PINE STREET CANAL SUPERFUND SITE
BURLINGTON, CHITTENDEN COUNTY, VERMONT

HISTORIC RESOURCES STUDY

John Milner Associates
Architects • Archeologists • Planners

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MANAGEMENT SUMMARY

This document constitutes the Historic Resources Study for the Pine Street Canal Superfund Site (the Site) in the City of Burlington, Chittenden County, Vermont. It has been prepared in partial fulfillment of the requirements of a Consent Decree entered into by the United States District Court for the District of Vermont, and relating to the implementation of remediation measures at the Site. The Site is located on the Burlington waterfront west of Pine Street and consists of approximately 38 acres within a larger 70-80 acre Study Area. The principal remediation measure is the placement of a subaqueous cap over contaminated sediments in Pine Street Canal and its associated turning basin.

This report evaluates the effects of the implementation of remediation measures on significant and potentially significant historic resources at the Site and discusses possible mitigation measures where appropriate. Potentially affected resources include the Pine Street Barge Canal itself, several canal boats sunk in the canal, and remains of two boathouse/marine railways. Also evaluated, at the request of the Vermont Division for Historic Preservation (VDHP), are two properties related to the canal—a drawbridge and breakwater remains. An update of a previous evaluation of prehistoric archeological sensitivity is also included, as requested by VDHP.

In the opinion of JMA, the Pine Street Barge Canal will be adversely affected by implementation of the selected remedy. Potential mitigation measures include preparation of a public history brochure describing the history and significance of the Canal and its associated resources. In the opinion of JMA the canal boat wrecks are significant and will also be adversely affected. Recommended mitigation includes documentation of other canal boats located off-site and the preparation of associated historic documentation on this resource category.

The remains of the boathouses associated with the marine railway constitute a potentially significant archeological site. To insure that the boathouse remains are not affected by the project, JMA recommends that the boundaries of the area containing the visible aboveground remnants of the boathouses be identified. Following boundary delineation this area should be fenced for the period of project-related construction to insure that it is not inadvertently encroached upon. In the opinion of JMA, the placement of a small quantity of soil on top of possibly buried boathouse remnants (south of the visible remains) to cap contamination in this area will not adversely affect those remains if the soil is deposited in a manner that does not require heavy equipment to traverse areas which have not already been covered by the clean fill. No mitigation relating to the submerged portions of the marine railways is recommended.

No construction activities associated with the proposed remedy are currently identified as occurring at the location where aboveground remnants of the boathouses were observed by JMA (see Section 3.3). However, the approximately 100 x 100-foot wetland area which will be covered with clean soil (see Figure 4) is located immediately south of the visible remains. According to Sanborn maps, the southern ends of both boathouses extended into this area. In the opinion of JMA, subsurface investigation of this area to confirm the presence of additional boathouse remains is not warranted.

The abutments of the existing drawbridge will be affected by the installation of a new concrete abutment placed against the canal-facing side of each of the two existing drawbridge abutments. This will result in a change in the appearance of the drawbridge abutments that could be considered an adverse effect. However, the physical integrity of the existing abutments will not be affected and, given the scale and industrial nature of the resource, the visual effect is

considered minor. Large format photography to Historic American Engineering Record (HAER)-standards is recommended as mitigation. The breakwaters will not be directly affected by the implementation of the selected remedy.

A re-evaluation of the prehistoric archeological sensitivity of the Site indicates that it is covered by fill deposits ranging from 5 to 25 feet thick. It is therefore highly unlikely that any prehistoric archeological remains would be affected by implementation of the proposed remedy.

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1.0 INTRODUCTION

1.1 Site/Project Location and Site Description

The Pine Street Canal Superfund Site (the Site) is located in the southern portion of the Burlington, Vermont waterfront between Pine Street and the shore of Lake Champlain (Figure 1). It consists of a currently vacant 38-acre area where contaminants associated with wastes from a manufactured gas plant have been found (Figures 2 and 3). It is located within a larger 70- to 80-acre Study Area that is bounded by Lakeside Avenue on the south, Pine Street on the east, Vermont Railway property on the north, and the Vermont Railway and Lake Champlain on the west.

The Site includes the surviving south portion of the Pine Street Barge Canal, the turning basin for the canal, and the outlet for the canal into Lake Champlain. The former north and south slips of the barge canal have been partially or completely filled. Other structures located within the project area are a steel railroad bridge across the outlet of the barge canal, the remains of stone breakwaters extending from either side of the outlet into the lake, and the remains of marine railways on the south side of the turning basin. A recently constructed Quonset hut storage building is located west of the canal and south of its outlet.

Access to much of the Site is difficult. The area east of the barge canal is largely overgrown, with few paths through the undergrowth. A path from the rear of the Maltex Building parking lot allows access to a section of the east portion of the canal, and a tributary path permits limited access to the south side of the turning basin. Access to the east side of the turning basin is possible in the rear of the former Citizen Oil Company property. Access to the west side of the barge canal is limited because of an active railroad right-of-way. A bicycle path extends along the lakefront west of the project area.

1.2 Project Background and Description

The Site was listed on the National Priorities List in 1983, and in 1992 the U.S. Environmental Protection Agency (USEPA) proposed a cleanup plan for the site. USEPA withdrew its proposal in 1993. After consideration of comments from environmental regulators, the potentially responsible parties (PRPs), citizen groups, and the general public, USEPA proposed a new remedy and issued its final Record of Decision (ROD) in September 1998. As part of a legal action brought by USEPA and the State of Vermont against the PRPs pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a group of the PRPs (the Settling Defendants) entered into a consent decree with USEPA and the State of Vermont. The consent decree calls for a group of the Settling Defendants, the Performing Defendants, to implement the proposed remedy.

The alternative (Alternative 3A) identified in the ROD as the selected remedy provides for capping of contaminated sediments in all areas where unacceptable ecological risk has been found, effectively isolating the contamination below the biologically active zone. Long-term performance monitoring of groundwater, surface water, stormwater, sediments and the caps is required along with the initiation of institutional controls.

Subaqueous caps are to be placed in Subareas 1, 2, and 8 of the Site, and a cap is to be constructed in the emergent wetlands in Subareas 3 and 7 (Figure 4). Subareas 1, 2 and 8

constitute what remains of the Pine Street Canal and its associated turning basin. The subaqueous cap in these subareas will be constructed of layers of sand (Figures 5, 6, and 7). It is expected that the sand will consist of medium to fine sand with a maximum particle size of 3/8 inch and less than 5 percent fines. A final cap thickness of 1.5 to 2.0 feet above the current bottom elevation is anticipated, but 2.5 to 3 feet of capping material may be required to attain final cap thickness after settling and consolidation occurs. It is not expected that excavation of existing bottom sediments will be required. If this is found to be necessary sediments will be dredged from the canal and transported to the turning basin for on-site placement. The cap placed over the sediments in Subareas 3 and 7 will be a combination of sand and wetland soil or topsoil uncontaminated with exotic plant seeds and containing 3-4 percent organic matter.

In addition to Subareas 1, 2, 3, 7, and 8, clean soil will be placed in an approximately 100 x 100-foot area immediately south of the turning basin (Figure 4). Elevated concentrations of compounds of concern were detected in shallow sediments in this area of emergent wetlands.

Associated with the cap design is the construction of a permanent weir at the mouth of the turning basin where it enters Lake Champlain. This weir will help maintain a water level of 96 feet above MSL or greater and will help to reduce the potential for cap erosion. Weir design will include the installation of a new concrete abutment on either side of the canal basin outlet for the purpose of anchoring the weir. Each new abutment will be placed against the canal-facing side of each of the two existing drawbridge abutments.

Construction of the caps will involve the following steps:

- mobilization and site preparation;
- site clearing to remove trees, brush and grass from the cap area;
- construction of the weir and a temporary turbidity curtain over the mouth of the canal;
- excavation of sediments from areas to be capped, if required to maintain wetlands functions, with disposal in the turning basin;
- construction of the subaqueous cap;
- wetland restoration or replacement; and
- site restoration.

Figure 8 shows possible area where clearing of trees and brush will be required in order to provide access to work areas, storage areas for materials, and staging and work areas for equipment. The subaqueous cap will be constructed of sand. A limited number of areas around the Canal and turning basin will be required as staging areas for receiving sand and delivering it to the barges placing the sand in the Canal. The sand will be delivered from the staging area to the barges via a telescoping conveyor. The cap over Subareas 3 and 7 will be placed using conventional earth-moving equipment.

1.3 The Historic Resources Study

A Stage IA cultural resources survey of the Study Area was carried out by John Milner Associates, Inc (JMA) in 1992 (Cook and McCarthy 1992). That study reported that previously identified cultural resources within the limits of what is now the Site, include the Pine Street Canal and eight canal boats sunk in the canal. The Canal has been determined by the Vermont State Historic Preservation Officer (SHPO) to be eligible for the National Register of Historic Places (NRHP). At the time of the Phase IA survey, SHPO considered the canal boats to be

potentially eligible for the NRHP but felt that more documentation was needed before a conclusive evaluation could be made. The Phase IA survey also identified a marine railway, and a drawbridge at the mouth of the canal turning basin, as potentially significant cultural resources. The IA survey also identified areas of archeological sensitivity within the Study Area (Figure 9).[1]

In 1996 underwater archeological investigations were undertaken at the Pine Street Canal (Cohn 1996). A side scan sonar survey, in conjunction with a remotely operated vehicle (ROV) survey and diving, identified the remains of five vessels and two marine railways. The report also indicated that the remains of "at least three additional vessels are located in the southern canal but buried under several feet of sedimentation" (Manley et al. 1996:3).

As part of the consent decree the Performing Defendants are required to submit to the USEPA and the Vermont Department of Environmental Conservation a Historical Resources Study. The Historical Resources Study is intended for use by USEPA and SHPO in complying with their obligations under Section 106 of the National Historic Preservation Act (NHPA), which USEPA has determined is an Applicable or Relevant and Appropriate Requirement (ARAR) under CERCLA.

The consent decree calls for the Historical Resources Study to "examine the potential resources (barges, marine railways) present in the canal and turning basin that will be affected by the selected remedy . . . [and] determine whether the barges and marine railways are eligible for listing on the National Registry (sic) of Historic Places." The consent decree also requires the Historic Resources Study to include "a determination of what level of mitigation may be required to mitigate the effect."

On June 29, 2000, SHPO staff requested that the scope of the Historic Resources Study be expanded to include an updated evaluation of the archeological sensitivity study prepared in 1992, documentation necessary to support the SHPO's prior determination of NRHP eligibility for the Pine Street Canal, and information about the drawbridge and breakwater at the Site.

This document constitutes the Historic Resources Study.

[1] The Phase IA survey also noted that the Queen City Cotton Company plant, now owned by General Dynamics, has been determined by the SHPO to be eligible for NRHP. It also noted that other potentially significant historic resources within the Study Area include a prehistoric site (VT-CH-81) located between the Vermont Railway and Lake Champlain, the Maltex Building complex west of Pine Street, and possible archeological remains associated with a non-extant nineteenth century planing mill which was located south of the Maltex complex. All of these locations are outside the Site boundary.

2.0 METHODS

Documentary research to collect information about the historic resources at the Pine Street Canal Superfund Site was conducted in the following repositories: the Special Collections, Bailey-Howe Library, University of Vermont, Burlington; the Fletcher Free Library, Burlington; the Vermont Historical Society Library, Montpelier; the Vermont Division of Public Records; the Vermont Division for Historic Preservation; and the Lake Champlain Maritime Museum, Vergennes. Information reviewed and evaluated included insurance maps (such as those published by the Sanborn Map Company), newspaper articles (some of which were identified from indices in the Special Collections, Bailey-Howe Library), published and unpublished local historical accounts, property records, and interviews with knowledgeable residents.

Documentary research was supplemented by field visits to the Site during the summer of 2000. A path from the rear of the Maltex Building parking lot allowed access to a section of the east portion of the canal, and a tributary path permitted limited access to the south side of the turning basin. Access to the east side of the turning basin was possible in the rear of the former Citizen Oil Company property. Access to the west side of the barge canal is limited because of an active railroad right-of-way. The west side of the turning basin of the barge canal was examined in the vicinity of the outlet.

3.0 HISTORIC RESOURCE DESCRIPTIONS

Historic resources located within the boundaries of the Pine Street Canal Superfund Site include the Pine Street Barge canal itself; a Strauss trunnion bascule bridge that extends across the mouth of the barge canal; breakwaters that extend into Lake Champlain on either side of the barge canal mouth; the remains of former marine railways/boathouses on the south bank of the canal turning basin; and remains of at least five canal boats sunk in the Canal and turning basin. A VDHP complex form has been prepared for the canal, the bridge, the breakwaters, and the boathouses. This form is included as Appendix I.

3.1 The Pine Street Barge Canal

The Pine Street Barge Canal (Plates 1 to 6) represents the remnants of an originally larger resource. A series of historic maps included in this report clearly show the canal as it appeared in the nineteenth and early to mid-twentieth centuries. As shown in Figure 9, the north and south barge slips have been filled in, the south portion of the main canal has been narrowed, and a portion of the turning basin has silted in. The outlet connecting the turning basin to Lake Champlain remains relatively intact. The canal basin is lined with boulders, many of which have been displaced from their original locations.

Most of the shore of the canal is now overgrown with trees, shrubs, and vines. Originally a strictly geometrical body of water, the shoreline is now less regular due to erosion, filling, and the partial collapse of bulkheads. Originally a maximum of eight feet deep, the depth of at least some portions of the waterway have been reduced.

The shoreline of the canal was originally surrounded by a dike, possibly constructed of rubble. The inner side of this dike was finished with planking. According to an area resident, planking or cribbing is visible along the southern reaches of the canal during times of low water (as cited in Cook and McCarthy 1992). Visible remains include piled rubble along the shore that may have been originally used to form the dike.

3.2 The Canal Drawbridge

The first bridge across the outlet of the canal basin was constructed to carry the tracks of the Champlain Valley Railroad (later the Rutland Railroad). In 1847, Timothy Follett, president of the Rutland and Burlington Railroad, acquired land along the Lake Champlain waterfront for a railroad right-of-way (Visser et al. 1990:25). The first tracks along the Burlington waterfront were laid in 1849, creating a direct link between Lake Champlain and New England markets and manufacturing centers (Crisman 1990:19).

The original drawbridge across the entrance to the canal basin was a single-track structure built of wood. In 1893, it was replaced by an iron gallows framed, jack knife drawbridge (Blow 1991:97). The gallows frame was constructed of 10-inch channel beams laced with 3 ½ inch bars, and was supported by a series of angled steel rods extending from the frame down to the bridge deck (Figure 10). The present steel trunnion bascule bridge was designed in 1919 by the Strauss Bascule Bridge Company of Chicago, one of the nation's leading designers of drawbridges (Figure 11). Steel for the bridge was manufactured by the Pennsylvania Steel Company (later Bethlehem Steel Company) of Steelton, Pennsylvania.

The term "bascule" is taken from the French word for "see-saw." A bascule bridge features a movable leaf which rotates on a horizontal hinged axis (a trunnion) to raise one end vertically. A bascule bridge employs a large counterweight to offset the weight of the raised leaf (Cridlebaugh 1999).

3.2.1 Strauss Bascule Bridge Company

The first Strauss bascule bridge, built for the Wheeling and Lake Erie Railroad and spanning the Cuyahoga River, was completed in 1905. This bridge design was patented by Joseph B. Strauss, and later patents were controlled by the bridge company. By the 1920s, more bascule bridges had been built to Strauss designs than from those of any other single type of bascule (Hovey 1926:115-116).

The Strauss Bascule Bridge Company produced several basic designs for its bridges. Types produced by the company included the vertical overhead counterweight type, the underneath counterweight type, and the heel trunnion type. The barge canal bridge is an example of the first type. The overhead counterweight type of bridge is illustrated in a figure in Hovey's *Movable Bridges*. The operation of the vertical counterweight bridge is described in that publication as follows (Figure 12):

> The center of gravity of the moving leaf is at g and that of the counterweight at g'. Trunnion A and joint B are in the same plane as g and link CD is parallel to gAB. $ABCD$ is a parallelogram. Hence, in any position, closed or in motion, $Px = Wy$, or $Px' = Wy'$; and a balance is maintained throughout the movement of the leaf. In this type the dead load on the trunnion is $P + W$, and the reaction is always positive and constant. The introduction of the parallelogram permits the center of gravity of the counterweight to be at any convenient height above B, while in a simple trunnion bridge it must be at B, in the plane of gAB. The break in the floor is in front of the trunnion (Hovey 1926:116).

An overhead counterweight bridge similar in scale to the barge canal bridge was that designed by the Strauss Company for the Chambly Canal at St. Johns, Quebec. This bridge spanned a clear channel of 70 feet and was powered by two, 7.5 hp motors (Hovey 1926:116).

3.2.2 The Barge Canal Bridge

The barge canal bridge (Plates 7 to 14) originally consisted of a steel-framed moving leaf with a main trunnion, counterweight trunnion, and concrete counterweight. A steel-framed tower extends across the width of the bridge and rises 38 feet from the base of the bridge. In its resting position, the leaf rested on poured concrete bridge seats anchored to the banks of the channel by pilings. The moving or bascule leaf, pivoted on a main trunnion mounted to the north bridge seat. Rising above the main trunnion is the trunnion tower. A link at the top of the tower connected to the counterweight trunnion and then to the counterweight. The counterweight was, in turn, connected to the tail trunnion on the tail of the moving leaf behind the main trunnion. The combination of power generated by the bridge engine and the shifting of the counterweight permitted the moving leaf to be raised and lowered. The moving leaf carries two railroad tracks across the 28-foot clear channel opening. The leaf is 18 feet wide.

The irregularly shaped, reinforced concrete counterweight is shown in Figure 13. The counterweight was mounted to the steel counterweight frame by a counterweight link, a riveted steel framework that measured 15 feet three inches long and six feet one inch wide. The counterweight has been removed from the bridge and presently rests on a site west of the bridge. The moving leaf is constructed of steel I-beam girders with steel laterals (Figure 14). The trunnions were mounted to steel-framed trunnion posts that measure 38 feet high (Figure 15).

Machinery enclosures were placed on both sides of the bridge beneath the bridge deck. These enclosures were fenestrated with three light windows. The enclosure walls are now gone and remaining portions of the machinery are clearly visible, mounted to a platform below the bridge deck.

The concrete slab operator's house measures 11 feet by eight feet in plan (Figure 16). Paired window openings are placed on the longer elevations. Each originally contained four-over-one, double-hung, sash windows. Single four-over-one, double-hung windows were placed in the shorter elevations. All window openings and frames are gone. Three-foot wide stairs extended from the north elevation of the operator's house down to the bridge deck. These stairs are also gone. The interior of the house contained a switchboard, a controller, and a lavatory. All interior furnishings have been removed. Its roof is sheathed in tar and gravel and flashed in galvanized iron. The operator's house is elevated above the machinery room by a steel substructure originally sheathed in asbestos but now uncovered.

The machinery enclosure originally consisted of asbestos-covered steel plate mounted to a light angle framing. The steel plates are now gone but the framing remains. The bridge was powered by an AC motor. Original specifications called for a General Electric 60 cycle, 220 volt, 3 phase, 5 horsepower motor operating at 900 RPM. The motor was to be equipped with a solenoid brake with a hand-operated mechanical release for use when the bridge was hand-operated. A series of shafts, flanges, and a rack and pinion connected the motor to the main trunnion (Figure 17). Rusted gears and shafts and the remains of a motor are still in place on the platform. It is highly unlikely that this machinery remains operational.

The Vermont Division for Historic Preservation determined the bridge eligible for listing in the National Register of Historic Places in March 1987. This determination was made in response to a request from the Vermont Agency of Transportation which had plans to modify the bridge. At that time, the decision was made that it would acceptable to remove the concrete counterweight for the bridge, providing that the weight was left at the site so that its historic function could still be understood (Gilbertson 1988).

In March 1987, the counterweight for the bridge was removed and placed on the north shore of the barge canal outlet west of the bridge. Portions of the counterweight and associated steel framework remain in place. A portion of one side of the counterweight was cut away to permit the construction of the Burlington bicycle path bridge across the opening of the barge canal.

In the statewide bridge survey undertaken by Roth and Clouette, only one other drawbridge was identified, that which crosses Missisiquoi Bay.

3.3 Marine Railways

Two structures (VT-CH-806), identified in a previous survey as marine railways (Cohn 1996), are located adjacent to the south side of the turning basin (Plates 15 to 18; Figure 18). Both structures

are in ruinous condition and are now largely hidden by undergrowth. Extant portions of the fabric of each structure include poured concrete ramp walls that extend downward into the south end of the turning basin and a series of parallel poured concrete footings. Timbers, probably either a portion of the shipway or a portion of the boathouse framing, lie on the ground in the vicinity of the concrete footings. No rails or remains of machinery were visible during a pedestrian reconnaissance of the area.

During a 1996 side scan sonar and ROV survey of the turning basin "two railroad tracks (each 2 m in width) were identified extending from the south edge and extending ~20 meters into the Turning Basin. These railway tracks are aligned with concrete walled cribs located on the southern shoreline of the Turning Basin" (Manley et al. 1996). These railways were located and measured during diving operations. Railway No. 1 extends 114 feet into the turning basin and then disappears into the mud of the basin bottom for an undetermined additional length. Railway No. 2 extends approximately 102.5 feet into the turning basin and then ends (Cohn 1996:2).

Early twentieth century Sanborn maps show two, wood-framed, one- and two-story boathouses in this location with ramps extending northward into the turning basin (Figure 19). No documentary evidence could be located about the date of construction and use of these structures. Cohn (1996:2) suggests that the structures were marine railways associated with the Proctor Boat Works, but does not provide the source of this information. Insurance maps of Burlington do not confirm this ownership nor do they identify the buildings as containing marine railways. On a 1926 Sanborn map, the west wood-framed boathouse is indicated as also being used for boat repairing. A single story, wood-framed, open lean-to had been appended to the east elevation (Figure 20). The boathouses are also shown on 1942 and 1955 Sanborn maps (Figures 21 and 22). None of the Sanborn maps indicate any machinery associated with the boathouses.

The concept of a marine railway, an inclined plane to be used for hauling ships onto land for repair was apparently developed in the early nineteenth century. Thomas Morton, an English shipbuilder, was granted a patent in 1819 for his "patent slip" consisting of the "application of a particular kind of carriage to the inclined plane." The earliest marine railway in North America was erected in Salem, Massachusetts in 1823, and soon others were constructed in coastal waterfronts. Nearly all the initial marine railways relied upon horse or human power for hauling, but some employed steam power (Rumm n.d.:2).

A marine railway consists of three basic elements: 1) the inclined plane leading into the water; 2) the cradle upon which the boat rests; and 3) some form of windlass or winch for hauling the cradled ship up the incline. The facility also generally includes facilities for repairing ships (Rumm n.d.:3). In his HAER documentation for the marine railway at the Thames (Connecticut) Shipyard, Alex Gratiot described the cradle, the heart of the railway:

> The cradle sat on rollers, which in turn rested on the iron strap rails. One set of stringers followed the incline of the plane, while another set on the lower two-thirds of the cradle supported a level working platform. This working platform was held above the stringers by heavy wood trusses. The space between the two sets of stringers was filled with scrap metal or fieldstone which served as ballast; it prevented the cradle from floating. Beams ran perpendicular to the longitudinal stringers and supported both the keel blocks, which bore almost all the weight of the ship on the cradle, and the sliding bilge blocks, which gave lateral stability to the craft. Winches for hauling the bilge block in and out from under the hull were placed on docking platforms on each side of the cradle supported by upright posts (as cited in Rumm n.d.:11).

Hauling a vessel up the railway involved substantial preparation. The cradle had to be adjusted to fit the hull of the craft. The craft was directed into position over the cradle arms, a delicate operation that often involved several attempts. The engine was powered up to haul the craft slowly along the ways. As the cradle ascended the railway, workers placed additional blocks under the ship's hull. Depending on the size of the ship and the means employed, hauling a ship up a railway could take from an hour to an entire day (Rumm n.d.:11-12).

Small shipways and marine railways were once located at various points along Vermont's lakefront. Many such structures lacked the machinery needed to haul boats back onto land and were used only to launch boats into the water. Few remain. The largest remaining marine railway in Vermont is presently located at the Shelburne Shipyard and is owned and operated by the Lake Champlain Transportation Company (Dumbleton 2001). This railway was one of two at the shipyard; the smaller one closed in the 1980s (Shelburne Shipyard 2001).

The railway replaced an earlier horse-powered structure (Cramer 1977). It was built by the Crandall Engineering Company of Boston and originally used two 150-horsepower steam engines to haul boats out of the water (Aske and Lane 1992:8). Opened on October 24, 1929, its cradle is 235 feet in length, 65 feet in width and weighs about 300 tons. The track upon which the cradle operates is approximately 800 feet in length. From its upper end to the water level, the track is built of reinforced concrete, and from the water line to its outer end, wood placed on piles. The rails consist of flat steel plates. The railway's original motive power was steam, the cradle operated by two steel hauling chains driven by a steam hoist. The engines were housed in a wood-framed building immediately beyond the inshore end of the track (Ross 1997:169). In recent years, the original steam engines have been replaced by electric motors but much of the rest of the 1929 structure remains intact (Dumbleton 2001). The railway has a capacity of 1,000 tons (Hill 1953:12).

3.4 Lake Champlain Breakwaters

Nineteenth and early twentieth century maps clearly show a pair of breakwaters located at either side of the barge canal outlet. A substantial portion of the south breakwater remains. This structure, constructed of stone slabs and rubble extends from the shore of the canal outlet in an arc westward into Lake Champlain.

On the north side of the outlet, the curve of the Lake Champlain shoreline is lined with rubble and a short rubble breakwater extends into Lake Champlain from the outer portion of the curve.

A short breakwater is shown extending from the north bank of the canal map on an 1869 map (Figure 23). A longer structure, indicated as a pier, extended from the south side of the canal mouth (Sanborn 1869). Later nineteenth century maps such as those by the U.S. Coast Survey (Ogden and Granger 1873) and Woodbury (1886) show breakwaters sheltering the mouth of the barge canal. These breakwaters extended the length of the south side of the mouth and along the angled north bank of the mouth east to the railway bridge abutment. These breakwaters were angled out into the lake with a northward turn at their outward ends. The breakwaters are shown on several Sanborn maps, most recently the 1955 edition. On that map, a tapering straight breakwater is shown angled northwest from the south side of the canal outlet and a longer breakwater is angled northwest from the point on the north side of the canal outlet (Figure 22).

Plates 19 and 20 show the breakwaters as they appeared in September 2000.

3.5 Pine Street Canal Boat Sites

Five wreck sites were located in the turning basin portion of the Pine Street Canal during a side scan sonar survey completed in 1996. Follow-up diving was conducted to identify the type of wrecks found on the sonar records. All five of the wrecks were canal boats of similar dimensions (97 ft. by 17.5 ft.). The report states that "while all the vessels are of the same basic size, dimension, and class, they all exhibit different construction characteristics and therefore are presumed to have been produced at different yards" (Cohn 1996:2).

Each of the wrecks appears to survive in a relatively good state of preservation. Vessel 1, located in the northeast corner of the turning basin, has concrete debris from the shoreline covering one end of the boat. Although only unscaled drawings are provided in the 1996 report, the other end and the sides of Vessel 1 (VT-CH-800) appears to be intact. An estimated three to four feet of silt cover the interior portions of the wreck. All of Vessel 2 (VT-CH-801) appears to remain intact. Vessel 2 is located along the eastern side of the turning basin. Similar to Vessel 1, the interior of the wreck is covered with an estimated two to three feet of sediment (Figure 5) .

Vessel 3 (VT-CH-802) lies parallel to the Vessel 2. The bow end of Vessel 3 is broken. Although the interior is covered with one to two feet of sediment, the sides of the boat appear to remain in a good state of preservation. Vessels 4 (VT-CH-799) and 5 (VT-CH-798) lie in a line on the west side of the turning basin. Vessel 5 is directly north of Vessel 4. Vessel 4 appears to be the best preserved of the group of wrecks in the canal. Portions of four interior bulkheads are depicted in the report and the bow and stern remain intact. Fewer details are provided for Vessel 5, but the site drawing indicates that the vessel remains relatively intact.

4.0 HISTORIC CONTEXTS

4.1 The Pine Street Canal and Associated Structures

Soon after European settlement of present Vermont, lumber from trees harvested along the Lake Champlain shore of Vermont was shipped to Quebec. In the earliest years, much Vermont lumber was destined to be exported to Europe, particularly to supply Britain's Royal Navy. Logs and lumber were transported to Quebec ports by means of rafts, floated north on Lake Champlain and then via the Richelieu and St. Lawrence rivers to Quebec City. The Quebec market for Vermont timber flourished until the stands of old growth timber on both sides of the Lake were exhausted (Gove 1971:36).

With the opening of the Champlain Canal in 1823 connecting Lake Champlain to the Hudson River and ultimately, the Erie Canal, easier access was possible to markets in lower New York. Schooners and canal boats laden with lumber began to move south from Vermont. By the 1840s, the shortage of New England timber became acute as much of the forests had been cut. Burlington appeared to have reached the end of its reign as a lumber shipping point, and the city fell into an economic decline (Gove 1971:37-38).

The situation changed with the development of the rail network in Vermont. In 1849, the Rutland and Burlington Railroad (later the Rutland Railroad) laid tracks along the Burlington waterfront. Burlington became the most feasible point for the junction of lake navigation and railroads. Sources of lumber and other commodities were located to the west and north, and railroads provided a link to world-wide markets (Gove 1971:38).

The building of the Sorel Canal provided ingress to Lake Champlain from the Ottawa River in Canada. Because the Sorel Canal could admit larger barges than the Champlain Canal, reloading of lumber to smaller vessels was necessary to ship the commodity south. Burlington was perfectly situated to be the point of reloading (Defebaugh 1906:II:170). Importation of Canadian lumber was facilitated by construction of the Chambly Canal that bypassed the rapids of the Richelieu River and opened a direct interior passage between the St. Lawrence River and the eastern United States (Crisman 1990:18).

The Pine Street Barge Canal owes its existence to a mid-nineteenth century loophole in federal tariff law that exempted unfinished lumber from Canada from tariff (Blow 1991:96). Burlington emerged as a center for the receipt of unfinished Canadian lumber, as a site of finishing of this lumber, and as a shipment point for finished boards. Canada had vast untapped softwood timber resources, resources that promised to supply the city's needs for decades to come (Gove 1971:39).

The first load of Canadian timber was brought to Burlington in 1850 by L.G. Bigelow, Esq. (Defebaugh 1906:II:170). Soon after, several Canadian lumber companies set up sales offices in the city (Gove 1971:39). Canadian timber came from the Ottawa River area and the Three Rivers and River Du Loup areas of the St. Lawrence River valley. At mid-century, the southern portion of the Burlington waterfront remained undeveloped, swampy land (Figure 26).

Within a short time, businesses developed in Burlington to use the wood shipped to the city. One such business was Cheney Kilburn and Company, manufacturers of chair stock. Using machinery including two upright saws, rounding machines, and cylindrical saws, the factory manufactured backs, rounds, and legs of chairs (Anonymous 1854). About 60 workers were employed. In 1858,

Joel H. and Stephen Gates set up a company to manufacture furniture and soon formed a partnership with Kilburn under the name of Gates, Kilburn and Company. In 1865, after Stephen Gates's death, a new partnership was established, Kilburn and Gates. Four years later a factory was constructed at Pine and St. Paul streets. In 1870, the company employed 115 workers and produced $165,000 worth of furniture (Amrhein 1958:227-228).

The establishment of Burlington's large-scale lumber industry is generally credited to Lawrence Barnes (Figure 25). A native of Hillsboro, New Hampshire, Barnes arrived in Burlington in 1856. His career began with 10 years of employment with a spool and bobbin company in New Hampshire and Maine. He then risked nearly all his resources by buying 10,000 acres of timber on the Saco River in Maine. This, and a subsequent timbering venture in Island Pond, Vermont failed. Undaunted, he purchased several million board feet of Canadian lumber and sold the lot for three times its cost (Amrhein 1958:222). Shortly after his arrival in Burlington, Barnes purchased a large lumber shipment at a mill in Three Rivers, Quebec, shipped it by boat up the Richelieu River into Lake Champlain to a newly established lumber yard on the lakefront in Burlington. From there, he began shipping the lumber by rail to various parts of New England (Gove 1971:39).

Barnes introduced an innovation that transformed Burlington into a major lumber center, an innovation described by William Gove in his history of the lumber industry in the city:

> As business grew rapidly Lawrence Barnes hit upon the idea that if lumber were dressed in shipment he could save 12 ½ percent in freight expenses, and in 1857 the first planing mill was built on the Burlington lakefront. This innovation gave real impetus to the newly created lumber trade, and from this point on the growth mushroomed (Gove 1971:39).

Barnes's steam mill was located on the lake shore. Boats would unload raw timber on the lake side of the mill, while finished lumber was loaded onto rail cars on the other side (Orr 1972:71). Following Barnes's lead, new wood products companies were established and purchased other lakeside property for their lumber yards.

In March 1859, the state of Burlington's lumber business was chronicled in an article in the *Free Press*. After noting the depression that the industry faced the previous summer, the author indicated that sales for the whole year were almost 20 million feet. Of these sales, a majority was attributed to Lawrence Barnes's interests:

> Mr. Barnes does not get out the lumber from the forest, but buys his stock of other parties and distributes it from this point. He has supplied himself largely, heretofore, from Canada, but has made arrangements now for a supply of Michigan lumber which is now competing extensively with the Canadian lumber in the Eastern markets. In addition to his lumber trade, Mr. Barnes does a heavy business in planing and matching. He leases, and has run during a good part of the year, the steam planing mill of Mr. H.N. Ballard....He employs here during the summer season about *seventy* hands, and from forty to fifty the year round (Anonymous 1859).

By the 1860s lumber sheds and planing mills covered much of the city's waterfront (Gove 1971:39). An 1863 article by Henry Rolfe, a Burlington lumberman, described the scene:

> Little did the projectors of our railroads dream that within ten years after the completion of their roads, almost every available space on their ground at Burlington would be lumbered up with boards and planks on their distant voyage to Europe, South America, California and the far off isles of the Pacific, but such is the fact.
>
> The lumber is brought here from the mills on the Ottawa and St. Lawrence and their tributaries without sorting, and is here sorted to meet the requirements of the different markets.
>
> If a ship at Boston, bound for Australia, needs a cargo of lumber, it is put into cars at the planing mill, carried to Boston and unloaded direct from the cars to the vessel. If one for the West Indies calls for a load, it can be supplied with a cargo of rough boards with the same facility and dispatch. Every demand for pine lumber or any of its manufactures, whether rough, dressed, tongued and grooved, made into doors, sash, blinds or boxes, or even houses, ready made, can be furnished to order upon very short notice...With the extension of the wharves...Burlington has facilities for increasing her trade to a much larger extent than at present, and bids fair to be second only to Boston as a lumber mart of New England (as cited in Defebaugh 1906:II:171).

Because Lake Champlain generally froze solidly through the winter months precluding shipments for much of the year, Burlington lumber companies were forced to build up huge inventories throughout the summer season. These inventories required a large amount of storage or yard space for the piles of lumber. In 1866, Lawrence Barnes expanded his storage yard onto the breakwater. The need for more storage space with waterfront access led him to come up with the idea of digging a canal and boat basin and filling in the swampy land owned by him south of Maple Street and west of Pine Street (Blow 1991:97).

An article in the *Free Press* described Lawrence Barnes's effort to transform a "miasmatic frog pond" to a center of the city's lumbering interests:

> ...the dyke which is intended to surround the basin—which is to be 300 feet square, and to hold 8 feet in depth of water at low water mark—was entirely completed save the facing with plank, which will be done eventually, and a very beginning has been made in digging out the "hole" by the forty men who were hard at it. Already a portion of the railroad track has been built, preparatory to the excavating for the draw-bridge, which will cross the channel, 80 feet in width, that will connect the waters of the basin and the lake.
>
> In addition to and leading north and south from this basin, it is a part of the plan to cut canals to extend as far as the business shall require. One of these will be *seventy-five* feet in width, and will be extended from the southwest corner of the basin in a southerly direction. Another, *fifty* feet wide, will extend 600 feet north of the northeast corner of the basin....
>
> The pier, building by Mr. Luther Whitney, of Port Douglass (New York), the contractor, extending into the lake, immediately south of the "draw" *seven hundred feet*, has been constructed during the past spring to within a few rods of the shore (Anonymous 1868b).

The land surrounding the basin was acquired by a variety of lumber interests including Messrs. Barnes & Davis, Messrs. Kilburn & Gates, Messrs. Flint and Hall, Mr. A.G. Stearns and Mr. Otis Shepard. Long lines of square-rigged boats, known as pin-flats, were loaded to the gunwales with raw lumber in Canada and towed by tugboats to Burlington. A contemporary observer described the pin-flat as a "curious scow-like boat, which carries a square sail, and makes good time only when running before the wind" (Bishop 1878:Chapter 3). These boats were extra large in size, wide and flat to boost capacity. They were much larger than the U.S.-built barges because of an international regulation which prevented them from navigating the Champlain and Hudson canals and thus removed size restrictions (Gove 1971:40). The pin-flats would be brought into the basin and the lumber load would be unloaded by local day laborers, known as "lumpers." Empty boats returned to Canada by sail power or were towed by north-bound tugs (Blow 1991:96).

In 1865, Burlington companies sold an estimated 60 million feet of lumber. According to statistics reported in the *Free Press*, this total put the city in either fourth or fifth place among United States lumbering centers, behind Chicago, Albany, and Bangor and roughly equal with Boston (Anonymous 1865).

In 1869, the *Free Press* proudly announced that Burlington ranked as the third largest lumber market in North America in terms of annual sales, exceeded only by Chicago and Albany. The anonymous writer noted that Bangor exceeded Burlington in feet sold, but since the average grade of lumber was lower, aggregate sales were also less. Burlington was called the "greatest receiving and distributing reservoir for the vast Canadian forests" (Anonymous 1869a). The appearance of the waterfront is shown in two maps of that year (Figures 23 and 26).

The same article profiled the leading lumber concerns of the city including C. Blodgett and Son, Hunterstown Lumber Company, L. Barnes and Company, Flint and Hall, and S.S. Churchill and Company. Of these, three, L. Barnes and Company, Shepard, Davis & Company and Flint and Hall, owned property bordering the barge canal.

L. Barnes and Company began business in 1856. As Barnes's business expanded he took on Charles Whitney of Boston and David Whitney of Detroit as partners, and later added E.N. Skillings of Boston and Mial Davis of Burlington (Defebaugh 1906:II:171). Offices were opened in Boston, Detroit, Montreal, Ogdensburg, Albany, and Whitehall, New York. In 1867, the *Plattsburgh Sentinel* proclaimed the firm the largest lumber dealing concern in the United States with operation stretching from Boston to the Great Lakes (Amrhein 1958:223-224). In 1868, it completed a new steam mill. This mill, erected at a cost of $100,000 dressed an average of 15 car loads of lumber per day and provided employment to about 100 men. Total lumber sales in 1868 were almost 58 million feet. During that year, the company employed a total of 286 men, received 46 canal boat loads of timber and shipped 3,778 rail car loads of lumber. The total value of products sold by the company and its subsidiaries was $4,082,829.46 during the year (Anonymous 1869a).

Shepard, Davis & Company was organized by Otis Shepard of Boston, Massachusetts, Lewis A. Hall of Boston, and Mial Davis of Burlington. About October 1876, the company failed and Otis Shepard; James MacLaren, of Ottawa, Canada; George H. Morse, William A. Crombie, and Frank Dudley of Portland, Maine, bought the property and formed the Shepard & Morse Lumber Company. The company had timber lands and sawmills in Michigan and Canada. Its Burlington planing mill was possibly the largest in the world with a yearly capacity of 40 million board feet. The company had 4,000 feet of dock frontage on Lake Champlain, enough to hold 30 to 35 vessels at one time. Its 25-acre yard had a lumber storage capacity of 30 million board feet. The company employed 300 in Burlington (Gove 1971:40-41).

