Appleton Locks and Dams
Between the 31.7 mile marker
and the 29.8 mile marker
on the Lower Fox River
Appleton
Outagamie County
Wisconsin

HAER No. WI-84

HAER
WIS
44-APPL,
1-

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
Rocky Mountain System Support Office
National Park Service
P.O. Box 25287
Denver, Colorado 80225-0287

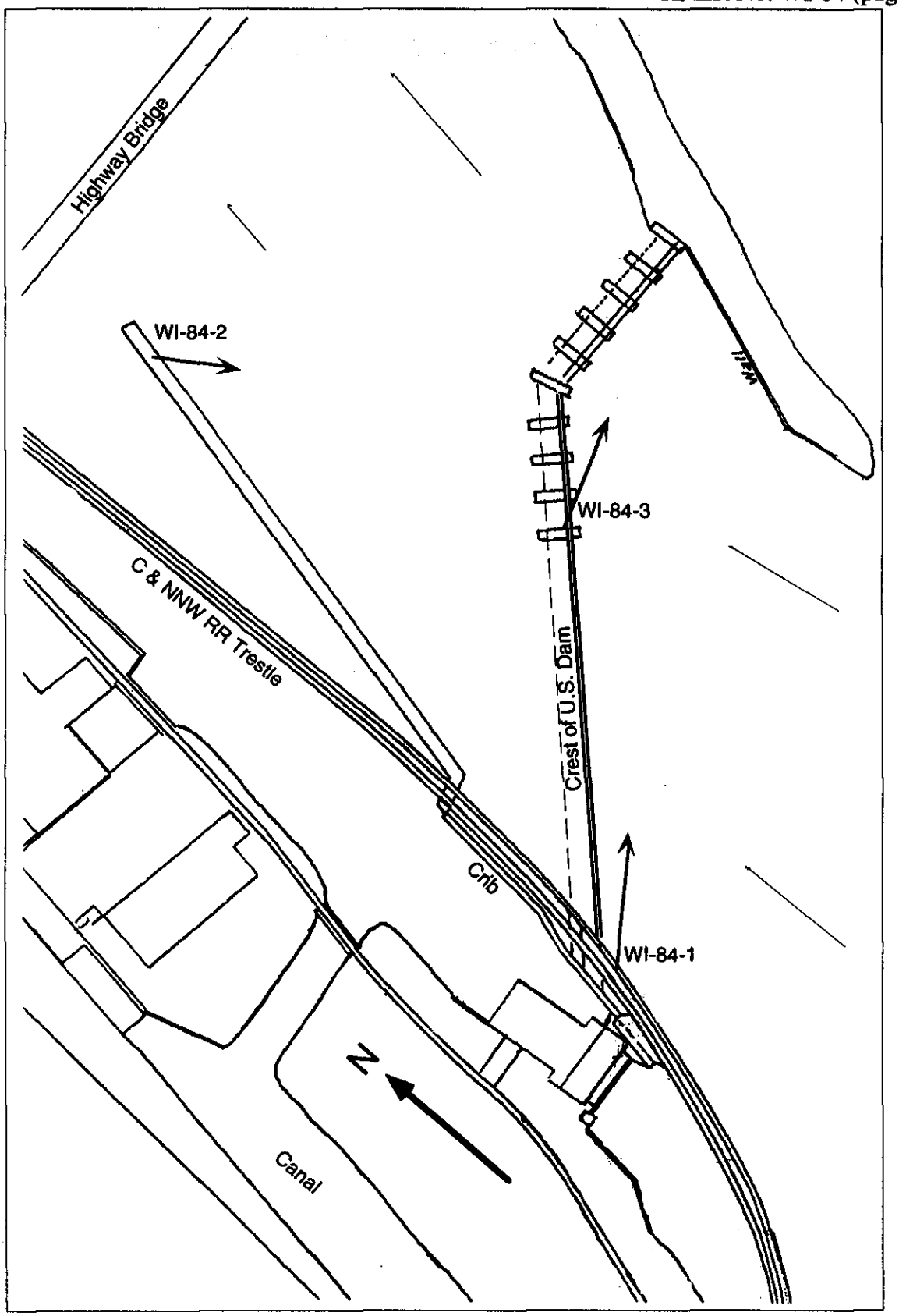

Highway Bridge
WI-84-2
WI-84-3
C & NNW RR Trestle
Crest of U.S. Dam
Crib
WI-84-1
N
Canal

Photo Key

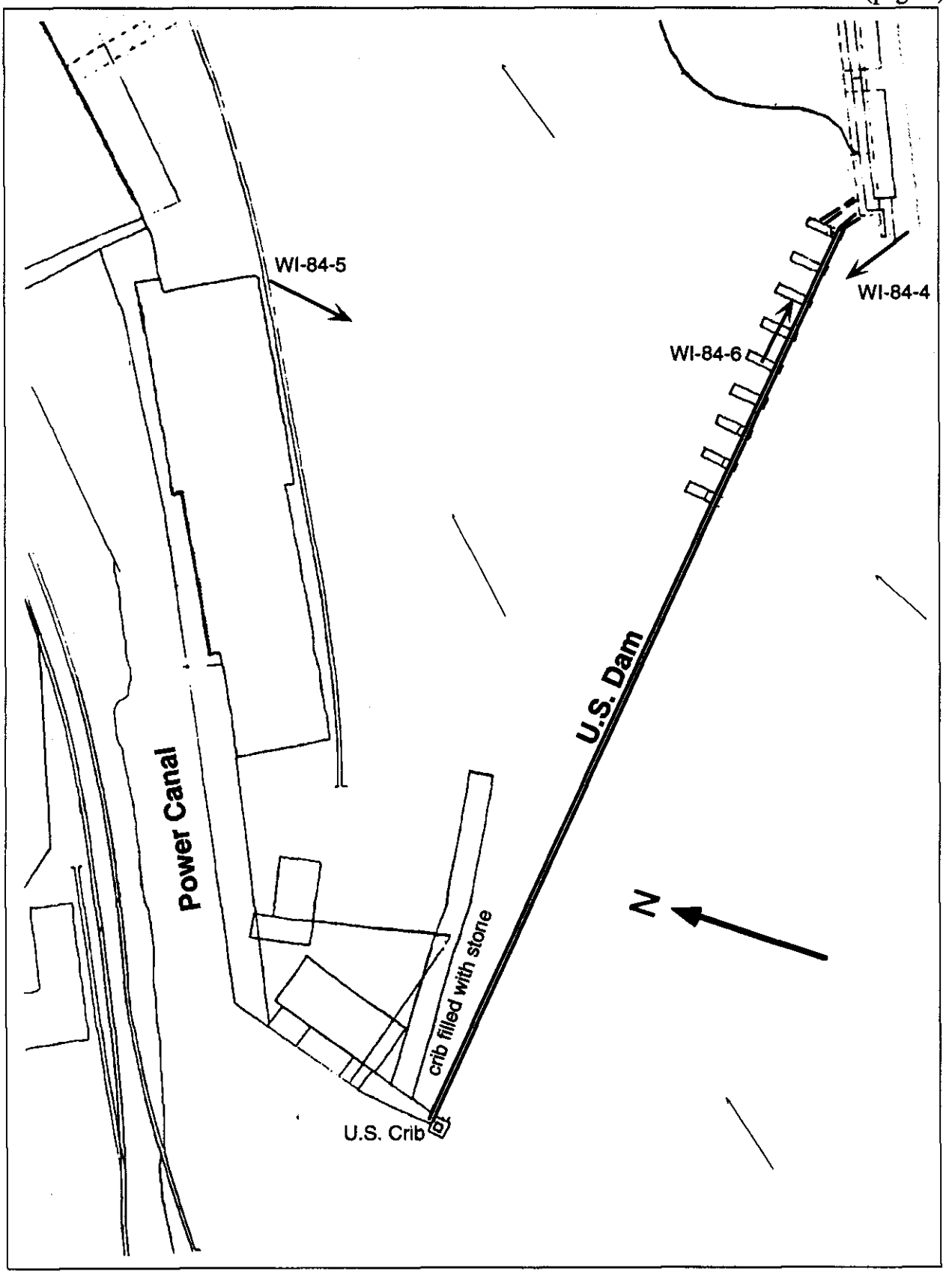

WI-84-5
WI-84-4
WI-84-6
Power Canal
U.S. Dam
crib filled with stone
U.S. Crib
N

Photo Key

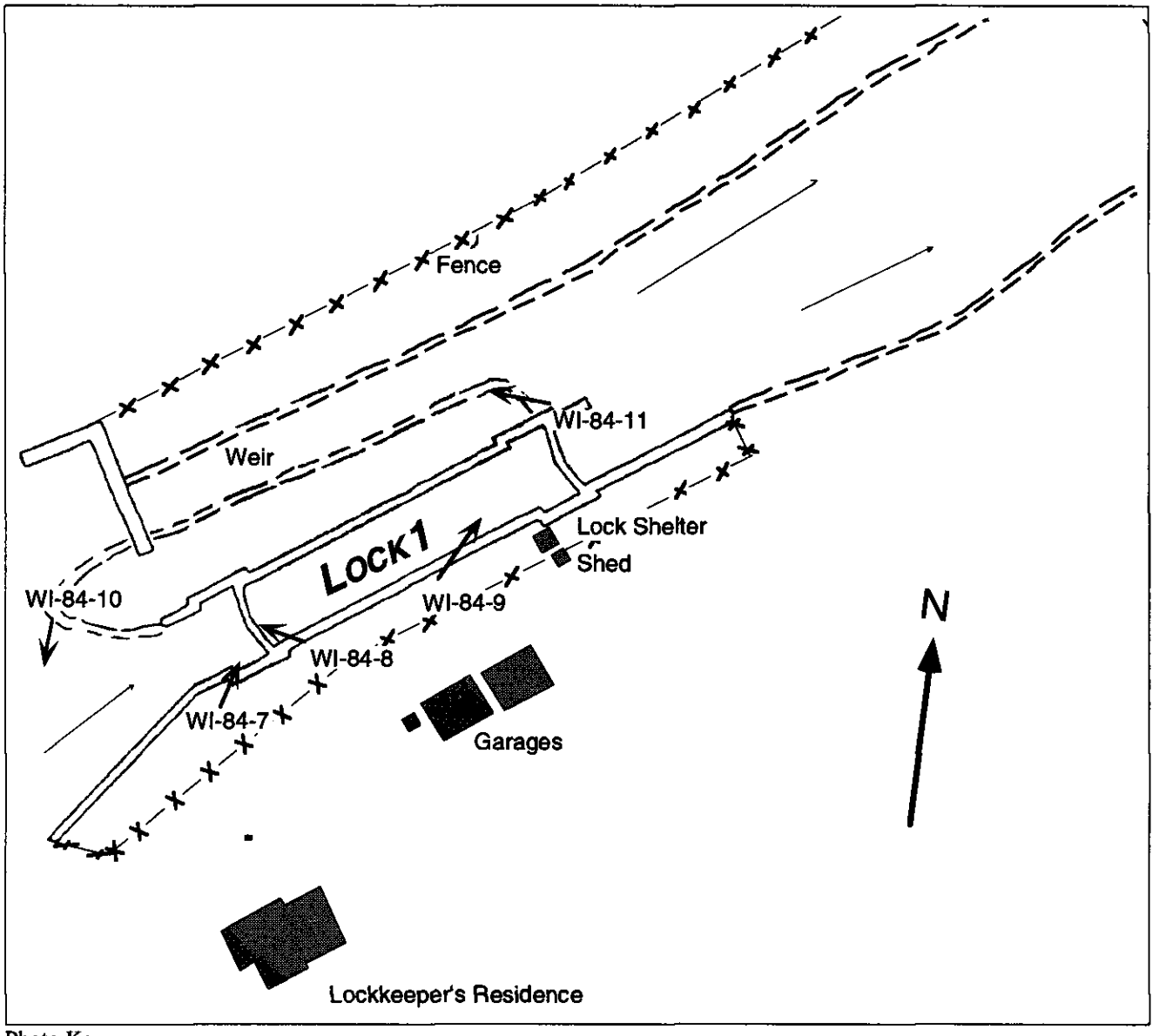

Fence
Weir
WI-84-11
LOCK 1
Lock Shelter
Shed
WI-84-10
WI-84-9
WI-84-8
WI-84-7
Garages
N
Lockkeeper's Residence

Photo Key

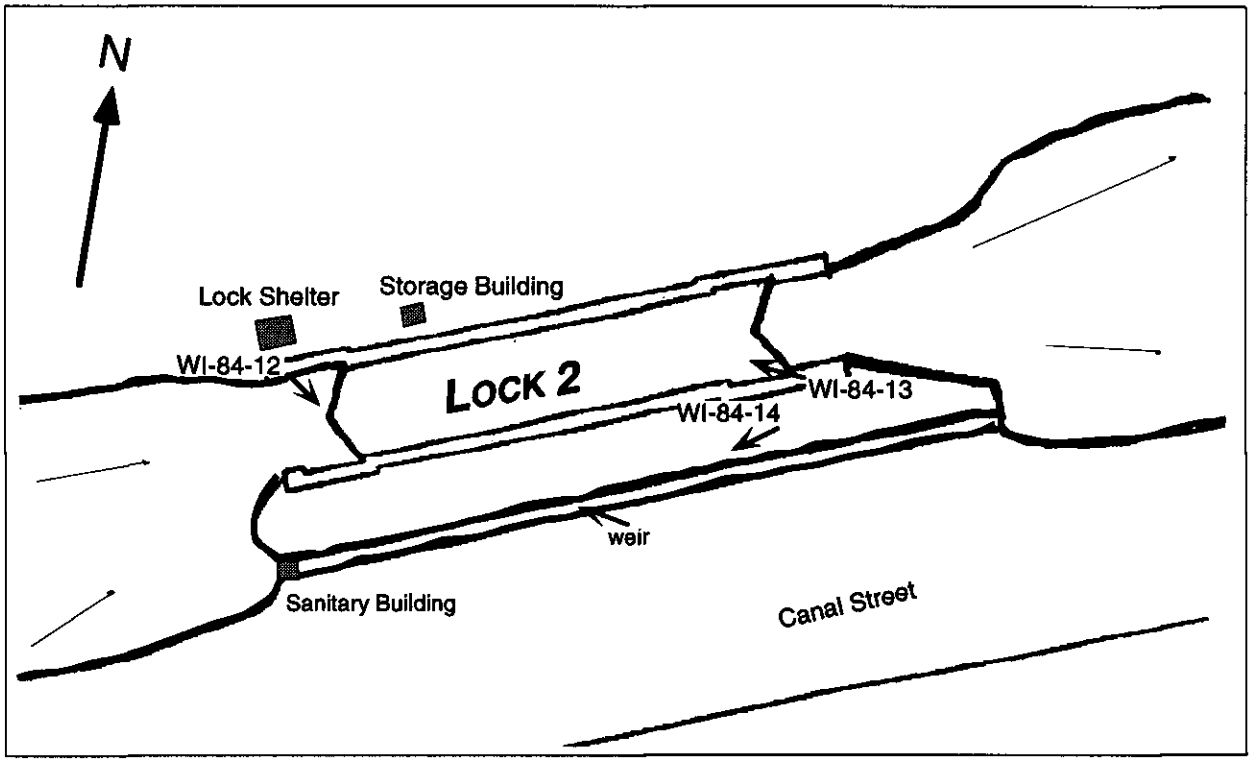

N
Lock Shelter
Storage Building
WI-84-12
LOCK 2
WI-84-13
WI-84-14
weir
Sanitary Building
Canal Street

Photo Key

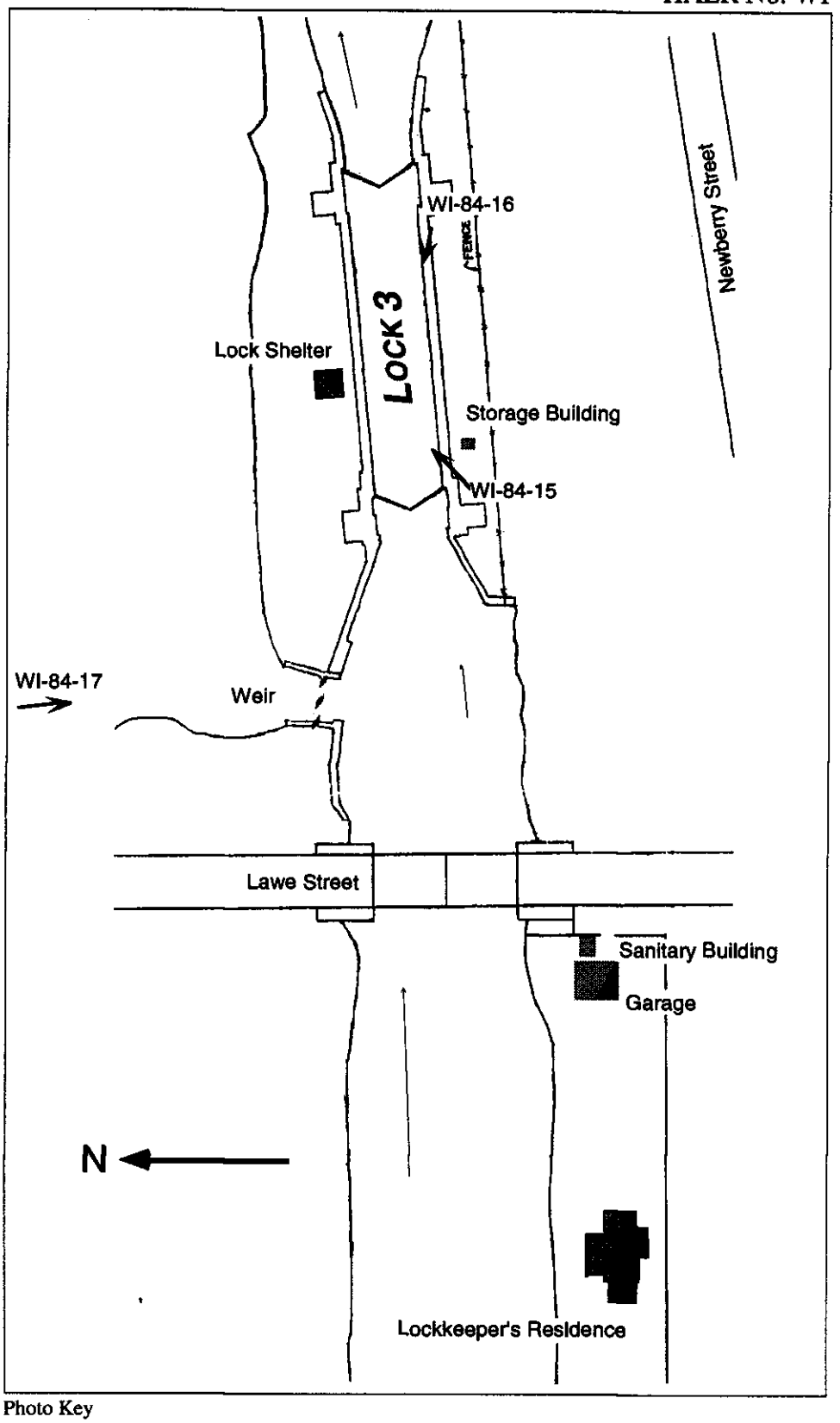

WI-84-16
FENCE
LOCK 3
Newberry Street
Lock Shelter
Storage Building
WI-84-15
WI-84-17
Weir
Lawe Street
Sanitary Building
Garage
N
Lockkeeper's Residence

Photo Key

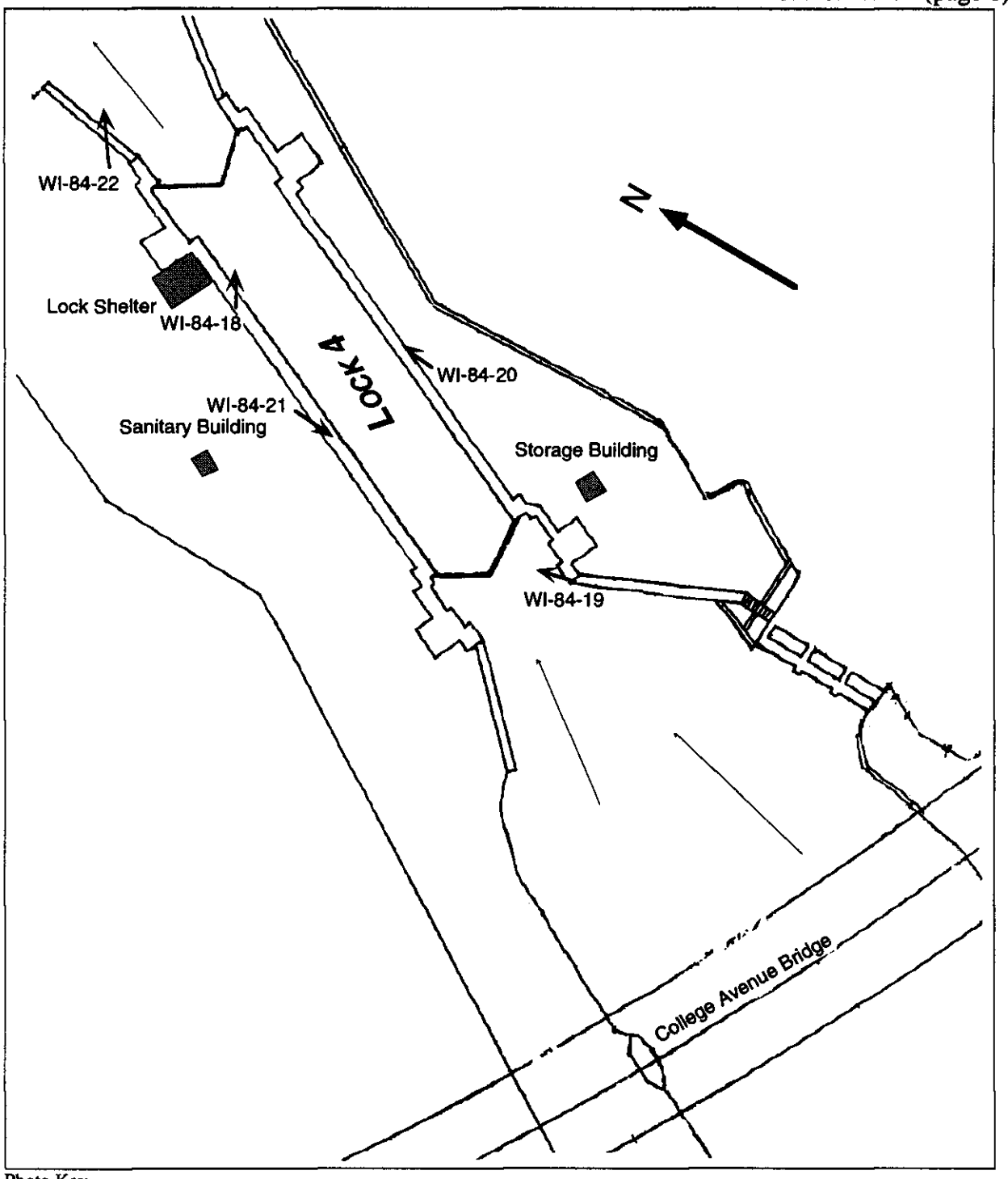

WI-84-22
N
Lock Shelter
WI-84-18
LOCK 4
WI-84-20
WI-84-21
Sanitary Building
Storage Building
WI-84-19
College Avenue Bridge

Photo Key

HISTORIC AMERICAN ENGINEERING RECORD

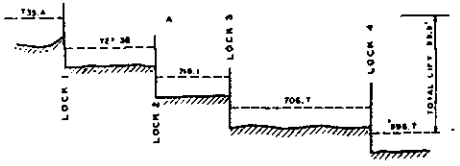
HAER
WIS
44-APPL,
1-

APPLETON LOCKS AND DAMS

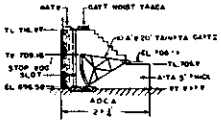
HAER NO. WI-84

Location:	The Appleton Locks and Dams Complex is located within the City of Appleton, between the 31.7 mile marker and the 29.8 mile marker on the Lower Fox River, Sections 25, 35, and 36, T21N, R17E, Civil Town of Grand Chute, Outagamie County, Wisconsin. UTM: Lower Dam, west bank 16/388910/4901300, east bank 16/389080/4901390 Upper Dam, west bank 16/387180/4900820, east bank 16/389360/4900780 Lock 1 16/387620/4900840 Lock 2 16/388170/4900900 Lock 3 16/388620/4900960 Lock 4 16/389220/4901570 USGS Quadrangle: Appleton, Wisconsin 7.5' series
Date of Construction:	1850 – 1941
Engineer:	United States Army Corps of Engineers with Contractors
Architect:	United States Army Corps of Engineers with Contractors
Present Owner:	United States Army Corps of Engineers
Present Use:	The locks at Appleton are currently not in use. The dams remain functional.
Significance:	The Appleton Locks and Dams Complex allows passage for watercraft around 1 1/2 miles of rapids as well as a 4 foot falls present in the Lower Fox River at Appleton.
Project Information:	This documentation was undertaken in 1995 in accordance with requirements detailed in a June 19, 1994 letter from Gregory D. Kendrick, Chief, History Branch, NPS to Dale Monteith, Acting Chief, Planning Division, USACOE, Detroit District. The Lower Fox system remains basically operational but was placed in caretaker status by the USACOE in 1982. The USACOE plans to divest itself of the Lower Fox system as soon as is feasible; therefore, NPS requested this documentation. All documentation conforms to HAER standards. Dr. John D. Richards, Principal Investigator; Georgia A. Lusk, Patricia B. Richards, and Robert J. Watson, Project Archivists with Great Lakes Archaeological Research Center, Inc.; Joseph Paskus, Project Photographer.

