Kaukauna Locks and Dam
Between Lawe and Canal Street to the west
and Augustine Street to the east
on the Lower Fox River
Kaukauna
Outagamie County
Wisconsin

HAER No. WI-87

HAER
WIS
44-KAUK,
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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

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HISTORIC AMERICAN ENGINEERING RECORD

KAUKAUNA LOCKS AND DAM

HAER NO. WI-87

Location: The Kaukauna Locks and Dam Complex is situated on the Lower Fox River in the City of Kaukauna near Lawe and Canal Streets to the west and Augustine Street to the east. The complex is located in French lots PC 1, PC 33, PC 34, PC 35, and Section 22, T21N, R18E and T21N, R19E, Civil Towns of Buchanan and Vandenbroek, Outagamie County, Wisconsin.

UTM:
North end of dam 16/398670/4903720; South end of dam 16/398500/4903620;
Lock 1 16/399260/4903800; Lock 2 16/399610/4903820;
Lock 3 16/399820/490390; Lock 4 16/400060/4904040;
Lock 5 16/400560/4904260
USGS Quadrangle: Kaukauna, Wisconsin 7.5' series

Date of Construction: 1851 – 1941

Engineer: United States Army Corps of Engineers with Contractors

Architect: United States Army Corps of Engineers with Contractors

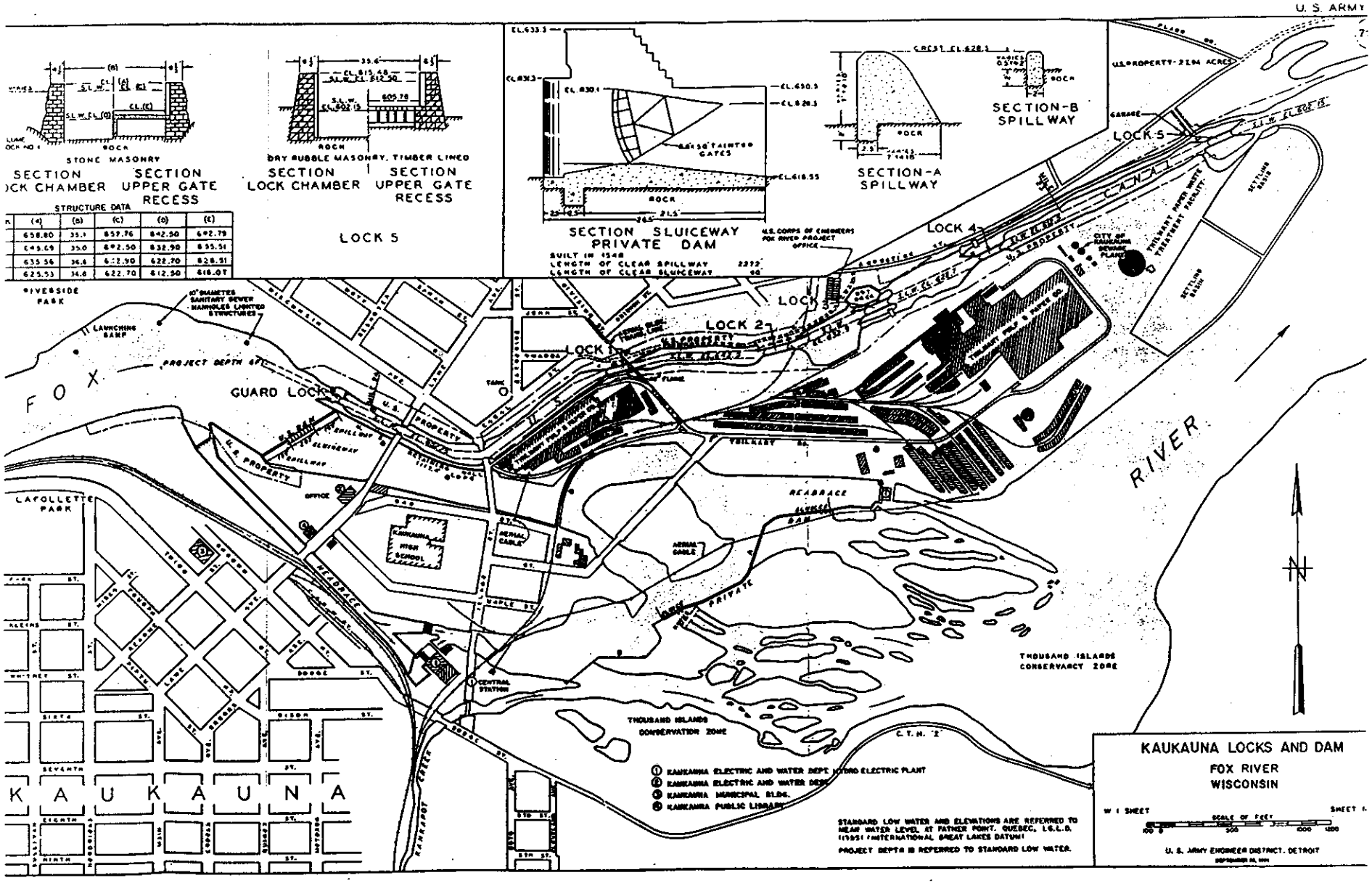
Present Owner: United States Army Corps of Engineers