Flint and Hall was a Boston firm with branches in New York and Burlington. Their Burlington operations were directed by George H. Morse. In 1867, the company shipped 1,221 carloads of lumber. During 1868, it received 105 boatloads containing over 19 million board feet of lumber valued at $650,000. The company shipped over 20 million board feet of lumber during the year. The large majority of this lumber was shipped in 1,178 railroad carloads (Anonymous 1868a; Anonymous 1869a).

In 1869, Shepard, Davis & Company purchased Barnes's Canadian interests, and the firm then used only western lumber. The 1870 census showed the company with capital of $800,000, a labor force of 640 and a gross product of $360,000 (Amrhein 1958:224). An 1869 Sanborn map (Figure 23) shows land usage along the barge basin and canal. At the north end of the canal was S.H. Wells's coal yard. East of the north end of the canal was the lumberyard for the Kilburn and Gates furniture factory. Shepard, Davis & Company owned the land south of the Kilburn and Gates property. Most of this land was a large stacking yard with streets laid out between the stacks. Most of the land west of the canal was owned by the Rutland Railroad. A small parcel adjacent to the south end of the canal was owned by Flint and Hall and was used as a lumberyard.

In 1870, the A.F. Stearns Company of Boston constructed a dock south of the basin. This construction was described in the *Free Press* of August 4th. The dock would extend:

> West into the lake 400 feet, then south 500 feet and back to the shore. This will be filled with earth upon which the [planing] mill will be built. This dock is to be continued 400 feet further into the lake, 500 feet south, and east 35 feet, forming a basin to hold logs and lumber. In the construction of the work about 120,000 cubic feet of lumber will be used and 20,000 perch of stone (as cited in Orr 1972:85).

The dock was built, but the mill was never erected.

By 1870, a total of approximately 110 million board feet of lumber was shipped annually to Burlington in about 1,200 vessels. The total fell the following year due to a reduced Michigan timber crop, drought in Canada, and Western fires. Five firms controlled the lumber business in Burlington: Blodgett & Son, Messrs. Shepard & Davis, Rolfe & Tyler, W. & D.G. Crane, and W.H. Barnes. The largest single mill in the city, built by Barnes and then owned by Shepard and Davis was 275 feet long, 100 feet wide, equipped with 30 planing and matching machines. Lumber sold in Burlington was almost exclusively pine. The estimated division of the lumber trade was Messrs. Shepard & Davis, 50 percent; Blodgett & Son, 25 percent; Rolfe & Tyler, 14 percent; and W. and D.G. Crane, 11 percent (Anonymous 1871b).

An item in the June 9, 1871 issue of the *Free Press* reported lumber barge arrivals from Canada during the previous week. As many as 10 barges could be pulled by one steamer (Gove 1971:40). A total of 43 barges were reported to have entered the Port of Burlington carrying a total of 5,600,081 feet of lumber. The average barge held from 100,000 to 130,000 linear feet of lumber. The largest cargo was on the *Minnehaha*, 192,752 feet, while the smallest, 25,096 feet was carried on the *Currier* (Anonymous 1871a). At one time, the lumber industry operated over 400 steamers and barges on the lake.

In 1871, a Canadian lumber firm, Bronson, Weston & Company, owner of about 1,500 square miles of timberland in Canada, extended its operations to Burlington. The company had previously developed extensive facilities in Albany, New York. To accommodate its Burlington

operations, the company purchased 10 acres of land south of the canal basin from Lawrence Barnes. An article in the *Free Press* described their plans:

> They will extend the canal from the basin for 600 to 700 feet to the south and will also cut a transverse slip of 400 feet, giving them over 1000 feet of water front. On their land, upon the extension of Pine Street to the south, they will erect, the coming summer, a mammoth planing mill, like that of Shepard, Davis & Co. Their immediate outlay of capital in docks, mill, etc. will be not less than $100,000 (Anonymous 1871c).

A map in the collection of the Vermont Historical Society shows the area around the barge canal in 1872 (Figure 27). Land to the east and west of the northern portion of the canal was used by Shepard and Davis as stacking yards (The company's planing mill was located further north, west of Water Street between Main and College streets). The land on east side of the south end of the canal was used by Bronsons, Weston, Greene and Company as the site of its stacking yard and planing mill.

The state of Burlington's lumber industry in 1873 was chronicled in an item in the *Free Press*:

> There are now five steam mills with a capacity of dressing from eight to ten million feet per month, one of which dresses fifty million feet per year...The lumber received here comes mostly from Ottawa, Quebec, and the River St. Lawrence, by water transportation, with an increasing amount from Michigan, by rail. The amount of capital now invested in real estate, docks, mills, machinery, and fixtures is estimated at a million of dollars. The market is largely New England but includes the territory between New York and Portland, Me.... furnishing freight to the railroads to the amount of about $600,000 per year. A large quantity also goes by boats to New York and the South in the season of navigation (Anonymous 1873).

That year marked the peak of the city's lumber production. Nearly 170 million feet of lumber valued at over $2 million passed through the port (Gove 1971:40). The mayor of Burlington described the appearance of the waterfront in his portion of the 1875 annual report of the city:

> Along our Lake front, the wharfing has been greatly extended and acres of land made, by filling all along the Lake shore, and the whole territory is covered by immense lumber yards and large mills (as cited in Amrhein 1958:220).

Production declined substantially in the second half of the decade due to a long-lasting economic depression (Gove 1971:42). A visual representation of the stacking yards and mills is shown in J.J. Stoner's 1877 bird's eye view of Burlington and Winooski (Figure 28). The land east of the north end of the canal was used by Kilburn and Gates for its stacking yard and furniture factory, while that west of the north end of the canal was used by L. Barnes Son and Company for its stacking yard. Barnes had additional stacking yard west of the south end of the canal. East of the south end of the canal, the land was used for Bronsons, Weston, Dunham and Company's stacking yard and planing mill, and as stacking yards for C. Blodgett Son & Co. and Jas. MacLaren Lumber Company.

An 1885 Sanborn map shows land use in the canal vicinity in that year. The breakwaters are clearly shown extending into Lake Champlain from either side of the canal mouth. The land to the north and east of the canal was owned by Skillings, Whitney & Barnes Lumber Company and

was used as their lumberyards. Land west of the canal was part of the Rutland Railroad right-of-way.

By the end of the 1880s, six major firms were engaged in the lumber business in Burlington. These firms boasted an aggregate capital of $4,000,000, handled 150 million feet of lumber annually, and employed about 1,000 (Possons 1889:78). The major lumber concerns in the city included Skillings, Whitneys, and Barnes Lumber Company, Bronsons, Dunham & Weston, and Shepard & Morse Lumber Company. Skillings, Whitneys and Barnes had its principal office in Boston with large planing mills located in Ogdensburg, New York and Burlington (Possons 1889:78). Bronsons, Dunham & Weston was located at the south end of the lumber district. The firm had 16 acres of piling ground, 2,000 feet of dockage, and steam mills for dressing and re-sawing lumber (Possons 1889:110). Shepard & Morse owned 25 acres of yards with a total capacity of 30 million feet and 4,000 feet of dock frontage on Lake Champlain from which 30 to 35 vessels could discharge at one time (Possons 1889:96-97).

By 1890, the barge canal had been enlarged to its greatest extent (Figure 29). Two breakwaters extended northwest from either side of the canal mouth into Lake Champlain. The land west and east of the north end of the barge canal was owned or leased by Skillings, Whitney and Barnes Lumber Company. On the east side of the canal south of the Skillings, Whitney and Barnes yard was the building and yard of the Adsit and Bigelow Coal Company. The land east of the basin was occupied by the Shepard and Morse Lumber Company while the land east and south of the basin was occupied by Flint and Hall as a lumber yard.

In an advertisement in the 1889-1890 *Burlington City Directory*, Shepard and Morse were listed as manufacturers, wholesalers and retail dealers of lumber of all descriptions with steam mills and yards at Burlington, Ottawa, and East Saginaw, Michigan (Waite 1889). It owned 25 acres of yards with a total capacity of 30 million feet and a total of 4,000 feet of dock frontage on Lake Champlain. The company's Burlington planing mill dressed 40 million feet yearly, and approximately 250 to 300 were employed in the city. Total annual sales were $3.5 million (Possons 1890:38).

In 1894, the land at the north end of the barge canal was used by Skillings, Whitney and Barnes, the successor firm to the Lawrence Barnes interests, as their lumberyard. On the east side of the canal, south of the lumberyard were several coal houses. The land east of the south end of the canal was used by Horatio Hickok & Company as their lumber yard, planing mill and match factory site (Figure 30).

Significant portions of the lumber produced in Burlington were used by local industry. Two of the major consumers of lumber included Mathews & Hickok, later Horatio Hickok Company. Mathews & Hickok manufactured packing boxes, cloth boards and other products. Established by Messrs. Mathews and Davis in 1871, it was reorganized in 1875. An 1891 publication described its operations:

> Hundreds, thousands of feet of lumber are worked up per week, and boxes of various shapes and sizes are produced, from the smallest box used in packing to the largest dry goods case. The factory is equipped with a full and complete complement of the most modern improved machinery, and a large force of hands find constant and remunerative employment (Anonymous 1891:50).

The major decline in the city's lumber industry occurred in the 1890s. Annual lumber shipments to Burlington from Canada fell below the 100 million foot mark as forests of the western United States began to be developed and offered competition (Gove 1971:42).

Changes in United States trade policy resulted in a fatal blow to Burlington's lumber industry. The Dingley Tariff, passed in 1897 largely as a result of lobbying by lumbermen from the North Carolina pine country (Defebaugh 1906:I:453), raised tariffs across the board and imposed a duty of $2 per thousand linear feet on all lumber from Canada (Gove 1971:42). Imported lumber became more expensive than that harvested domestically. In 1897, over 158 million board feet valued at $1.4 million was imported to the United States, while the following year, the amount imported fell to 55 million (Amrhein 1958:219). Importation of logs and round timber fell from 40 million feet in 1897 to less than 600,000 feet three years later (Amrhein 1958:220).

William Gove, historian of the city's lumber industry, concluded that, even without the tariff, Burlington's days as a lumber center would have been numbered. Rapidly changing modes of transportation cancelled out the city's earlier geographic advantages (Gove 1971:42). Planing mills had been constructed on the St. Lawrence River and a direct rail line had opened between the St. Lawrence River and Boston (Orr 1972:89).

By the late nineteenth century, lumber businesses located along the canal had begun to be supplanted by other businesses who sought to take advantage of the availability of docking space. One such company was Adsit and Bigelow, a wholesaler and retail dealer of coal and wood. In an 1890 directory entry, the company reported that it had on hand "a large supply of Lackawanna and Lehigh, also George's Creek Cumberland, and Cannel Coal." Much of the company's product was shipped to it from the coalfields of eastern Pennsylvania and western Maryland (Waite 1890:62).

A 1900 Sanborn map indicates that the L. Bartley Coal House was located at the north end of the canal, while coal houses owned by E.S. Adsit, Gay and Henderson, and Citizens Coal Company were located on the east side (Figure 31). Citizens Coal Company had been established in 1899-1900 near the north end of the canal (Corey and Petersen 1996:30). Its directory advertisement indicated that its modern coal pockets insured quick delivery and clean coal (Waite 1900:92). The remaining land adjacent to the north end of the canal was used as lumber yards by Robinson, Edwards Company, while the land to the east of the south end of the canal was owned by the Horatio Hickok Company and used as a lumber yard and planing mill. The map also shows evidence of non-wood products uses located in the vicinity of the canal. The Malted Cereal Company (later Maltex) had erected a building on the west side of Pine Street in a former lumber yard (Figure 31; Plate 21).

Lawrence Bartley began leasing land and dock front for a coal yard from the Rutland Railroad in April 1898. The lease also granted a right of way for teams to approach the property and for boats to go through the basin and canal. By 1929, the Bartley complex consisted of two coal sheds, several smaller sheds, a barn, and an office/scale building. The Bartley Corporation surrendered the lease to the land in 1942 (Nimke 1990:136).

Before the advent of piped natural gas, gas used for lighting and heating was produced by coal gas manufacture. In 1895, a manufactured gas plant (MGP) began operations on Pine Street, southeast of the barge canal. This plant converted oil and coal into gas. As part of the manufacturing process, wood chips were used to filter contaminants from the gas. Coal gasification wastes included coal tar, fuel oil, tar-saturated wood chips, cinders, cyanide, and

metals. Wastes were reportedly disposed of in the wetlands surrounding the canal. The plant operated until 1966 (USEPA 1998:5).

By 1919, much of the land adjacent to the north end of the canal was owned by the Robinson-Edwards Lumber Company and was used for lumber store houses, lumber sheds, and lumber storage. West of the north end of the canal, Lawrence Bartley had a coal shed, and the Standard Coal and Ice Company had two sheds with trestle connections to the canal (Figure 32).

By 1926, the E.S. Adsit Coal Company had built coal sheds on the west side of the north end of the canal, and T.A. Haigh Lumber had established a lumber and building supplies yard adjacent to the north end of the canal. The main yard of the City of Burlington Street Department was located on the east side of the north end of the canal (Figure 33).

By 1942, Bartley Corporation operated the former E.S. Adsit Coal Company sheds adjacent to the north end of the canal. E.S. Adsit had relocated its operations to a yard on the east side of the canal. The main yard of the City of Burlington Street Department remained on the east side of the canal, while an auto junkyard occupied land south of the Bartley Corporation sheds (Figure 21).

The most recent available Sanborn map of the canal area is 1955 (Figure 22). In that year, E.S. Adsit Coal Company occupied the site at the north end of the barge canal initially developed by Lawrence Bartley. Its building included coal sheds and scales. The north end of the canal was bordered by the southwest corner of the T.A. Haigh Lumber Company lumber yard. The east side of the north portion of the canal was the site of the main yard of the Burlington Street Department and the coal yard of the Citizens Coal Company. Both properties bordered on Pine Street and extended west to the canal. Citizens Coal and Oil Company, whose president and manager was George H. Jarrett, had its office and yard at 377 Pine Street (Manning 1955:86). T.A. Haigh Lumber Company had its lumber yard and builders' supply office at 315 Pine Street. Its president and manager was T. Arnold Haigh (Manning 1955:147).

No buildings or structures adjoined the south portion of the canal. The property on the east side of the canal was the location of the Maltex Company manufacturing plan and warehouses of the E.B. and A.C. Whiting Company, manufacturers of brush fibers.

By 2000, all older buildings in the immediate vicinity of the barge canal had been demolished and a Quonset hut has been erected south of the barge canal bridge. The barge canal bridge remains, though the mechanism is inoperable. Several older buildings remain east of the barge canal on the west side of Pine Street. These include the Maltex Building, now used as offices, and the former Citizen Oil complex (Figure 2).

4.2 Champlain Valley Canal Boats

The first canal boats of the Champlain Valley region were constructed for use on the Champlain Canal. When completed in 1823, the Champlain Canal, extending in a north-south direction, connected Lake Champlain at Whitehall with the northern terminus of Hudson River navigation at Waterford, New York. As originally constructed, the canal consisted of 17 locks, each measuring 75 feet in length and 14 feet in width. By the time the canal was open for its first traffic, the locks had been increased to 90 feet in length and 14 feet in width. The actual canal prism was 40 feet wide at the top and 28 feet wide at the bottom, and held a four-foot depth of water. Because of the shallow water depth and the narrow locks, most existing lake craft could not utilize the canal. Specially designed canal boats were therefore constructed at various yards in

the Champlain Valley. Early canal boats consisted of crude, box cargo carriers and passenger boats called "packets." Both were towed through the canal by teams of mules or horses. By 1833, there were 232 cargo and passenger canal boats registered at towns along Lake Champlain and the canal (Crisman 1990:10-11; Bellico 1992:238).

Two years after the completion of the Champlain Canal, the Erie Canal, New York's east-west canal was completed. It extended from Buffalo along the Mohawk River Valley to the southern terminus of the Champlain Canal at Waterford. The Erie Canal was constructed very similar to the Champlain Canal. Between 1833 and 1843, Canada's Chambly Canal was constructed. It was built to bypass a series of rapids on the Richelieu River between Chambly Basin and Saint-Jean-sur-Richelieu, in Quebec province, Canada. Along with the smaller Saint-Ours Canal, built around the same time to the south of Sorel, these canals permitted uninterrupted water communication for about 90 miles from Lake Champlain to the St. Lawrence River (Bellico 1992:238).

Two basic types of canal boats operated on Lake Champlain. One was the standard canal boat that had to be towed on the open lake and the other consisted of half sloop or schooner and half canal boat. Canal sloops and schooners were propelled by sail. On entering the canal their masts would be taken down in order to pass under low bridges. It was then towed along the canal by the traditional method of using mules or horses (Bellico 1992:238-239).

The primary boat used on the Erie Canal was the standard canal boat. Between 1825 and 1862, the standard canal boat was approximately 78 ½ feet in length, 14 ½ feet in width, with a 3 ½ foot draft (Glenn 1980:100). The dimensions of the sailing canal vessels and the standard canal vessels operating on Lake Champlain during this period were very similar. Prior to the 1860s the average Champlain Canal boat (both sailing and standard) was between 77 and 79 ½ feet in length, with a width of 13 ½ feet. After some enlargement of the Champlain Canal in the 1860s, the boats became slightly larger with a typical length of 88 feet in length and 14 ½ feet in width (Bellico 1992:239). By 1862, the Erie Canal had also been enlarged, with all of its locks now measuring 110 feet by 18 feet. Between 1862 and 1899, the standard Erie Canal boat measured 98 feet by 17 ½ feet and had a 6-foot draft (Larkin 1998:31). It was not until 1877 that all of the locks on the Champlain Canal were increased to match those of the Erie Canal (Bellico 1992:239).

Site files of the Vermont Division for Historic Preservation indicate that there are 15 positively identified standard canal boat archaeological sites within Vermont's portion of the Lake Champlain Valley (Table 1). The Lake Champlain Maritime Museum (LCMM) identified the majority of these sites between 1983 and 1998.

Very little information about five of the canal boats (VT-AD-720, 723, 724, 726 and 727) was gained from the VDHP files. Of the remaining ten vessels, six are in a poor state of preservation (VT-CH-589, 592, 796, VT-GI-23, VT-RU-262 and Wreck D), two are considered in good condition (VT-AD-728 and VT-CH-575), and two are in an excellent state of preservation (Wreck N and Wreck Z).

Wreck N was discovered in 1997, and Wreck Z in 1998, during the LCMM Lake Champlain Underwater Cultural Resources Survey (Sabick et al. 2000:115-116, 130-133). These investigations record that Wreck N lays in deep water and is the site of a standard canal boat that apparently sank unexpectedly, since it is still full of its cargo of coal and its two anchors sit on the deck at the bow. The wreck is very well preserved, though the central section of the hull is filled with silt. The boat has a single large open cargo hatch, which is supported by a series of beams,

standing knees and stanchions. The bow of the vessel is flat and is tied together with a bresthook. The wrecks stern cabin is quite large and decorated with ornate wood trim. The windows surrounding the cabin are all broken out and one of the window frames rests on the starboard rail. The vessel's transom has a large overhang, through which the rudderpost passes. In the starboard quarter of the stern deck is a small hatch that allowed access to the living area. The rudderpost is attached to a barn door rudder (Sabick et al. 2000:115-116).

Wreck Z, also a standard canal boat loaded with coal, is recorded as being in an excellent state of preservation. The site lies at a depth of 100 feet and it sits on the firm lake bottom. A swift current in the area scours away any silt that might collect around the hull. The hull is of similar construction to Wreck N, built plank-on-frame, with a single large open cargo hatch that runs the length of the deck. An iron windlass at the bow is supported by two bits and a substantial bresthook. A single anchor is present on the starboard side of the bow. Directly aft of the windlass is a small hatch that leads to the forward cabin. This enclosure is devoid of artifacts or furnishings, so it was most likely used as a cable locker (Sabick et al. 2000:130-131).

The cargo hold is full of coal that does not appear to have shifted forward, indicating that the vessel sank rather slowly. Throughout the length of the cargo hatch, the hull is reinforced with a number of transverse beams supported by knees and stanchions. The junctions between the transverse beams and stanchions are supported with U-shaped iron bands (Sabick et al. 2000:131).

At the stern end of the hatch and forward of the stern cabin stands a steering mechanism, which consists of an iron wheel and gear assembly. The roof of the stern cabin has torn loose of the hull, and rests off the starboard side of the boat. A jumble of timbers fills the interior of the cabin, and numerous artifacts, consisting of cookware, a stove, silverware and furniture are scattered among the timbers. The roof of the deckhouse has a typical opening for a portside companionway, as well as a stovepipe hole. On the stern deck of the vessel stands a small windlass and the tiller for the rudder is pushed over the port. The rudderpost passes through the deck, which overhangs the transom of the vessel (Sabick et al. 2000:131-132).

5.0 EVALUATION OF POTENTIAL NATIONAL REGISTER ELIGIBILITY

National Register of Historic Places eligibility criteria are set forth at 36 CFR 60.4. To be eligible for the NRHP a district, site, building, structure, or object must possess integrity of location, design, setting, materials, workmanship, feeling, and association, and satisfy one or more of four additional criteria. The historic property must be: associated with events that have made a significant contribution to the broad patterns of our history (Criterion A); and/or be associated with the lives of persons significant in our past (Criterion B); and/or embody the distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction (Criterion C); and/or have yielded, or be likely to yield information important in prehistory or history (Criterion D).

5.1 The Pine Street Canal and Associated Structures

The Vermont Division for Historic Preservation (DHP) has previously evaluated Pine Street Canal and the Barge Canal bridge and determined that they are eligible for the NRHP. On February 18, 1986, the VDHP acting as the SHPO rendered an opinion that the Pine Street Barge Canal was eligible for the NRHP for historic and archeological merit. The VDHP, again acting as the SHPO, rendered the opinion that the barge canal bridge was eligible for the National Register in March 1987. Documentary research and field survey indicate that the Barge Canal, the barge canal bridge, the breakwaters, the sunken canal boats (see Section 5.2), and the remains of two boathouses/marine railways should be treated as a complex of related structures, objects, and structural remains.

The barge canal played a pivotal role in the lumber industry that dominated the economy of Burlington in the second half of the nineteenth century. Supplementing the dockage areas of the waterfront, it provided mooring for barges loaded high with Canadian lumber, lumber that was processed in the planing mills of Burlington. The drawbridge over the mouth of the barge canal carried the lakeside line of the Rutland Railroad. This railroad served the city's lumber interests and carried its products to markets throughout the northeastern United States. The breakwaters facilitated entry into the barge canal during times when the water of the lake turned rough and also helped prevent ice jams in the canal mouth.

In addition, the Study Area, with the exception of the south end of the canal, is located within the boundaries of the Pine Street Historic District, a resource recommended as NRHP-eligible in 1996 (Figure 34). The boundaries of this district are described in a 1996 report prepared by Vermont Agency of Transportation consultant Liz Pritchett:

> The northern boundary is coterminous with the southern boundary of the Battery Street Historic District, the western boundary is Lake Champlain, the southern boundary is coterminous with the southern property lines of the Maltex Partnership and the Canal Basin, and the properties along the south side of Howard Street to the intersection with Hayward Street; the eastern boundary is defined by the properties that front the east side of Pine Street as far south as Howard Street, extended east along both sides of Kilburn Street, Pine Place, and Marble Avenue to St. Paul Street; Hayward Street between Marble and Howard is also included in the district (Pritchett 1996:3-4).

5.1.1 Assessment of Integrity

Guidance on interpreting and assessing integrity, a necessary prerequisite to NRHP eligibility has been issued by the National Park Service in National Register Bulletin 15, *How to Apply the National Register Criteria for Evaluation.*

Location. Location is the place where the historic property was constructed or the place where the historic event occurred. To retain integrity of location, a resource must not have been moved. The barge canal, remains of two boathouse/marine railways, and breakwaters appear to remain at their original locations. The bridge remains at its original location, although the counterweight, critical to its operation, has been removed, and is lying west of the bridge.

Design. Design is the combination of elements that create the form, plan, space, structure, and style of the property. The barge canal has been altered through the filling in of portions of its original slips. However, the basic form of much of it remains intact, as does original fabric including riprap and some planking or cribbing. The design of the bridge has been altered by removal of the counterweight and its associated steel framework. The two boathouse/marine railways are in ruins with only foundation piers and the walls of the ramps intact and in place. The breakwaters are partly intact. Though shorter then when originally built, the basic form and plan of the breakwaters remains identifiable.

Setting. Setting in the physical environment of a historic property. In the period since the initial construction of the canal, its surroundings have undergone change. Woods and overgrown parcels have replaced open lots used for storage of wood. A bicycle path has been constructed along the Lake Champlain waterfront. Despite these obvious changes, the setting retains its basic character. The railway line that extended through the area in the nineteenth century remains. The surrounding area is still the location of light industry and related uses. Therefore, the complex retains integrity of setting.

Materials. Materials are the physical elements that were combined or deposited during a particular period of time and in a particular pattern or configuration to form a historic property. To retain integrity, a property must retain the key exterior materials dating from the period of its historic significance. The barge canal retains some of its original materials, although much of the original planking is probably no longer in place. The bridge retains the steel superstructure, although as mentioned, the counterweight and its associated framing has been removed. Much of the materials of the boathouse/marine railways are missing including the boathouse superstructure and the hauling mechanism, if any. The basic materials used in the breakwater remain, although the breakwaters have been shortened in length.

Workmanship. Workmanship is the physical evidence of crafts of a particular culture or people during any given period in history or prehistory. It is the evidence of the artisan's labor and skill in constructing or altering a building, structure, object, or site. The workmanship of the barge canal remains visible, as does the basic workmanship of the railroad bridge and the breakwaters. Because only ruins remain of the boathouses/marine railways, evidence of workmanship is lacking.

Feeling. Feeling is a property's expression of the aesthetic or historical sense of a particular period of time. Each of the structures retains a feeling of the time in which they were erected. This feeling is due to the survival of fabric identifiable as a product of the time of erection.

Association. Association is the direct link between an important historic event or person and a historic property. A property retains association if it is the place where the event actually occurred and is sufficiently intact to convey that relationship to an observer (U.S. Department of the Interior 1990:44-45). The barge canal, breakwaters, and railroad bridge all convey their historic roles to the contemporary observer. Because of the lack of historic fabric and fragmentation of remaining fabric, the boathouses/marine railways do not convey this association to the observer.

5.1.2 Conclusions

In the opinion of JMA, the Pine Street Barge Canal complex (including the canal boats described in Section 5.2) should be considered eligible for the National Register of Historic Places under Criterion A. Although time has taken its toll on the Canal and related resources, the canal, bridge, and breakwaters appear to possess the requisite integrity for National Register listing. The boathouses and marine railways are not sufficiently intact to qualify for the NRHP as structures. They must be considered archeological sites. Archeological data about them is limited. In the absence of archeological testing data about the upland portions of these features, they must be considered to have the potential to yield information about boathouse and marine railway construction and operation. If so, they would satisfy NRHP eligibility Criterion D.

5.2 The Pine Street Canal Boat Sites

The potential significance of the individual Pine Street Barge Canal canal boats, as well as their potential significance as part of a Pine Street Barge Canal complex, was determined though a systematic investigation of each site's qualities, associations, and characteristics. Significance was evaluated in conjunction with the *Lake Champlain Commercial Navigation National Register Nomination Draft Historic Context* (Crisman, 1990) and the *Preliminary Results of An Archaeological Assessment Within the Pine Street Canal Barge* (Cohn 1996).

In addition to the NRHP criteria set forth at 36 CFR 60.4, and the guidance provided in National Register Bulletin 15, *How to Apply the National Register Criteria for Evaluation*, additional guidance relevant to evaluation of the canal boats is found in National Register Bulletin 20, *Nominating Historic Vessels and Shipwrecks to the National Register of Historic Places*, which clarifies the National Register process for shipwrecks and other submerged cultural resources. As with other types of historic properties, shipwrecks must have integrity and meet at least one of the four NRHP eligibility criteria. Determining the significance of a historic vessel also depends on meeting at least one of the following additional criteria:

1. be the sole, best, or a good representative of a specific vessel type; or

2. be associated with a significant designer or builder; or

3. have been involved in important maritime trade, naval recreational, government, or commercial activities.

The submerged cultural resources in the Pine Street Canal are potentially significant in the areas of architecture, commerce, industry, maritime history, and transportation. In the opinion of JMA and Dolan Research, the five canal boat sites satisfy NRHP eligibility criteria C and D. It appears that the hulls of the five boats have survived mostly intact with the interior portions covered in one to four feet of sediment. Construction features of the boats confirm that the wrecks represent

a vessel type (standard canal boat) that operated in Lake Champlain and its canals during the last quarter of the nineteenth century. The 17 ½ -foot beam confirms that the vessel operated in the canals after they were enlarged in the 1877. The canal boats have the potential to yield additional historically important information such as hull construction details. Detailed documentation of the hull construction would likely provide information on adaptations incorporated into the last periods of Lake Champlain canal boat construction and use.

The type of canal vessel represented by those in the Pine Street Barge Canal played a major role in the economic development of Burlington during the last quarter of the nineteenth century. Towed canal boats were used to haul much of the Canadian timber that was processed and transshipped at Burlington. Although a large number of these vessels were constructed in the Lake Champlain region, there are few documented archaeological sites of larger and later canal vessels. In terms of the Guidance provided by National Register Bulletin 20, the canal boats individually could be determined to be "a good representative of a specific vessel type," and "was involved in important maritime trade."

6.0 PROJECT IMPACTS AND RECOMMENDED MITIGATION

The effects that a proposed undertaking will have on a historic property are based on the distinguishing characteristics of the resource and the design and the anticipated consequences of the undertaking. Effects to historic properties on or eligible for listing in the National Register of Historic Places are evaluated with regard to the Criteria of Adverse Effect set forth in the regulations of the Advisory Council on Historic Preservation at 36 CFR 800.5. According to these criteria:

> An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. or use may be relevant depending on a property's significant characteristics and should be considered
>
> Adverse effects on historic properties include, but are not limited to:
>
> (i) Physical destruction, damage, or alteration of all or part of the property;
>
> (ii) Alteration of a property, including restoration, rehabilitation, repair, maintenance, stabilization, hazardous material remediation, and provision of handicapped access that is not consistent with the Secretary of the Interior's standards for the treatment of historic properties (36 CFR 68) and applicable guidelines;
>
> (iii) Removal of the property from its historic location;
>
> (iv) Changes of the character of the property's use or of physical features within the property's setting that contribute to its historic significance;
>
> (v) Introduction of visual, atmospheric, or audible elements that diminish the integrity of the property's significant historic features;
>
> (vi) Neglect of a property which causes its deterioration, except where such neglect and deterioration are recognized qualities of a property of religious and cultural significance to an Indian tribe or Native Hawaiian organization; and
>
> (vii) Transfer, lease or sale of property out of Federal ownership or control without adequate and legally enforceable restrictions or conditions to ensure long-term preservation of the property's historic significance.

6.1 The Pine Street Barge Canal

In the opinion of JMA, the Pine Street Barge Canal will be adversely affected by implementation of the selected remedy. The placement of up to three feet of capping material within the Canal and turning basin can be viewed as resulting in an "alteration" of the property. Although, the

placement of the capping material is a potentially reversible effect, this is not likely to occur. In addition, the present appearance of the Canal will be slightly changed as a result of alterations to the vegetation in the southern part of the Canal. Several feet of water will be maintained in the Canal and its appearance to observers will not be permanently altered or affected. A possible mitigation measure would be the preparation of a popular history brochure describing the history and significance of the barge canal and its associated resources.

The proposed remedy also calls for the placement of institutional controls on the Pine Street Canal Superfund Site. According to the Final Additional Feasibility Study which is incorporated into the ROD, these "would include deed restrictions on the property to ensure that only industrial or commercial activities are conducted with appropriate health and safety safeguards for construction workers. A barrier would be installed across accessible portions of the Site to prevent unauthorized vehicular access. Pedestrian access would be unaffected. The integrity of the Site barriers would be evaluated yearly to ensure that access restrictions are maintained" (RETEC 1998:2-25). As public accessibility to the canal will remain unchanged construction of the barrier will, in the opinion of JMA, have no effect on the Canal and associated resources. As deed restrictions will place limits on the types of future activities permitted at the Site (e.g. no excavations to depths greater than five feet except under special, limited circumstances) they will not, in the opinion of JMA, have an adverse effect.

6.2 The Canal Drawbridge and Breakwaters

Associated with the implementation of the selected remedy is the construction of a permanent weir at the mouth of the turning basin where it enters Lake Champlain. Detailed design information on this structure is not yet available. However, weir design will include the installation of a new concrete abutment on either side of the canal basin outlet for the purpose of anchoring the weir. Each new abutment will be placed against the canal-facing side of each of the two existing drawbridge abutments. This will result in a change in the appearance of the drawbridge abutments that could be considered an adverse effect. However, the physical integrity of the existing abutments will not be affected and, given the scale and industrial nature of the resource, the visual effect is considered minor. Large format photography to Historic American Engineering Record (HAER)-standards is recommended as mitigation. The breakwaters will not be directly affected by the implementation of the selected remedy.

6.3 The Marine Railways

The shipways associated with the boathouse/marine railways at the south end of the Pine Street Barge Canal turning basin extend into the turning basin and will be covered by the subaqueous cap which will be placed in that area. The underwater portions of these remains are already partially buried by sediments in the turning basin. They were measured, sketched and photographed by ROV in 1996 (Manley et al. 1996; Cohn 1996). As with the Pine Street Barge Canal itself, the placement of up to three feet of capping material on the underwater portions of the marine railways could be viewed as resulting in an "alteration" of the property. While the placement of the capping material is a potentially reversible effect, this is not likely to occur. Given the limited nature of the effect of the selected remedy, and the fact that it is unlikely that additional direct study of the underwater portions of the marine railways is likely to contribute any important additional information, in the opinion of JMA no mitigation measures relating to this portion of this historic property are warranted.

The remains of the boathouses associated with the marine railway constitute an archeological site. The archeological data potential of this site has not been evaluated through test excavations. Although the remains of the boathouses have the potential to yield important information about the design, construction and operation of the marine railways, their ability to do so in the absence of archeological test data is unknown. No construction activities associated with the proposed remedy are currently identified as occurring at the location where aboveground remnants of the boathouses were observed by JMA (see Section 3.3). However, the approximately 100 x 100-foot wetland area which will be covered with clean soil (see Figure 4) is located immediately south of the visible remains. According to Sanborn maps, the southern ends of both boathouses extended into this area. In the opinion of JMA, subsurface investigation of this area to confirm the presence of additional boathouse remains is not warranted. The placement of a small quantity of clean soil on top of possibly buried structural remains will not adversely affect those remains if the soil is deposited in a manner that does not require heavy equipment to traverse areas which have not already been covered by the clean fill.

To insure that the visible boathouse remains are not affected by the project, JMA recommends that the boundaries of the area containing the visible boathouse remains be re-identified in the field immediately prior to the start of work at the Site. Following boundary delineation this area should be demarcated with safety fencing for the period of project-related construction to insure that it is not inadvertently encroached upon.

6.4 The Pine Street Canal Boat Sites

In assessing the effects of implementation of the proposed remedy on the canal boats, it is understood that the placement of a subaqueous cap over the wreck sites will not physically damage the hulls of the boats. The cap must be designed to provide resistance to erosion caused by surface currents, waves caused by wind, and propeller wash, as well as a barrier to the effects of burrowing bottom dwelling organisms (bioturbation). This effectively means that the cap will also serve to protect the remains of the canal boats from these same effects. Existing contaminated sediments within the Canal and turning basin have effectively eliminated the ability to archeologically investigate the boats. Cap placement will restrict that ability even further. The contamination of the sediments in the Pine Street Canal makes mitigation through further on-site data recovery a less feasible option. To compensate for the adverse effects on these cultural resources, a preferred management option for the wreck sites may involve an off-site mitigation of a similar vessel type. This approach, termed "Low Impact Remediation," was first proposed for the canal boats in the Pine Street Canal by Art Cohn of the Lake Champlain Maritime Museum (Johnson 1998).

At least 15 other similar standard canal boat wrecks have been documented in Lake Champlain (see Section 4.2). Study of some of these might afford archaeologists a better and safer opportunity to gather data on this vessel type. Wreck Z may be the best preserved of these wrecks and may be most similar to the Pine Street Barge canal wrecks. Identified during an intensive survey of Lake Champlain by personnel from the Lake Champlain Maritime Museum, Wreck Z was also a standard canal boat that was loaded with coal. It is recorded as being in an excellent state of preservation, lying at a depth of 100 feet. Although at a relatively deep depth, the wreck has been undisturbed and would provide archaeologists with significant archeological data on the construction, role and significance of "enlarged" Erie Canal boats. The valuable information contained within such a pristine site would lend itself to display and interpretation in regional repositories specializing in these topics, such as the Lake Champlain Maritime Museum, Vergennes, Vermont.

The most feasible mitigation option would be to record data from the alternative wreck on the bottom. Prior to initiating field work, archival documentary information should be gathered to answer research questions on the construction, operation, and role of the standard canal boats in the Pine Street Barge Canal specifically, and Lake Champlain in general. As part of the mitigation process, a research design should be developed that outlines the exact recordation procedures to use at the wreck site, and delineates research questions that could be answered with field data. Due to the relatively deep water at the wreck site, video and photographic records of the wreck should be a priority. A pre-disturbance site map should be completed prior to any underwater recordation or excavation. Divers should collect sufficient data to generate a three-dimensional site map of the wreck. All structural evidence should be mapped *in situ* and recorded where desirable and possible. It is not anticipated that any cultural material would have to be removed. This would limit conservation costs.

Data collected through fieldwork should be disseminated to the public in several ways. Mitigation efforts of a canal boat wreck site could produce the following:

1) A small museum-quality display on the wreck site and standard canal boats in general;

2) An illustrated history of standard canal boats suitable for publication in booklet format and as an accompaniment to a display on the wreck site;

3) A narrated video-tape of the underwater archaeological project;

4) An NRHP nomination form; and

5) Information to support the consideration of the wreck site for inclusion in the Lake Champlain Underwater Historic Preserve System (if appropriate).

6.5 Areas of Prehistoric Archeological Sensitivity

The 1992 Phase IA cultural resources survey (Cook and McCarthy 1992) identified areas of high, moderate, and low archeological sensitivity within the boundaries of the Site (Figure 35). The 1992 assessment was based on a reconnaissance of the site and assumed that any area where prior disturbance could be documented possessed a low sensitivity for prehistoric archeological resources. Wetland areas are considered areas of moderate sensitivity because better drained soils *adjacent* to wetlands would have been attractive locations for aboriginal campsite or food-processing locations. The Phase IA survey also states that areas that were "not wetlands and not documented as disturbed by extant or former structures are deemed to possess high potential for prehistoric archeological remains" (1992:17).

At the time of the 1992 survey, no geotechnical information was available regarding subsurface conditions within the Study Area. Several studies since that time have confirmed the presence of extensive fill deposits over the Site. A 1992 Feasibility Study for the project (Metcalf and Eddy 1992) concluded that a layer of fill covered most of the Site. The fill was described as containing ashes and gas plant purifier wood chips in many locations. The Additional Remedial Investigation Report (The Johnson Company 1997) cites the earlier Feasibility Study and notes that the "composition and age of the fill are believed to be highly variable across the Site. Sources of wood chips in the fill could include lumber activity at the Site in the 1800s, when over six million

board feet were processed, as well as gas plant wastes" (1997:62). Other sources of fill probably include spoil from the excavation of the Pine Street Canal and turning basin.

A 1998 Additional Feasibility Study (RETEC 1998) incorporates geotechnical information from a report prepared by the Vermont Department of Environmental Conservation. Figure 36 shows the locations of borings in the Study Area including borings at the Site and the locations of interpolated cross sections of subsurface conditions. Copies of the cross-sections are presented as Figures 37-41. These confirmed the presence fill up to 15 feet thick in some areas. An extensive set of additional borings conducted by the Johnson Company has been used to develop a fill isopach map of the Site (Figure 42). These data clearly indicate that, except for some small areas west of the Maltex complex, all of the Site is covered with a minimum of five feet of fill, and in some areas fill thickness exceeds 25 feet.