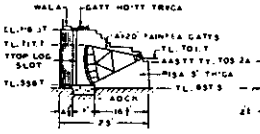
STRUCTURE DATA				
	LOCK 1	LOCK 2	LOCK 3	LOCK 4
AVAILABLE LENGTH	144.7'	184.4'	144.0'	184.0'
ALTAA WIDTH	75.0'	75.1'	55.0'	75.0'
TYPE, MIAM SPACE	10.0'	5.0'	6.7'	7.6'
UPATR MITSA SILL EL.	570.3	518.24	708.35	699.14
LOWTR MISSA TYTL SL.	714.54	710.11	638.9	691.45
GATASS WALL SL.	729.75	548.54	706.88	699.72



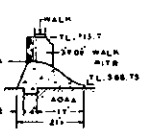
STANDARD LOW WATER PROFILE
U.S. CANAL



SECTION
SLUICEWAY "A"



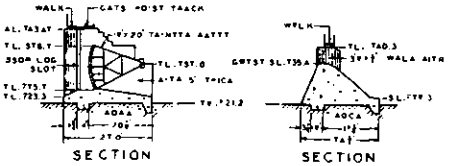
SECTION
SLUICEWAY "B"



SECTION
SPILLWAY

U.S. LOWER DAM

STRUCTURE DATA
LENGTH OF ALEAR SPILLWAY 305.4'
LENGTH OF CLEAR SLUICEWAY 180.0'
6 FLASHBOARDS AUTHORIZED
AUG. 30, 1919 (R.O. 174, SH/A)
5 SLUICE GATES

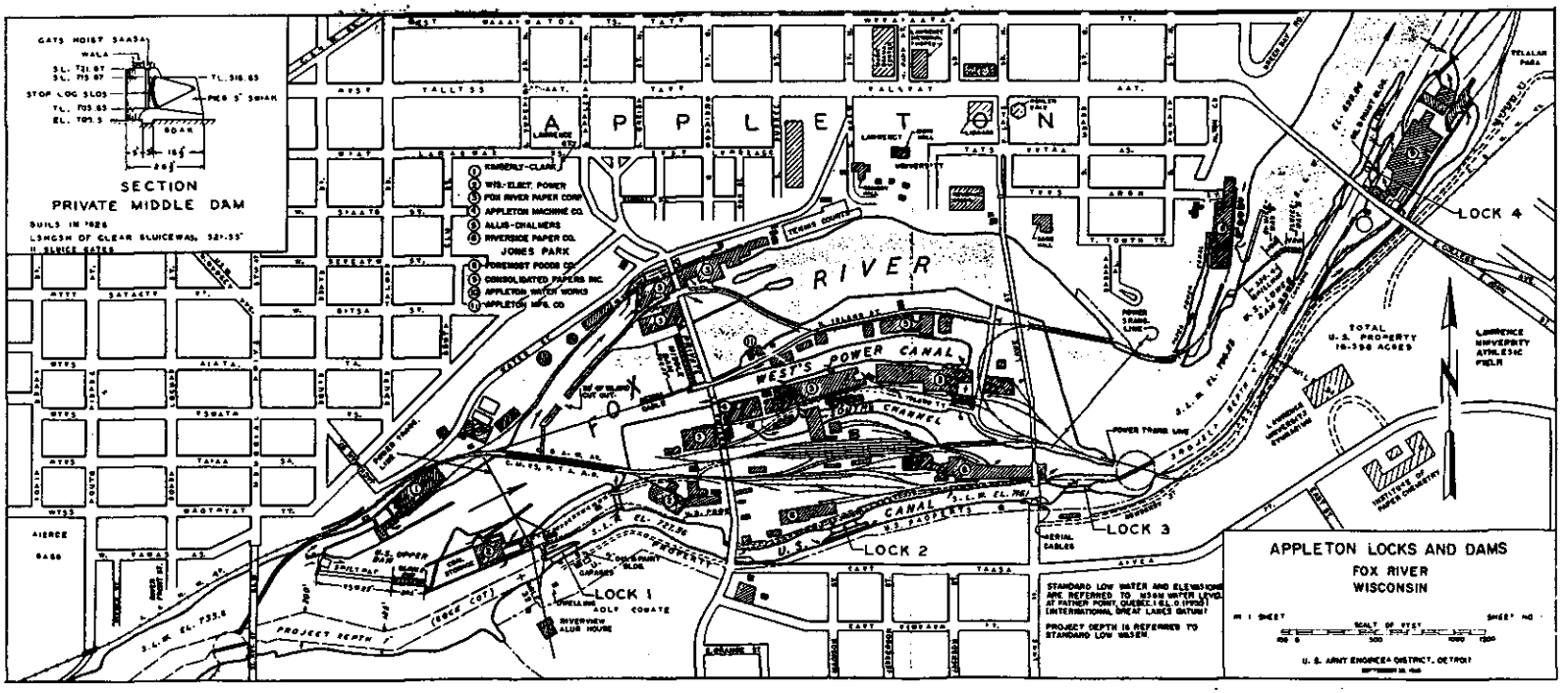


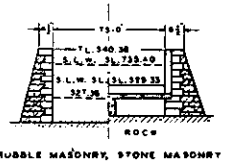
SECTION
SLUICEWAY

SECTION
SPILLWAY

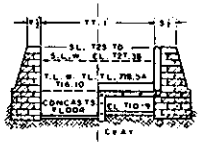
U.S. UPPER DAM

STRUCTURE DATA
LENGTH OF CLEAR SPILLWAY 482.7'
LENGTH OF CLEAR SLUICEWAY 180.0'
NO FLASHBOARDS AUTHORIZED
6 SLUICE GATES

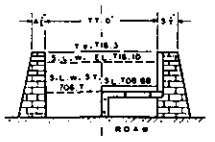




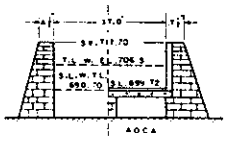
DRY RUBBLE MASONRY, STONE MASONRY LINED
SECTION LOCK CHAMBER SECTION UPPER GATE RECESS
LOCK 1



DRY RUBBLE MASONRY, STONE MASONRY LINED
SECTION LOCK CHAMBER SECTION UPPER GATE RECESS
LOCK 2



STONE MASONRY
SECTION LOCK CHAMBER SECTION UPPER GATE RECESS
LOCK 3



STONE MASONRY
SECTION LOCK CHAMBER SECTION UPPER GATE RECESS
LOCK 4

APPLETON LOCKS AND DAMS

General Description

The Appleton Locks and Dams facility is located in the City of Appleton situated between the 31.7 mile marker and the 29.8 mile marker on the Lower Fox River. The complex consists of two dams, four locks, a canal, two lockkeeper's residences, four lock shelters, three garages, four storage buildings, and three sanitary buildings. Appleton Lock 1 is west of Oneida Street and just south of the Wisconsin-Michigan Power Company facility in the City of Appleton. Appleton Locks 2 and 3 are within 0.2 miles of one another, and are within an industrial area of Appleton known as the "Appleton Flats." This area includes the site of the Fox River Paper Corporation, The Appleton Machine Company and the Riverside Paper Company. Appleton Lock 4 is located beneath the College Street viaduct just east of downtown Appleton and just west of Consolidated Paper Company.

History

In 1848, the Board of Public Works of the newly formed State of Wisconsin appointed engineer Condy R. Alton to survey and assess the condition of the existing dams on the Fox River and suggest navigational improvements to other areas of the river.[1]

Included in the report were Alton's recommendations for improvements of the locks and dams at Appleton, then known as Grand Chute. The rapids at Appleton extended 1.5 miles and fell 4 feet in elevation, representing one of the greater navigational challenges along the Lower Fox River. To avoid these hazards, Alton suggested the construction of a canal in excess of 9,600 feet in length to bypass the rapids. He also suggested that a 660 foot long dam with a 6 1/2 foot head be built above the rapids to flood the canal. Alton recommended four locks be placed within the canal, including two with a 10 foot lift, one with a 9 foot lift, and one with an 8 foot lift.

In November 1849, the Board of Public Works met to consider proposals for work at Grand Chute (Appleton).[2] However, proposed costs for the Grand Chute facilities exceeded the amount the Board wanted to pay at the time. Consequently, no action was undertaken for the construction of the locks and dams at Appleton until the following year.

The Board of Public Works accepted bids for the facilities at Grand Chute in 1850. The Board accepted Fitch P. Talmadge's proposal to build the Grand Chute canal and locks for $56,747. In 1851, Alton reported to the Board that about 20 chains of canal had been excavated at Grand Chute, as was the upper lock chamber. Although work continued on the facilities at Grand Chute in August 1852, they were interrupted by mounting financial difficulties and a tense political atmosphere at the state capitol.[3] By October 1853, work had resumed at Grand Chute. By 1859, the lower dam, fourth lock, and canal were completed, and their locations are depicted on a 1859 map produced by the Wisconsin Improvement Company.

In 1866, control of the Fox River waterway was transferred from the bankrupt Fox and Wisconsin Improvement Company to the Green Bay and Mississippi Canal Company. The federal govemment continued its interest in the canal system during this period, sending Major Charles Sutter to survey the Lower Fox and offer recommendations for improvement.

At Grand Chute, Sutter found two dams and four sets of locks. The lower dam was noted as being 440 feet long and watertight, therefore not requiring extensive improvements or repairs. The upper dam at Grand Chute was 800 feet long and 7 feet high. It had experienced some seepage, and approximately 430 feet of it had settled. Locks 1, 2 and 3 were positioned in a 3,600 foot canal

which bypassed the upper dam. Each of these locks required some new planking and new gates. The fourth lock at Grand Chute, situated in a 1,267 foot canal bypassing the lower dam, was in good condition, although a new gate was recommended.

By 1870, the Green Bay and Mississippi Canal Company successfully interested the United States Government in taking over the waterway and all aspects of achieving and maintaining navigation on it. Major D.C. Houston was placed in charge of the water way in 1872 and his initial responsibility was to inspect and ascertain the condition and improvement.[4] In his report to Congress, Houston described the facilities at Appleton as not being in good condition.[5] The Upper Dam required graveling each season to keep it tight, Locks 1, 3, and 4 needed replanking below the water line, and lock two needed replacing since its south wall was being undermined and was liable to collapse.[6]

In response to Houston's report, a five point plan was recommended and later implemented to revitalize the Fox-Wisconsin waterway. The government immediately began replacing the weakest facilities on the Lower Fox River. Between 1880 and 1890 the first and second locks at Appleton had been rebuilt, and the third lock was rebuilt in the 1890s.[7]

When the government acquired the Fox River Lock and Dam System in 1872, it began a program of rebuilding crib and brush dams with those constructed from stone. However, by the late 1920s, even these dams were unable to the meet the demands of the system. In 1933, the Corps of Engineers reported that the "lower timber crib dam at Appleton is badly decayed and has inadequate flood discharge capacity. The dam should be rebuilt as soon as funds are available."[8] Removal of the lower Appleton timber crib dam and construction of a new concrete dam was completed in 1934.[9] In 1937, the upper dam at Appleton was reported to be "in poor condition and having insufficient flood-discharge capacity for the proper regulation of Lake Winnebago."[10] This upper Appleton dam was removed and rebuilt in concrete in 1941.[11]

LOWER APPLETON DAM

The lower dam at Appleton has undergone three major structural construction episodes. The first dam was a crib and timber dam constructed between 1851 and 1859. In 1889, following the assumption of waterway control by the U.S. government, the crib and timber dam was completely rebuilt, the angle of the spillway altered, and a sluiceway added. By the 1930s, the crib and timber/stone masonry construction had badly decayed and the entire dam was replaced with concrete. Four additional sluiceways were also constructed.

The existing lower dam at Appleton has changed little structurally since it was rebuilt in concrete in 1934 and 1935. Oriented along a general SW/NE axis, the dam measures 549 feet 5 inches in length and is comprised of two sections: a spillway located on the southwestern end of the dam; and a sluiceway located on the northeastern end.[12] Midway along its length, the sluiceway is angled approximately 45 ° from its axis as it approaches the eastern dam abutment.[13] The dam is anchored to bedrock at the river's bottom, and maintains a standard low water pool elevation of 707.95 feet above mean sea level, an average depth ranging from 8 to 10 feet above the river bottom.[14] Due to unique engineering challenges poised by the Fox River, each section of the lower Appleton dam is different in design and construction from the other sections of the dam.

Spillway

The spillway, located at the southwestern end of the lower Appleton dam between the sluiceway and the left dam abutment, measures 320 feet 5 inches in length.[15] The southwestern edge of the spillway is connected to a concrete abutment which was constructed in 1889 and modified in 1934-

1935. The 1889 abutment, measuring 6 feet 10 inches in length, is constructed of stone masonry with a concrete cap. The stone masonry portion of the abutment is 13 feet 8 inches high, and the concrete cap 2 feet high. The base of the stone masonry wall, which is secured to the limestone bedrock has a width of 7 feet. The riverward side of the abutment is straight along its entire height, while the tailrace side is beveled from the base to the concrete cap, which is 4 feet 6 inches wide.[16]

The spillway is comprised of 15 poured concrete construction sections. Each construction section is anchored to the bedrock of the river bottom by twenty 1 by 18 inch steel anchor bolts grouted into the rock, and by eight 1/2 inch by 4 foot split iron dowels grouted into the rock at the upstream end of the section. In addition to the iron fasteners, a 4 foot wide concrete key, poured into a trench cut at a minimum depth of 2 feet into the bedrock, runs the entire length of the spillway, securing it to the river's bottom.[17]

The widths of each individual construction section varies according to its position in the overall layout of the spillway. The construction section located adjacent to the left dam abutment is the widest of the east spillway sections, measuring 36 feet across at its upstream end. Due to the angle of the spillway as it crosses the Fox River, this section forms a right triangle at its connection with the left dam abutment. The hypotenuse of the triangle is tied to the abutment with thirty-five 1 inch by 3 foot machine bolts spaced 3 feet apart center to center, and a 8 foot 3 inch length of 4 by 4 by 3/8 inch angle iron bolted and grouted between the construction section and the abutment. The construction section adjacent to the sluiceway is the smallest of the spillway sections, having a width of 17 feet 1 inches. The section is tied to the first sluiceway pier section by 1 inch by 3 foot stub bolts screwed into 1 inch by 3 foot sleeve nuts in the sluice pier. The remaining 13 sections of the spillway measure 21 feet 1 inch or 21 feet 2 inches across.[18]

Apart from their differing widths, each construction section of the spillway conforms to specifications of a generalized construction section plan. When measured parallel to the river channel, each construction section has a basal length of 16 feet 5 inches. The upstream face of the spillway, measuring 5 feet horizontally from the upstream base to a vertical plane established by the crest line, is beveled at a 12V:5H pitch to a point located at an upstream horizontal distance of 1 foot 10 1/8 inch and a vertical distance of 1 foot 2 3/4 inch from the crest line plane. From this point, the upstream face of the spillway curves toward the crestline at a 2 foot radius. The downstream face of the spillway, measuring 16 feet from the crest line to the down stream edge, is constructed as a compound curve consisting of three tangential circles with radii of 12 feet 6 inches, 5 feet 6 inches, and 4 inches.[19]

Measured from the rock bottom of the Fox River, each construction section of the spillway is approximately 8 feet 4 inches at the crest line. The crest line is the highest point of the spillway, maintaining an elevation of 707.95 feet above sea level. By comparison, the downstream "toe" of the spillway measures 1 foot 10 inch from the average elevation of the river bottom, maintaining an average elevation of 700.45 feet above sea level.[20]

The spillway construction sections are secured together by a concrete mortise and tenon joint running the full height of each spillway section. The tenon, slightly beveled from a 23 inch width at its widest end to a 21 inch width at the smaller end, is secured in a 5 1/2 inch deep mortise in the adjoining construction section. A 3/8 by 12 inch steel plate securing the mortise to the tenon runs the full height of the section. The seams between each spillway section are filled by 1/8 inch thick construction joints, with 1/8 inch thick expansion joints at every third joint. At each expansion joint, a 1/32 by 15 inch soft copper sheet runs the entire height of the concrete mortise and tenon joint.[21]

Five of the spillway construction sections support concrete piers which serve as the support bases for a walkway running the length of the spillway. Measured from the left dam abutment, walkway piers are located on the third, fifth, eighth, tenth, and twelfth spillway sections. The longitudinal centerlines of the walkway piers on the third, eighth, and twelfth spillway sections are located at a distance of 8 feet 1 inch from the western edge of the section. The longitudinal centerlines of the walkway piers on the fifth and tenth spillway sections are located 18 feet 7 inches from the western edges of these sections.[22]

The walkway piers of the spillway are bullet shaped, with the parabolic end pointing upstream. Each pier measures 8 feet 4 3/4 inches from the tip of the parabolic end to the downstream edge. Measured from the downstream side, the pier sections maintain their maximum width of 3 feet for a length of 4 feet 10 inches, at which point the sides begin to curve gently toward the tip of the parabola. Each side of the pier arches toward the upstream tip, maintaining a curve with a 5 foot circular radius. The upstream nose of each of the walkway piers is armored with a 8 foot 6 inch section of 4 by 4 by 3/8 inch angle iron secured onto the pier with 3/4 by 18 inch steel bolts.[23]

The walkway piers are tied into the individual spillway construction sections by two concrete keys recessed into the top of the construction section. The upper key measures 4 feet 2 1/8 inches in length, and is recessed 18 inches into the surface of the front portion of the spillway construction section. The downstream key is located 2 feet 6 inches from the upper key and is recessed 6 inches into the downstream surface of the spillway section. In addition to the concrete keys, the spillway piers are secured to the spillway construction section upon which it sits with fourteen 5 foot sections of 3/4 inch diameter vertical bars. The rebar sections are spaced 15 inches center to center from one another, 3 inches inside the outer dimensions of the pier.[24]

In profile, the walkway piers are somewhat rectangular, with concave bottoms conforming to the curved surfaces of the spillway construction sections. The piers were designed to maintain an elevation of 715.4 feet above sea level at their tops. Measured from the point of contact with the spillway construction section, the difference in elevation of the upstream end of the walkway piers from 715.4 feet above sea level is 7 feet 5 inches, while the difference in elevation of the downstream end is 9 feet 11 1/2 inches. On the downstream end of the pier there are two 12 inch steps which carry the elevation from 713.4 to 715.4 feet above sea level.[25]

A walkway spans the entire length of the spillway from the dam abutment to the first pier section of the sluiceway. Although the actual construction plans of the spillway walkway of the lower Appleton dam are not available, based on plans from similar facilities in the Fox River system, a general description of the walkway can be compiled. The following discussion is generalized from the specifications of the spillway walkways of the De Pere dam.[26]

A typical spillway walkway in the Fox River Lock and Dam System consists of sections of channel iron bolted onto walkway pier sections with 3/4 by 18 inch split anchor bolts fitted with specially beveled washers. The channel beams are bolted end to end, and spaced so that the channels of opposite beams face one another. The interior space between the channel beams is spanned by 3 foot 5 1/4 inch lengths of I beams which have been bolted to the channel iron. The horizontal I beam sections serve as support ribs along the entire length of the walkway.[27]

On the exterior of the channel beams, sections of angle iron have been spaced along the length of the spillway to form the uprights for a handrail. The walkway uprights are spaced so that the bolts used to secure the horizontal I beam sections to the interior of the channel beam can also serve as the lower of two bolts used to secure the uprights to the exterior of the beam. On each side of the spillway walkway, two lengths of 1/2 inch galvanized 7 strand Siemens-Martin wire rope has been threaded through holes drilled in the walkway uprights.[28]

The decking of the spillway walkway is made up of 18 foot sections of 3 by 12 inch planking laid three across to cover the span between the channel beams. The planking is nailed onto 3 foot 2 inch sections of 4 by 4 inch wooden beams which are bolted to the tops of the horizontal I beam sections spanning the interior space between the channel beams. On many dams in recent years, the wooden decking of the walkway has been replaced with steel grating.[29]

Sluiceway

The sluiceway section of the upper Appleton dam is located on the northeastern end of the dam.[30] The overall length of the sluiceway is 229 feet. Midway along its length, the sluiceway is angled approximately 45 ° from its axis as it approaches the eastern dam abutment.[31] The sluiceway of the lower Appleton dam is made up of 9 poured concrete construction sections arranged in two discrete sections.[32] The section immediately adjacent to the eastern dam abutment consists of five sluice gates originally constructed in 1889, and improved when the four western gates were constructed in 1934 and 1935.[33]

The first five sluiceway piers were constructed from stone masonry in 1889 to a height of 12 feet 6 inches in order to maintain an elevation of 712.93 feet above sea level at their tops. Detailed plans of the 1934-1935 reconstruction of these sluiceway piers are lacking, but available plans reveal that an additional 5 feet 1 3/4 inches of concrete was poured on top of the masonry piers during this reconstruction to achieve an elevation of 718.07 feet above sea level. Between the piers of the older portion of the sluiceway are rectangular concrete slabs each measuring 20 feet in length, 4 feet 6 inches in width, and 9 inches in thickness. The slabs are anchored directly to the limestone bottom of the Fox River. These slabs serve as the sill plate for the taintor gates that were hung in the sluice gate openings.[34]

More detailed construction information is available for the section of the sluiceway newly constructed during 1934-1935. With the exception of the two 10 foot wide construction sections immediately adjacent to the older sections, the construction sections of the sluiceway conform to the specifications of a generalized construction section plan. Measured parallel to the river channel, each section has a basal length of 9 feet 6 inches and a width of 25 feet. The sluiceway construction sections are anchored to the limestone bedrock of the river by two rows of steel anchor bolts spanning the width of the section. The first row is located 2 feet 9 inches from the upstream edge of the construction section.[35] Each row consists of six 4 foot lengths of 1 1/2 inches diameter steel anchor bolts spaced at 4 foot 2 inch intervals center to center. The sluiceway construction sections are also held to the bottom of the river by a concrete key which runs the entire length of the spillway. The key has a minimum width of 7 feet and has been poured into a trench cut at a minimum depth of 2 feet into the bedrock.[36] Additional reinforcement of the construction section is provided by thirteen 8 foot lengths of 3/8 inch diameter rebar placed across the length of the section.[37] The sluiceway construction sections are secured together by lengths of 1 inch diameter rebar which run the width of the section and are spaced at 8 inch intervals.[38]

Trapezoidal in profile, the sluiceway construction sections have a maximum height of 9 1/2 inches from the average elevation of the river bottom, or an elevation of 700.4 feet above mean sea level. From the river bottom, the sections are beveled for a horizontal distance of 4 inches before achieving the maximum 9 1/2 inch height. This thickness is maintained for a horizontal distance of 8 feet, at which point the section is beveled toward the river bottom, covering a horizontal distance of 4 inches.[39]

The sluiceway construction sections of the newer portion of the lower Appleton dam serve as foundations for five upright piers which are supports for a sluiceway walkway and contain the gate pins on which the sluiceway taintor gates are hung.[40]

The first of the new sluiceway piers (pier 5) is located at the point where the older and newer portions of the sluiceway meet. Prior to the 1934-1935 reconstruction of the lower Appleton dam, the stone masonry wall underlying the pier was part of the left abutment of the 1889 sluiceway. During the 1934-1935 construction, portions of the stone masonry of the left abutment were removed and other sections modified. This included removing the upstream end of the existing stone masonry pier and replacing it with a parabolic concrete nose curved along a radius of 1 foot 3 1/2 inches. An additional 5 feet 6 13/16 inches of poured concrete was added to the end of the existing pier so that the maximum width at the base of the pier is 11 feet 6 3/4 inches. The new concrete is anchored to the old masonry with 1 inch diameter vertical machine bolts and tie rods with double cinch anchors grouted in place. Horizontally, it is tied to the stone masonry of the abutment with 1 foot by 3 foot double cinch anchor bolts.[41]

The reconstructed pier is somewhat triangular in plan view. The straight side of the pier, facing the old sluiceway, has a maximum length of 28 feet 13/16 inches. The side of the pier facing the new sluiceway section maintains a 22° plane from the nose of the pier for a length of 25 feet 6 inches. From this point, the side of the pier meets the newly extended, poured concrete section and is parallel to the other wall for a distance of 4 feet 9 7/8 inch.[42]

In profile, the pier is rectangular with three distinct sections of varying heights. The downstream section consists of two ledges. The first ledge, located on the side of the pier closest to the old sluiceway section, is made up of the remnants of the old masonry abutment. It measures 6 feet in width, and maintains a height of 12 feet 6 inches for a horizontal distance of 13 feet from the downstream end of the pier. The second ledge, facing the new sluiceway section, is the newly extended section of the pier, measuring 5 feet 6 3/4 inches in width, and having a height of 7 feet 1/2 inches.[43]

The second ledge of the downstream end of the pier is beveled up to match the 12 foot 6 inch height of the old masonry abutment, thereby forming the middle section of the pier. The middle section maintains a 12 foot 6 inch elevation above the river bottom to a point 15 feet 13/16 inches downstream from the nose of the pier. At this point are a series of three risers, or steps, each 1 foot 4 inch wide and 1 foot 6 inch high connect the middle and upper pier sections. The upstream section maintains an elevation of 718.07 feet above sea level along its entire 11 foot 13/16 inch length.[44]

The reconstructed first pier of the new sluiceway is tied to the rock surface of the river bottom by a concrete key and split anchor bolts. The key, located 4 feet 1/4 inch from the upstream tip of the pier, measures 5 feet 1/2 inch in width and is poured in a 2 foot deep trench cut into the bedrock. Fifteen 1 1/2 inch by 4 foot split anchor bolts set 3 feet apart center to center are also used to secure the new portion of the pier to the river bottom. Various lengths of vertical and horizontal 3/8 inch diameter rebar have been set in the new concrete sections of the pier to provide reinforcement for the pier. The lengths of the bars have been adjusted to correspond to the dimensions of the particular section of the pier in which they have been placed. Both the horizontal and vertical rebar is spaced 1 foot 6 inches apart center to center.[45]

The second pier of the new sluiceway (pier 6) is located west of the first pier section, and is also on the curved portion of the new sluiceway.[46] The second pier is secured to the sluiceway construction section and the bottom of the river with 1 1/2 inch diameter by 4 foot split anchor bolts spaced 4 feet 2 inches center to center.[47] In addition, the sluiceway construction section on which the pier is built, serves as a key extending 9 1/2 inches into the bottom of the pier section.