Present Use: The Kaukauna locks are currently not in use; the Kaukauna dam remains operational. The office and storage facilities at Kaukauna Lock 3 serve as the USACOE Fox River Project Office.

Significance: The Kaukauna Locks and Dam Complex provides passage around drop in elevation of 50 feet in the Lower Fox River at Kaukauna. The complex served as an integral part of the Lower Fox River Waterway System.

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.



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KAUKAUNA LOCKS AND DAM

General Description

The Kaukauna Locks and Dam Complex provides a navigable stretch of water between the 23.6 mile marker and the 27.8 mile marker on the Lower Fox River in the City of Kaukauna. The present complex consists of five locks, a guard lock, a dry dock, a dam, a canal, a lockkeeper's residence, a boathouse, a stable, an office building, five lock shelters, eight storage buildings, and a sanitary building.

History

In 1848, The Board of Public Works of the State of Wisconsin appointed engineer Condy R. Alton to survey and assess the condition of the dams on the Fox River and suggest navigational improvements to other areas of the river.[1] Following the survey, Alton noted 1 1/2 miles of rapids at Kaukauna, where he recommended the construction of a 1.5 mile long canal containing five locks, two with a 10 foot lift, two with a 9 foot lift, and one with an 11 foot lift.[2] In addition, Alton recommended construction of a 660 foot long, 6 foot high dam.[3]

Nothing was done about Alton's recommendations for making the Fox River more easily navigable at Kaukauna until 1851, when the Board of Public Works contracted with Morgan Martin to build the required facilities at Kaukauna.[4] Plans called for the locks to be built of stone and timber; dimensions were specified as 160 feet long and 5 feet deep in order to handle the larger ships which were being constructed at the time.[5] The contract called for the construction to be completed within two years of May 1851.[6]

However, by April of 1853, the Kaukauna complex was still incomplete. As a result, the State of Wisconsin instituted an investigation into the construction status of the dams and locks on the Fox River. The investigation committee was formed in April, began inspection of the facilities in May, and completed a report in June of 1853.[7] In the report, the investigators noted that construction was not complete at Kaukauna, and it would cost about $65,000 to finish.[8]

By this time, the State of Wisconsin funds for the construction of the canal system along the Fox River were exhausted. Accordingly, a private venture named the Fox River Improvement Company was formed in order to complete the construction.[9] In October of that year, the new company received a land grant, and work was resumed at Kaukauna.[10] By May of 1854, the Kaukauna facilities were operational and steamships were making daily trips from Green Bay to Kaukauna.[11]