In the opinion of JMA, fill deposits at the site are not a potentially significant historic resource. Precise sources of fill cannot be confirmed and available information suggests that extensive mixing of various fill types has occurred.

It is possible that prehistoric sites could exist under existing fill. However, the proposed laydown and staging area for the project, located just north of the turning basin, is covered by up to 15 feet of fill. Soil compaction from heavy equipment and spoil stockpiling is generally confined to the upper two feet of soil. Soil disturbance associated with the movement of heavy equipment during the most adverse of weather conditions (rain and snow) is generally confined to the same zone. For these reasons project-related activities do not, in the opinion of JMA, have the potential to affect prehistoric archeological resources which may be present under the existing fill at the Site. No additional studies or mitigation relating to potential prehistoric archeological sites is recommended in connection with the project.

7.0 REFERENCES

Amrhein, Joseph

1958 Burlington, Vermont: The Economic History of a Northern New England City. Doctoral dissertation, New York University.

Anonymous

1854 The Manufactures of Burlington. *The Daily Free Press*. December 20, 1854.

1859 The Lumber Business of Burlington. *The Daily Free Press*. March 30, 1859.

1865 The Lumber Trade of Burlington. *The Daily Free Press*. December 28, 1865.

1867 New Lumber Firm. *Burlington Free Press*. April 23, 1867.

1868a The Lumber Trade of Burlington. Business of 1867. *The Free Press* (Burlington). February 19, 1868.

1868b Down at the Lake Shore. *The Free Press* (Burlington). July 20, 1868.

1869a The Lumber Trade of Burlington. The Figures for 1868. *Daily Free Press and Times*. February 6, 1869.

1869 Heavy Change of Lumber Concern. *Daily Free Press and Times* (Burlington). September 4, 1869.

1871a [Lumber imported from the Dominion of Canada.] *The Free Press and Times* (Burlington). June 9, 1871.

1871b The Lumber Trade of Burlington. *The Free Press and Times* (Burlington). November 15, 1871.

1871c Important Accession to the Lumber Interests of Burlington. *The Free Press and Times* (Burlington). December 5, 1871.

1873 The Lumber Business of Burlington. *The Free Press and Times*. August 25, 1873.

1891 *Industries and Wealth of the Principal Points of Vermont*. American Publishing and Engraving Company, New York.

Archaeology Consulting Team, Inc.

1991 Phase I Archaeological Study, AT&T Fiber Optic Cable, Burlington, Vermont to Keesville, New York. On file Vermont Division for Historic Preservation, Montpelier, Vermont.

Aske, Jerry, Jr., and Gardiner Lane

1992 *The History of the Shelburne Shipyard and its shipbuilding activities during World War II and the Korean conflict*. Chittenden County Regional Planning Commission, Essex Junction, Vermont.

Beers, F.W.
1869 *Atlas of Chittenden County, Vermont.* Reprinted in 1971 by C.E. Tuttle Company, Rutland. A.D. Ellis and G.G. Soule, New York.

Bellico, Russell, P.
1992 Champlain Canal Boats. In *Sails and Steam in the Mountains: A Maritime and Military History of Lake George and Lake Champlain.* Purple Mountain Press, Fleischmanns, New York.

Bishop, Nathaniel H.
1878 *Voyage of a Paper Canoe: A Geographical Journey of 2500 Miles from Quebec to the Gulf of Mexico during the Years 1874-5.* Originally published by Lee and Shepard, Boston. Reprinted on website: www.eldritchpress.org/nhb/paperc/intro.html.

Blow, David J.
1991 *Historic Guide to Burlington Neighborhoods.* Chittenden County Historical Society, Burlington, Vermont.

Champlain Maritime Society
1984 Phase I Underwater Archaeological Assessment for the Proposed Burlington Waterfront Redevelopment Project. On file, Vermont Division for Historic Preservation, Montpelier, Vermont.

Cohn, Arthur
1996 Preliminary results of An Archaeological Assessment within the Pine Street Barge Canal. Submitted to The Johnson Company, Montpelier, Vermont.

Cook, Lauren J., and John P. McCarthy
1992 A Stage IA Cultural Resources Survey of the Pine Street Canal Superfund Site, Burlington, Vermont. Prepared by John Milner Associates, Inc. for Metcalf & Eddy, Inc. and the U.S. Environmental Protection Agency.

Corey, Richard P., and James B. Petersen
1996 An Archeological Phase IA Study of the C-6 Alignment, Southern Connector Project, MEGC-5000(1), Burlington, Chittenden County, Vermont. Prepared by Archeology Research Center, University of Maine at Farmington for the Vermont Agency of Transportation. Revised March 1998. On file at the Vermont Division for Historic Preservation, Montpelier.

Cramer, Adele
1977 Shelburne Shipyard. State of Vermont Historic Sites and Structures Survey Form. Survey Number: 0413-10. On file at the State of Vermont, Division for Historic Preservation, Montpelier.

Cridlebaugh, Bruce S.
1999 Bridges and Tunnels of Allegheny County, Pennsylvania: Terminology. Website: www.buildingtechnology.com/bcba/bridges/termsBrg.htm.

Crisman, K.
1990 Lake Champlain Commercial Navigation. Historic Context. Ms. on file, Vermont Division for Historic Preservation, Montpelier.

Defebaugh, James Elliott
1906 *History of the Lumber Industry of America*. Two volumes. The American Lumberman, Chicago.

Dolan Research, Inc.
1992 A Phase II Archaeological Evaluation of Three Identified Marine Archaeological Resources at the USGS Station Burlington, Burlington, Vermont. On file Vermont Division for Historic Preservation, Montpelier, Vermont.

Dumbleton, William (Lake Champlain Transportation Company)
2001 Telephone interview. Burlington, Vermont. January 16, 2001.

Gilbertson, Eric (Director, Vermont Division for Historic Preservation)
1988 Letter to Charles Van Winkle, Fitzpatrick-Llewellyn concerning the counterweight from the Burlington Barge Canal Bridge. June 2, 1988.

Glenn, Morris F.
1980 Volume 4, Canal Boats. In *Glenn's History of Lake Champlain (New York and Vermont)*. Morris F. Glenn, Alexandria, Virginia.

Gove, William F.
1971 Burlington: the Former Lumber Capital. *The Northern Logger and Timber Processor*. May 1971:36 ff.

Hill, Ralph Nading
1953 Shelburne Shipyard. *Vermont Life* VIII:1 (Autumn 1953): 9 ff.

Hopkins, G.M.
1890 *Map of City of Burlington, Vermont from Official Records, Private Plans and Actual Surveys*. G.M. Hopkins, Philadelphia. In Wilbur Special Collections, Bailey-Howe Library, University of Vermont.

Hovey, Otis Ellis
1926 *Movable Bridges*. Volume I-Superstructure. John Wiley & Sons, Inc., New York.

Johnson Company, Inc.
1997 *Pine Street Superfund Site, Burlington, Vermont. Additional Remedial Investigation*. Volume I – Report. Submitted to the U.S. Environmental Protection Agency, Region I. The Johnson Company, Montpelier, Vermont.

1997 Additional Remedial Investigation, Pine Street Canal Superfund Site, Burlington, Vermont. Report submitted to USEPA Region I. The Johnson Company, Montpelier, Vermont.

Johnson, Gregory B.
1998 Letter dated January14, 1998 from Gregory B. Johnson, P.E., Senior Engineer, The Johnson Company, to Ross Gilleland, U.S. Environmental Protection Agency, Boston.

Larkin, F. Daniel
1998 *New York State Canals: A Short History*. Purple Mountain Press, Fleischmanns, New York.

Manley, Pat, Tom Manley and Art Cohn (Manley et al.)
1996 Pine Street Barge Canal Survey, Side-scan Sonar and ROV, April-May 1996. Report prepared for the Johnson Company, Montpelier, Vermont.

Manning, H.A. Company
1955 *Manning's Burlington, Winooski, South Burlington and Essex Junction Directory for Year Beginning January, 1956*. H.A. Manning Company, Springfield, Massachusetts.

Meilbek, E.
1877 *Birds Eye View of Burlington and Winooski, Vt.* Shober & Carqueville Lith., Chicago. In Wilbur Collection, University of Vermont.

Metcalf and Eddy
1992 Feasibility Study, Final Report. Prepared for USEPA, Contract No. 68-W9-0036 (SRS), November, 1992.

Nimke, R.W.
1990 *The Rutland: 60 Years of Trying*. Volume V, Part 1. The Main Line, Rutland-Alburgh, Vermont. Sharp Offset Printing Company, Rutland, Vermont.

Ogden, H.G. and F.D. Granger
1873 *U.S. Coat Survey, Burlington, Vermont*. Wilbur Special Collections, Bailey-Howe Library, University of Vermont, Burlington, Vermont.

Orr, David Wallis
1972 The Port of Burlington, Vermont: Site and Situation. A Study in Historical Geography. Master of Arts thesis, Graduate College, University of Vermont.

Pichot, H.
1872 *Plan of the Lumber District, Burlington, VT.* Map in the collection of the Vermont Historical Society, Montpelier.

Possons, C.H., compiler
1889 *Vermont: Its Resources and Industries*. C.H. Possons, Glens Falls, New York.

1890 *Burlington, Vt. As a Manufacturing, Business and Commercial Center*. Second edition. Burlington Board of Trade, Burlington.

Presdee and Edwards
1853 *Map of Burlington, Vermont*. Sarony and Major, New York. In Wilbur Special Collections, Bailey-Howe Library, University of Vermont, Burlington.

Pritchett, Liz
1996 Historic Resource Review. Vermont Agency of Transportation, Southern Connector/Champlain Parkway Project, MEGC-M5000(1), Chittenden County, Burlington, Vermont. Prepared for Earth Tech, Inc. by Liz Pritchett Associates.

February 7, 1996. On file at the Vermont Division for Historic Preservation, Montpelier.

Remediation Technologies, Inc. and The Johnson Company (RETEC)
1998 Draft Final Additional Feasibility Study, Pine Street Canal Superfund Site, Burlington, Vermont. Report prepared for Green Mountain Power Company and New England Electric Service, May 1998.

Ross, Ogden
1997 *The Steamboats of Lake Champlain: 1809 to 1930.* Reprint of 1930 edition. Edited by J. Kevin Graffagnino. Vermont Heritage Press, n.p.

Rumm, John C.
n.d. St. Thomas Marine Repair Slip. HAER No. VI-1. Historic American Buildings Survey.

Sabick, Christopher R., Lessmann, Anne W., McLaughlin, Scott A., and Arthur B. Cohn
2000 Lake Champlain Underwater Cultural Resources Survey. Volume II: 1997 Results and Volume III: 1998 Results. Lake Champlain Maritime Museum, Vergennes, Vermont.

Sanborn
1869 *Map of Burlington, Vermont.* Wilbur Special Collections, Bailey-How Library, University of Vermont, Burlington, Vermont.

Sanborn Map Company
1885 *Insurance Maps of Burlington, Vermont.* Sanborn Map Company, New York.

1894 *Insurance Maps of Burlington, Vermont.* Sanborn Map Company, New York.

1900 *Insurance Maps of Burlington, Vermont.* Sanborn Map Company, New York.

1906 *Insurance Maps of Burlington, Vermont.* Sanborn Map Company, New York.

1912 *Insurance Maps of Burlington, Vermont.* Sanborn Map Company, New York.

1919 *Insurance Maps of Burlington, Vermont.* Sanborn Map Company, New York.

1926 *Insurance Maps of Burlington, Vermont.* Sanborn Map Company, New York.

1942 *Insurance Maps of Burlington, Vermont.* Sanborn Map Company, New York.

1955 *Insurance Maps of Burlington, Vermont.* Sanborn Map Company, New York.

Shelburne Shipyard
2001 E-mail to Douglas McVarish. January 11, 2001.

Strauss Bascule Bridge Company
1919 Strauss Trunnion Bascule Bridge Patented for Rutland Railroad at Burlington, Vermont. Microfilm copy of engineering drawings on file at the Vermont State Records Center, Middlesex, Vermont.

United States Environmental Protection Agency (USEPA)
1998 *Cleanup Plan Proposed for Pine Street Barge Canal Superfund Site, Burlington, VT.* May 1998. EPA Region I, New England, Superfund Program, Boston, Massachusetts.

United States Geological Survey (USGS)
1948 *Burlington, VT* 7.5-minute quadrangle. Photorevised 1987. U.S. Geological Survey, Reston, Virginia.

Visser, Thomas, Elizabeth Rosin, Dr. Peter Thomas, and Prudence Doherty
1990 Historic Site Review. Burlington Wastewater Treatment Plan Project, Department of Public Works, Burlington, Vermont. Architectural Conservation and Education Service, Burlington.

Waite, L.P. and Company (Waite)
1889 *Burlington City Directory.* 1889-1890 edition. Free Press Association, Burlington.

1900 *Burlington City Directory for 1900.* Free Press Association, Burlington.

Woodbury, C.L.
1886 Map of Dock Line, Lumber Yards and Break-water, Burlington Harbor. Surveyed by Class of '88. Wilbur Collection, Bailey-Howe Library, University of Vermont (call # 143.914. 1886).

36 CFR 800.5
Protection of Historic Properties. Assessment of Adverse Effects. Code of Federal Regulations, Title 36, Chapter VIII, Part 800.5. U.S. Government Printing Office, Washington, D.C.

TABLES

Table 1. List of Standard Canal Boat Archeological Sites Within Vermont.

VDHP Site #	Site Name/ Site Identifier	Location	Depth	Dimensions	Description/ State of Preservation	Source
VT-AD-720	Diamond Island Barge East; VT-83-06; Site 15; LC83-15	Ferrisburgh	Unknown	Unknown	Standard Canal Boat/unknown state of preservation	VDHP Site Files
VT-AD-723	Diamond Island Stone Boat; VT-LC83-10; Site #15; LC83-05	Ferrisburgh	12-25'	93' x 14'	Sides of boat have broken away from hull exposing massive stone block	VDHP Site Files; The Diamond Island Stone Boat Preserve fact sheet n.d.
VT-AD-724	VT-LC84-01; Target #21	Addison	Unknown	Unknown	Standard Canal Boat/unknown state of preservation	VDHP Site Files
VT-AD-726	VT-LC84-03; LC84-19	Shoreham	Unknown	Unknown	Standard Canal Boat/unknown state of preservation	VDHP Site Files
VT-AD-727	VT-LC84-04; LC84-16;Wreck F	Shoreham	Unknown	Unknown	Standard Canal Boat/unknown state of preservation	VDHP Site Files
VT-AD-728	VT-LC84-05; LC84-17; Wreck G	Shoreham	Unknown	95' 9" x 18' 6" x 8' to 10'	Late 19th- early 20th-century standard canal boat/wreck is in overall good condition with the hull mostly intact; decking has collapsed into hull; no evidence of deckhouse or stern cabin; stern and bow of boat are in excellent condition	VDHP Site Files; Sabick et al 2000:81-88
VT-CH-575	VT-LC85-05	Burlington	14'	95' x 18' 7"	Late 19th century standard canal boat/Most of hull buried under sediment and crib debris; the stem post, rudder, stern ceiling planking, portions of a collapsed aft cabin, port side frame tops, and stem post are partially exposed; In 1992, site was recommended eligible for the National Register	VDHP Site Files; Dolan Research 1992
VT-CH-589	*A.R. Noyes*; VT-LC85-01; Site #19; LC85-28	Shelburne	65' to 85'	90' x 14'	1884 Coal Barge/bow was crushed and partially buried by shifting coal which still remains in her hold; rudder and rudder post are visible; wreck is extremely fragile	VDHP Site Files; Coal Boat Preserve fact sheet n.d.
VT-CH-592	VT-LC85-04	Burlington	14'	87' x 12' 6"	Standard canal cargo boat/ preservation unknown; was not recommended eligible for National Register	VDHP Site Files; Champlain Maritime Society 1984

VT-CH-796	Shipwreck #4	Burlington	Unknown	Unknown	Possible standard canal boat/remains are in very poor condition	VDHP Site Files; Archaeology Consulting Team, Inc. 1991
VT-GI-23	VT-LC81-01	Alburg	Unknown	97' in length	1890s or later canal boat/flat bottom of vessel still remaining; some associated decking lies on hull	VDHP Site Files
VT-RU-262	VT-LC84-08; Site #6	Benson	Unknown	Unknown	Standard canal boat loaded with coal/the site is in overall poor condition; the bow is mostly intact, but the stern is in poor condition	VDHP Site Files
-	Wreck D	Providence Island	Unknown	Unknown	Standard canal boat/wreck in very poor condition; only bow and stern still visible; sides have collapsed into interior of vessel	Sabick et al 2000:77-78
-	Wreck N	Unknown	Unknown	Unknown	Standard canal boat/the wreck is very well preserved containing a full cargo of coal; central section of the hull is filled with silt	Sabick et al 2000:115-116
-	Wreck Z	Unknown	100'	Unknown	Standard canal boat/wreck is in an excellent state of preservation; vessel sits on the on firm lake bottom; boat is full of coal; roof of the stern cabin has torn loose exposing numerous artifacts within the cabin including cookware, a stove, silverware, and furniture.	Sabick et al 2000:130-133

FIGURES

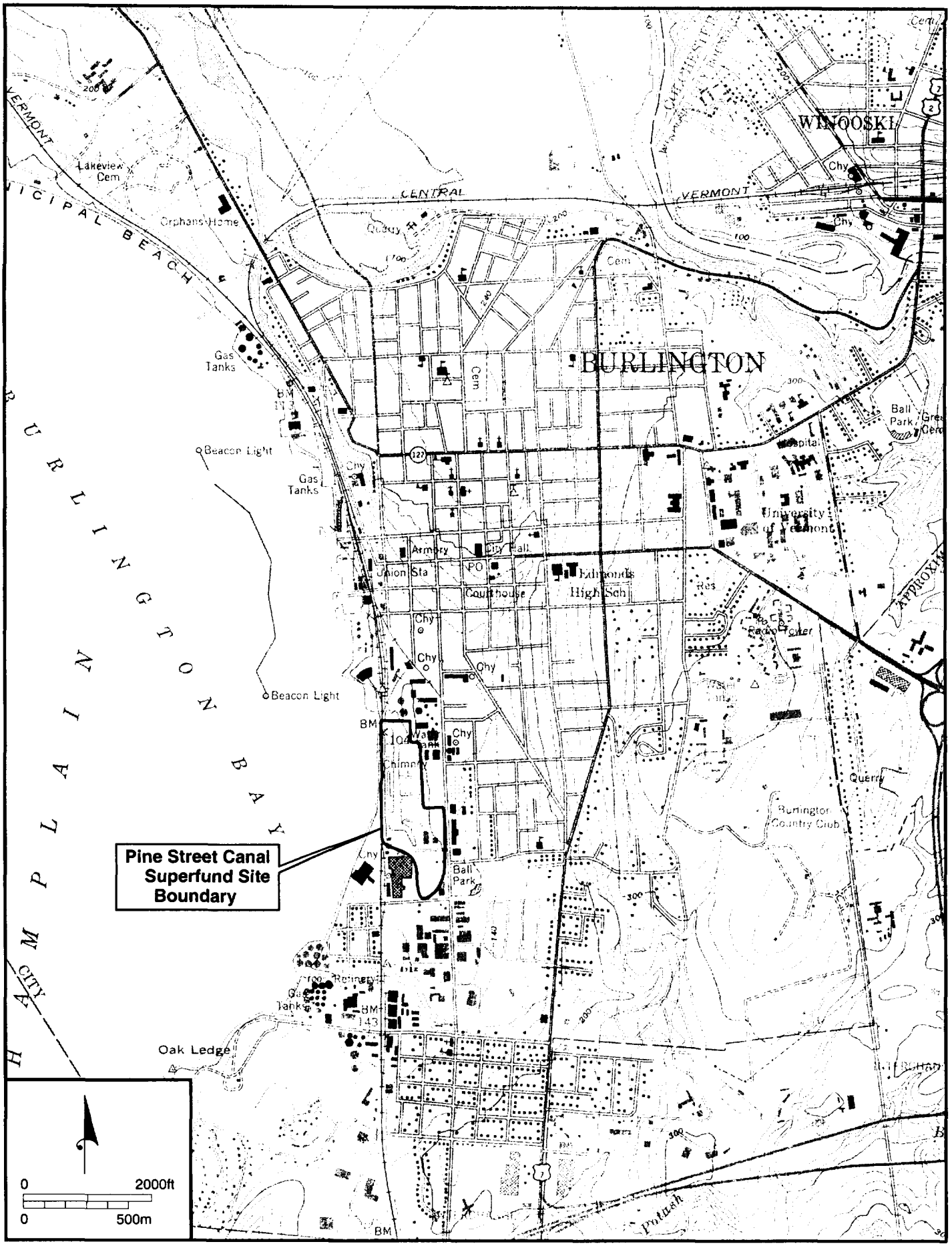
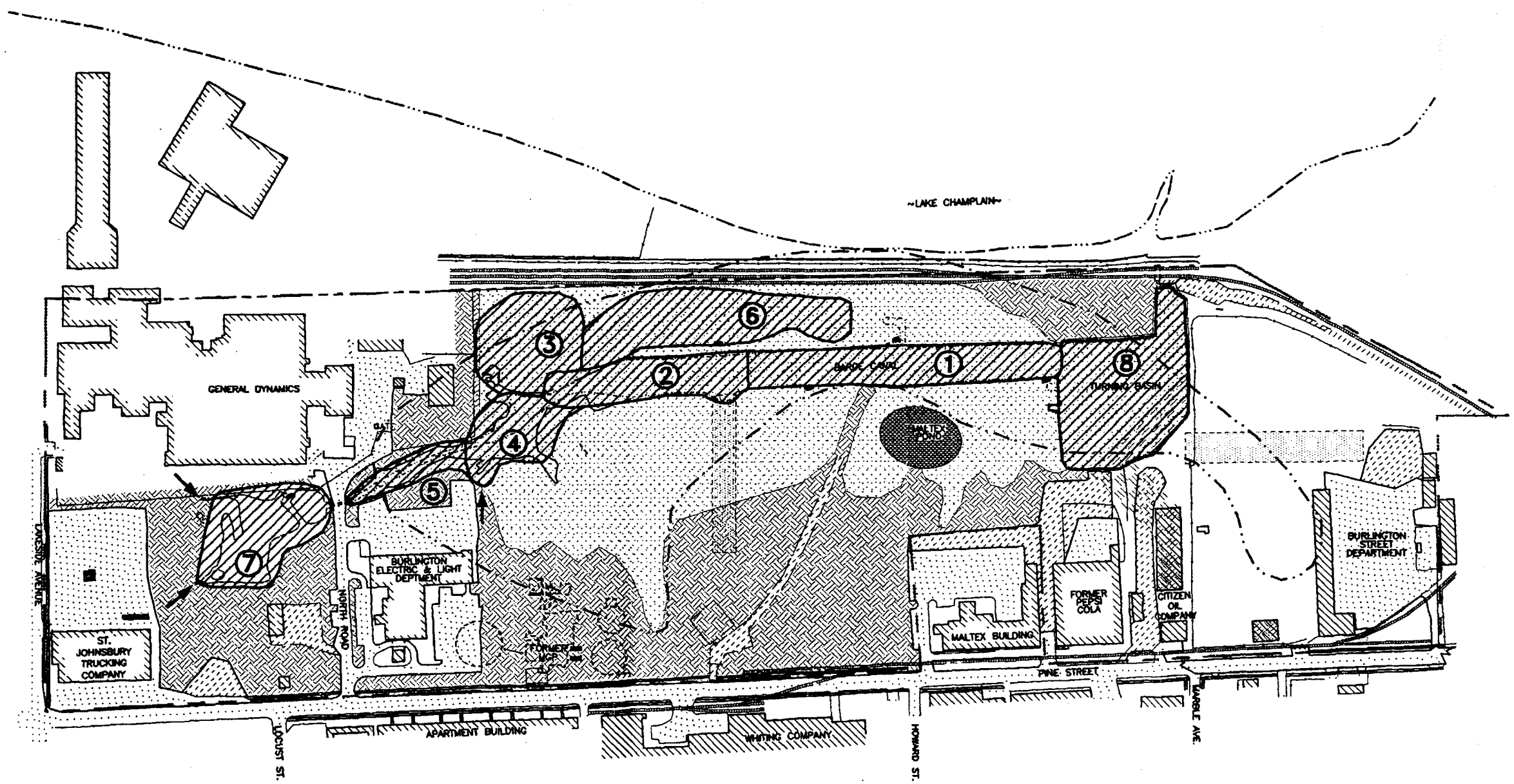


Figure 1. Project area location (detail, *Burlington, VT* 7.5-minute quadrangle, USGS 1948, photorevised 1987).

REITEC

NOTE:

1. PLAN DEVELOPED FROM: FIGURE 1-1 CONTAINED IN DRAFT ADDITIONAL REMEDIAL INVESTIGATION PHASE I WORK PLAN BY THE JOHNSON COMPANY, INC., JULY 11, 1994; UPDATE PLAN FROM NEW SURVEY DATA BY THE JOHNSON COMPANY, INC., JANUARY 10, 1995; MAP DELINEATING AN AREA FOR FURTHER STUDY ATTACHED TO A FEBRUARY 24, 1995 MEMORANDUM BY SONJA SCHUYLER (THE JOHNSON COMPANY) REGARDING DECISIONS FROM AN ECOLOGICAL WORK GROUP MEETING, 2/23/95. UPDATED FOLLOWING FEBRUARY 25,1997 PSBCCC MEETING.



LEGEND:

- AREA OF STUDY
- EDGE OF WATER
- RAILROAD
- EXISTING BUILDINGS
- FORMER MGP
- CLASS IV GROUNDWATER BOUNDARY
- FENCE
- AREA OF FOCUS
- UPLAND
- APPROXIMATE PAVED SURFACE
- APPROXIMATE DRIVE AREAS
- APPROXIMATE FILLED BARGE SLIP
- APPROXIMATE MALTEX POND
- WETLAND
- APPROXIMATE POINTS OF STORMWATER DISCHARGE

DRAFT

N

0 200 400

1" = 300'

SITE LAYOUT
PINE STREET BARGE CANAL SUPERFUND SITE
BURLINGTON, VERMONT

1829S003
FIGURE
1-2

Figure 2. Pine Street Canal Superfund Site showing Study Area boundary.

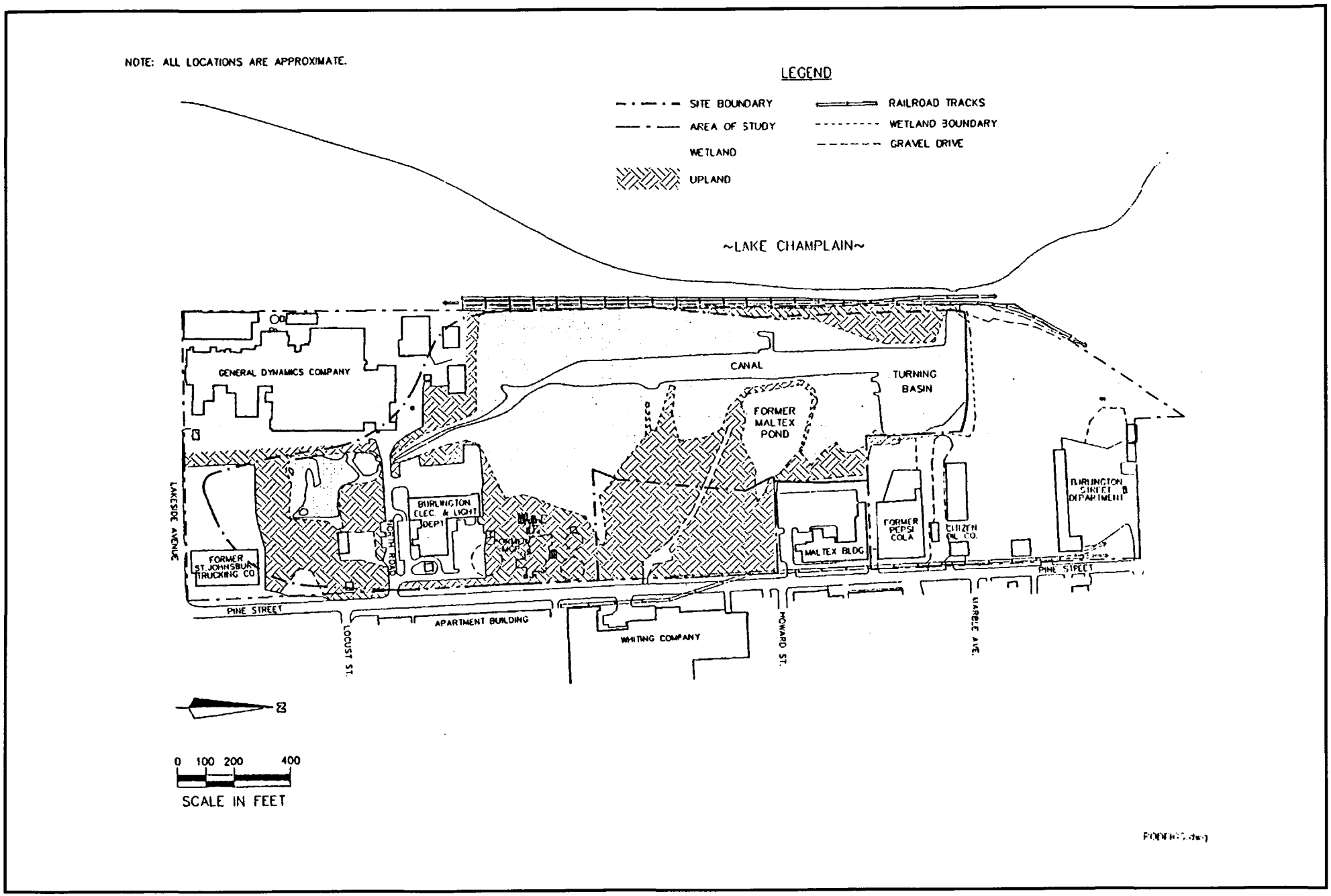


Figure 3. Pine Street Canal Superfund Site showing Site boundary.

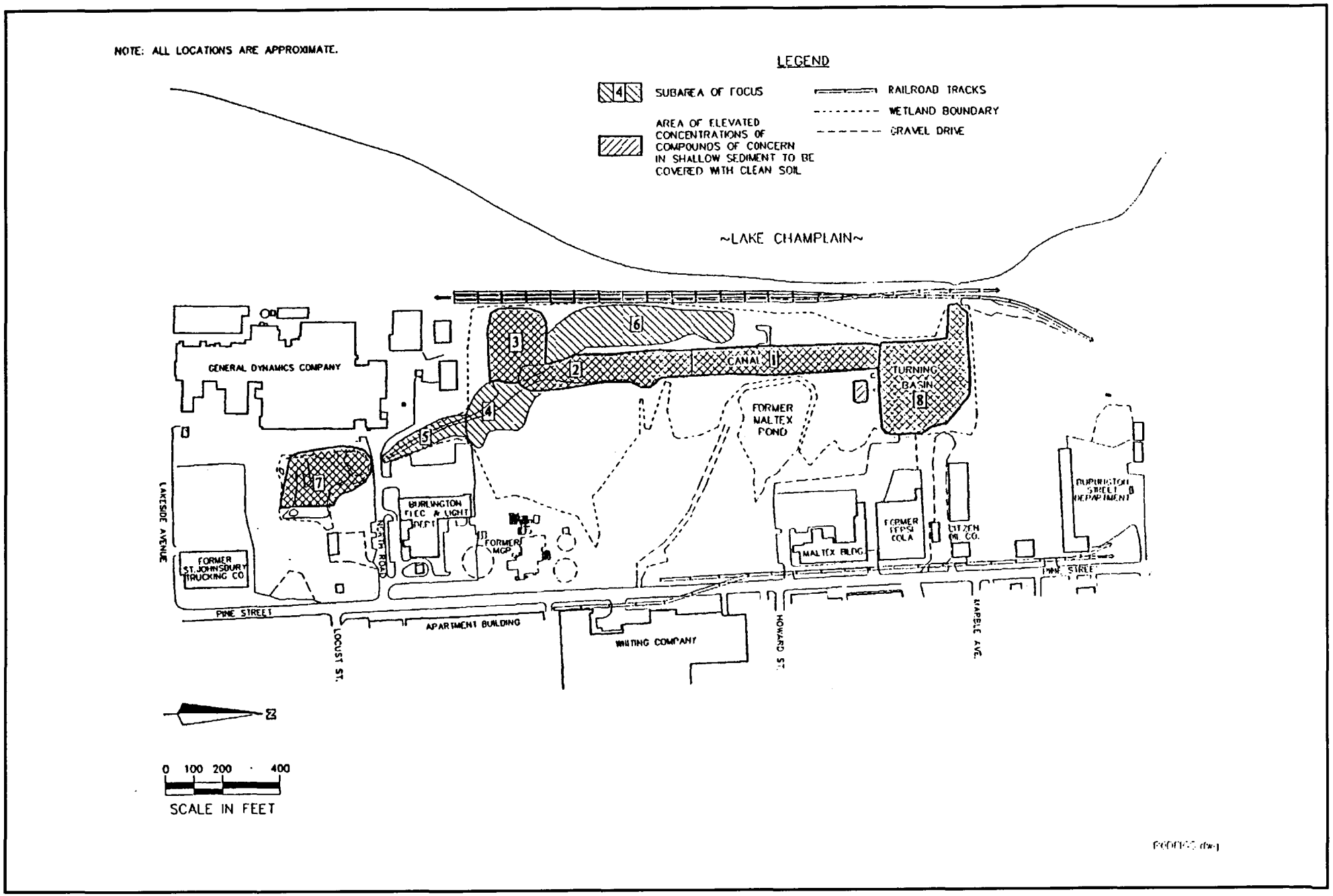


Figure 4. Pine Street Canal Superfund Site showing areas to be capped.

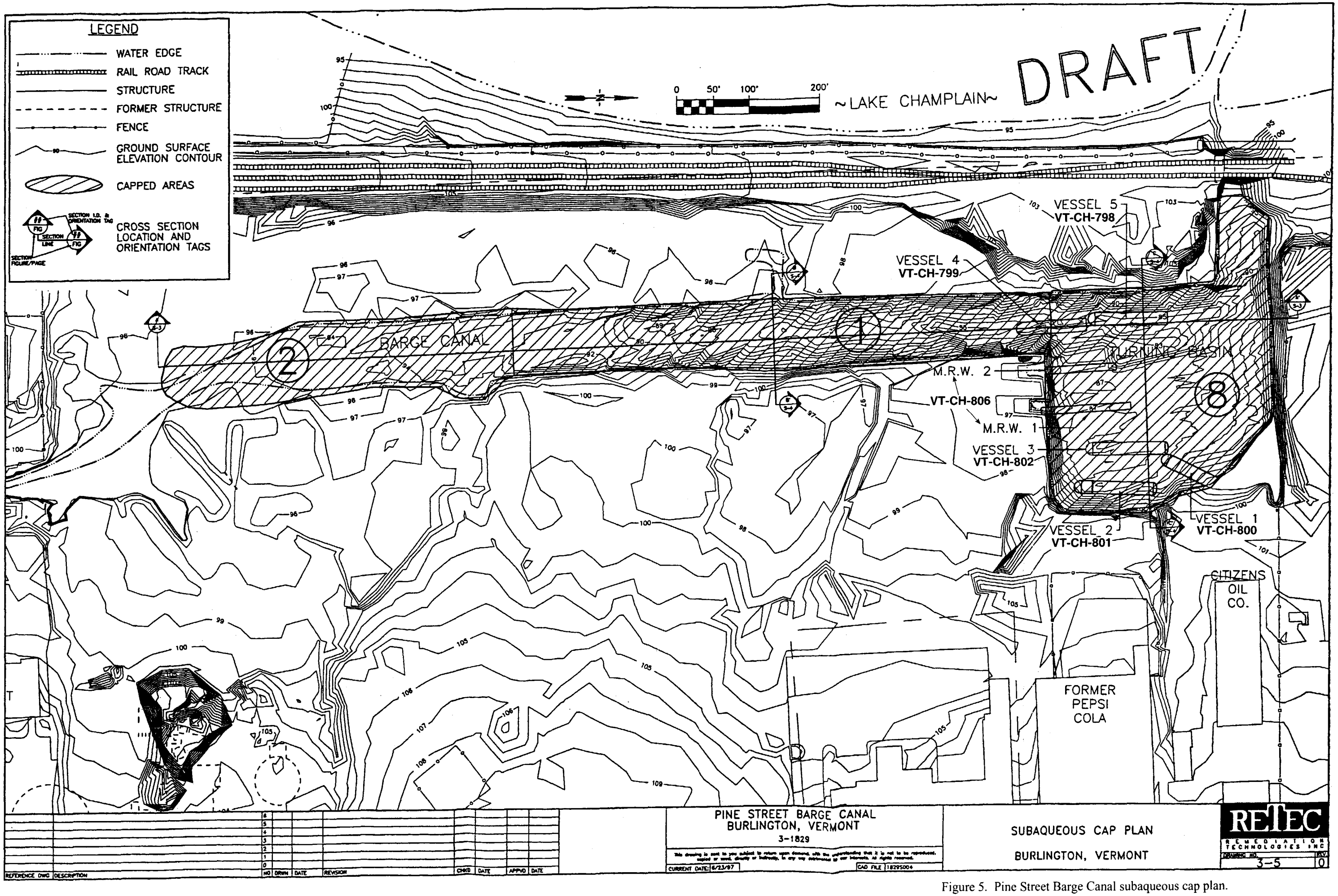
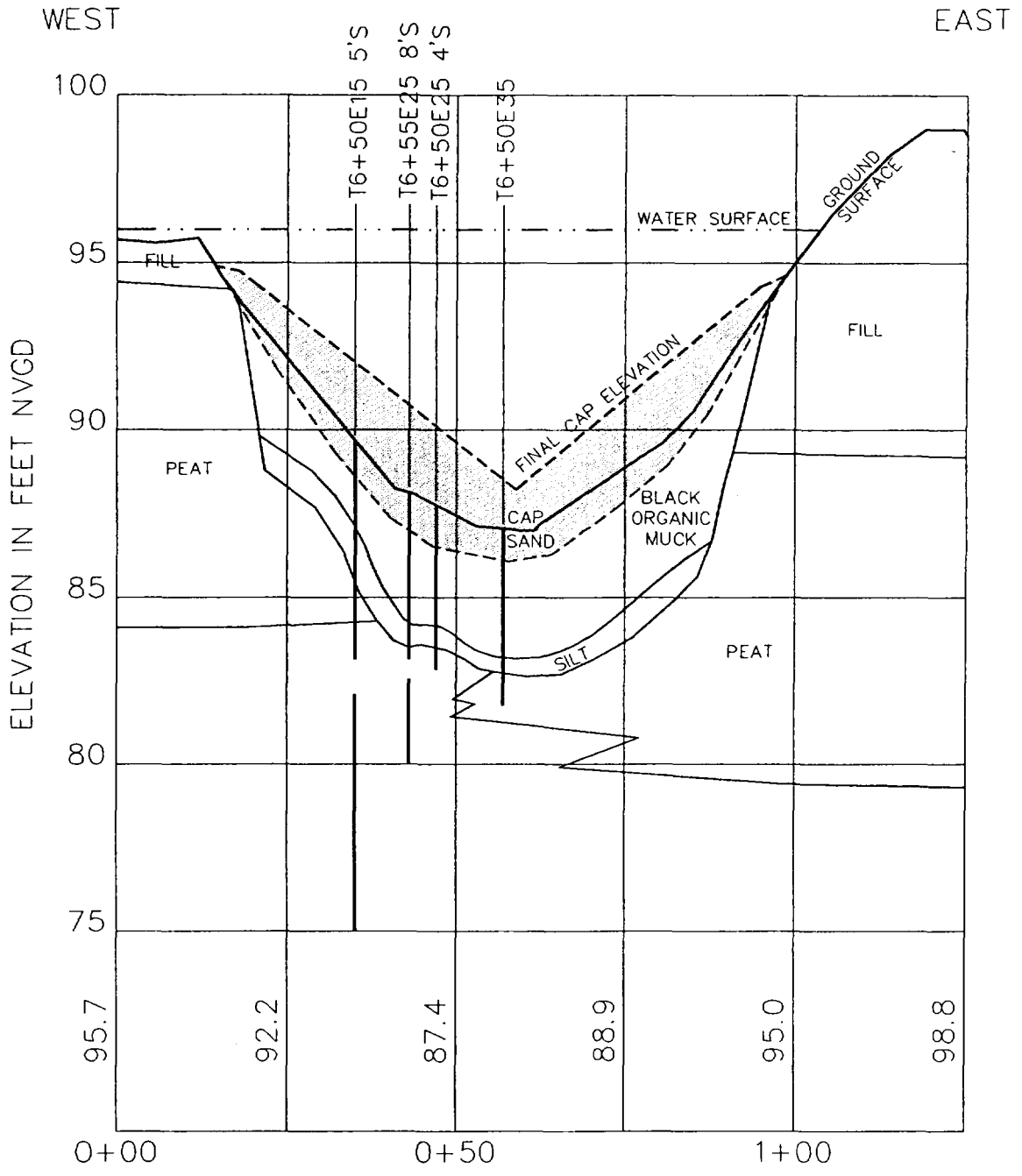


Figure 5. Pine Street Barge Canal subaqueous cap plan.

