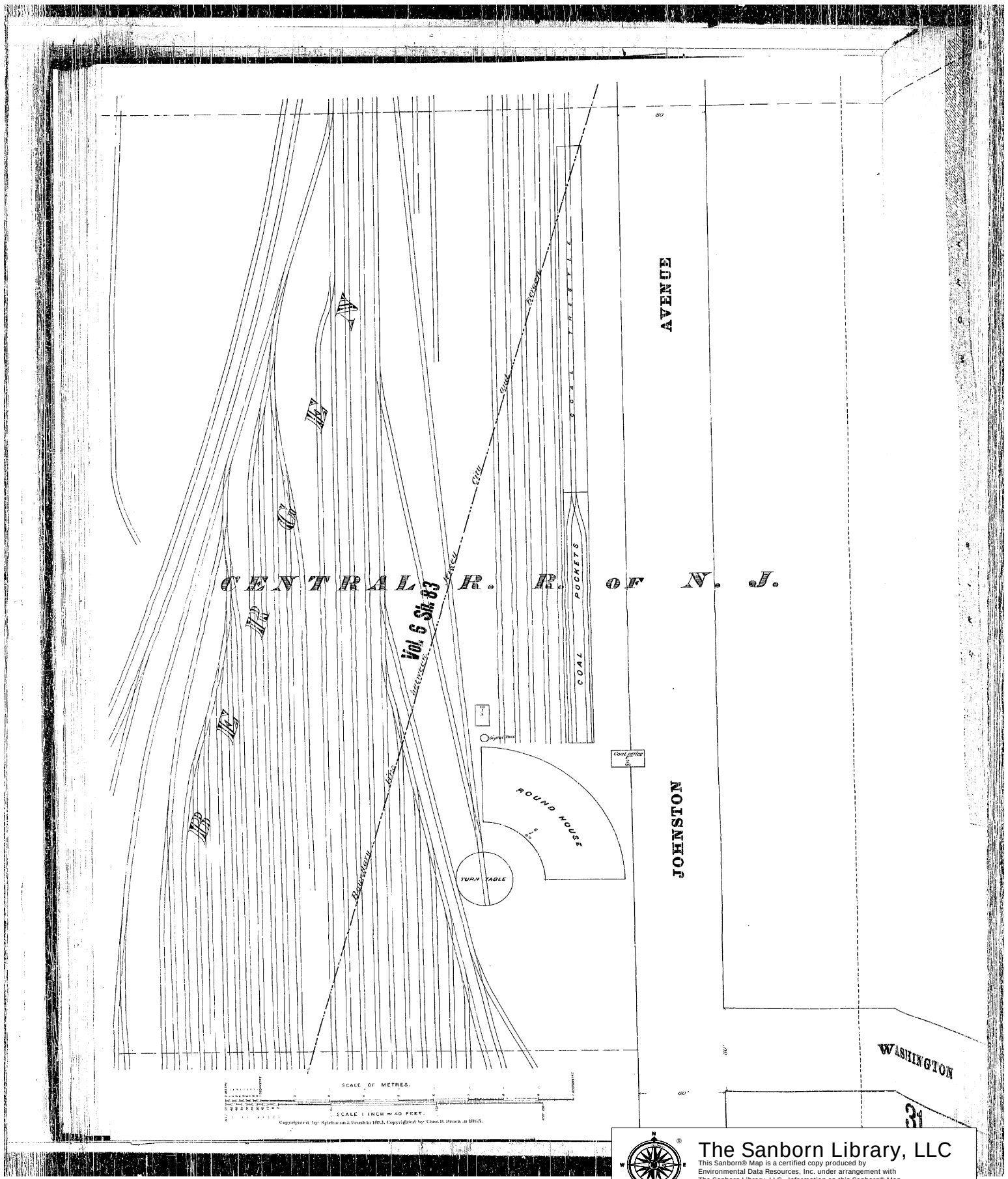
HACKENSACK

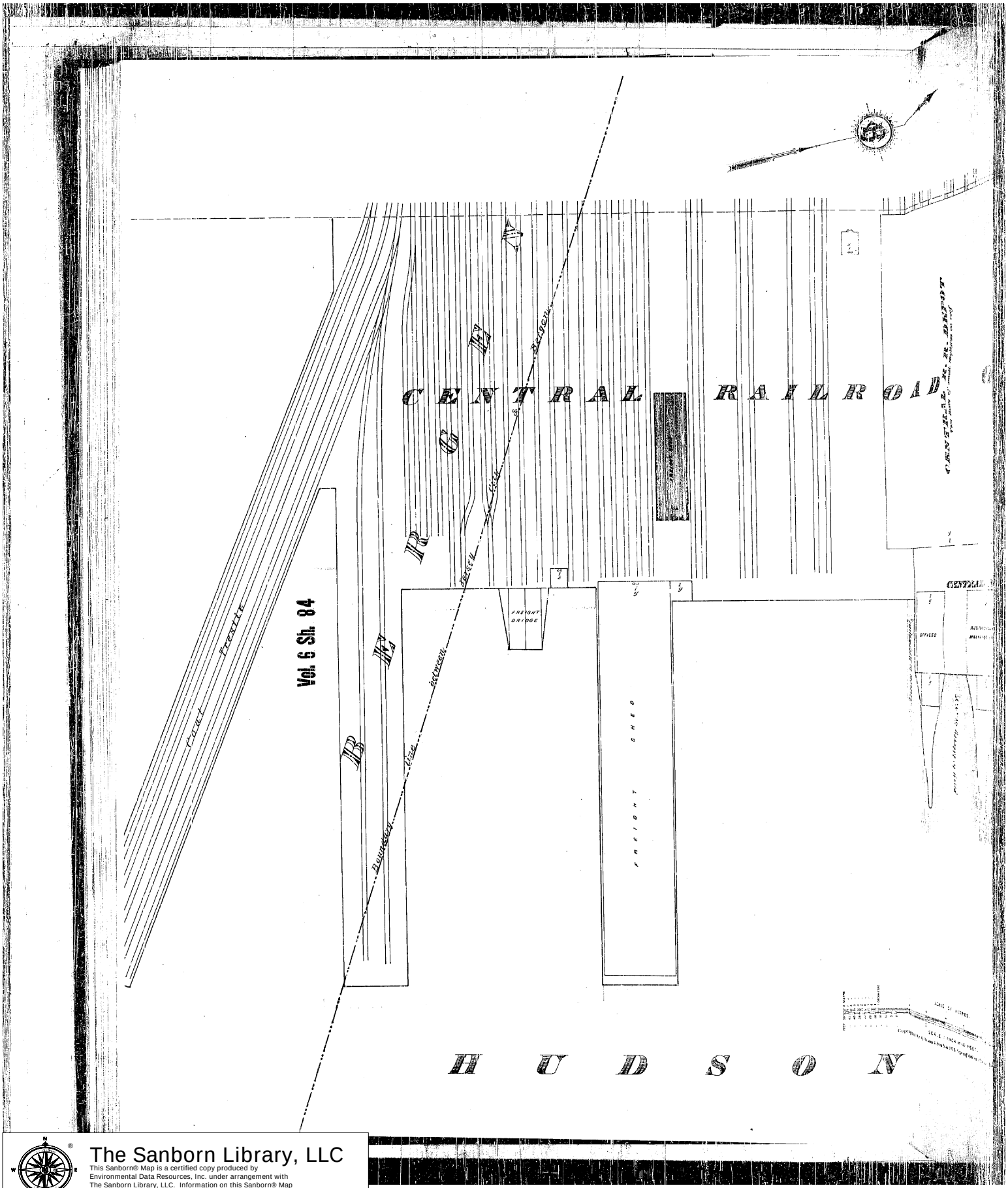
TIDE WATER BASIN

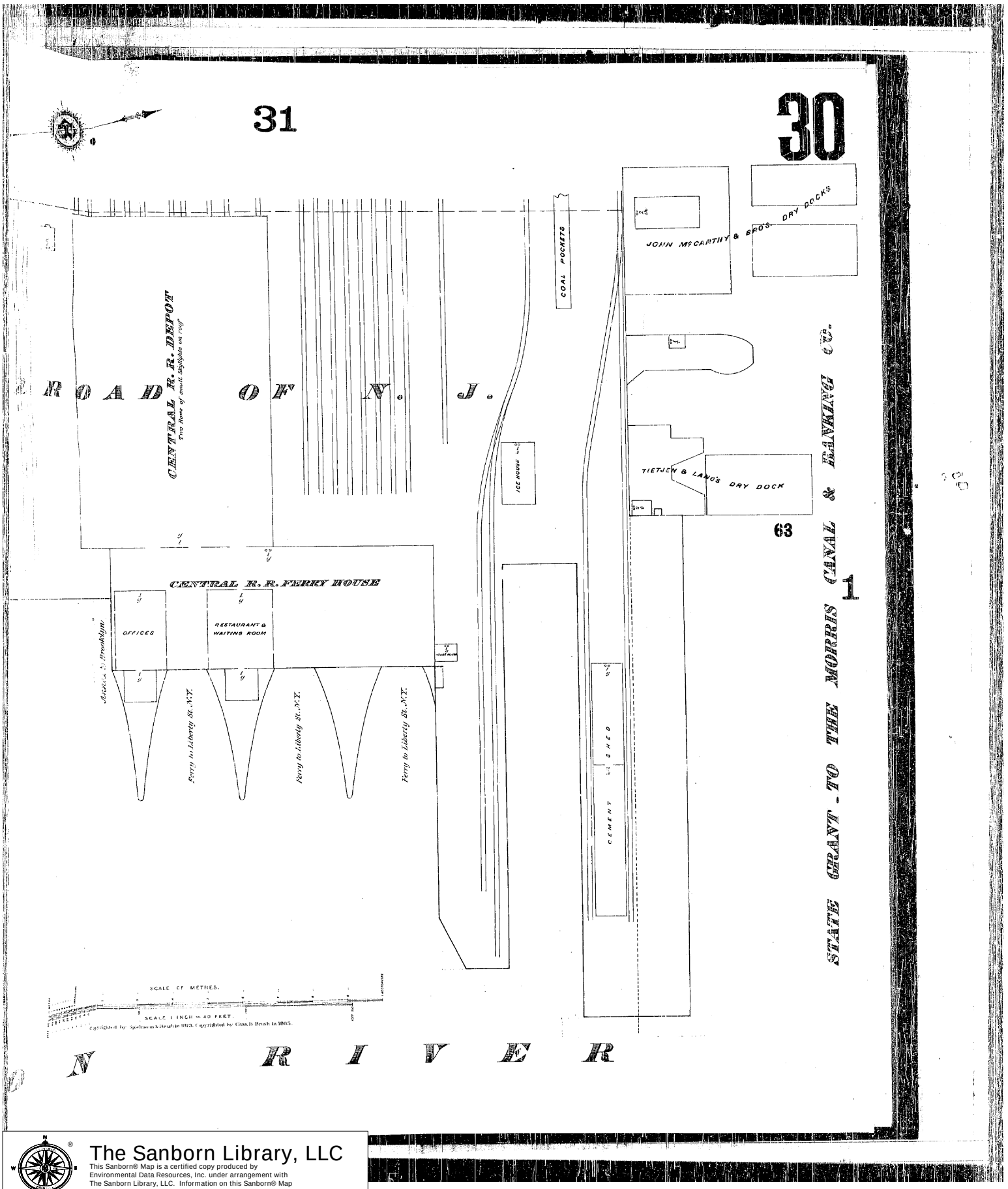
Van Vorst Street produced

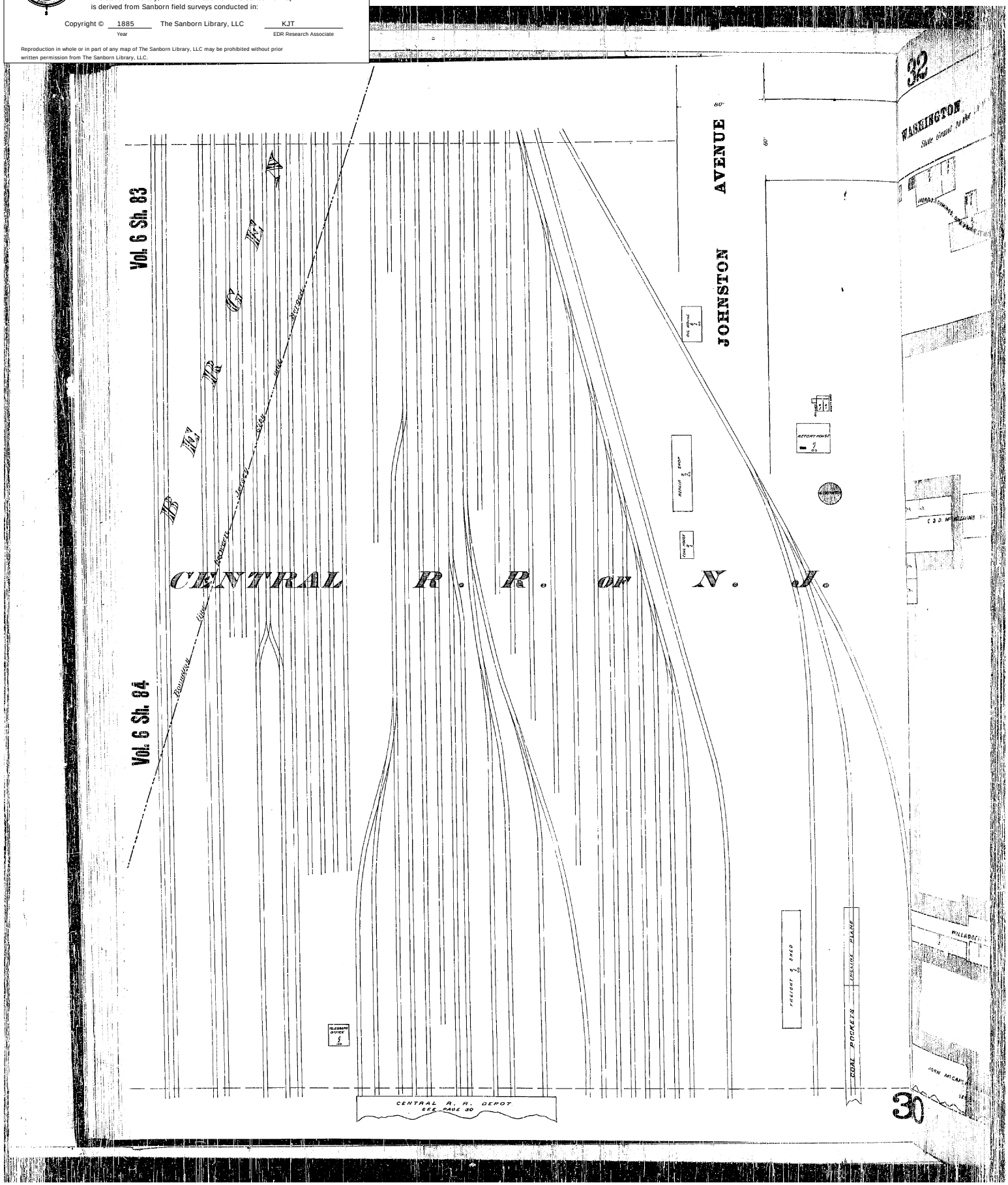












32

31

WASHINGTON STREET

New Jersey West Line Rail Road Company

State Grant to the

MORRIS & CUMMINGS DREDGING COMPANY

MORRIS CANAL & BANKING COMPANY

C & D. McWILLIAMS. DRY DOCK

63

5

STATE GRANT TO THE MORRIS CANAL & BANKING COMPANY

WILLADSEN & JOHNSON. DAY DOCK

JOHN McCARTHY & BRO. DAY DOCKS

SEE PAGE 30

SCALE OF METRES.

SCALE 1 INCH = 40 FEET.

30

10

Proposed Slip No 5

Proposed Slip No 6

Proposed Pier No 5

Proposed Pier No 6

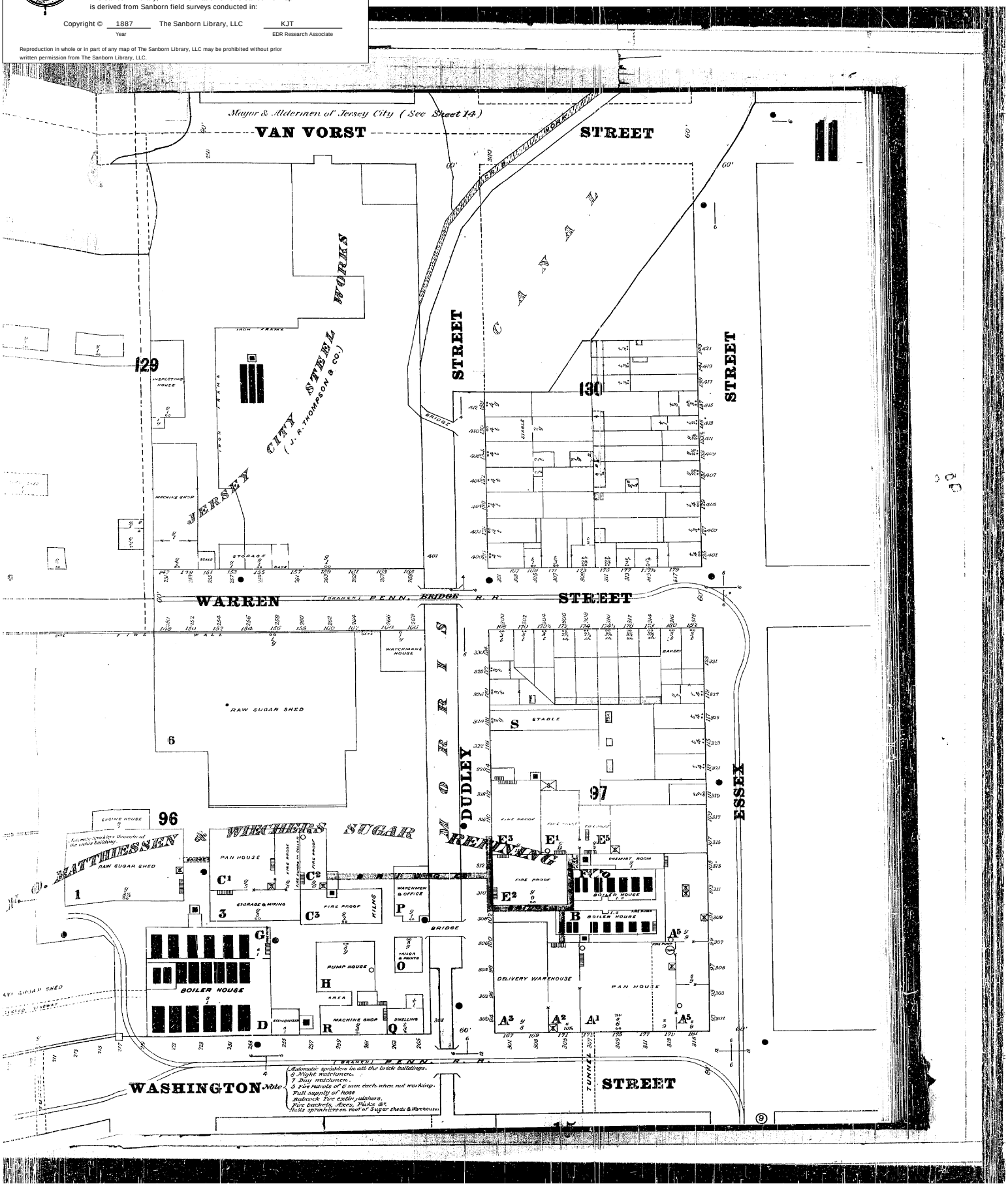
PIER No 7.

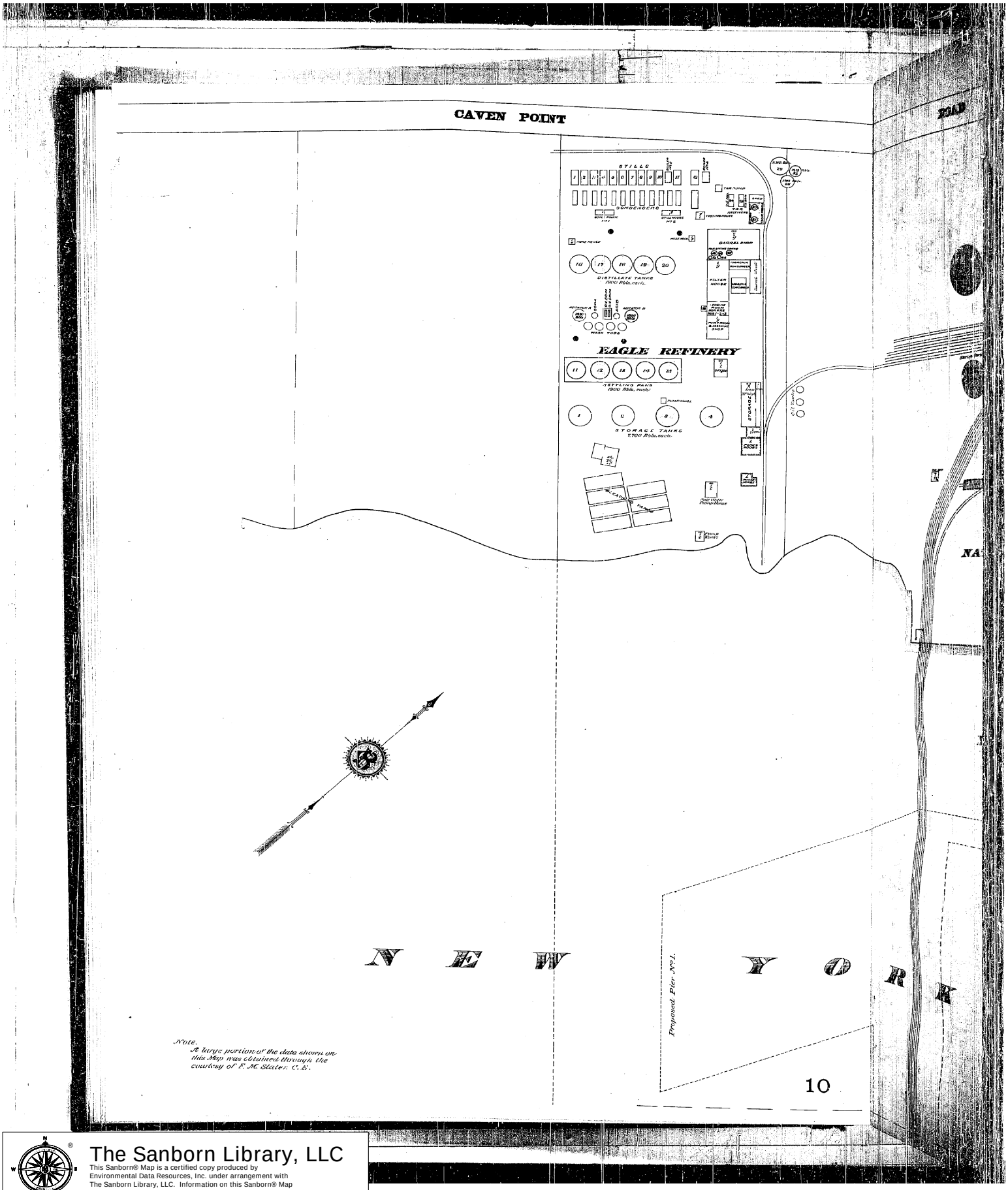
SHIP CANAL 25 feet deep.

SHIP CHANNEL 20 feet deep.