In plan view, the second pier of the new sluiceway is shaped like an isosceles triangle with a rounded nose. The pier has a maximum length of 28 feet and a downstream width of 12 feet 8 3/4

inches. The upstream end is parabolic in shape, curved along a 1 foot 3 1/2 inch radius. The pier nose is armored with a 15 foot 4 inch long section of 3/8 inch diameter steel. The pier head measures 4 feet from the parabolic tip of the upstream edge. Located immediately posterior of the pier head is a stop log slot which runs the entire height of the pier section. The stop log slots, which are 6 inches deep and 1.5 feet wide, are located on pier faces interior of the sluiceway openings.[48]

The remaining three piers (piers 7, 8, 9) of the new sluiceway section are similar in construction. Each measures 28 feet in length, and 5 feet in width. The upstream ends of the piers are parabolic in shape, and curved along a 6 foot 3 inch radius. The upstream nose of the piers are armored with a 17 foot 8 inch long section of 4 by 4 by 3/8 inch angle iron secured onto the pier with 3/4 inch by 1 foot 6 inch steel bolts countersunk flush. The pier heads measure 4 feet 4 inches from the upstream edge to the downstream edge. Immediately posterior to the pier head is a pair of "stop log" slots which run the full height of the pier section. The stop log slots, which are 6 inches deep and 13 inches wide, are located on pier faces interior of sluiceway openings. The downstream corners of the stop logs have been armored with 18 foot 6 inch sections of 4 by 4 by 3/8 inch angle iron secured onto the pier face with 3/4 inch by 1 foot 6 inch steel bolts countersunk flush.[49]

Rectangular in profile, the sluiceway piers are made up of three distinct tiers of differing heights. The downstream section consists of two ledges, one that is 2 feet 9 5/16 inches wide, and has a height of 7 feet 5 inches above the river's bottom, and another that is 2 feet 2 1/16 inches wide, and 10 feet 6 inches high. The middle section of the piers is elevated 712.74 feet above sea level, or 13.14 feet above the river bottom to a point 12 feet downstream from the nose of the pier. At this point a series of three risers, or steps, each 1 foot 4 inch wide and 1 foot 6 inch high connect the middle and upper pier sections. The upstream section maintains an elevation of 718.07 feet above sea level along its 12 foot length. The upstream section of the sluiceway pier is thus approximately 10.22 feet higher than the downstream section. [50]

The three sluiceway piers are secured to the sluiceway construction section and the bottom of the river with 1 1/2 inch diameter by 4 foot split anchor bolts spaced 4 feet 2 inches center to center. In addition, the sluiceway construction section on which the pier is built serves as a key extending 9 1/2 inches into the bottom of the pier section. Various lengths of vertical and horizontal 3/8 inch diameter rebar have been set in the concrete of the piers to provide reinforcement. The lengths of the bars have been adjusted to correspond to the dimensions of the particular section of the pier in which they have been placed. Both the horizontal and vertical rebar is spaced 1 foot 6 inches apart center to center.[51]

Nine steel taintor gates are located within each of the sluiceway openings. The five gates found in the older section of the sluiceway are shorter than those of the newer section. The gates measure 10 feet 6 inches in height, and are 19 feet 9 inches in width hung on 6 inch diameter cold rolled steel gate pins.52

Each gate is connected to the gate hinges by end girders and bracing composed of pieces of 3 by 3 by 5/16 inch angle iron. The upper and lower arms of the end girders are made of 12 foot 3 inch sections of angle iron bolted on top of one another and bolted to a 1 1/2 inch steel plate connected to the gate hinges with 3/4 inch rivets. The upper and lower arms of the taintor gate end girders form the sides of an isosceles triangle with the top of the triangle located at the gate hinge.[53]

The arms of the end girders are braced with three sections of triangulated angle iron. Two sections are 3 inches by 3 inches by 5/16 inch and one section is 2 1/2 inches by 2 1/2 inches by 5/16 inch angle iron. Two short sections of 2 1/2 by 2 1/2 by 5/16 inch angle iron bolted together form a vertical spar 5 1/2 inches from the gate hinge. The ends of the vertical spar are attached to 5/16 inch

plates at the upper and lower arms. From these plates, two longer sections of angle iron are crossed over the height of the gate and connected to a 5/16 inch web plate which spans the space between the upper and lower arms directly behind the face of the taintor gate. The space between gate end girders directly behind the gate is spanned by sections of 5 by 3 by 5/16 inch angle iron running the width of the gate and connecting the upper and lower arms of opposite gate end girders. A 15 inch I beam between the upper and lower arms provides horizontal support at the gate hinge. Along the centerline of the gate, two 3 by 3 by 5/16 inch sections of angle iron are connected between the gate face and the 15 foot horizontal I beam at the hinges. Additional gate support is provided by four sections of triangulated 3 by 3 by 5/16 inch angle iron connected to the center of the centerline support and the corners of the gate frame.[54]

The fronts of the sluiceway gates are faced with 3/8 inch thick steel plates secured to the gate bracing with 3/8 by 6 inch splice plates. The widths of the steel plates facing the gates vary. From the vertical centerline of the gate faces to the ends of the gate, the plates used measure 5 feet, 3 feet, and 1 foot in length respectively.[55]

Fourteen foot high steel taintor gates are located within each of the newer sluiceway openings. Although the steel detail plans specific to the lower Appleton dam are not on file at the Corp of Engineer's office, the plans of sluice gates from similar facilities can be used to generalize a description of the Appleton sluice gates. The following discussion relies on detail plans for the gates of the De Pere dam.[56]

The taintor gates are hung on a 6 foot 8 inch long, 6 inch diameter cold rolled steel gate pin by a cast steel gate hinge. Each gate is connected to the gate hinges by end girders and bracing composed of 8 by 8 by 3/4 inch angle iron. The upper and lower arms of the end girders are 16 foot sections of angle iron bolted to the gate hinges with 7/8 inch rivets. The upper and lower arms of the taintor gate end girders form the sides of an isosceles triangle with a 40° angle located at the gate hinge. The arms of the end girders are braced with three sections of triangulated 3 by 3 by 3/8 inch angle iron. Two of these angle iron sections are also connected to a 3/8 inch thick steel web plate which spans the space between the upper and lower arms directly behind the taintor gate face. The space between gate end girders is spanned by sections of channel iron running the width of the gate and connecting the upper and lower arms of opposite gate end girders. Additional bracing between end girders is located 5 feet 4 inches behind the gate face at the top and bottom of the gate. A 3/8 inch thick steel web plate is located directly behind the gate face at the centerline of the gate. This web plate is, in turn, tied to the horizontal gate bracing by two 4 foot 9 inch sections of 3 by 3 by 3/8 inch angle iron.[57]

The fronts of the sluiceway gates are faced with 3/8 inch thick steel plates secured to the gate bracing and web plates by 8 by 18 1/4 inch horizontal I beams. Seams between the plates are secured by 6 inch wide strips of 3/8 inch steel plate which run the entire height of the taintor gate. A twenty foot long 8 by 8 inch oak beam is bolted to the channel iron running along the foot of the gate, providing a sill for the gate.[58]

The sluiceway gates of the lower Appleton dam are operated by a "crab", a mechanism containing a pair of èlectric winches that moves from gate to gate along a track on top of the sluiceway.[59] The crab is constructed of two 21 foot lengths of channel iron connected parallel to each other by four sections of 2 foot 2 1/2 inch I beam iron. The crab winches are powered by a five horse power open type wound rotor motor mounted at the middle of the crab frame. A winch hand wheel is also located near the middle of the crab frame. The crab mechanism rides along a 3 foot 8 inch guage track mounted along the downstream length of the sluiceway.[60]

In order to raise or lower a gate, the crab is positioned over the gate, and the winch chains are connected to the hoist chain connections on the gate.[61] Once positioned, the crab is connected to a power source, and the winches are turned on until the gate has been raised to the desired height. Once this height is reached, the crab is disconnected from the power source and moved to the next gate to be opened.[62] The electric winches are capable of lifting the gate at a rate of 2 feet per minute. In contrast, it takes 61.5 revolutions of the hand wheel to lift the gate 1 foot.[63]

When not in use, the crab mechanism is housed in a wooden structure built over the span between the two sluiceway piers immediately adjacent to the eastern dam abutment. The gate hoist house is built on top of two horizontal timbers spanning the space between the sluiceway piers. Along the upstream side of the gate hoist house, a 4 by 4 inch sill plate has been bolted directly to the top of the sluiceway walkway planking. The sill plate on the downstream side of the crab house is a 4 by 8 inch beam which has been bolted 1 foot 3 inches above the top of the sluiceway pier section. At each end of the sill plates, 4 by 4 inch wall studs are fastened directly to the sill plate. Between these beams, 2 by 4 inch studs have been spaced 2 feet apart, center to center. On top of the 4 by 4 inch wall studs, two 2 by 4 inch beams have been strung to form the top plate.[64]

A 2 foot 8 inch wide personnel door is located on the end of the crab house facing the abutment. A set of double doors on the sluiceway side of the crab house allow the crab to be moved along its track and positioned at the gates. The upstream and downstream sides of the crab house each contain a single window located in the center of the wall. The crab house is covered with a moderately pitched, front-gabled asphalt shingle roof.[65]

A walkway spans the entire length of the sluiceway. The walkway consists of a total of 9 sections of channel iron bolted onto the sluiceway pier sections with 3/4 by 18 inch split anchor bolts fitted with specially beveled washers.[66] The interior space between the channel beams is spanned by I beams which have been bolted to the channel iron. The horizontal I beam sections serve as support ribs spaced along the entire length of the walkway.

On the exterior of the channel beams, sections of angle iron have been spaced the length of the sluiceway to form the uprights for a handrail. The walkway uprights are spaced so that the bolts used to secure the horizontal I beam sections to the interior of the channel beam can also serve as the lower of two bolts used to secure the uprights to the exterior of the beam. On each side of the west spillway walkway, lengths of 1/2 inch galvanized 7 strand Siemens-Martin wire rope has been threaded through holes drilled in the walkway uprights.[67]

The decking of the spillway walkway is made up of 25 foot sections of 3 by 12 inch planking laid three across to cover the span between the channel beams. The planking has been nailed onto 2 foot 4 inch sections of 4 by 4 inch beams which are bolted to the tops of the horizontal I beam sections spanning the interior space between the channel beams. In recent years, the wooden decking of the walkway has been replaced with steel grating.[68]

A 5 foot 4 inch wide by 8 foot long steamhouse is located on top of the sluiceway pier at the connection point between the two sluiceway sections. Constructed in the 1980s, the steamhouse is a pre-fabricated structure manufactured by Armco Building Systems of Cincinnati, Ohio. The modular wall panels, which are bolted directly onto the sluiceway pier, support four 16 inch roof panels.[69] An entrance door is located on the upstream side of the steamhouse, and a single, louvered vent is centered on the downstream side.[70]

The steamhouse is used to store a portable steam cleaner used to periodically clean the dam surface and gates. The steam cleaner is also used to melt ice that builds up on the gates and hampers gate operation during the winter.[71]

APPLETON UPPER DAM

A stone masonry dam with a rock foundation was constructed at the site of the Appleton upper dam in 1872-1873. This structure was replaced between 1940 and 1941 with a poured concrete dam. The new upper Appleton dam was built north of the masonry dam, which was abandoned and later removed.

The existing upper dam at Appleton has changed little structurally since it was rebuilt in concrete. Oriented along a general NW/SE axis, the dam measures 691 feet in length and is comprised of two sections: (1) a spillway located on the western end of the dam; and (2) a sluiceway on the eastern end.[72] The dam is anchored to bedrock at the river's bottom, and maintains a standard low water pool elevation of 737.1 feet above mean sea level. Average pool depth ranges from 10 to 12 feet above the river bottom.[73]

Spillway

The spillway of the upper dam at Appleton measures 486 feet 3 inches in length along its crest line. It is connected to a 30 foot long, 17 foot high concrete abutment at its eastern end. The eastern dam abutment is made up of two sections, an upper section and a lower section which serves as a foundation for the upper section. The concrete slab of the abutment is 17 foot 6 inch wide, and has a minimum thickness of 3 feet. The slab is secured to the underlying bedrock by 4-foot-long sections of 1/2 inch split anchor bolts spaced at 4 foot intervals center to center. The upper section of the abutment measures 15 feet 11 1/4 inches at its base, and is 14 feet high. The wall is beveled from the base to the top, where it is 6 feet 5 inches wide. The upper abutment section is secured to the concrete slab by a 1 foot 11 inch wide concrete key which runs the entire length of the abutment and extends 5 1/2 inches into the top of the slab. The top of the eastern dam abutment maintains an elevation of 742 feet above sea level.[74]

The spillway of the upper dam at Appleton is comprised of 27 poured concrete construction sections. Each construction section is anchored to the bedrock of the river bottom by 4 foot sections of 1/2 inch steel anchor bolts grouted into the rock, and by 5 foot sections of 1 inch diameter rebar secured to a depth of at least 18 inches into the bedrock. In addition to the iron fasteners, two concrete keys are used to secure the spillway construction sections to the river bottom. At the front of the spillway, a 4 foot wide key has been poured into a trench cut at a minimum depth of 2 feet along the length of the spillway. A second key is located at the rear of the section. The rear key was poured into a trench cut at a minimum depth of 3 feet into the bedrock, and runs the entire length of the spillway.[75]

The widths of the spillway construction sections of the upper Appleton dam vary according to their position in the overall layout of the spillway. The three sections located closest to the dam's sluiceway are the widest, each measuring 18 feet 11 inches. The western end section of the spillway is the smallest section, with a width of 15 feet 6 inches. The remaining 21 sections of the spillway of the upper Appleton dam are 18 feet wide.[76]

Apart from their differing widths, each construction section of the east spillway conforms to specifications of a generalized construction section plan. When measured parallel to the river channel, each construction section has a basal length of 24 feet 8 inches. The upstream face of the spillway, measuring 6 feet 11 inches horizontally from the upstream base to a vertical plane established by the crest line, is beveled at a 12V:5H pitch from the upstream base to a point located at a horizontal distance of 2 feet upstream of the crest line. From this point, the upstream face of the spillway curves toward the crest line at a 2 foot radius. The downstream face of the east spillway, measuring 17 feet 9 inches horizontally from the crest line to the downstream edge, is

constructed as a compound curve consisting of four tangential circles with radii of 7 feet, 3 feet, and 4 inches.[77]

Measured from the rock bottom of the Fox River, each construction section of the east spillway is approximately 13 feet 1 inch at the crest line. The crest line is the highest point of the spillway, maintaining an elevation of 737.1 feet above sea level. By comparison, the downstream "toe" of the spillway measures 2 feet 6 inches from the average elevation of the river bottom, maintaining an average elevation of 726 feet above sea level.[78]

The spillway construction sections are secured together by a concrete mortise and tenon joint running the full height of each spillway section. The tenon, slightly beveled from a 23 inch width at its widest end to a 21 inch width at the smaller end, is secured in a 5 1/2 inch deep mortise in the adjoining construction section. A 1/8 by 12 inch steel plate securing the mortise to the tenon runs the full height of the section. The seams between each spillway section are filled by 1/8 inch thick construction joints, with 1/8 inch thick expansion joints at every third joint. At each expansion joint, a 1/32 by 15 inch soft copper sheet runs the entire height of the concrete mortise and tenon joint.[79]

Beginning at the western dam abutment, every third construction section of the spillway supports a concrete pier which serves as a base for a metal walkway running the length of the spillway. The longitudinal centerline of each of these spillway walk piers is located 2 feet 6 inches from the western edge of the spillway construction section on which it is located. A total of eight spillway walk piers are located on the spillway.[80]

The spillway walk piers are bullet shaped, with the parabolic end pointing upstream. Each pier measures 8 feet 6 inches from the tip of the parabolic end to the downstream edge. Measured from the downstream side, the pier sections maintain their maximum width of 3 feet for a length of 5 feet, at which point the sides begin to curve gently toward the tip of the parabola. Each side of the pier arches toward the upstream tip, maintaining a curve with a 5 foot circular radius. The upstream nose of each of the walk piers is armored with a 6 inch section of 4 by 4 by 3/8 inch angle iron secured onto the pier with 3/4 by 12 inch steel bolts.[81]

The walk piers are tied into the individual spillway construction sections by two concrete keys recessed into the top of the construction section. The upper key measures 2 feet 6 inches in length, and is recessed 16 inches into the surface of the front portion of the spillway construction section. The downstream key is located 2 feet 6 inches from the upper key and is recessed 6 inches into the downstream surface of the spillway section. In addition to the concrete keys, the spillway piers are secured to the spillway construction section upon which it sits with sections of 3/4 inch diameter vertical bars. The rebar sections are spaced 15 inches center to center beginning 3 inches inside the outer dimensions of the pier.[82]

The spillway piers of the upper Appleton dam were designed to reach an elevation of 742 feet above sea level in order to extend above the anticipated headwater elevation of 737.1 feet above sea level.[83] On the downstream end of the pier there is a 13 inch high step that produces a 15 inch wide ledge situated 740.9 feet above sea level.[84]

A walkway spans the entire length of the spillway from the dam abutment to the first pier section of the sluiceway. Although the actual construction plans of the spillway walkway of the upper Appleton dam are not available, based on plans from similar facilities in the Fox River system, a general description of the walkway can be generalized from the specifications of the spillway walkways of the De Pere dam.[85]

A spillway walkway typical of dams in the Fox River system consists of sections of channel iron bolted onto walkway pier sections with 3/4 by 18 inch split anchor bolts fitted with specially beveled washers. The channel beams are bolted end to end, and spaced so that the channels of opposite beams face one another. The interior space between the channel beams is spanned by 3 foot 5 1/4 inch long I beams which have been bolted to the channel iron. The horizontal I beam sections serve as support ribs along the entire length of the walkway.[86]

On the exterior of the channel beams, sections of angle iron have been spaced along the length of the spillway to form the uprights for a handrail. The walkway uprights are spaced so that the bolts used to secure the horizontal I beam sections to the interior of the channel beam can also serve as the lower of two bolts used to secure the uprights to the exterior of the beam. On each side of the spillway walkway, two lengths of 1/2 inch galvanized 7 strand Siemens-Martin wire rope has been threaded through holes drilled in the walkway uprights.[87]

The decking of the spillway walkway is made up of 18 foot sections of 3 by 12 inch planking laid three across to cover the span between the channel beams. The planking has been nailed onto 3 foot 2 inch sections of 4 by 4 inch beams which are bolted to the tops of the horizontal I beam sections spanning the interior space between the channel beams. On many dams in recent years, the wooden decking of the walkway has been replaced with steel grating.[88]

Sluiceway

The eastern portion of the upper Appleton dam is made up of a sluiceway with an overall length of 205 feet. The sluiceway is comprised of 15 poured concrete construction sections which are anchored to the bedrock of the river bottom by 4 rows of steel anchor bolts spanning the width of the section and secured at least 18 inches into the river bottom. In addition to the iron fasteners, two concrete keys are used to secure the sluiceway construction sections to the river bottom. At the front of the sluiceway, a 4 foot wide key has been poured into a trench cut at a minimum depth of 2 feet along the length of the spillway. A second key is located at the rear of each sluiceway section. The rear key was poured into a trench cut at a minimum depth of 3 feet into the bedrock, and runs the entire length of the spillway.[89]

The sluiceway of the upper dam at Appleton is comprised of 27 poured concrete construction sections. Each construction section is anchored to the bedrock of the river bottom by 4 foot sections of 1/2 inch steel anchor bolts grouted into the rock, and by 5 foot sections of 1 inch diameter rebar secured to a depth of at least 18 inches into the bedrock. In addition to the iron fasteners, two concrete keys are used to secure the spillway construction sections to the river bottom. At the front of the spillway, a 4 foot wide key has been poured into a trench cut at a minimum depth of 2 feet along the length of the spillway. A second key is located at the rear of the section. The rear key was poured into a trench cut to a minimum depth of 3 feet into the bedrock. The trench runs the entire length of the sluiceway.[90]

The construction sections of the sluiceway conform to the specifications of a generalized construction section plan. With the exception of the sections at the extreme ends of the sluiceway, which are 15 feet in width, each of the construction sections is 25 feet wide. Measured parallel to the river channel, the base of each section is 28 feet in length.[91]

Somewhat ramp-shaped in profile, the sluiceway construction sections attain a maximum height of 4 feet above the average elevation of the river bottom, or 727 feet above mean sea level. From an upstream height of 2 feet from the average elevation of the river bottom, the sluiceway sections slope up to achieve this 4 foot maximum height at a horizontal distance of 4 feet from the upstream end. The 4 foot thickness is maintained for a horizontal distance of 8 feet, at which point the

section begins to slope gently downstream to a height of 2 feet above the average elevation of the river bottom at the extreme downstream edge, or 725 feet above mean sea level.[92]

The sluiceway construction sections are secured together by 11 foot lengths of 3/4 inch diameter rebar which run the width of the section and are spaced at 2 foot intervals. The seams between sluiceway sections are filled by construction joints.[93]

The sluiceway construction sections of the upper Appleton dam serve as foundations for a series of nine upright piers which not only support a sluiceway walkway, but also contain the gate pins on which the sluiceway taintor gates are hung. Seven of the sluiceway piers are located along the centerlines of construction sections, while the two end piers are located at the extreme ends of the eastern and western sections.[94] Eight sluiceway openings are created by the placement of the pier sections.

The sluiceway piers are 28 feet in length, and measure 5 feet in width. The upstream ends of the piers are parabolic in shape, curved along a radius of 6 feet 3 inches. The upstream nose of each of the piers is armored with a 19 foot long section of 4 by 4 by 3/8 inch angle iron secured onto the pier with 3/4 inch by 1 foot anchor bolts.[95]

Sluiceway pier heads measure 4 feet 4 inch from the parabolic tip of the upstream end to the downstream edge. Located immediately posterior of the pier heads are a pair of "stop log" slots which run the entire height of the pier section. The stop log slots, which are 6 inches deep and 13 inches wide, are located on pier faces interior of sluiceway openings. The comers of the stop log slots have been armored with 18-foot-long sections of 4 by 4 by 3/8 inch angle iron secured onto the pier face with 3/4 by 18 inch steel bolts.[96]

The sluiceway piers are tied into the sluiceway construction sections by two rectangular concrete keys, sections of rebar, and anchor bolts.[97] Both concrete keys extend 6 inches from the bottom of the sluiceway piers into the top of the construction sections.

The first key, located approximately 4 feet 6 inches downstream from the pier nose, measures 7 feet in length and 2 feet in width. It is secured to the sluiceway construction section with eight 3/4 inch diameter by 5 foot steel bars spaced at 1 foot 10 inch intervals along the length of the key. The second key, located along the slanted downstream section of the sluiceway construction section, measures 10 feet in length and 2 feet in width. It too is secured to the sluiceway construction section with rows of 3/4 inch diameter by 5 foot steel rods spaced at 1 foot 10 inch intervals along the length of the key.[98]

In addition to the concrete keys, each sluiceway pier is tied onto the construction sections with 19 sections of 3/8 inch diameter rebar. The rebar sections are spaced 18 inches center to center from one another, 4 inches inside the outer dimensions of the pier. The lengths of the rebar sections vary according to their position in the pier section, with a 19 foot section utilized in the upstream end, and 9 foot sections used in the downstream end.[99]

Rectangular in profile, the sluiceway piers are made up of three distinct tiers of differing heights. The downstream section consists of two ledges, one that is 2 feet 9 15/16 inches wide, elevated 12 feet above the river's bottom, and another that is 2 feet 2 1/16 inches wide, elevated 14 feet 6 inches above river bottom. The middle section of the piers rises of 739.83 feet above sea level, or 16.83 feet above the river bottom at a point 15 feet 10 inches downstream from the nose of the pier. At this point a series of three risers, or steps, each 1 foot 4 inch wide and 1 foot 6 inch high connect the middle and upper pier sections. The upstream section maintains an elevation 745.17 feet above sea level along its 11 foot 10 inch length.[100]

Fourteen-foot-high steel taintor gates are located within each of the newer sluiceway openings. Although the steel detail plans specific to the upper Appleton dam are not on file at the Corps of Engineer's office, the plans of sluice gates from similar facilities can be used to generalize a description of the Appleton sluice gates. The following discussion relies on detail plans for the gates of the De Pere dam.[101]

The taintor gates are hung on a 6 foot 8 inch long, 6 inch diameter cold rolled steel gate pin by a cast steel gate hinge. Each gate is connected to the gate hinges by end girders and bracing composed of 8 by 8 by 3/4 inch angle iron. The upper and lower arms of the end girders consist of 16 foot sections of angle iron fastened to the gate hinges with 7/8 inch rivets. The upper and lower arms of the taintor gate end girders form the sides of an isosceles triangle with a 40° angle located at the gate hinge. The arms of the end girders are braced with three sections of triangulated 3 by 3 by 3/8 inch angle iron. Two of these angle iron sections are also connected to a 3/8 inch thick steel web plate which spans the space between the upper and lower arms directly behind the taintor gate face. The space between gate end girders is spanned by sections of channel iron running the width of the gate and connecting the upper and lower arms of opposite gate end girders. Additional bracing between end girders is located 5 feet 4 inches behind the gate face at the top and bottom of the gate. A 3/8 inch thick steel web plate is located directly behind the gate face at the centerline of the gate. This web plate is, in turn, tied to the horizontal gate bracing by two 4 foot 9 inch sections of 3 by 3 by 3/8 inch angle iron.[102]

The fronts of the sluiceway gates are faced with 3/8 inch thick steel plates secured to the gate bracing and web plates by 8 by 18 1/4 inch horizontal I beams. Seams between the plates are secured by 6 inch wide strips of 3/8 inch steel plate which run the entire height of the taintor gate. A twenty foot long 8 by 8 inch oak beam is bolted to the channel iron running along the foot of the gate, providing a sill for the gate.[103]

The sluiceway gates of the upper Appleton dam are operated by a "crab", a mechanism containing a pair of electric winches that moves from gate to gate along a track on top of the sluiceway.[104] The crab is constructed of two 21 foot lengths of channel iron connected parallel to each other by four sections of 2 foot 2 1/2 inch I beam iron.[105] The crab winches are powered by a five horse power open type wound rotor motor mounted at the middle of the crab frame. A winch hand wheel is also located near the middle of the crab frame. The crab mechanism rides along a 3 foot 8 inch guage track mounted along the downstream length of the sluiceway.[106]

In order to raise or lower a gate, the crab is positioned over the gate, and the winch chains are connected to the hoist chain connections on the gate.[107] Once positioned, the crab is connected to a power source, and the winches are turned on until the gate has been raised to the desired height. Once this height is reached, the crab is disconnected from the power source and moved to the next gate to be opened.[108] The electric winches are capable of lifting the gate at a rate of 2 feet per minute. In contrast, 61.5 revolutions of the hand wheel are required to lift the gate 1 foot.[109]

When not in use, the crab mechanism is housed in a wooden structure built over the span between the eastern dam abutment and the first sluiceway pier adjacent to the abutment. The gate hoist house is built on top of two horizontal timbers spanning the space between the sluiceway piers. Along the upstream side of the gate hoist house, a 4 by 4 inch sill plate has been bolted directly to the top of the sluiceway walkway planking. The sill plate on the downstream side of the crab house is a 4 by 8 inch beam which has been bolted 1 foot 3 inches above the top of the sluiceway pier section. At each end of the sill plates, 4 by 4 inch wall studs are fastened directly to the sill plate. Between these beams, 2 by 4 inch studs have been spaced 2 feet apart, center to center.[110] On top of the 4 by 4 inch wall studs, two 2 by 4 inch beams have been strung to form the top plate.