CAPXSEC.dwg



SECTION T6+50 (1/1)

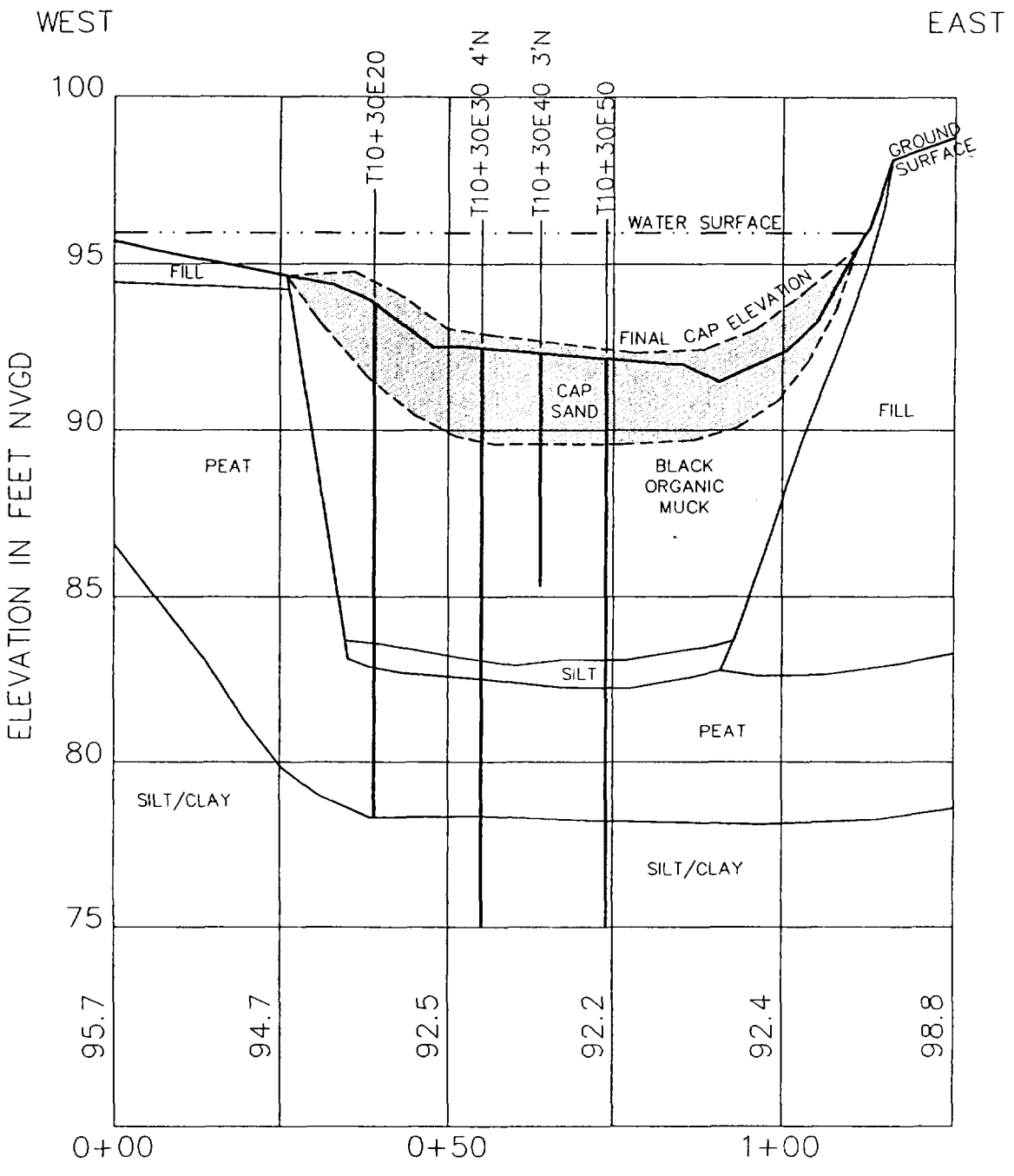
SCALE: 1"=25'HOR., 1"=5' VER.; V.E. = 5:1

FIGURE 6. CAP CROSS SECTION T6+50
PINE STREET CANAL SITE
BURLINGTON, VERMONT

THE JOHNSON COMPANY, INC.
Environmental Sciences and Engineering
100 STATE STREET MONTPELIER, VT 05602

DATE: 1/24/01 PROJECT: 1-0870-1
DRAWN BY: TJK SCALE: AS SHOWN

CAPXSEC.dwg



SECTION T10+35 (1/1)

SCALE: 1"=25'HOR., 1"=5' VER.; V.E. = 5:1

FIGURE 7. CAP CROSS SECTION T10+35
PINE STREET CANAL SITE
BURLINGTON, VERMONT

THE JOHNSON COMPANY, INC.
Environmental Sciences and Engineering
100 STATE STREET MONTPELIER, VT 05602

DATE: 1/24/01 PROJECT: 1-0870-1
DRAWN BY: TJK SCALE: AS SHOWN

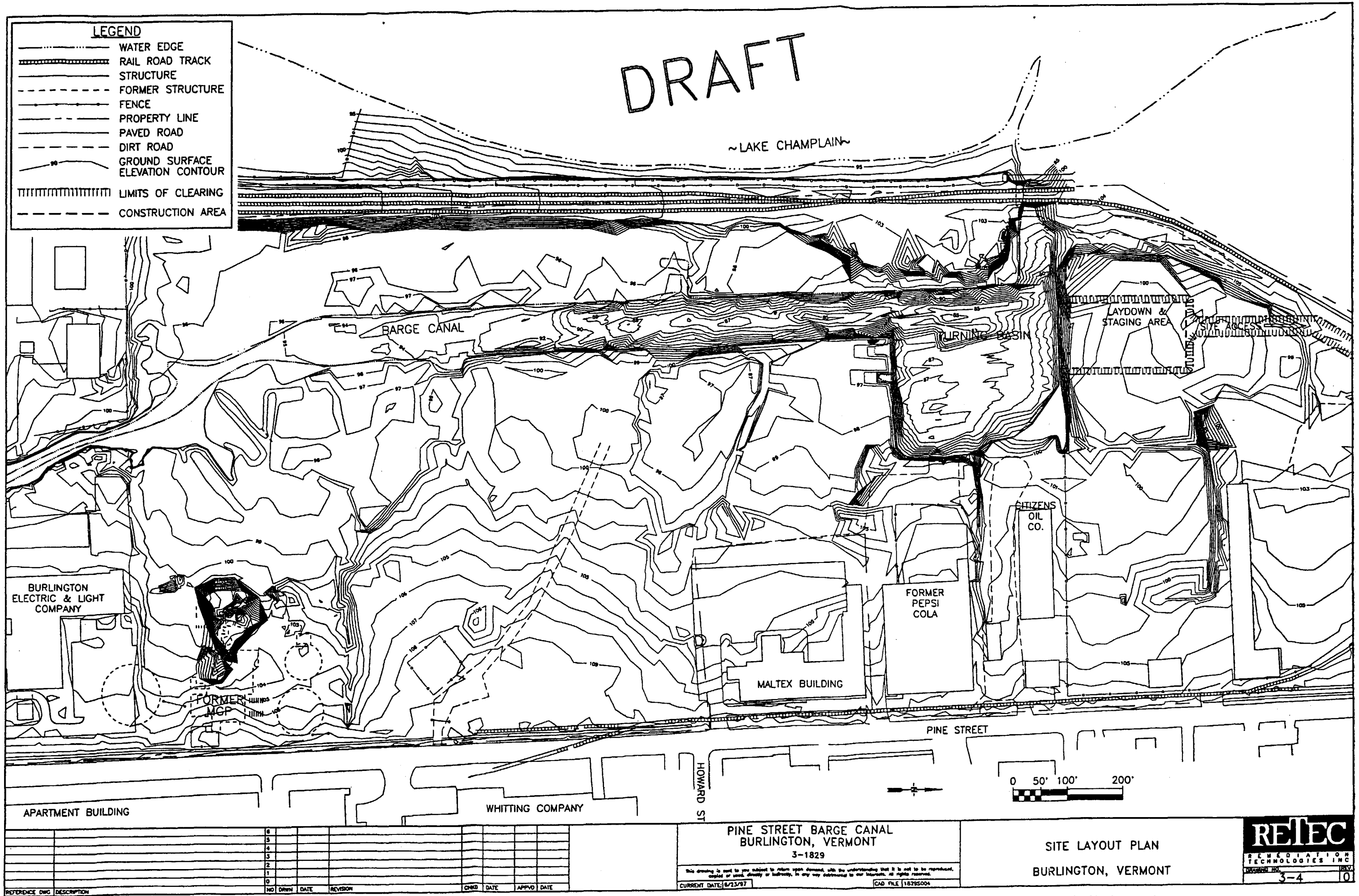


Figure 8. Site layout plan.

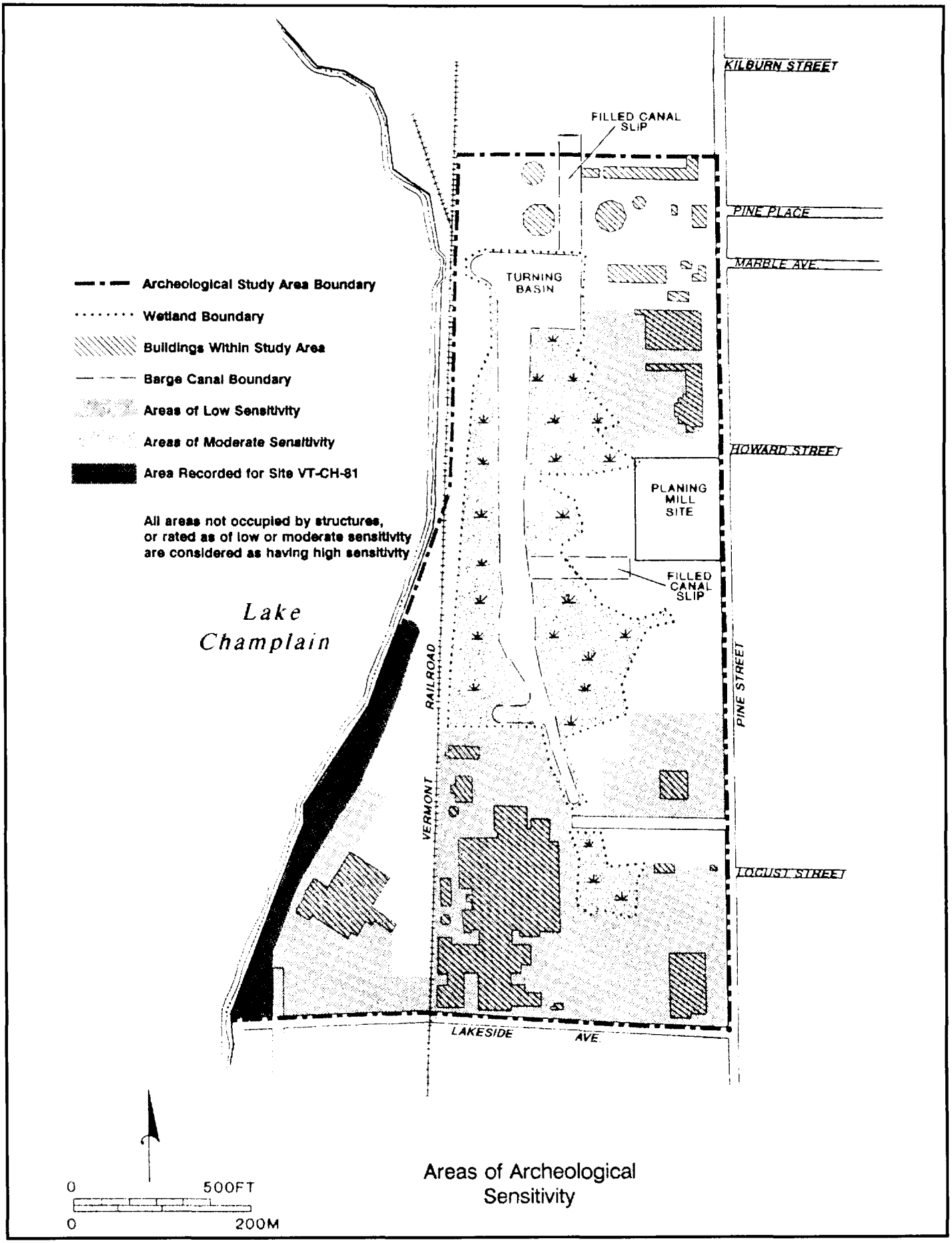


Figure 9. Areas of archeological sensitivity.

DESIGN FOR
GALLOWS FRAME
JACK KNIFE DRAW, BURLINGTON, VT.
C. V. P. P.

Figure 10. Design for gallows frame for jack knife draw, Burlington, Vermont. From microfilm bridge files of the Vermont Agency of Transportation. Vermont State Records Center, Middlesex, Vermont.

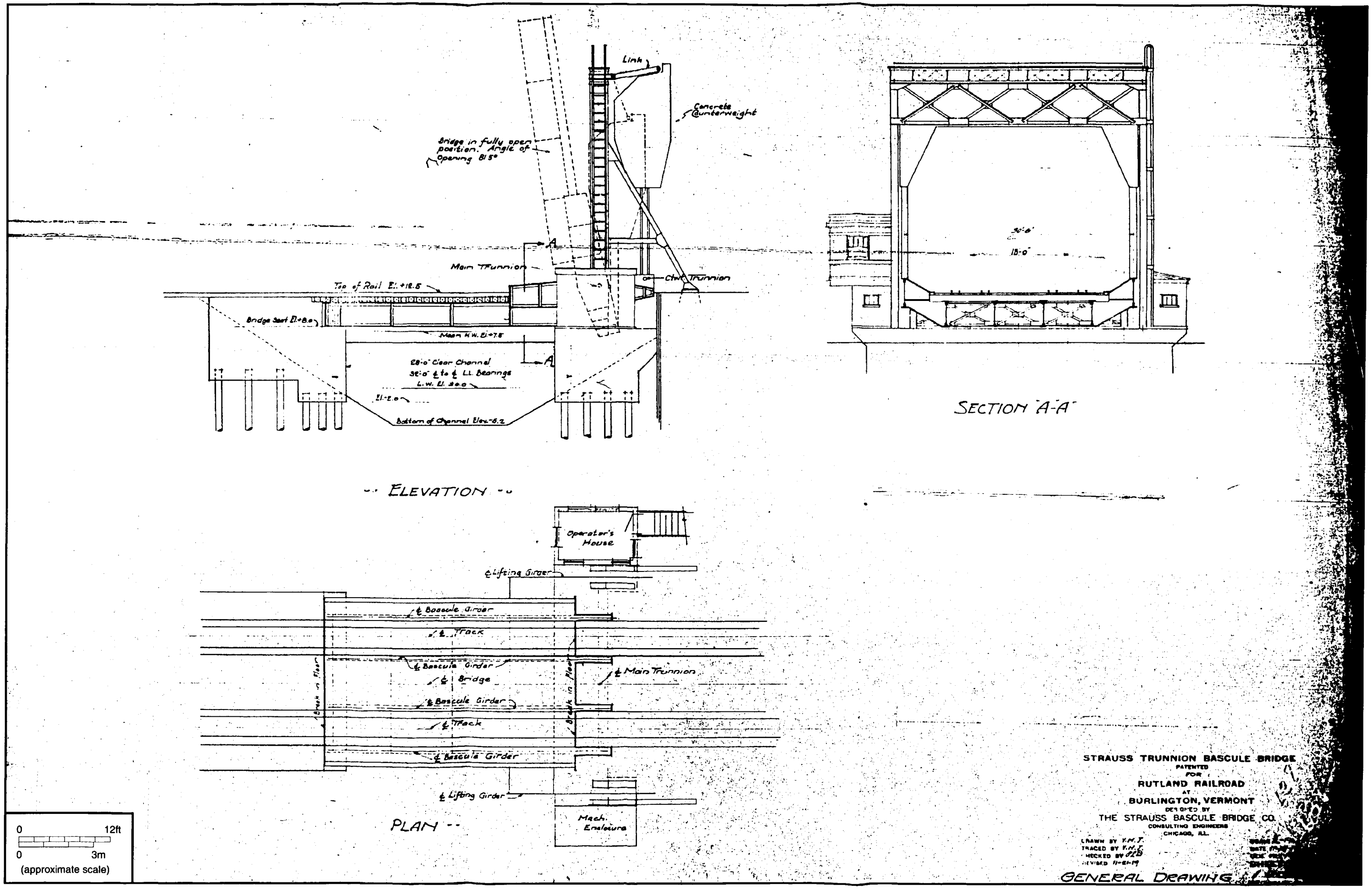


Figure 11. Elevation, section, and plan. Strauss trunnion bascule bridge over entrance to barge canal (Strauss Bascule Bridge Company 1919).

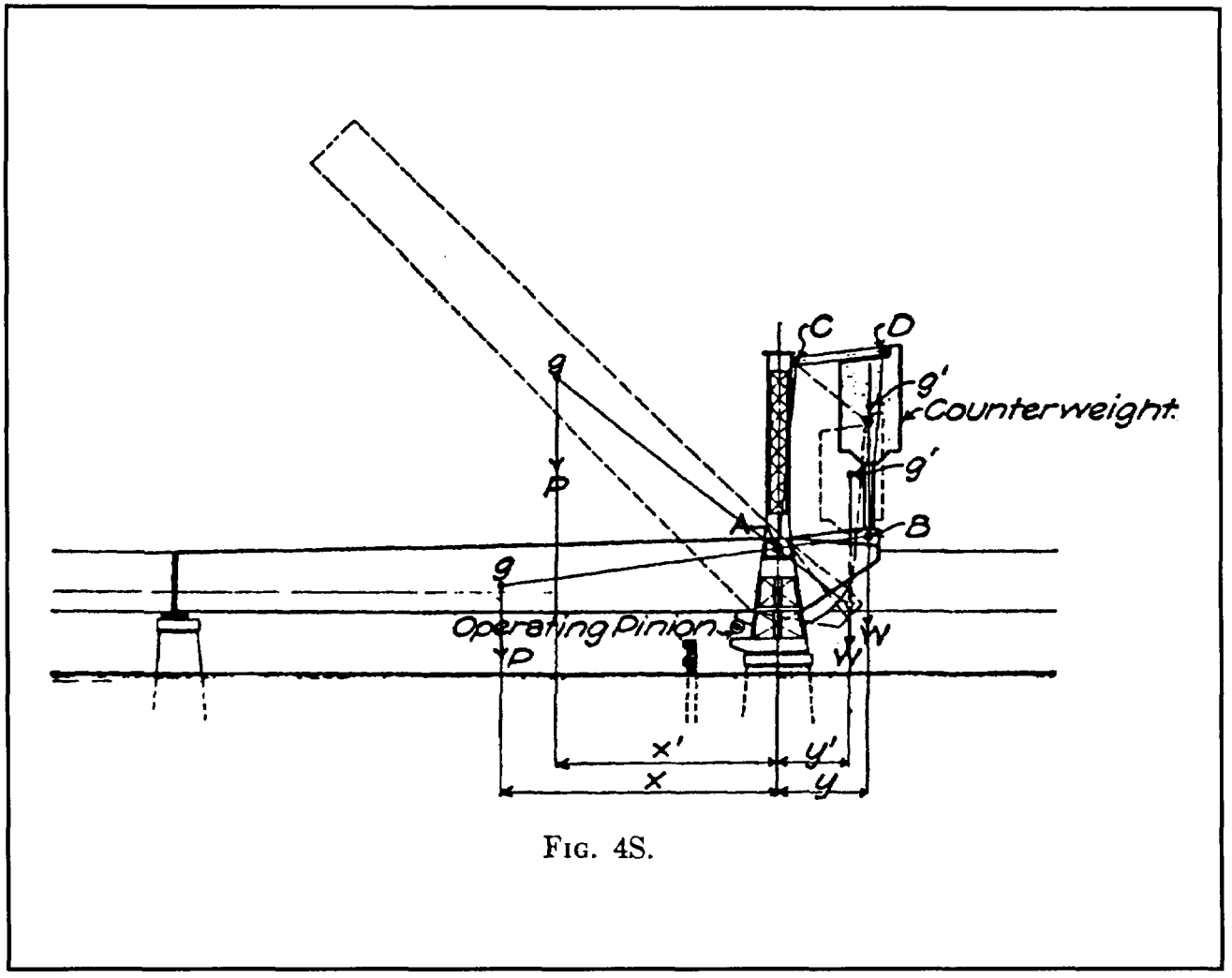


FIG. 4S.

Figure 12. Vertical overhead counterweight-type Strauss trunnion bascule bridge (Hovey 1926).

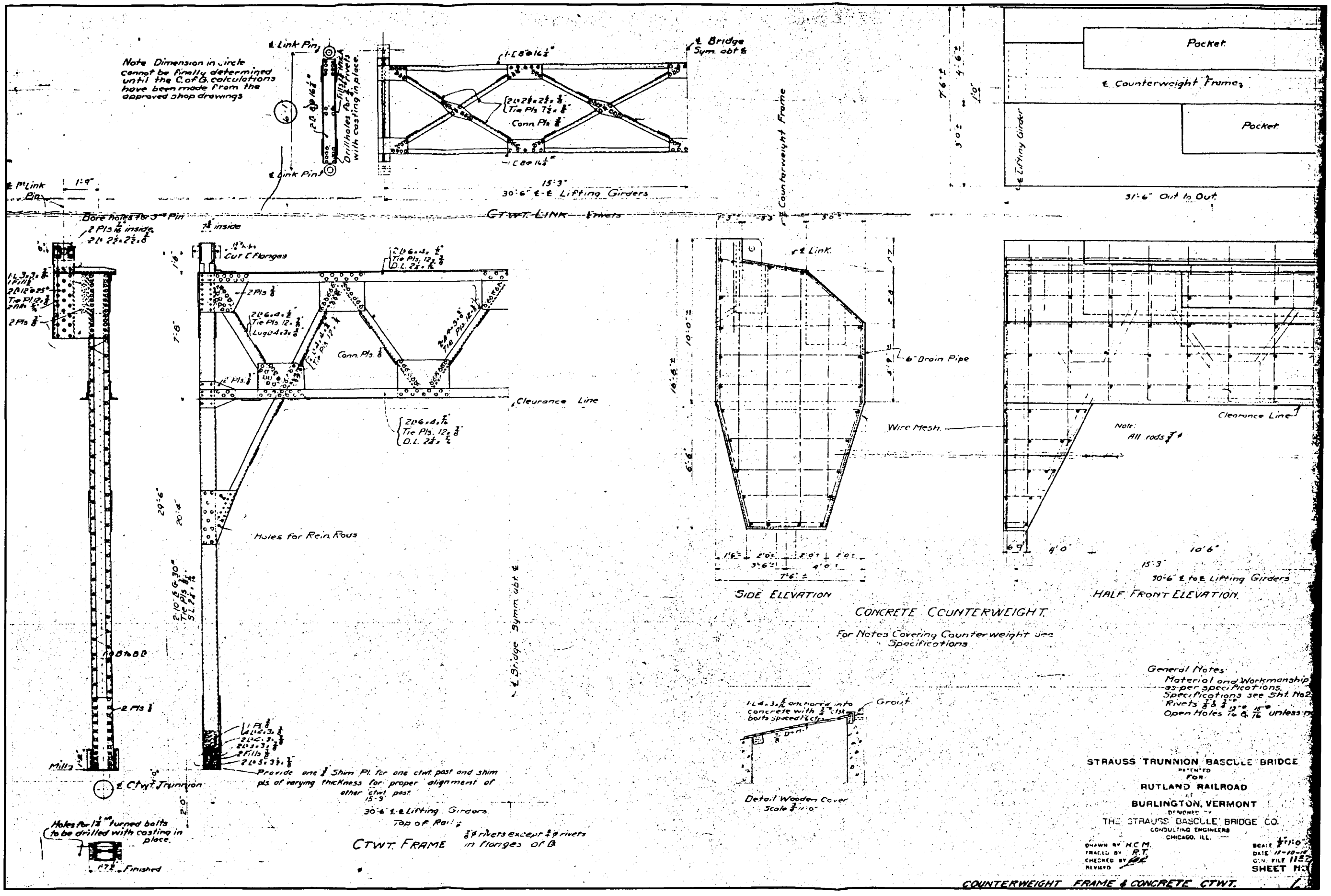


Figure 13. Counterweight frame and counterweight. Strauss trunnion bascule bridge over entrance to barge canal (Strauss Bascule Bridge Company 1919).

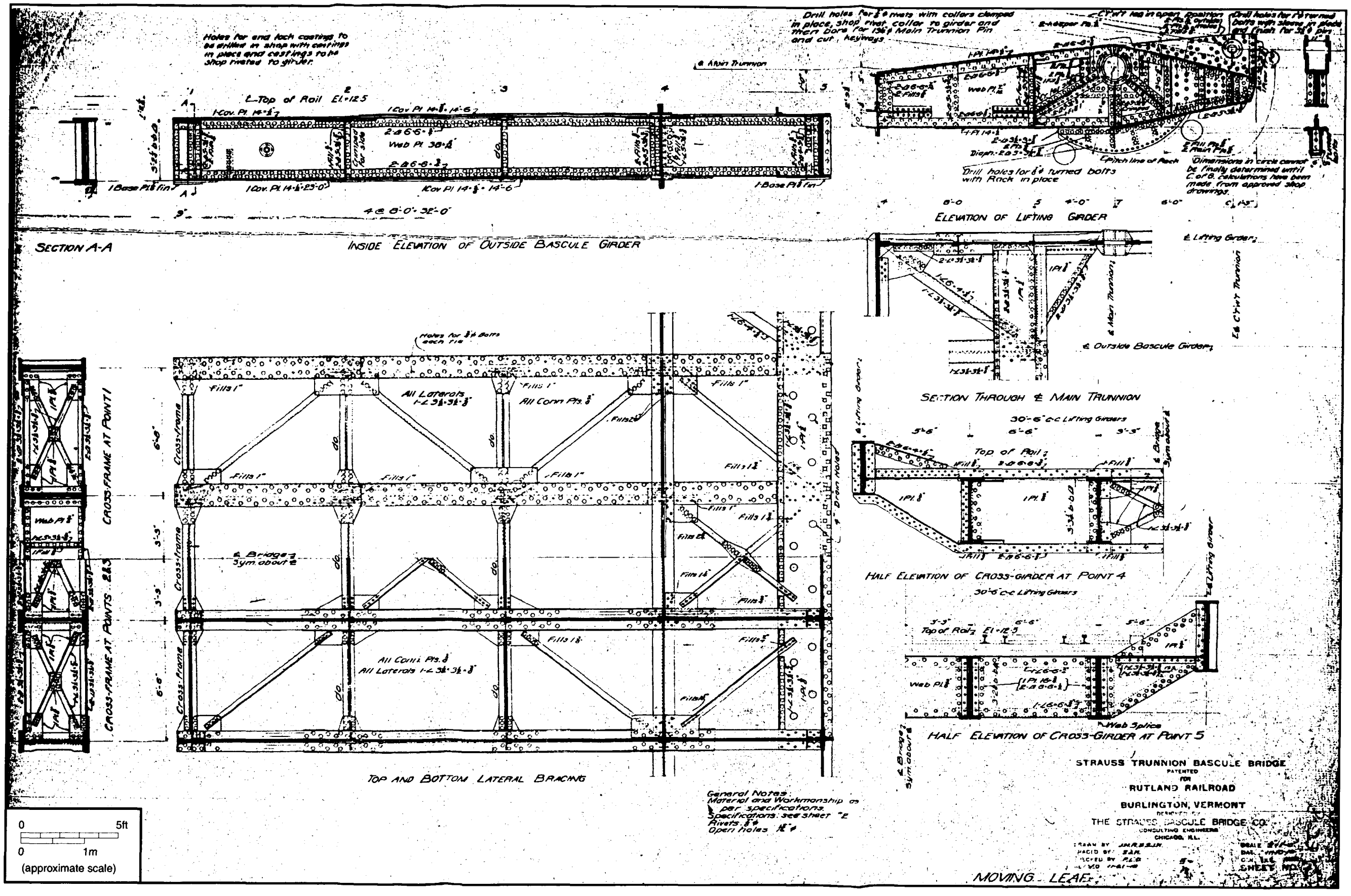


Figure 14. Moving leaf. Strauss trunnion bascule bridge over entrance to barge canal (Strauss Bascule Bridge Company 1919).

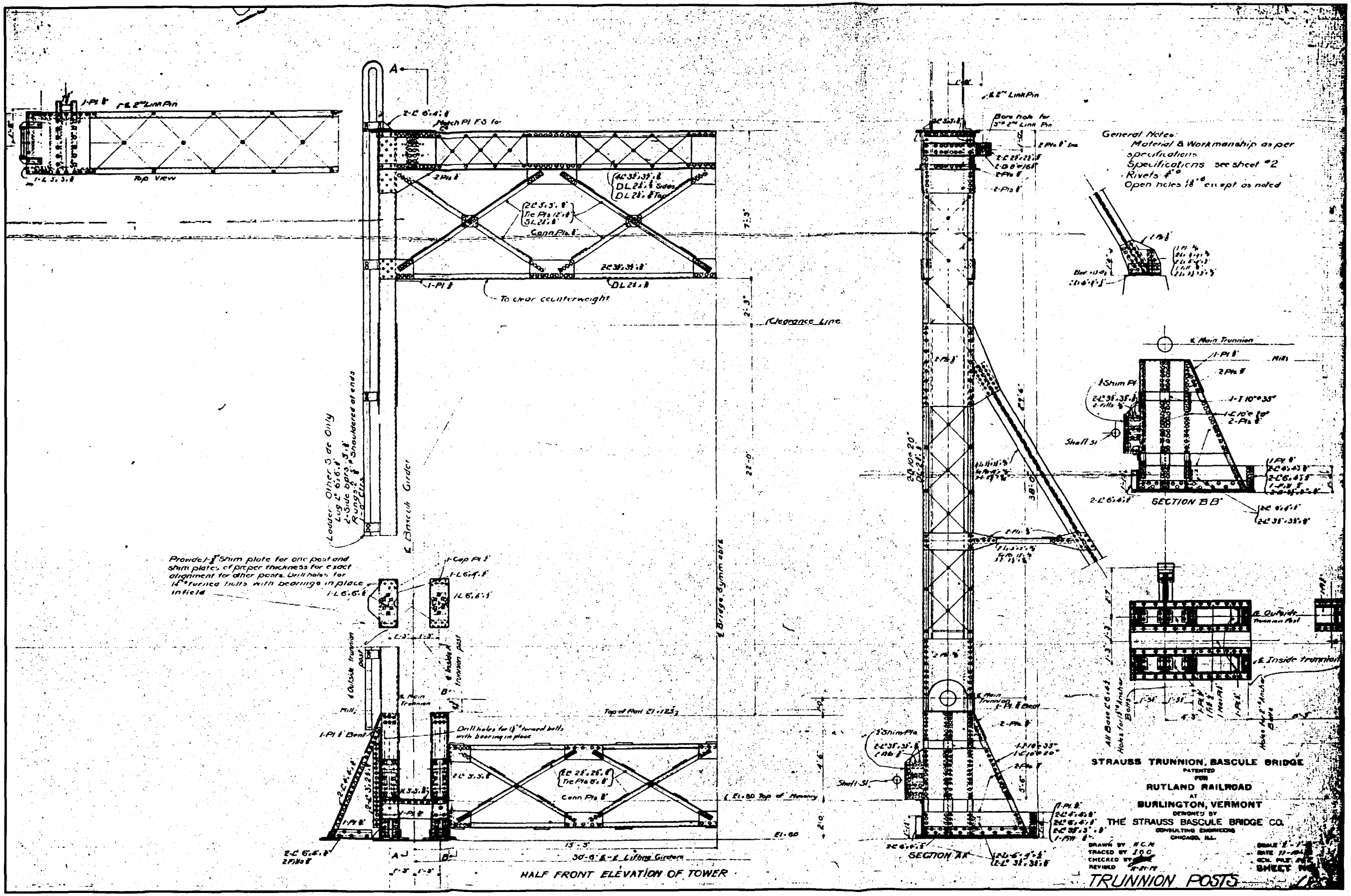


Figure 15. Trunnion posts. Strauss trunnion bascule bridge over entrance to barge canal (Strauss Bascule Bridge Company 1919).

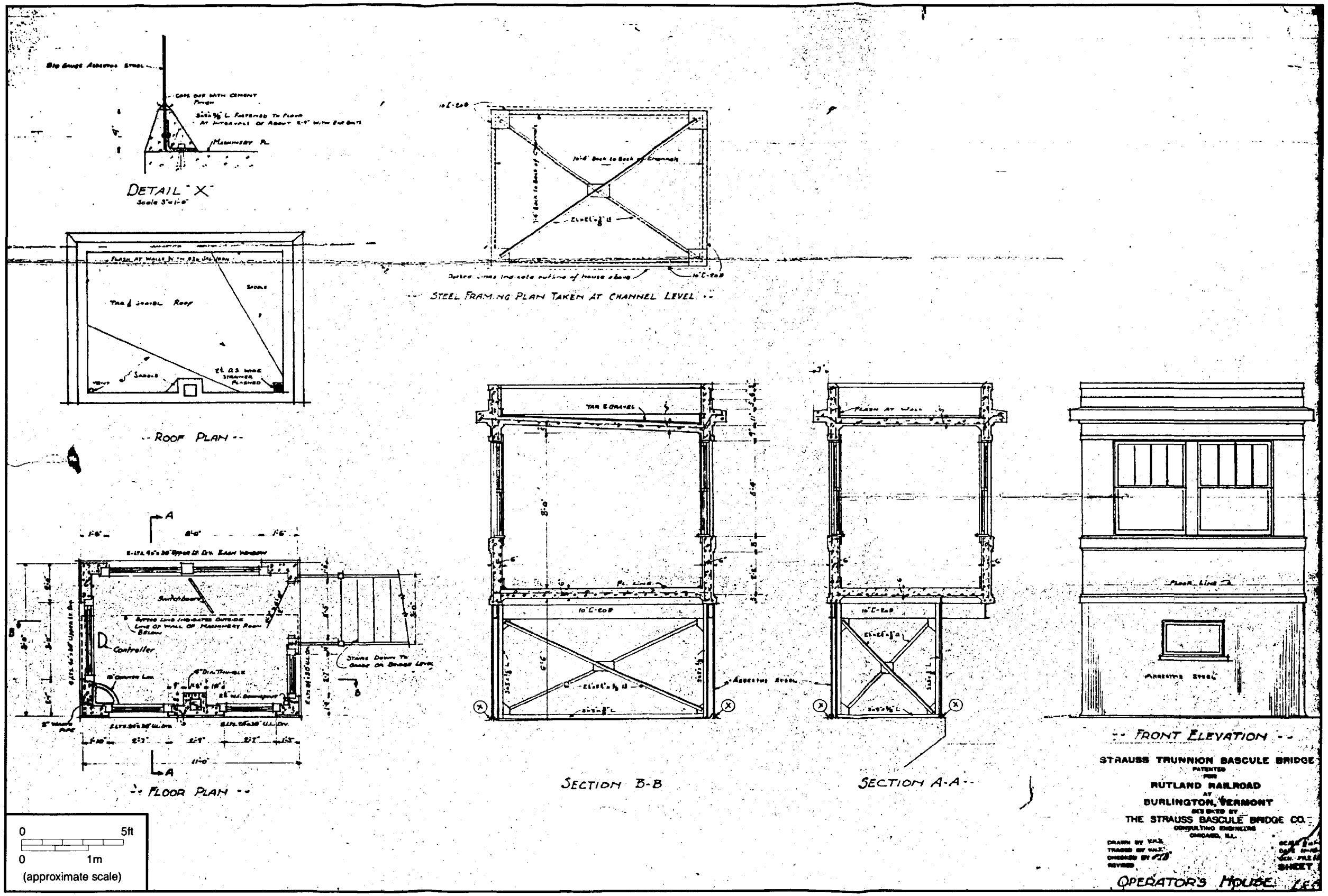
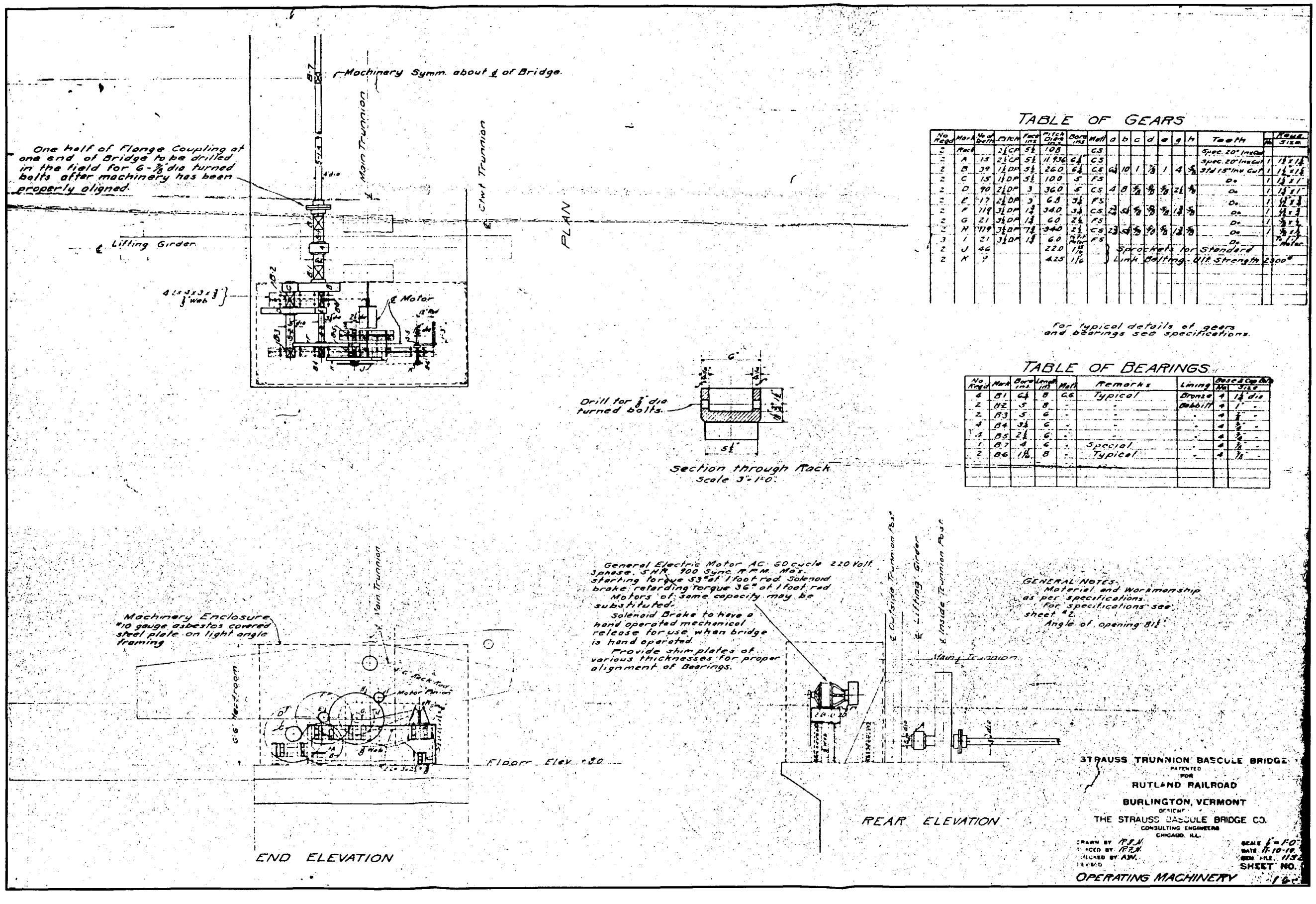


Figure 16. Operator's house. Strauss trunnion bascule bridge over entrance to barge canal (Strauss Bascule Bridge Company 1919).