In 1856, the steamship Aquila, became the first commercial vessel to successfully navigate the passage of the Wisconsin and Fox Rivers from the Mississippi River to Green Bay.[12] Although Aquila completed the journey, the steamer ran into trouble several times due to low water. As a result, the Fox and Wisconsin Improvement Company determined that the locks and canals should be enlarged in order to accommodate vessels with drafts of up to 4 feet.[13]

Various financial difficulties prevented timely construction and repairs of the facilities along the Fox River in the years prior to the 1880s. For example, the financial Panic of 1857 all but ended lock and dam construction along the Fox River. The sole exception was the facilities at Little Kaukauna which remained under construction.[14] Finally, in 1866, the Fox River Improvement Company went bankrupt and sold its assets to a group of east coast investors who reorganized and formed the Green Bay and Mississippi Canal Company.[15]

The new company appointed Major Charles Sutter to conduct a new survey in order to identify the major trouble spots along the waterway. From September 30 to October 16, 1866, Sutter surveyed the Lower Fox River, including Kaukauna. At Kaukauna, Major Sutter found a 7,400 foot canal with two passing basins which contained a total of five locks. Sutter reported the Kaukauna dam to be 583 feet long and 6 feet high.[16]

The federal government assumed control of the locks and dams on the Wisconsin and Fox Rivers in 1872.[17] Subsequently, an additional survey was conducted by an Officer Edwards. Edwards recommended that the dam at Kaukauna be rebuilt of stone. Officer Edwards also stated that, although all five of the locks at Kaukauna had received some repairs since 1866, all needed additional work.[18]

In accordance with Officer Edwards' recommendations, Kaukauna Locks 3 and 4 were reconstructed as permanent structures built of quarried stone blocks. This work was completed by 1880.[19] Kaukauna Lock 1 was similarly rebuilt in 1882.[20] Kaukauna Lock 2 was not rebuilt until 1903.[21] Kaukauna Lock 5 was never rebuilt, although the lock received substantial repairs throughout its working life. Finally, the dam at Kaukauna was rebuilt of concrete in 1932.[22]

Thus by 1932, the Kaukauna facilities were complete in their present configuration. The only changes made since include refurbishing and routine maintenance.[23]

KAUKAUNA DAM

The dam at Kaukauna is located immediately south of the guard lock and is oriented along a general NE/SW axis. The dam consists of a north and south spillway separated by a sluiceway; all three sections are anchored to bedrock. Each spillway consists of four 47 foot 6 inch sections, divided by 3 foot wide walk piers, comprising a total spillway section length of 199 feet each. The sluiceway is made up of eight 20 foot sluice gates and nine 5 foot sluice piers, one on either side of each sluice gate. The total length of the sluiceway is 205 feet. The total length of the dam is thus 603 feet.[24] The Kaukauna dam has not changed structurally since it was rebuilt of concrete in 1932.[25] Approximate pool elevation at crest is 660.46 feet above sea level. Standard low water upper pool elevation is 654.46.[26] Due to unique engineering challenges posed by the Fox River, each section of the Kaukauna dam differs slightly in design and construction. Consequently, each section will be described separately.

North Spillway

The north spillway is 199 feet in length and is defined by that portion of the dam between the abutment at the northernmost end of the dam and the northernmost sluice pier. This section of the spillway consists of four 47 foot 6 inch spillway sections divided by three 3 foot wide walk piers.[27]

The northern end of the north spillway is connected to a concrete abutment. The abutment is on a general east/west axis, and consists of three 20 foot long sections. The western and center sections of the abutment are approximately 12 feet thick, while the eastern section is about 4 feet thick. The center section is further supported by a perpendicular buttress extending 8 feet to the north. The top of the abutment maintains an elevation of 659.96 feet above sea level. To the west of the abutment, the bank is paved with stone to an elevation of 660.5 feet above sea level.[28]