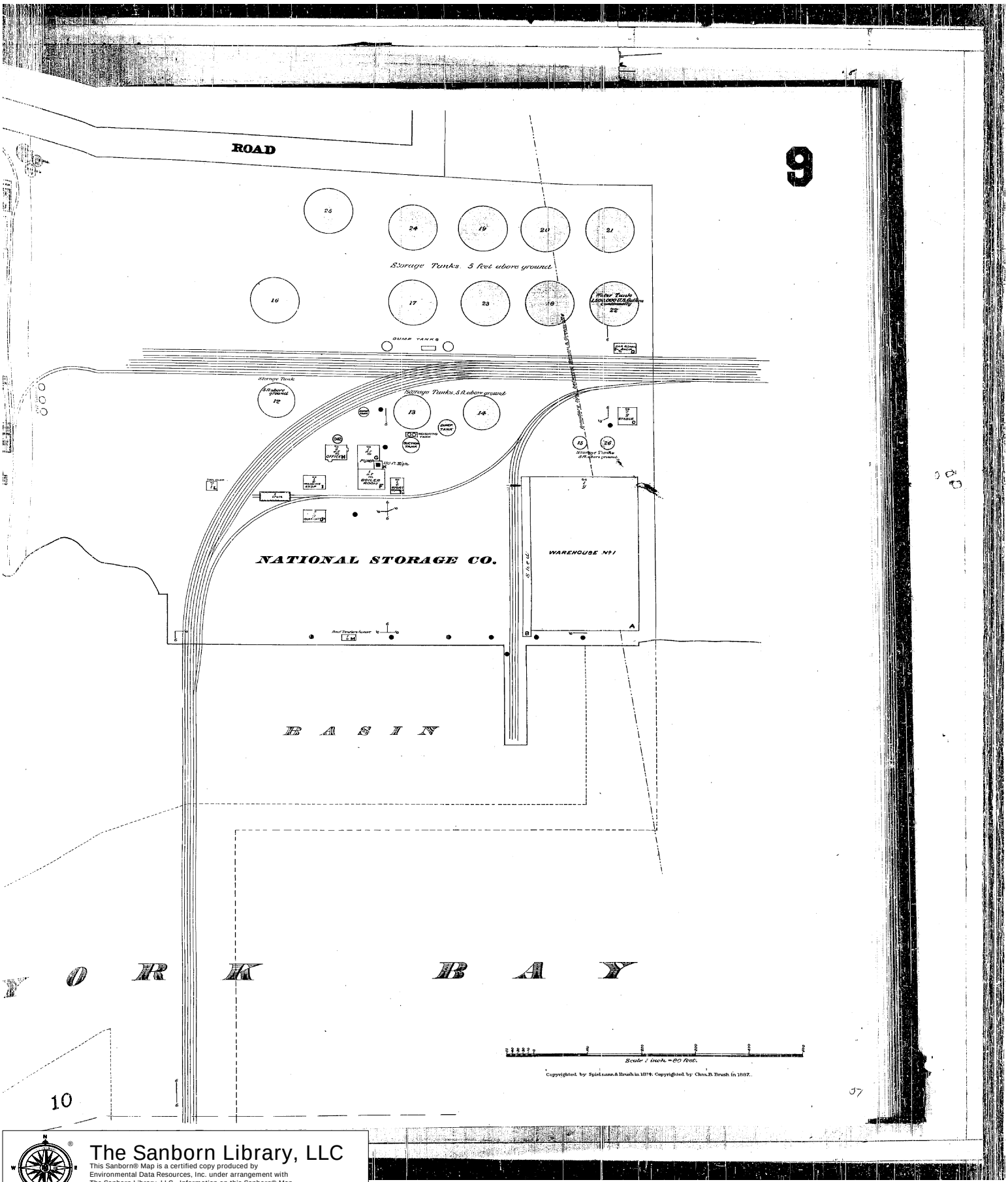
PIERS

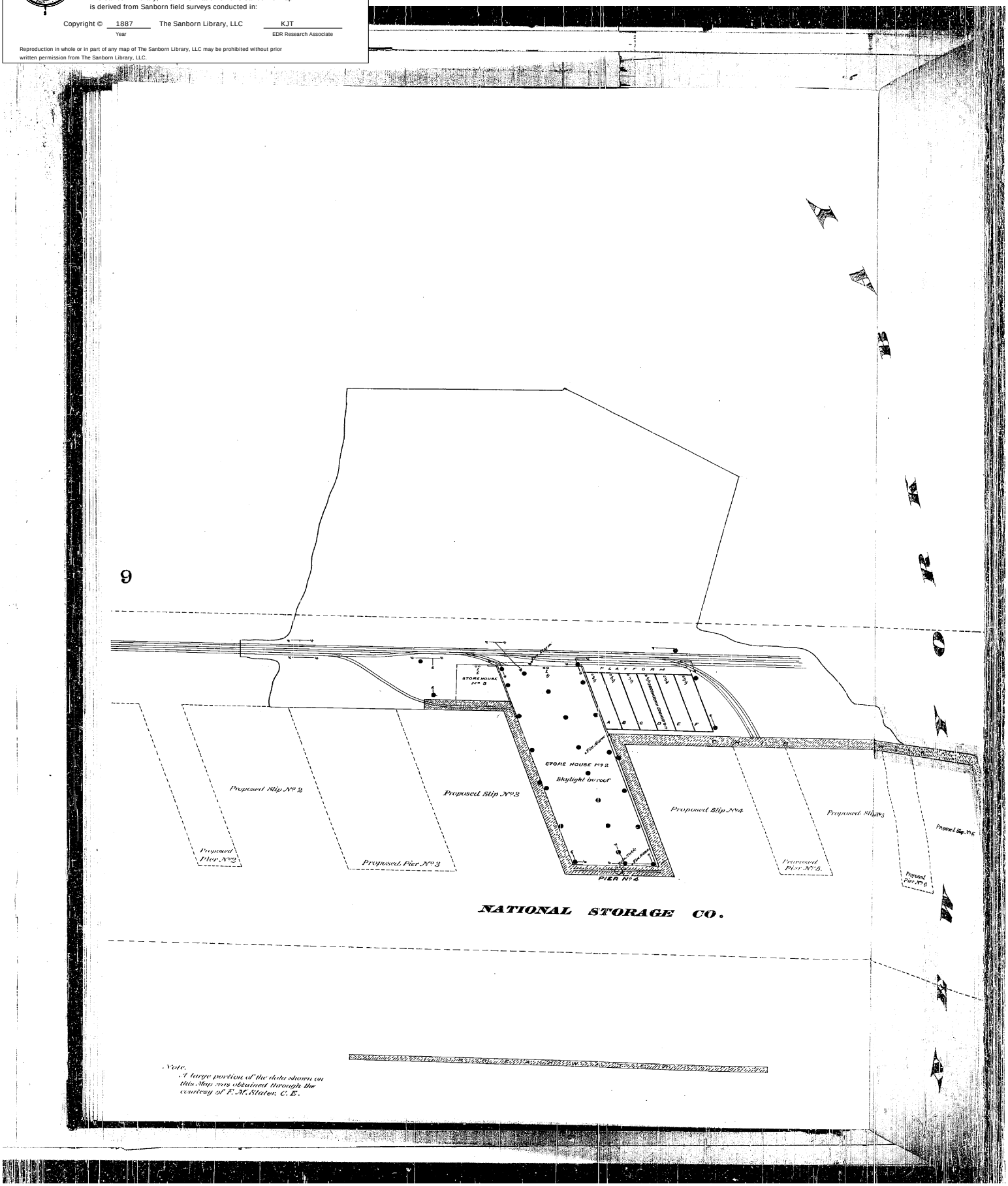
Scale 1 inch=100 feet

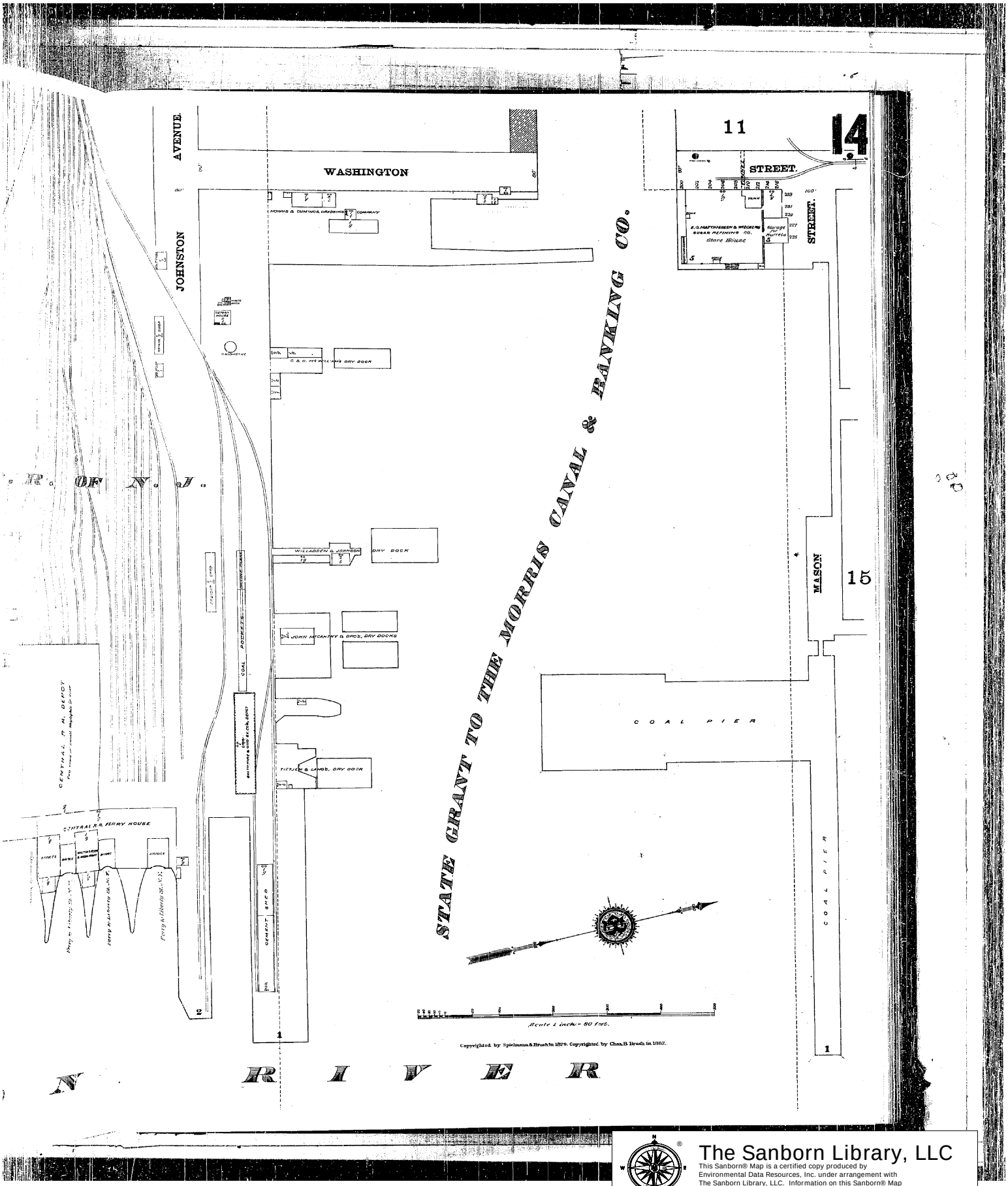


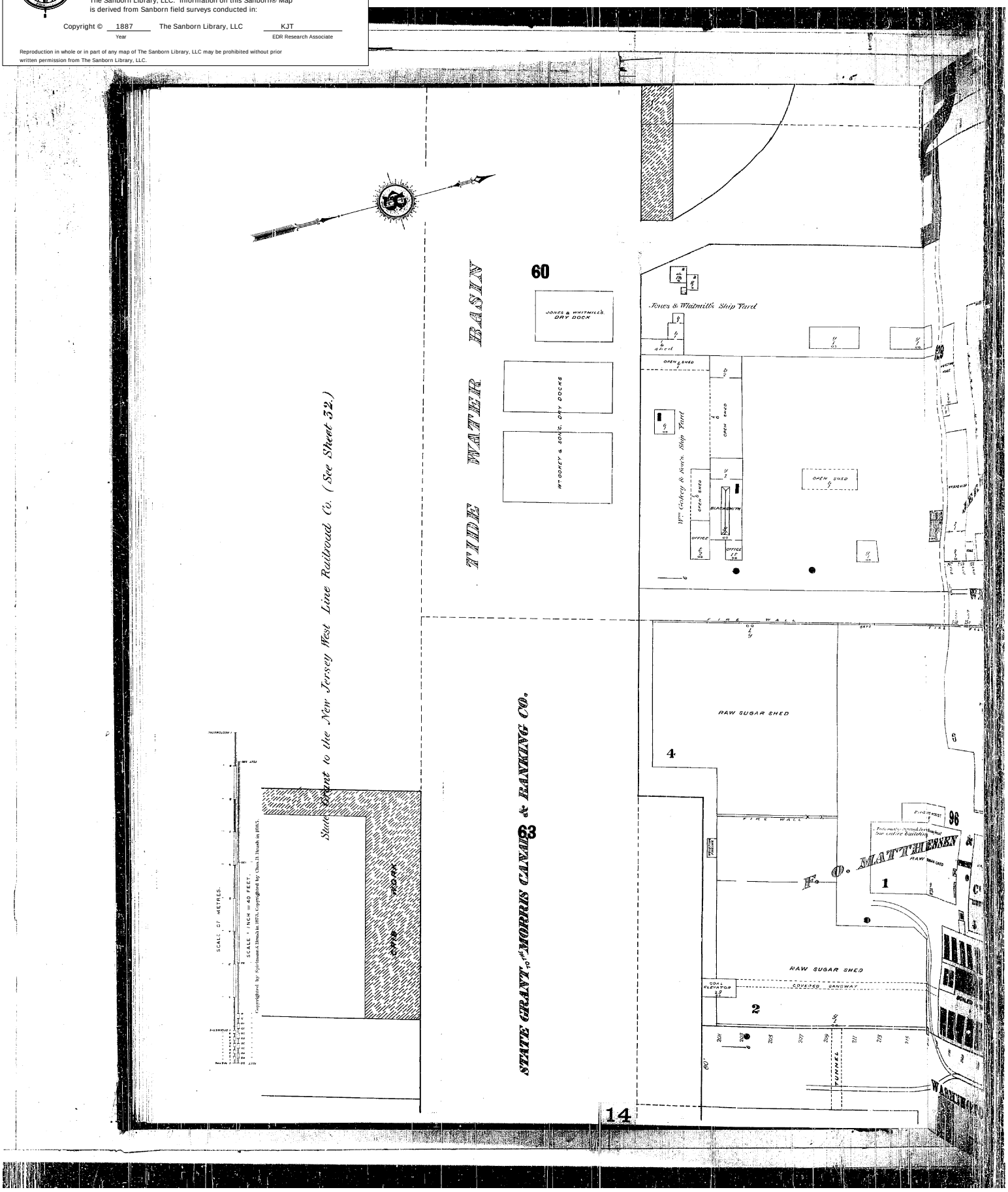


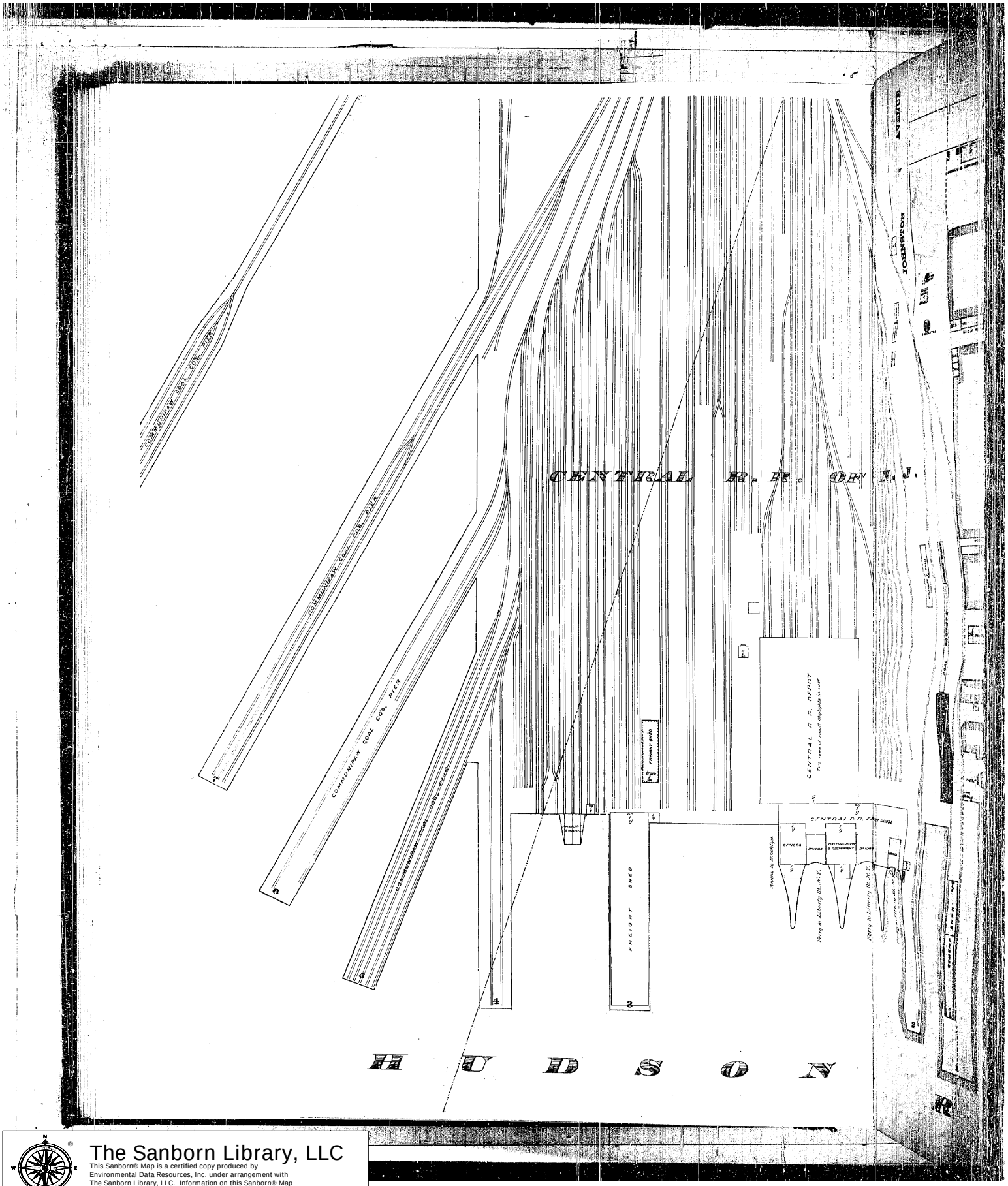
Note.
A large portion of the data shown on this Map was obtained through the courtesy of F. M. Slater, C. E.