No Reqd	Mark	No of Teeth	Pitch	Face ins	Pitch Diam ins	Bore ins	Matl	a	b	c	d	e	g	h	Teeth	Keyway No	Keyway Size
2	Rack		2½ CP	5½	108		CS								Spec. 20° Involute		
2	A	15	2½ CP	5½	11.936	6½	CS								Spec. 20° Involute	1	1½ x 1½
2	B	39	1½ DP	5½	26.0	6½	CS	6½	10	1	⅞	1	4	⅝	31d 15° Involute	1	1½ x 1½
2	C	15	1½ DP	5½	10.0	5	FS								Do.	1	1½ x 1"
2	D	90	2½ DP	3	36.0	5	CS	4	8	⅝	⅝	⅝	21	⅝	Do.	1	1½ x 1"
2	E	17	2½ DP	3	6.8	3½	FS								Do.	1	1½ x ¾
2	F	119	3½ DP	1⅝	34.0	3½	CS	2½	6½	⅝	⅝	⅝	1⅝	⅝	Do.	1	1½ x ¾
2	G	21	3½ DP	1⅝	6.0	2½	FS								Do.	1	⅝ x ¼
2	H	119	3½ DP	7⅛	34.0	2½	CS	23	6½	⅝	⅝	⅝	1⅝	⅝	Do.	1	⅝ x ¼
3	I	21	3½ DP	1⅝	6.0	Pitch Matl	FS								Do.		⅝ x ¼ Motor
2	J	46			22.0	1⅛		Spec Nuts for Standard Link Bolting - Ult Strength 23000#									
2	K	9			4.25	1⅛											

No Reqd	Mark	Bore ins	Length ins	Matl	Remarks	Lining	Brass & Cap Nut No	Brass & Cap Nut Size
4	B1	6½	8	CS	Typical	Bronze	4	1½ dia
2	B2	5	8	-	-	Babbitt	4	1" -
2	B3	5	6	-	-	-	4	¾ -
4	B4	3½	6	-	-	-	4	½ -
4	B5	2½	6	-	-	-	4	½ -
1	B7	4	6	-	Special	-	4	½ -
2	B6	1⅝	8	-	Typical	-	4	½ -

Figure 17. Operating machinery. Strauss trunnion bascule bridge over entrance to barge canal (Strauss Bascule Bridge Company 1919).

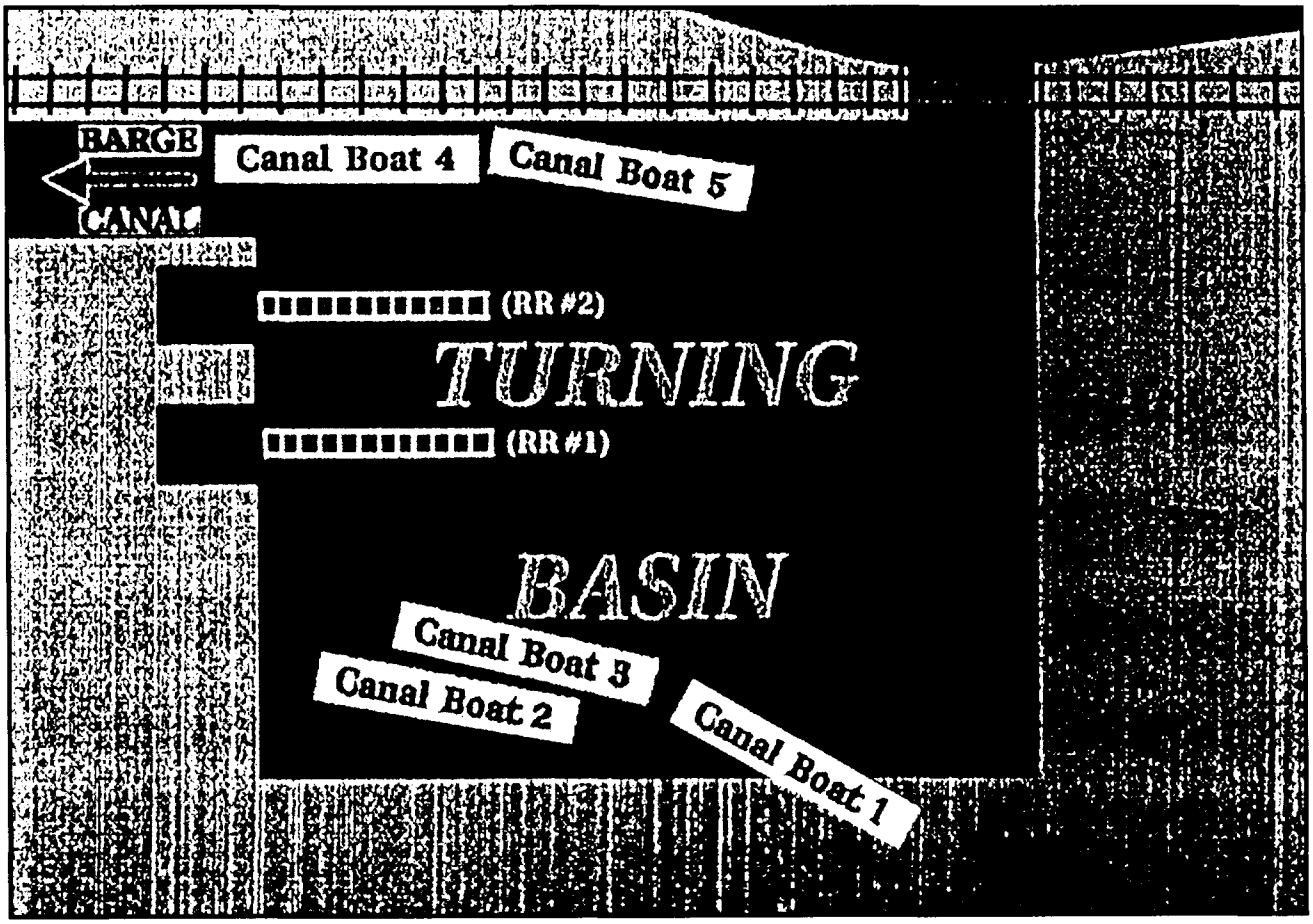


Figure 18. Approximate location of sunken canal boats and marine railways (reproduced from Cohn 1996).

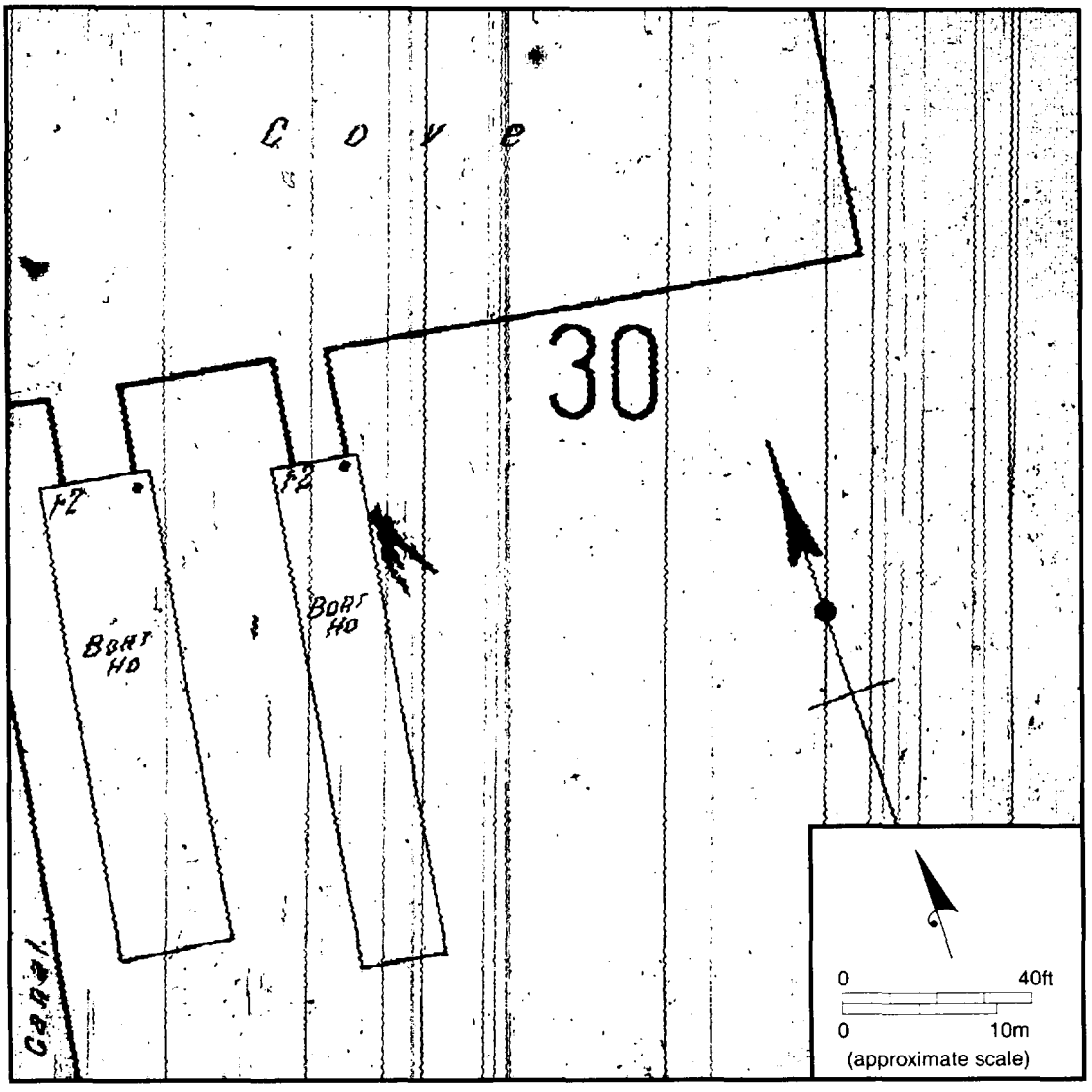


Figure 19. Boathouses on south side of turning basin (Sanborn 1912).

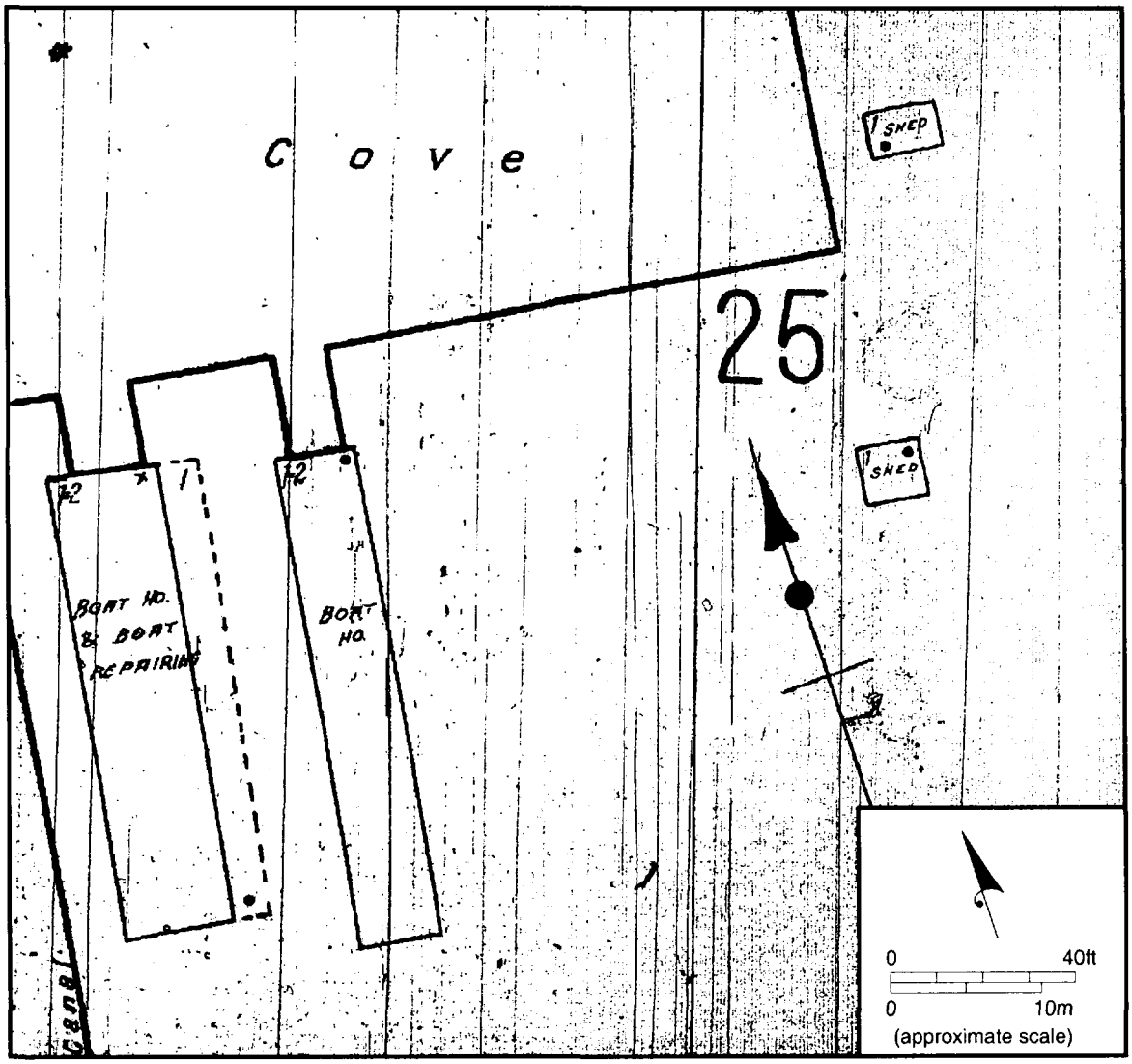


Figure 20. Boathouses on south side of turning basin (Sanborn 1926).

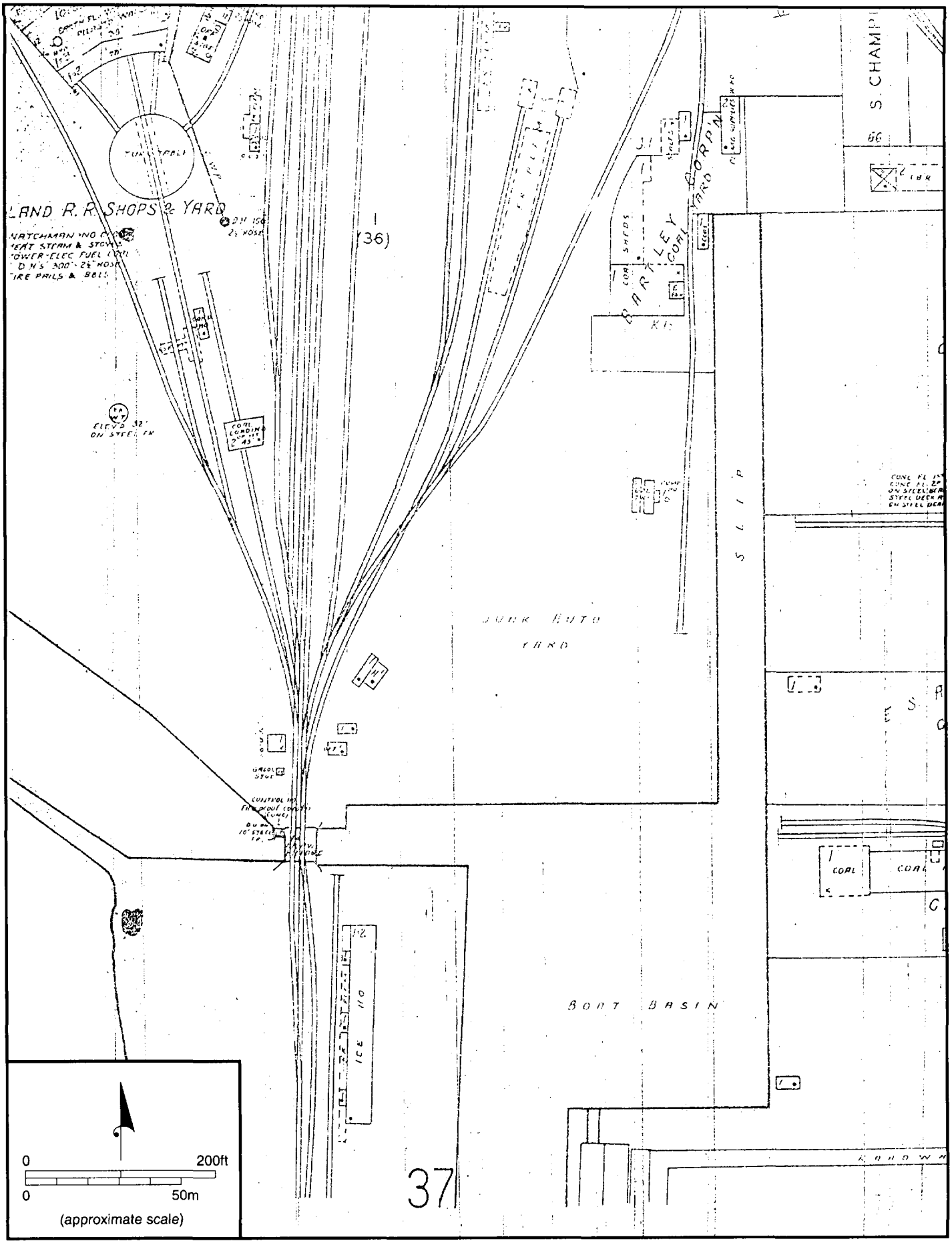


Figure 21. Detail, *Insurance Maps of Burlington, Vermont* (Sanborn 1942), showing Pine Street Barge Canal.

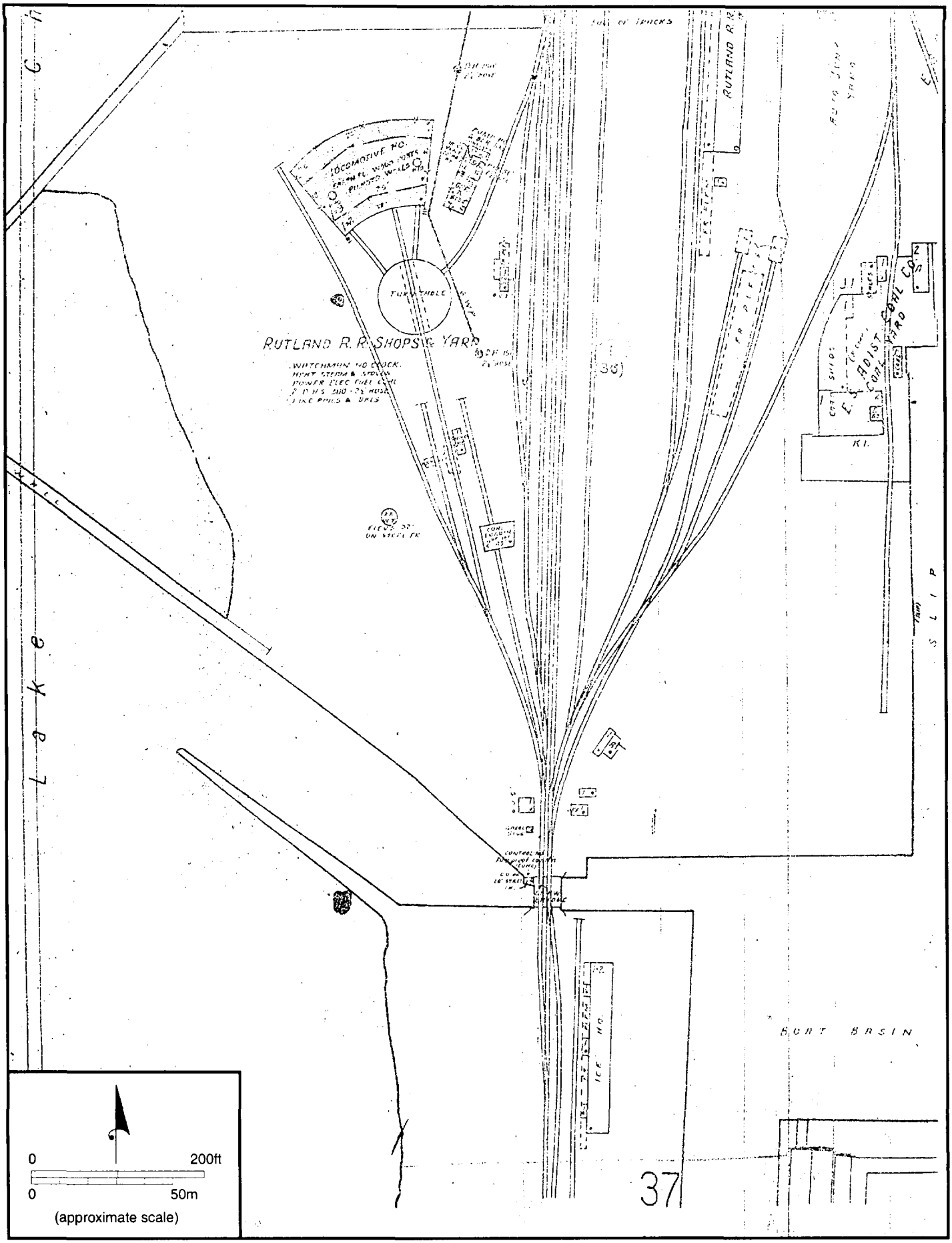


Figure 22. Detail, *Insurance Maps of Burlington, Vermont* (Sanborn 1955), showing Pine Street Barge Canal.

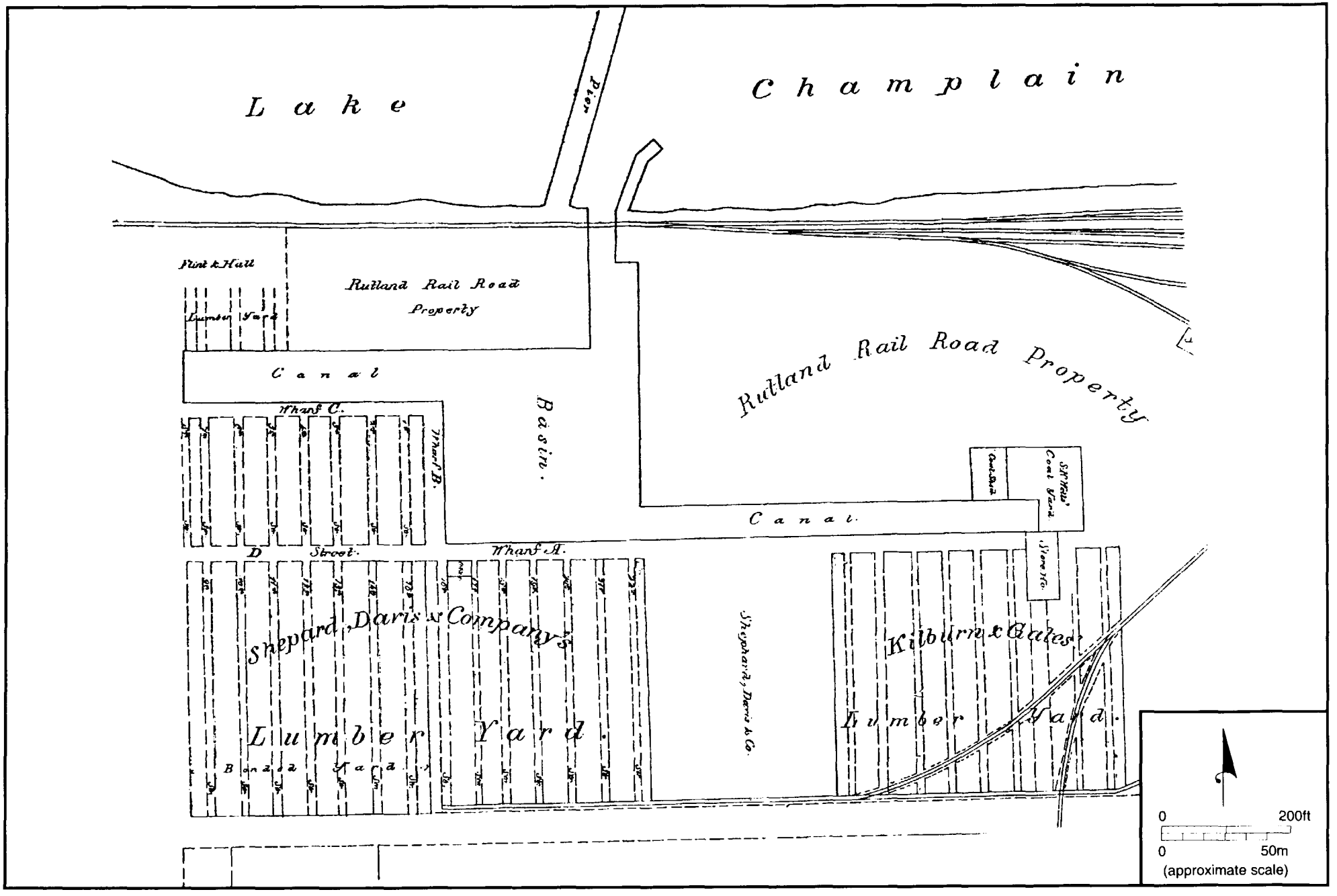


Figure 23. Detail, *Map of Burlington* (Sanborn 1869), showing Pine Street Barge Canal.

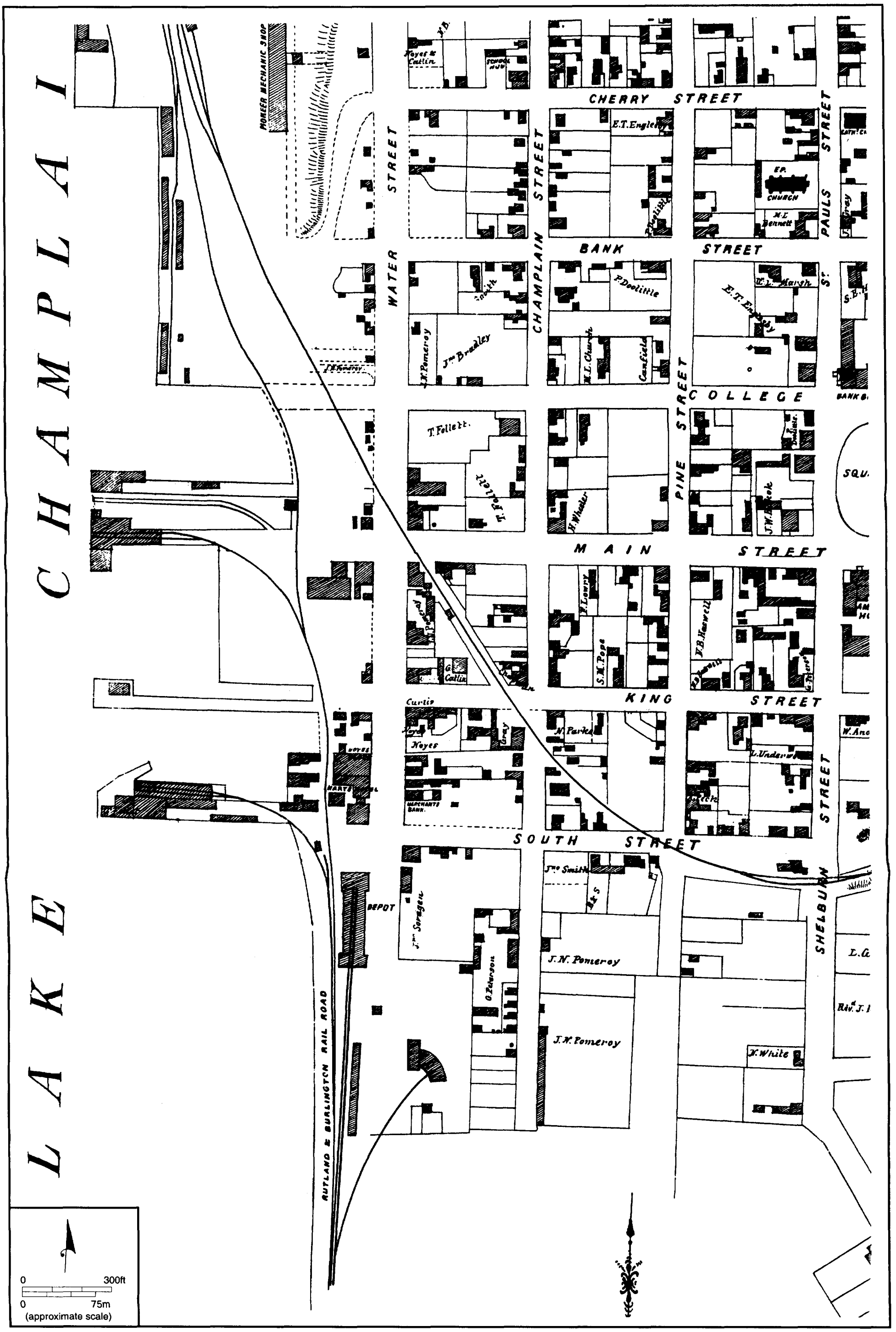


Figure 24. Detail, *Map of Burlington, Vermont* (Presdee and Edwards 1853), showing lack of development at present Pine Street Barge Canal site.

Figure 25. Lawrence Barnes (Defebaugh 1906).

Burlington City
Subscriber's Business Directory.

Officers

Phineas D. Ballou..City Mayor
W. H. Root..City Clerk
P. D. Pistering..Supt of the City Water Works
Wm. G. Shaw..City Judge
John B. Hollenbeck..Justice of the Peace
G. H. Stanlow..Postmaster
C. S. Whitwell..City Engineer and Supt of Water Works

Attorneys at Law

Alger C J..Attorney and Real Estate Agent, office Main st, opposite City Hall
Ballard H..Attorney and Counsellor at Law, office Bank Block, College st
Hiskok J. R..Attorney and Counsellor at Law
Hurd E. R..Attorney and Counsellor at Law, cor College and Church sts
Lawrence & Barnes..Attorneys and Counsellors at Law, College st North side "Square"
Roberts Dan'l..Attorney and Counsellor at Law, College st, North side "Square"
Smalley H. B..Attorney and Counsellor at Law, and Clerk of U. S. Court, office Custom House
Smalley D. A..Judge of the U. S. Court
Pinnott H. H..Attorney and Counsellor at Law, College st
Shaw Wm. G..Attorney and Counsellor at Law, cor College and Church sts
Underwood L..Attorney, Res Head of Pearl st
Wales & Taft..Attorneys and Counsellors at Law, office City Hall
Watson A. O..Attorney and Counsellor at Law, College st, North side "Square"

Architects

Johnson Elmore..Office College st
Roby H. & Bro..Office Mechanics Row
Ryer E. C..Res First st

Agents

Appleton G. S..Agent for Vt. Central R. R.
Drury H. N..Telegraph and Ticket Agent, American Hotel Building
Henderson W..Agent for Nat. Express Co, office The "Square"
Wardwell John W..Agent for Rutland R. R.

Banks

Burlington Savings Bank..C. F. Ward, Treasurer
First Nat. Bank..O. A. Lodge, President; L. O. Dodge, Cashier
Merchants' Nat. Bank..H. P. Hickok, President

Builders & Joiners

Crocker W. E..Mason Builder, and manufacturer and dealer in Brick, Yard Pearl st
Johnson Elmore..Architect and Builder, office College square
Pease & Edmond..Carpenters and Builders, cor College and Pearl sts
Roby H. & Bro..Architects and Builders, Mechanics' Row
Roby John..Carpenter and Slater, res Maiden Lane
Robichaud A..Carpenter and Builder, upper part of Locust st
Smith W. W..Carpenter and Slater, cor Maple and Champlain sts
Spear Geo. N..Mason Builder and dealer in Lime, Cement, and Plaster, at Wholesale and Retail, cor. Pine and Pearl sts
Townsend & Hill..Carpenters and Builders, Church st, rear of Floyd's Jewelry Store
Willard G. N..Mason and Builder, Shelburn st

Brewer

Peterson B. D..Brewery, foot of Champlain st

Bookbinder

Scott Wm..Bookbinder, Blank Book Manufacturer, Paper Ruling of every description done to order. Magazines, Music &c, Bound in Plain and Fancy Binding, cor Church and College sts

Boot & Shoe Dealers

Harbour G. W..Manufacturer and dealer in Ladies', Gents', Misses, and Children's Boots, Shoes, and Rubbers, Church st, opp. Loomis & Co's
Hutchins W. F..Manufacturer of Fine Boots and Shoes, to order, cor Champlain and Pearl sts
Miles B. S..Manufacturer of and dealer in Ladies', Gents', Misses and Children's Boots and Shoes also Boot, Shoe, and Gaiter Uppers, Church st
Mooney E. A..Manufacturer of and dealer in Boots, Shoes and Rubbers. Particular attention paid to Custom Work. Church st
Wood W. W..Manufacturer and dealer in Boots, Shoes, Rubbers, and special attention given to Custom Work, Church st, opp. Union Block

Blacksmiths

Bostwick G. E..Horseshoeing and General Blacksmithing, st Paul st
Gordon A..Horseshoeing and General Blacksmithing. Jobbing. Wheelwright Work and General Repairing promptly done, Church st
Roberge John B..Blacksmith at Chas. B. Gray's

Collectors

Arthur J. A..Deputy Collector of Customs
Deane A. J..Collector of Internal Revenue, office cor Main and College sts
Jewett B. A..Deputy Collector, Internal Revenue

Civil Engineers & Surveyors

Linsley D. C..Res William st
Barlow J. W..St Paul st Square
Whitwell C. S..City Engineer and Supt of Water Works

Clergymen

Atwill E. E..Rector St Paul's Church
De Goesbriand L..Bishop of Burlington
Griffin E. H..Pastor 1st Cong. Church

Coal Dealers

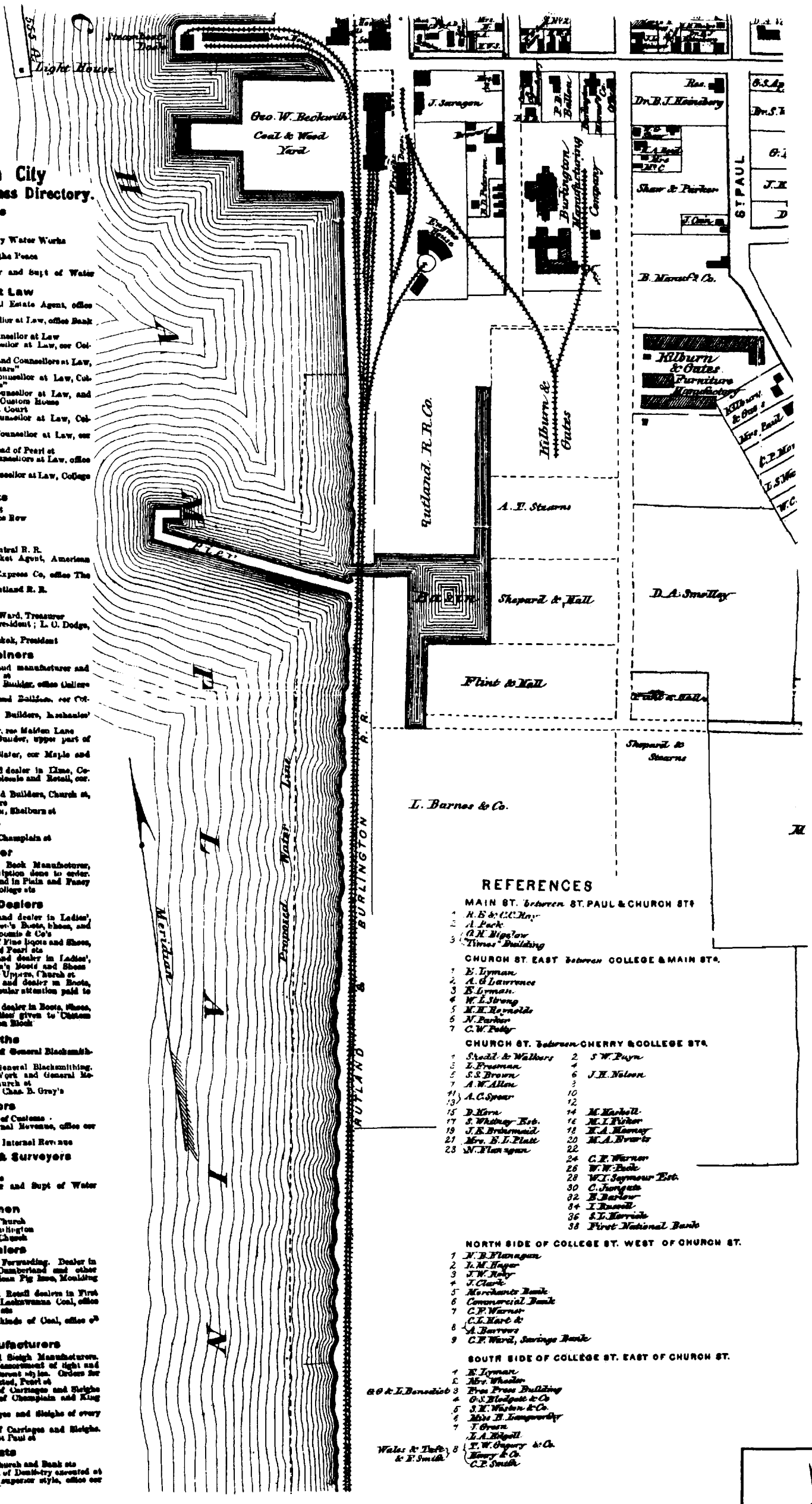
Beckwith Geo. W..Storage and Forwarding. Dealer in Lehigh, Lackawanna, Cumberland and other Coals, Scotch and American Pig Iron, Moulding Sand, &c, north Wharf
Bacon & Pope..Wholesale and Retail dealers in First Quality of Lehigh and Lackawanna Coal, office cor Pearl and Champlain sts
Linsley G. L..Dealer in all kinds of Coal, office on Steamboat Wharf

Carriage Manufacturers

Curtis & Floyd..Carriage and Sleigh Manufacturers. Constantly in store an assortment of light and heavy work in all the different styles. Orders for repairing promptly attended, Pearl st
Gray Chas. B..Manufacturer of Carriages and Sleighs of every description, cor of Champlain and King streets
Ray E. A..Manuf. of Carriages and Sleighs of every description, Pearl st
Smith & Eastman..Manufs. of Carriages and Sleighs. Repairing neatly done, st Paul st

Dentists

Lewis & Watson..Office cor Church and Bank sts
Reed M. H..Every description of Dentistry executed at reasonable prices and in superior style, office cor Church and Bank sts



REFERENCES

MAIN ST. between ST. PAUL & CHURCH STS

1. R.E. & C.C. Hayes
2. A. Park
3. G.H. Bigelow "Times" Building

CHURCH ST. EAST between COLLEGE & MAIN STS.