A 2 foot 8 inch personnel door is located on the end of the crab house facing the abutment. A set of double doors on the sluiceway side of the crab house allow the crab to be moved along its track and positioned at the gates. The upstream and downstream sides of the crab house each contain a single window located in the center of the wall. The crab house is covered with a moderately pitched, front-gabled asphalt shingle roof.[111]

A walkway spans the entire length of the sluiceway. The walkway consists of a total of sections of channel iron bolted onto the sluiceway pier sections with 3/4 by 18 inch split anchor bolts fitted with specially beveled washers.[112] The interior space between the channel beams is spanned by lengths of I beams which have been bolted to the channel iron. The horizontal I beam sections serve as support ribs spaced along the entire length of the walkway.

On the exterior of the channel beams, sections of angle iron have been spaced the length of the sluiceway to form the uprights for a handrail. The walkway uprights are spaced so that the bolts used to secure the horizontal I beam sections to the interior of the channel beam can also serve as the lower of two bolts used to secure the uprights to the exterior of the beam. On each side of the west spillway walkway, lengths of 1/2 inch galvanized 7 strand Siemens-Martin wire rope has been threaded through holes drilled in the walkway uprights.[113]

The decking of the spillway walkway is made up of 25 foot sections of 3 by 12 inch planking laid three across to cover the span between the channel beams. The planking has been nailed onto 2 foot 4 inch sections of 4 by 4 inch beams which are bolted to the tops of the horizontal I beam sections spanning the interior space between the channel beams.[114] In recent years, the wooden decking of the walkway has been replaced with steel grating.

A 5 foot 4 inch wide by 8 foot long steamhouse is located on top of the sluiceway pier at the connection point between the two sluiceway sections. Constructed in the 1980s, the steamhouse is a pre-fabricated structure manufactured by Armco Building Systems of Cincinnati, Ohio. The modular wall panels, which are bolted directly onto the sluiceway pier, support four 16 inch roof panels.[115] An entrance door is located on the upstream side of the steamhouse, and a single, louvered vent is centered on the downstream side.[116]

The steamhouse is used to store a portable steam cleaner used to periodically clean the dam surface and gates. The steam cleaner is also used to melt ice that builds up on the gates and hampers gate operation during the winter.[117]

APPLETON LOCK CANAL

The Appleton locks are located within artificially created canals that bypass both Appleton dams to the east. Construction of the Appleton canal began in 1949, after Wisconsin Board of Public Works engineer Condy R. Alton recommended a 9,600 foot canal be built to bypass the rapids at Appleton.[118] Work on the Appleton canal progressed over the next seven years, with the first steamer navigating the Fox and Wisconsin Waterway in 1856.[119]

When the Fox River locks system was surveyed in 1866, there were two canals bypassing the dams at Appleton. Traffic was carried around the upper dam by a 3,600 foot canal containing locks 1, 2, and 3. A second 1,267 foot canal containing lock 4 bypassed the lower dam.[120]

Canal channels are unlined excavations and periodically dredged to maintain adequate water depth. Banks are largely natural although occasional stone riprap is present also. The current upper Appleton lock canal is approximately 3,300 feet in length, including the portions of the canal

within locks 1, 2, and 3.[121] The canal averages 6 feet in depth, and varies in width between 100 and 125 feet.

The lower Appleton lock canal contains lock 4 and extends approximately 750 feet as it bypasses the lower dam to the east. Canal depth does not exceed 6 feet and width is approximately 125 feet.

Waste water weirs have been excavated adjacent to Appleton locks 1, 2, and 3. The weirs are designed to carry the overflow water past the locks so that the gates are not damaged.[122]

APPLETON LOCK 1

Detailed design sheets specific to Appleton Lock 1 are not on file at the Corps of Engineers Fox River Project Office at Kaukauna. However, since Appleton Lock 1 is similar in design and construction to other locks in the Fox River system, the plans from these facilities provide detailed information about the construction and design of the first lock at Appleton. In fact, the Cedars lock and the Kaukauna Lock 1 are identical in design to the Appleton Lock 1.[123] Therefore, plans of these facilities were examined in order to compile a detailed description of the design and construction of Appleton Lock 1.

Appleton Lock 1 has changed little since its reconstruction in 1884. Oriented on a general WSW/ENE axis, the lock consists of a 144 foot by 35 foot quarried limestone lock chamber with wing walls at both inlet and outlet ends.[124]

The lower wing walls, or those located at the downstream end of the lock, are 16 feet 6 inches high. Each lower wing wall consists of a single construction section comprised of rubble masonry. The north wall measures 38 feet in length and is 5 feet wide at its base, while the south wall measures 40 feet in length and is 5 feet in width at its base. The north and south masonry walls are a foot wide at their tops, and are beveled on their exterior faces at a 1V:10H slope.[125]

The upper wing walls, located at the upstream end of the lock, are 11 feet 7 inches high. Each upper wing wall consists of a single construction section comprised of rubble masonry. The north wall extends 180 feet in length and is 6 feet wide at its base, while the south wall extends 170 feet in length and is 6 feet in width at its base.[126] The north upper wing wall is a foot wide at its top and is beveled on the side exterior to the lock channel at a 1V:8H slope. The south wall is also a foot wide at its top, but is beveled at a 1V:10H slope exterior of the lock channel.

The lock chamber of Appleton Lock 1 extends 132 feet 6 inches in length. Additionally, the lock includes a 40 foot 5 inch long upper gate section at the west end of the lock, and a 46 foot 9 inch long lower gate section at the east end of the lock.[127] Including the upper and lower gate sections, the overall length of the lock is 219.6 feet [128]

The upper gate section is that part of the lock that is slightly larger in width than the lock chamber and contains the upper valve mechanisms used to fill the lock. Spaced 39 feet 6 inches apart, the walls of the upper gate section are 22 feet high and 5 feet wide. The walls of the upper gate section are built directly on top of limestone bedrock, and their interior faces are perpendicular to the natural rock floor of the lock. The wall surfaces facing the lock channel are constructed of fourteen tiers of 19 inch thick quarried limestone blocks laid horizontally to form the face of the wall. Rubble masonry has been built up behind the cut blocks in order to reinforce the wall. At its base, the wall is 8 feet wide narrowing to 4 feet 6 inches at its top. Directly behind the upper lock gates, the interior walls of the upper gate section are recessed 2 feet in order to allow the open gate to recess flush with the lock wall.[129]

The upper gate is constructed from pine timbers laid horizontally and held together with vertical oak beams. In addition to the oak beams, the horizontal pine timbers used in the gate construction of Appleton Lock 1 are secured together by vertical steel I beams bolted to both faces of the gate with 3/4 inch and 1 1/4 inch bolts. The wooden upper lock gate is 16 feet 7 inches high and 19 feet 8 inches wide.[130]

The upper lock gates are opened and closed by horizontal spars which connect the inside of the gates to geared vertical shafts enclosed within steel tripods mounted on both sides of the lock wall. A removable bar is inserted in a socketed hub attached to a vertical shaft and serves as a handle used to turn the shaft. In order to open or close the gate, the locktender must use the handle to rotate the vertical shaft by walking around the tripod. If the gates are to be opened, the locktender walks in a counterclockwise direction, and if the gates are to be closed, the locktender walks in a clockwise direction.

When the lock gates are closed and sealed, six butterfly valves in the floor of the upper gate section are opened and water is allowed to flow through a culvert below the mitre sill and into the lock. The valves are operated by geared mechanisms connected to levers mounted on top of the lock gates. When opened, the four upstream valves fill the lock chamber in about 4 minutes and provide the 8 feet of lift needed to negotiate the passage from the 727.36 feet above sea level elevation of the lower pool to the 735.40 upper pool elevation.[131]

The lower gate section is that part of the lock that is slightly larger in width than the lock chamber and contains the lower valve mechanisms used to empty the lock. Spaced 35 feet apart, the walls of the lower gate section are 22 feet high and 5 feet wide. The walls of the lower gate section are built directly on top of limestone bedrock, and their interior faces are perpendicular to the natural rock floor of the lock. The wall surfaces facing the lock channel are made up of fourteen tiers of 17 inch thick quarried limestone blocks laid horizontally to form the face of the wall. Rubble masonry has been built up behind the cut blocks in order to reinforce the wall. At its base, the wall is 10 feet wide and narrows to 4 feet 6 inches at its top. Directly behind the upper lock gates, the interior walls of the upper gate section are recessed 2 feet in order to allow the fully opened gates to recess flush with the lock walls.[132]

The original wooden gates of the lower gate section were replaced in 1926.[133] Design sheets specific to the replacement gates are on file at the Corps of Engineers Fox River Project Office in Kaukauna. The lower gates are constructed of pine timbers laid horizontally and held together with vertical oak beams. In addition to the oak beams, the horizontal pine timbers used in the lower gate construction are secured by vertical steel I beams bolted to both faces of the gate with 3/4 inch and 1 1/4 inch bolts. The lower gates are similar to the upper gates in their construction, except that they are considerably taller and wider, extending to a height of 21 feet and a width of 20 feet 8 inches.[134]

The lower lock gates are closed by horizontal spars which connect the inside of the gates to geared vertical shafts enclosed within steel tripods mounted on both sides of the lock wall. A removable bar is inserted in a socketed hub attached to a vertical shaft and serves as a handle used to turn the shaft. In order to open or close the gate, the locktender must use the handle to rotate the vertical shaft by walking around the tripod. If the gates are to be opened, the locktender walks in a counterclockwise direction, and if the gates are to be closed, the locktender walks in a clockwise direction.

When the lock gates are closed and sealed, six butterfly valves located in the lower lock gates are opened and water is allowed to flow out of the lock. Located three per gate, the valves are operated

by levers located on the top of each gate. When opened, the lower valves can discharge the lock chamber to the lower pool elevation in 2 minutes and 46 seconds.[135]

The lock chamber wall between the upper and lower gate sections is constructed of fourteen tiers of quarried limestone blocks laid horizontally to form the face of the wall. The walls of the lock chamber are built directly on top of limestone bedrock, and their interior faces are perpendicular to the natural rock floor of the lock. Rubble masonry has been built up behind the cut blocks in order to reinforce the wall. The cut block walls of the lock chamber are 10 feet in width, and are beveled to 4 feet 6 inches at the top of the wall.[136]

In recent years, pipe guard rails and concrete tripod platforms have been added to the first Appleton lock, and both sets of gates have been replaced. However, apart from these superficial improvements and periodic repairs to the gates, valves, and stone walls, Appleton Lock 1 appears very much as it did when construction was completed in 1884.

Waste Weir at Lock 1

The waste weir at Appleton Lock 1 flows parallel to the northwest side of the lock for an approximate distance of 200 feet.[137] Designed to prevent damage to the lock gates due to flooding, the waste weir is coincident with the location of Old lock 1. Located at the upstream head of the waste weir is a concrete spillway and needle gate regulating water into the weir canal. The weir canal maintains an approximate width of 30 feet from the upstream spillway to the main lock canal. The weir canal is bounded by stone walls.[138]

APPLETON LOCK 2

Oriented slightly NW/SE, Appleton Lock 2 has changed little since its construction in 1901. The lock consists of a 144 foot by 35 foot quarried limestone lock chamber with wing walls at each end.[139]

Detailed design sheets specific to Appleton Lock 2 are not on file at the Corps of Engineers Fox River Project Office in Kaukauna, Wisconsin. However, since Appleton Lock 2 is similar in design and construction to other locks in the Fox River system, the plans from these facilities provide detailed information regarding the construction and design of Appleton Lock 2. Specifically, Appleton Locks 1 and 2 are similar in design.

The lower wing walls, or those located at the downstream end of the lock, consist of a single construction section comprised of rubble masonry.[140] The upper wing walls, located at the upstream end of the lock, are also constructed of a single rubble masonry wall section. The specific dimensions of the second lock wing walls are not provided on the extant plans of the facility, but generally, lock wing walls are wider at the base of the wall and are beveled to an approximate 5 foot width at the top.

The lock chamber of the Appleton second lock measures 89 feet 8 inches between the hollow quoins of the lock.[141] Additionally, there is a 29 foot 9 13/16 inch upper gate section at the west end of the lock, and a 24 foot 6 inch lower gate section at the east end of the lock.[142] Including the upper and lower gate sections, the overall length of the lock is approximately 144 feet.[143]

The upper gate section is that part of the lock that is slightly larger in width than the lock chamber and contains the valve mechanisms used to fill the lock. Spaced approximately 37 feet apart, the interior walls of the upper gate section are made up of tiers of 19 inch thick quarried limestone blocks laid horizontally to form the face of the wall. Rubble masonry has been built up behind the

cut blocks in order to reinforce the wall. The walls of the upper gate section are built directly on top of limestone bedrock, and their interior faces are perpendicular to the natural rock floor of the lock. Directly behind the upper lock gates, the interior walls of the upper gate section are recessed 2 feet in order to allow the fully opened gates to recess flush with the lock walls.[144]

The upper gate of the Appleton second lock is constructed from pine timbers laid horizontally and held together with vertical oak beams.[145] In addition to the oak beams, the horizontal pine timbers are secured by vertical steel I beams bolted to both faces of the gate with 3/4 inch and 1 1/4 inch bolts.

The upper lock gates are closed by horizontal spars which connect the inside of the gates to geared vertical shafts enclosed within steel tripods mounted on both sides of the lock wall. A removable bar is inserted in a socketed hub attached to a vertical shaft and serves as a handle used to turn the shaft. In order to open or close the gate, the locktender must use the handle to rotate the vertical shaft by walking around the tripod. If the gates are to be opened, the locktender walks in a counterclockwise direction, if the gates are to be closed, the locktender walks in a clockwise direction.[146]

When the upper lock gates are closed and sealed, six butterfly valves located in the floor of the upper gate section are opened and water is allowed to flow through a culvert below the mitre sill and into the lock. The valves are operated by geared mechanisms connected to levers mounted on top of the lock gates. When opened, the six upstream valves can fill the lock chamber to provide the 9.6 feet of lift needed to match the 727.36 feet above sea level elevation of the upper pool.[147]

The lower gate section is that part of the lock that is slightly larger in width than the lock chamber and contains the lower valve mechanisms. Spaced approximately 37 feet apart, the interior walls of the lower gate section are made up of tiers of 19 inch thick quarried limestone blocks laid horizontally to form the face of the wall. Rubble masonry has been built up behind the cut blocks in order to reinforce the wall. The walls of the lower gate section are built directly on top of limestone bedrock, and their interior faces are perpendicular to the natural rock floor of the lock. Directly behind the lower lock gates, the interior walls of the lower gate section are recessed 2 feet in order to allow the gates to recess flush when fully opened.[148]

The lower gate is constructed from pine timbers held together with vertical oak beams.[149] In addition to the oak beams, the pine timbers are secured together by vertical steel I beams bolted to both faces of the gate with 3/4 inch and 1 1/4 inch bolts. The lower gates are similar to the upper gates in their construction, except that they are considerably taller in height.

The lower lock gates are closed by horizontal spars which connect the inside of the gates to geared vertical shafts enclosed within steel tripods mounted on both sides of the lock wall. A removable bar is inserted in a socketed hub attached to a vertical shaft and serves as a handle used to turn the shaft. In order to open or close the gate, the locktender must use the handle to rotate the vertical shaft by walking around the tripod. If the gates are to be opened, the locktender walks in a counterclockwise direction, if the gates are to be closed, the locktender walks in a clockwise direction.

When the lock gates are closed and sealed, the butterfly valves located in the lower lock gates are opened and water is allowed to flow out of the lock. The valves are operated by levers located on the top of each gate. When opened, the lower valves can discharge the lock chamber to the lower pool elevation in 2 minutes and 46 seconds.[150]

The walls of the lock chamber between the upper and lower gate sections are constructed of 19 inch thick quarried limestone blocks laid horizontally to form the face of the wall. Rubble masonry has been built up behind the cut blocks in order to reinforce the wall. The walls of the lock chamber are built directly on top of limestone bedrock, and their interior faces are perpendicular to the natural rock floor of the lock.

In recent years, pipe guard rails and concrete tripod platforms have been added to Appleton Lock 2, and both sets of gates have been replaced. Apart from these superficial improvements and periodic repairs to the gates, valves, and stone walls, the second lock at Appleton appears very much as it did when it was completed in 1901.

Waste Weir at Lock 2

The waste weir at lock two is a circular flume flowing parallel to the south side of the lock. Approximately 6 feet wide, the weir canal has a poured concrete bottom and side walls. At the head of the waste weir is a small spillway with a stop log barrier. Located on top of a platform covering the weir sluiceway, is a small, approximately 6 foot by 6 foot, cinder block structure with a sloped roof and a single door. A pipe guard rail extends the entire length of the weir on its lockward side, and a chain link fence extends the length of the outer edge.

APPLETON LOCK 3

Oriented on a general E/W axis Appleton Lock 3 was probably constructed around 1900, since the design plans on file at the Corps of Engineers Fox River Project Office date to 1899.[151] The lock consists of a 144 foot by 35 foot quarried limestone lock chamber with wing walls at each end.[152]

The lower wing walls, or those located at the downstream end of the lock, are 9 feet 4 inches high. Each lower wing wall consists of a single construction section comprised of rubble masonry. The north, or left, wall measures 26 feet in length and is 5 feet 6 inches wide at its base, while the south, or right, wall is 28.3 feet in length and is 5 feet in width at its base. The north and south masonry walls are 4 feet wide at their tops, and are beveled on their exterior walls to bottom widths of 5 feet 6 inches and 5 feet respectively.[153]

The upper wing walls, located at the upstream end of the lock, are 9.6 feet high. Each upper wing wall consists of a single construction section comprised of rubble masonry. The north, or left, wall is 45 feet in length and is 4 feet wide at its base, while the south, or right, wall extends 58.6 feet in length and is 7 feet in width at its base. Both of the upper wing walls are beveled from their basal widths to 3 feet at their top.[154]

The lock chamber of the Appleton Lock 3 measures 138 feet between the upper and lower gate sections of the lock.[155] Located at the west end of the lock, the upper gate section is 41 feet 6 inches in length, and the lower gate section is 32 feet 6 inches in length.[156] Including the upper and lower gate sections, the overall length of the lock is 220 feet 6 inches.[157]

The upper gate section is that part of the lock that is slightly larger in width than the lock chamber and contains the upper valve mechanisms used to fill the lock. Spaced 35 feet apart, the walls of the upper gate section are 20 feet 10 inches high and are 32 feet 6 inches long. The wall surfaces facing the lock channel are made up of tiers of 19 inch thick quarried limestone blocks laid horizontally to form the face of the wall. Rubble masonry has been built up behind the cut blocks in order to reinforce the wall. At its base, the block wall is 8 feet wide and is beveled to a 4 foot 6 inch width at the top. The walls of the upper gate section are built directly on top of limestone bedrock with their interior faces perpendicular to the natural rock floor of the lock. Directly behind

the upper lock gates, the interior walls of the upper gate section are recessed 2 feet in order to allow the gates to recess flush when fully opened.[158]

The upper gate is constructed from pine timbers held together with 1 1/2 by 4 inch iron bars. In addition to the exterior iron bars, the horizontal pine timbers are secured together by two 1/2 inch diameter rods which have been threaded the entire height of the gate and bolted at both ends. The wooden upper lock gate is 12 feet high and 20 feet 7 inches wide.[159]

The upper lock gates are closed by horizontal spars which connect the inside of the gates to geared vertical shafts enclosed within steel tripods mounted on both sides of the lock wall. A removable steel bar is inserted in a socketed hub attached to a vertical shaft and serves as a handle used to turn the shaft. In order to open or close the gate, the locktender must use the handle to rotate the vertical shaft by walking around the tripod. If the gates are to be opened, the locktender walks in a counterclockwise direction, and if the gates are to be closed, the locktender walks in a clockwise direction.

When the lock gates are closed and sealed, the four butterfly valves in the floor of the upper gate section are opened and water is allowed to flow through a culvert below the mitre sill and into the lock. The valves are operated by geared mechanisms connected to levers mounted on top of the lock gates.[160] When opened, the four upstream valves can fill the lock chamber to provide the 9.8 feet of lift needed to match 716.1 feet above sea level elevation of the upper pool in a little under 4 minutes.[161]

The lower gate section is that part of the lock that is slightly larger in width than the lock chamber and contains the lower valve mechanisms used to drain the lock. Spaced 35 feet apart, the walls of the lower gate section are 20 feet 10 inches high and 37 feet in length. The wall surfaces facing the lock channel are made up of tiers of 17 inch thick quarried limestone blocks laid horizontally to form the face of the wall. Rubble masonry has been built up behind the cut blocks in order to reinforce the wall. At its base, the block wall is 8 feet wide and is beveled to a 4 foot 6 inch width at its top. The walls of the lower gate section are built directly on top of limestone bedrock with their interior faces perpendicular to the natural rock floor of the lock. Directly behind the upper lock gates, the interior walls of the upper gate section are recessed in order to allow the gates to recess flush when fully opened.[162]

The lower gates are constructed from timbers held together with 1 1/2 by 4 inch iron bars. In addition to the exterior iron bars, the horizontal pine timbers are secured together by two 1/2 inch diameter rods which have been threaded the entire height of the gate and bolted at both ends. The lower gates of Appleton Lock 3 are similar to the upper gates in their construction, except that they are taller and wider, rising to a height of 21 feet and spanning a width of 20 feet 7 inches.[163]

The lower lock gates are closed by horizontal spars which connect the inside of the gates to geared vertical shafts enclosed within steel tripods mounted on both sides of the lock wall. A removable bar is inserted in a socketed hub attached to a vertical shaft and serves as a handle used to turn the shaft. In order to open or close the gate, the locktender must use the handle to rotate the vertical shaft by walking around the tripod. If the gates are to be opened, the locktender walks in a counterclockwise direction, and if the gates are to be closed, the locktender walks in a clockwise direction.

When the lock gates are closed and sealed, the six butterfly valves located in the lower lock gates are opened and water is allowed to flow out of the lock. Located three to a gate, the valves are operated by levers located on the top of each gate. When opened, the lower valves can discharge the lock chamber to the lower pool elevation in 2 minutes and 51 seconds.[164]

The lock chamber walls between the upper and lower gate sections are constructed of tiers of quarried limestone blocks laid horizontally to form the face of the wall. Rubble masonry has been built up behind the cut blocks in order to reinforce the wall. The block walls of the lock chamber are 8 feet in width at the base, and are beveled to 4 feet 6 inches at the top. The walls of the lock chamber are built directly on top of limestone bedrock with their interior faces perpendicular to the natural rock floor of the lock.[165]

In recent years, pipe guard rails and concrete tripod platforms have been added to Appleton Lock 3, and both sets of gates have been replaced or rebuilt. However, apart from these superficial improvements and periodic repairs to the gates, valves, and stone walls, Appleton Lock 3 appears very much as it did when construction of the cut stone masonry lock was completed in the early 1900s.

Waste Weir at Lock 3

The waste weir at Appleton Lock 3 bypasses the lock to the northwest. The weir is made up of a concrete spillway which carries overflow water from the Appleton lock canal directly into the Fox River, and is approximately 60 feet long, flaring slightly to 20.3 feet wide at its point of maximum constriction.[166] The waste weir at Appleton Lock 3 has no weir canal associated with the spillway, and is bounded on its sides by 2 feet 6 inches concrete abutment walls and pipe guard rails.[167]

APPLETON LOCK 4

Appleton Lock 4 was built in 1907 to replace the original composite lock built prior to 1870.168 Oriented on a general NE/SW axis, the present lock consists of a 212 foot by 35 foot quarried limestone lock chamber with wing walls at each end.[169]

The lower wing walls, or those located at the downstream end of the lock, are 20 feet 6 inches high. Each lower wing wall consists of a single construction section comprised of rubble masonry faced with cut limestone blocks. The north wall is approximately 38 feet in length and is 10 feet 6 inches wide at its base, while the northeast wall is approximately 92 feet length and is 10 feet 6 inches in width at its base. The exterior surfaces of the lower wing walls are beveled from their basal width to achieve a width of 4 feet 6 inches at the top.[170]

The upper wing walls, located at the upstream end of the lock, are 22 feet high. Each upper wing wall consists of a single construction section comprised of rubble masonry faced with cut limestone blocks. The southwest wall is approximately 53 feet in length and is 10 feet 6 inches wide at its base, while the longer southeast wall measures approximately 81 feet in length and is 10 feet 6 inches wide at its base.[171] Both of the upper wing walls are beveled from their basal width to achieve a 4 foot 6 inch width at the top.