The north spillway is comprised of 12 poured concrete construction sections. Each construction section is 16 feet 3 inches wide, except the one nearest the abutment, which is 20 feet 3 inches

wide. A 4 foot wide concrete key, a minimum of 2 feet deep, extends the entire length of the dam and serves to anchor the dam to the bedrock at the river bottom.[29]

Aside from their differing widths, each construction section of the north 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 26 feet. The upstream face of the north spillway is beveled at a 12V:5H pitch to reach a crest elevation of 654.46 feet above sea level, 7 horizontal feet from the most upstream point of the dam. The downstream face is beveled at a 11V:12H pitch from the crest elevation to an elevation of 643.96 above sea level at the most downstream edge of the dam. The downstream face thus extends a horizontal distance of 18 feet 10 inches.[30]

When measured from the rock bottom of the Fox River, each construction section of the north spillway is approximately 14 feet high at the crest line. The crest line is the highest point of each spillway section, maintaining an elevation of 654.46 feet above sea level. By comparison, the downstream "toe" of the spillway rises about 3 feet 6 inches above the elevation of the river bottom, maintaining an elevation of 643.96 feet above sea level.[31]

Detailed construction plans of the Kaukauna dam north spillway sections are not available at the Fox River Project Office at Kaukauna. However, based on the many similarities with other dams along the Fox River, a general description of spillway section construction can be compiled for the Kaukauna dam. The spillway construction sections are generally secured together by a concrete mortise and tenon joint running the full height of each spillway section. A slightly beveled tenon is secured into a shallow mortise in the adjoining construction section. The seams between the spillway sections are filled by construction or expansion joints, with soft copper sheets running the entire height of the section at each expansion joint.

Beginning at the abutment on the north end of the dam, the third, sixth, and ninth spillway construction sections support concrete piers on their southern ends. These piers provide a base for a metal walkway running the length of the spillway. The spillway piers are bullet shaped, with the parabolic end pointing upstream.[32]

In profile, the walk piers are somewhat rectangular, with concave bottoms conforming to the curved upper surfaces of the spillway construction sections. The piers were designed to reach a maximum elevation of 660.46 feet above sea level. Thus, although the sides of the piers average 6 feet in height, the difference in elevation from the base of the pier varies. Measured from the point of contact with the spillway construction section, the difference in elevation at the upstream end of the walkway piers is 6 feet, while the difference in elevation at the downstream end is 8 feet. On the downstream end of the piers there are two 12 inch risers which carry the elevation from 660.46 to 658.46 feet above sea level.[33]

A walkway spans the entire length of the spillway from the dam abutment to the first pier section of the sluiceway. Detailed construction plans of this spillway walkway are not available at the Fox River Project Office at Kaukauna. However, an engineering drawing titled "Dam Plans, File Number 4-N-8.8, Sheet 1," contains the following information on the spillway walkway. Each side of the walkway is comprised of channel beams bolted onto the walkway pier sections 3 feet 5 1/4 inches apart so that the channels of opposite beams face one another. The interior space between the channel beams is spanned by 1 beams that are bolted to the channel beams.[34] These 1 beams serve as support ribs along the entire length of the walkway.

Four foot sections of angle iron are bolted to the exterior of the channel beams to serve as uprights for a handrail. On each side of the north spillway walkway, lengths of wire rope have been threaded through holes on the uprights to form a railing.[35]

The decking of the spillway walkway is made up of sections of 12 inch wide wooden planking, laid three across in such a way as to span the distance between the channel beams.[36]

South Spillway

The south spillway is 199 feet in length and is defined by that portion of the dam between the abutment at the southernmost end of the dam and the southernmost sluice pier. This section of the spillway consists of four 47 foot 6 inch spillway sections divided by three 3 foot wide walk piers.[37]