1. E. Lyman
2. A. & Lawrence
3. E. Lyman
4. W. L. Strong
5. M.H. Reynolds
6. N. Parker
7. C.W. Petty

CHURCH ST. between CHERRY & COLLEGE STS.

1. Stodd & Walkers
2. S.W. Payn
3. L. Freeman
4.
5. S.S. Brown
6. J.H. Nelson
7. A.W. Allen
8. A.C. Spear
9.
10.
11.
12.
13.
14. M. Kimball
15. B. Korn
16. M.I. Fisher
17. S. Whitney Est.
18. E.A. Murray
19. J.E. Bridesmaid
20. M.A. Everts
21. Mrs. E.I. Platt
22.
23. N. Flanagan
24. C.F. Warner
26. W.W. Peck
28. W.J. Seymour Est.
30. C. Jurgens
32. E. Barlow
34. I. Russell
36. S.L. Herrick
38. First National Bank

NORTH SIDE OF COLLEGE ST. WEST OF CHURCH ST.

1. N.B. Flanagan
2. L.M. Hager
3. J.W. Raby
4. J. Clark
5. Merchants Bank
6. Commercial Bank
7. C.F. Warner
8. C.L. Hart & A. Barrows
9. C.F. Ward, Savings Bank

SOUTH SIDE OF COLLEGE ST. EAST OF CHURCH ST.

1. E. Lyman
2. Mrs. Wheeler
3. Free Press Building
4. G.S. Blodgett & Co
5. J.H. Wasten & Co.
6. Miss B. Langworthy
7. J. Green
- J.A. Edgell
8. T.W. Osgood & Co. Henry & Co. C.P. Smith

G.G & L. Benedict

Wales & Taft & F. Smith

0 400ft
0 100m
(approximate scale)

Figure 26. Detail, *Atlas of Chittenden County, Vermont* (Beers 1869; reprinted 1971), showing canal and surrounding area.

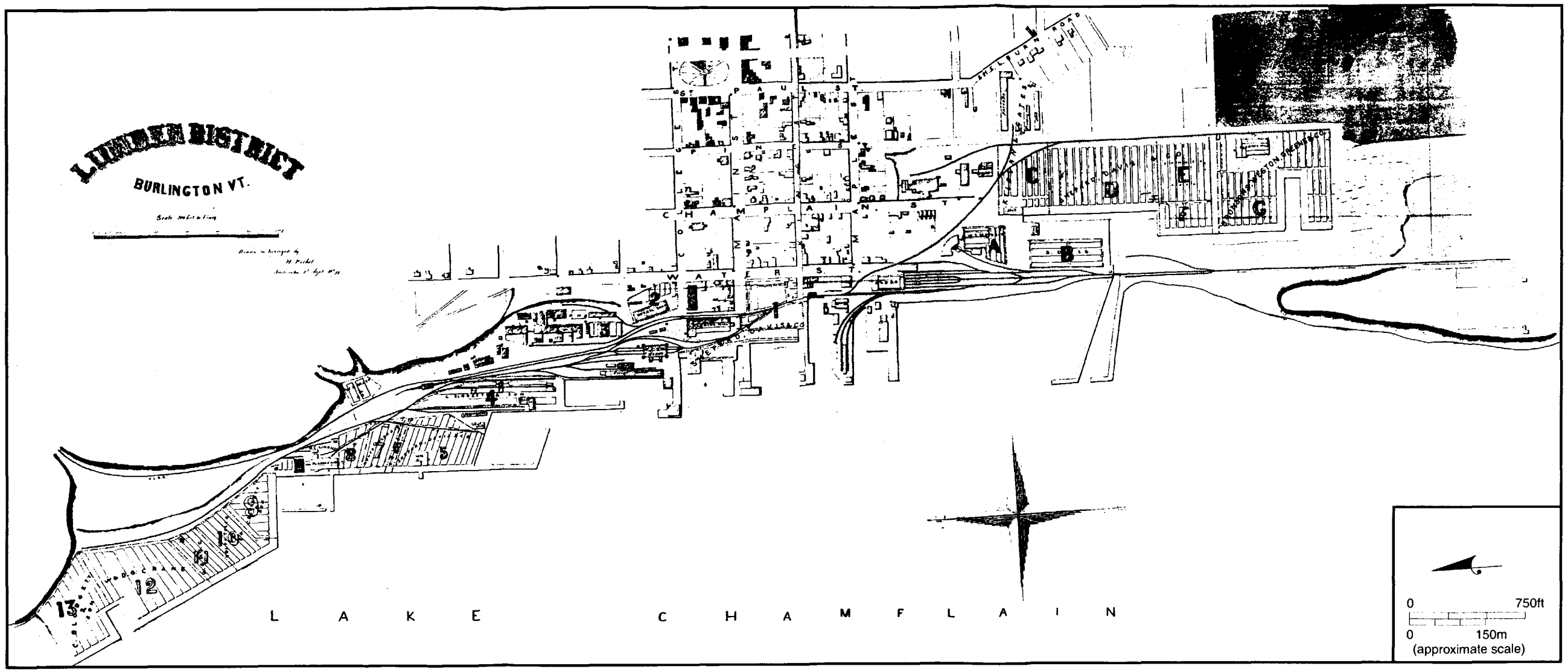


Figure 27. Detail, *Plan of the Lumber District, Burlington, VT* (Pichot 1872), showing the Pine Street Barge Canal.

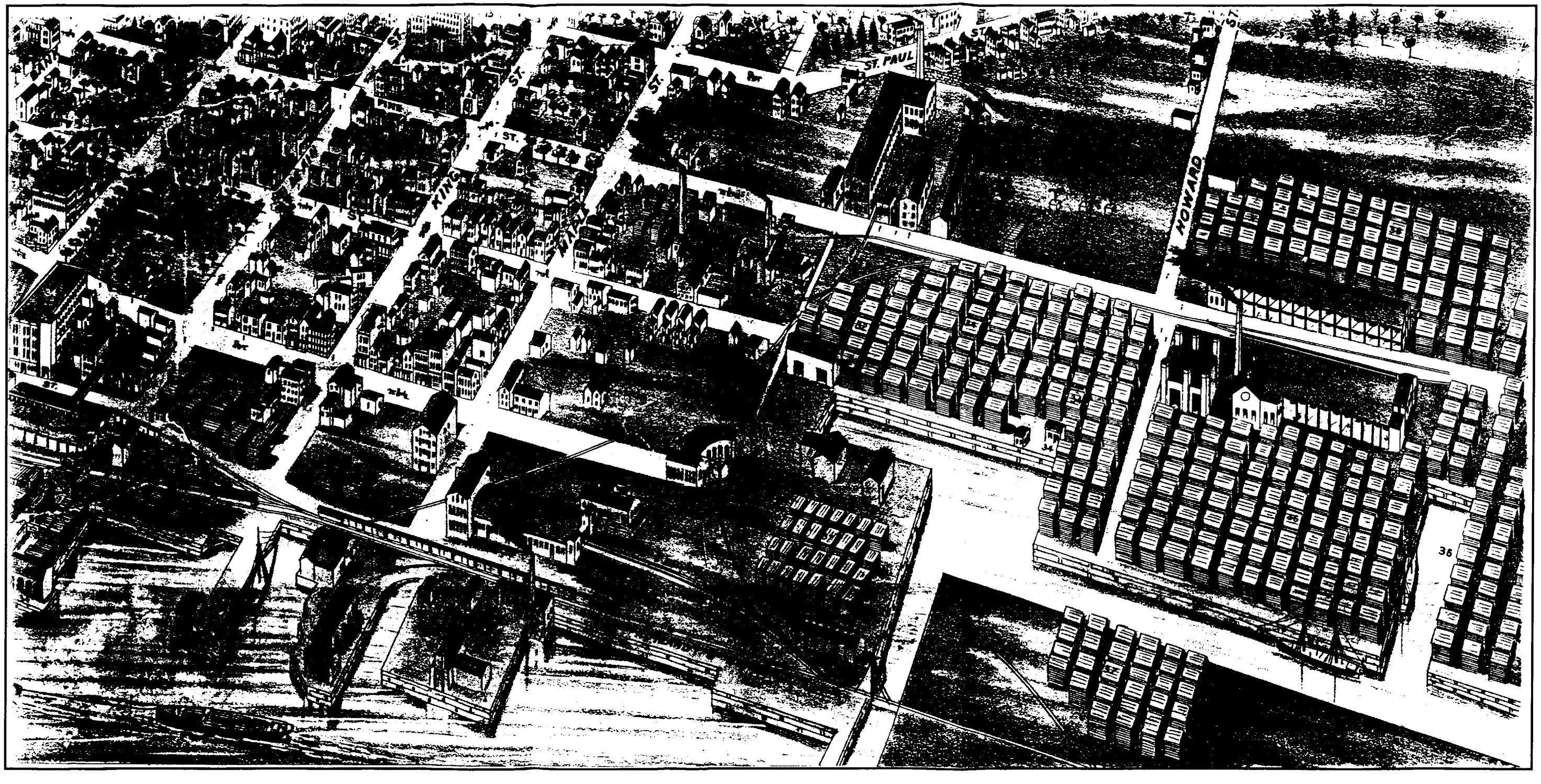


Figure 28. Detail, *Birds Eye View of Burlington and Winooski, VT* (Meilbek 1877), showing northern edge of barge canal.

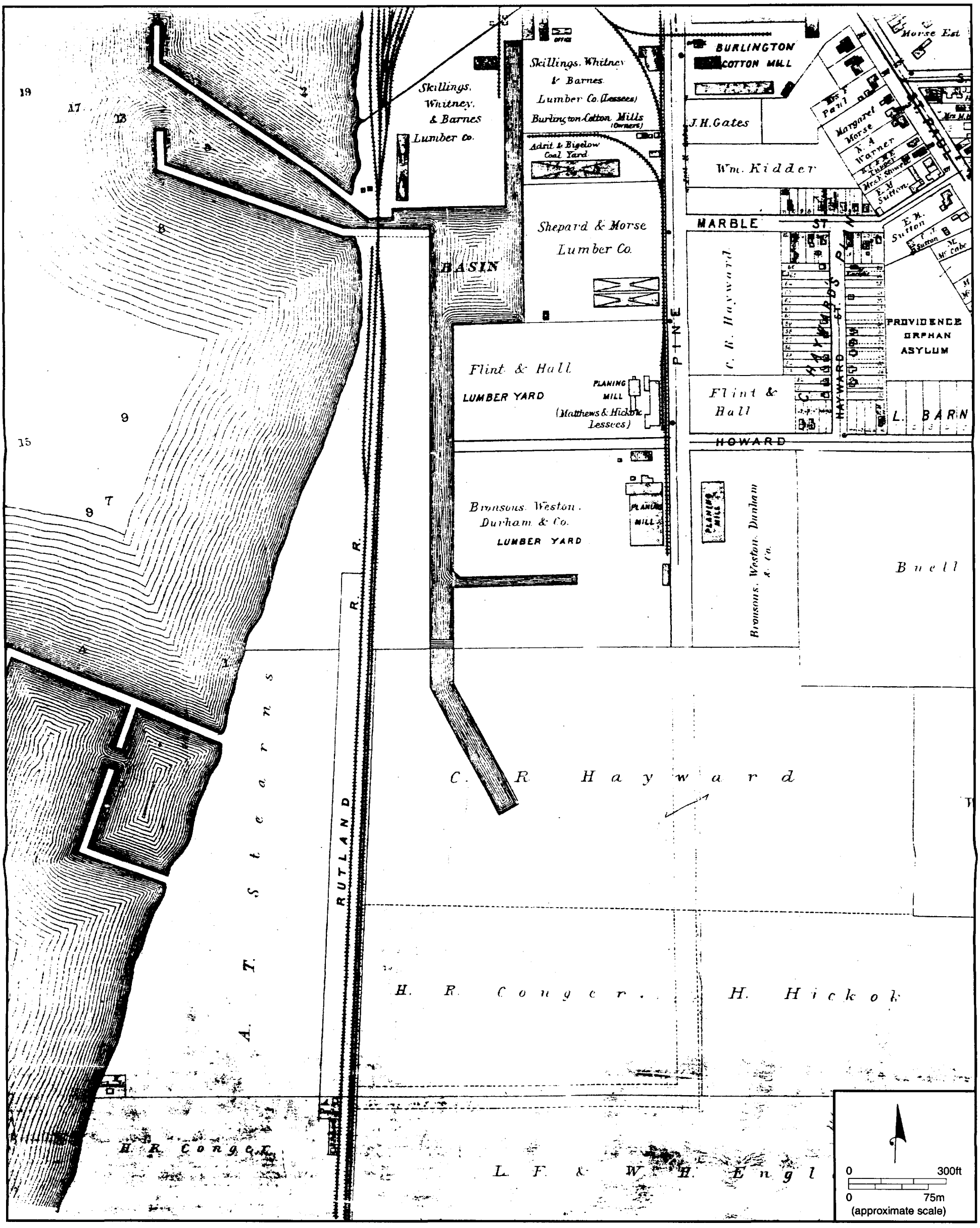


Figure 29. Detail, *Map of Burlington, Vermont* (Hopkins 1890), showing Pine Street Barge Canal. Note breakwaters extending in to Lake Champlain from either side of canal mouth.

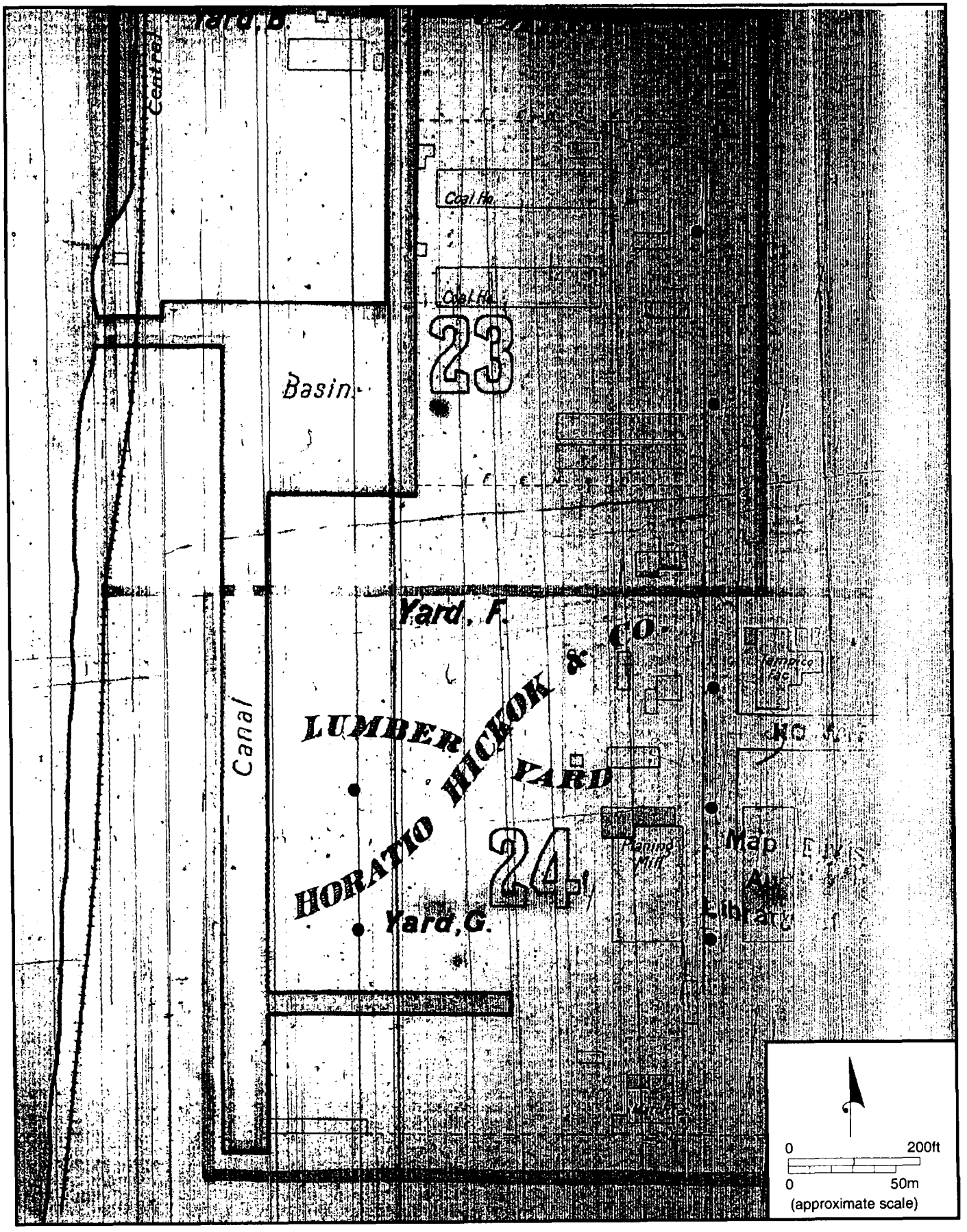


Figure 30. Detail, *Insurance Maps of Burlington, Vermont* (Sanborn 1894), showing Pine Street Barge Canal.

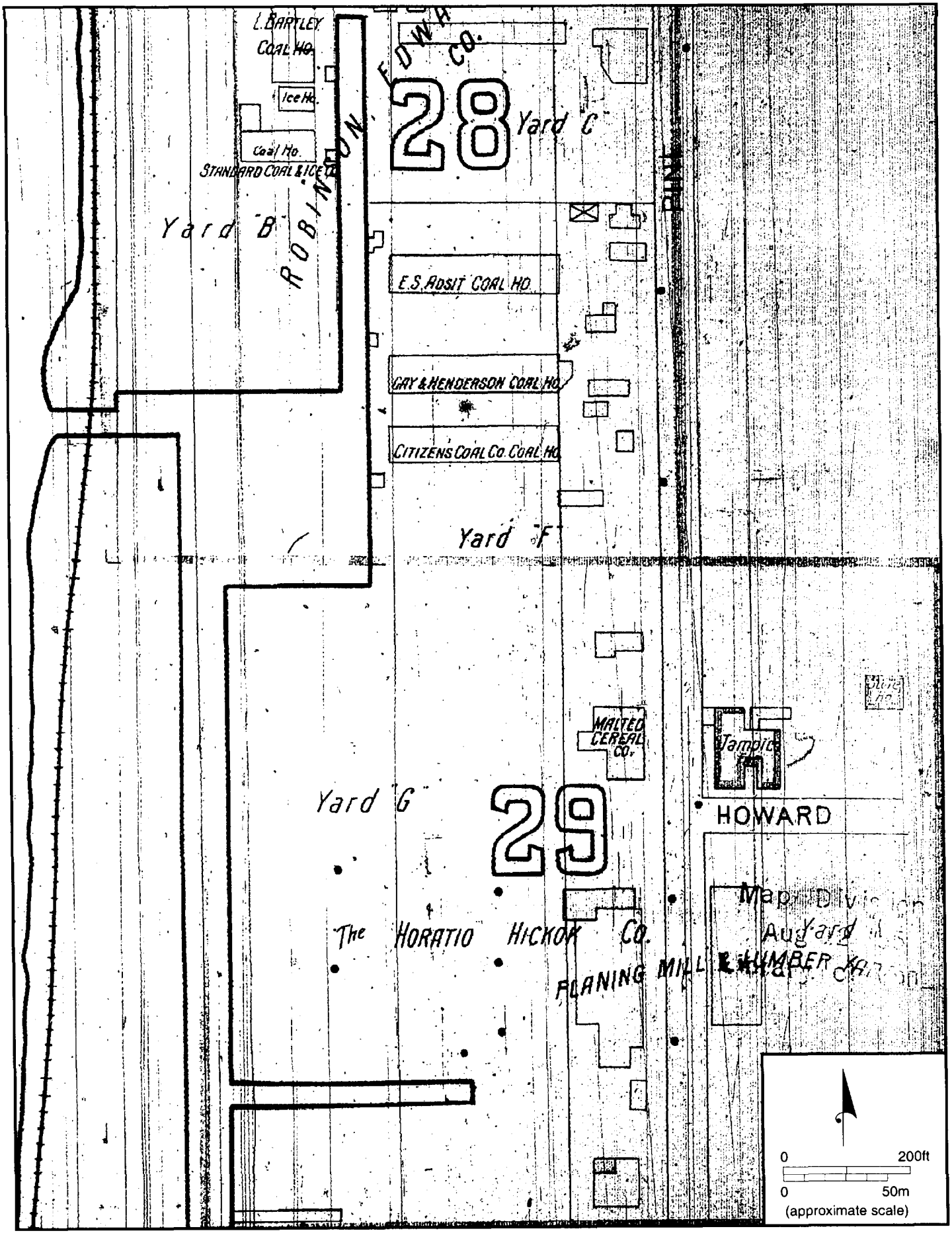


Figure 31. Detail, *Insurance Maps of Burlington, Vermont* (Sanborn 1900), showing Pine Street Barge Canal.

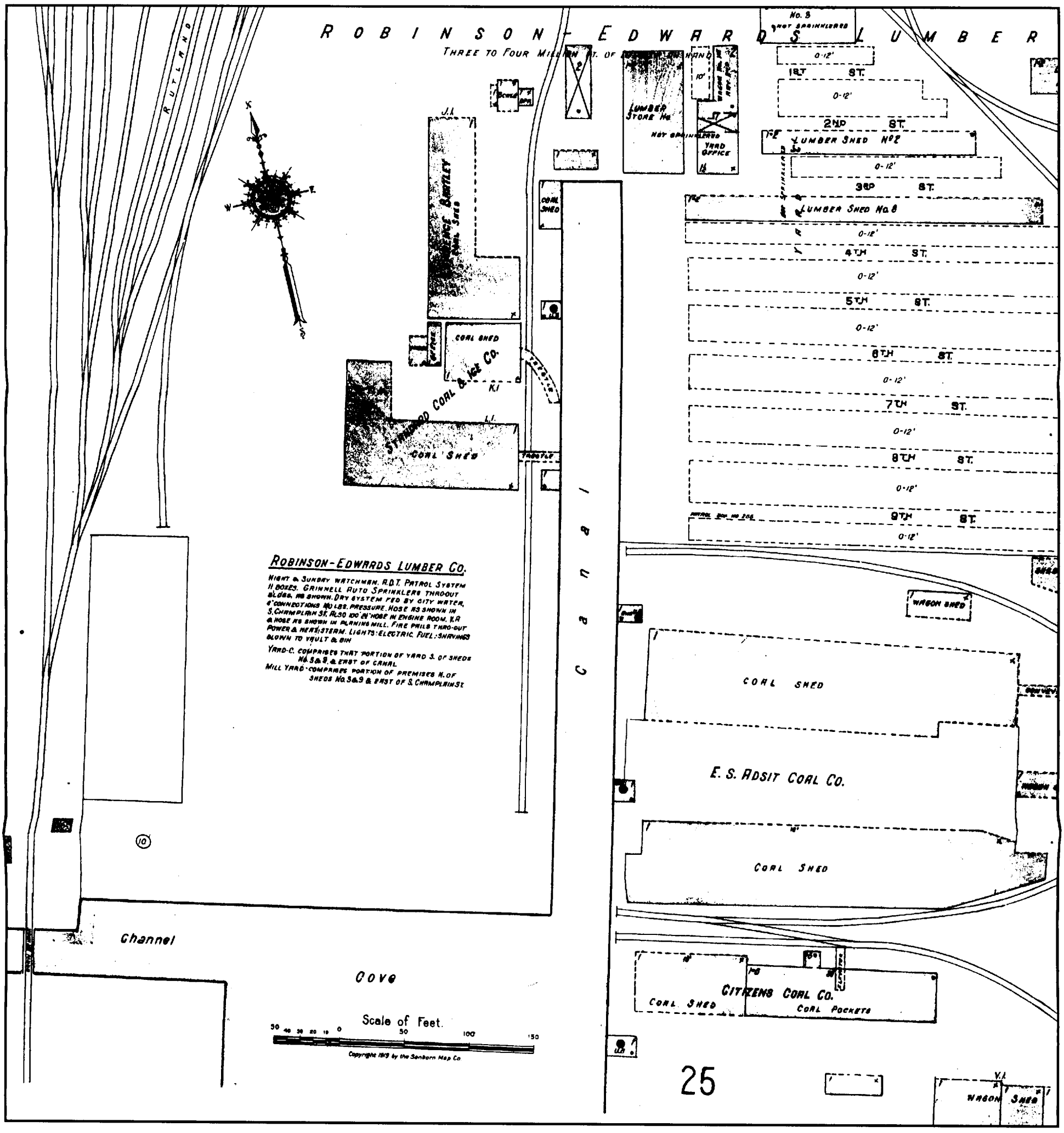


Figure 32. Detail, *Insurance Maps of Burlington, Vermont* (Sanborn 1919), showing northern end of Pine Street Barge Canal.

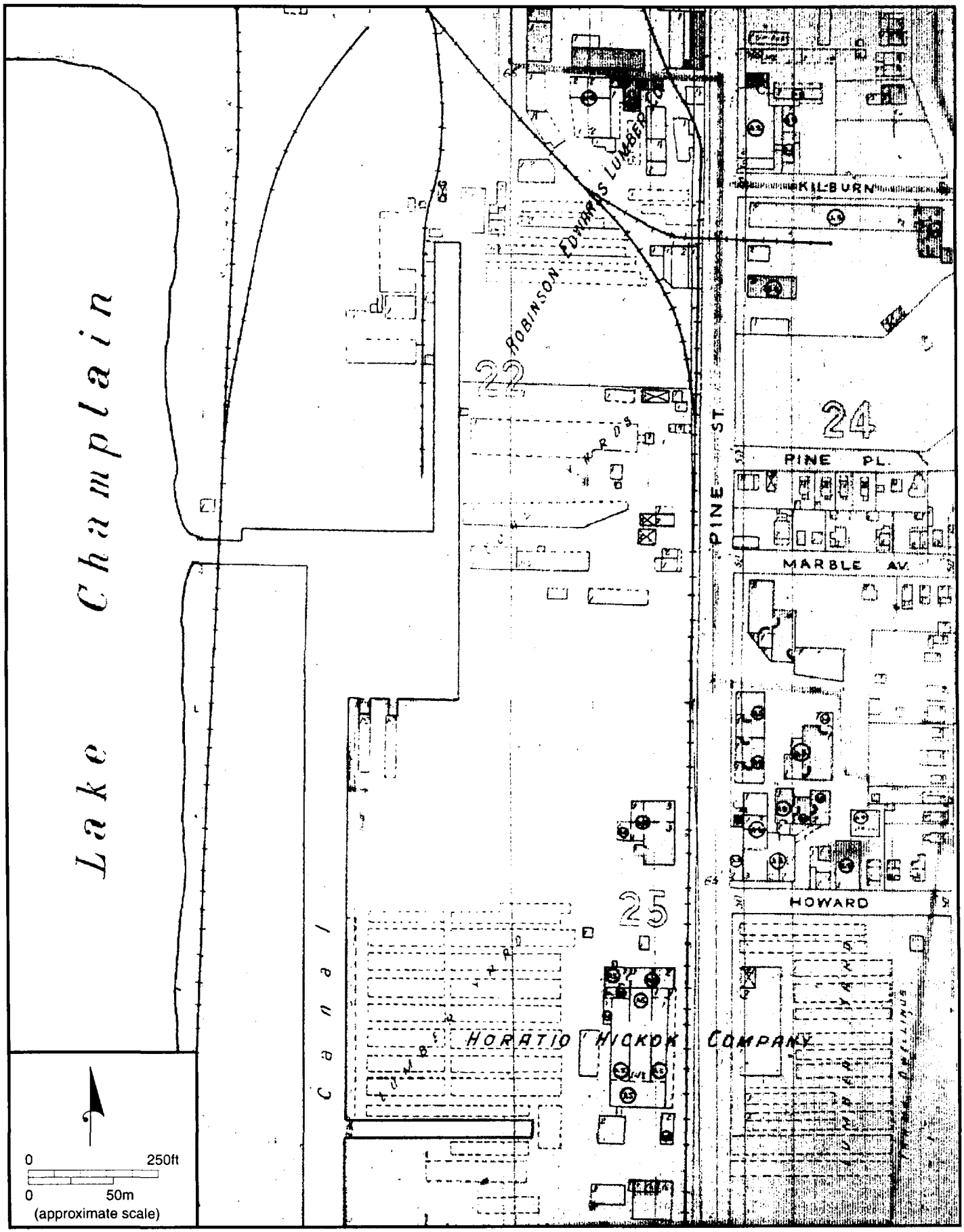


Figure 33. Detail, *Insurance Maps of Burlington, Vermont* (Sanborn 1926), showing Pine Street Barge Canal. Note boathouses on south side of turning basin.

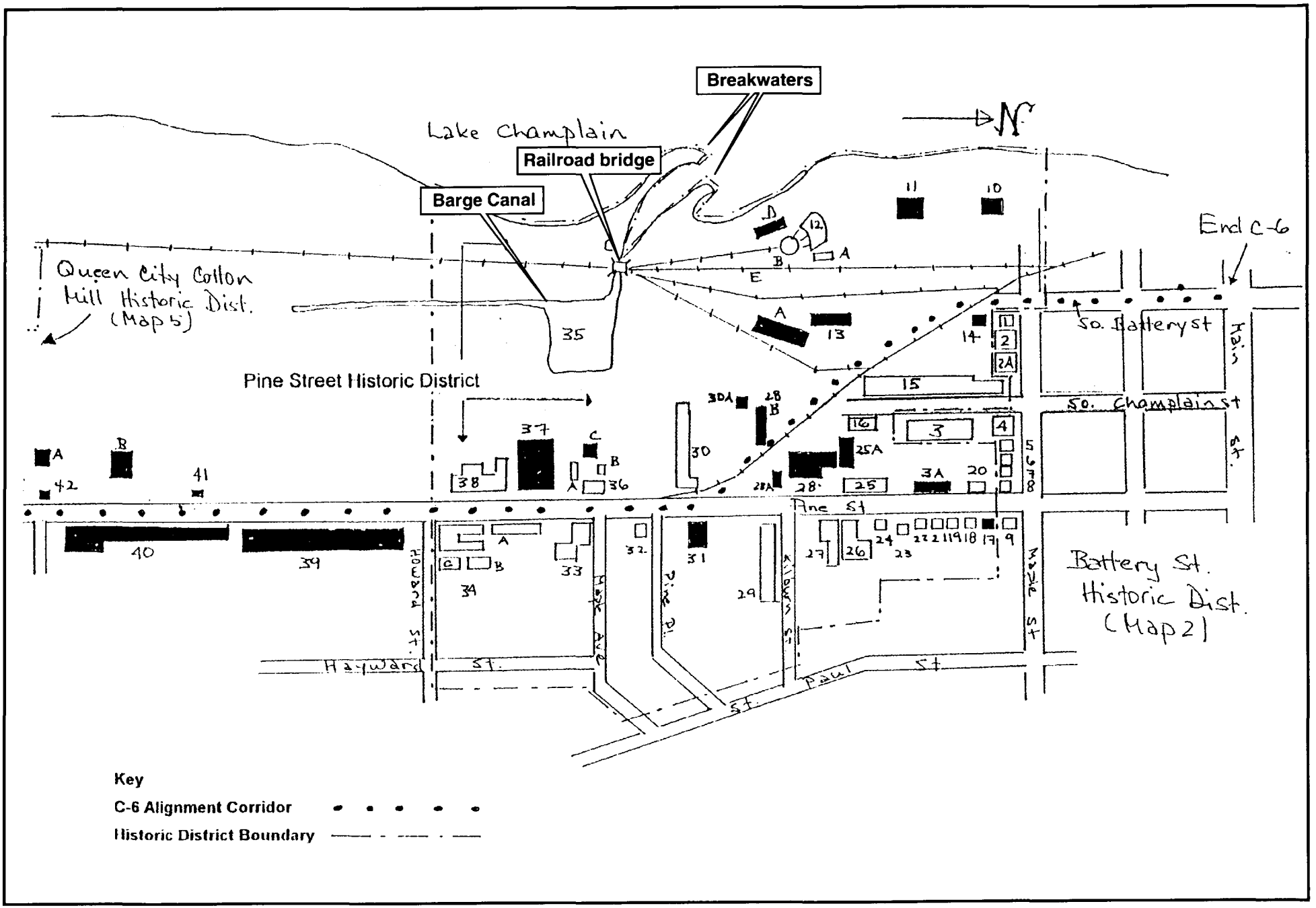


Figure 34. Pine Street Historic District (Pritchert 1996).

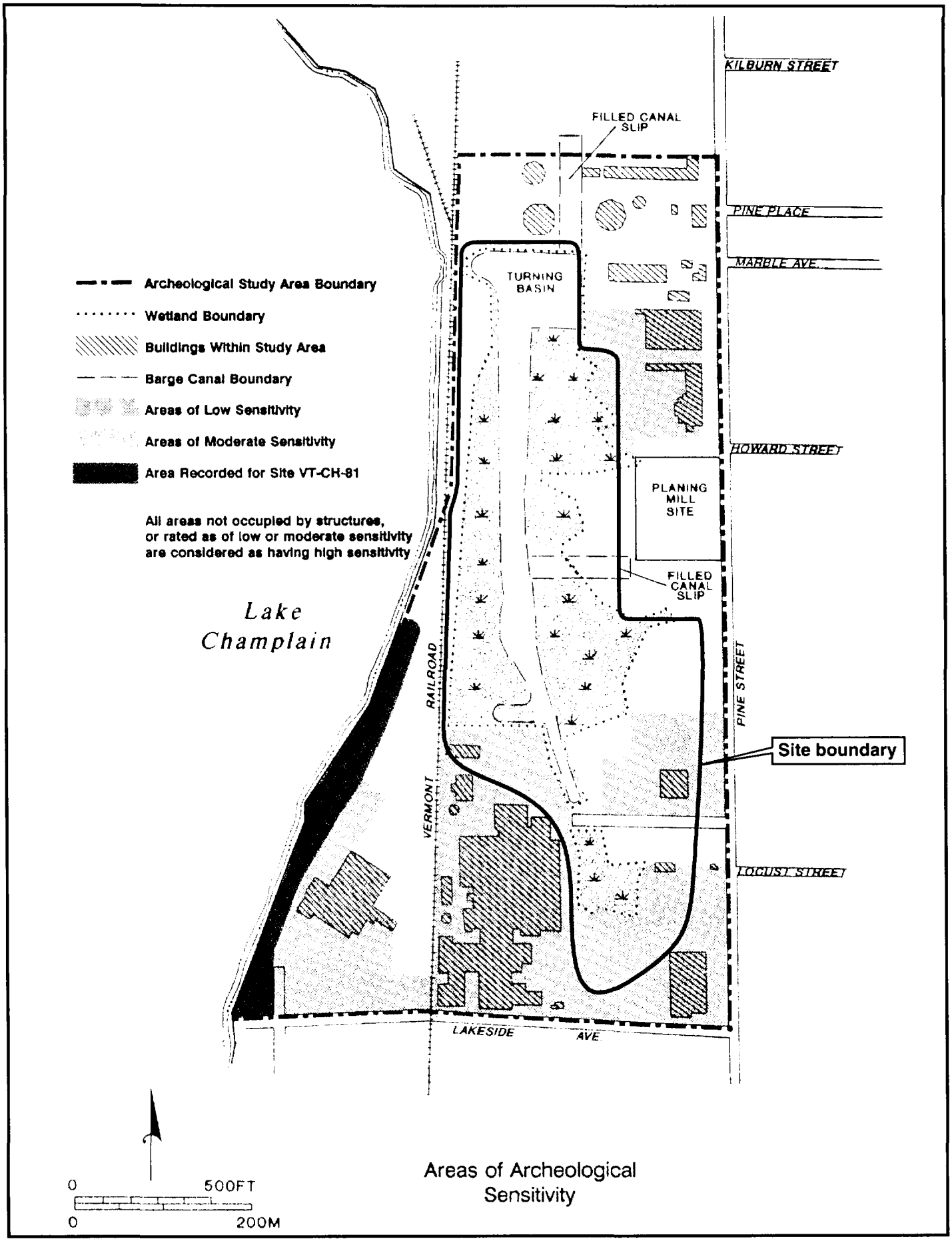


Figure 35. Areas of archeological sensitivity in relation to the Site boundary (modified from Cook and McCarthy 1992).

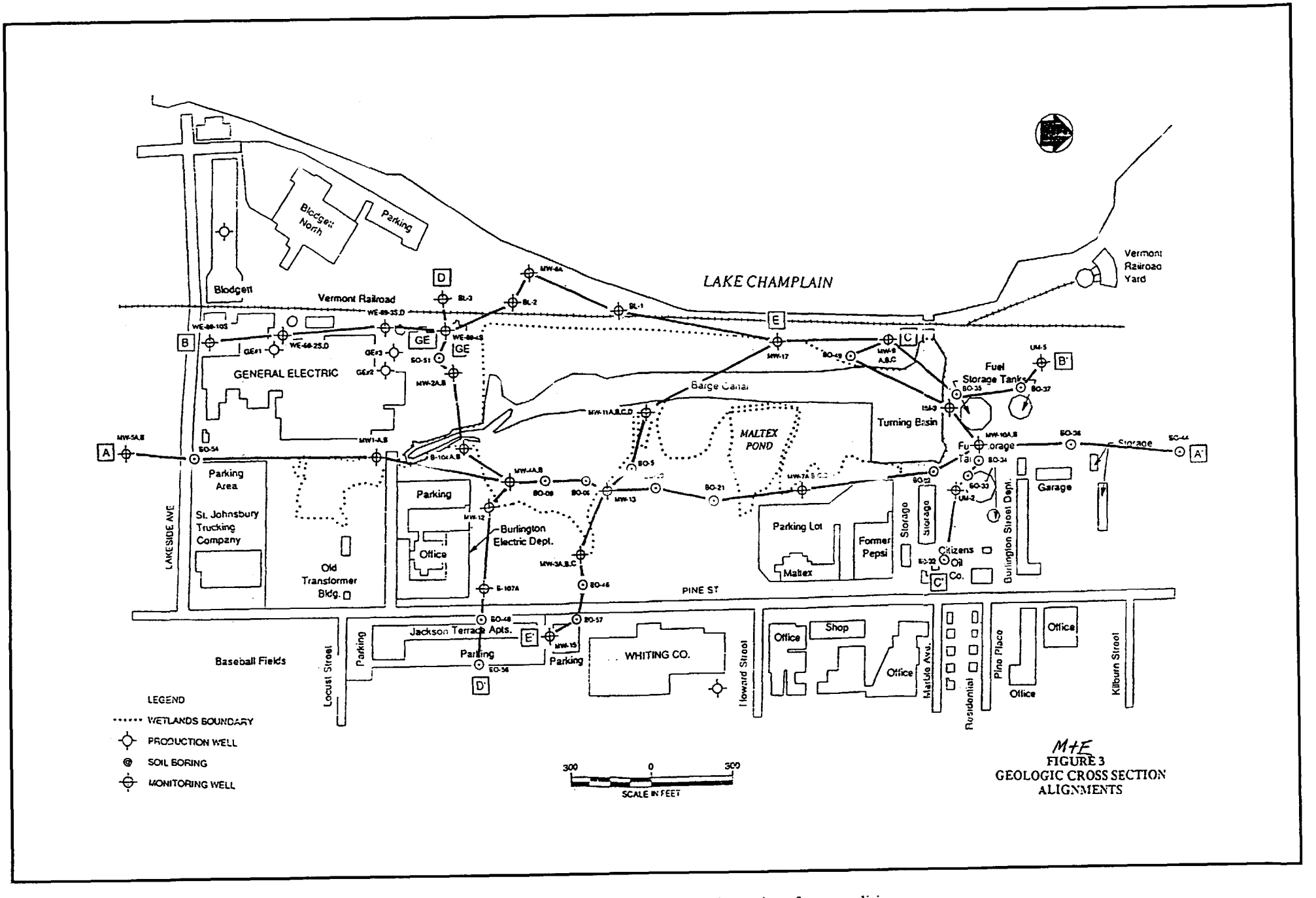


Figure 36. Locations of cross-sections showing subsurface conditions.