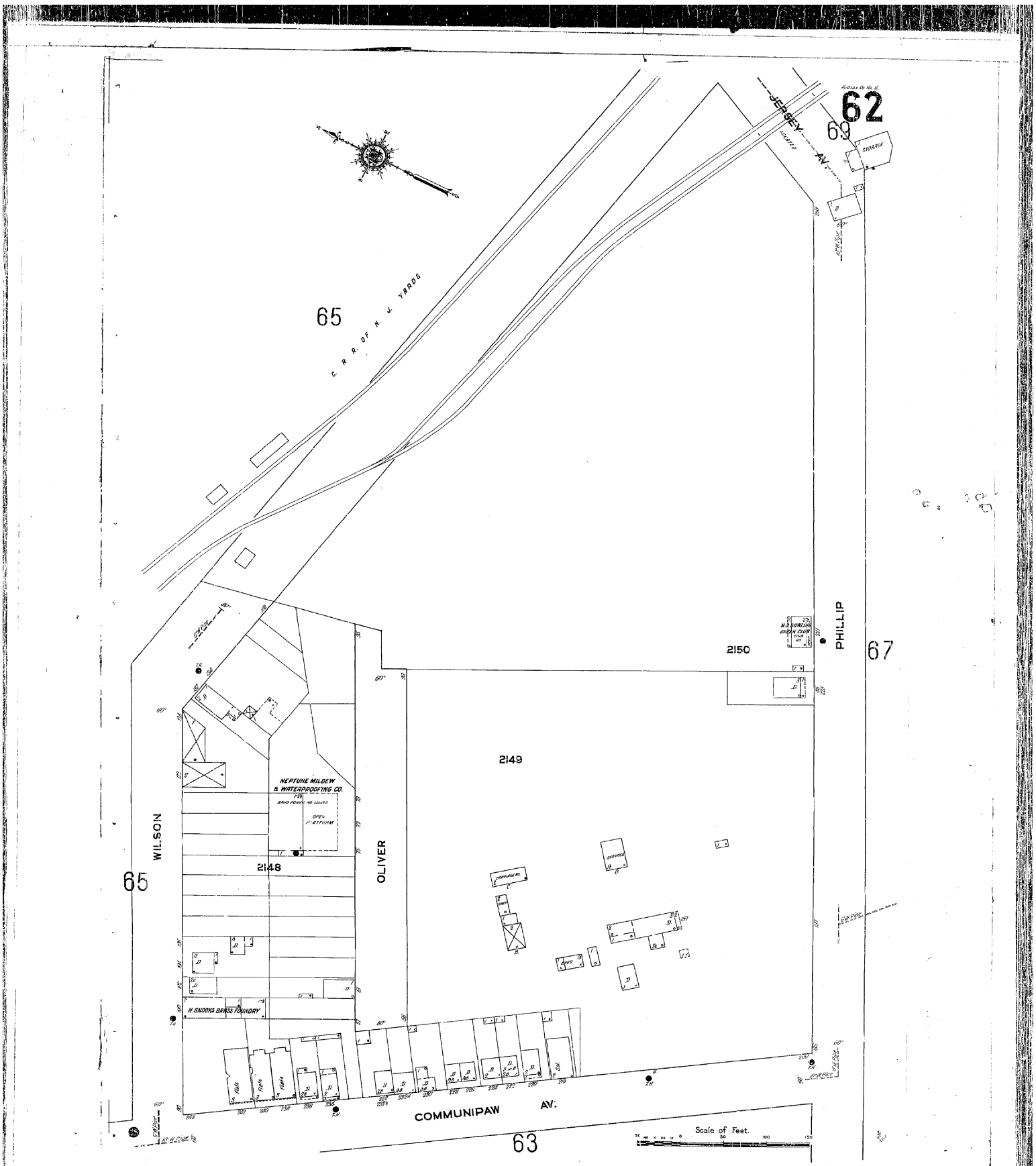


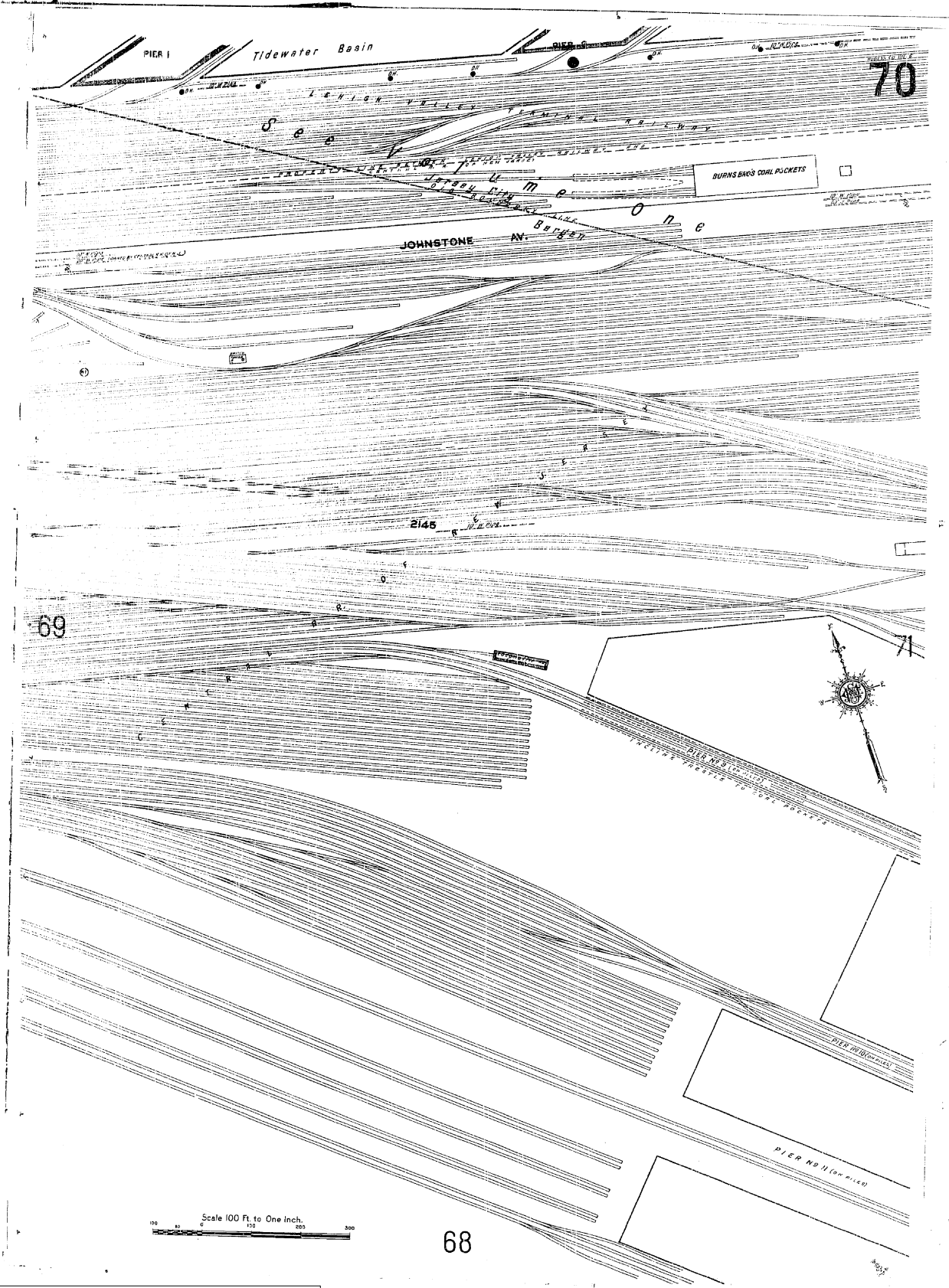


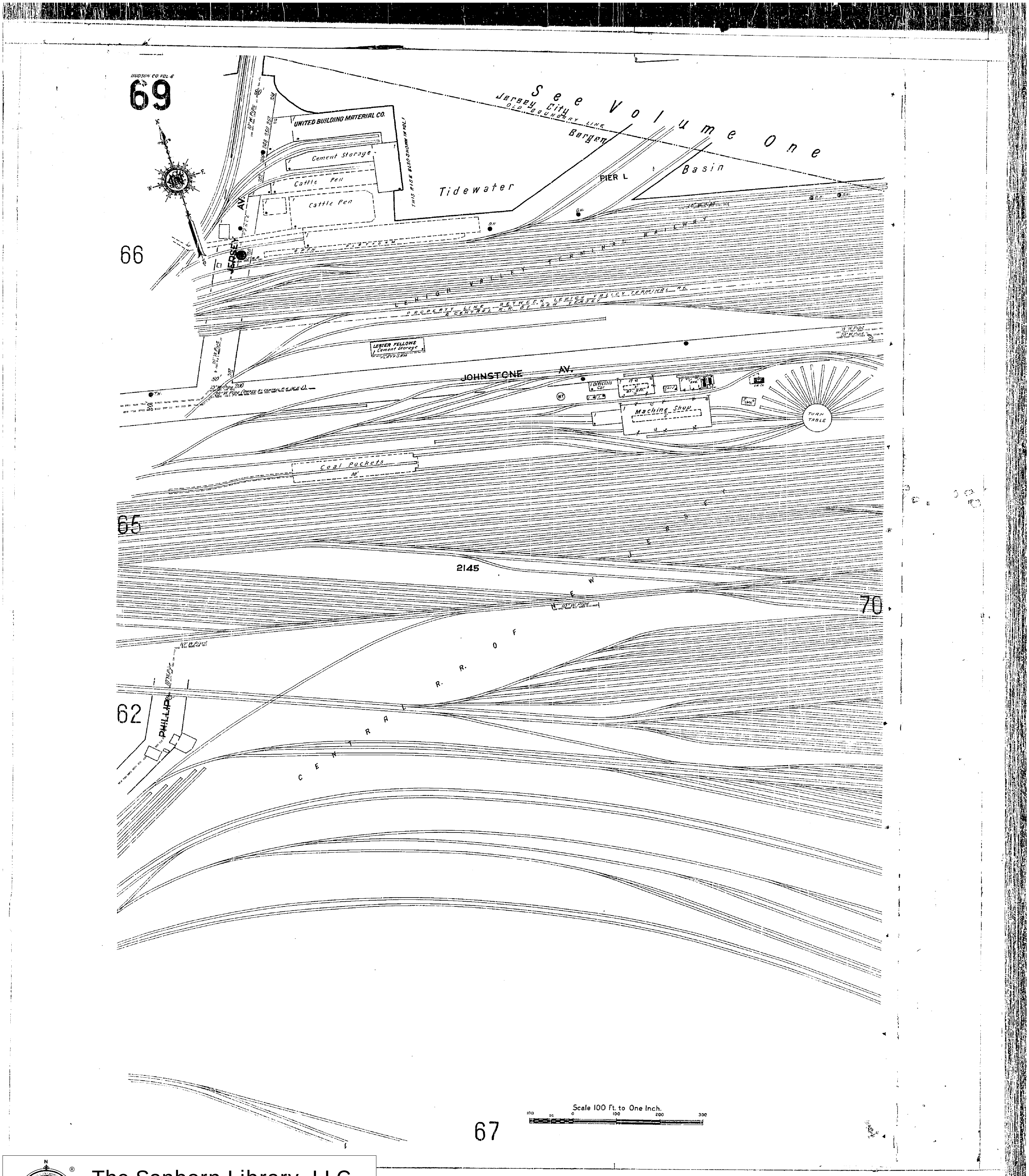


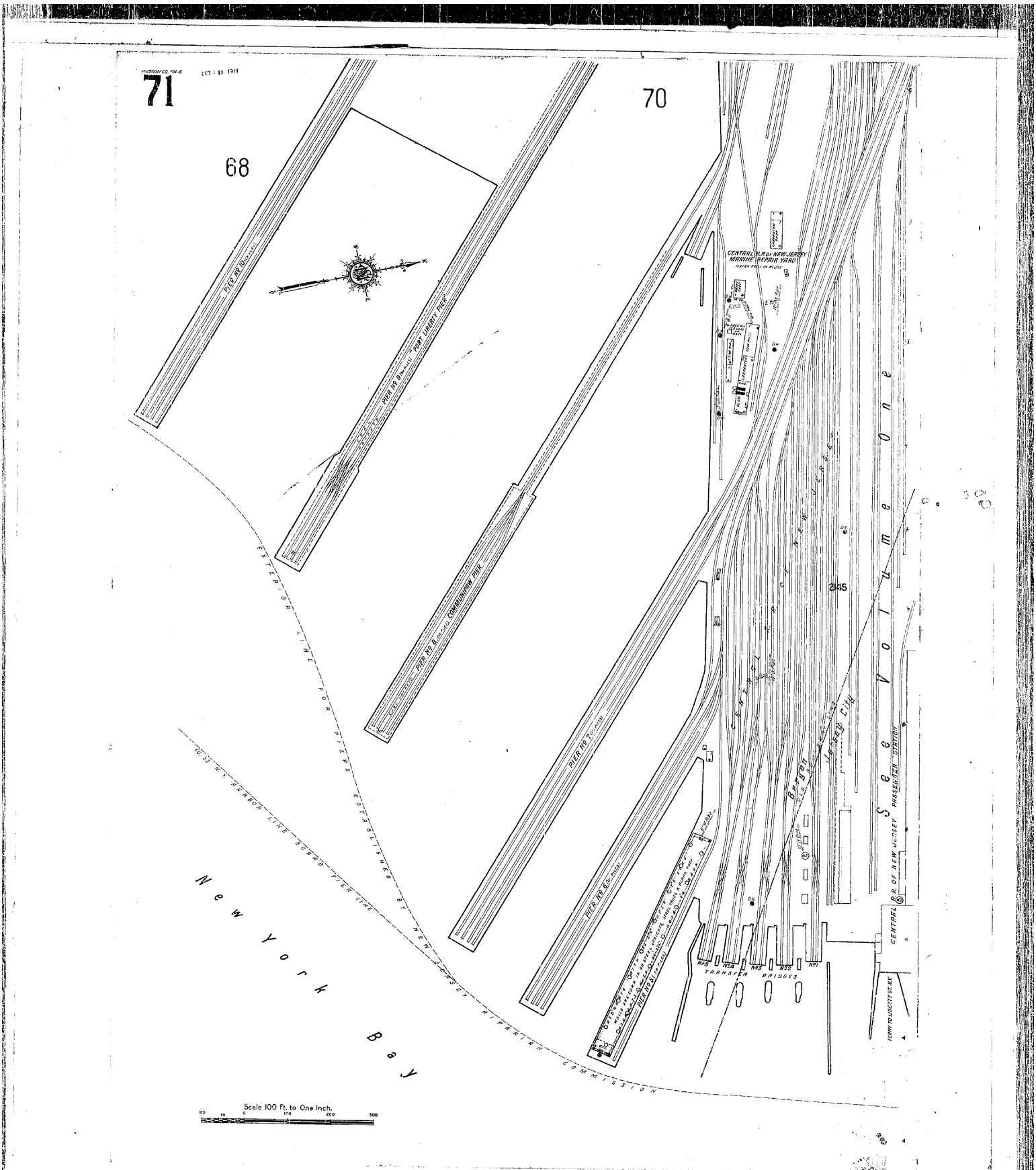


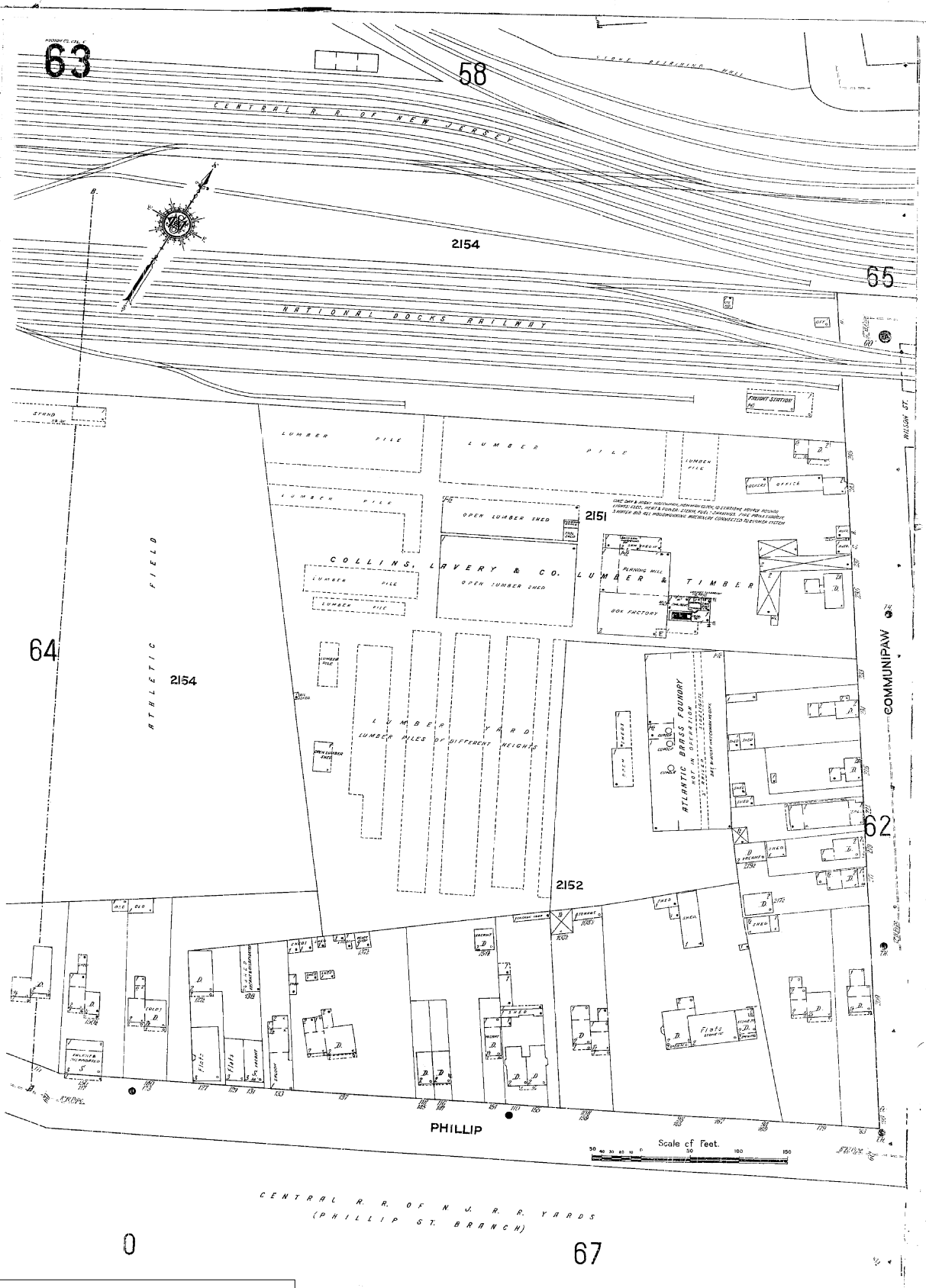


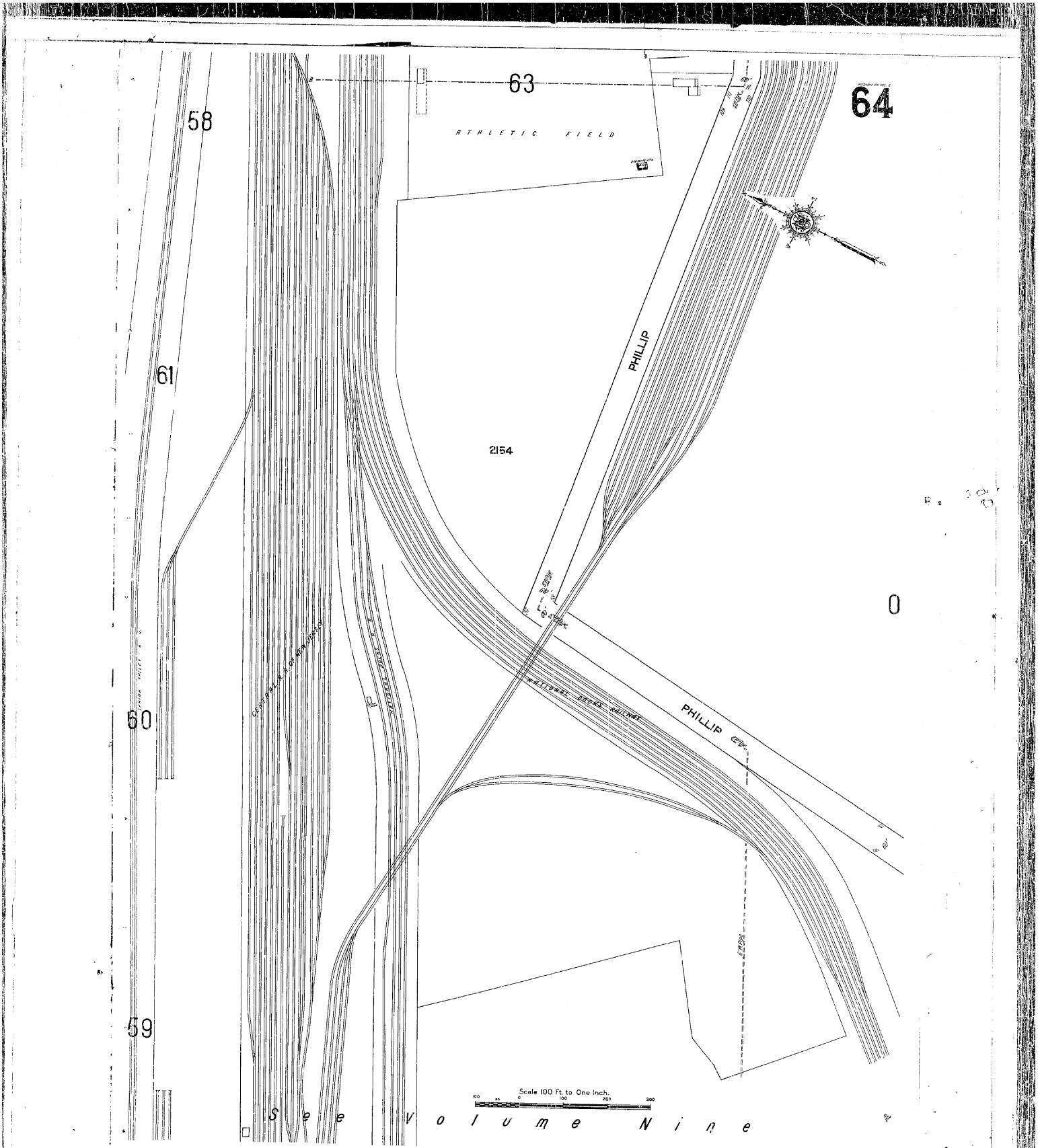


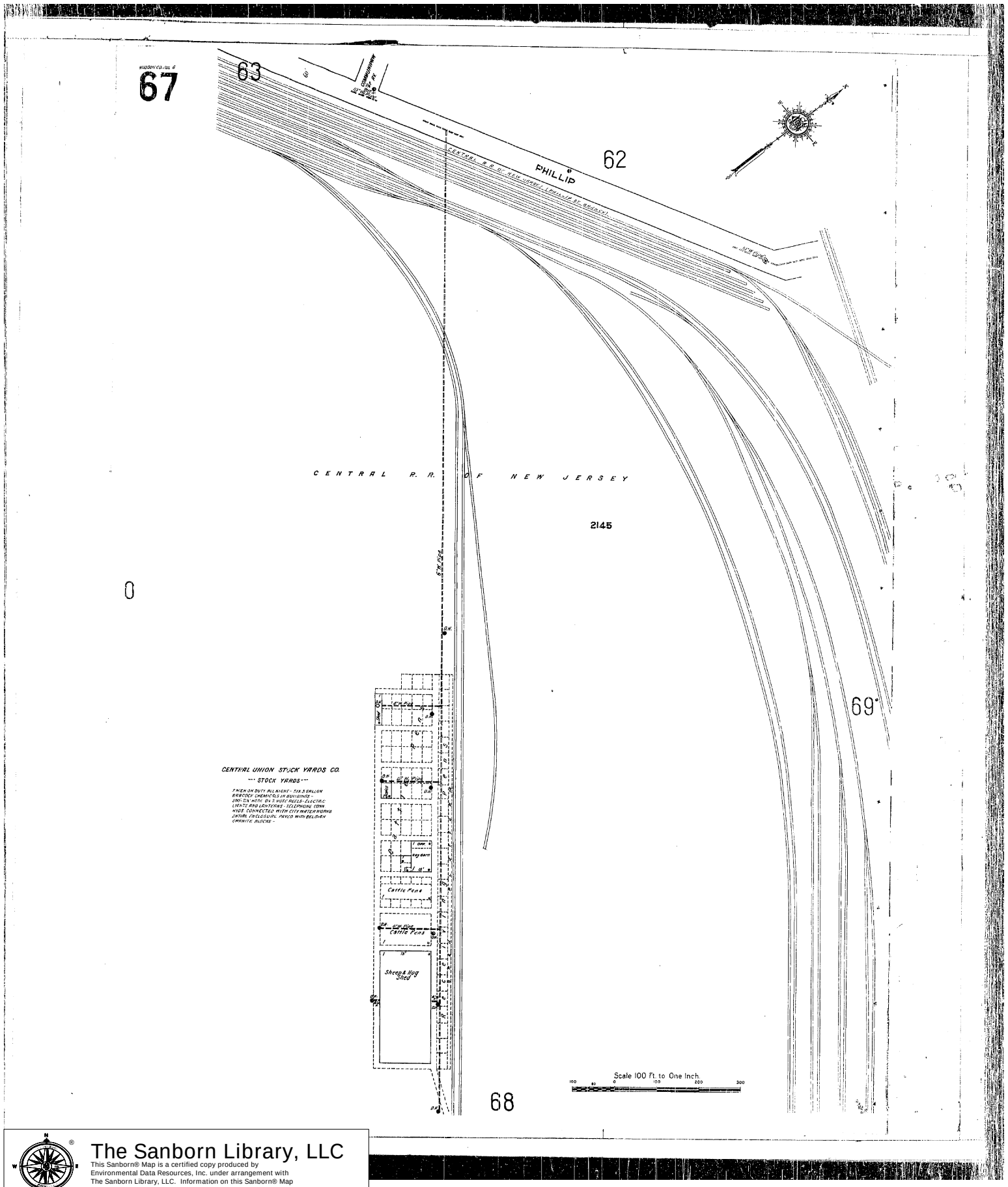


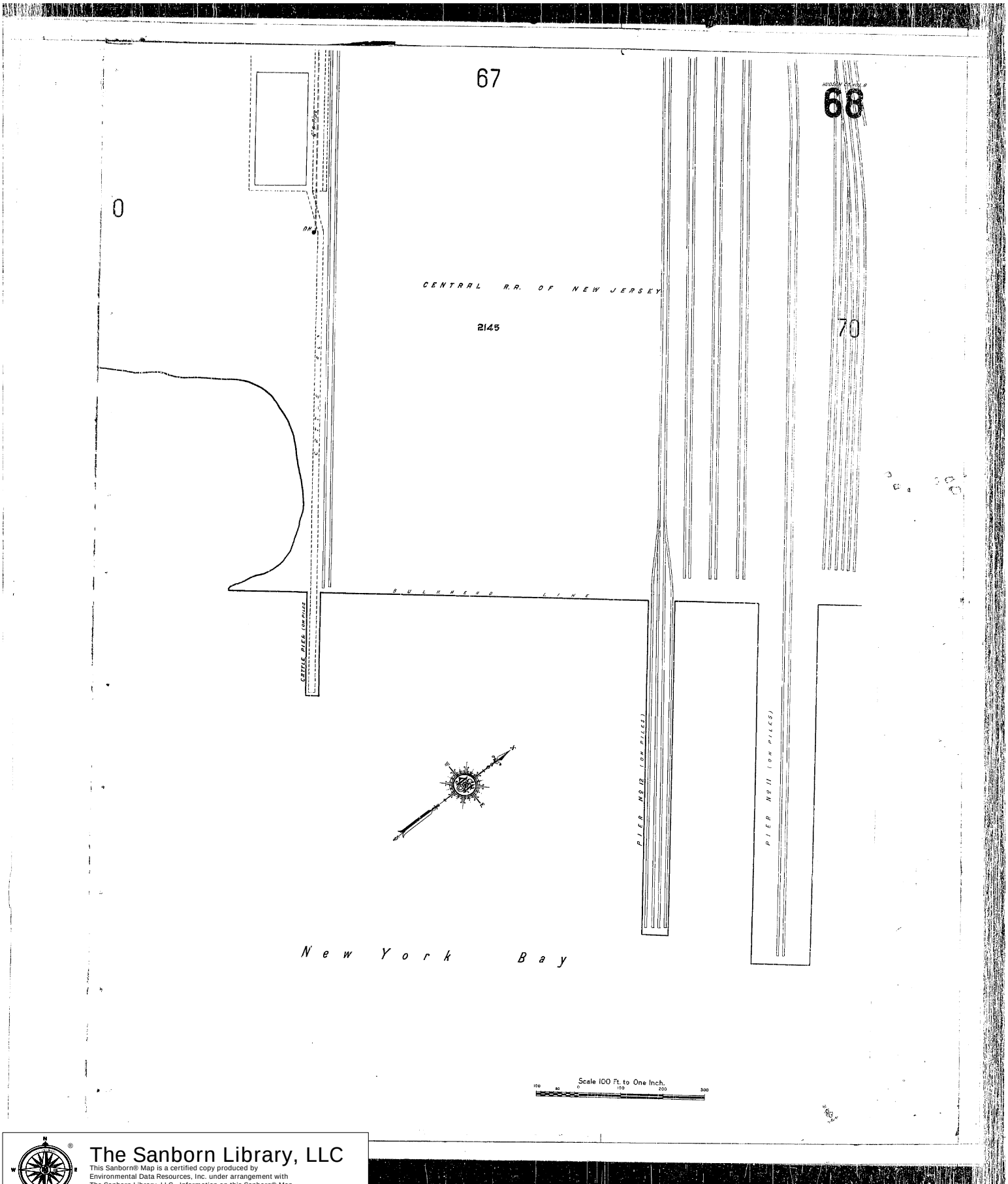


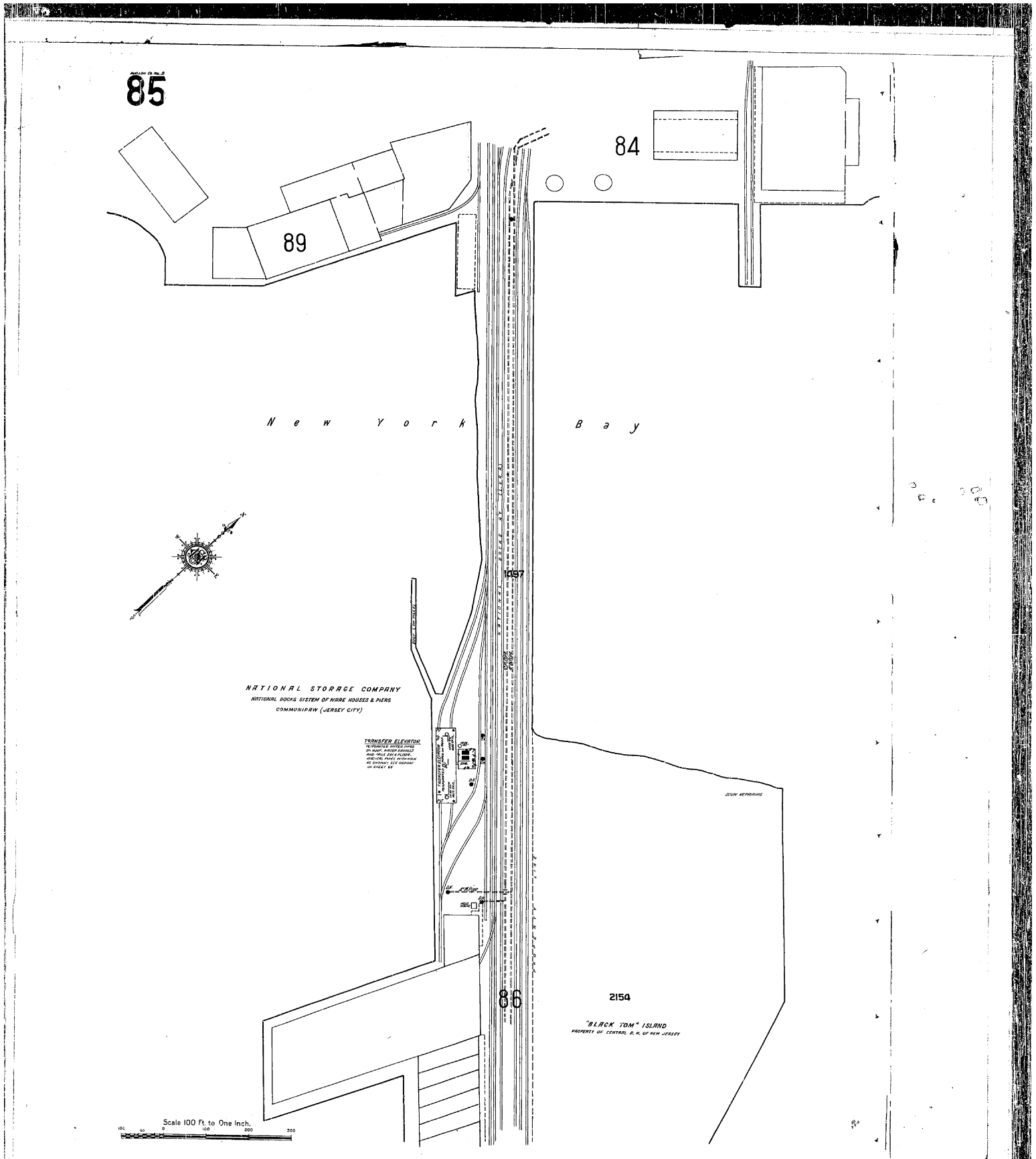


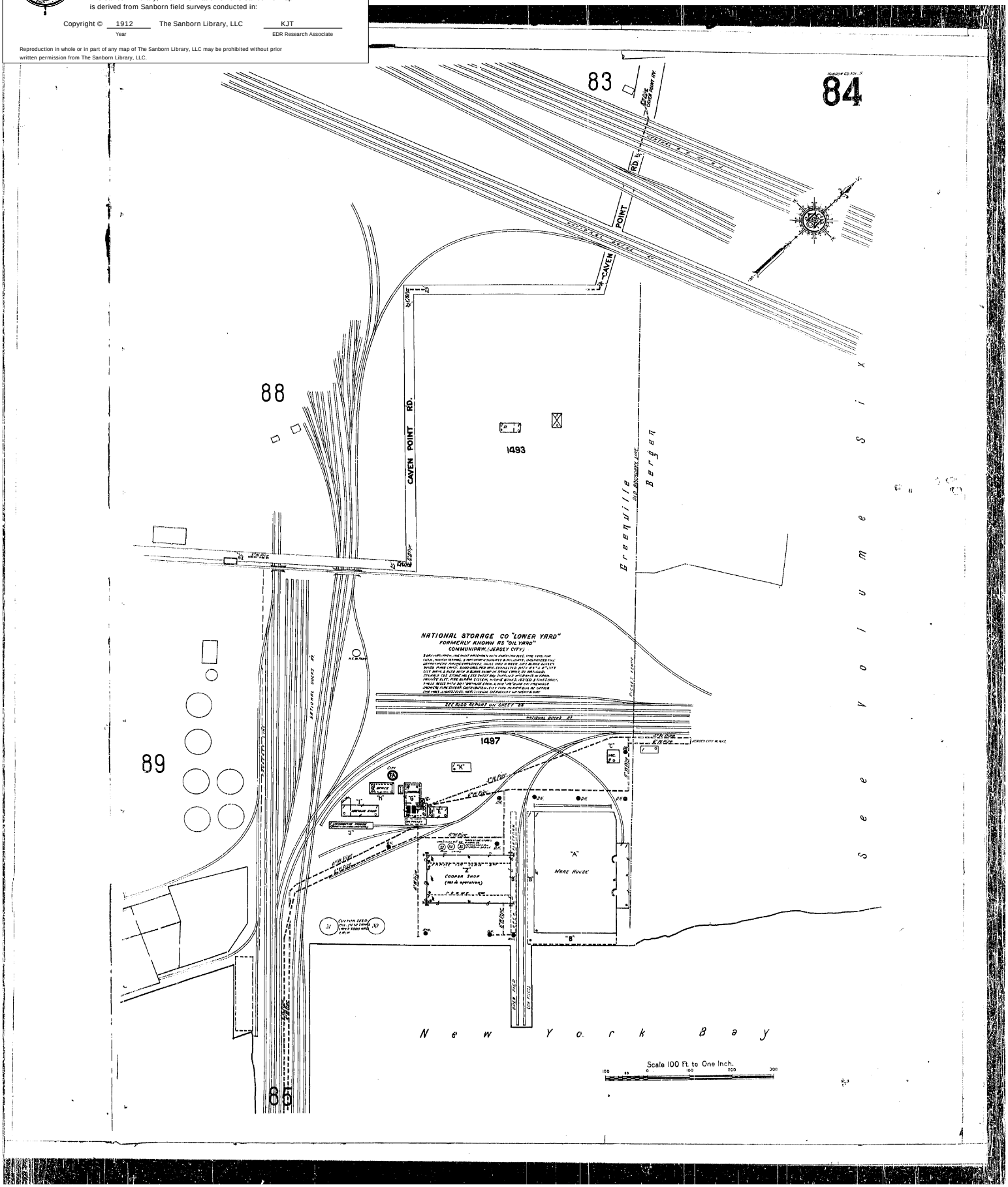


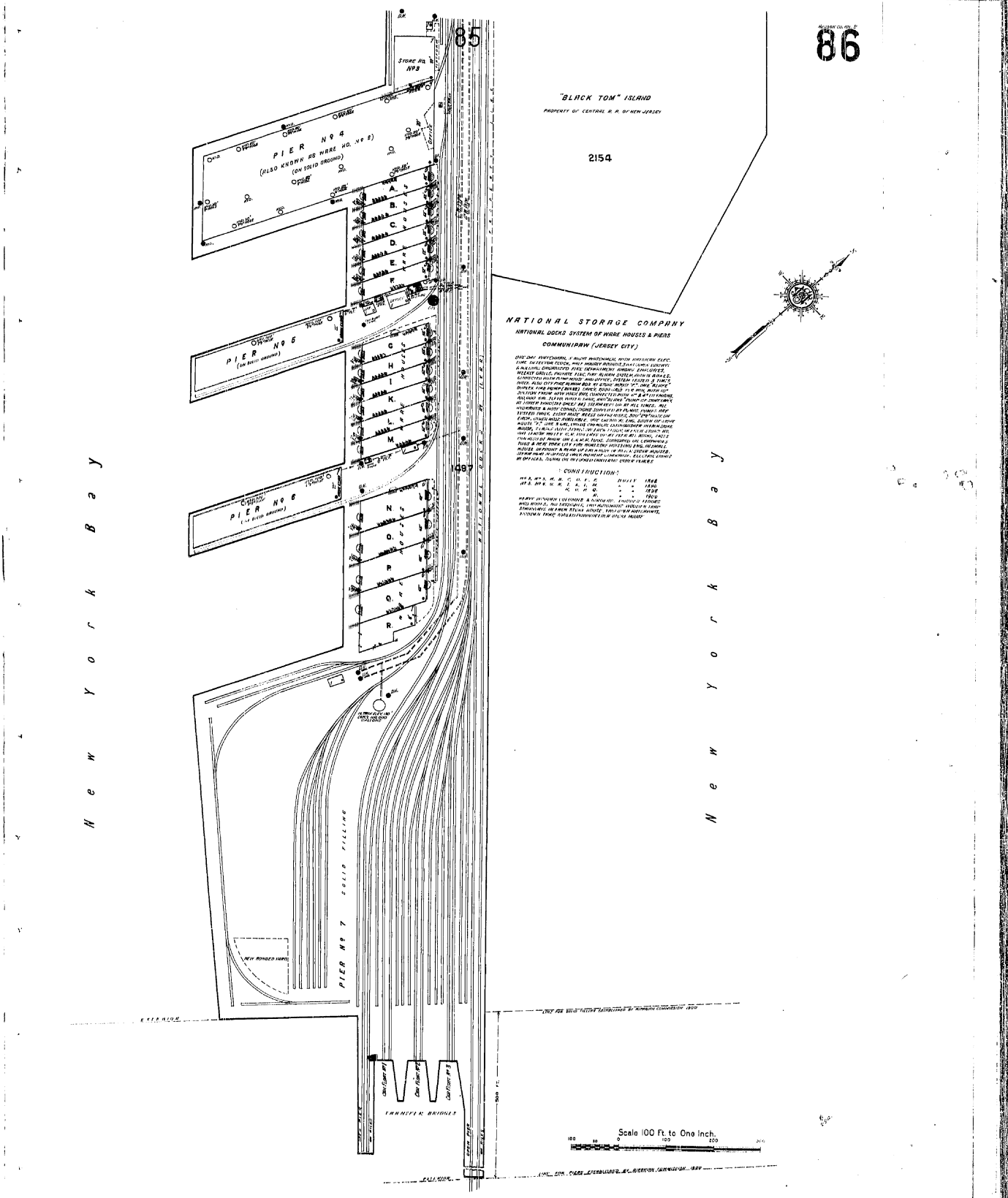


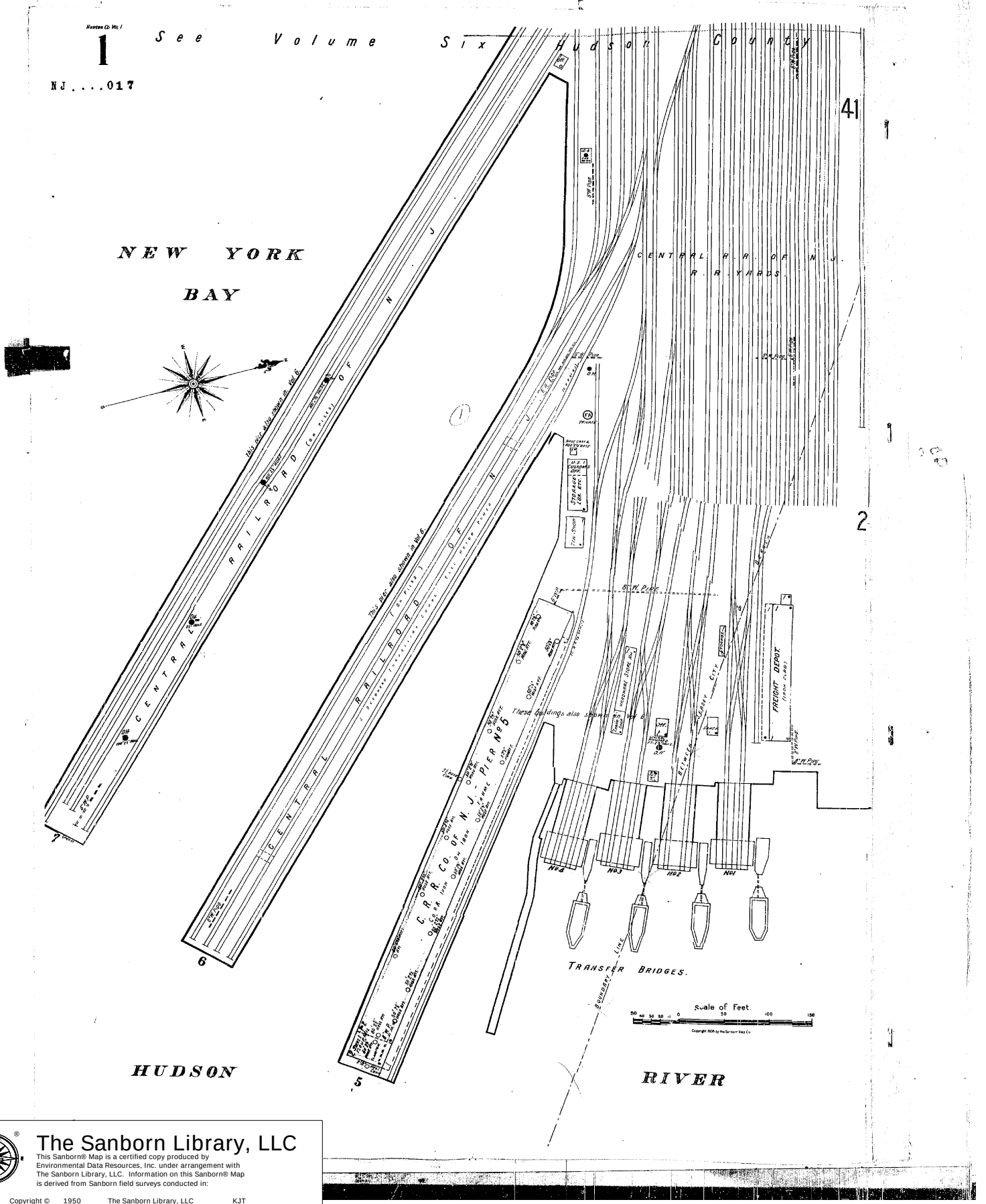




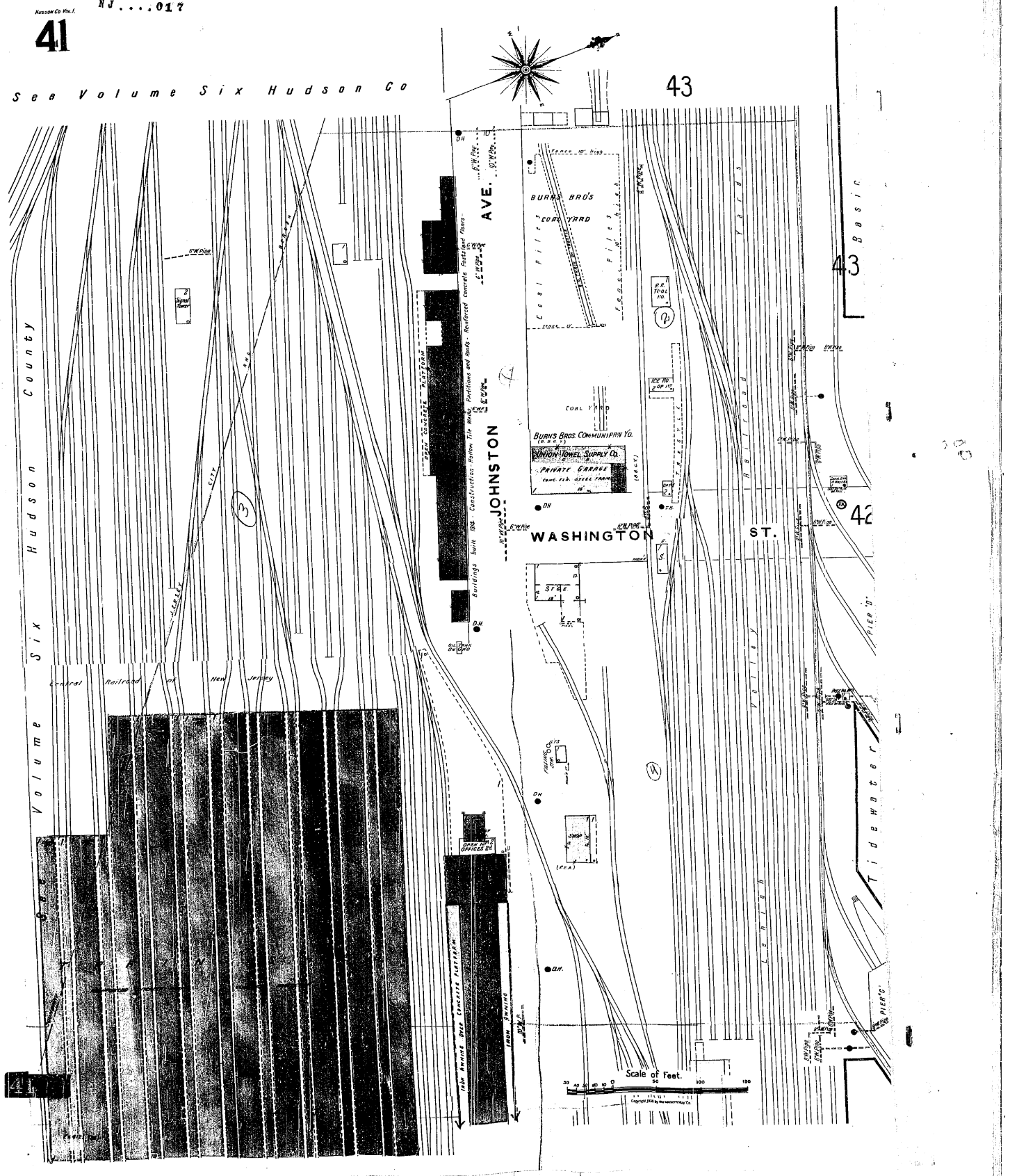








See Volume Six Hudson Co



"BLACK TOM" ISLAND
PROPERTY OF CENTRAL R. R. OF NEW JERSEY

2154

PIER No 4
(IRON CLAD) ON SOLID GROUND
JOHNSONS W. No.
GREENWICH TERMINAL CO.
A. B. C. D. E.
(G.T.Co)

PIER No 5
(IRON CLAD) ON SOLID GROUND

PIER No 6

PIER No 7 SOLID FILLING

GREENWICH TERMINAL CO.
NATIONAL DOCKS SYSTEM OF WARE HOUSES & PIERS
COMMUNIPAW (JERSEY CITY.)

ONE DAY WATCHMAN. 5 NIGHT WATCHMEN. HOSE REELS ON PREMISES. 300' 2½" HOSE ON EACH STAND WHERE AVAILABLE. ONE 3 GAL. CHILDS CHEMICAL EXTINGUISHER IN EACH STORE HOUSE. 8 CASKS WITH 3 PAILS ON EACH FLOOR IN EACH STORE No. 6. ONE LEHIGH VALLEY R.R. 10T LOCK UP AT PIER. ALL NIGHT CALLS CAN ALSO BE MADE ON L.V.R.R. TUGS. STANDARD OIL CO. TUGS & NEW YORK CITY FIRE BOATS. ONE HOISTING ENG. IN SMALL HOUSE IN FRONT & REAR OF EACH PAIR OF BRICK STORE HOUSES. STEAM HEAT IN OFFICES ONLY. NO BERT OTHERWISE. ELECTRIC LIGHTS IN OFFICES. SIGNAL OIL IN LOCKED LANTERNS OTHER PLACES.

(G.T.Co.) CONSTRUCTION.
A.B.C.D.E. BUILT 1888
HEAVY WOODEN COLUMNS & GIRDERS. WOODEN FLOORS AND R.F.S. NO SKYLIGHTS. TWO DUTCHMEN TO WOOD TRAP STAIRWAYS IN EACH STORE HOUSE. TO EACH HATCHWAYS. WOODEN TRAP NAILED DOWN IN EACH STORE HOUSE.

ALLEN S. SPOONER & SONS INC.
MARINE CONTRACTORS

WALK ON PILING

EXTERIOR LINE FOR SOLID FILLING ESTABLISHED BY RIPARIAN COMMISSION 1906

DOCK ON PILING

86

TUG & BARGE SUPPLY CO.