The southern end of the south spillway is connected to a concrete abutment. The abutment consists of two sections; (1) a 40 foot long concrete construction section aligned perpendicular to the dam; (2) a downstream end that is 20 feet long and oriented on a general east/west axis. The upstream section of the abutment is approximately 12 feet 6 inches thick, while the main section is 12 feet 6 inches thick on the upstream end and 8 feet thick on the downstream end. The main section is further strengthened by a buttressing construction aligned perpendicular to the spillway that extends 8 feet bankward. Four 12 inch risers on top of the abutment increase the elevation at the top from 656.46 on the downstream end to 660.46 on the upstream end.[38]

The south spillway is comprised of 12 poured concrete construction sections. Each construction section is 16 feet 3 inches wide, except the one nearest the abutment, which is 20 feet 3 inches wide. A 4 foot wide concrete key, a minimum of 2 feet deep, extends the entire length of the dam and serves to anchor the dam to the bedrock at the river bottom.[39]

Aside from their differing widths, each construction section of the south 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 26 feet. The upstream face of the north spillway is beveled at a 12V:5H pitch to reach a crest elevation of 654.46 feet above sea level, 7 horizontal feet from the most upstream point of the dam. The downstream face is beveled at a 11V:12H pitch from the crest elevation to an elevation of 643.96 above sea level at the most downstream edge of the dam. The downstream face thus extends a horizontal distance of 18 feet 10 inches.[40]

When measured from the rock bottom of the Fox River, each construction section of the south spillway is approximately 14 feet high at the crest line. The crest line is the highest point of each spillway section, maintaining an elevation of 654.46 feet above sea level. By comparison, the downstream "toe" of the spillway rises about 3 feet 6 inches above the elevation of the river bottom, maintaining an elevation of 643.96 feet above sea level.[41]

Detailed construction plans of the Kaukauna dam south spillway sections are not available at the Fox River Project Office at Kaukauna. However, based on the many similarities with other dams along the Fox River, a general description of spillway section construction can be compiled for the Kaukauna dam. The spillway construction sections are generally secured together by a concrete mortise and tenon joint running the full height of each spillway section. A slightly beveled tenon is secured into a shallow mortise in the adjoining construction section. The seams between the spillway sections are filled by construction or expansion joints, with soft copper sheets running the entire height of the section at each expansion joint.

Beginning at the abutment on the south end of the dam, the third, sixth, and ninth spillway construction sections support concrete piers on their northern ends. These piers serve as a base for a metal walkway running the length of the spillway. The spillway piers are bullet shaped, with the parabolic end pointing upstream.[42]

In profile, the walk piers are somewhat rectangular, with concave bottoms conforming to the curved upper surfaces of the spillway construction sections. The piers were designed to reach a maximum elevation of 660.46 feet above sea level. Thus, although the sides of the piers average 6 feet in height, the difference in elevation from the base of the pier varies. Measured from the point of contact with the spillway construction section, the difference in elevation at the upstream end of the walkway piers is 6 feet, while the difference in elevation at the downstream end is 8 feet. On the downstream end of the piers there are two 12 inch risers which carry the elevation from 660.46 to 658.46 feet above sea level.[43]

A walkway spans the entire length of the spillway from the dam abutment to the first pier section of the sluiceway. Detailed construction plans of this spillway walkway are not available at the Fox River Project Office at Kaukauna. However, an engineering drawing titled "Dam Plans, File Number 4-N-8.8, Sheet 1," contains the following information on the spillway walkway. Each side of the walkway is comprised of channel beams bolted onto the walkway pier sections 3 feet 5 1/4 inches apart so that the channels of opposite beams face one another. The interior space between the channel beams is spanned by I beams that are bolted to the channel beams.[44] These I beams serve as support ribs along the entire length of the walkway.