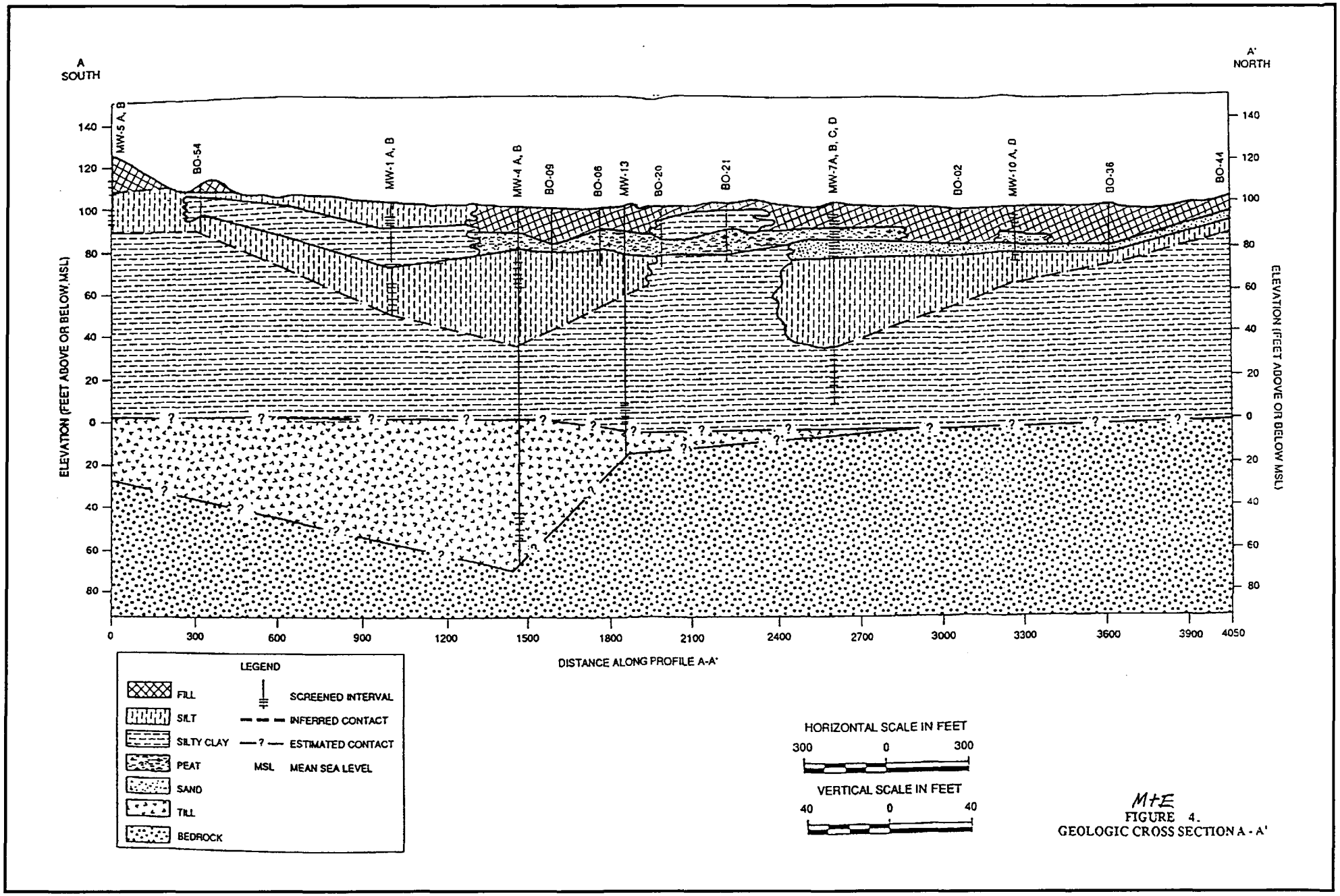


Figure 37. Geologic cross-section A-A'.

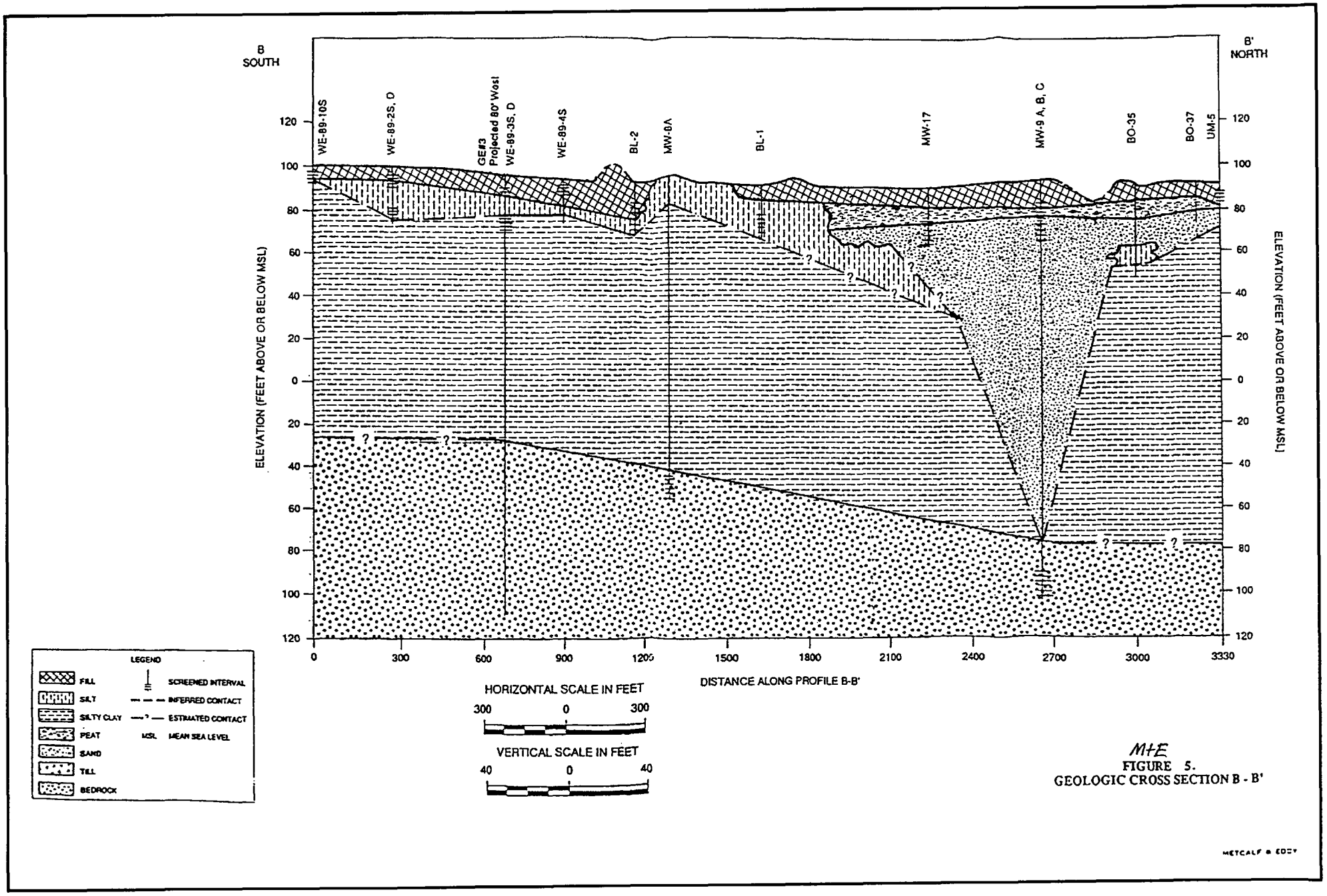
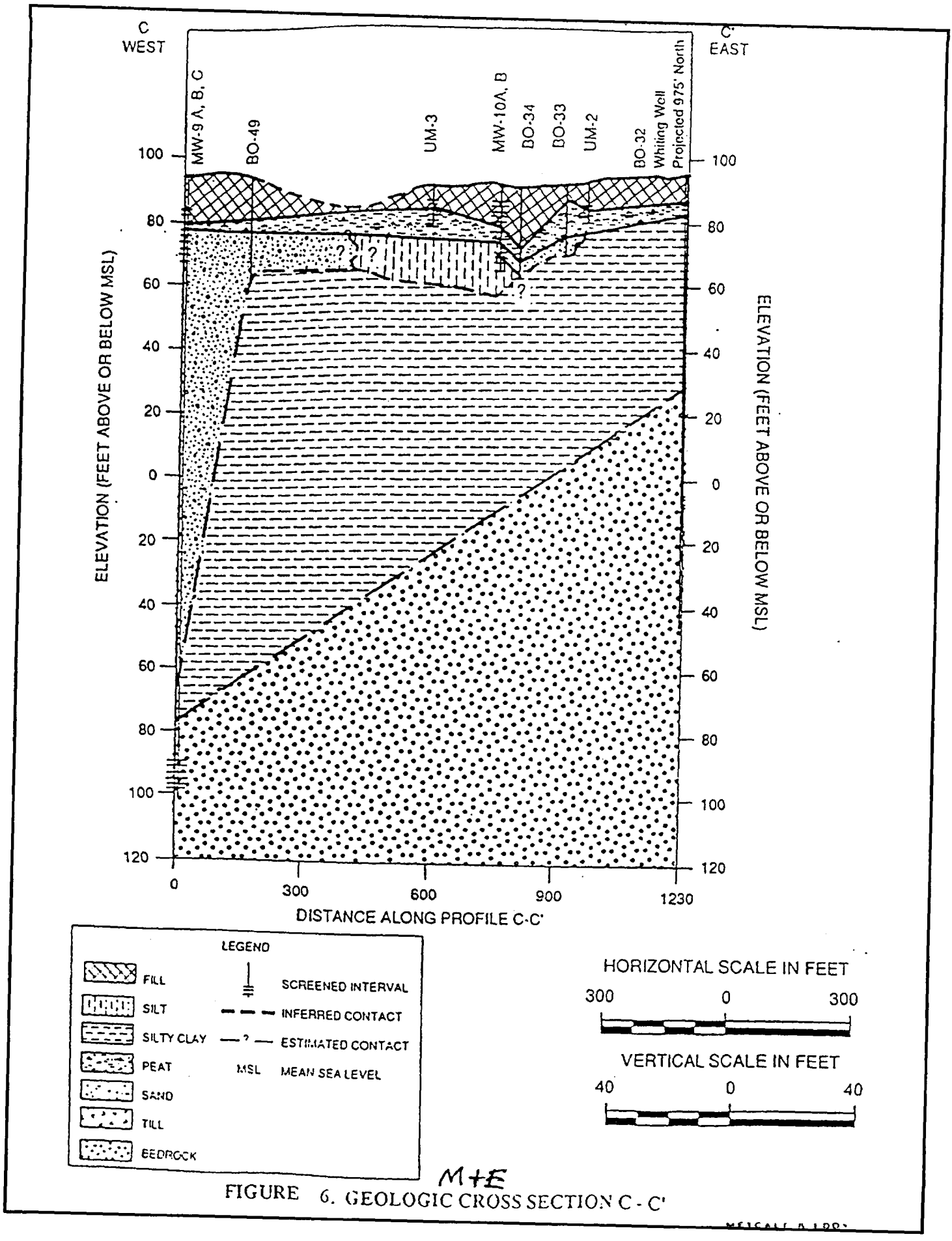


Figure 38. Geologic cross-section B-B′.



M+E

FIGURE 6. GEOLOGIC CROSS SECTION C - C'

Figure 39. Geologic cross-section C-C'.

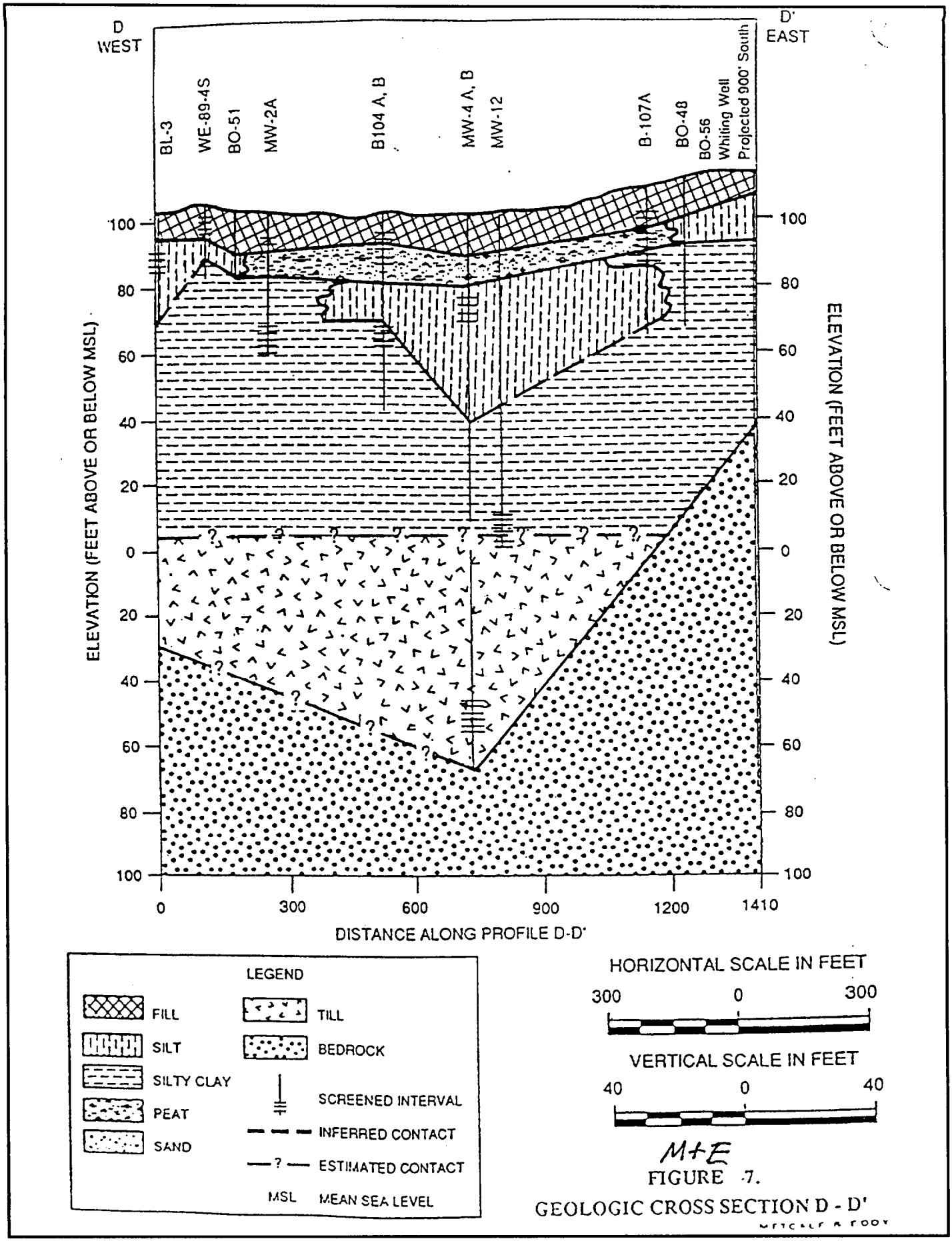
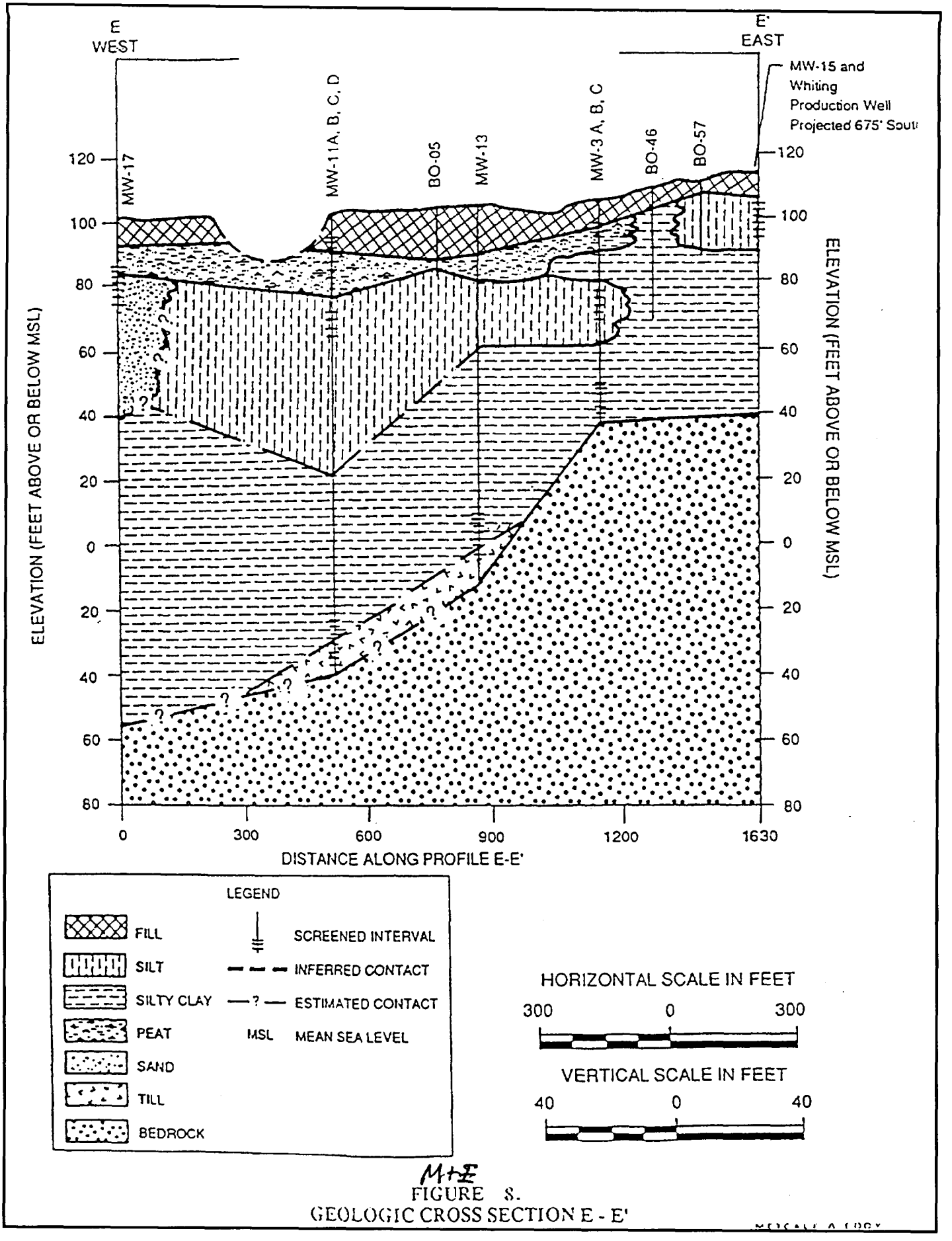


Figure 40. Geologic cross-section D-D'.



M+E

FIGURE 8.
GEOLOGIC CROSS SECTION E - E'

Figure 41. Geologic cross-section E-E'.

NOTE: SEE "TOP OF PEAT" BY THE JOHNSON COMPANY, INC. DATED 1/14/93
REVISED 3/7/95 FOR INFORMATION ON SAMPLE DATA, ACCURACY, AND SOURCES.

N

0 50 100 300

SCALE IN FEET

BLODGETT

BLODGETT NORTH

~LAKE CHAMPLAIN~

GENERAL DYNAMICS

CANAL

TURNING BASIN

BURLINGTON ELECTRIC & LIGHT DEPARTMENT

NORTH ROAD

FORMER PEPSI COLA

CITIZEN OIL COMPANY

BURLINGTON STREET DEPARTMENT

MALTEX BUILDING

PINE STREET

PINE STREET

LOCUST ST.

APARTMENT BUILDING

WHITING COMPANY

HOWARD ST.

MARBLE AVE.

LEGEND

------ BARGE SLIP (FILLED)

RAILROAD TRACKS

FILL 5' ISOPACH

PEAT PINCHOUT

• BOREHOLE LOCATION

$\bar{K}g$ = 1.05 FPD
$\bar{K}Vg$ = 0.0005 FPD
Kmax = 66.8 FPD
Kmin = 0.0091 FPD

ISOFILL.dwg

FILL ISOPACH

PINE STREET CANAL SITE
BURLINGTON, VERMONT

THE JOHNSON COMPANY, INC.
Environmental Sciences and Engineering
100 STATE STREET MONTPELIER, VT 05602

DATE: 1/20/99 DRAWN BY: TJK PROJECT: 1-0730-6 SCALE: SHOWN

Figure 42. Fill isopatch map.

PLATES

Plate 1. View of barge canal outlet from new bridge over outlet. General view to northeast.

Plate 2. Barge canal outlet and north end of turning basin from new bridge over outlet. General view to east.

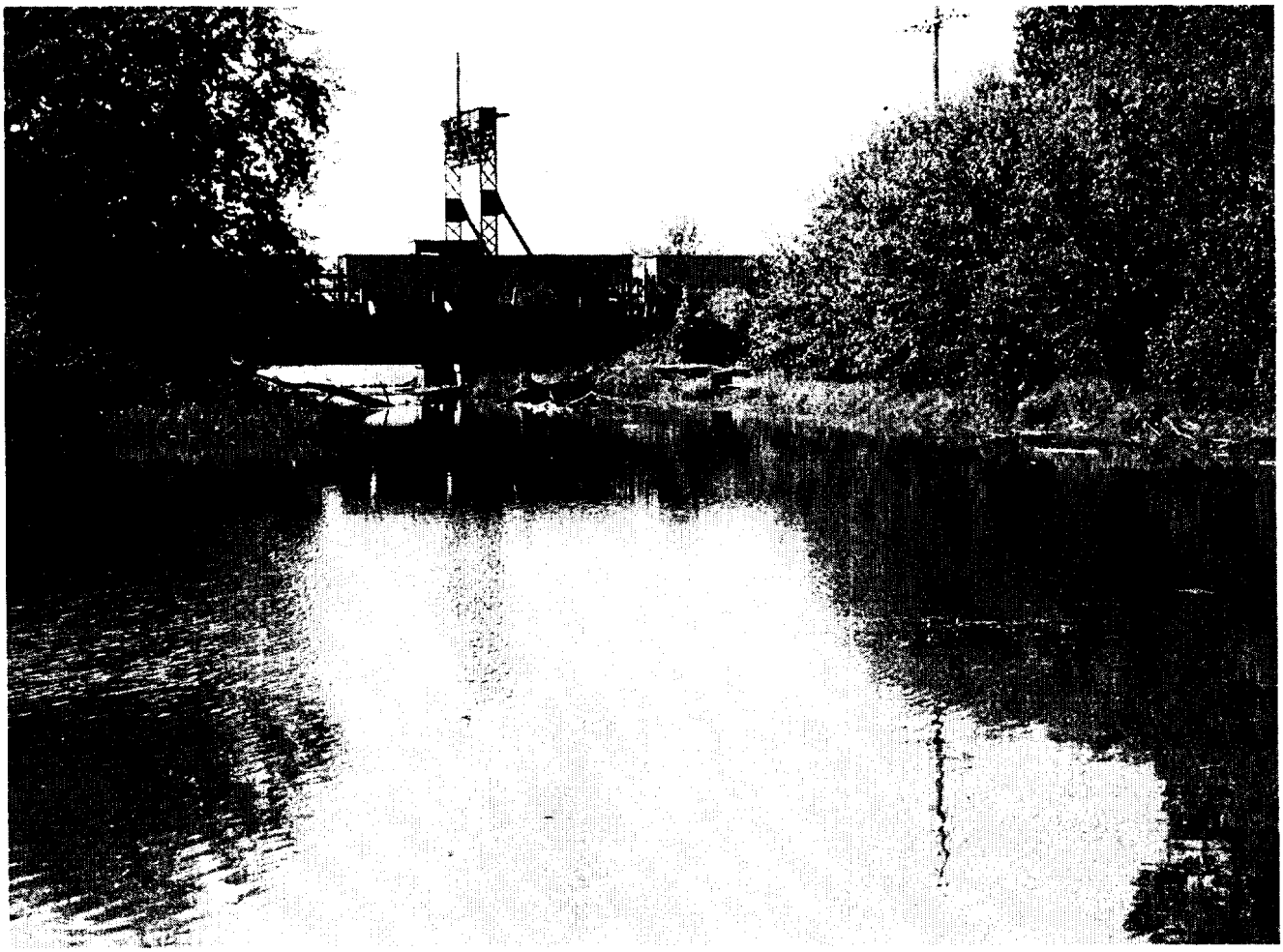


Plate 3. Turning basin and barge canal outlet with railroad bridge in background. View to northwest.

Plate 4. Southern portion of Pine Street barge canal. View to west. Note boulders piled on far shore of barge canal.

Plate 5. Southern portion of Pine Street barge canal. View to northwest.

Plate 6. Southern portion of barge canal and south end of turning basin. View to northwest.

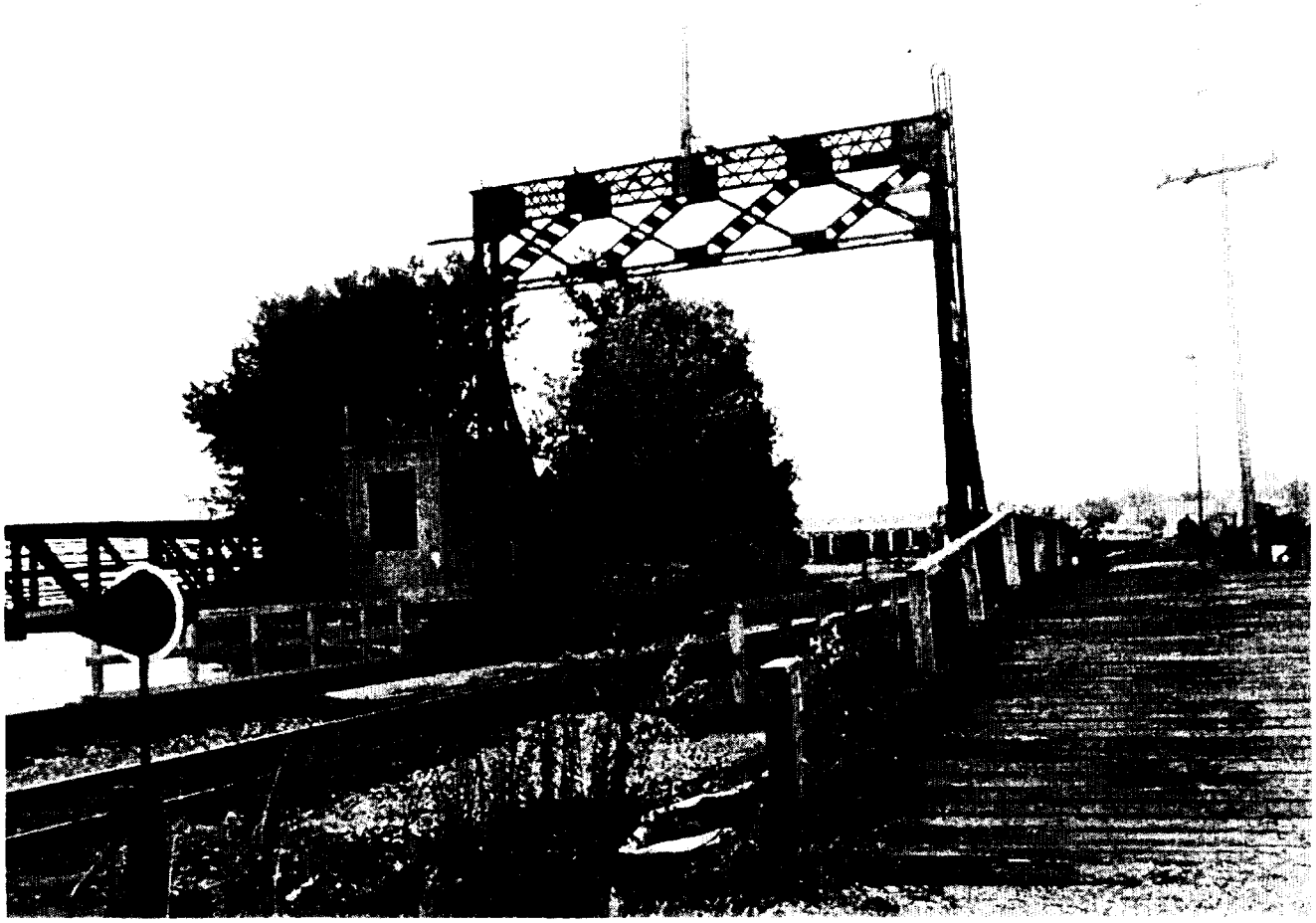


Plate 7. Strauss trunnion bascule bridge over mouth of barge canal. General view to northwest. Note bicycle path bridge at left of photograph.

Plate 8. Strauss trunnion bascule bridge over mouth of barge canal. Note recently constructed wood bridge at right and wood railings along sides of bridge. View to northeast.

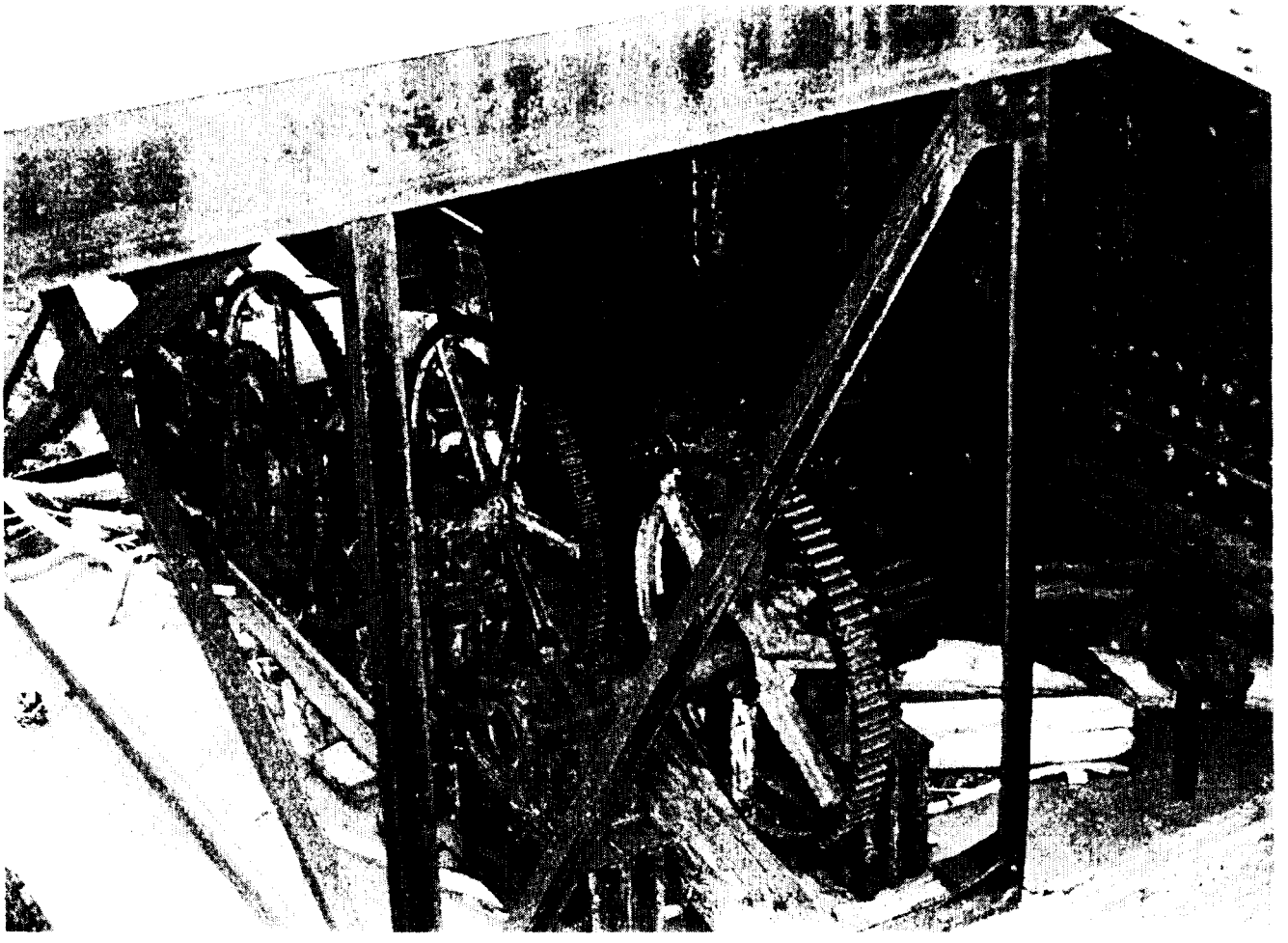


Plate 9. View of portion of bridge operating machinery in place beneath operator's house. View to northeast.

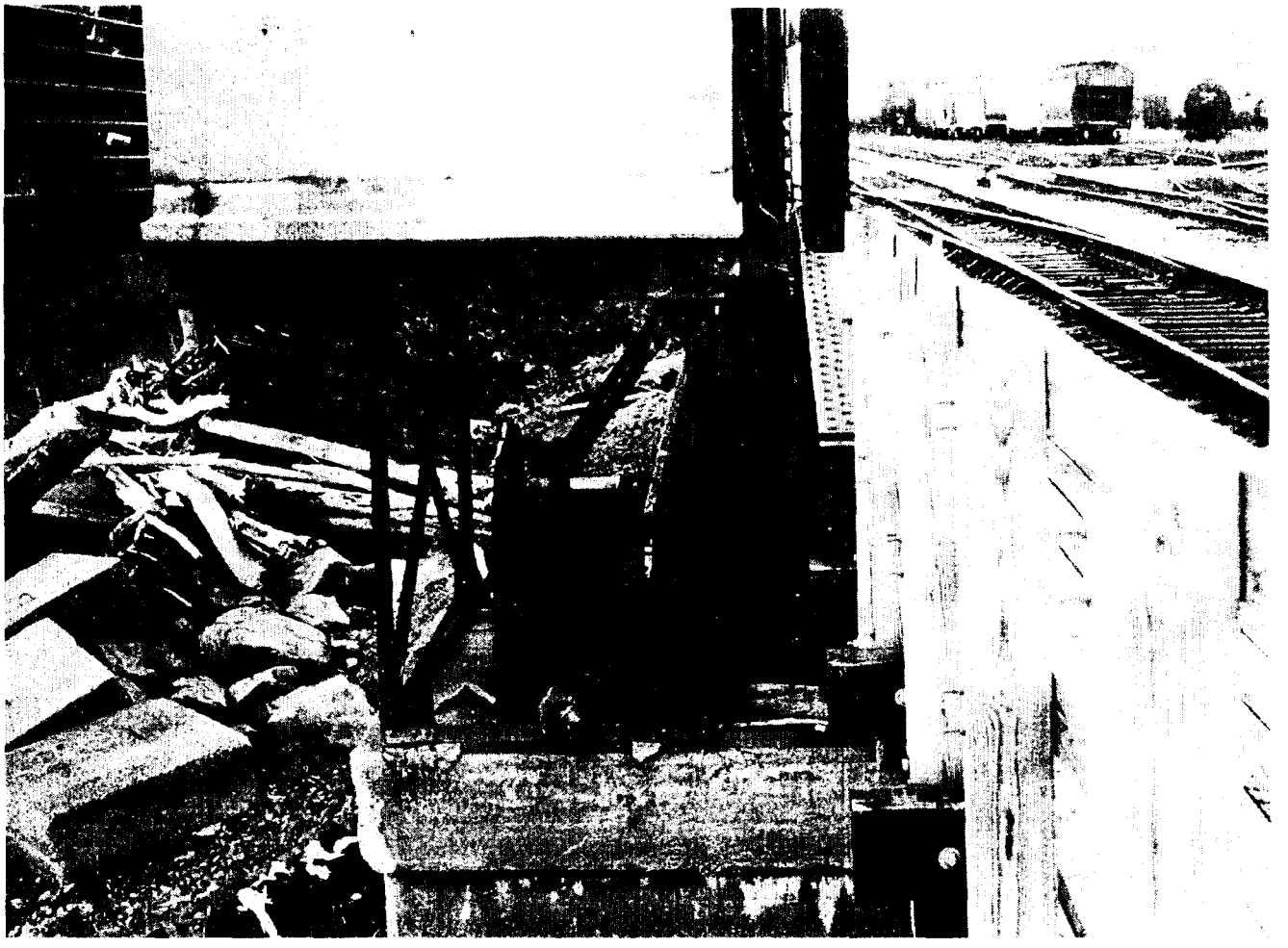


Plate 10. Bridge operating machinery raised on concrete platform beneath operator's house. Note recently installed bridge railing at right. View to north.

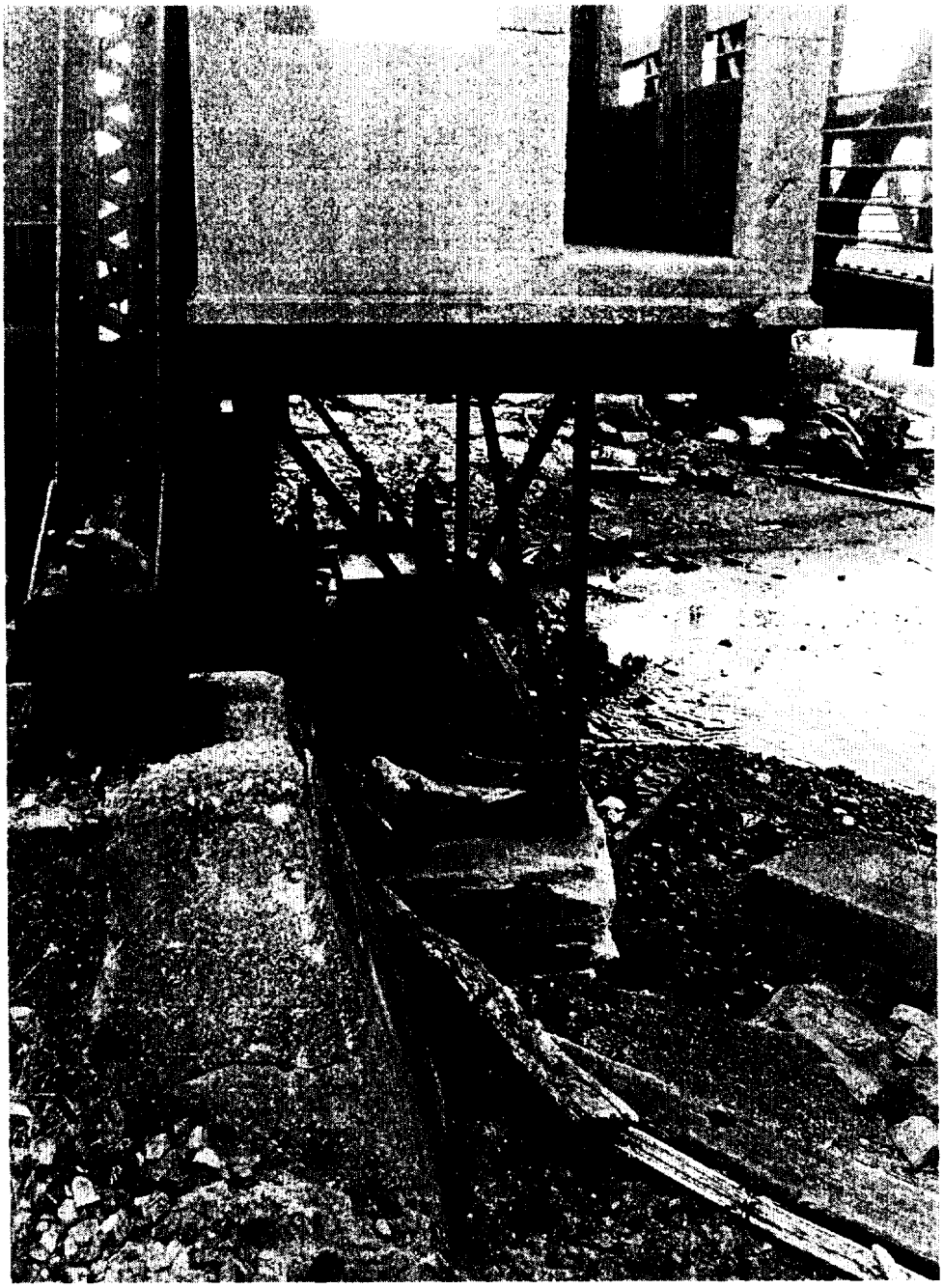


Plate 11. Machinery platform of bridge. Note steel framework anchored in concrete footing at left, operator's house in upper center, and remains of steelwork to right of machinery platform. View to south.