The lock chamber of Appleton Lock 4 lock measures 138 feet between the upper and lower gate sections of the lock. Additionally, there is a 33 foot 6 inch upper gate section at the southern end of the lock, and a 40 foot 6 inch lower gate section at the northern end of the lock. Including the upper and lower gate sections, the overall length of the lock is 212 feet.[172]

The upper gate section is that part of the lock that is slightly larger in width than the lock chamber and contains the upper valve mechanisms used to fill the lock. Spaced 35 feet apart, the walls of the upper gate section are 22 feet high and 33 feet 6 inches long. The wall surfaces facing the lock channel are made up of tiers of 19 inch thick quarried limestone blocks laid horizontally to form the face of the wall. Rubble masonry has been built up behind the cut blocks in order to reinforce the

wall. At its base, the block wall is 12 feet 6 inches wide and is beveled to 6 feet at the top. The walls of the upper gate section are built directly on top of limestone bedrock with their interior faces perpendicular to the natural rock floor of the lock. Directly behind the upper lock gates, the interior walls of the upper gate section are recessed 2 feet in order to allow the gates to recess flush when fully opened.[173]

Design sheets specific to these replacement gates are not among the plans of the Appleton Lock 4 facility on file at the Corps of Engineers Fox River Project Office. However, since Appleton Lock 4 is similar in design and construction to other locks at Appleton, plans from these facilities supplemented by visual inspection of Appleton Lock 4 were used to compile a general description.

The upper gates of Appleton Lock 4 are constructed from pine timbers held together with vertical angle iron. In addition to the exterior iron, the horizontal pine timbers are secured together by rods which have been threaded the entire height of the gate and bolted at both ends. The wooden upper lock gate is 17 feet high and 20 feet 7 inches wide.[174]

The upper lock gates are closed by horizontal spars which connect the inside of the gates to geared vertical shafts enclosed within steel tripods mounted on both sides of the lock wall. A removable bar is inserted in a socketed hub attached to a vertical shaft and serves as a handle used to tum the shaft. In order to open or close the gate, the locktender must use the handle to rotate the vertical shaft by walking around the tripod. If the gates are to be opened, the locktender walks in a counterclockwise direction, and if the gates are to be closed, the locktender walks in a clockwise direction.

When the lock gates are closed and sealed, the six butterfly valves in the floor of the upper gate section are opened and water is allowed to flow through a culvert below the mitre sill and into the lock. The valves are operated by geared mechanisms connected to hand wheels mounted on top of the lock walls adjacent to the gates. When opened, the six upstream valves can fill the lock chamber to provide the 7.6 feet of lift needed to match the 706.3 feet above sea level upper pool in a little under 4 minutes.[175]

The lower gate section is that part of the lock that is slightly larger in width than the lock chamber and contains the lower valve mechanisms. Spaced 35 feet apart, the walls of the lower gate section are 22 feet high and 40 feet 6 inches in length. The wall surfaces facing the lock channel are made up of tiers of 19 inch thick quarried limestone blocks laid horizontally to form the face of the wall. Rubble masonry has been built up behind the cut blocks in order to reinforce the wall. At its base, the block wall is 10 feet 6 inches wide and is beveled to 4 feet 6 inches at the top. The walls of the lower gate section are built directly on top of limestone bedrock with their interior faces perpendicular to the natural rock floor of the lock. Directly behind the lower lock gates, the interior walls of the upper gate section are recessed 2 feet in order to allow the gates to recess flush when fully opened.[176]

The lower gates of Appleton Lock 4 are constructed from square pine timbers laid horizontally and held together with vertical angle iron. In addition to the exterior iron, the pine timbers are secured together by rods which have been threaded the entire height of the gate and bolted at both ends. The wooden upper lock gate is 19 feet high and 20 feet 7 inches wide.[177]

The lower lock gates are closed by horizontal spars which connect the inside of the gates to geared vertical shafts enclosed within steel tripods mounted on both sides of the lock wall. A removable bar is inserted in a socketed hub attached to a vertical shaft and serves as a handle used to tum the shaft. In order to open or close the gate, the locktender must use the handle to rotate the vertical shaft by walking around the tripod. If the gates are to be opened, the locktender walks in a

counterclockwise direction, and if the gates are to be closed, the locktender walks in a clockwise direction.

When the lock gates are closed and sealed, the six butterfly valves located in the lower lock gates are opened and water is allowed to flow out of the lock. Arranged three to a gate, the valves are operated by levers located on the top of each gate. The lower valves can discharge the lock chamber to the lower pool elevation in 2 minutes and 31 seconds.[178]

The lock chamber walls between the upper and lower gate sections are constructed of tiers of quarried limestone blocks laid horizontally to form the face of the wall. Rubble masonry has been built up behind the cut blocks in order to reinforce the wall. The block walls of the lock chamber measures 12 feet 6 inches in width, and are beveled to 6 feet 6 inches at the top.[179] The walls of the lock chamber are built directly on top of limestone bedrock with their interior faces perpendicular to the natural rock floor of the lock.[180]

In recent years, pipe guard rails and concrete tripod platforms have been added to the third Appleton lock, and both sets of gates have been replaced or rebuilt. However, apart from these superficial improvements and periodic repairs to the gates, valves, and stone walls, Appleton Lock 4 appears very much as it did when construction of the cut stone masonry lock was completed in the early 1900s.

SIGNIFICANCE

The Appleton Locks and Dams Complex is a part of the Lower Fox River Waterway System constructed by private companies in the decade spanning 1850 – 1860, and rebuilt by the United States Army Corps of Engineers between 1872 and 1936. Conceived as a part of the larger Fox River Waterway, the Lower Fox River System operated between Green Bay and Lake Winnebago. The Upper Dam at Appleton creates the pool that flooded the canal for Locks 1, 2, and 3. The Appleton Complex allows passage around a thirty foot drop in elevation in this section of the Lower Fox River. The Lower Dam at Appleton creates the pool that floods the Lock 4 canal. The Appelton Locks and Dams Complex is an integral component of the greater Lower Fox River Waterway System.

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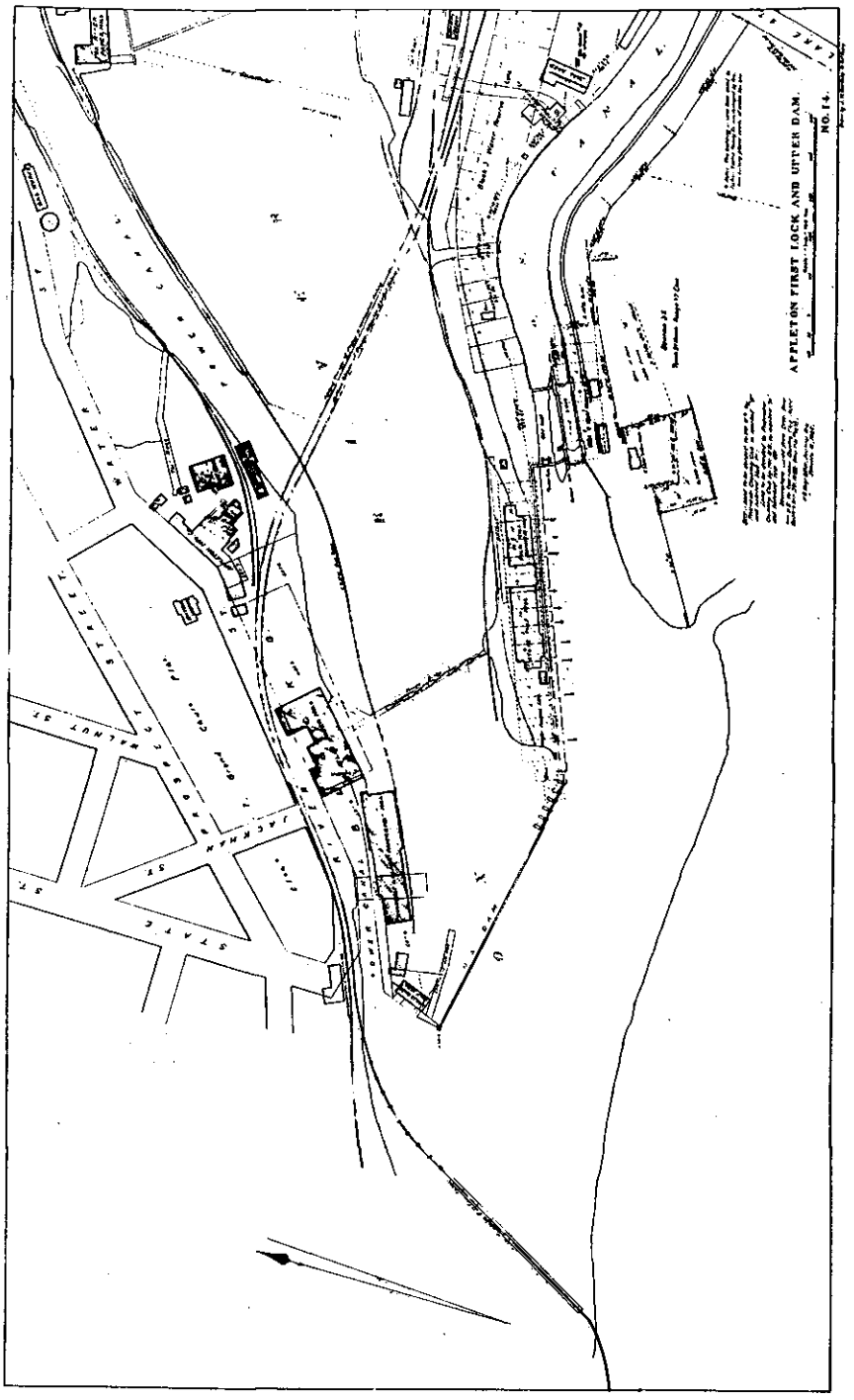

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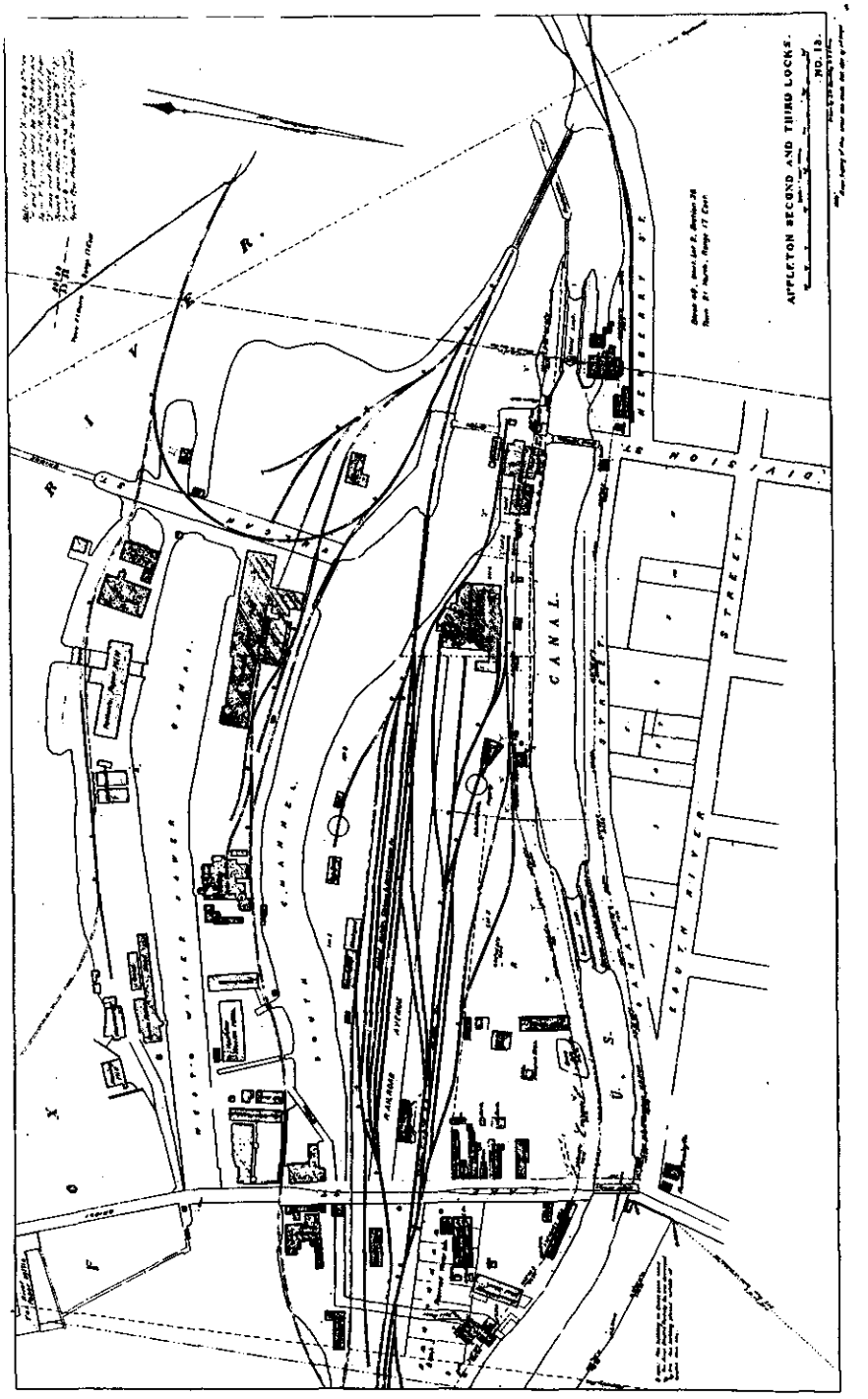

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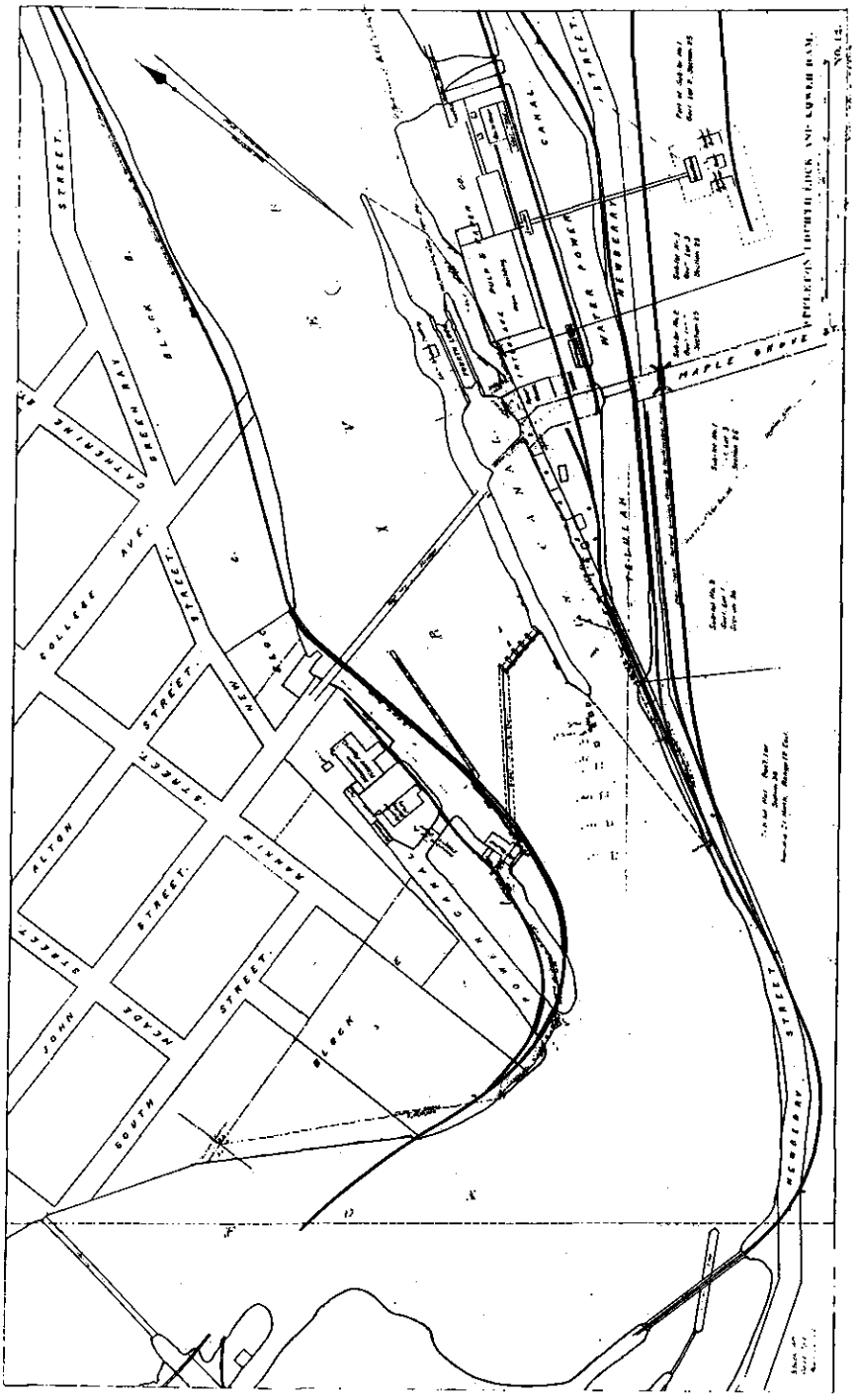

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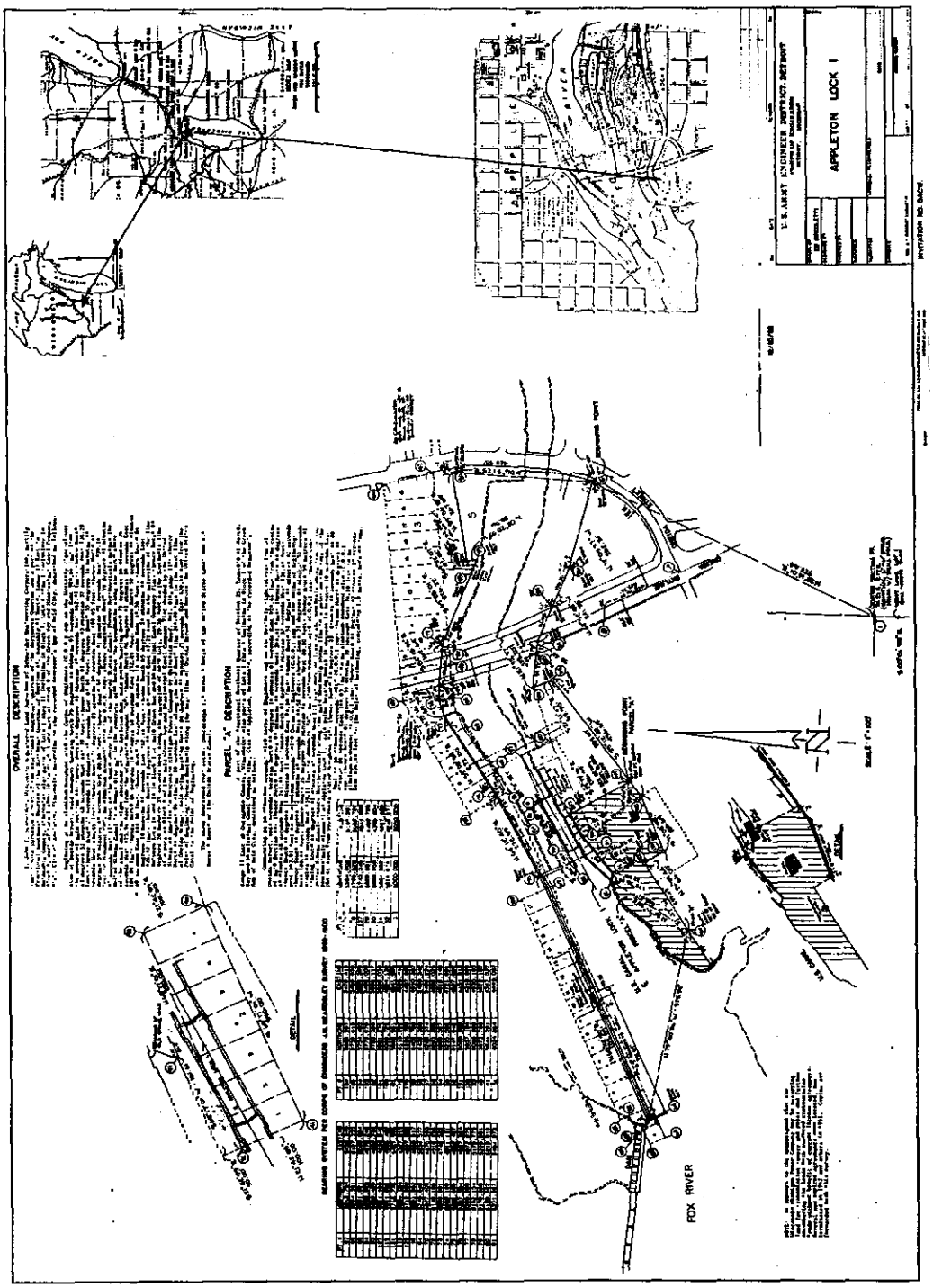

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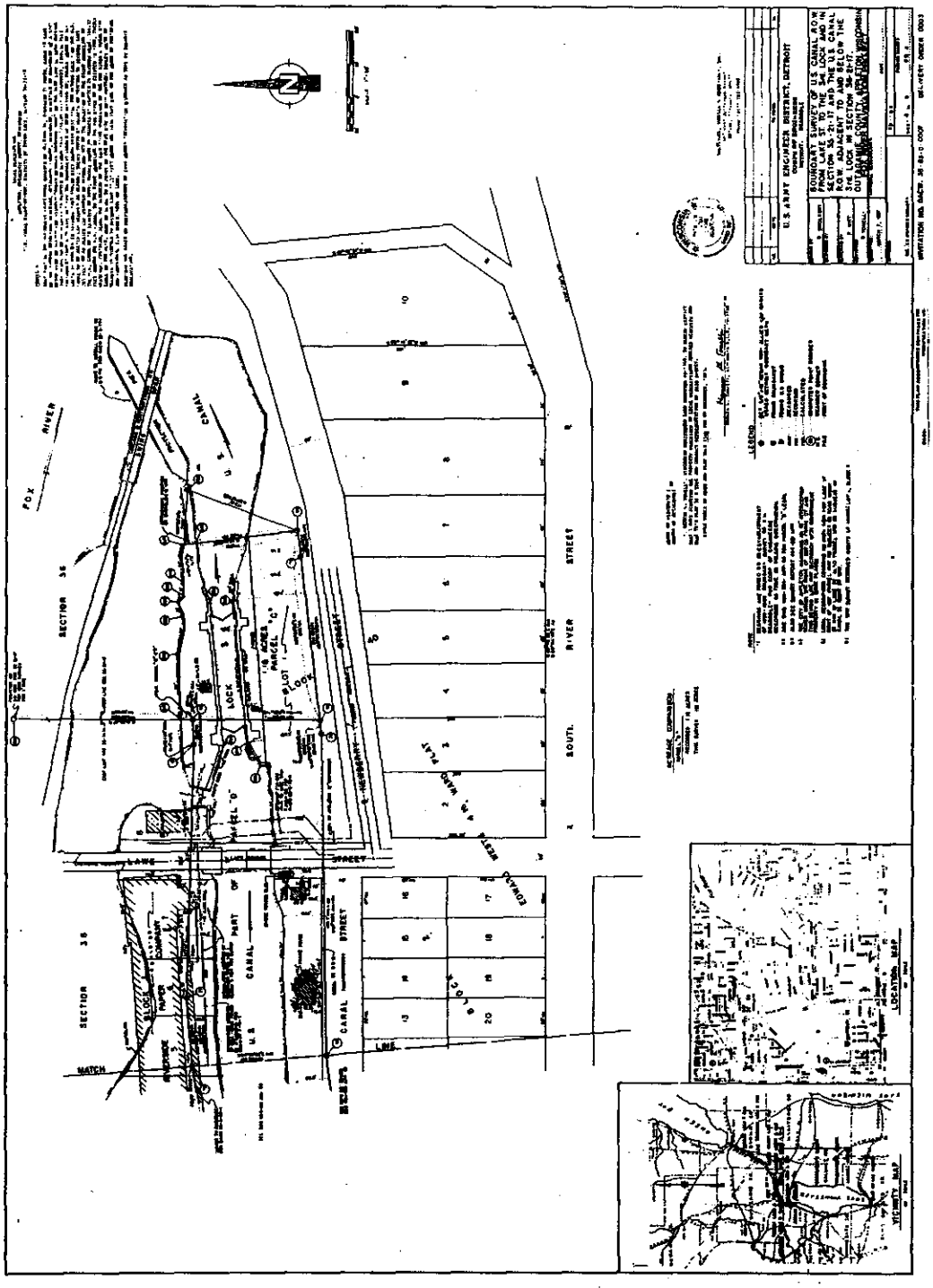