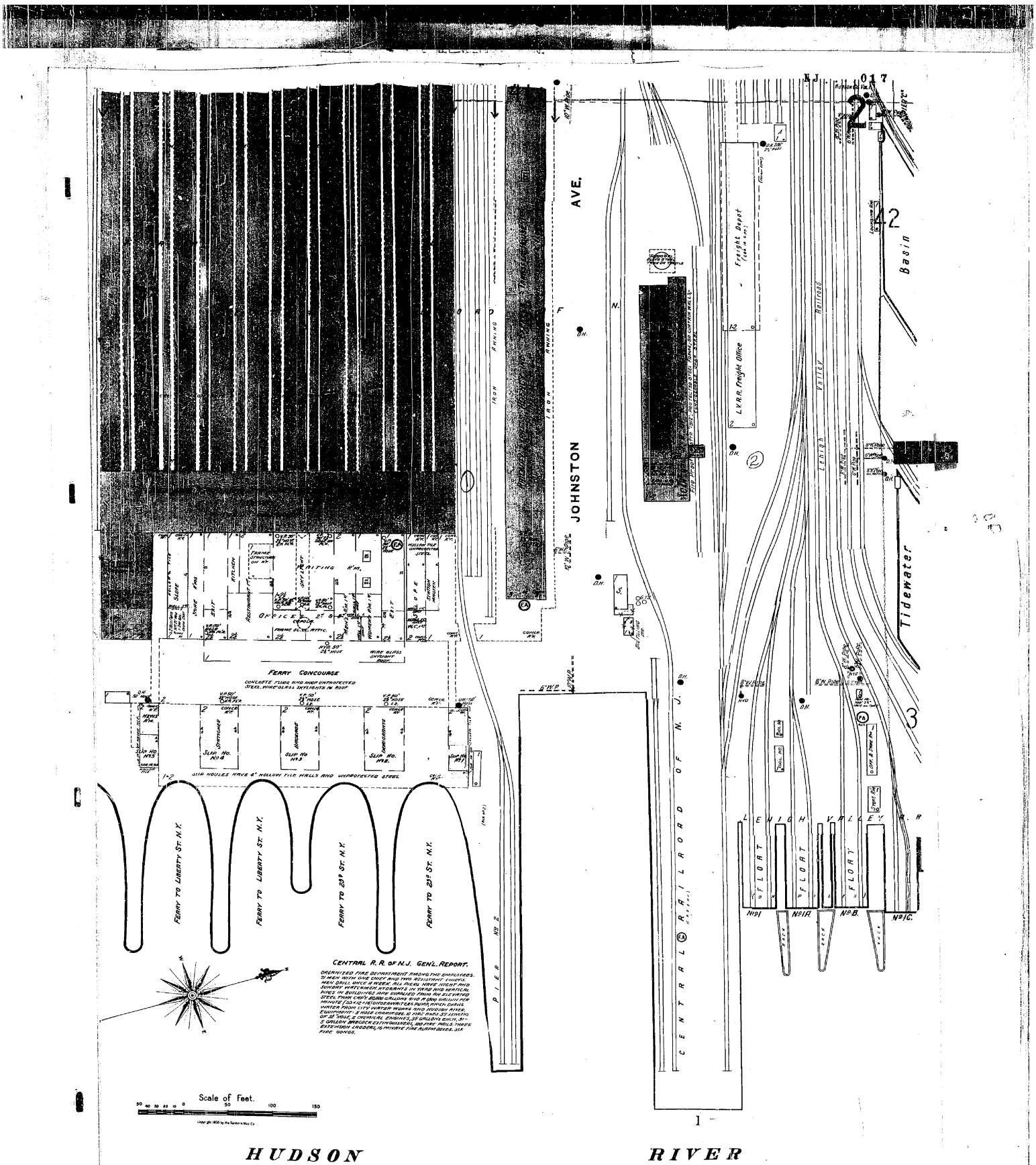
OPEN PIER ON WOOD PILES

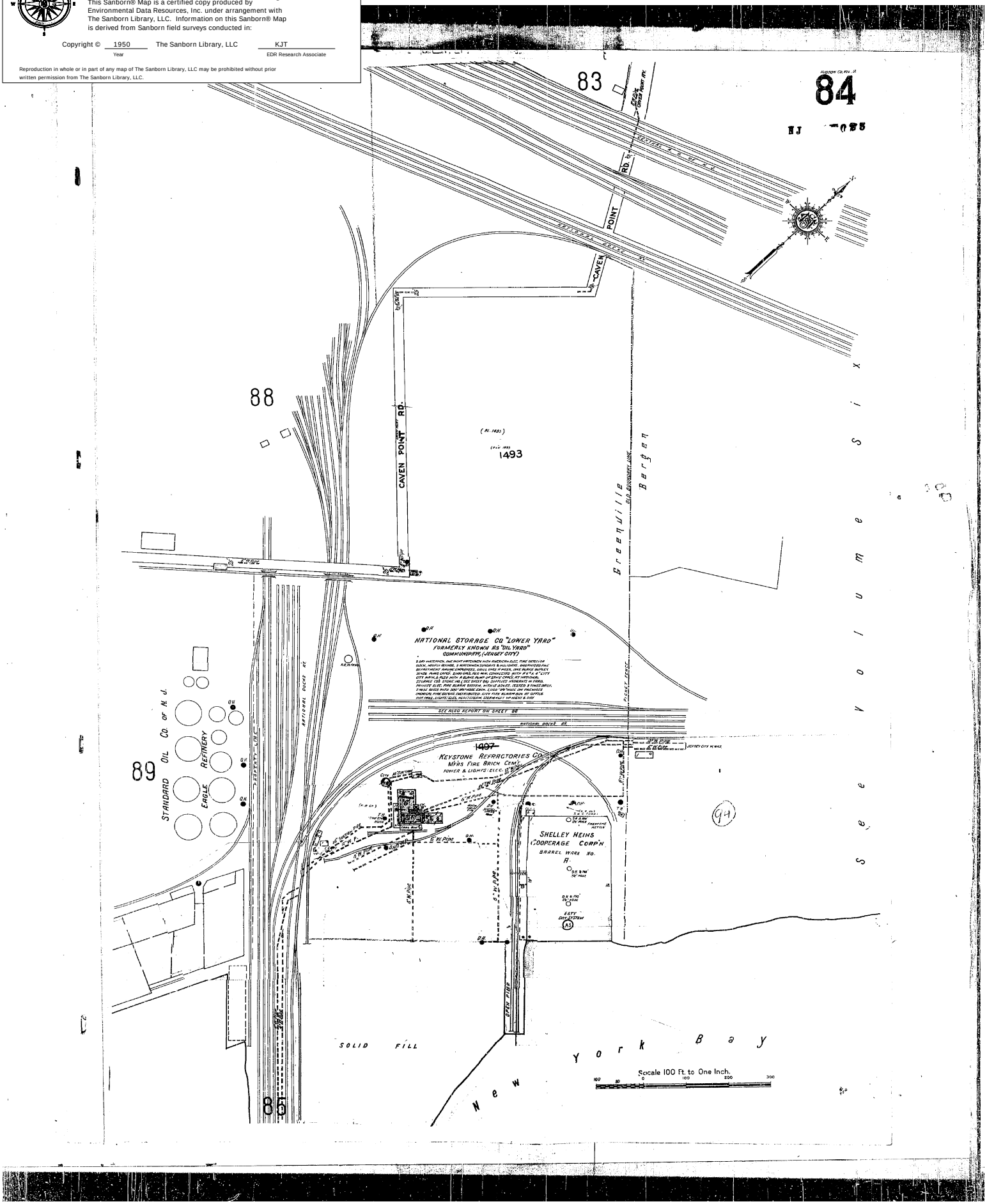
New York Bay

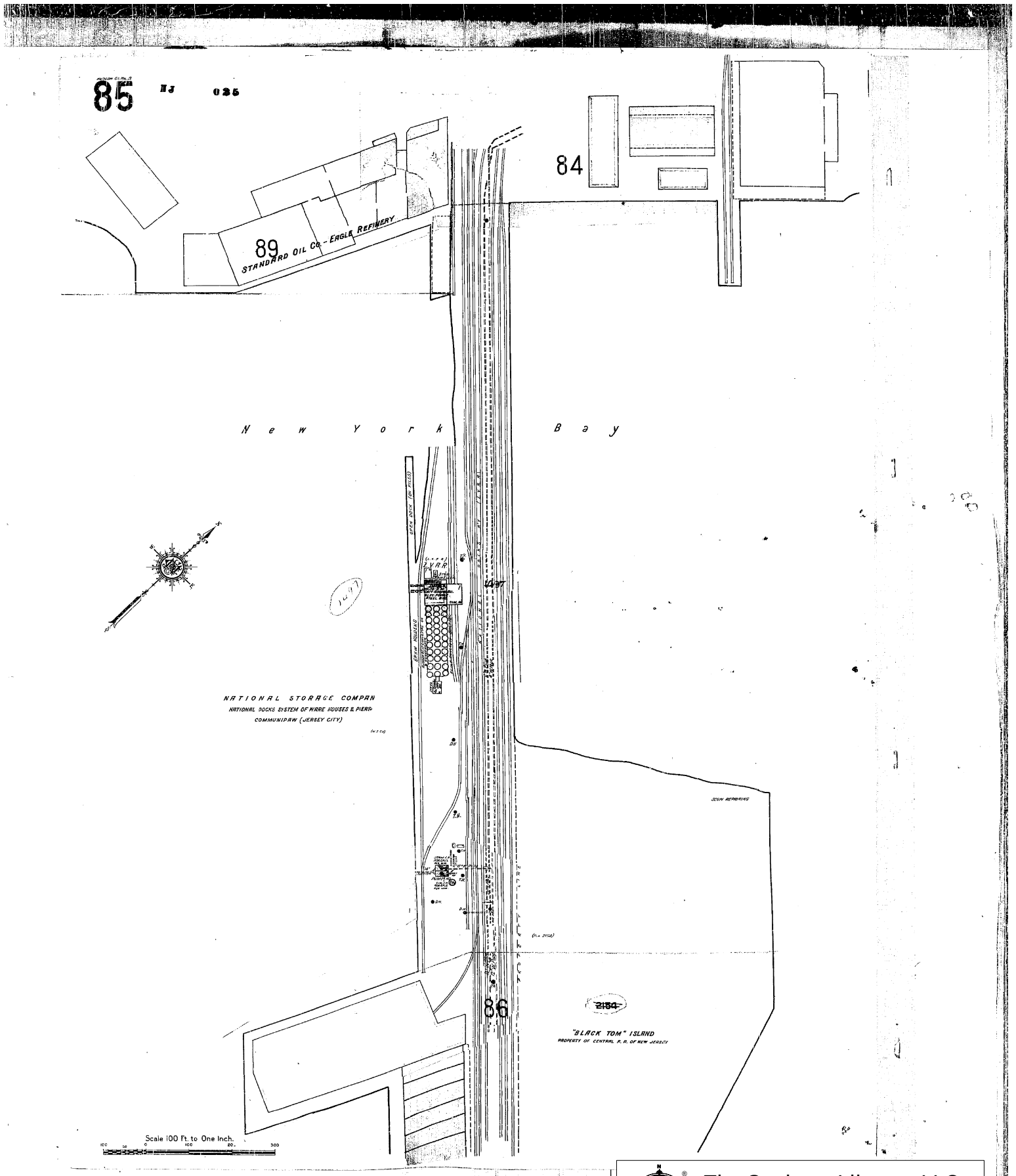
EXTERIOR PIER LINE

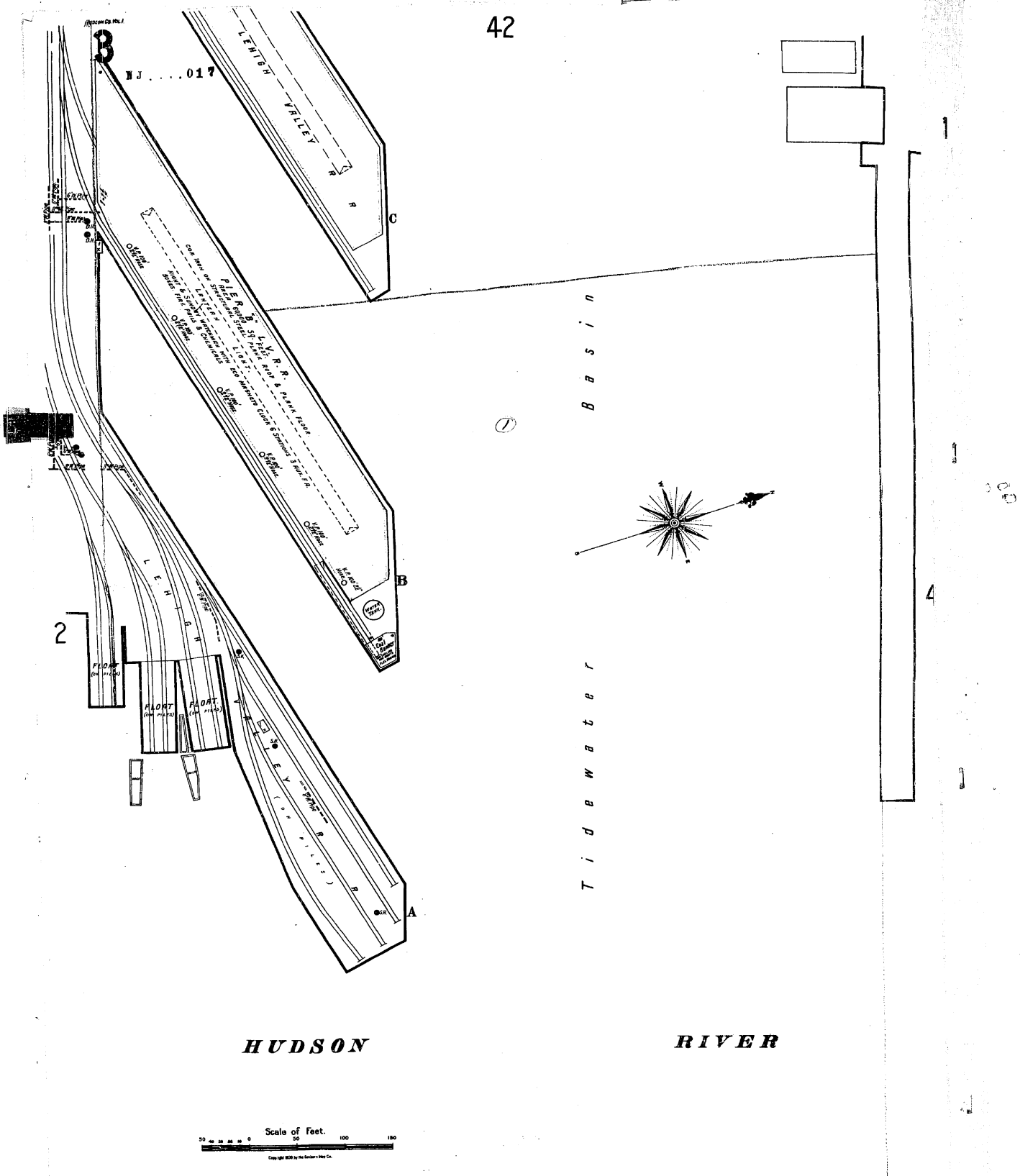
Scale 100 Ft to One Inch.

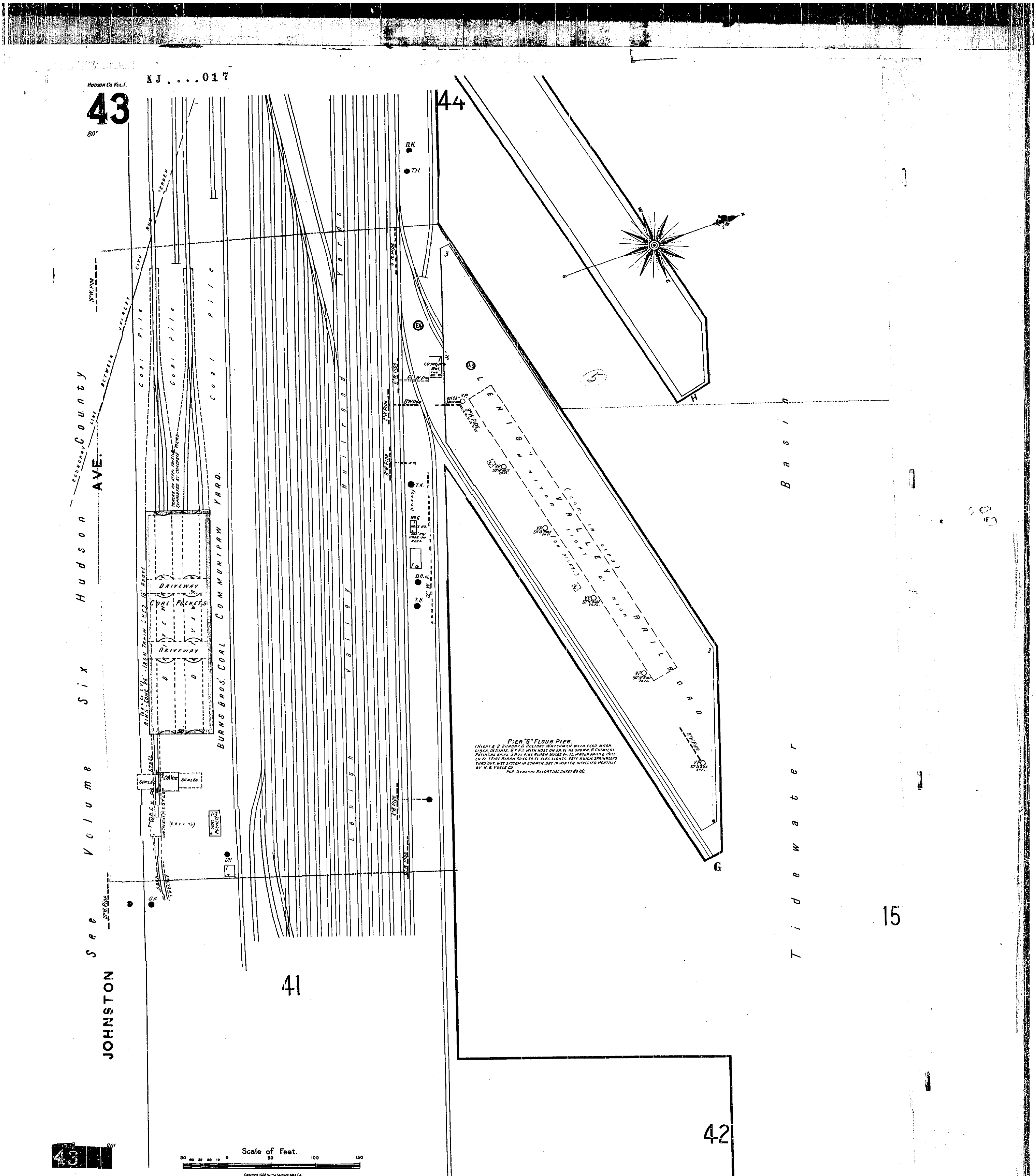
LINE FOR PIERS ESTABLISHED BY RIPARIAN COMMISSION 1906