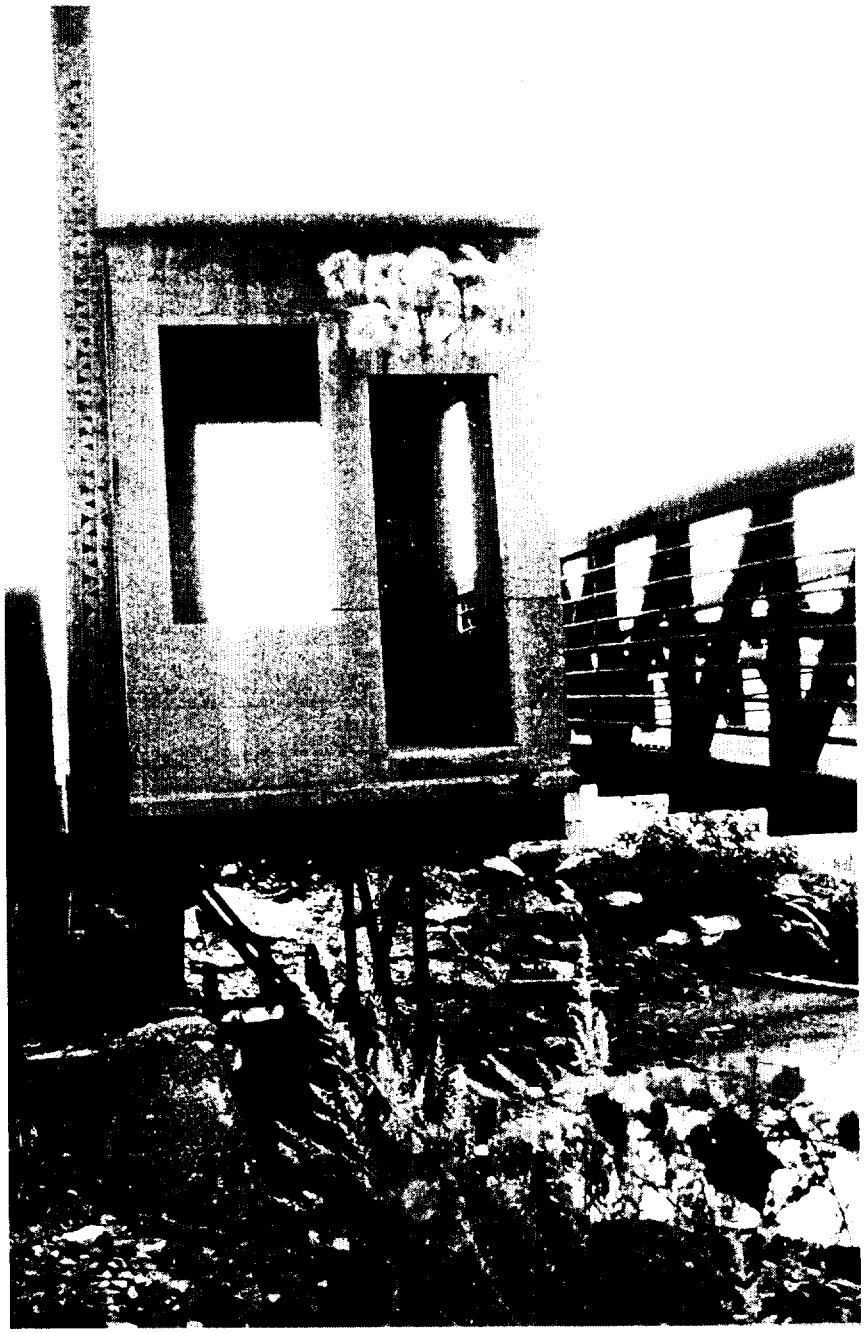


Plate 12. View of bridge operator's house to south.

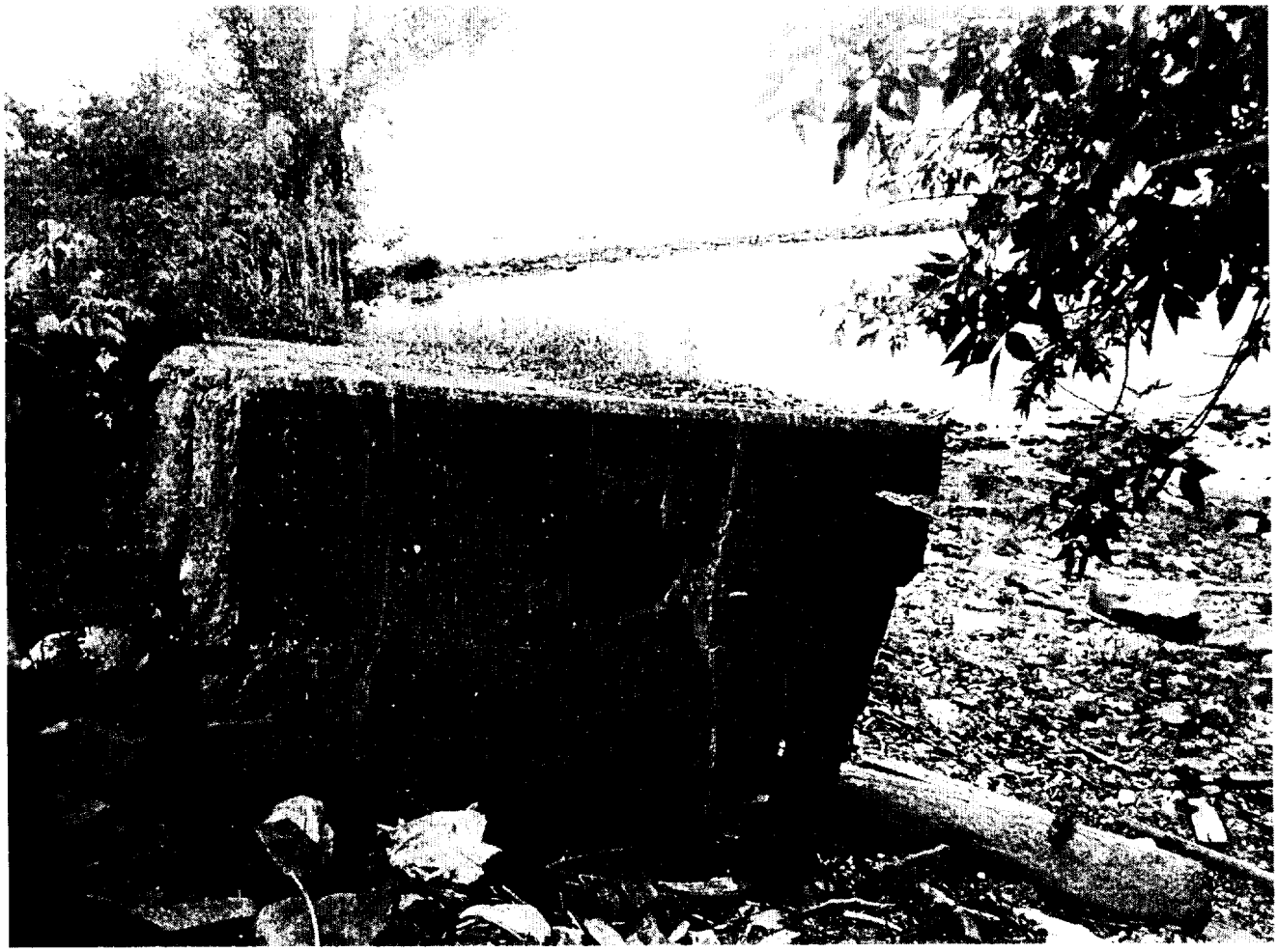


Plate 13. Portion of concrete bridge counterweight lying on ground next to bicycle path bridge. View to southwest. Note breakwater in background.

Plate 14. View of shore at barge canal outlet with concrete counterweight at center. Note cut made in upper right portion of counterweight to accommodate the bicycle path bridge. View to north.

Plate 15. Possible building timbers in vicinity of former location of east boathouse, south side of turning basin. View to north.

Plate 16. Close-up of concrete footing for east boathouse ramp. View to northwest.

Plate 17. Close-up of concrete footing for east boathouse ramp. Note building timber resting on footing. View to west.

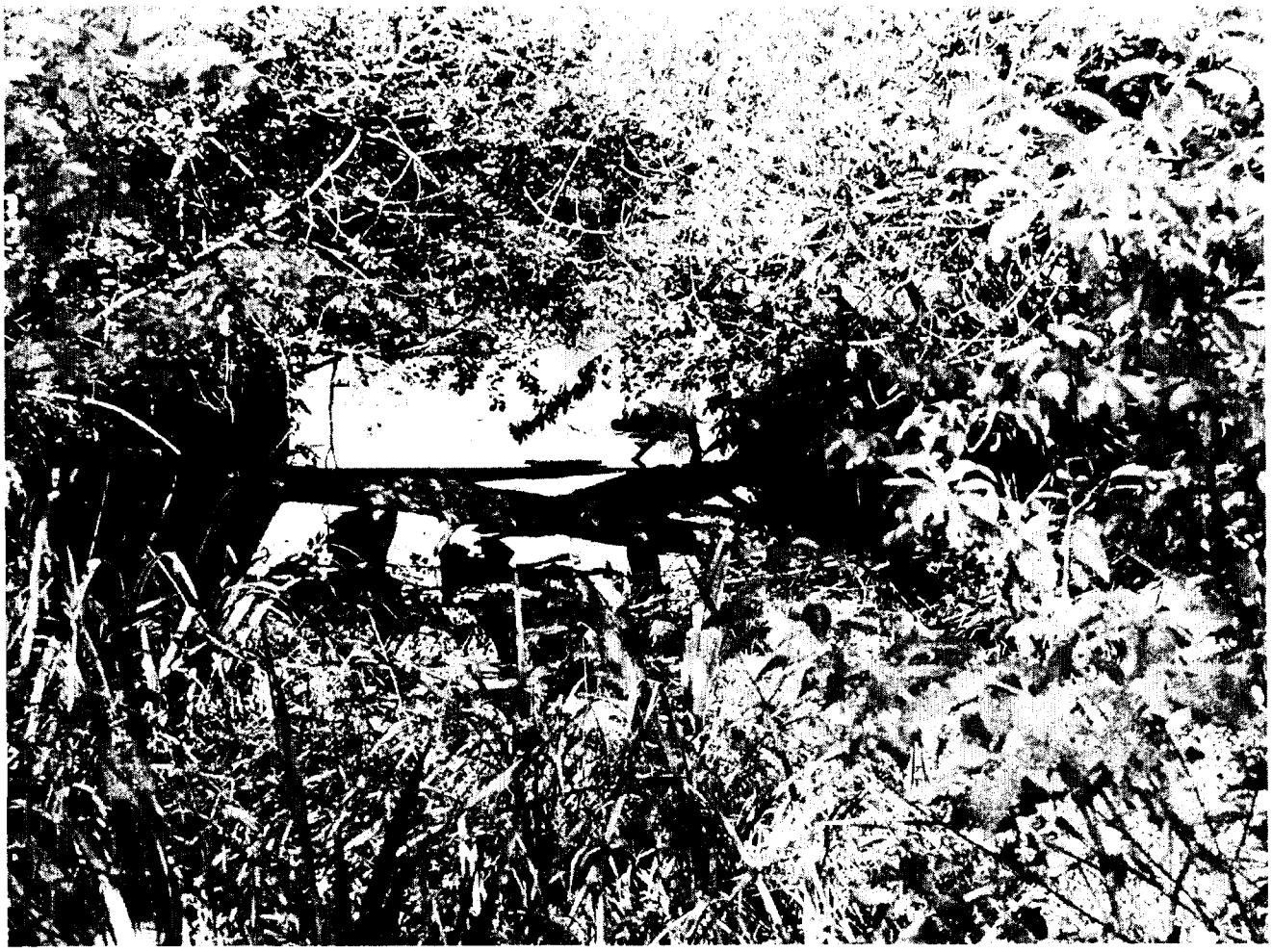


Plate 18. View of area of former boathouse ramp in the vicinity of the south shore of turning basin. Dark shadow at left is one of pair of angled poured concrete walls extending into the turning basin. View to north.

Plate 19. Breakwater on south side of outlet of barge canal. General view to west.

Plate 20. Remains of breakwater on north side of outlet of barge canal. View to northwest.

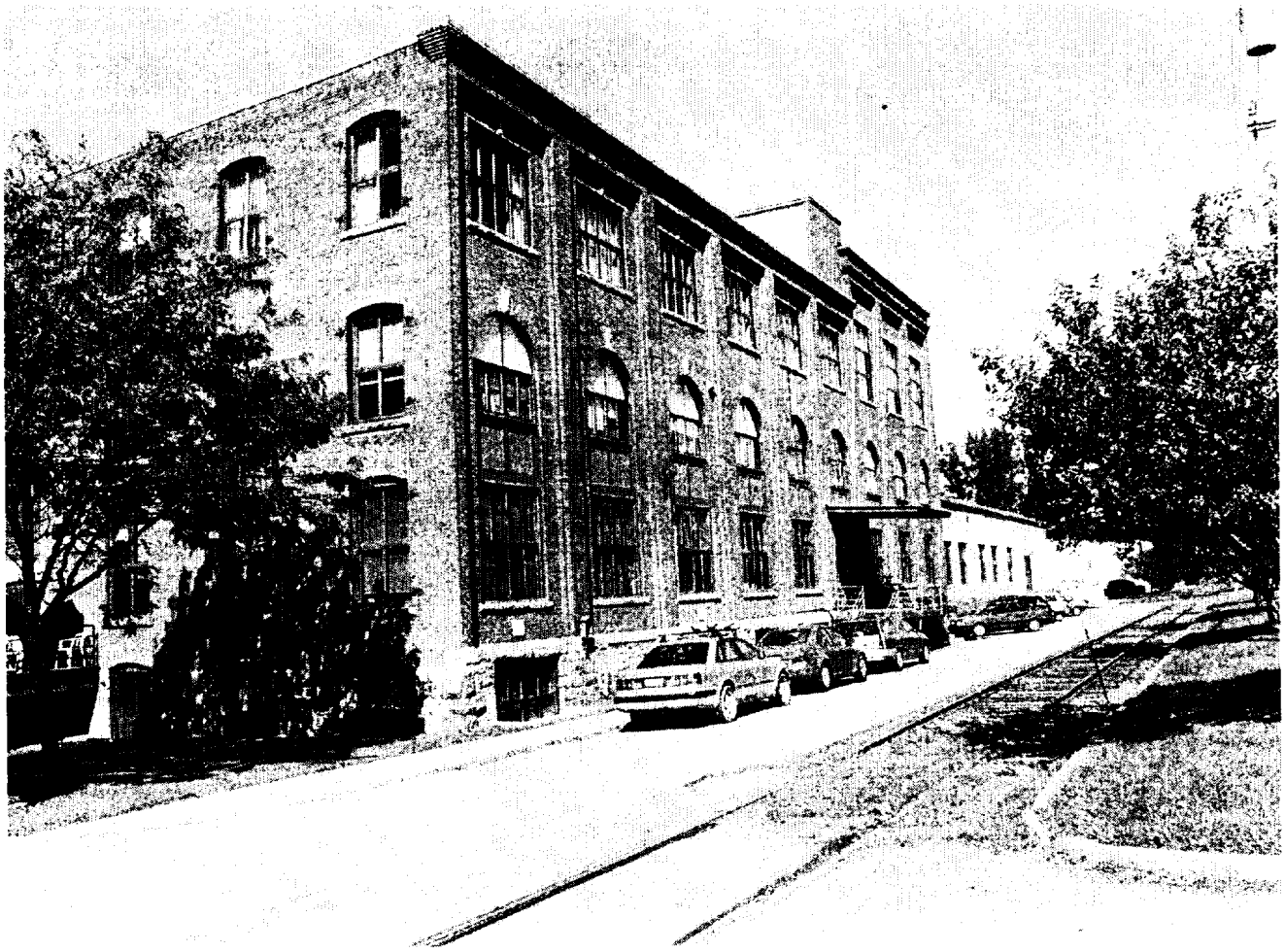


Plate 21. The Maltex Building. 431 Pine Street. General view toward northwest.

APPENDIX I:

VERMONT HISTORIC SITES AND STRUCTURES SURVEY FORMS

STATE OF VERMONT Division for Historic Preservation Montpelier, VT 05602 HISTORIC SITES & STRUCTURES SURVEY District ☐ Complex ☒ Survey Form	SURVEY NUMBER: NEGATIVE FILE NUMBER(S): 7189, 7193 UTM REFERENCES: Zone/Easting/Northing A B C D U.S.G.S. QUAD. MAP: Burlington, VT COMPLEX INFORMATION ONLY
COUNTY: Chittenden TOWN: Burlington	COMMON NAME: Pine Street Barge Canal
LOCATION: Pine Street	PRESENT FORMAL NAME: Pine Street Barge Canal
NAME OF DISTRICT: Pine Street Barge Canal	ORIGINAL FORMAL NAME: Pine Street Barge Canal
TYPE OF DISTRICT: industrial, archeological	TYPE OF COMPLEX: industrial, archeological
PHYSICAL CONDITION OF STRUCTURES: Excellent % Good % Fair 50 % Poor 50 % LEVEL OF SIGNIFICANCE: Local ☐ State ☒ National ☐	TYPES OF STRUCTURES: boat basin, breakwater, railroad bridge, remains of boathouses PRESENT USE: not in use, railroad bridge ORIGINAL USE: boat basin, boat repair, railroad bridge
THEMES: Industry Lake Champlain Navigation	ARCHITECT/ENGINEER: Strauss Bascule Bridge Company (bridge) BUILDER/CONTRACTOR: Luther Whitney (Port Douglass, NY) Canal ACCESSIBILITY TO PUBLIC: Yes ☐ No. ☐ Restricted ☒

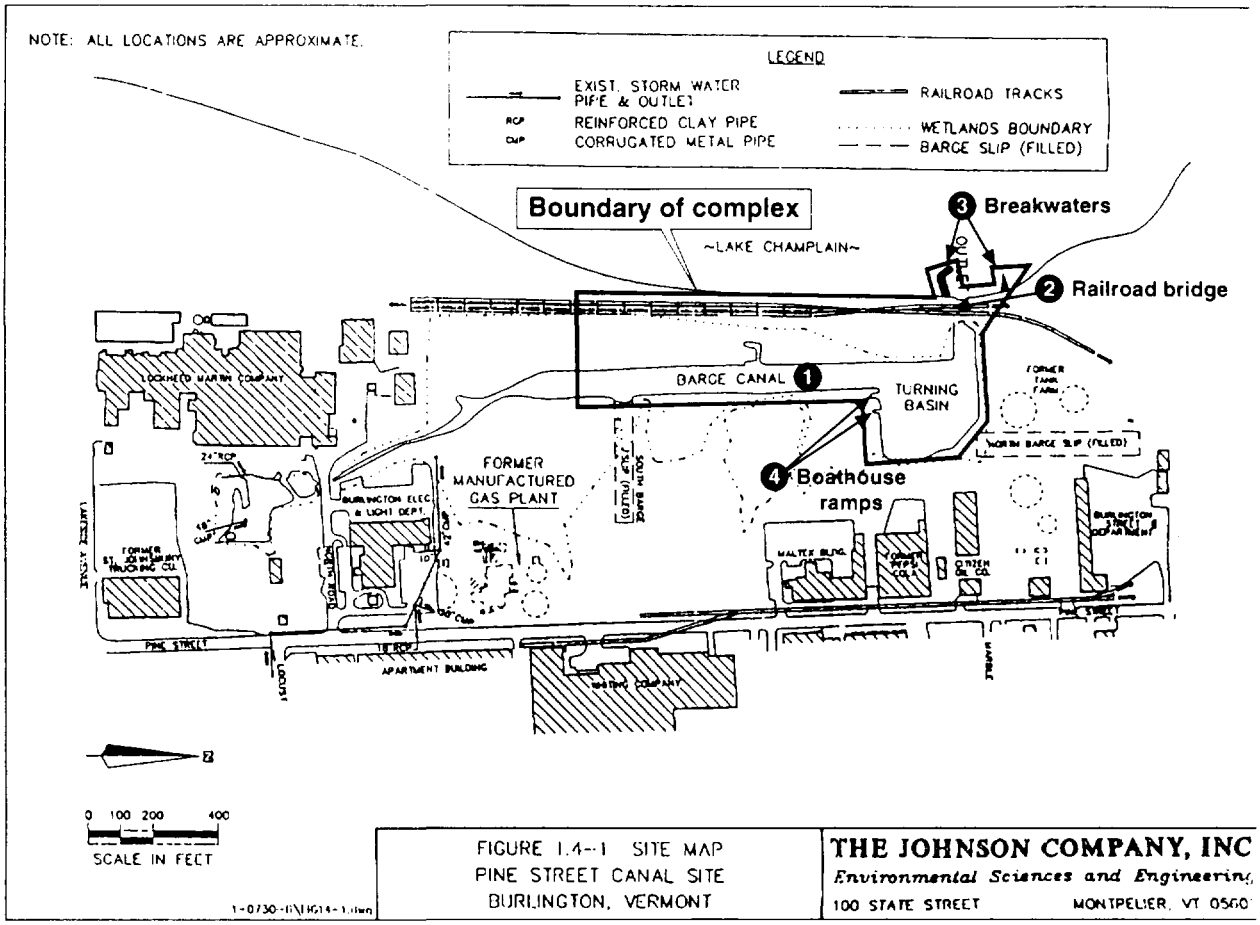
STATEMENT OF SIGNIFICANCE:

The Pine Street Barge Canal is one of the few visible remnants of the nineteenth century lumber industry of Burlington. Beginning in the mid-nineteenth century and continuing to almost the end of the century, Burlington was one of the major lumber ports and lumber processing centers of the United States. Canadian timber was floated down Lake Champlain on barges to Burlington. The raw logs were transformed into lumber by large mills along the waterfront. Some of the lumber was converted into finished goods at Burlington factories, while most of the lumber produced was loaded onto railroad cars for shipment to urban centers of New England and other parts of the northeast.

Early on, lumber businesses faced a shortage of storage space. The waterfront of Burlington was a relatively narrow strip of land along the lakefront with residential, commercial and industrial development bounding it on the east and extending up the hillside. One of the early lumbermen, Lawrence Barnes, sought to expand both lumber storage and manufacturing areas by filling a swampy area, described in one source as a "miasmatic frog pond," at the south end of the waterfront. A centerpiece of Barnes's plan was a sheltered boat basin, the Pine Street Barge Canal, where lumber barges could be moored to unload timber for processing in the city's mills. Construction of the canal was begun in 1868, and the waterway was enlarged later in the century in response to increased demand from lumber companies located along its banks.

THREAT TO STRUCTURES: No Threat ☐ Zoning ☐ Roads ☐ Development ☐ Deterioration ☒ Alteration ☐ Other: Hazmat Remediation	LOCAL ATTITUDES: Positive ☐ Negative ☐ Mixed ☒ Other:

MAP: (1. Indicate NORTH in circle. 2. Represent each structure as an open box. 3. Number each structure inside of its box.)



BOUNDARY DESCRIPTION:

The boundary of the complex is an irregular figure whose northwest corner is indicated by the end of the north breakwater extending from the north side of the turning basin outlet. The boundary then extends east along the northern shore of the turning basin and including the railroad bridge across the outlet to the turning basin. At the eastern edge of the turning basin, the boundary extends south and includes the area on the south side of the turning basin formerly occupied by the boathouses/boat ramps. The southern end of the complex is the point at which the south arm of the Pine Street canal loses its historic linear form. At that point, the boundary extends west to the west side of the former Rutland Railroad right-of-way and extends north to the vicinity of the south side of the turning basin outlet, turning west to include the south breakwater.

REFERENCES:

A complete list of references is contained in the bibliography for the report, *Pine Street Canal Superfund Site, Burlington, Chittenden County, Vermont: Historic Resources Study* (John Milner Associates, Inc., 2001). Principal sources used in compilation of this form were: (continued on attached sheet)

RECORDED BY:	ORGANIZATION:	DATE RECORDED:
Douglas C. McVarish	John Milner Associates, Inc.	December 2000

OUTSTANDING COMPONENTS OF DISTRICT ☐ COMPLEX ☒
(Include individual survey number ONLY if surveyed individually.)

MAP NUMBER: 1 DATE BUILT: 1868	SURVEY NUMBER:
FUNCTIONAL TYPE: boat basin	NEGATIVE FILE NUMBER: 7189-8
COMMON NAME: Pine Street Barge Canal	OWNER: unknown

DESCRIPTION:

The present Pine Street Barge Canal is the remnant of an originally larger resource. At its maximum extent, the canal consisted of a square turning basin with an outlet to Lake Champlain, narrower channels extending from the northeast and southwest corners of the turning basin, and a side channel extending east off the southern end of the south channel. The north channel has been infilled as has the south side channel. The south end of the south channel has silted in.

The canal basin is lined with boulders, many of which have been displaced from their original locations. Most of the shore of the canal is now overgrown with trees, shrubs, and vines. Originally a strictly rectangular body of water, the shoreline is now less regular due to erosion and filling. Originally a maximum of eight feet deep, the depth of at least some portions of the waterway appears to have been reduced. (continued on attached sheet)

MAP NUMBER: 2 DATE BUILT: 1919	SURVEY NUMBER:
FUNCTIONAL TYPE: bridge	NEGATIVE FILE NUMBER: 7193-10
COMMON NAME:Barge Canal Railroad Bridge	OWNER: Vermont Agency of Transportation

DESCRIPTION:

The barge canal bridge originally consisted of a steel-framed moving leaf with a main trunnion, counterweight trunnion, and concrete counterweight. A steel-framed tower extended across the width of the bridge and rose 38 feet from the base of the bridge. In its resting position, the leaf rested on poured concrete bridge seats anchored to the banks of the channel by pilings. The moving or bascule leaf pivoted on a main trunnion mounted to the north bridge seat. Rising above the main trunnion was the trunnion tower. A link at the top of the tower connected to the counterweight trunnion and then to the counterweight. The counterweight was, in turn, connected to the tail trunnion on the tail of the moving leaf behind the main trunnion. The combination of power generated by the bridge engine and the shifting of the counterweight permitted the moving leaf to be raised and lowered. (continued on attached sheet)

MAP NUMBER: 3 DATE BUILT: late 19th c	SURVEY NUMBER:
FUNCTIONAL TYPE: breakwaters	NEGATIVE FILE NUMBER: 7193-23
COMMON NAME: Barge Canal breakwaters	OWNER: unknown

DESCRIPTION:

Nineteenth and early twentieth century maps clearly show a pair of breakwaters located at either side of the barge canal outlet. A substantial portion of the south breakwater remains. This structure, constructed of stone slabs and rubble extends from the shore of the canal outlet in an arc westward into Lake Champlain. On the north side of the outlet, the curve of the Lake Champlain shoreline is lined with rubble, and a short rubble breakwater extends into Lake Champlain from the outer portion of the curve.

MAP NUMBER: 4 DATE BUILT: c. 1910	SURVEY NUMBER:
FUNCTIONAL TYPE:boat ramp	NEGATIVE FILE NUMBER: 7159-22
COMMON NAME: Barge Canal boathouse ramps	OWNER: unknown

DESCRIPTION:

Two structures, identified in a previous survey as marine railways (Cohn 1996) are located adjacent to the south side of the turning basin. Both structures are in ruinous condition and are now largely hidden by undergrowth. Extant portions of the fabric of each structure include poured concrete ramps walls that extend downward into the south end of the turning basin and a series of parallel poured concrete footings. Timbers, probably either a portion of the shipway or a portion of the boathouse framing, lie on the ground in the vicinity of the concrete footings. No rails or remains of machinery were visible during a partial pedestrian reconnaissance of the area. (continued on attached sheet)

Continuation Sheet:

Statement of Significance (continued).

As transportation routes evolved in the late nineteenth century and protectionist tariffs were instituted, Burlington lost its leading role as a lumbering center. The Pine Street barge canal continued in use. Instead of lumber barges, coal barges tied up in the waterway and unloaded their cargo to pockets located along the canal. As coal was supplanted by more environmental sensitive and efficient methods of home and industrial heating, the canal ceased active use. A variety of industrial concerns located along the canal and in the canal vicinity. One such enterprise was a manufactured gas plant, established in 1895. Waste from its operations was routinely dumped in the wetlands surrounding the canal. This documentation was prepared in connection with remediation of these hazardous materials.

Contributing resources of the canal complex include the canal itself, the remains of two breakwaters built to provide a sheltered entrance into the canal from Lake Champlain, the former Rutland Railroad bridge across the outlet to the canal, and the remnants of early twentieth century boathouses/marine railways on the south bank of the turning basin and extending into the turning basin. Although definitive evidence is lacking, the last-mentioned structures appear to have been erected in the early twentieth century for a boat repair business.

Description Pine Street Barge Canal (continued).

The shoreline of the canal was originally surround by a dike, possibly constructed of rubble. The inner side of this dike was finished with planking. According to a local informant, planking or cribbing is visible along the southern reaches of the canal during times of low water.

Description Barge Canal Railroad Bridge (continued).

The machinery for the bridge is still largely intact, though not operational. The concrete slab walls of the operator's house remain. In March 1987, the counterweight for the bridge was removed and placed on the north shore of the barge canal outlet west of the bridge. Portions of the counterweight and associated steel framework remain in place. A portion of one side of the counterweight was cut away to permit the construction of the Burlington bicycle path across the opening of the canal.

Description Barge Canal boathouse ramps (continued).

Early twentieth century Sanborn maps show two, wood-framed, one- and two-story boathouses in this location with ramps extending northward into the turning basin. No documentary evidence could be located concerning the date of construction and use of these structures.

References (continued).

Blow, David J.
1991 *Historic Guide to Burlington Neighborhoods*. Chittenden County Historical Society, Burlington, Vermont.

Cohn, Arthur
1996 Preliminary results of An Archaeological Assessment within the Pine Street Barge Canal. Submitted to The Johnson Company, Montpelier, Vermont.

Cook, Lauren J. and John P. McCarthy
1992 A Stage IA Cultural Resources Survey of the Pine Street Canal Superfund Site, Burlington, Vermont. Prepared by John Milner Associates, Inc. for Metcalf & Eddy, Inc. and the U.S. Environmental Protection Agency.

Manley, Pat, Tom Manley and Art Cohn
1996 Pine Street Barge Canal Survey, Side-scan Sonar and ROV, April-May 1996. Report prepared for the Johnson Company, Montpelier, Vermont.

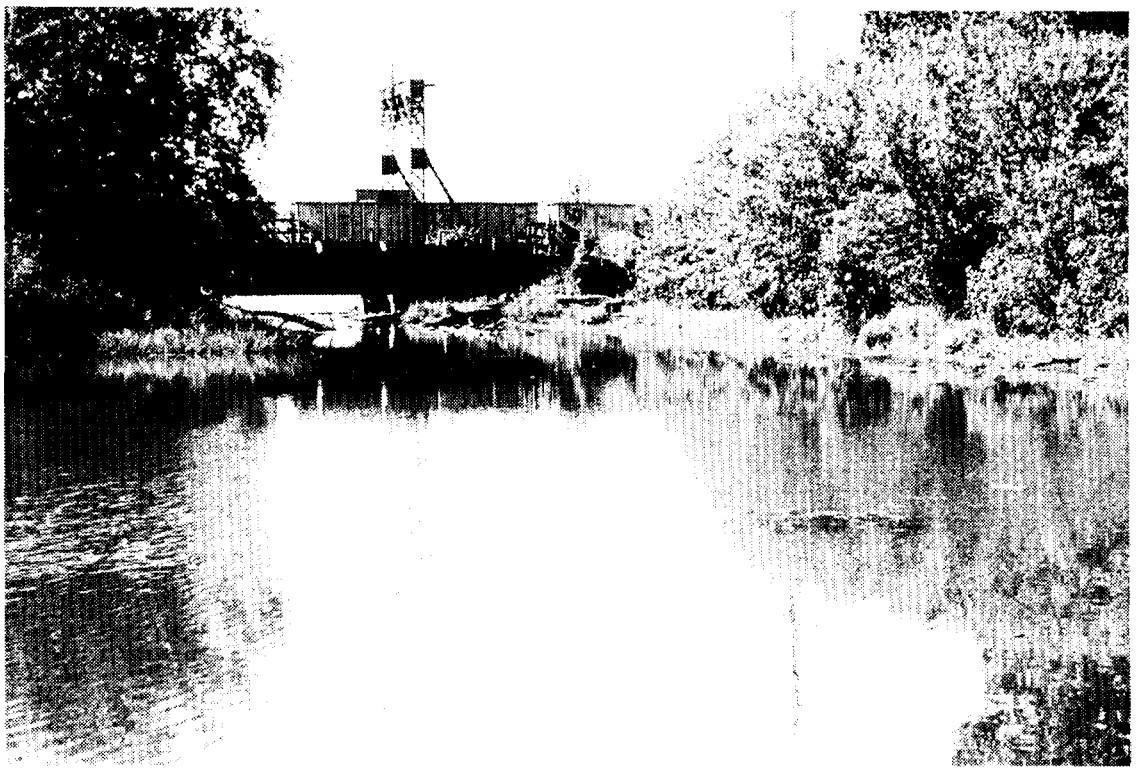
References (continued).

Sanborn Map Company

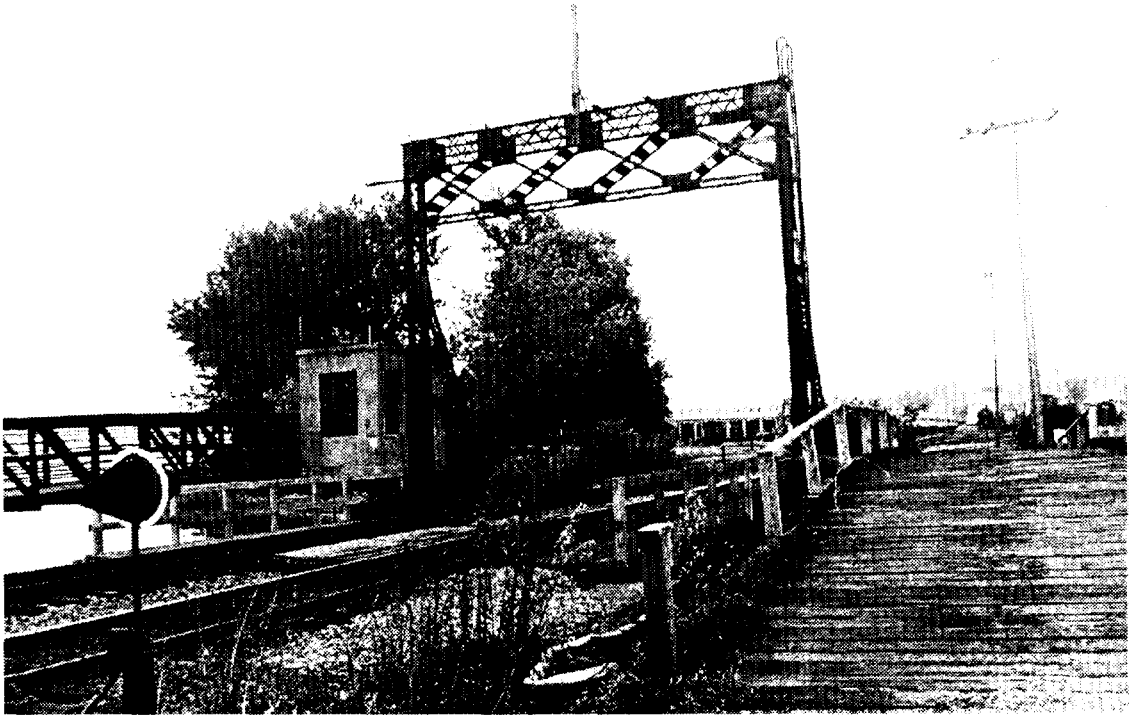
Insurance Maps of Burlington, Vermont. Sanborn Map Company, New York. 1885, 1894, 1900, 1906, 1912, 1919, 1926, 1943, 1955.

Strauss Bascule Bridge Company

1919 Strauss Trunnion Bascule Bridge. Patented for Rutland Railroad at Burlington, Vermont. Microfilm copy of engineering drawings on file at the Vermont State Records Center, Middlesex, Vermont.

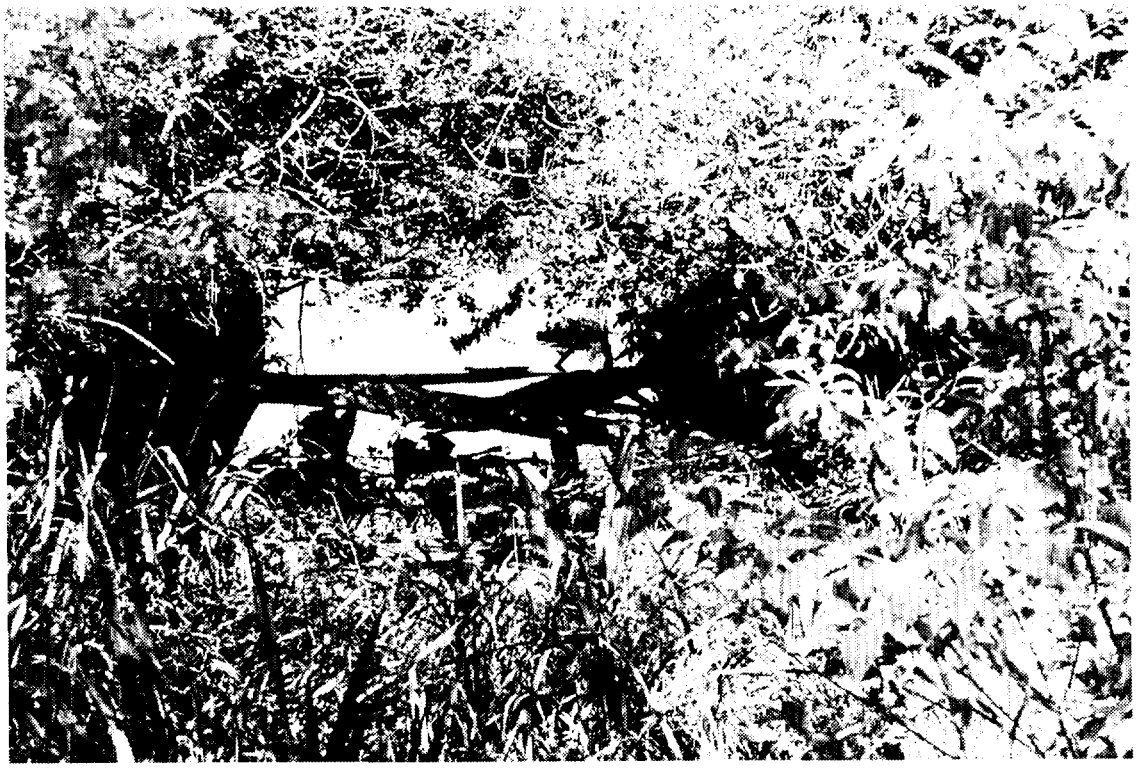


1) Turning basin and barge canal outlet with railroad bridge in background. Toward northwest.



2) Barge canal railroad bridge. Toward north.

3) Breakwater on south side of outlet of barge canal. Toward west.



4) View of area of former boathouse ramp in the vicinity of the south shore of the turning basin. Toward north.