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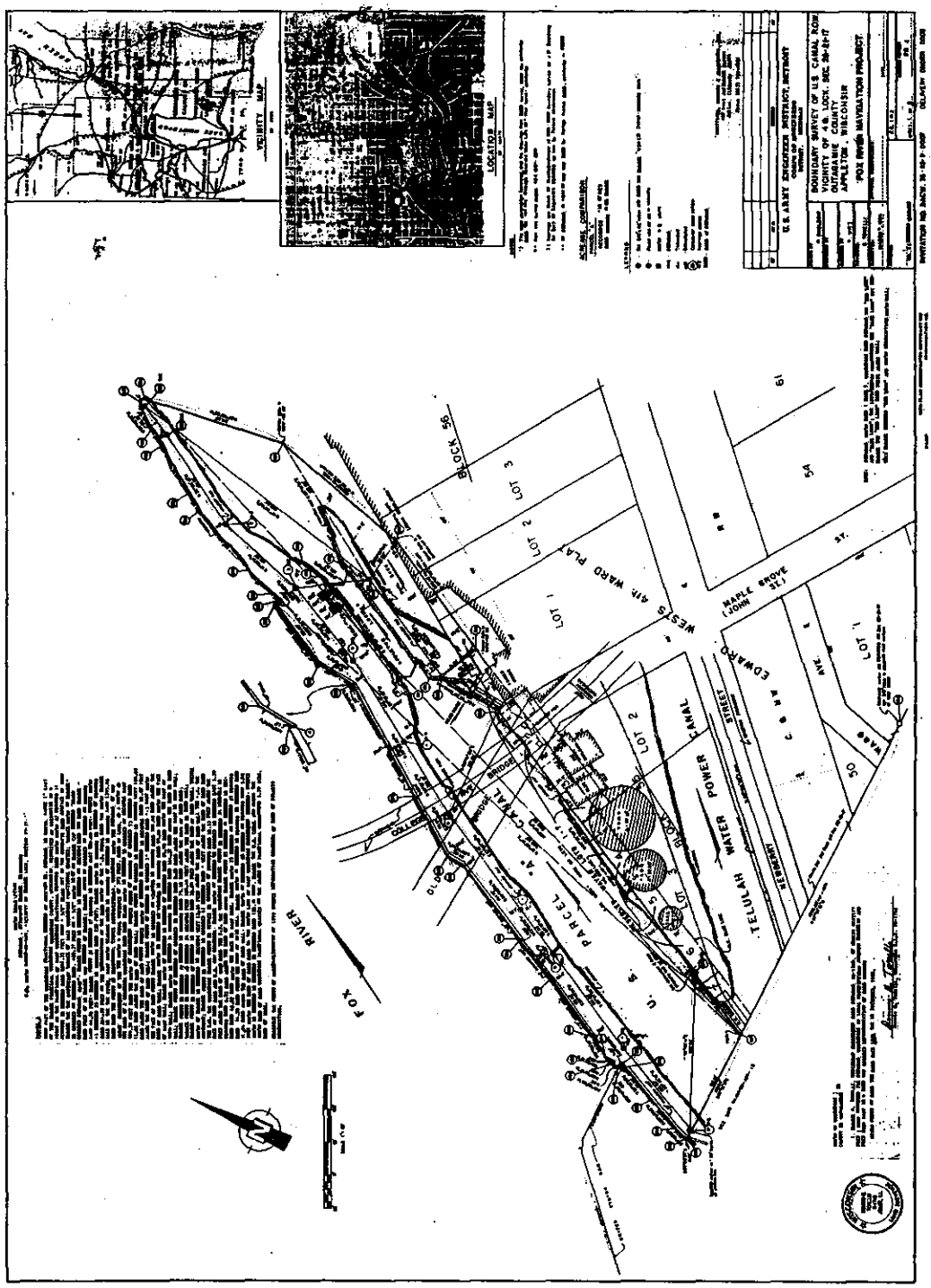

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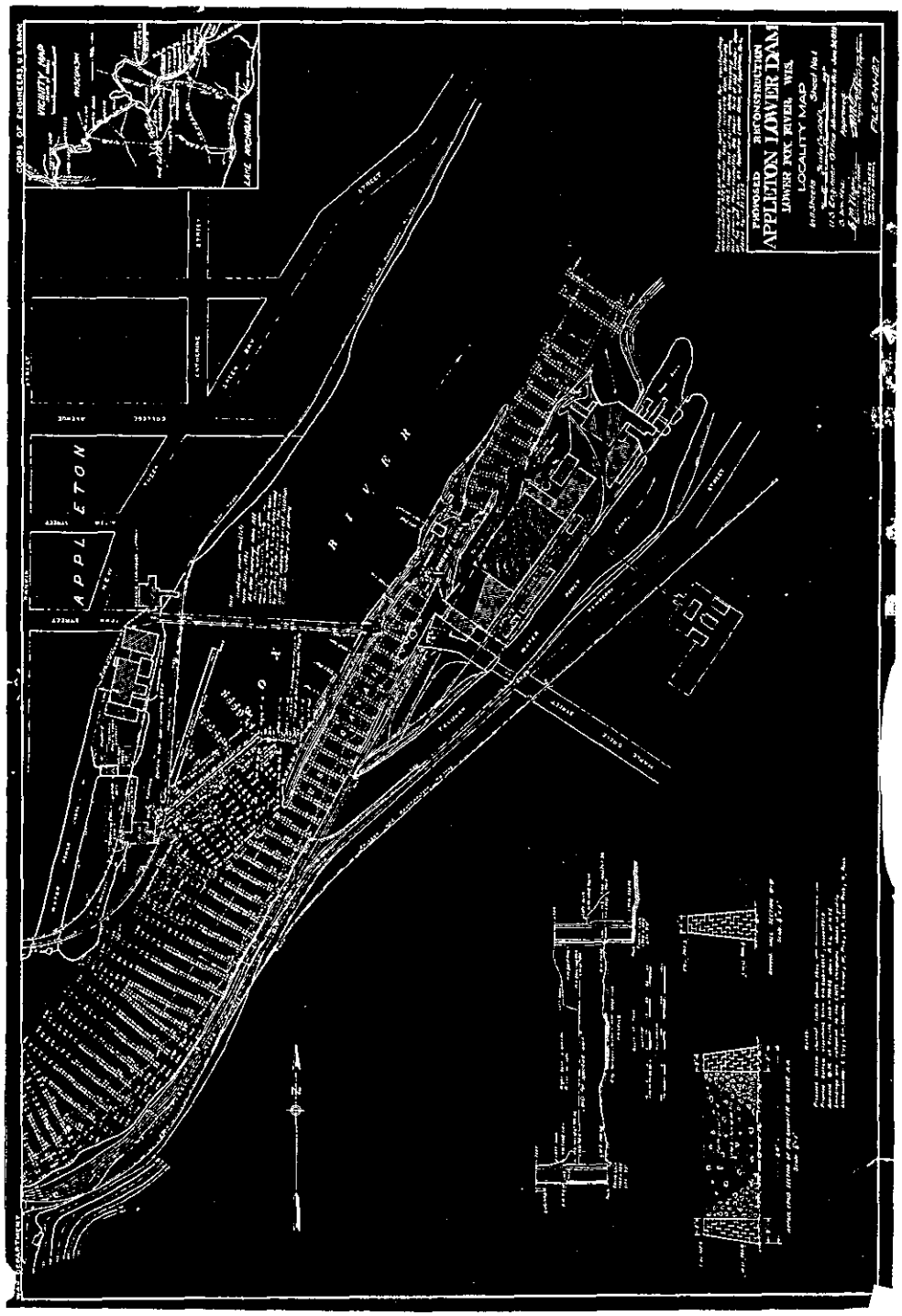

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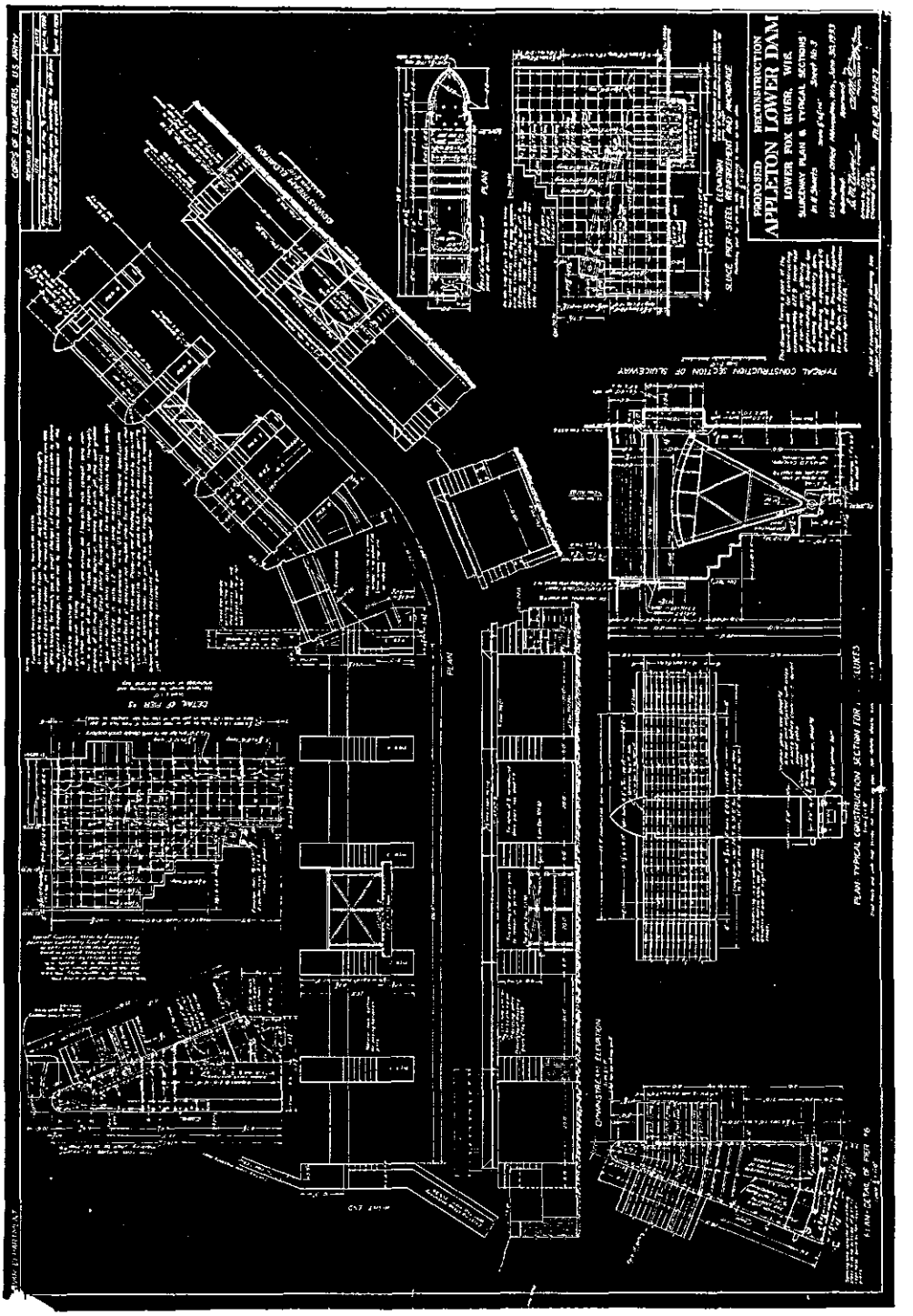

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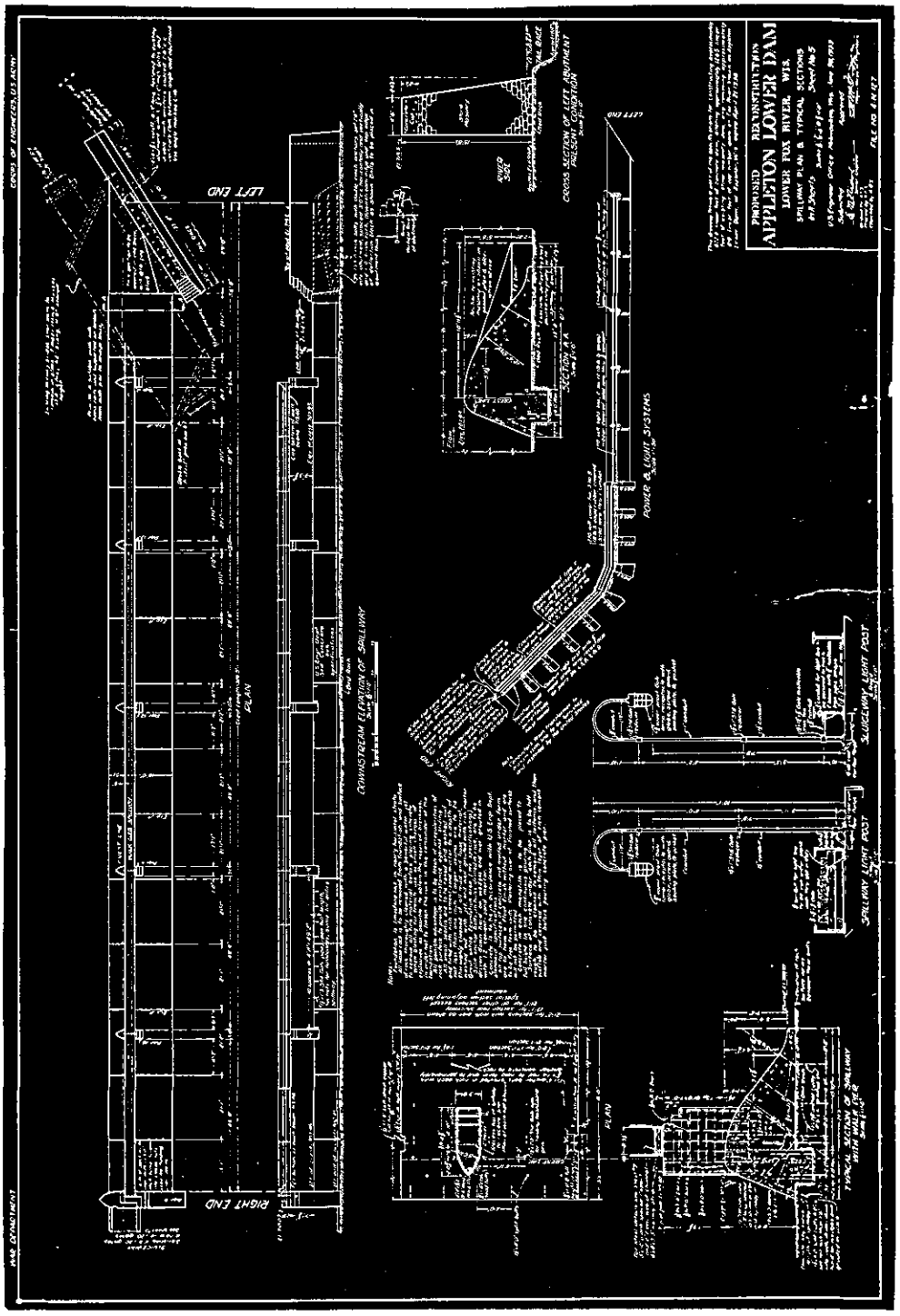

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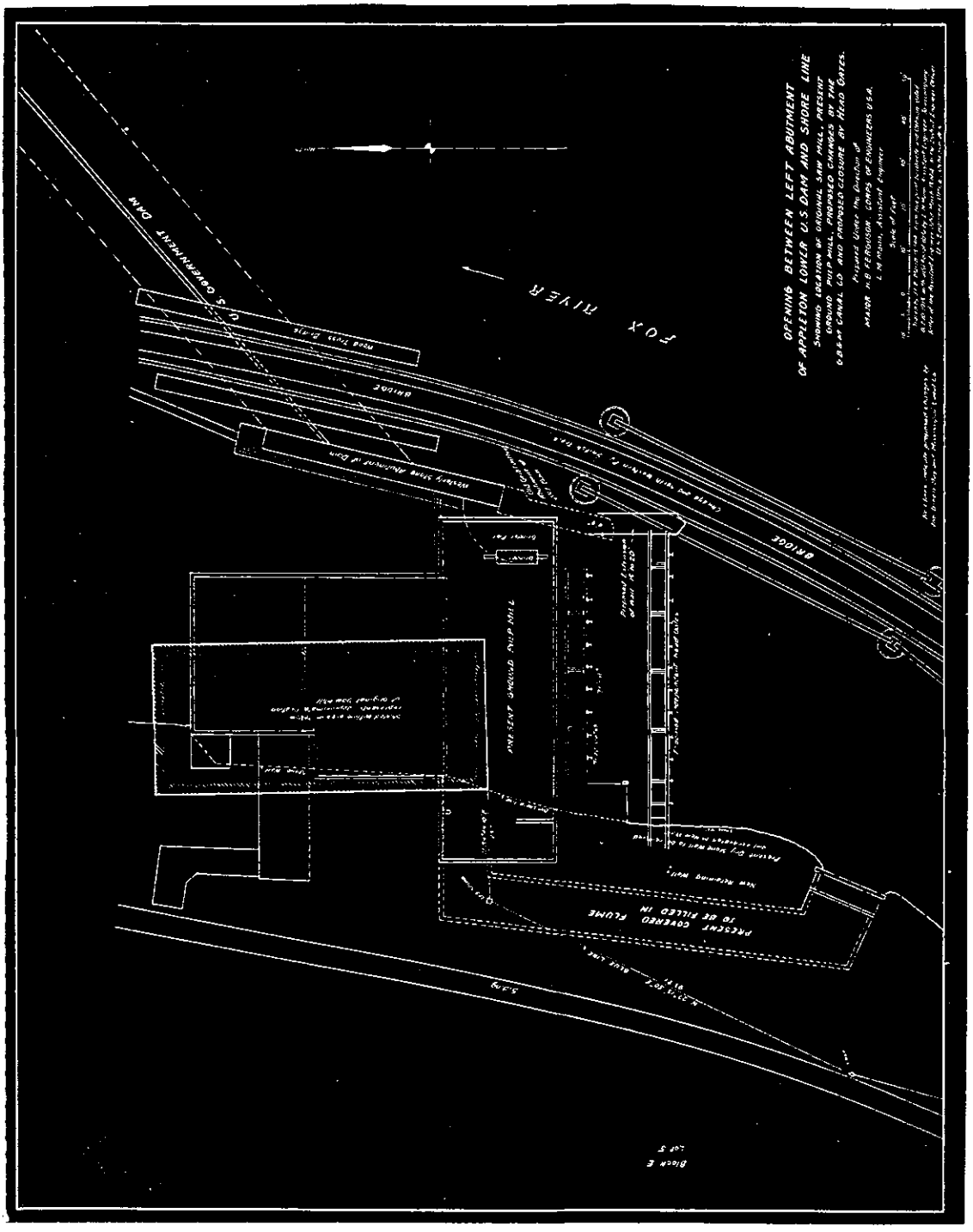
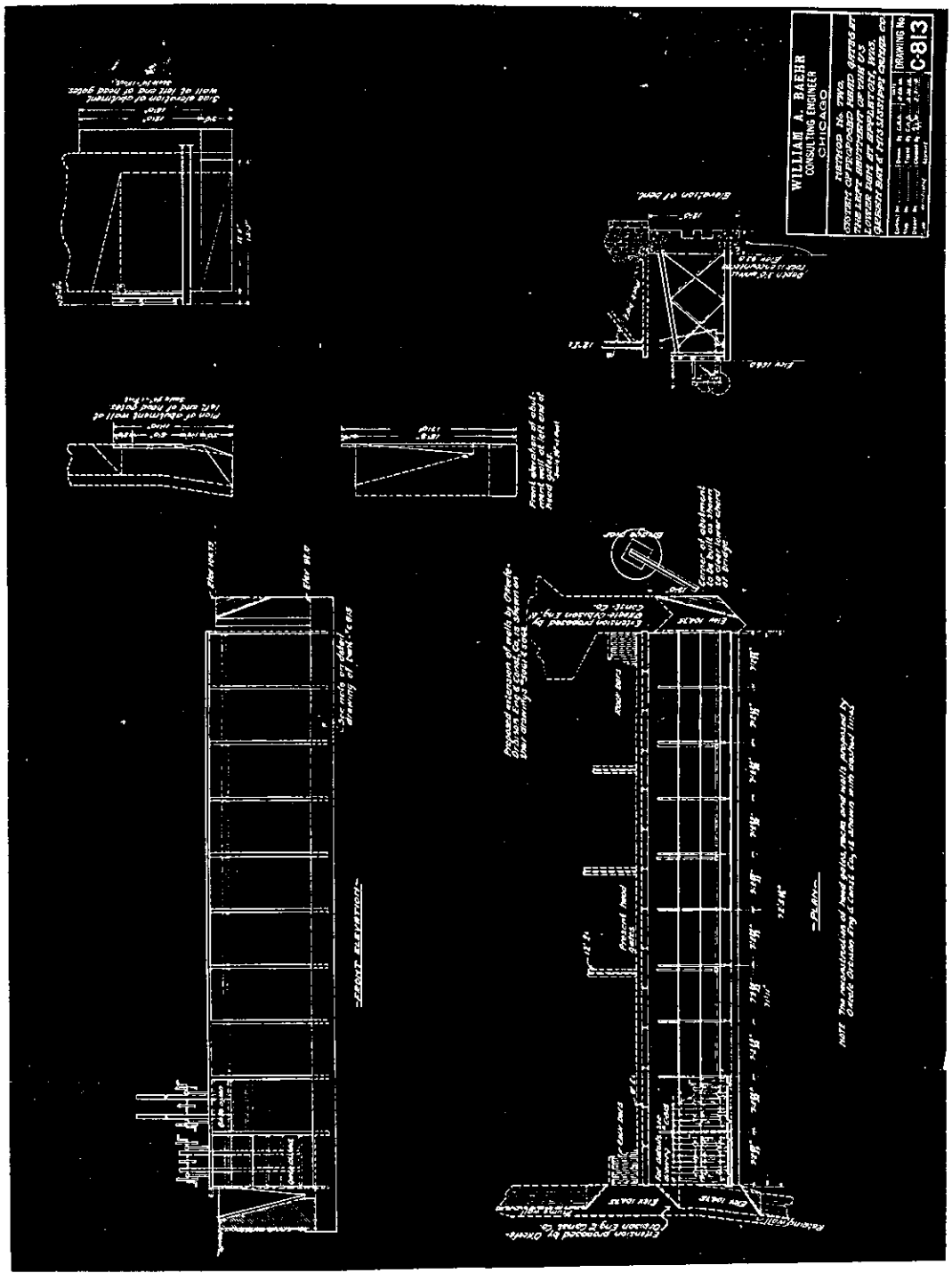
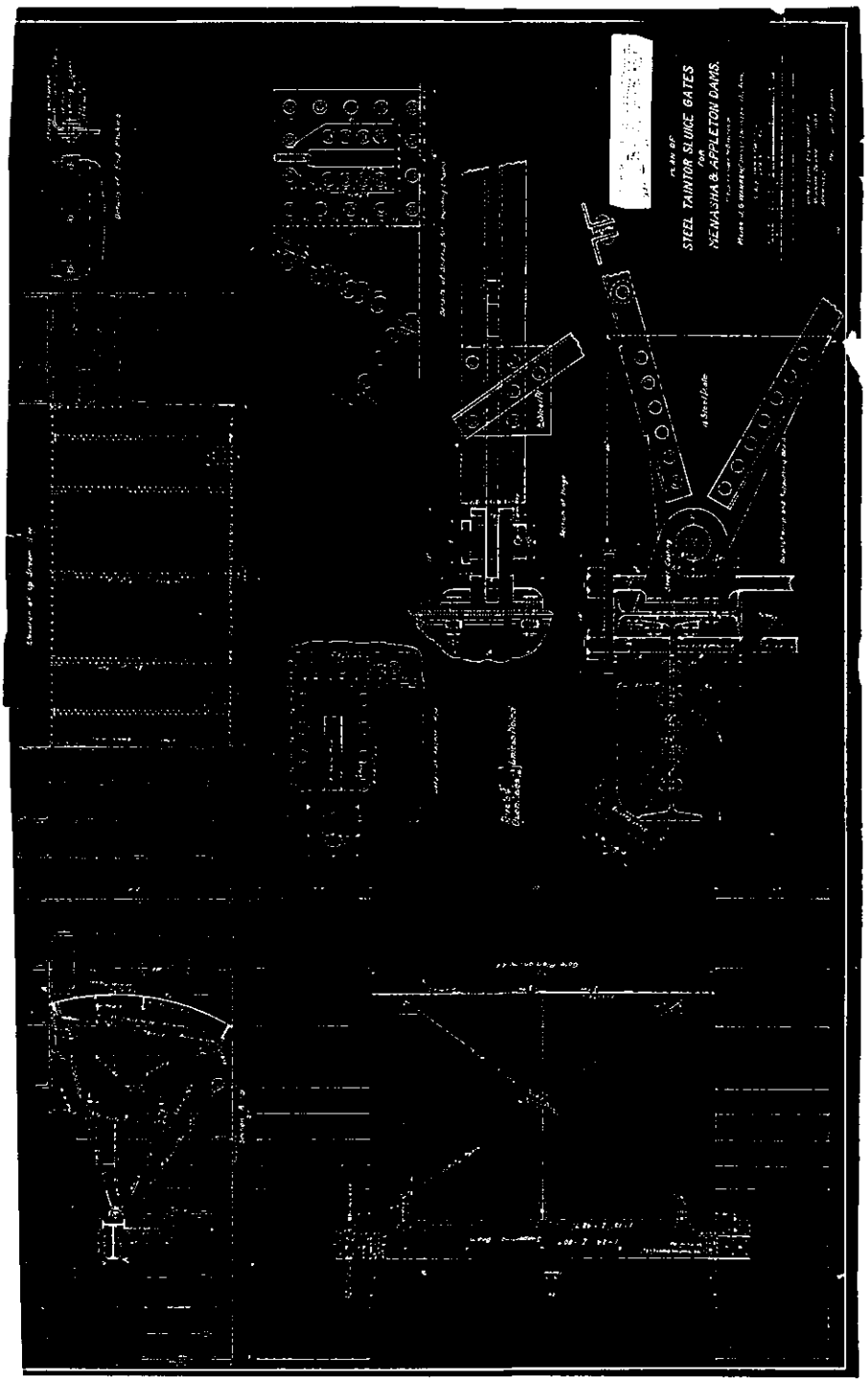


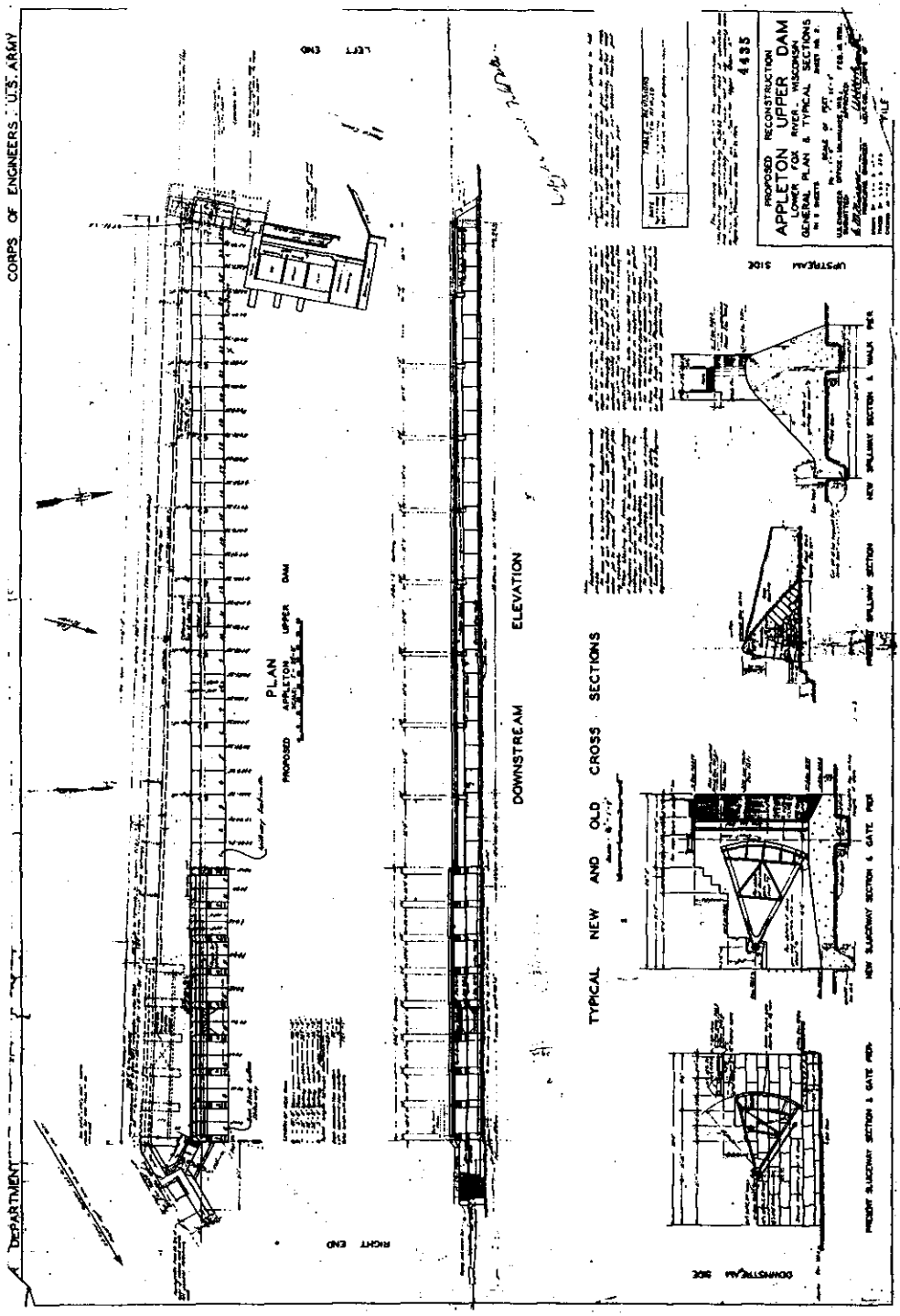
Photocopy of blueprint of Opening Between Left Abutmentof Appleton Lower U.S. Dam and Shore Line, 1914, File #1230.