Four foot sections of angle iron are bolted to the exterior of the channel beams to serve as uprights for a handrail. On each side of the south spillway walkway, lengths of wire rope are threaded through holes on the uprights to form a railing.[45]

The decking of the spillway walkway is made up of sections of 12 inch wide planking, laid three across in order to cover the span between the channel beams.[46]

Sluiceway

The sluiceway section of the Kaukauna dam is located in the center of the dam, between the two spillways. The overall length of the sluiceway is 205 feet. The sluiceway includes nine poured concrete construction sections. Each sluiceway construction section is anchored to the bedrock of the river bottom by four rows of steel split bolts spanning the width of the section. The first row of bolts is located 5 feet 9 inches from the upstream edge of each section and consists of sections of 4 foot 6 inch long, 1 1/2 inch diameter bolts, spaced 4 feet center to center. The second and third rows consist of 4 foot sections of 1 inch diameter split bolts, spaced 4 feet apart. The second row is 5 feet downstream from the first, and the third is 6 feet 9 inches downstream from the second. The fourth row, which is 6 feet 9 inches downstream from the third row, consists of 3 foot 6 inch lengths of 1 inch diameter split bolts, also spaced 4 feet center to center. All of the split bolts are grouted 18 inches into the bedrock of the river bottom. The spillway construction sections are also held to the bottom by a 4 foot wide concrete key, poured into a trench cut to a minimum depth of 2 feet into the bedrock. The key extends the entire length of the spillway. Additional reinforcement is provided by 4 foot 6 inch long upright sections of rebar which are spaced at 18 inch intervals in two rows 2 feet apart the entire length of the key.[47]

The construction sections of the sluiceway conform to the specifications of a generalized construction section plan. The sections at opposite ends of the sluiceway are 20 feet wide; the remaining construction sections extend to a width of 25 feet. Measured parallel to the river channel, each section has a basal length of 28 feet.[48]

The sluiceway construction sections of the Kaukauna Dam are somewhat ramp-shaped in profile. From an upstream height of 3 feet 8 inches above the average elevation of the river bottom, the sluiceway sections slope up to reach a maximum 5 foot 2 inch height (646.46 feet above sea level) at a horizontal distance of 4 feet from the upstream end. The maximum height is maintained for a horizontal distance of 8 feet, at which point the section begins to slope gently downstream to a

reduced height of 2 feet 2 inches above the average elevation of the river. At this point the sea level elevation of the downstream end is 643.46 feet above sea level.[49]

The sluiceway construction sections are secured together by lengths of 1 inch diameter rebar extending the basal length of the section and spaced at 15 inch intervals. Additional lengths of 3/8 inch diameter rebar bridge the width of the section, spaced at 2 foot intervals. The seams between sluiceway construction sections are filled by construction joints.[50]

The sluiceway construction sections of the Kaukauna 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 northern and southern sections.[51] Eight sluiceway openings are created by the placement of the pier sections.

The sluiceway piers are 28 feet in length and 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 16 foot 8 inch long section of 4 by 4 by 3/8 inch angle iron secured onto the pier with 3/4 inch by 18 inch steel bolts. Sluiceway pier heads measure 4 feet 4 inches from the parabolic tip of the upstream end to the downstream edge. Immediately to the rear of the pier heads is a "stop log" slot which runs the entire height of the pier section. The stop log slots are 6 inches deep and 13 inches wide and are located on pier faces interior of sluiceway openings. The downstream corners of the stop log slots are armored with 16 foot 8 inch long sections of 4 by 4 by 3/8 inch angle iron secured to the pier face with 3/4 inch by 18 inch steel bolts.[52]

The sluiceway piers are tied to the sluiceway construction sections by two rectangular concrete keys and sections of rebar. Both concrete keys extend 6 inches from the top of the sluiceway sections into the bottom of the pier sections. The first key, located on top of the horizontal section of the sluiceway construction section, is 6 feet in length and 2 feet in width. It is secured to the sluiceway construction section with two rows of 3/4 inch diameter by 3 foot 6 inch sections of rebar spaced at 1 foot 10 inch intervals along the length of the key. The second key, located on top of the slanted downstream section of the sluiceway construction section, extends 10 feet in length and 2 feet in width. It is secured to the sluiceway construction section with two rows of 3/4 inch diameter by 2 foot 6 inch rebar spaced at 1 foot 10 inch intervals along the length of the key. In addition to the concrete keys, each sluiceway pier is tied to the constructions sections with forty - 4 foot 6 inch long sections of 7/8 inch diameter rebar. The rebar sections are spaced 18 inches center to center, 4 inches inside the outer dimensions of the pier.[53]