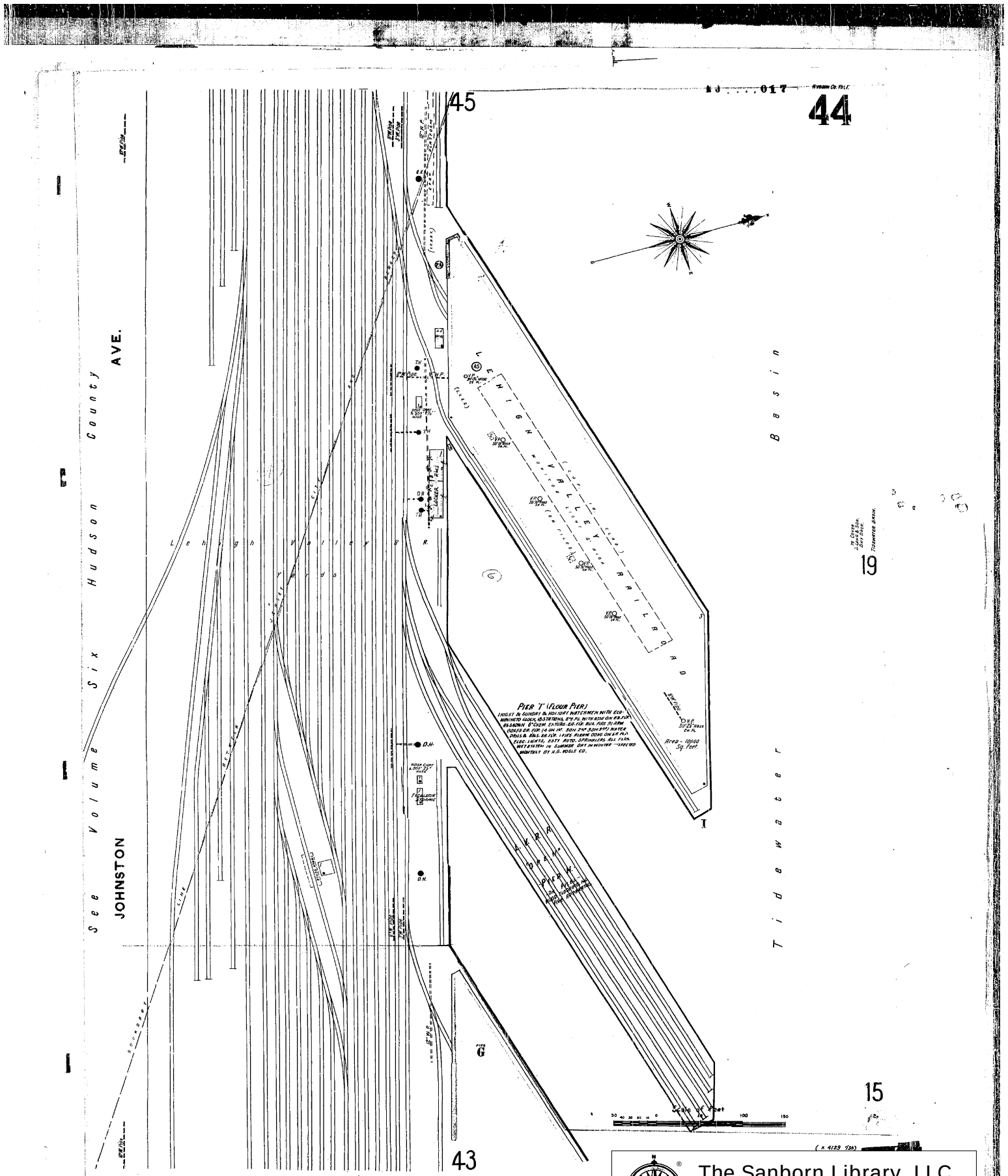


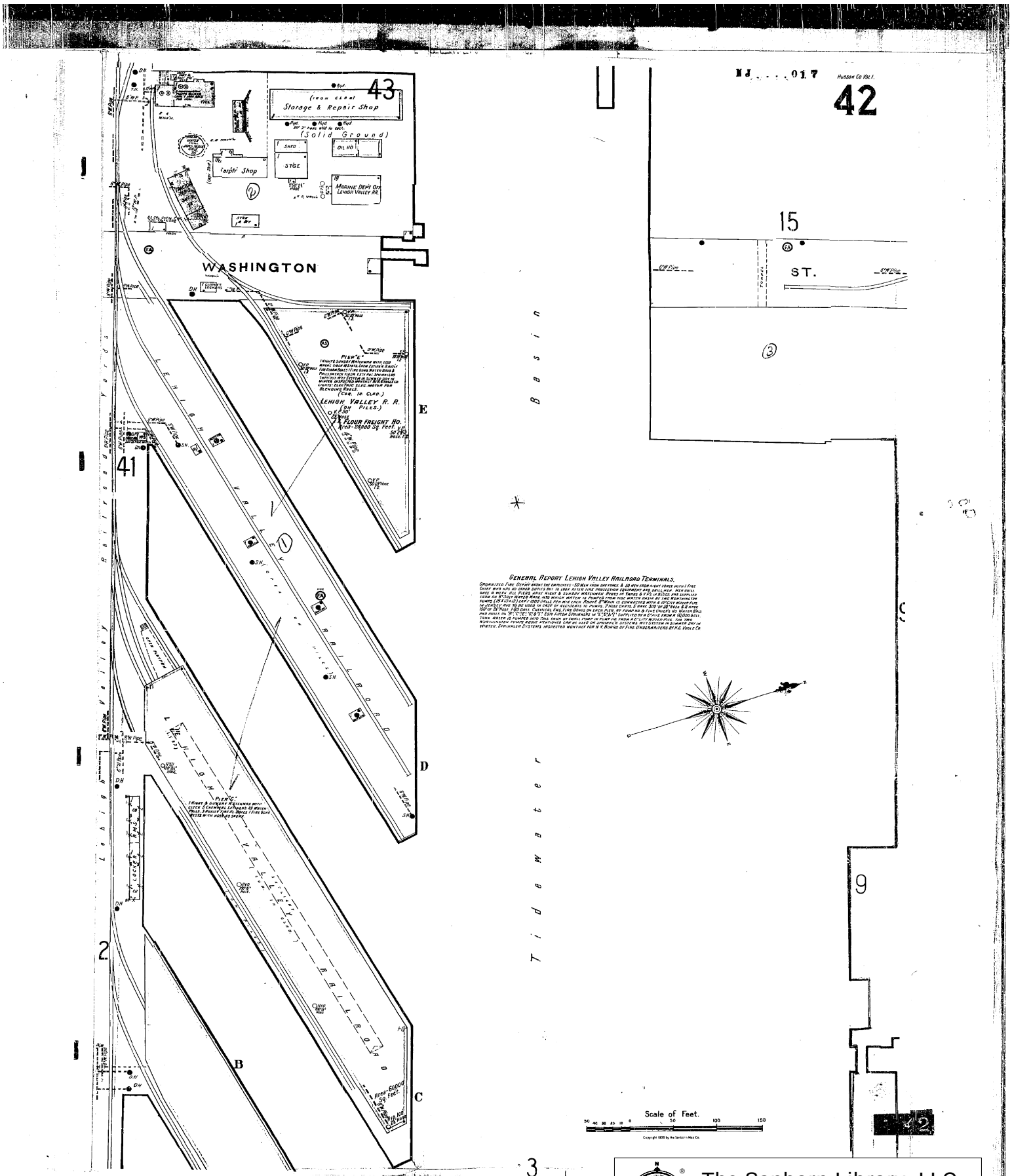


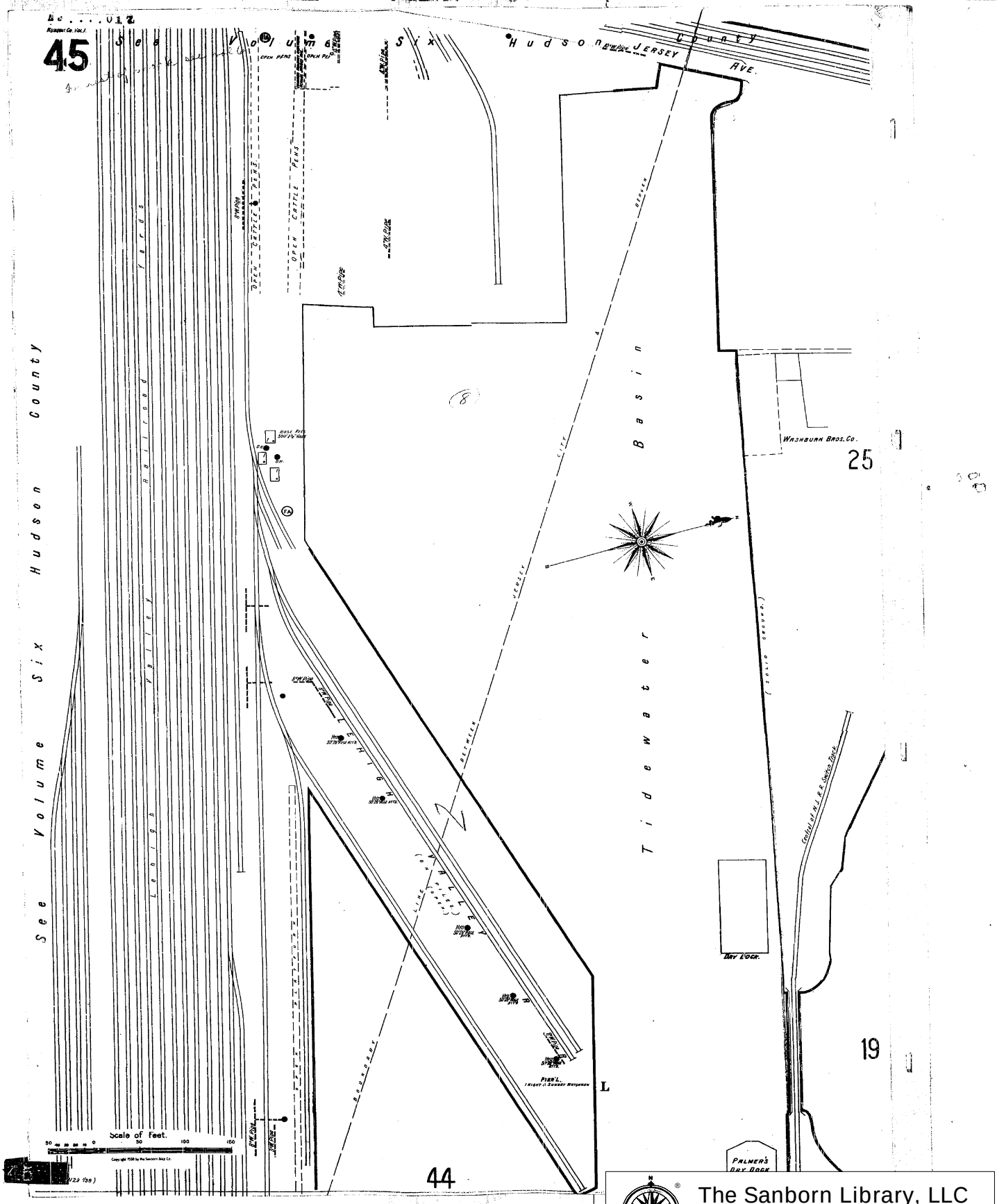


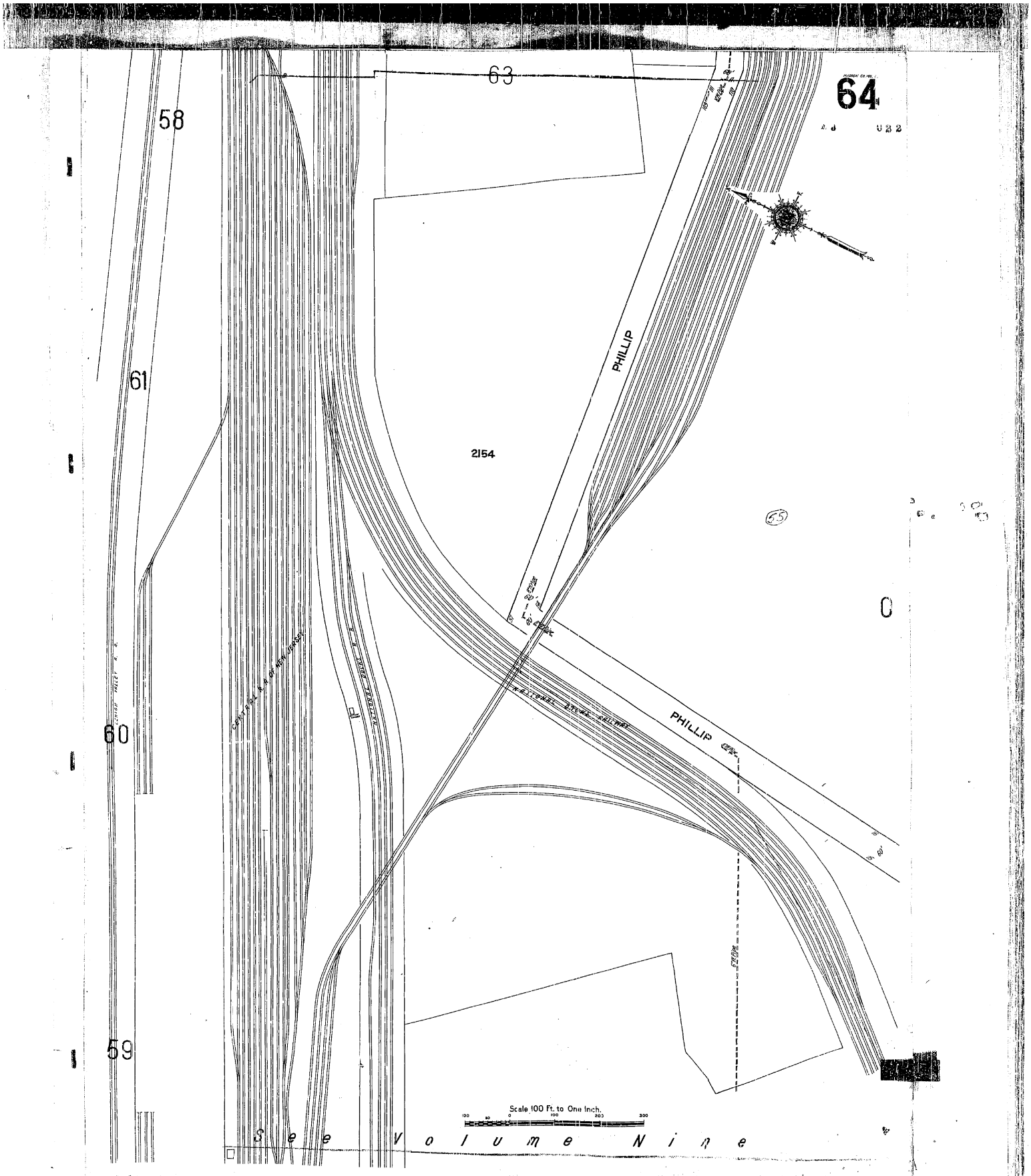


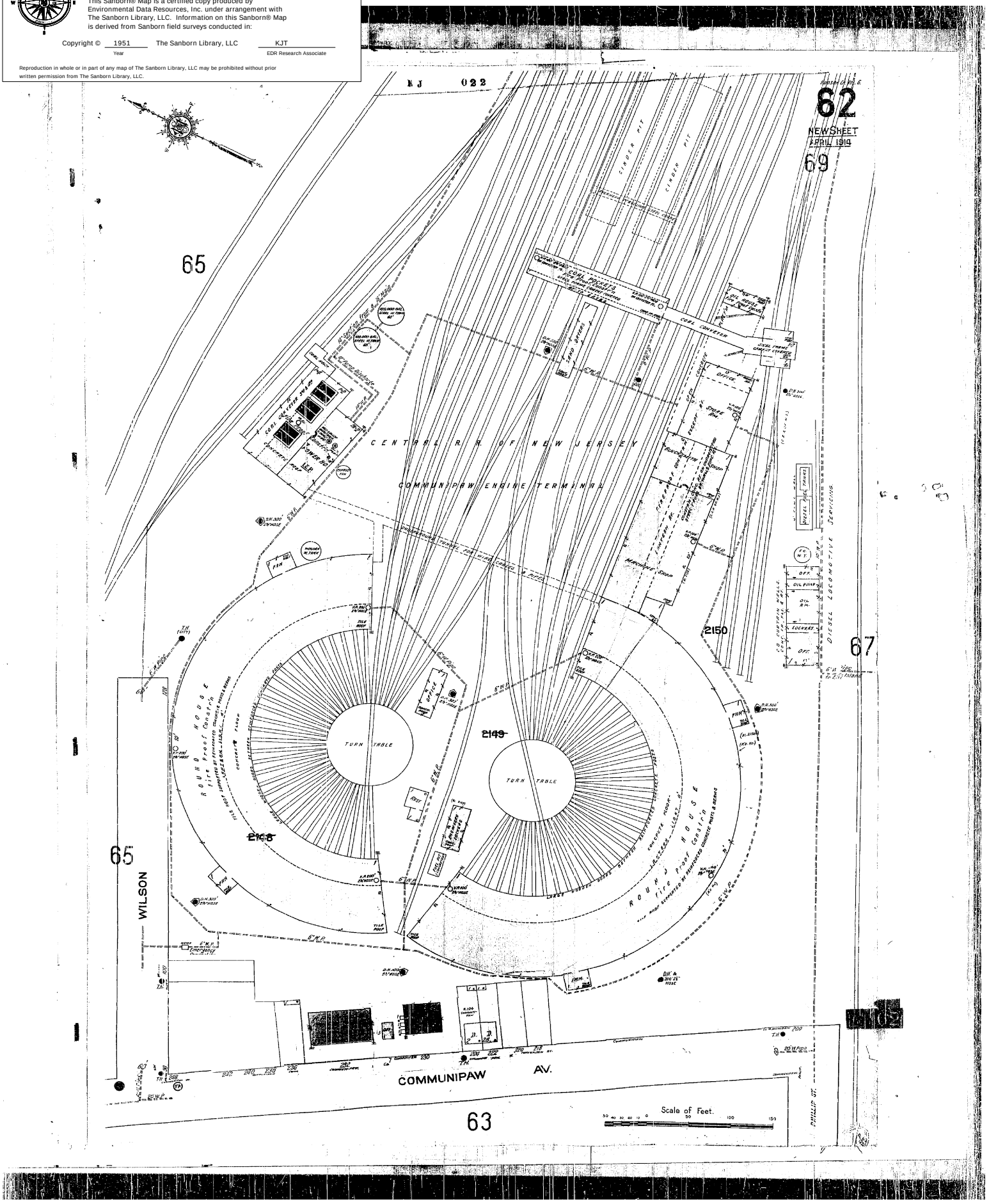


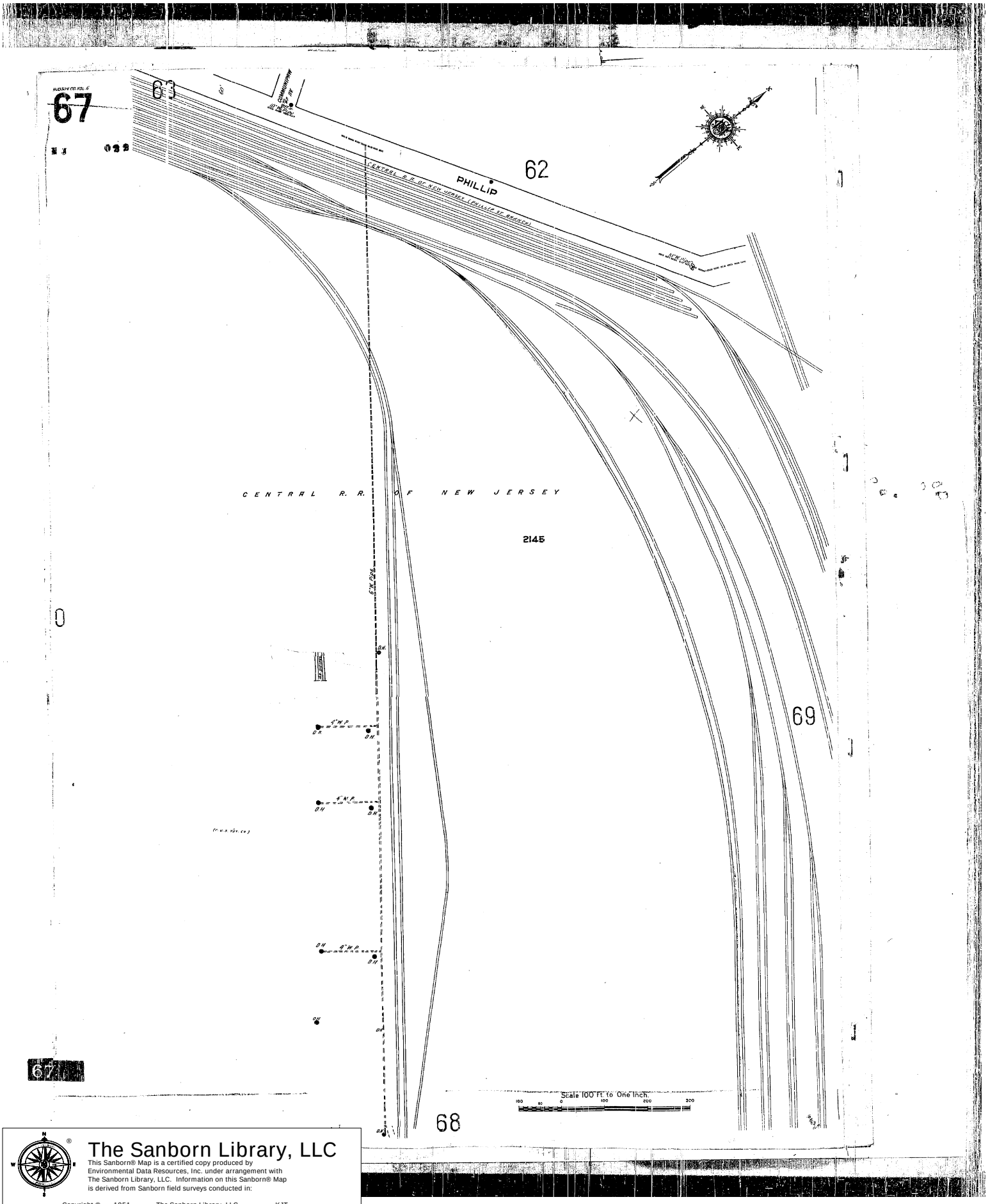


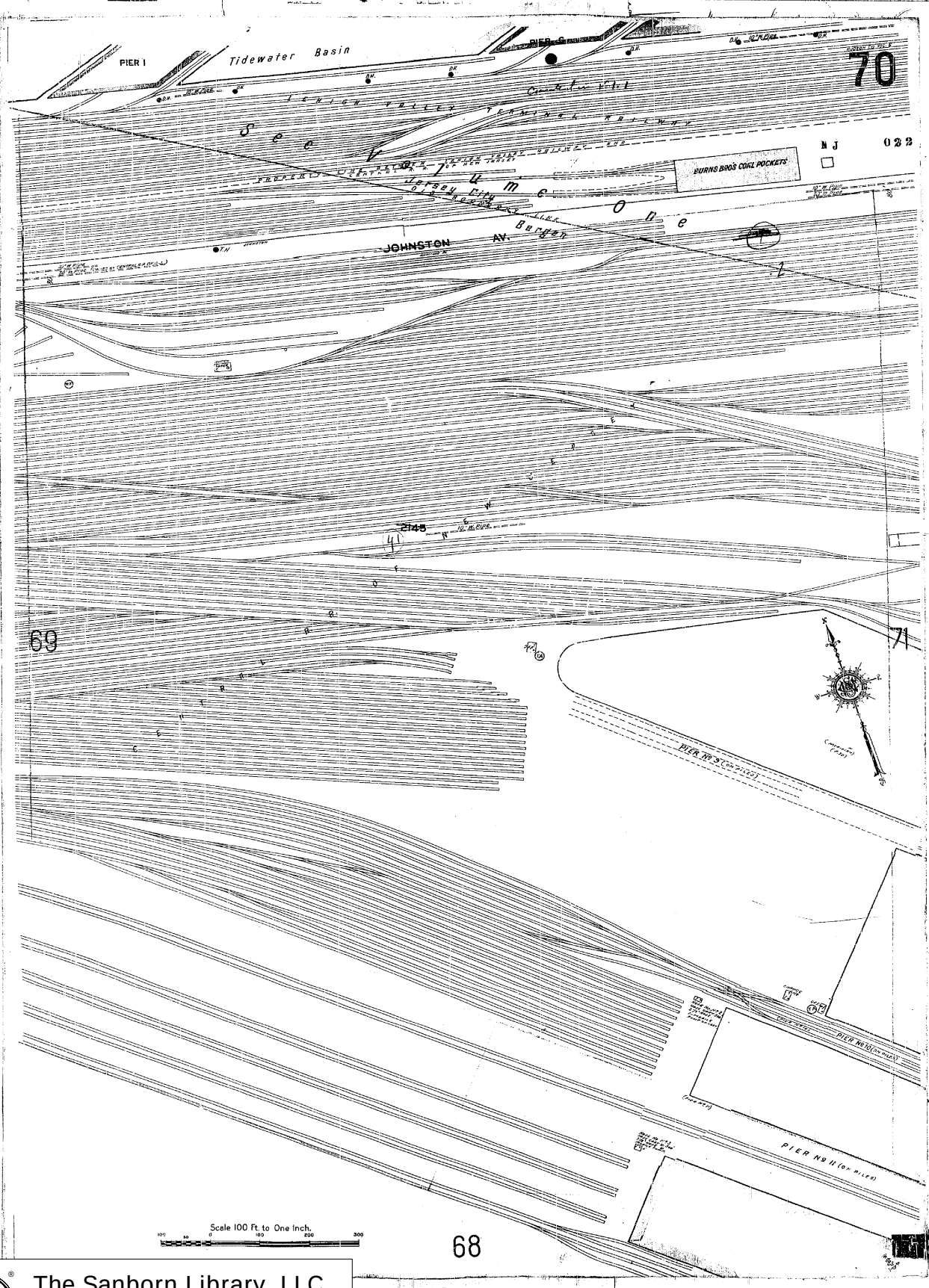


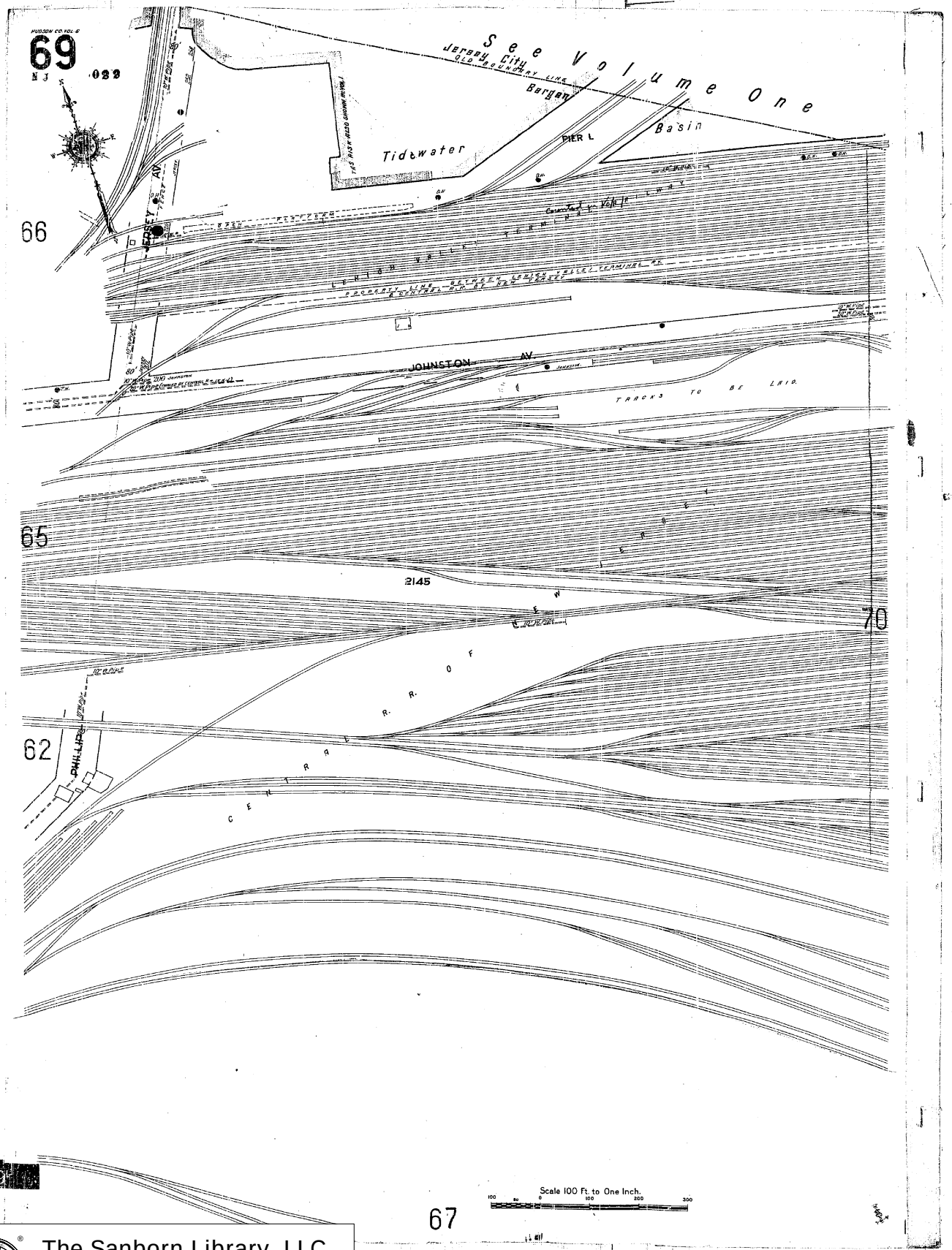


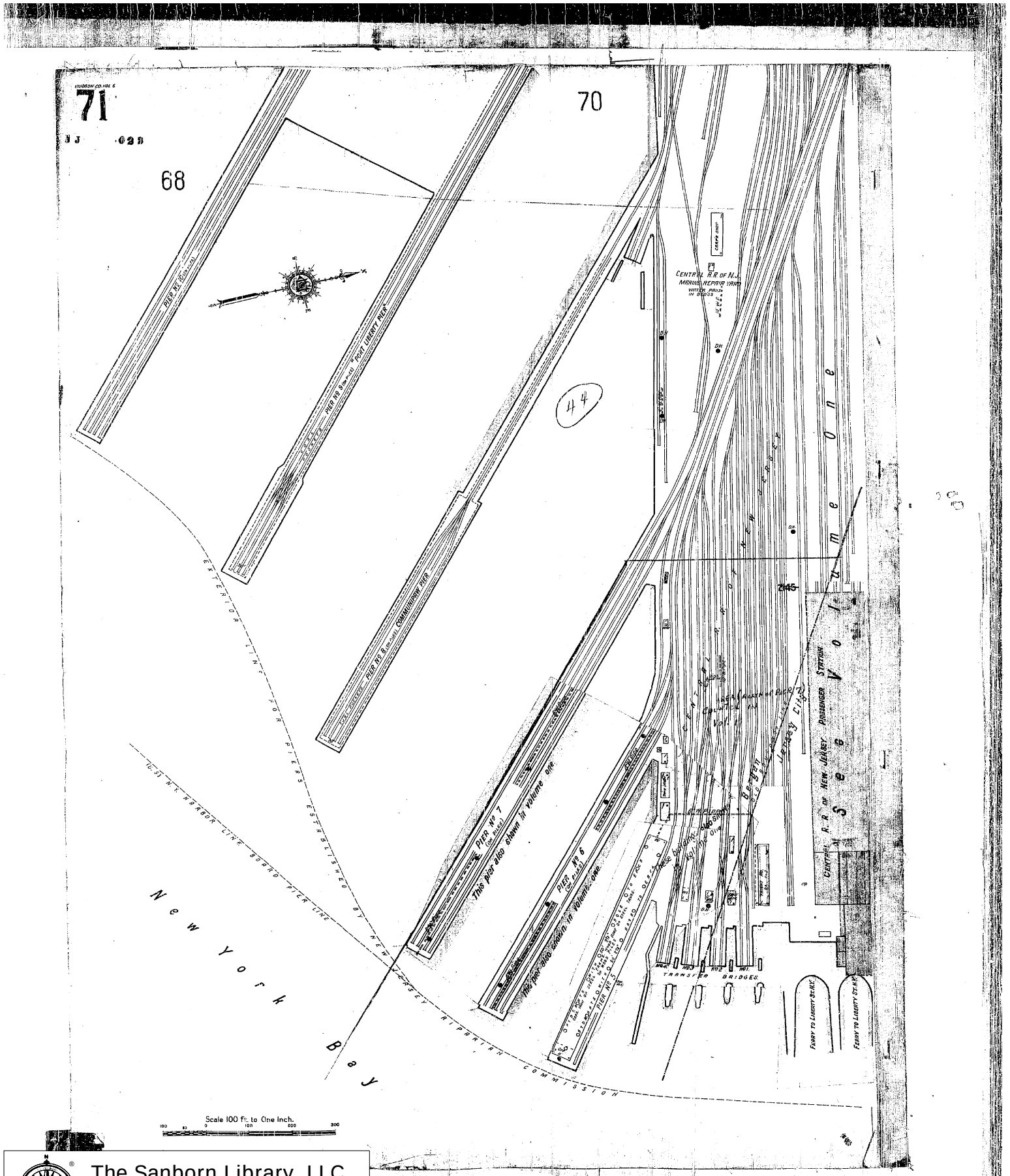


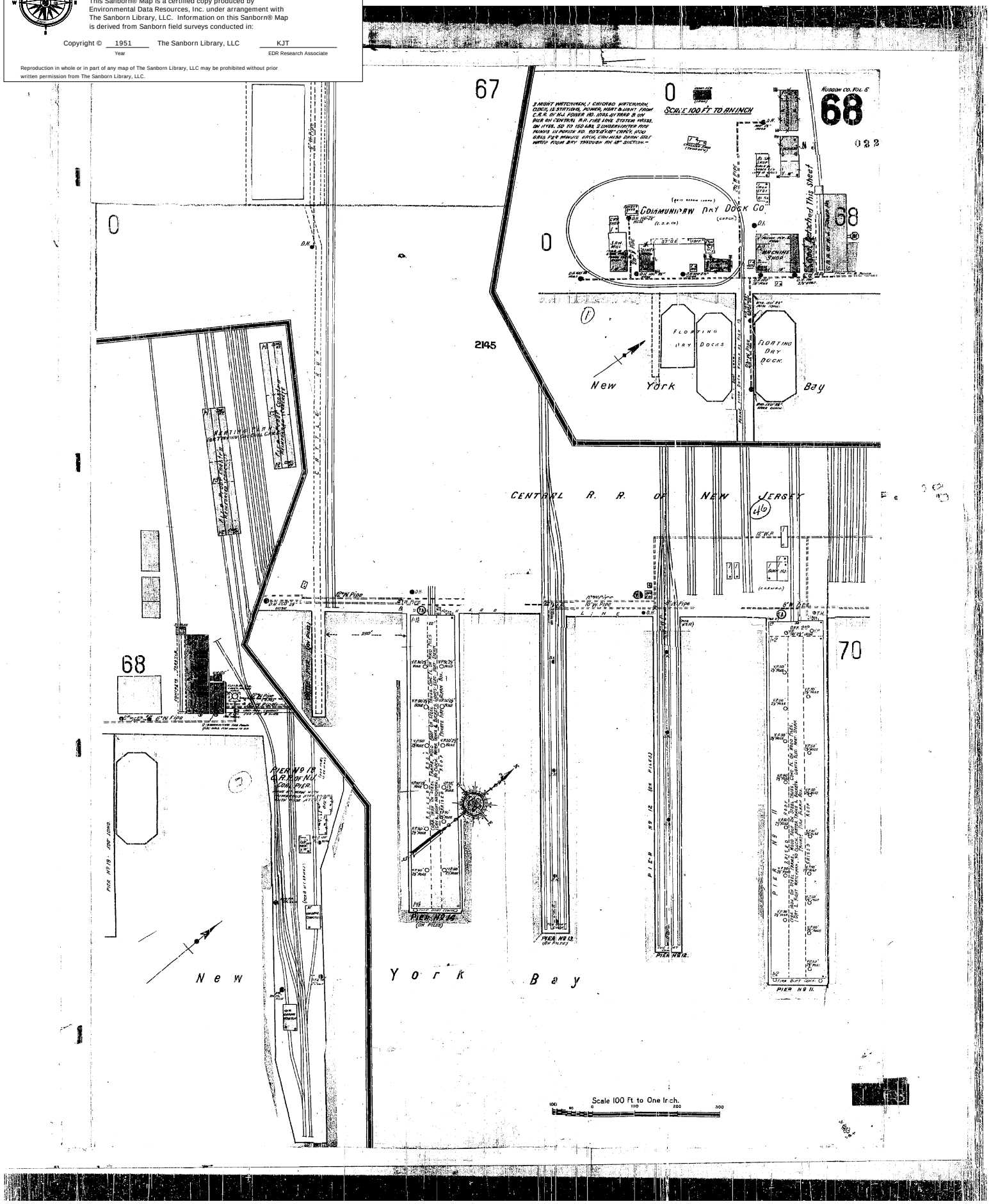


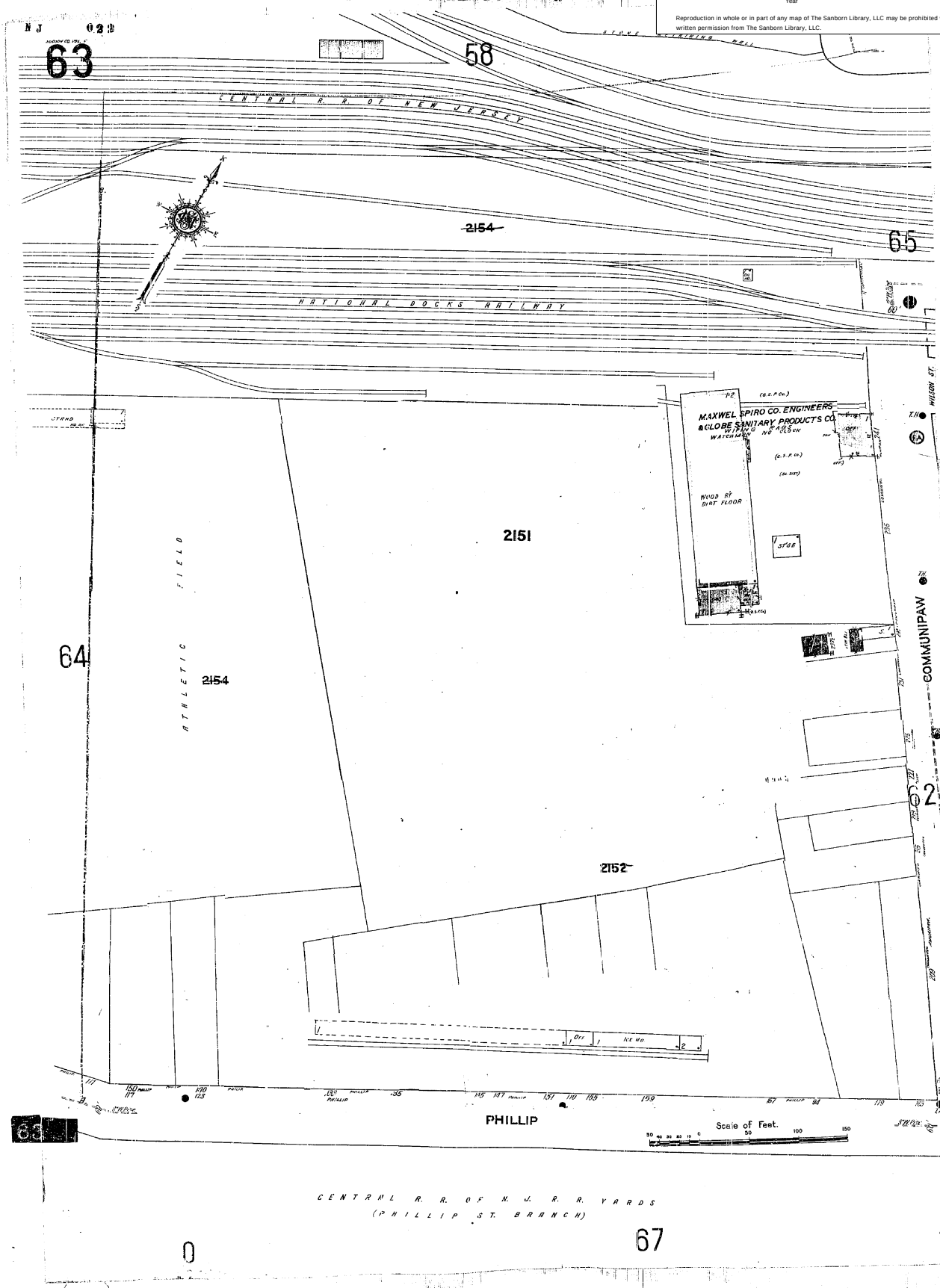


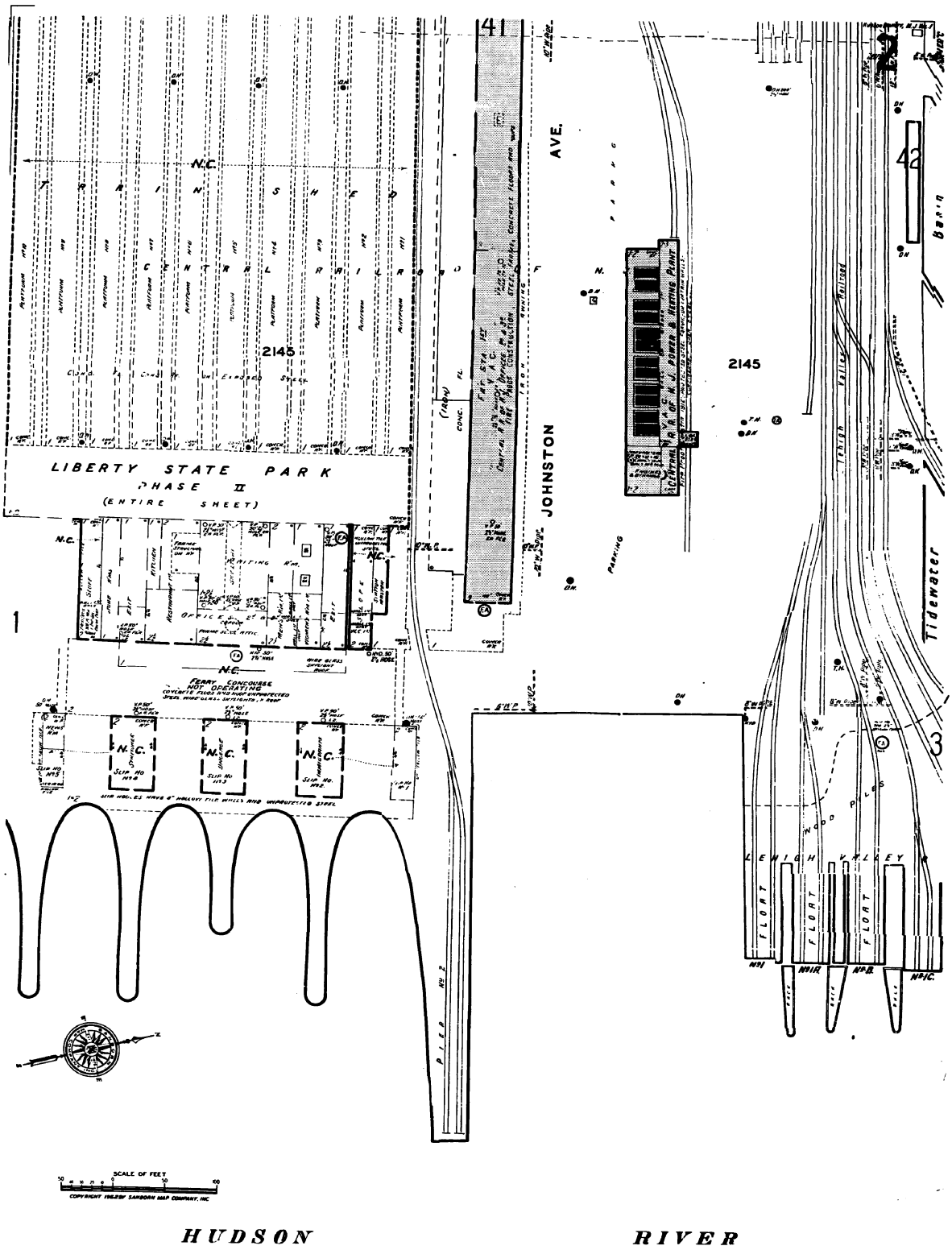


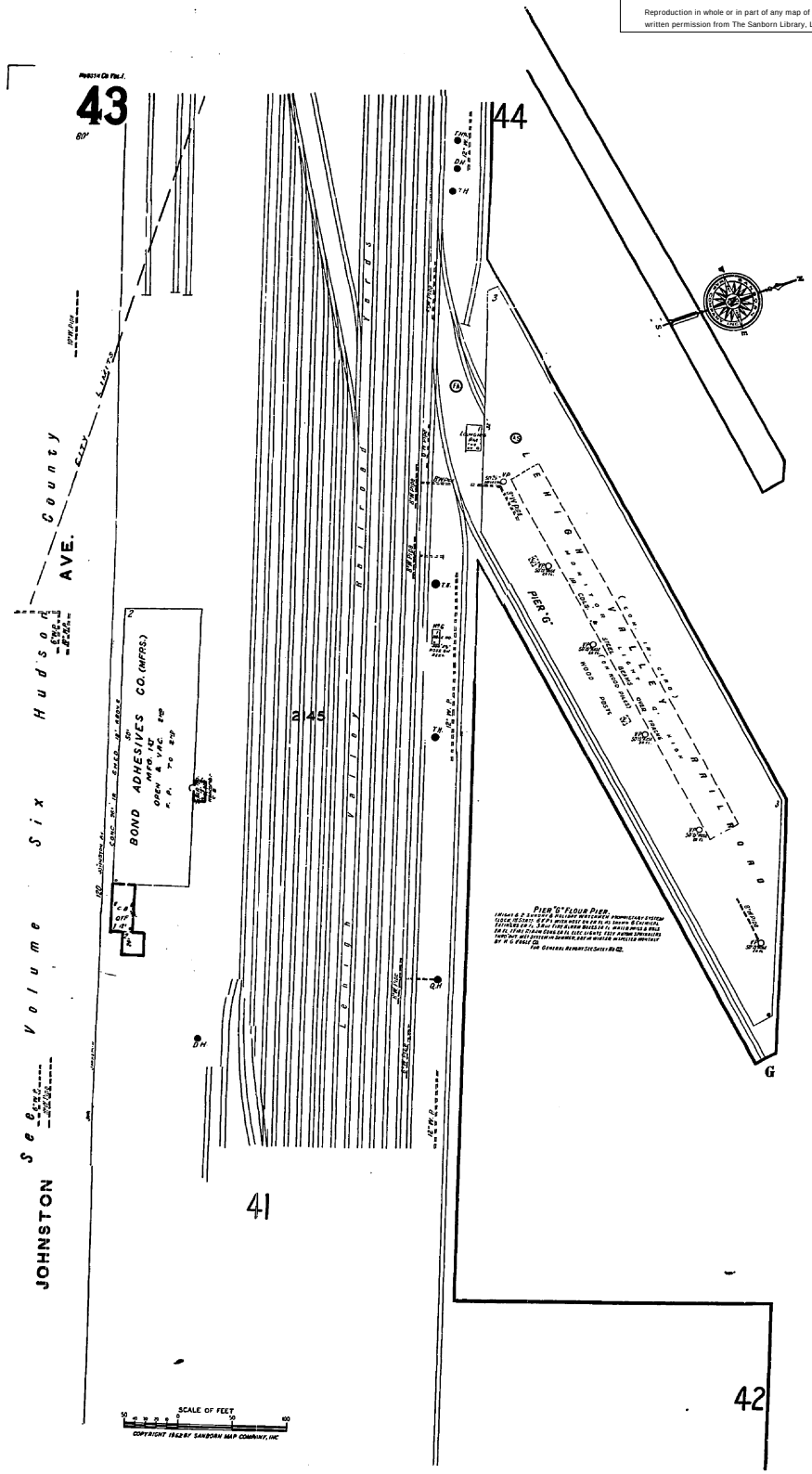


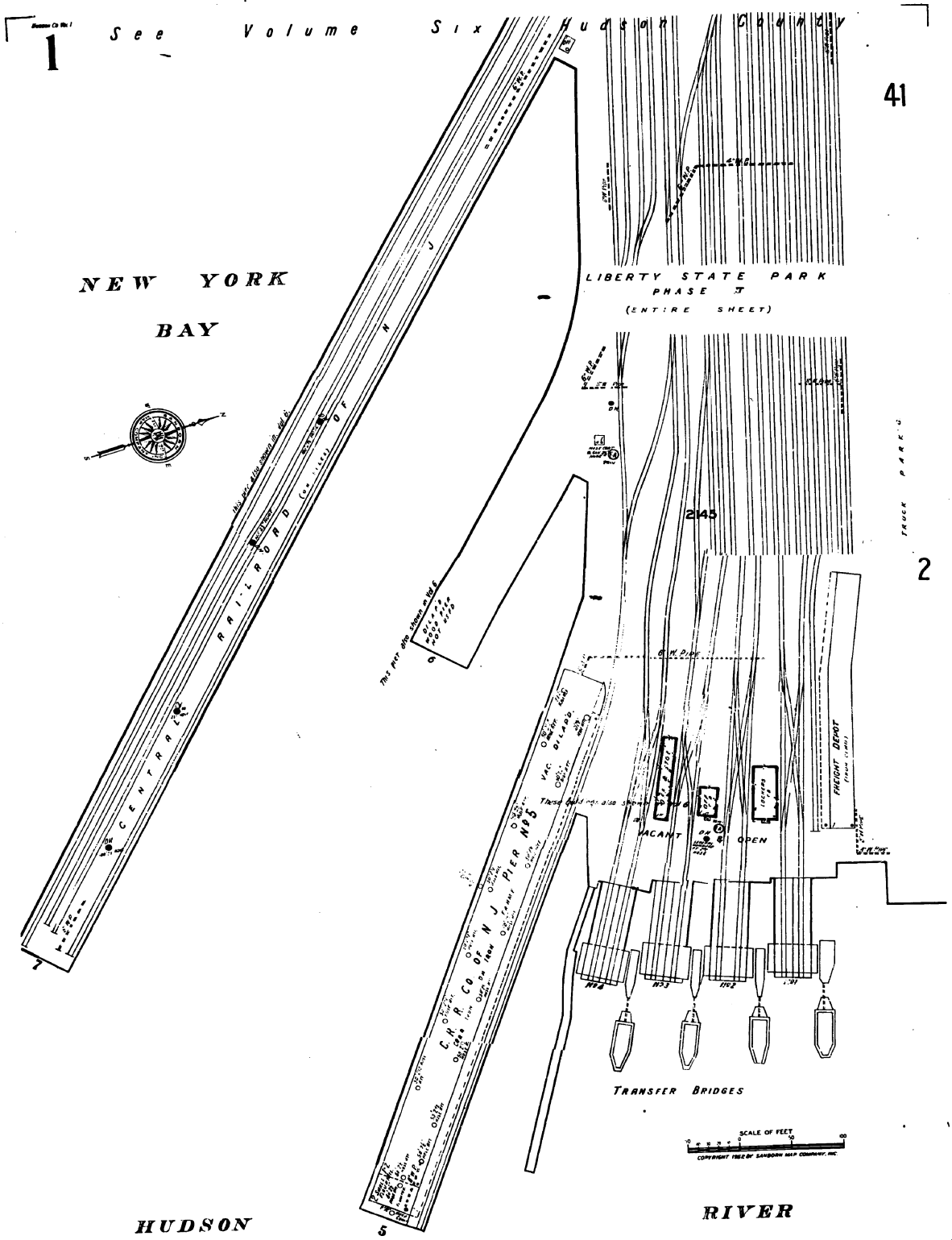


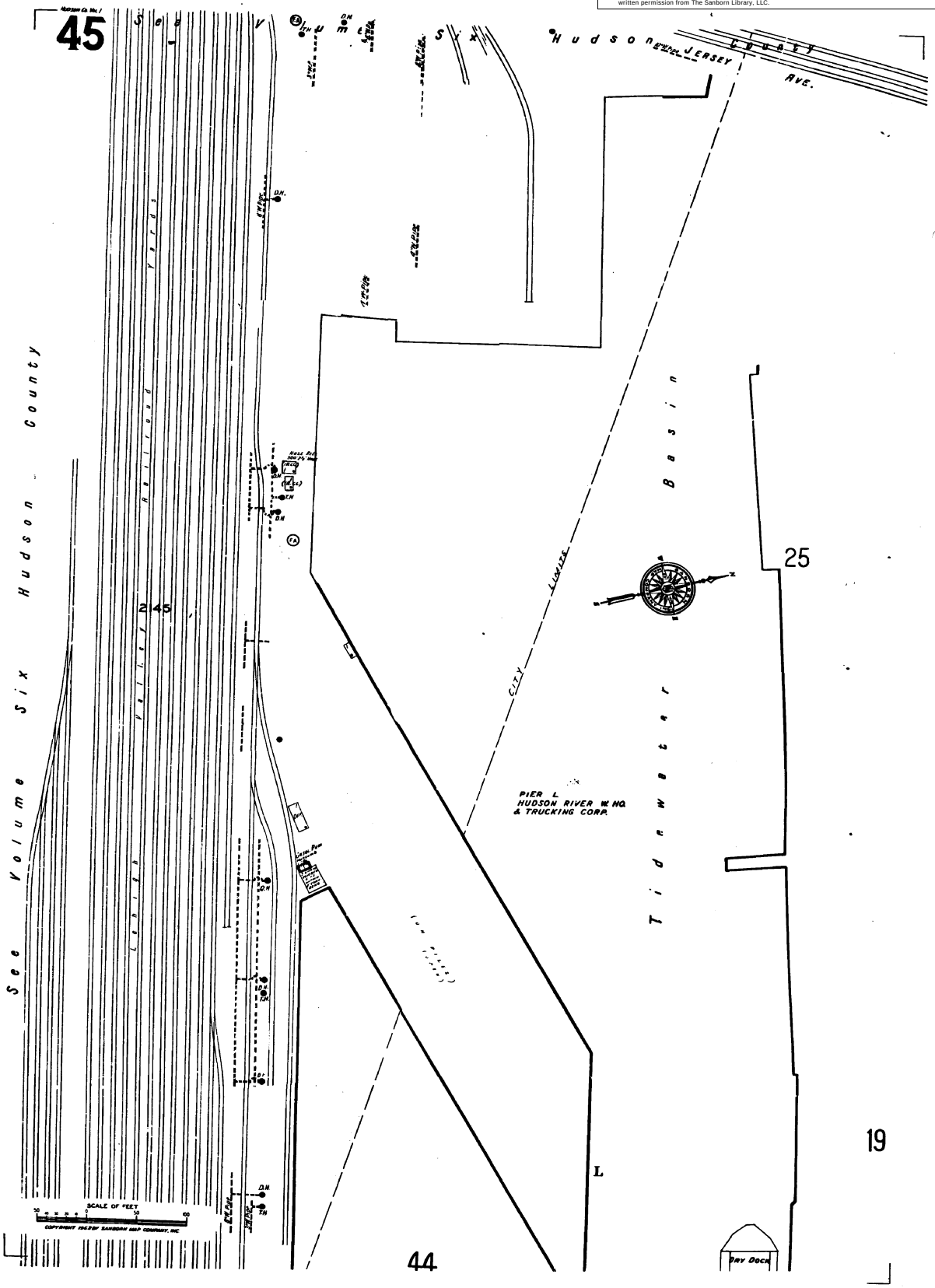


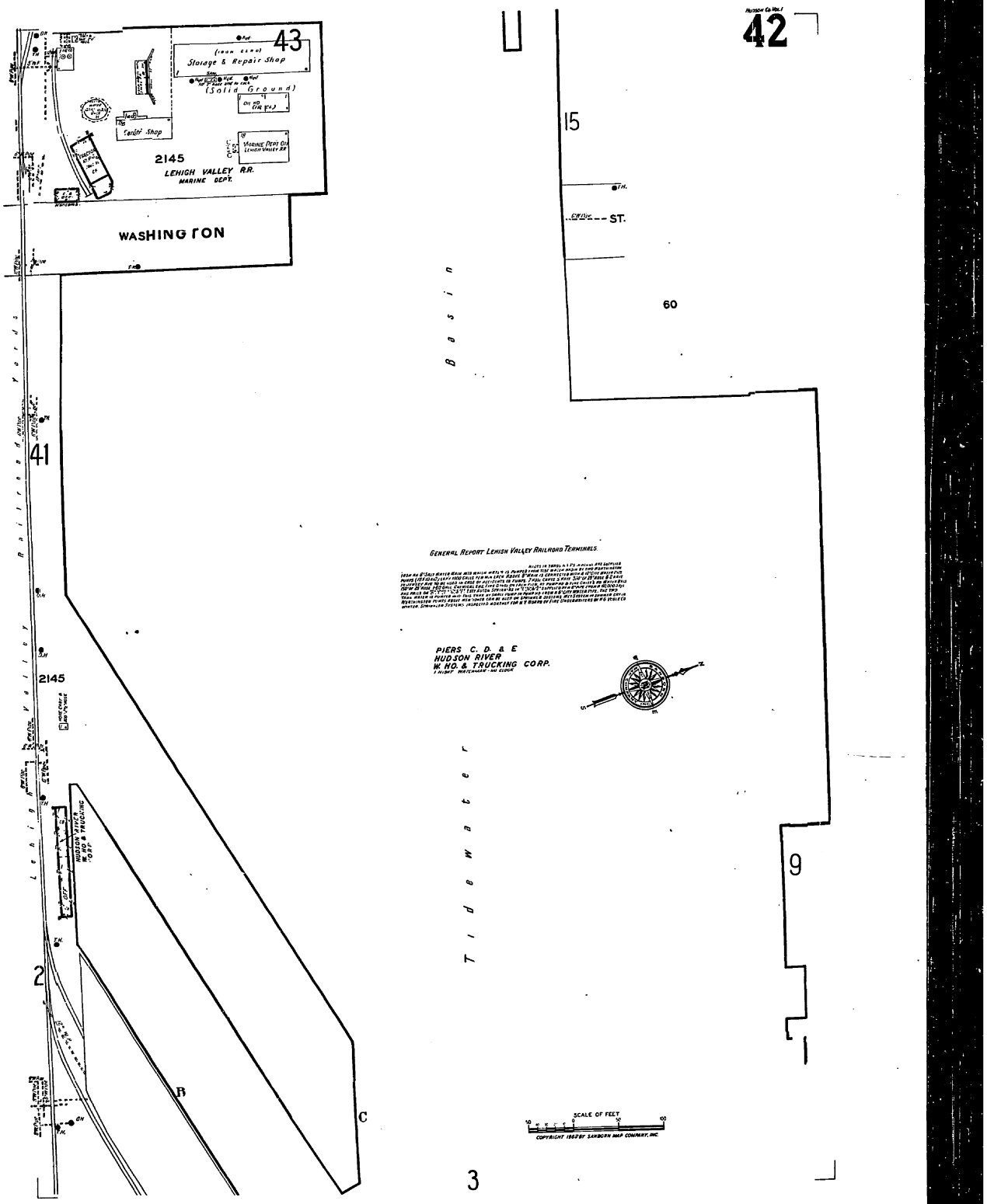


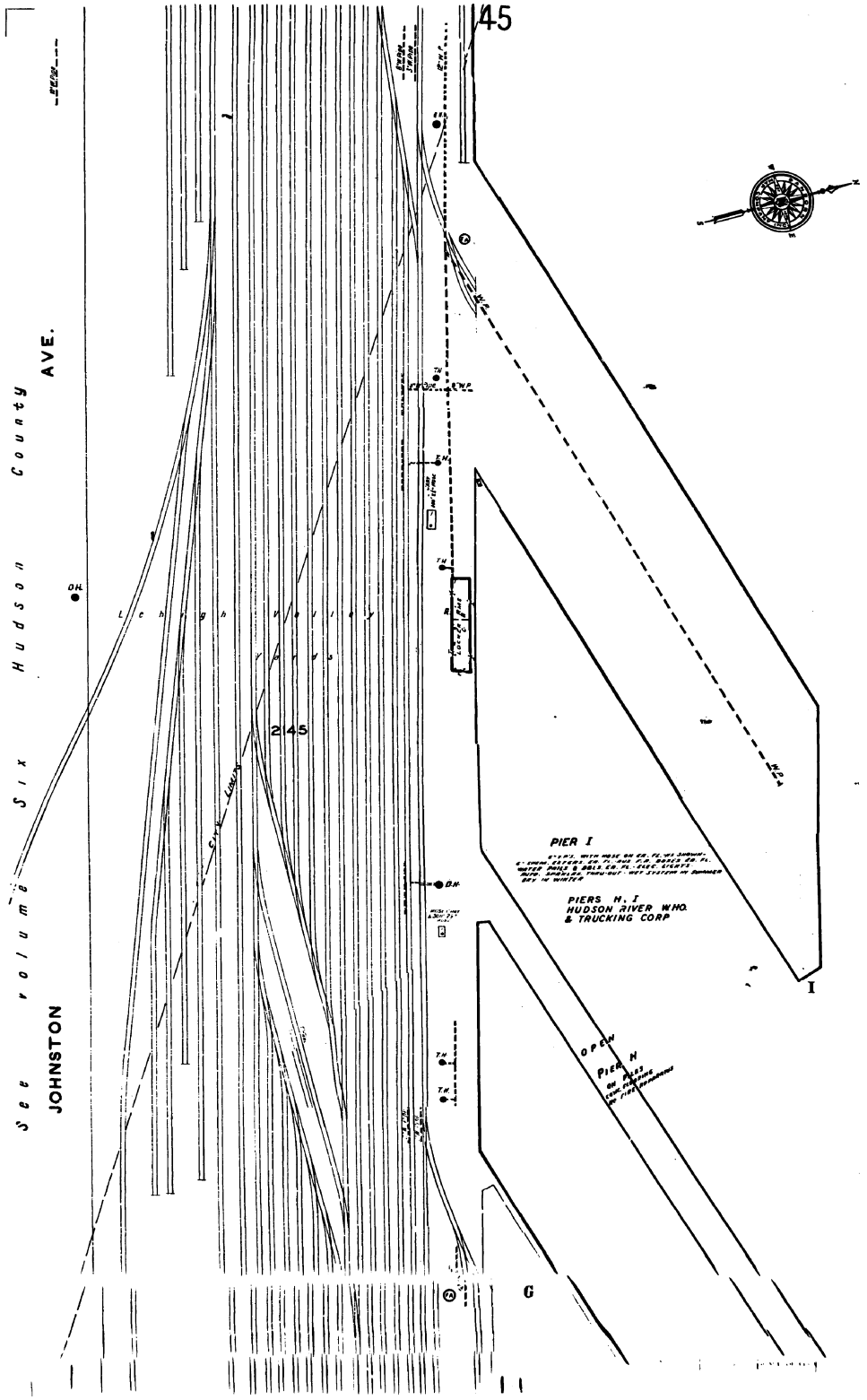


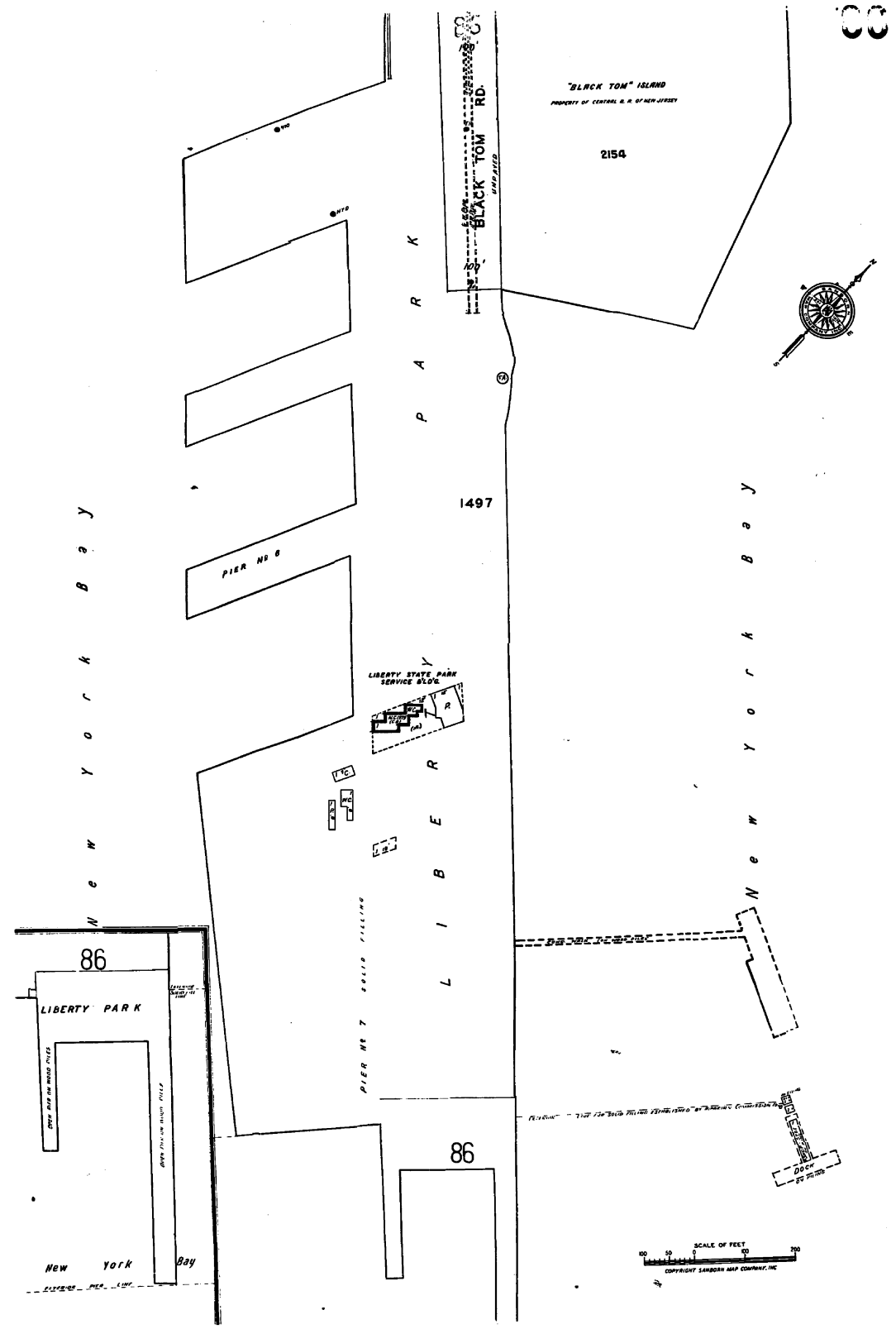


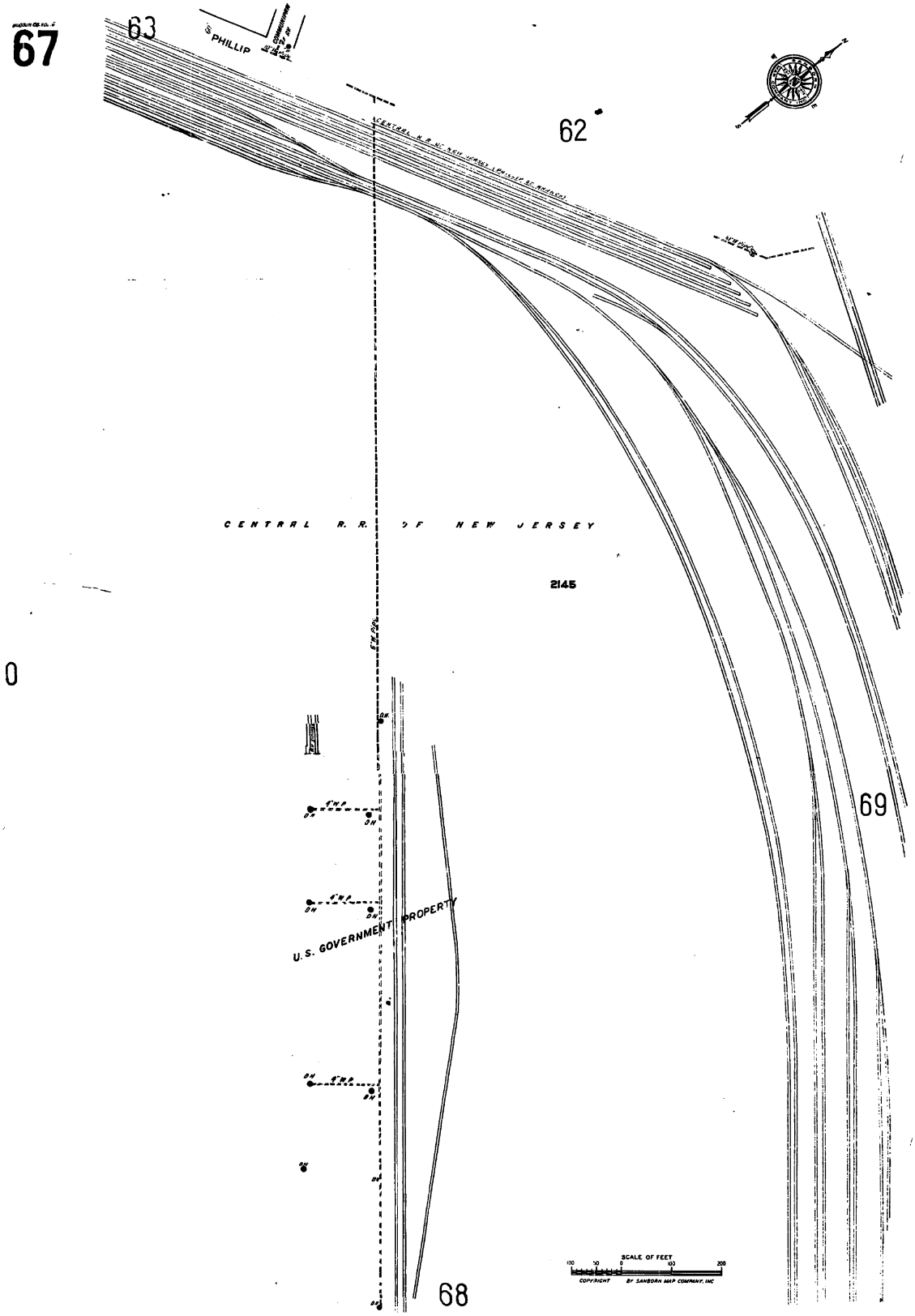


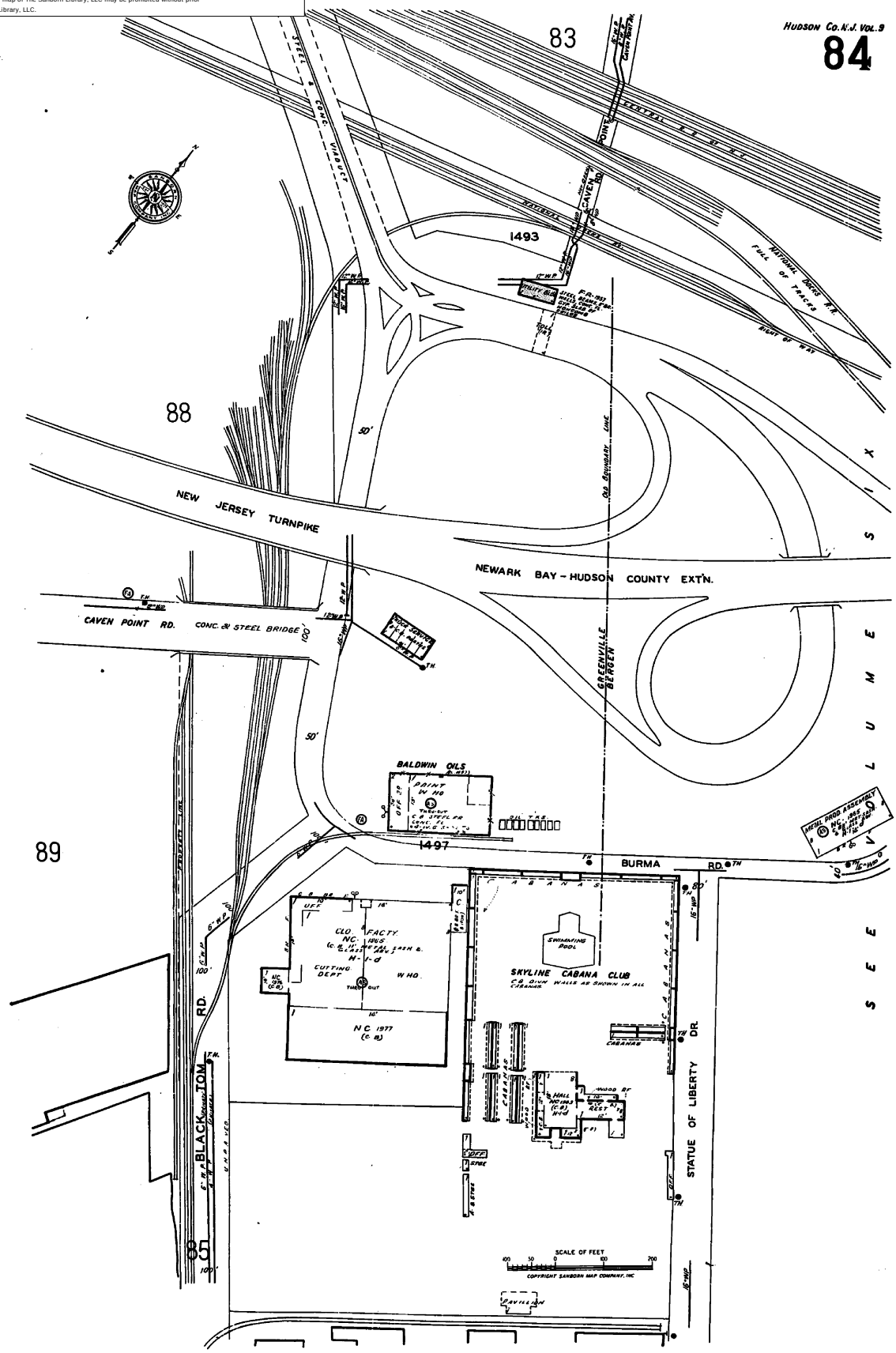