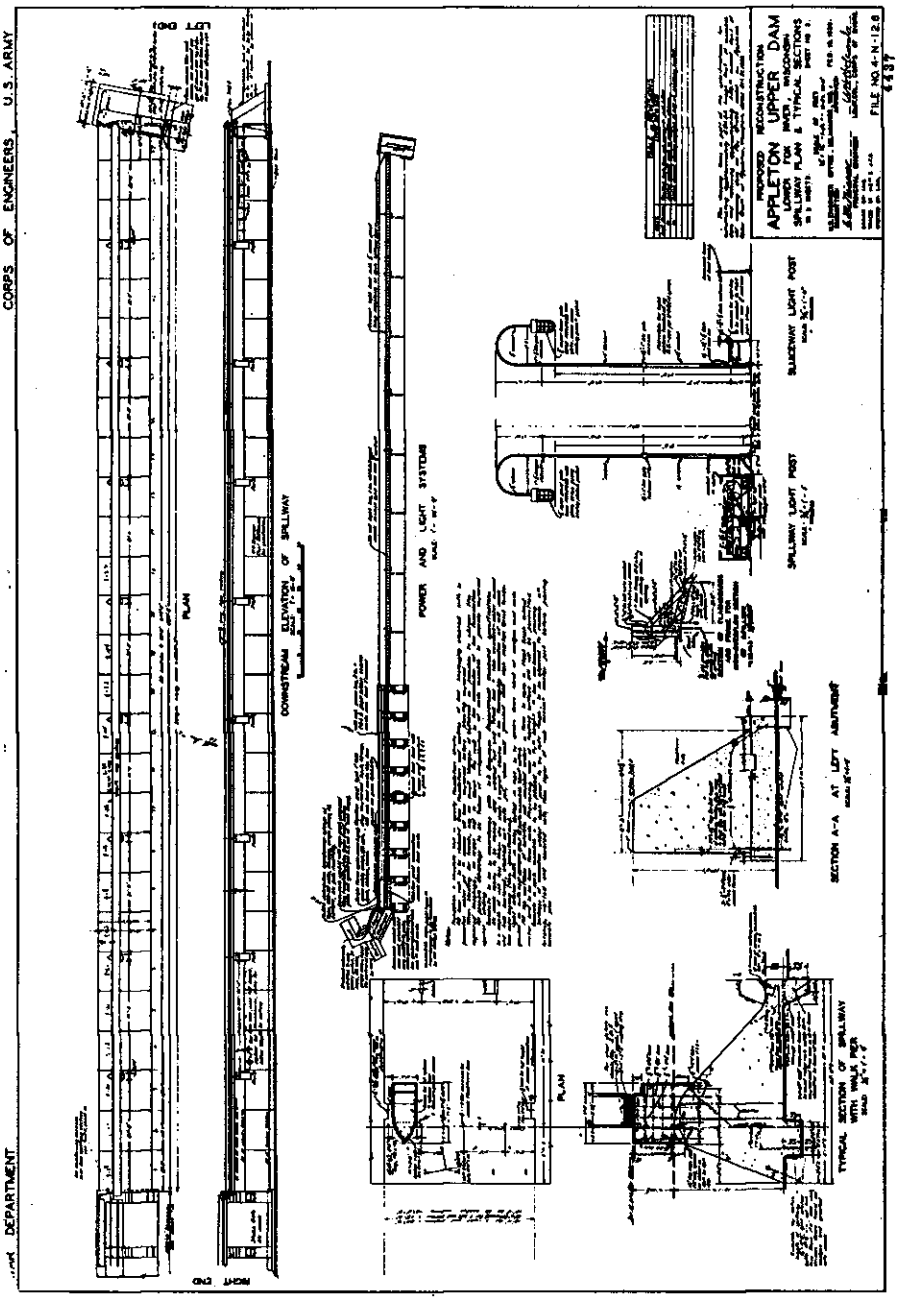
Photocopy of blueprint of Method No. Two: System of Proposed Head Gates at The Left Abutment of the U.S. Lower Dam at Appleton, 1914, Drawing C-813.



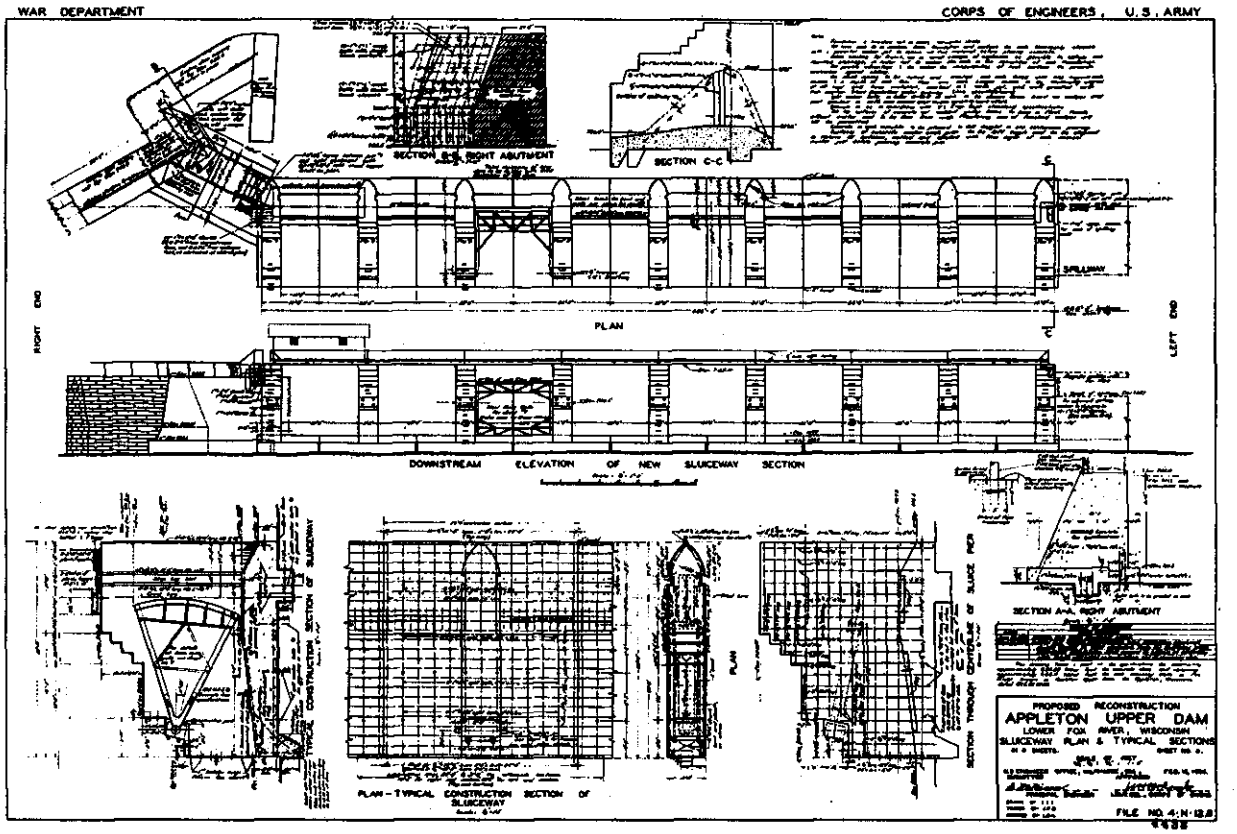
Photocopy of blueprint of Plan of Steel Taintor Sluice Gates for Menasha & Appleton Dams, 1904.



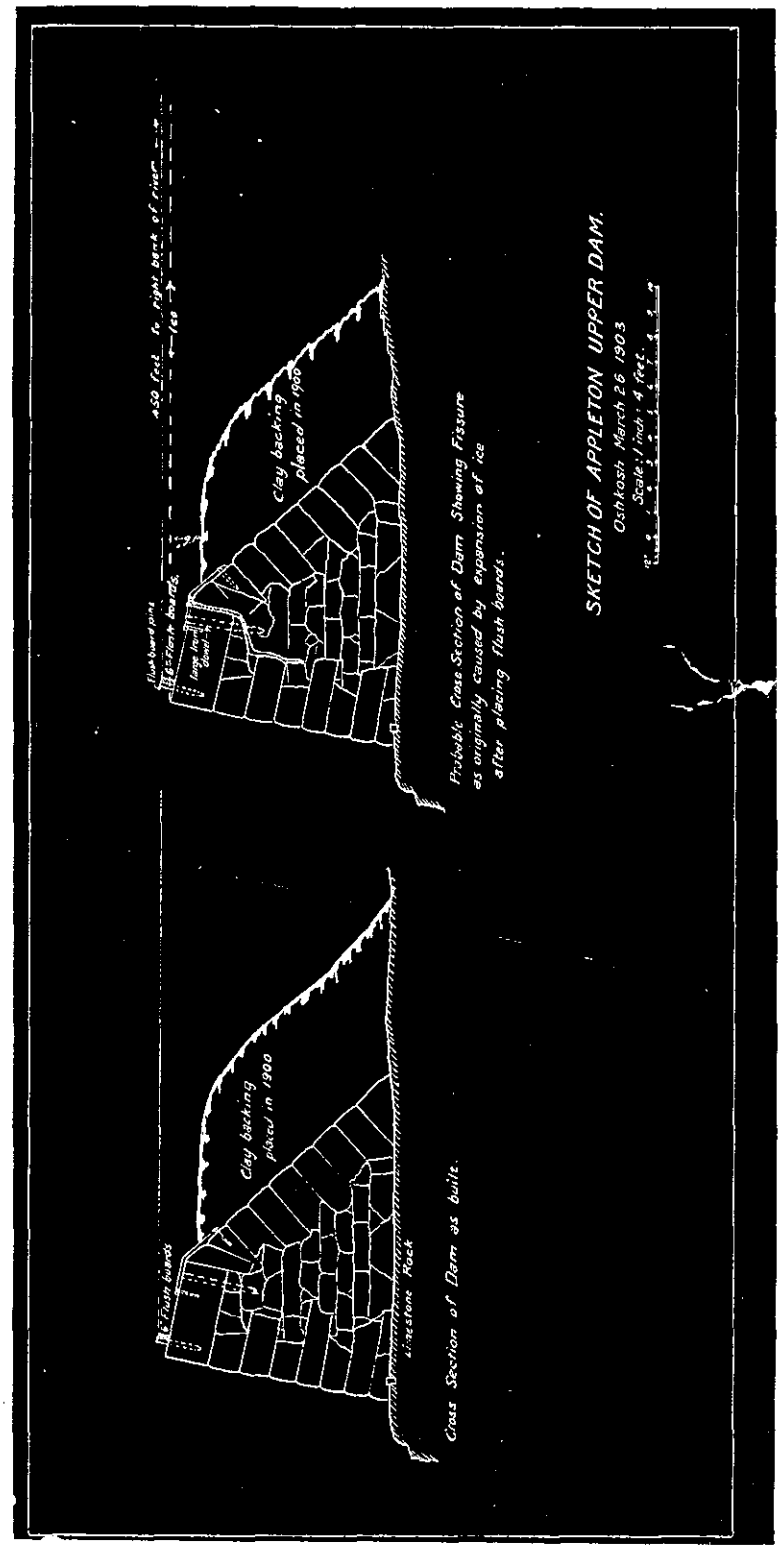
Photocopy of blueprint of Proposed Reconstruction of Appleton Upper Dam, General Plan & Typical Sections, File #4-N-12.7, sheet 2.



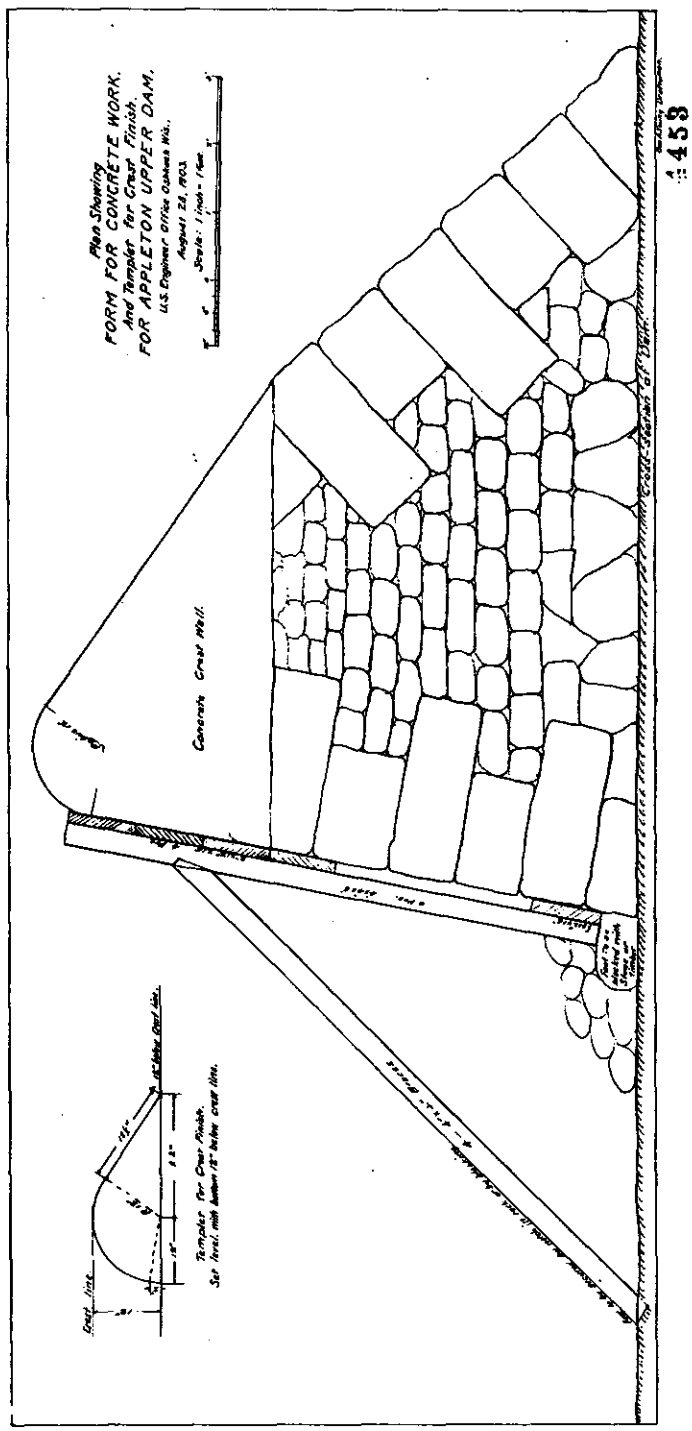
Photocopy of blueprint of Proposed Reconstruction of Appleton Upper Dam, Spillway Plan & Typical Sections, File #4-N-12.8, sheet 3.



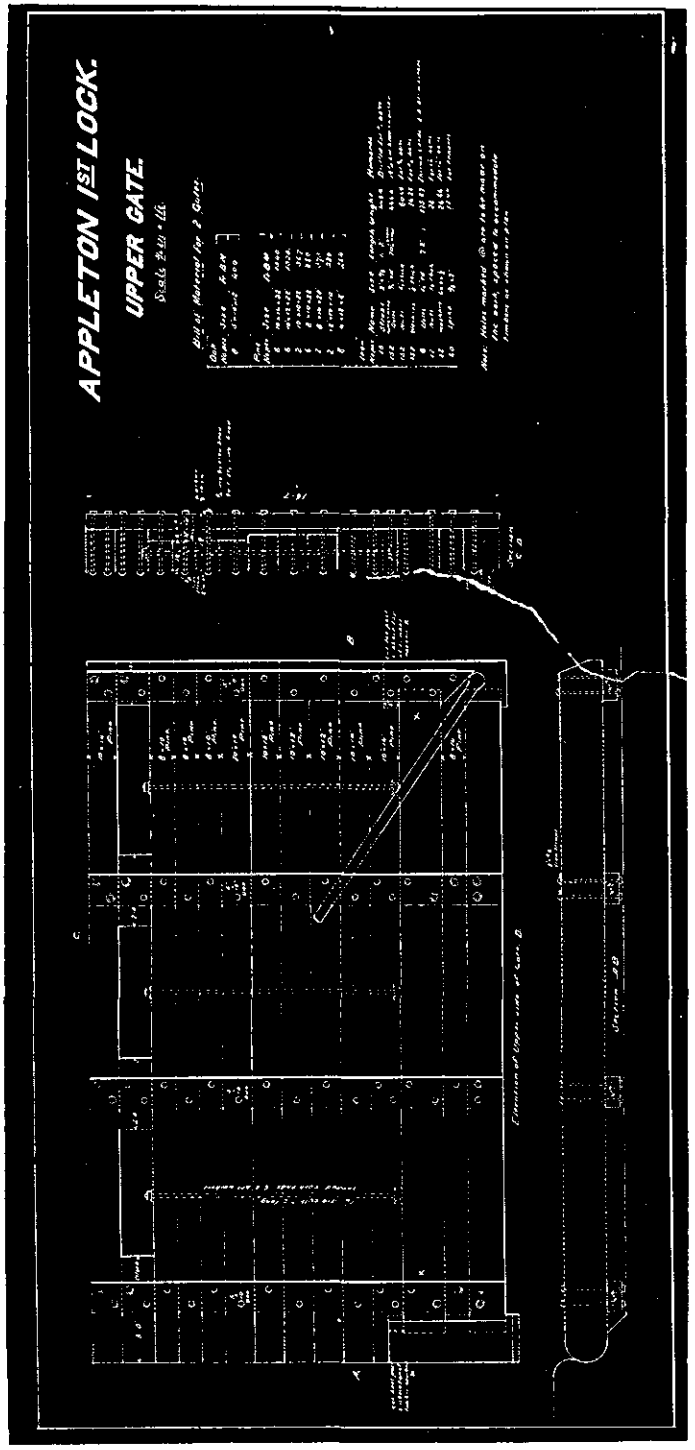
Photocopy of blueprint of Proposed Reconstruction of Appleton Upper Dam, Sluiceway Plan & Typical Sections, File #4-N-12.8, sheet 4.



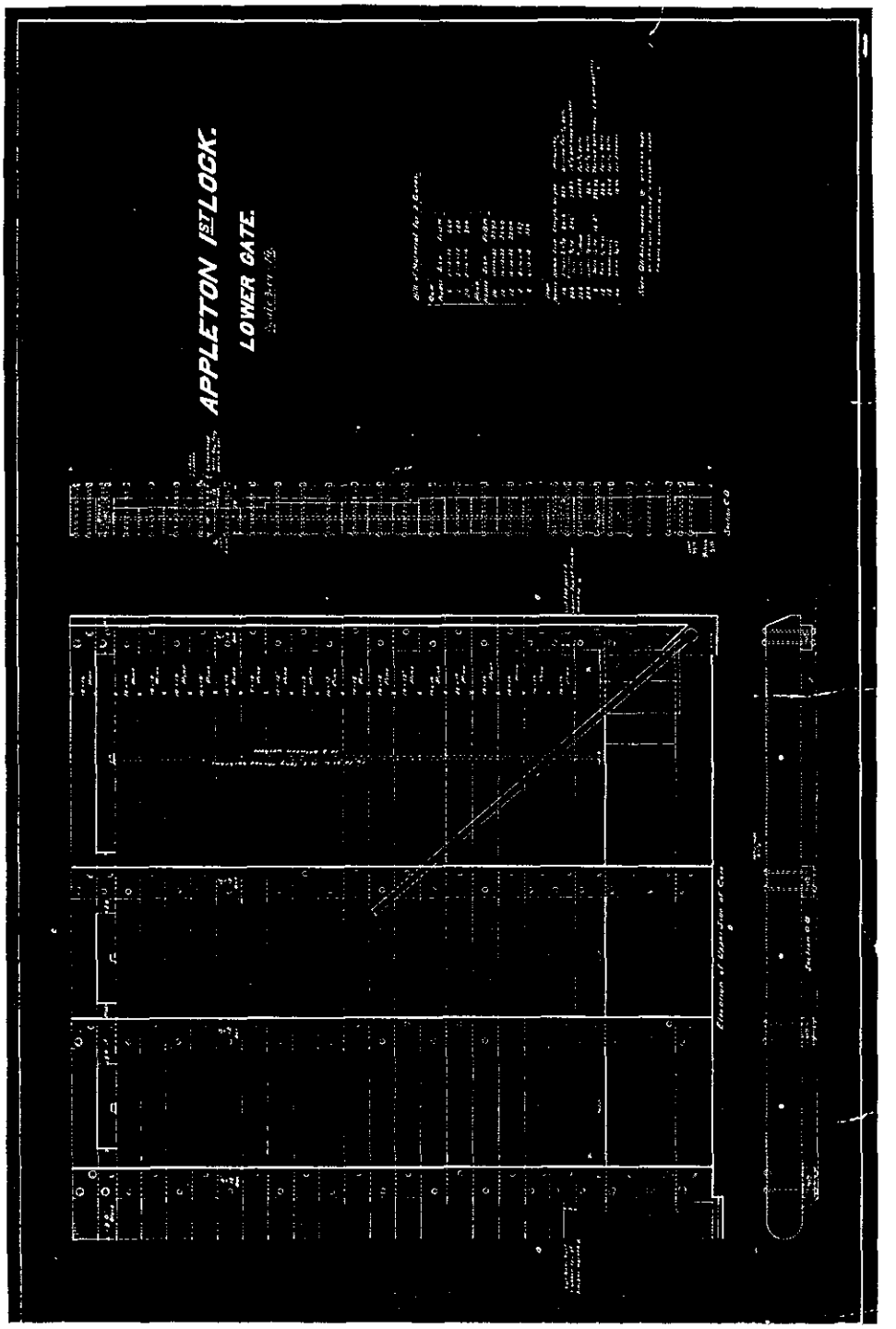
Photocopy of sketch of Appleton Upper Dam, 26 Mar 1903.