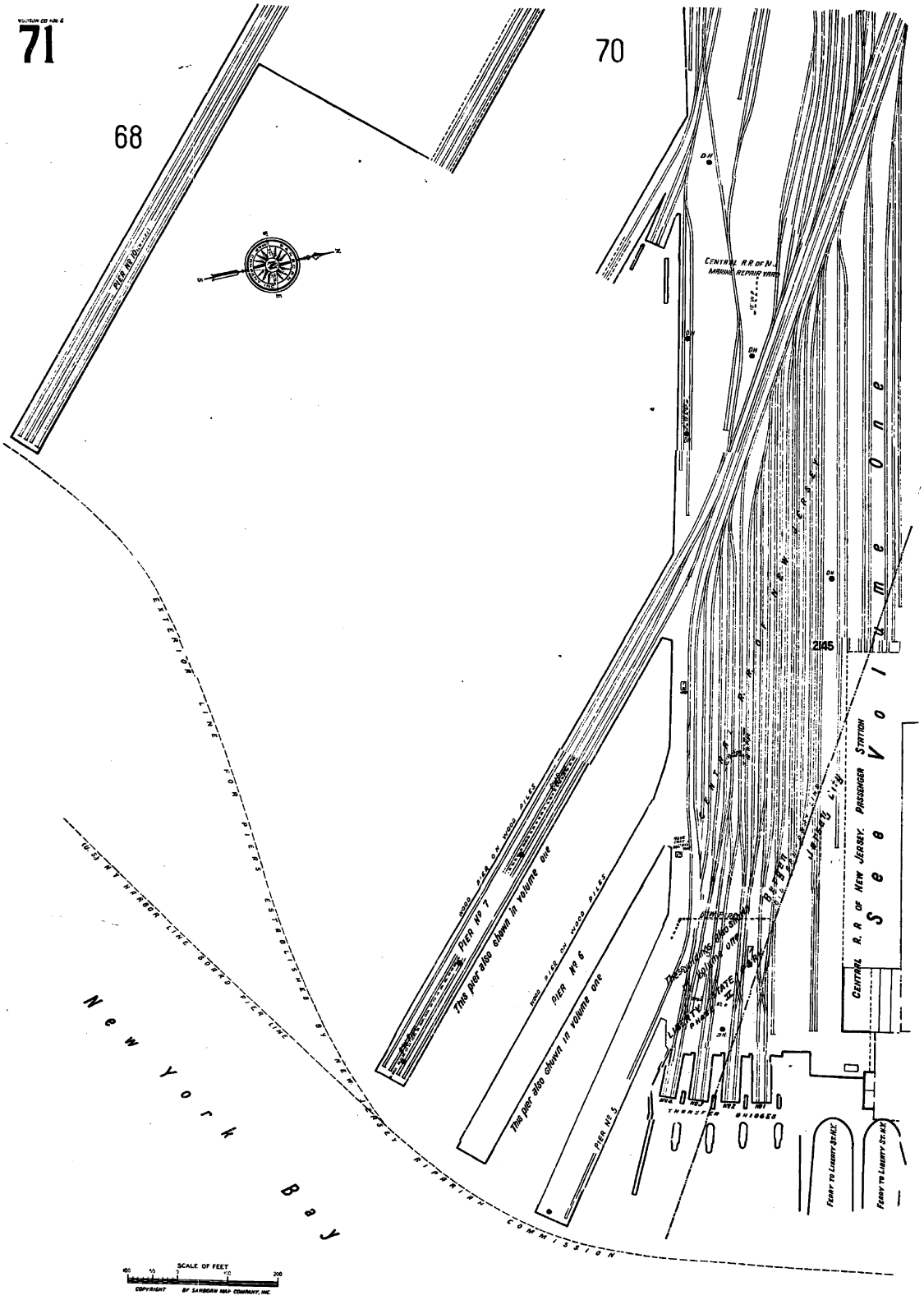


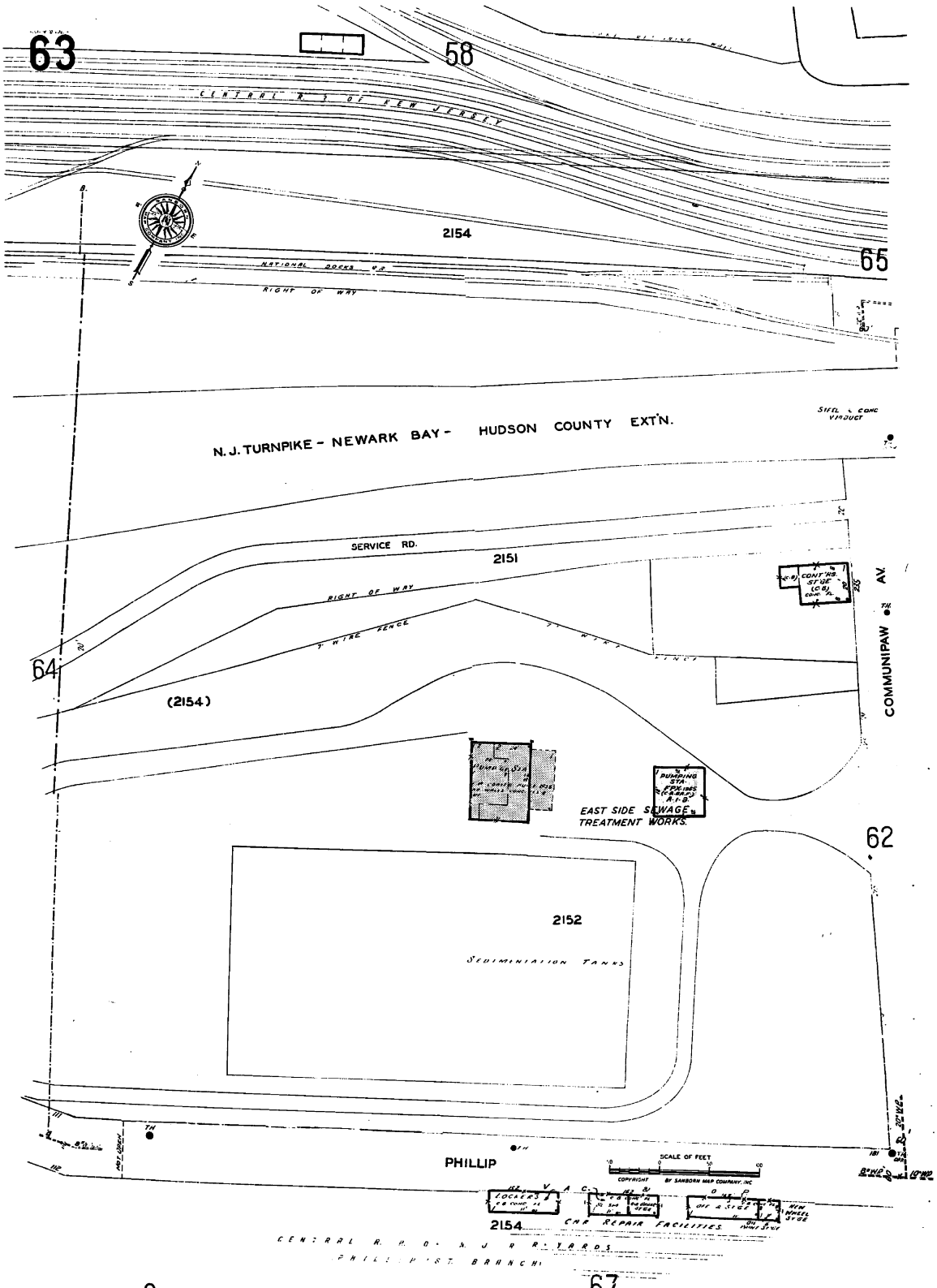


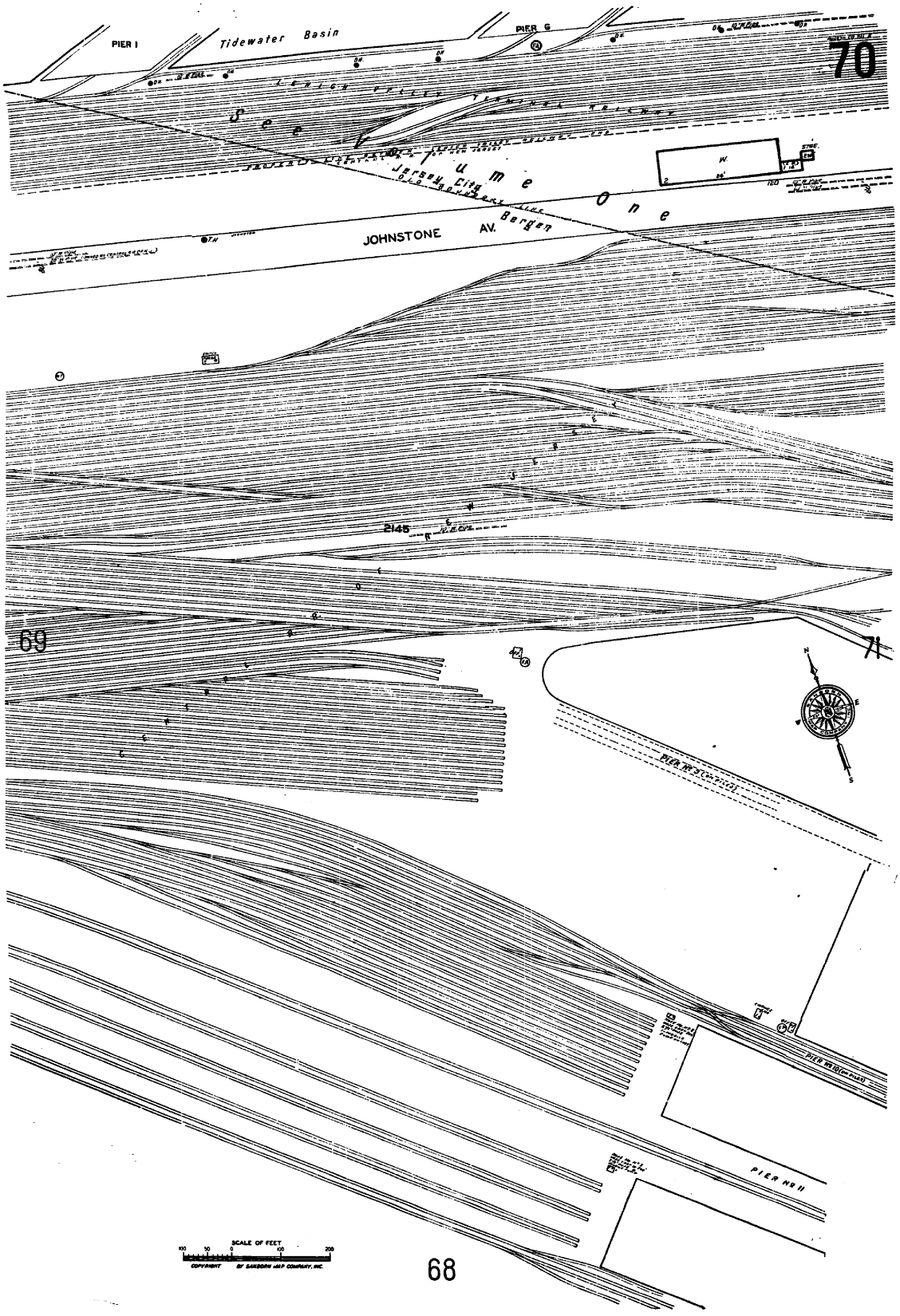


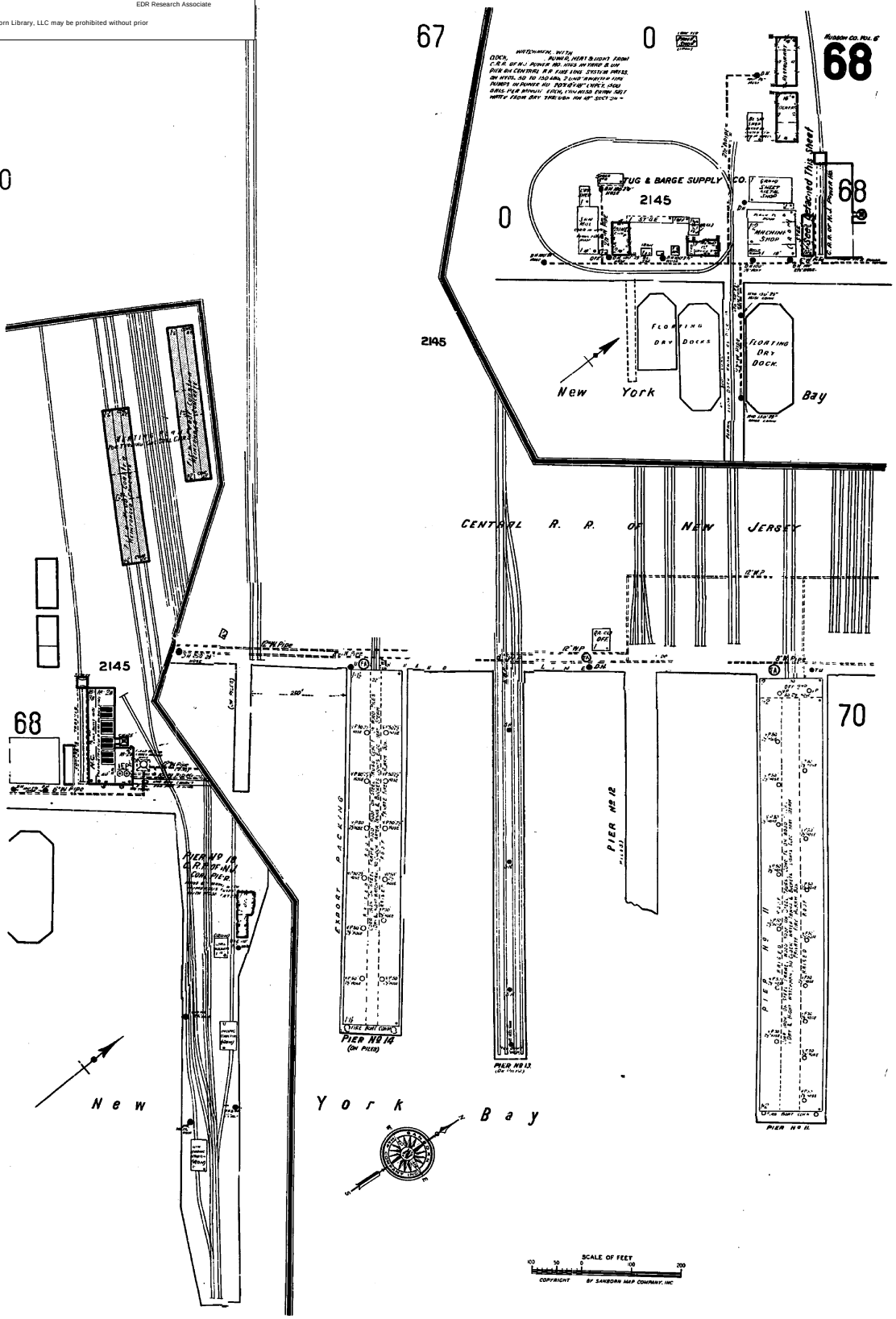


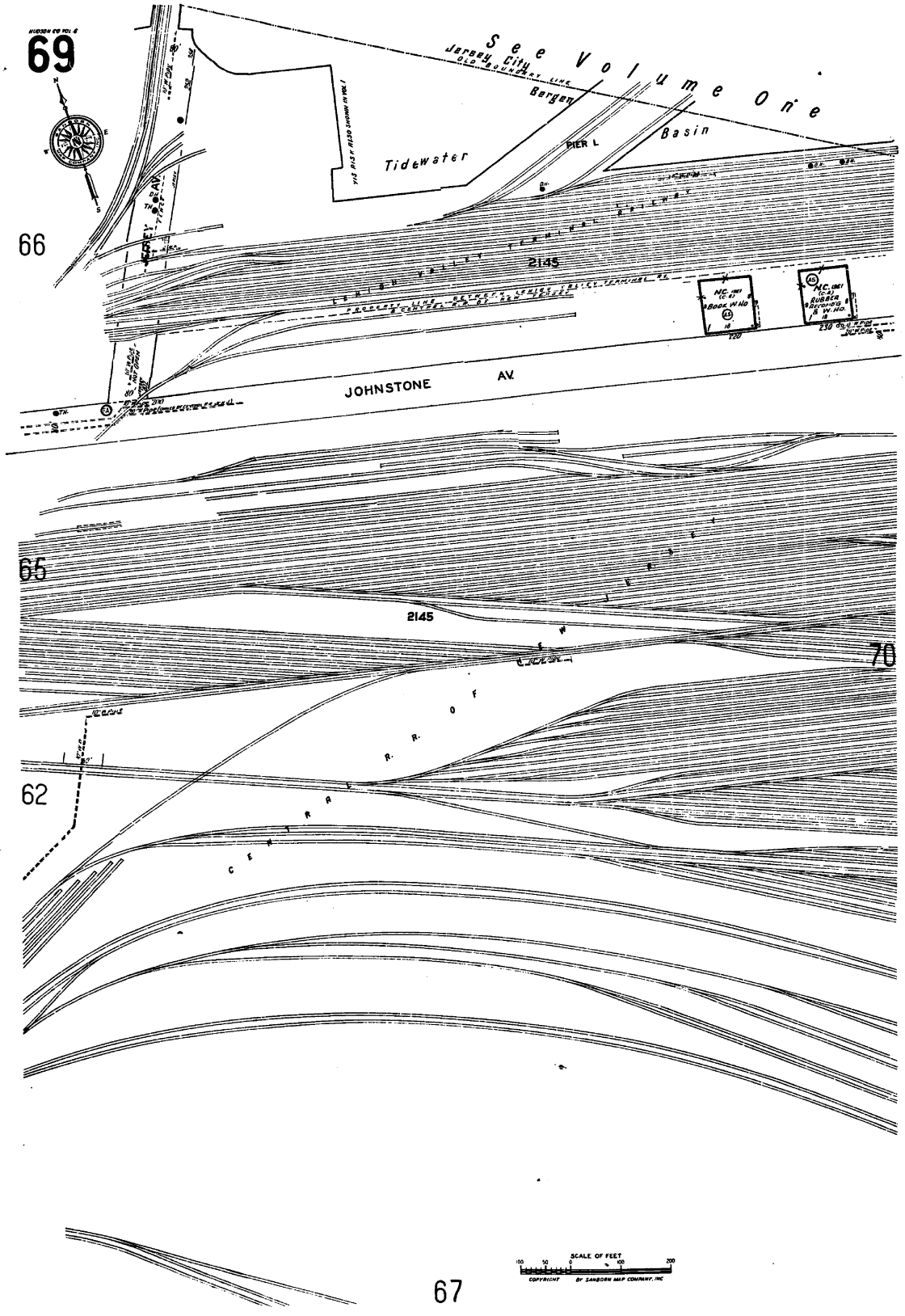


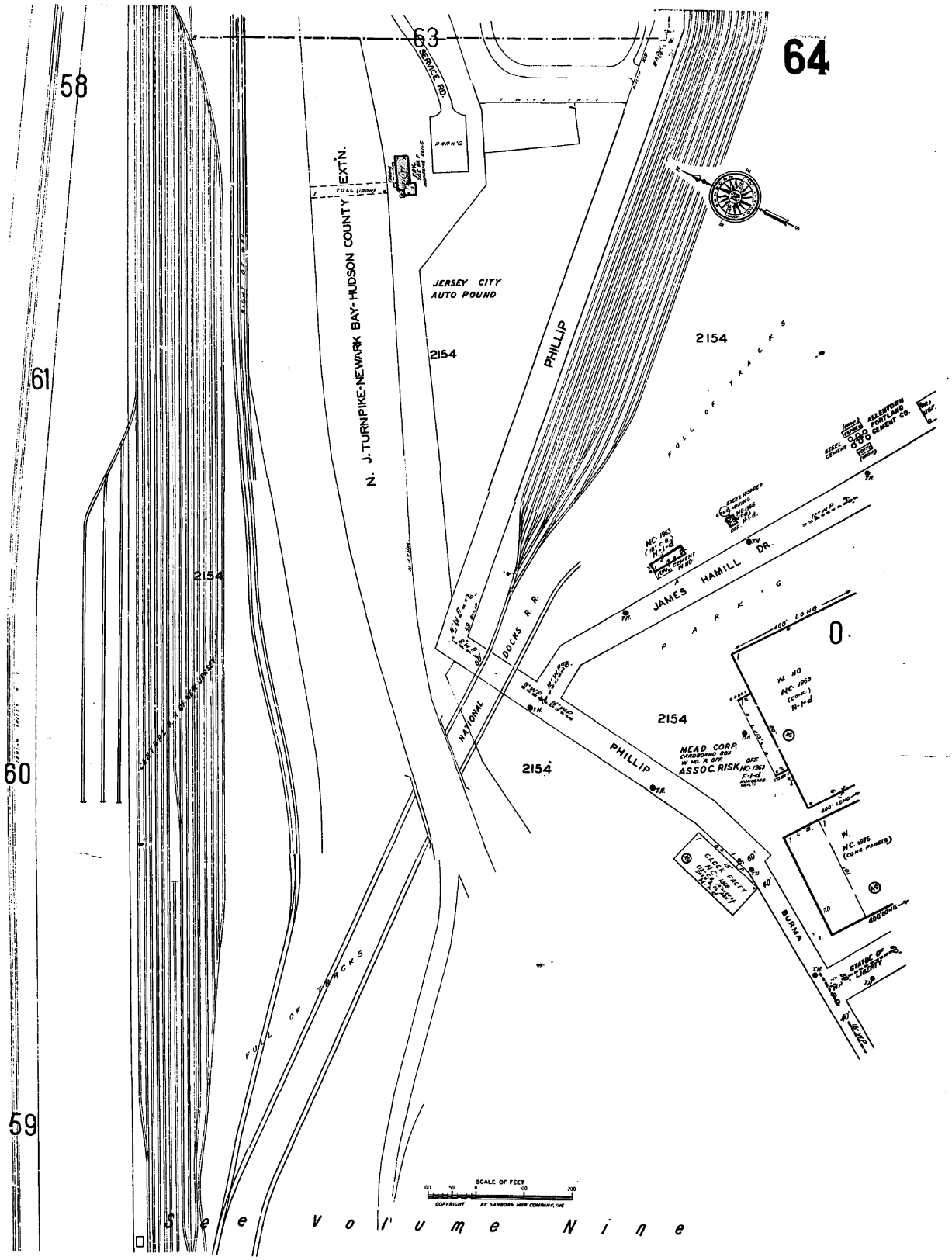


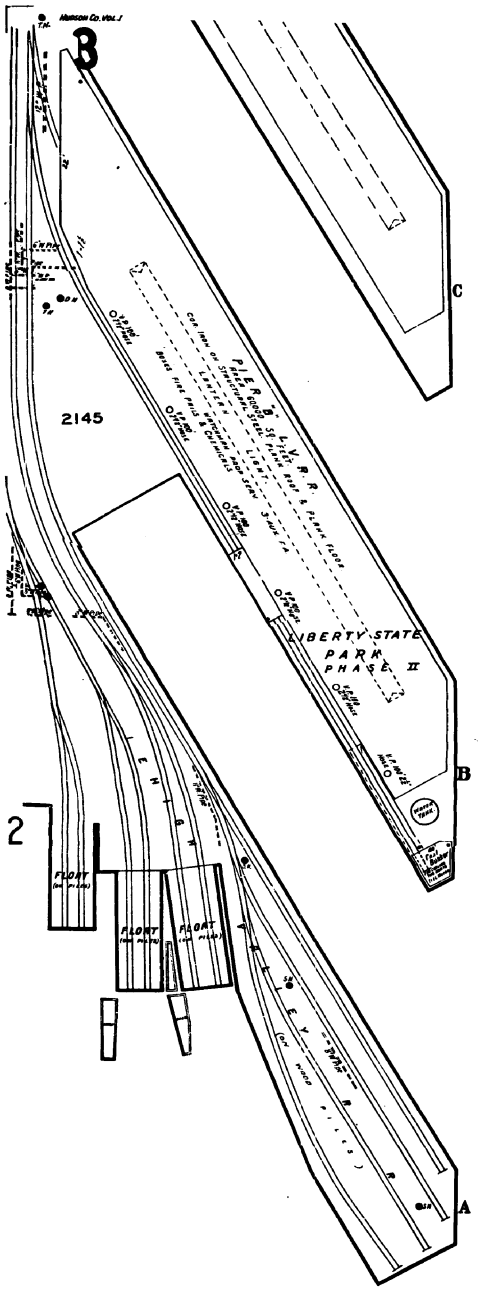












42

Basin

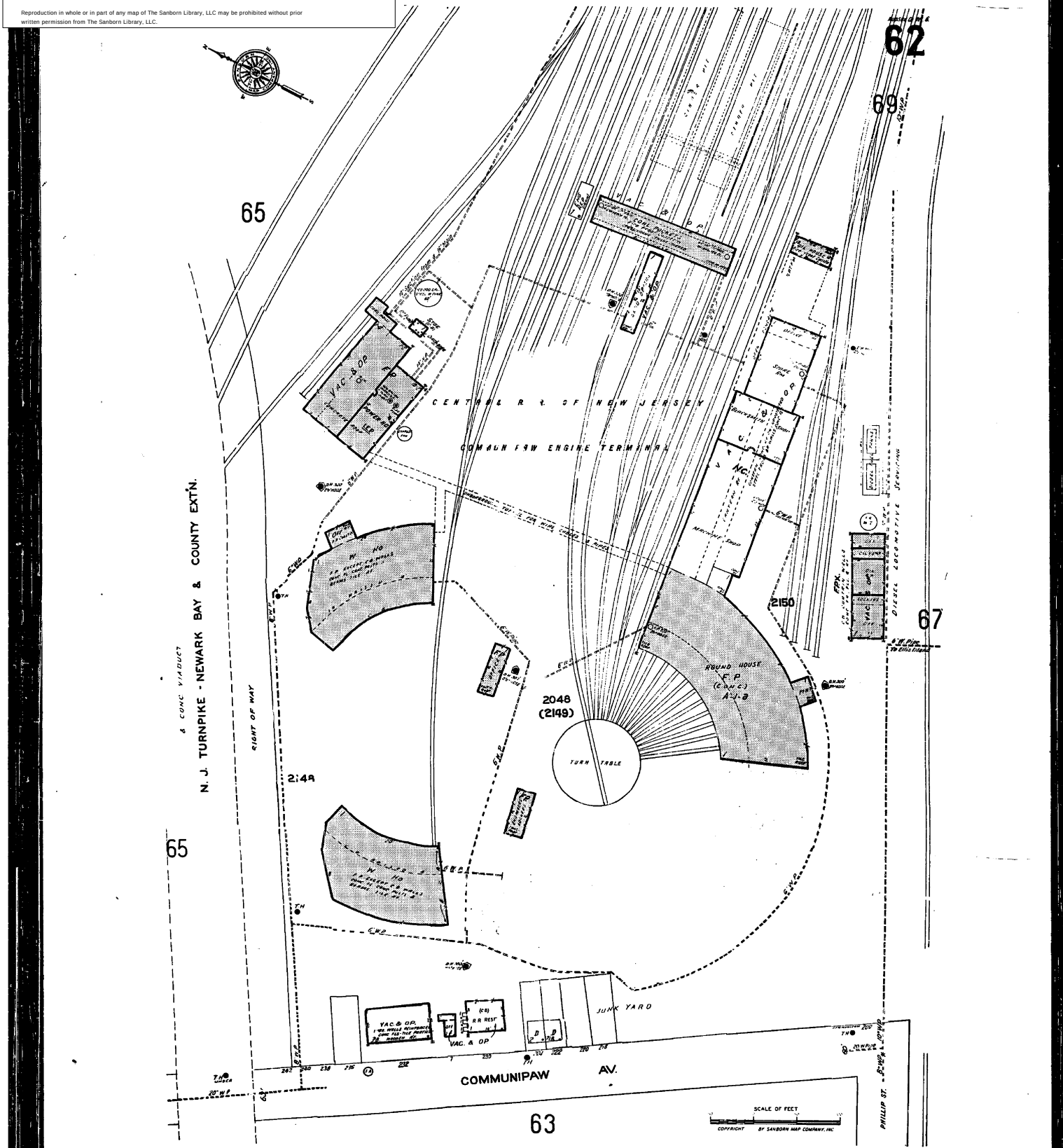
Tidewater

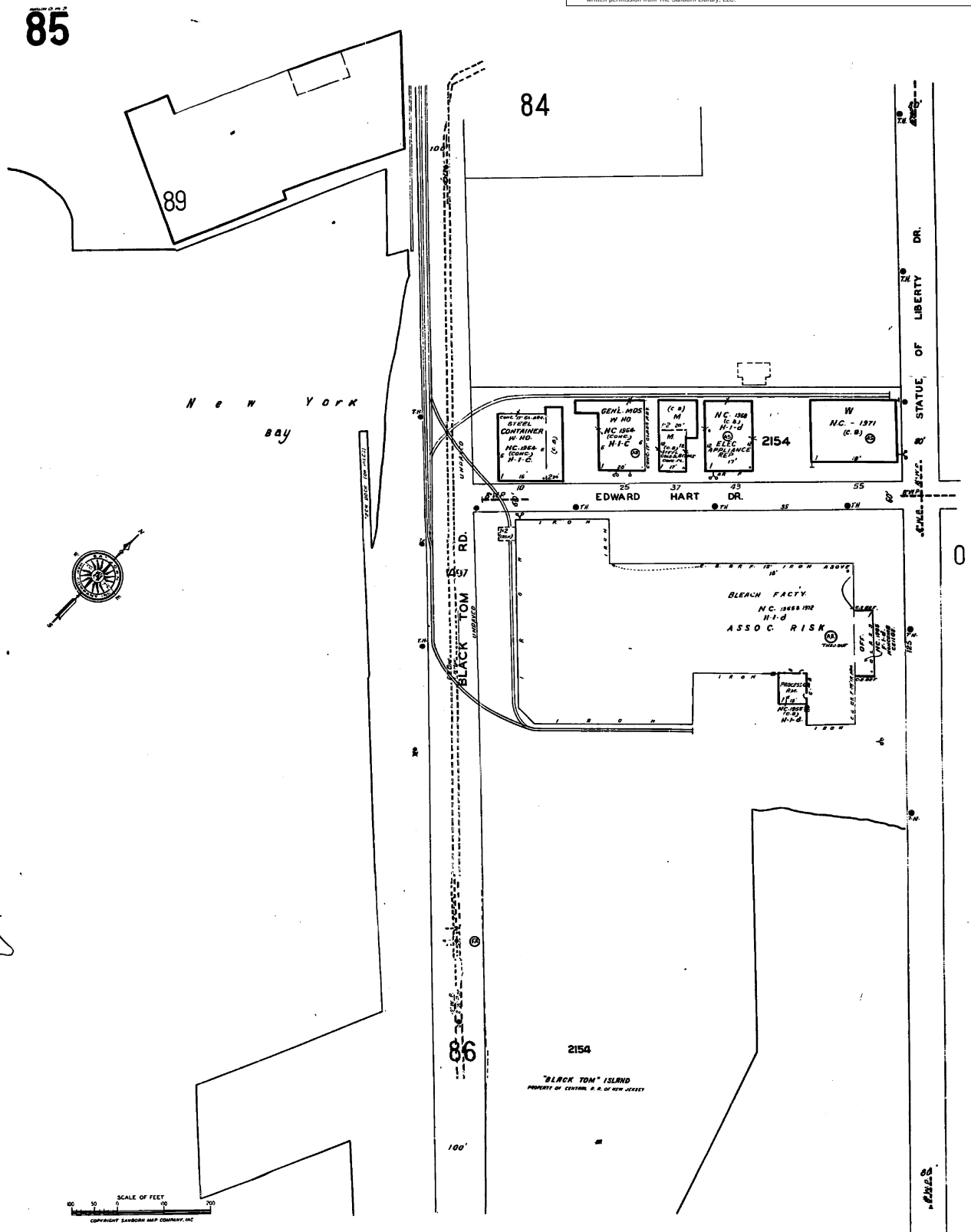
4

HUDSON

RIVER

SCALE OF FEET





US Army Corps
of Engineers

BALTIMORE DISTRICT

SITE SPECIFIC HEALTH AND SAFETY PLAN

GEOTECHNICAL SUBSURFACE INVESTIGATION
LIBERTY STATE PARK
JERSEY CITY, NEW JERSEY

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10 South Howard Street
Baltimore, MD 21201

July 2003

SITE SPECIFIC HEALTH AND SAFETY PLAN

GEOTECHNICAL SUBSURFACE INVESTIGATION
LIBERTY STATE PARK
JERSEY CITY, NEW JERSEY

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

SITE HEALTH AND SAFETY PLAN APPENDICES

SITE HEALTH AND SAFETY PLAN TABLES

SITE SPECIFIC SAFETY & HEALTH PLAN

GEOTECHNICAL SUBSURFACE INVESTIGATION
LIBERTY STATE PARK
JERSEY CITY, NEW JERSEY

1.0 HAZARD IDENTIFICATION

1.1 Task Analysis

Site Mobilization/Demobilization: The hazards of this phase of activity are those associated with equipment movement, manual materials handling, and manual site preparation. Manual materials handling and manual site preparation may cause blisters, sore muscles, joint and skeletal injuries and may present the potential for eye hazards, contusions and lacerations. The animal and plant life of the site may present hazards of poison ivy, poison oak, ticks, fleas, mosquitoes, wasps, spiders and snakes. Slippery work surfaces can increase the likelihood of back injuries, overexertion injuries, and slips and falls.