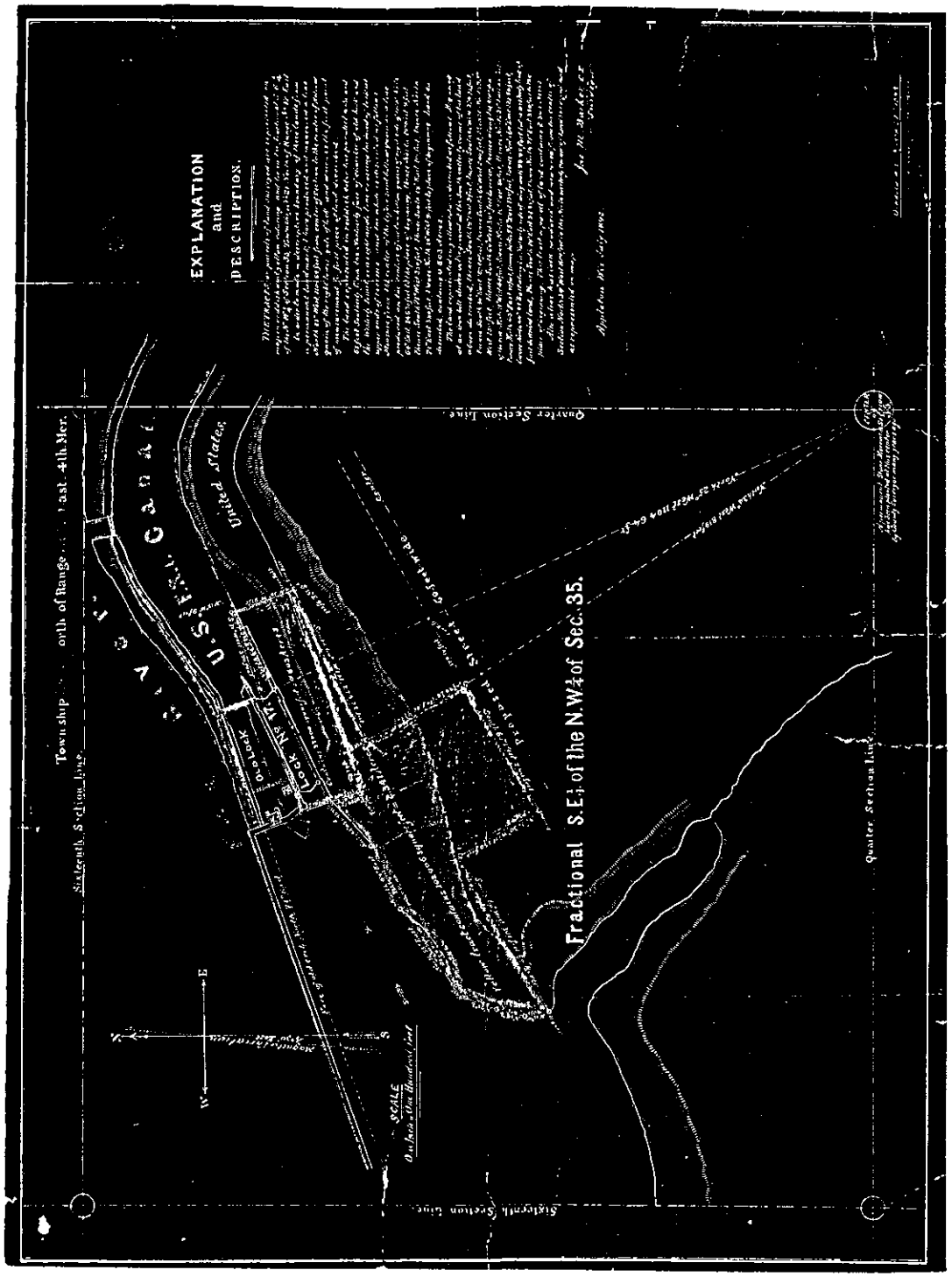
Photocopy of Plan Showing Form for Concrete Work for Appleton Upper Dam, File #4453.



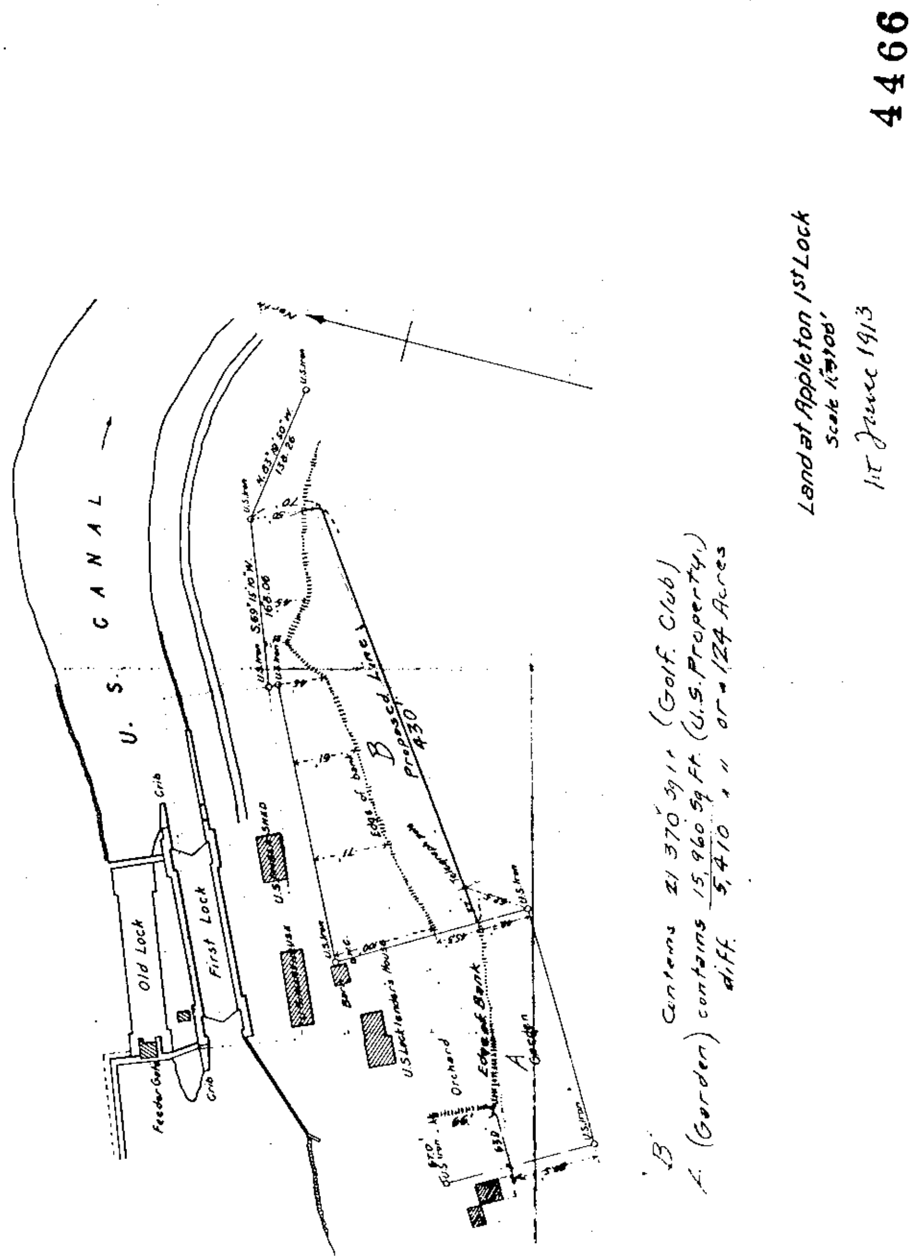
Photocopy of blueprint of Plan of Appleton 1st Lock, Upper Gate.



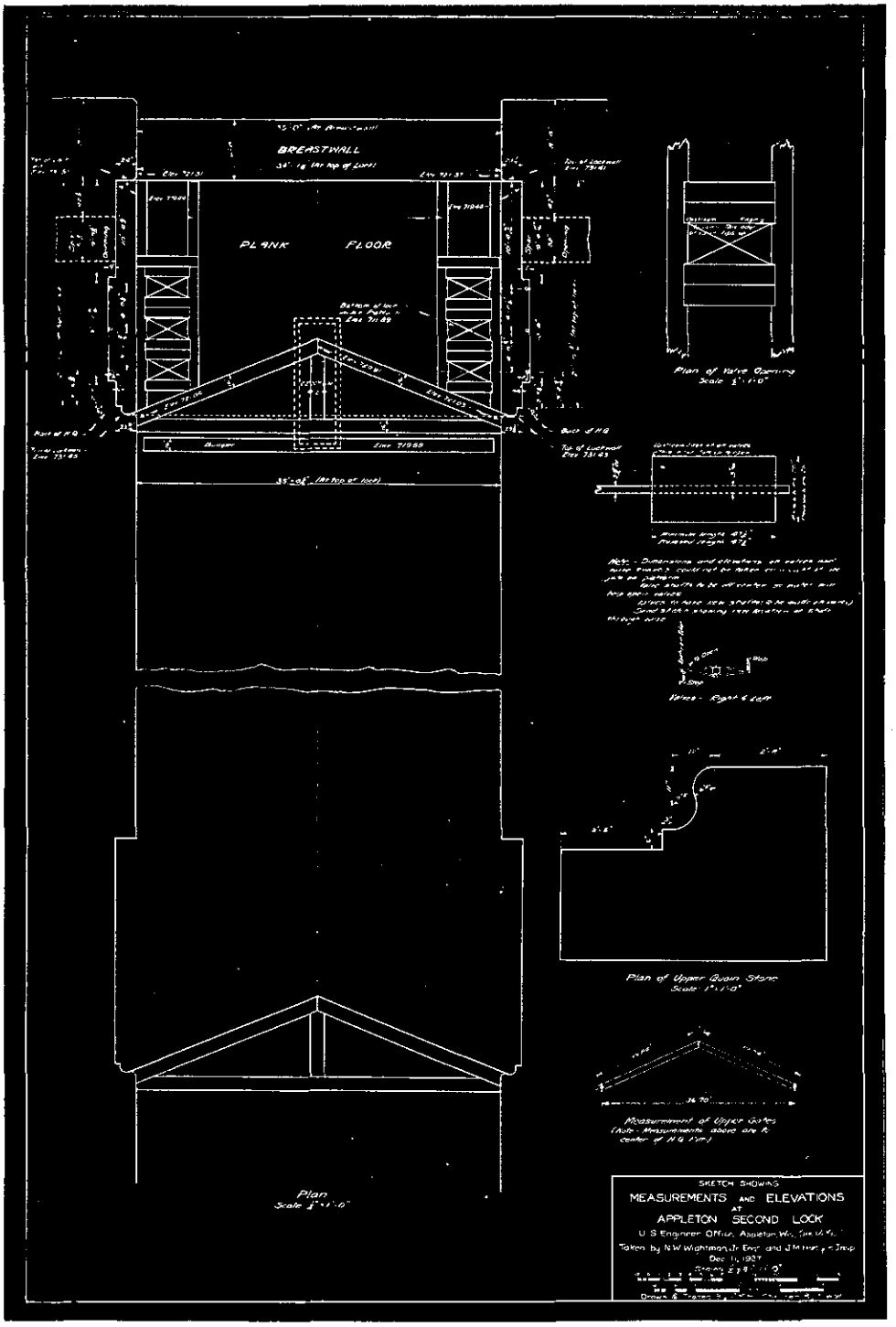
Photocopy of blueprint of Plan of Appleton 1st Lock, Lower Gate.



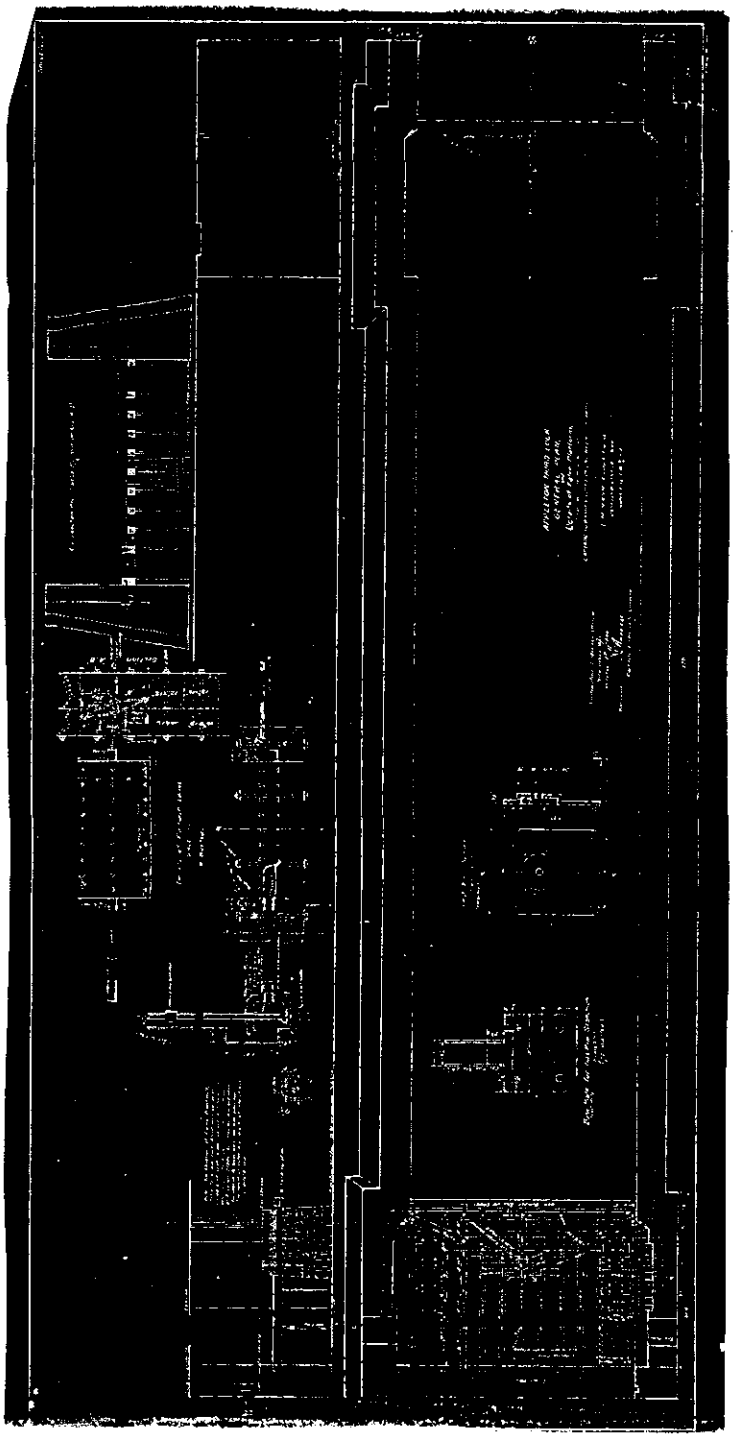
Photocopy of 1893 sketch of Appleton 1st Lock.



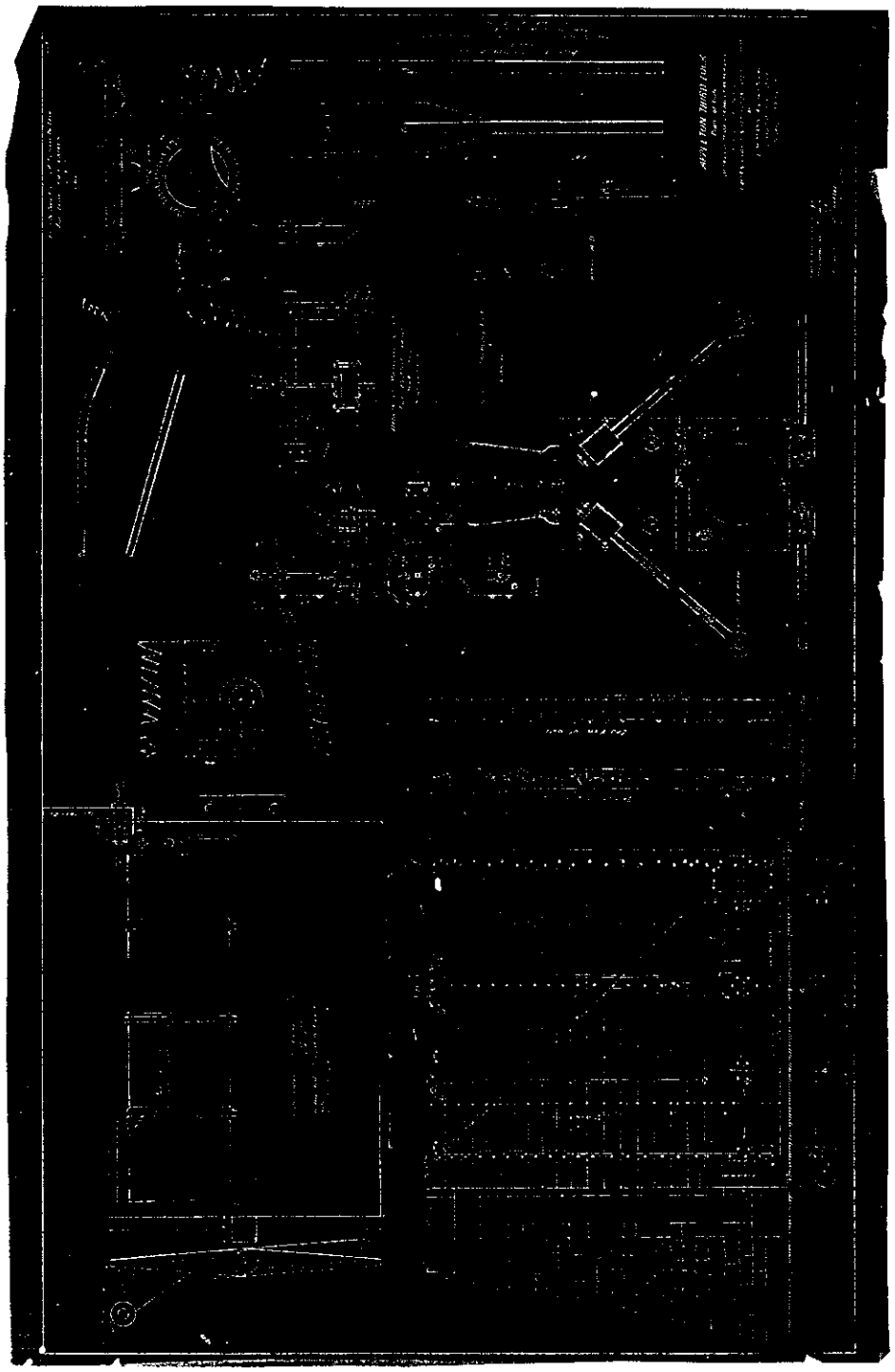
Photocopy of June 1913 sketch of Land at Appleton 1st Lock, File #4466.



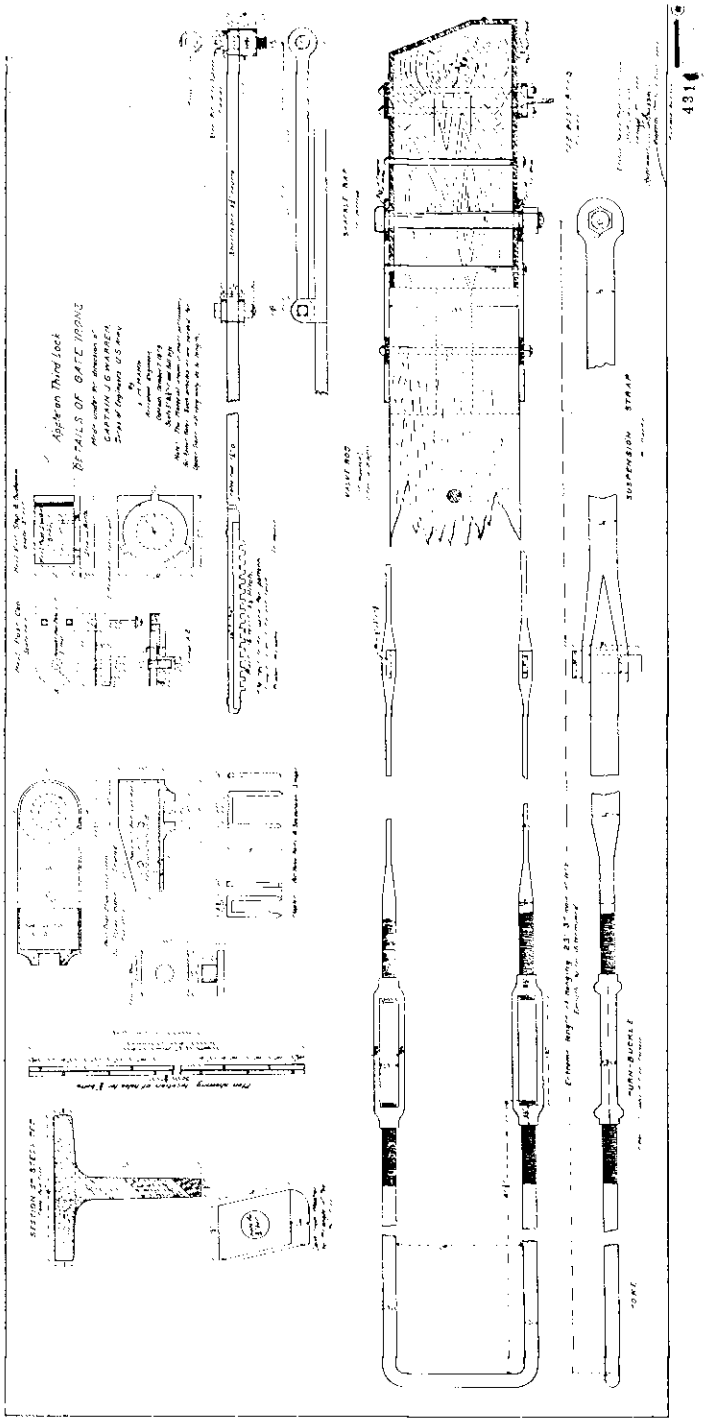
Photocopy of sketch Showing Measurements and Elevations at Appleton Second Lock, 1927.



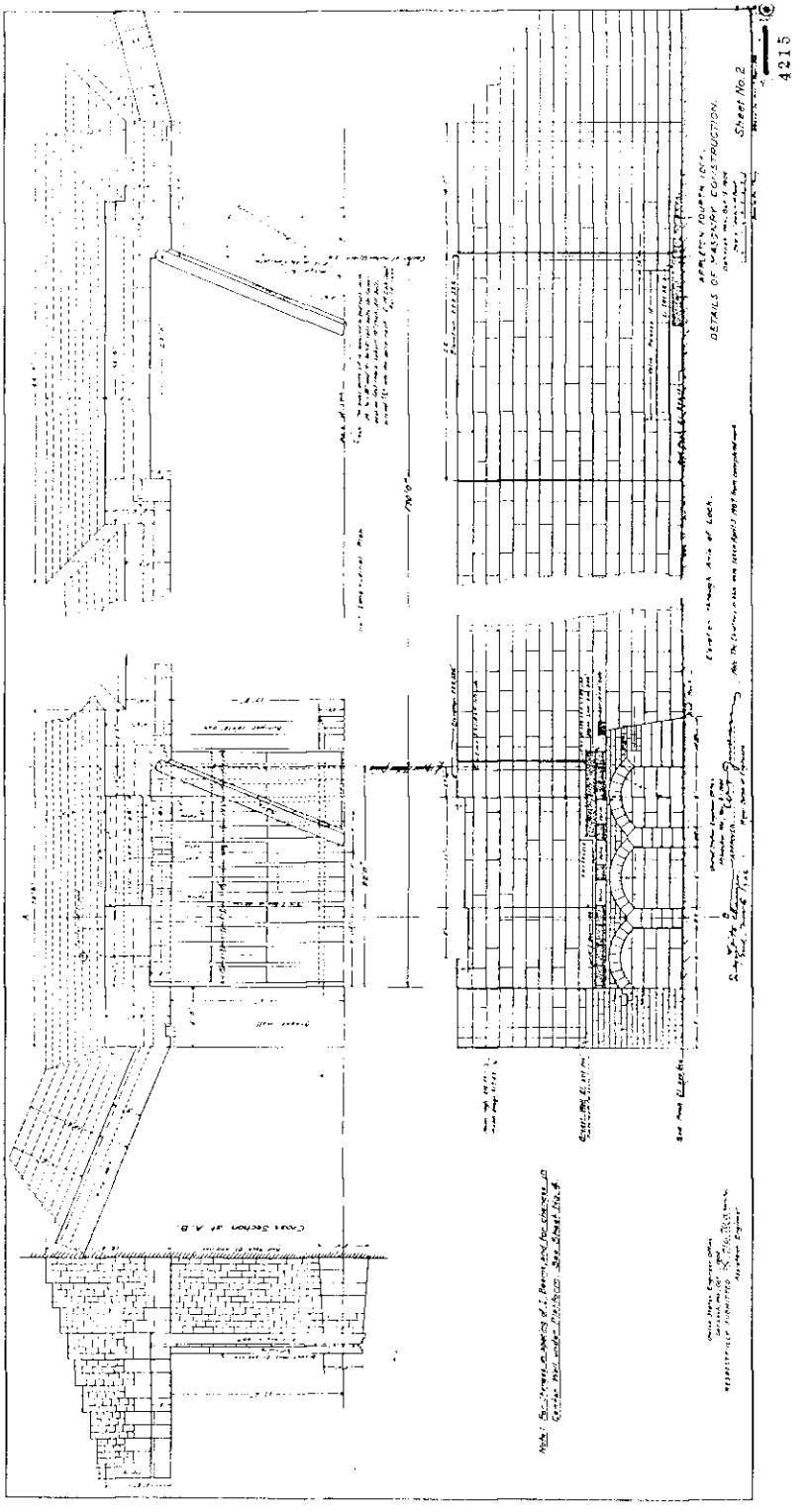
Photocopy of blueprint of Appleton Third Lock, General Plan, File #4315.



Photocopy of blueprint of Appleton Third Lock, Plan of Gate, File #4317.



Photocopy of plan of Appleton Third Lock, Details of Gate Irons, File #4316.



Photocopy of plan of Appleton Fourth Lock, Details of Masonry Construction, File #4215.

Appleton Locks and Dams, Lockkeeper's Residence at Lock 1
100 feet south of Lock 1
Appleton
Outagamie County
Wisconsin

HAER No. WI-84-A

HAER
WIS
44-APPL,
1A-

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

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