Drill Rig Operation: Rig accidents can occur as a result of improperly placing the rig on uneven or unstable terrain, or failing to adequately secure the rig prior to the start of operations. Underground and overhead utility lines can create hazardous conditions if contacted by drilling equipment. During operation of heavy equipment associated with the installation of monitoring wells and bore holes there is the potential for personnel to be cut, struck, or pinned by equipment. Chapter 16, Section M of EM 385-1-1, provides detailed requirements for drilling equipment safety. The following standard procedures will be required during drilling operations:

- Drilling equipment will be inspected, operated, and maintained in accordance with the manufacturer's operating manual. A copy of the manufacturer's manual will be maintained on site.
- Overhead electrical hazards, ground hazards, and underground utilities will be identified prior to bringing the drill rig onsite.
- Drilling crews will be trained in the operation, inspection, maintenance, and safety features of the equipment based on the equipment's operating manual. Training will also include the locations of overhead electrical and underground utilities hazards.
- Drilling equipment will not be moved with the mast up unless the following conditions have been met:
  (1) movement is over level, smooth terrain;
  (2) the path of travel has been inspected for stability and the absence of holes, other ground hazards, and electrical hazards; and
  (3) the travel distance is limited to short, safe distances.
- Equipment will be set up on stable ground and maintained level; cribbing will be used when necessary. Outriggers will be extended in accordance with the manufacturer's specifications.
- Weather conditions will be monitored. Work will cease during electrical storms or when electrical storms are imminent.
- Loose clothing, jewelry, or equipment that can get caught in moving machinery will not be worn on site.

- Equipment operators will verbally alert employees and visually ensure employees are clear from dangerous parts of equipment before starting or engaging equipment.
- Hoists will be used only for their designed intent and will not be loaded beyond their rated capacity.
- Open boreholes will be capped and flagged; open excavations will be barricaded.

Sample Collection: The primary hazard of this task could be the potential for inhalation of contaminant organic vapors discharged during intrusive activities if hot spots are encountered. Dermal contact with contaminated water will be minimized through use of chemical resistant garments as described in Appendix A and avoidance of media that is suspected of being contaminated. Air monitoring for hazardous atmospheres will be conducted as described in section 8.0.

Decontamination Activities: Personnel involved in decontamination activities may be exposed to contaminated soil from heavily contaminated soil boring equipment, high pressure water spray, noise, and cold exposure from the water spray.

1.2 Chemical Exposure

The potential contaminants of concern (COC) at the site are Volatile Organics, Semi-Volatile Organics, Priority Pollutant – Metals, Total Chromium, Hexa-Valent Chromium, Pesticides/PCB's.

Even though the airborne exposure route for these COC is considered minimal for the site, they can still potentially cause adverse health effects to workers by the exposure routes of ingestion and direct contact.

Protective measures taken to mitigate exposure will also provide adequate and appropriate protection against known chemical contaminants detected on site. If the recommended PPE is used properly according to this plan, and Standard Operating Procedures (SOP) and decontamination procedures followed, unhealthful exposures should not occur.

1.3 Physical Hazards

Tasks required for activities associated with this project may involve exposure to slipping, falling, heat/cold stress, noise, and other physical hazards associated with intrusive activities which generate airborne particulates and/or release toxic vapors into the breathing zone of the workers. Skin absorption and ingestion may occur from contaminated soils or surface waters directly or from airborne contaminants.

1.4 Biological Hazards

Potential biological danger associated with this site are those which would be encountered working outside. Employees should exercise caution when encountering hazardous plants (poison ivy), animals and insects (snakes, spiders, bees, wasps, ticks, mosquitoes, ants, etc.) and

the surface waters at the worksite. Field personnel should wear adequate clothing to deny access to the skin and should examine themselves carefully everyday for the presence of ticks. Employees who are known to be highly sensitive to insect stings should carry a "sting kit" and notify the SSO at the worksite.

1.5 Overall Hazard Evaluation

[ ] High [ ] Medium [x] Low [ ] Unknown

1.6 Activities Of Greatest Concern (AGC)

All intrusive activities which generate airborne particulates can release toxic vapors into the breathing zone of the workers are AGC. Skin absorption may occur from contaminated soils and waters directly and from airborne contaminants.

2.0 TRAINING

All employees on this project have completed the hazardous waste worker training (40 hrs) which met the specific subjects outlined in 29 CFR 1926.65 (e) and have had the following additional training:

a. 3 days of actual field experience under the direct supervision of a trained experience supervisor.

b. 8-hours of refresher training, which is given annually.

All on-site supervisors have completed the above requirements and an additional 8-hour course for Management and Supervisor Training of hazardous waste operations. At least two members of the on-site personnel are currently certified in first aid and CPR. Documentation of training of Baltimore District employees is maintained in the Baltimore District office.

2.1 Visitors

Authorized visitors will not be permitted to enter areas where they may be exposed to hazardous substances if they do not meet the training requirements summarized above and applicable safety and health requirements. All visitors will be restricted to a passive status in which they may observe activities at the site from a distance, typically 50 feet or more.

3.0 PERSONAL PROTECTIVE EQUIPMENT

A personal protective equipment (PPE) program in accordance with 29 CFR 1926.65 (g) (5) and 29 CFR 1910.134 will be implemented. The level of protection to be implemented at the worksite was determined based on the type of chemicals suspected to be present, chemical toxicity characteristics and potential routes of worker exposure. The use of appropriate personal protective equipment, in conjunction with site entry and safety decontamination procedures will reduce the potential for worker contact with hazardous substances present at the site. It should be noted that the use of PPE can itself create hazards such as heat stress, impaired vision and mobility, and communication difficulties. Equipment and clothing selected will provide an adequate level of protection, but avoid, to the maximum extent practical, potentially adverse affects that can result from overprotection.

Levels of PPE will be used/worn as described by this plan are indicated in the following section. No downward changes to the level of protection as specified in this plan will be allowed without the approval of the Site Safety Officer. Appendix A states the specific equipment requirements of the designated Levels of Protection.

1) Description of Tasks: soil sampling, piezometer installation.

The project has planned to have the field team use a drill rig to drill boreholes at Liberty State Park and install piezometers in 20 boreholes. The SSO will collect the samples for eventual testing of volatile organic compounds, metals and other chemical groups.

[x] Intrusive [ ] Non-intrusive

Level of Protection

[ ] A [ ] B [ ] C [x] Mod-D [ ] D

2) Description of Tasks: piezometer development, decontamination, slug testing, long term monitoring

Sampling personnel will decontaminate the sampling equipment where necessary and develop the piezometers.

[] Instrusive [x] Non-intrusive

Level of Protection

[ ] A [ ] B [ ] C [x] Mod-D [ ] D

4.0 MEDICAL SURVEILLANCE

All employees working on this site have received proper medical clearance for respirator use and are enrolled in a medical surveillance program in accordance with 29 CFR 1926.65 and 29 CFR 1910.134 and are included in a medical surveillance program for hazardous waste workers.

5.0 EXPOSURE MONITORING/AIR SAMPLING PROGRAM

5.1 Chemical Contaminants

VOC monitoring will be conducted by the Site Safety Officer continuously during the soil sampling tasks required by the project. Exposure monitoring will be conducted for the VOCs using a photoionization detector (PID) with a preferred 9.5 (or higher) eV bulb. The worker's breathing zone near the intrusive activities will be checked with the PID.

A single spike on the PID should not stop work, but a sustained reading (longer than ten seconds) or repetitive spikes (5 within 10 minutes) shall stop work. Detection of unusual odors shall not stop work.. (See emergency procedures for further instructions.) Work shall resume after adequate upgrade of PPE is accomplished. (See Appendix A for specific requirements of Levels of Protection.) Highest levels of PPE shall remain donned until additional monitoring indicates that a lower level of PPE is allowed.

Notations of momentary spikes, high readings, and actions taken will be recorded on the borings logs and in the intrusive activities logbook. All instruments will be calibrated daily according to the manufacturers instructions and recorded in the logbook.

Prior to performing field activities in dry, dusty areas where contaminated soils are likely to be encountered, workers will wet down the area of activity with water in order to decrease dust generation. If the wetting process is expected to result in potentially contaminated runoff, measures will be taken to contain the runoff. In the event that dust suppression measures are not feasible or adequate, workers in such areas will wear Level C PPE.

Monitoring Action Levels for chemical contaminants, explosion/fire, noise and temperature are shown in Table SSHP-1.

5.2 Noise

With the use of drill rig equipment as a part of this project, the potential for elevated noise levels in excess of 85 dBA is probable. A hearing protection program will be instituted if either continuous or impact noise levels exceed 85 dBA (slow response) for an 8-hour work shift, in accordance with 29 CFR 1910 and 1926. If unable to carry on conversation at an arm length, or at 3 ft. distance, hearing protection measures should be instituted. The SSO will use a Type II Noise Level Meter to monitor worker exposures. Hearing protection, such as ear plugs and

muffs, or administrative controls will be used if engineering controls are not feasible. If noise levels have sustained measurements exceeding 105 dBA, then double hearing protection (use of ear plug and muff together) will be required.

5.3 Temperatures

Heat stress monitoring of employees will be conducted when employees are wearing impermeable clothing and the ambient shaded dry bulb temperature is 70 °F or higher. Weather conditions will be monitored by the SSO. All monitoring data will be recorded in the logbook. Heat stress monitoring procedures are stated in section (1)(f) of Appendix B.

5.4 Fire and Explosion

Whenever identified materials are characterized as being flammable, the potential exist that fire and explosion could occur. Areas of intrusive activities will be monitored for combustible gas using a combustible gas/oxygen level indicator (CGI/O_2 Meter).

Table SSHP-1
Monitoring Action Levels

INSTRUMENT	LOCATION	ACTION LEVEL	ACTION
PID	Borehole	Reading above background	Move instrument to breathing zone, compare results
	Breathing zone	1.0 ppm or higher as a sustained[1] reading	Leave work area to allow levels to drop. If not dissipated in 30 minutes, continue work in Level C PPE.
		10ppm or higher as a sustained[1] reading	Cease work and consult Health and Safety Officer
		10 ppm or higher	Cease work and consult Health and Safety Officer
CGI/O_2	Borehole	< 10% of Lower Explosive Limit	No action required. Proceed with caution in areas that may contain combustible gas.
		10%-20% of LEL	Monitor work area to identify cause, perform continous CGI monitoring, remove ignition sources.
		> 20% of LEL	Evacuate work area and contact H&S Officer
Noise Meter	Entire worksite	Continuous 85 dBA or higher,	Continue work using personal hearing protection with minimum NRR of 20 dB
Environmental stress	Entire worksite	Any elevated stress condition[2]	Apply preventive measures, as required
Weather conditions	Entire worksite	Lightning within 10 statute miles	Cease work, move employees to safe area, wait for change in weather
Eye Protection	Entire worksite	Potential of projectiles/splash	Safety Glasses will be worn in the work zone, full face shield as appropriate
Slip/Trip/Fall	Entire worksite	Potential of incident	Work area will be kept clear of equipment , sediments and water. Good housekeeping practices will be followed.
Spill Containment	Entire worksite	Water/sediment	Shovels to move sediment. Absorbents applied as needed.

ACTION LEVEL - The action levels for the PID are based on measurements taken above background concentrations when the background concentration is less than 1 ppm. When background concentrations exceed 1 ppm total volatile hydrocarbons, PID action levels will be inclusive of background concentrations and so noted in the logbook.

[1] A sustained reading on the PID is a reading (longer than 10 seconds) or repetitive spikes (5 spikes within 10 minutes).

[2] As outlined in Appendix B (Environmental Stress).

6.0 STANDARD OPERATING SAFETY PROCEDURES, ENGINEERING CONTROLS AND WORK PRACTICES

6.1 Safety Meetings

The Site Safety Officer (SSO) will conduct a safety meeting at the start of each workday. Additional meetings may be conducted, as required. Meetings will include pertinent information regarding the day's work and include, but is not limited to, any of the following areas:

a. The whereabouts of any hazardous chemicals near specific work areas.

b. Methods used to detect the presence or release of hazardous chemicals at the site.

c. The physical and chemical health hazards of the hazardous chemicals at the site.

d. Protective measures such as safe work practices, emergency procedures, and personal protective equipment (PPE).

e. Details regarding the proper use of protective measures and material safety data sheets.

f. The location of the evacuation point.

g. Changes to the SSHP.

6.2 Hazard Control

Work shall comply with all Federal, State, and local health and safety requirements including; OSHA 29 CFR 1904, 1910 and 1926, EPA 40 CFR 260-270, USACE EM 385-1-1, and all District safety directives and policies.

All instrusive activity sites will be inspected for health and safety hazards by the SSO prior to entering the site for the intrusive activity. The SSO will then take all corrective measures necessary to safely work at the site. This inspection and all corrective measures will be documented and communicated to all site workers at the initial safety meeting and subsequent safety meetings held.

6.3 Standard Operating Procedures

a. No eating or drinking is permitted within the contamination reduction zone (CRZ) or the exclusion zone (EZ). The CRZ and EZ are discussed in Section 10.0 and Appendix B. An exception is made for the replacement of fluids as a preventive measure for heat stress, however hands and face must be washed with potable water prior to drinking replacement fluids.

b. No tobacco use is permitted within the EZ or CRZ.

c. No beards or facial hair is allowed on site that may interfere with the seal of a negative pressure respirator.

d. No contact lenses will be worn on site in the EZ or CRZ.

e. Contamination avoidance shall be practiced to include not walking through puddles or mud unnecessarily, avoiding kneeling on ground or leaning on equipment whenever possible. Weather conditions that may escalate potential site hazards such as lightning, rain or extreme temperatures will be logged.

f. Wood planking and weighted plastic coverings will be placed over any bore holes that will remain open overnight.

g. If evidence of illegal dumping or other suspicious fill is encountered outside the project area, work at the location will stop. The area will be designated an Exclusion Zone and encircled with caution tape. The SSO will be notified immediately.

h. Noise-Hearing protection devices will be worn by all field personnel in work areas where noise levels are at or above 85 dBA.. The wearing of hearing devices is a condition of employment.

i. Employees will use extreme caution in inclined areas of the worksite. Ground surfaces may be wet, slippery and have hazardous objects protruding from the surface.

j. Dependent on the season in which the work will be performed, employees should exercise caution when encountering hazardous plants (poison ivy) and animals (snakes, spiders, bees, wasps, ticks, mosquitoes, ants, etc.) at the worksite. Employees who are known to be highly sensitive to insect stings should carry a "sting kit" and notify the SSO at the worksite. All employees are encouraged to use permethrin (0.50%) clothing repellent and DEET (30%) skin repellent for protection against ticks and mosquitoes. Skin repellent will not be used by sampling personnel.

k. Electrical - Equipment will be grounded and operating procedures will be in accordance with EM 385-1-1, Section 11.C.

l. Employees will exercise extreme caution in the vicinity of open excavations, if present. Under no circumstances will employees enter excavations or other confined spaces.

m. Thermal stress - All personnel will be assigned a "buddy" who will observe the employee for signs of thermal stress, although personnel should be alert for heat or cold related injuries. The signs and symptoms of thermal stress are included in Appendix C. In

addition, work/rest regimes, as outlined in the appendix in accordance with the ACGIH guidelines, will be established by the SSO when necessary. Water, Gatorade, or similar electrolyte liquid will be available on site.

n. Fire - No heaters or open flames will be allowed in any exclusion zone. If a heater is to be used, it will be a construction type (i.e. salamander). Flammable liquids will be stored in appropriate containers.

7.0 SITE CONTROL AND SECURITY

The worksite will be zoned to reduce the spread of hazardous substances to clean areas. An Exclusion Zone (EZ) will be established with a radius of 25 feet, when feasible, around the sampling operations and other areas of intrusive activities. No unauthorized person will be allowed within the EZ, nor will any authorized person remain unnecessarily in this zone. This zone will be delineated by yellow caution tape. Since this area has the highest potential for exposure to hazardous chemicals, the proper PPE must be worn in this area.

The Contamination Reduction Zone (CRZ) will be located just outside the EZ and delineated with yellow caution tape. Personnel in this area will be required to wear PPE which is one level less than that worn in the EZ. During intrusive field activities, the exact layout will depend on the wind direction the day of work and site conditions. The CRZ will have only one accessible point to the EZ.

The on site Support Zone (SZ) will be located upwind of the exclusion zone. The command post and staging area will be located inside this zone. No specific PPE requirements are needed in this area.

Site access will be denied to the general public by the SSO and the caution barriers. All equipment and materials will be secured during non-work hours.

Boreholes will not be left open when unattended.

7.1 Communication Procedures

a. Personnel will be informed of all known site hazards during an initial safety meeting and will be kept informed of hazards discovered during the site investigation.

b. Personnel in the Exclusion Zone will remain in constant communication or within sight of the Support Zone personnel. Failure of communication requires evacuation of the Exclusion Zone until communication is reestablished.

c. A mobile (cellular) telephone will be on-site whenever intrusive work is performed in the project area. The phone number will be determined once the SSO has been selected.

d. When the emergency signal is sounded, all personnel will depart the Exclusion Zone. Personnel will relocate to the decontamination area for personnel accountability. An emergency signal is considered an emergency signal for the Exclusion Zone and the project area.

e. The emergency signal will be one of the following:

(1) Any blast from a pressurized air horn.
(2) Verbal notification.

f. The following standard hand signals will be used:

(1) Hand gripping throat -- Out of air and cannot breathe.
(2) Grip buddy's wrist -- Leave area immediately.
(3) Both hands on buddy's waist -- Leave area immediately.
(4) Hands on top of head -- Need assistance.
(5) Thumb down -- No / negative.
(6) Thumb up -- Yes / I'm OK / I am all right.

7.2 Hazard Communication

Pursuant to OSHA, 29 CFR 1926.59, Material Safety Data Sheets (MSDS) along with a list for those materials covered by the MSDS will be available for all hazardous substances brought on site. Personnel will also be briefed by the SSO regarding hazardous chemicals present at the worksite prior to starting work that personnel could be exposed to.

8.0 EMERGENCY PROCEDURES

8.1 Emergency Procedures

a. Buddy System. A buddy system will be in effect in the Exclusion Zone (EZ) at all times.

b. Personal Injury in the EZ. If an employee is injured while in the EZ, the employee and his buddy will exit the EZ and proceed through the Primary Decontamination Area (PDA). An employee qualified in first aid/CPR will evaluate the nature of the injury and the integrity of the PPE and determine the need for first aid, evacuation and replacement of PPE. The SSO will be immediately notified of the incident. If additional aid is

required, the employee and his buddy will proceed through the Secondary Decontamination Area (SDA) as required.

c. Personal Injury in the Contaminant Reduction Zone (CRZ). If an employee is injured while in the CRZ, an employee qualified in first aid/CPR will evaluate the nature of the injury and determine the need for first aid and evacuation. The employee and his buddy will exit the CRZ, as required, proceeding through the Secondary Decontamination Area (SDA) if necessary. The SSO will be immediately notified of the incident.

d. Personal Injury in the Support Zone. If an employee is injured while in the Support Zone (SZ), an employee qualified in first aid/CPR will evaluate the nature of the injury and determine the need for first aid and evacuation. The SSO will be immediately notified of the incident.

e. Fire/Explosion. In the event of fire and/or explosion, the emergency signal will be sounded (see Section 10.1.e). All personnel will depart the EZ and move to the SDA for personnel accountability. The SSO will take appropriate action, such as controlling the spread of a small fire, summoning outside assistance or evacuating personnel to another location. For the proper operation of a fire extinguisher, the OSHA guidelines in 29 CFR 1926.150 (a) and the USACE Health and Safety Requirements from EM 385-1-1 (Section 09.E.) will be followed.

f. PPE failure. If an employee experiences a failure or alteration of PPE, the employee and his buddy shall stop work and exit the EZ. Reentry shall not be permitted until the PPE has been repaired or replaced.

g. Other Equipment Failure. If any other equipment on site fails to operate properly, the SSO and Project Team Leader shall be notified to make a determination of the effect this failure will have on operations.

h. In all situations, when an on-site emergency results in evacuation of the Exclusion Zone, personnel shall not re-enter until:

(1) The condition resulting in the emergency has been corrected;

(2) The hazards have been re-assessed;

(3) The safety plan has been revised and approval by all the initial concurring officers and

(4) Site personnel have been briefed on any changes in the SSHP.

8.2 Emergency Telephone Numbers

Names and phone numbers of all emergency response personnel (ambulance, physician, hospital, fire and police) and a map showing the route to the hospital will be conspicuously posted at the work site. All field personnel will be briefed concerning the people and equipment which will be summoned during an emergency and their responsibilities during an emergency situation requiring hospitalization. Emergency contacts and telephone numbers are provided below.

Hospitals

Name : **Christ Hospital**
Address : 176 Palisade Ave
Jersey City, NJ 07306
Telephone No.: **201-795-8200**

Name :- **Franciscan Health System**
Address :- 25 Mcwilliams Pl
Jersey City, NJ 07302
Telephone No.: **201-795-0390**

Name : **Garden State Surgical Center**
Address : 550 Newark Ave Fl 5
Jersey City, NJ 07306
Telephone No.: **201-795-0646**

Name : **Greenville Hospital**
Address : 1825 John F Kennedy Blvd
Jersey City, NJ 07305
Telephone No.: **201-547-6100**

Name : **Jersey City Medical Center** (see Figure #1 for map)
Address : **50 Baldwin Ave**
Jersey City, NJ 07304
Telephone No.: 201-915-2251

Name : **Pollack Hospital**
Address : 100 Clifton Pl
Jersey City, NJ 07304
Telephone No.: **201-432-1000**
Name : **Progressive Healthcare**
Address : 100 Clifton Pl
Jersey City, NJ 07304
Telephone No.: **201-946-2227**

Name : **St Mary Hospital**
Address : 25 McWilliams Pl
Jersey City, NJ 07302
Telephone No.: **201-418-1000**

Police **911**

Fire Department and Ambulance (EMS) **911**

Poison Control Center **1-800-210-3985**

Environmental Response Teams (NY DEP) **(718) 337-4357 or (800) 457-7362**

8.3 Emergency Medical Care

See Figure #1 for a map to the JERSEY CITY MEDICAL CENTER.

Jersey City Medical Center
50 Baldwin Ave
Jersey City, NJ 07304
201-915-2251

8.4 Emergency Reporting

The New York District Safety Office shall be notified of any incident at (212) 264-9050 and CENAN-PL-EA at (212) 264-4662. The SSO shall submit the necessary forms in accordance with EM 385-1-1.

9.0 STATEMENT OF UNDERSTANDING

SITE SAFETY AND HEALTH PLAN

Geotechnical Site Investigation
Liberty State Park, NJ
Jersey City, NJ

All site personnel have read the above plan and are familiar with its provisions. My signature below certifies that I have read, understand and will comply with the guidelines set forth.

Name **Signature** **Date**

Site Safety Officer (SSO):

_____

_____

Other Site Personnel:

_____

_____

_____

_____

_____

_____

_____

FIGURES

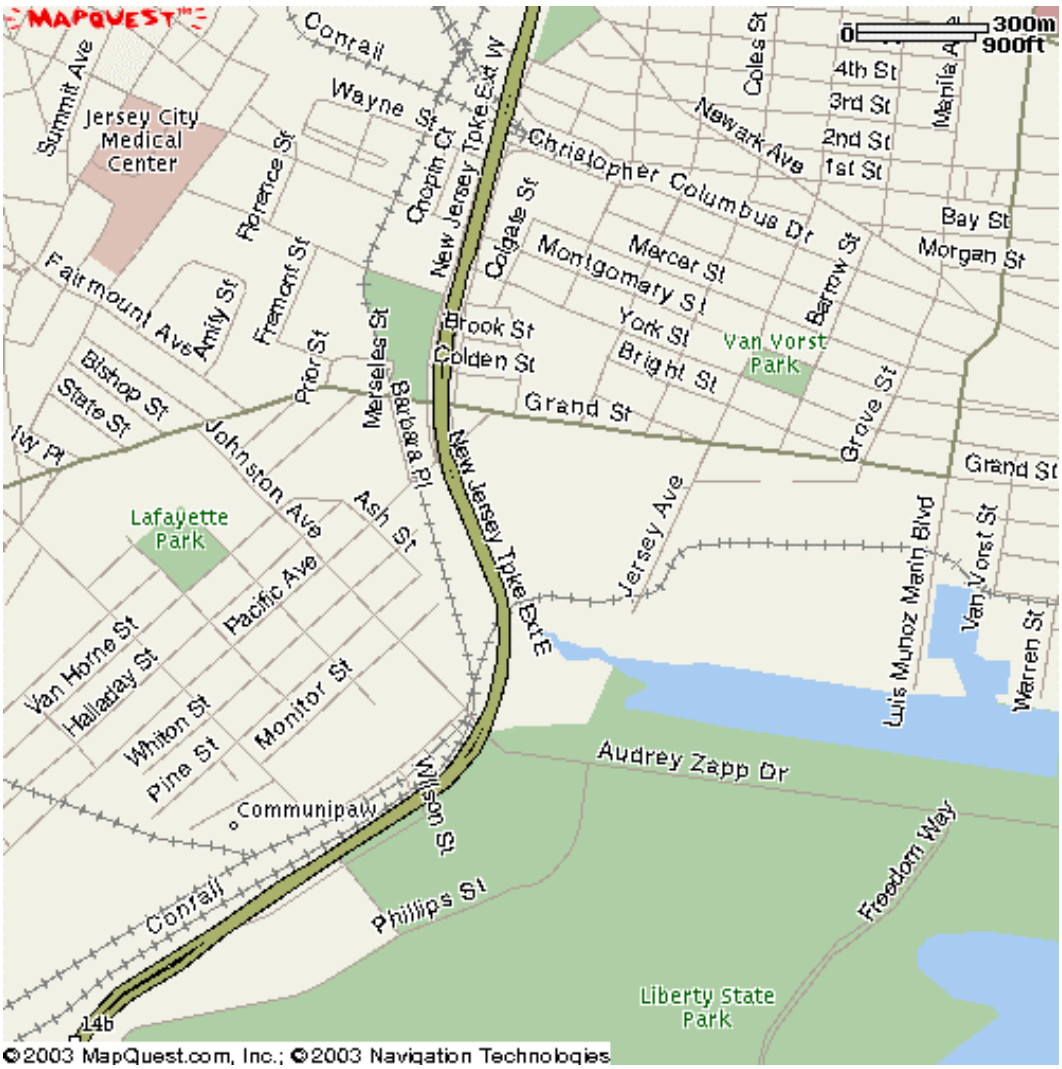

FIGURE #1 – Map to the **JERSEY CITY MEDICAL CENTER**.

Jersey City Medical Center
50 Baldwin Ave
Jersey City, NJ 07304
201-915-2251

APPENDIX A

LEVELS OF PROTECTION

Personal Protective Equipment - Levels of Protection

1. **Level B**

Positive-pressure, full-facepiece SCBA or positive-pressure, supplied-air respirator, with escape SCBA approved by NIOSH/MSHA
Inner (latex/nitrile) and outer chemical-resistant gloves (Viton)
Disposable hooded chemical-resistant coveralls (Saranex)
Chemical resistant boots with steel toe and shank
Hard hat and optional long underwear, cooler vest and inner coveralls

2. **Level C**

Hard hat, as required
Steel toe boots
Chemical-resistant outer boots, (nitrile)
Outer chemical-resistant gloves, (Viton)
Chemical-resistant inner (latex/nitrile) gloves
Hooded chemical-resistant/breathable clothing such as disposable coveralls (Kleenguard)
Hearing protection, as required
Full-face, air purifying respirator with (NIOSH approved) combination organic vapor/HEPA filtered cartridges (GMC-H)
Optional: chemical splash gear

3. **Level D Modified**

Safety glasses and same as **Level C** above, except no respiratory protection required
Optional: chemical splash gear including face shield or goggles

4. **Level D**

Hard hat, as required
Steel toe boots/shoes
coveralls
Chemical splash gear: rubber gloves, goggles, rubber boots, and rainsuit or apron (as required)

Table SSHP-A1
Personal Protective Equipment Requirements

PPE	A	B	C	Mod-D	D
Protective headgear (hardhat), as required	X	X	X	X	X
Hearing protection (minimum NRR 20 dB) (as required)	X	X	X	X	X
Safety glasses, as required				X	X
Overgarment					
Impermeable, encapsulating	X				
Impermeable, non-encapsulating (e.g. Saranex)		X	X[1]	X[1]	
Permeable, chemical resistant (e.g. Kleenguard)			X[2]	X[2]	
Permeable, non-chemical resistant (e.g. cotton)					X
Supplied air (e.g. SCBA[3] airline with EEBA[4])	X	X			
Full-face air-purifying respirator (combination organic vapor/HEPA filtered cartridges)			X		
Inner gloves (latex)	X	X	X	X	
Outer gloves (Viton or SilverShield)	X	X	X	X	
Footwear, with steel toe and shank	X	X	X	X	X
Footwear, outer, chemical resistant	X	X	X	X	
Splash-proof safety goggles				X[5]	
Face Shield (8 inch minimum length)				X[5]	

[1] For tasks involving splash or possible spills.
[2] For tasks not involving splash or possible spills.
[3] Self-contained breathing apparatus
[4] Emergency escape breathing apparatus
[5] For sediment and surface water sampling as necessary

APPENDIX B

ENVIRONMENTAL STRESS

1. Heat Stress

a. Heat stress injuries can easily occur when clothing (especially protective clothing) impairs the body's cooling capacity, the internal body temperature rises, and the normal thirst mechanism is not adequate to bring about fluid replacement that is lost through sweat.

b. When body temperatures taken at the beginning of a rest period indicate temperatures exceeding 99.6 ^{o}F (37.6 ^{o}C), the next work cycle should be shortened by 1/3. Another indication of rising internal temperatures is the heart rate. Heart rates can be obtained by counting the radial pulse during a 30 second period (and double it) as early as possible in a work period. If the heart rate exceeds 110 beats per minute shorten the following work cycle by 1/3.

c. The symptoms of heat stress in order of increasing severity include:

(1) Heat Cramps (inadequate fluid replacement)

(i) muscle spasms

(ii) pain in hands and feet

(2) Heat Exhaustion (inadequate blood circulation)

(i) pale, cool, moist skin

(ii) heavy sweating

(iii) dizziness

(iv) nausea

(v) fainting

(3) Heat Stroke

(i) red, hot, usually dry skin

(ii) lack of or reduced sweating

(iii) nausea

(iv) dizziness and confusion

(v) strong, rapid pulse

(vi) coma

d. Heat stress first aid includes:

(1) Heat Cramps

(i) Replace fluids

(ii) Monitor for additional symptoms

(2) Heat Exhaustion

(i) Move person to cool place

(ii) Rest with feet elevated

(iii) Give water in small amounts

(iv) Recovery is usually rapid, if not emergency medical treatment is necessary.

(3) Heat Stroke

(i) Cool body immediately with cool water or cold compresses

(ii) Call ambulance immediately

(iii) Continue cooling until ambulance arrives

e. Heat stress prevention includes:

(1) Adjusting work hours during the coolest hours;

(2) Scheduled rest periods;

(3) Maintaining body fluids at normal levels by consuming small drinks of moderate temperature every 15 to 20 minutes.

f. Since the ACGIH TLV work/rest schedule is designed for use with ordinary work clothes and not impermeable PPE, and a Wet Bulb Globe Temperature (WBGT) meter may not be available, the following modified schedule will be used to accommodate the PPE. If PPE is not being utilized, 10 ^{o}F should be added to the temperature schedule below.

(1) On a <u>cloudy</u> day, continuous work may be performed below 70 ^{o}F. Above this temperatures be aware of heat stress and use buddy system and guidelines below.

75% work / 25% rest each hour at air temperature 70-79 °F
50% work / 50% rest each hour at air temperature 79-85 °F
25% work / 75% rest each hour at air temperature above 85 °F

(2) At temperatures above 85 °F everyone should have their heart rate measurements taken at 30 minute intervals stop work in PPE when heart rate reaches 120 beats per minute. This schedule is conservative and if one is under a light work load the work periods can be extended. If under a heavy work load or a sunny day the rest periods can be extended.

(3) Note: Work shall cease at a shaded dry bulb temperature of 98 ^{o}F.

(4) Each employee should be aware of their own heart rate. If, between work periods, one feels their heart rate (pulse) may be greater that 120 beats per minute, STOP WORK, notify SSO, go to a shaded area, take heart rate and, if necessary, REST.