In profile, the sluiceway piers are rectangular, with concave bottoms conforming to the curved surfaces of the sluiceway construction sections. The upstream portion is stepped up by four 16 inch risers above the rest of the pier section. The tops of the upstream portion of the piers reach an elevation of 663.13 feet above sea level, while the downstream portions maintain an elevation of 657.79 feet above sea level. The upstream ends of the sluiceway piers are 18 feet 2 inches from the tops of the sluiceway construction sections and the downstream ends are 13 feet 8 inches from the surface of the sections.[54]

Fourteen foot high steel taintor gates are located within each of the sluiceway openings. 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 44° 21 foot 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 6 foot 1/2 inch sections of 3 by 3 by 3/8 inch angle iron.[55]

The fronts of the sluiceway gates are faced with 8 inch I beams. Seams between the plates are secured by strips of 1/2 inch steel plate which run the entire height of the taintor gate. A 20 foot long 8 inch by 8 inch oak beam is bolted to the channel iron running along the foot of the gate in order to provide a sill for the gate.[56]

The sluiceway gates of the Kaukauna 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.[57] 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 gauge track mounted along the downstream length of the sluiceway.[58]

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.[59] 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.[60] 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.[61]

When not in use, the crab mechanism is housed in a wooden structure built over the span between the fourth and fifth sluiceway piers from the southern end.[62] The gate hoist house is built on top of two 22 foot 4 inch horizontal timbers spanning the space between the sluiceway piers. Along the upstream side of the gate hoist house, a 4 inch 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 inch 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 inch by 4 inch wall studs are fastened directly to the sill plate. Between these beams, 2 inch by 4 inch studs have been spaced 2 feet apart, center to center.[63] On top of the 4 inch by 4 inch wall studs, two 2 inch by 4 inch beams have been strung to form the top plate.

A 2 foot 8 inch personnel door is located on the northern end of the crab house. A set of double doors on the northern end 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.[64]

A walkway spans the entire length of the sluiceway. Detailed construction plans of this feature are not available at the Fox River Project Office at Kaukauna. However, general information was abstracted from Dam Plans, File Number 4-N-8.8, Sheet 2. The following information on the sluiceway walkway was compiled from reference to these plans augmented by field observation.

The walkway is constructed in two levels, with the upstream level approximately 6 inches higher than the downstream level. The upper level consists of two rows of sections of channel iron bolted end to end onto the sluiceway pier sections. The channel iron is spaced 2 feet 8 inches apart so that

the channels of opposite beams face one another. The interior space between the channel beams is spanned by lengths of I beams bolted to the channel beams as support ribs along the entire length of the walkway. On the exterior of the channel beams on the upstream side of the walkway, sections of angle iron are bolted to the channel beams to serve as handrail uprights. The handrail is 1/2 inch diameter wire rope. The decking of the upstream portion of the sluiceway walkway is constructed of 25 foot sections of 3 inch by 12 inch wooden planking laid two across, with a 1-inch gap, to cover the span between channel beams. The planking is nailed onto 2 foot 4 inch sections of 4 inch by 4 inch beams bolted to the tops of the horizontal I beam sections spanning the interior space between the channel beams.[65]

The lower portion of the walkway is 2 feet 4 inches wide, flush against the upper section, and consists of 2 foot 3 inch sections of 4 inch by 4 inch beams which are attached to the sluiceway pier sections. The decking of the lower spillway walkway is make up of 25 foot sections of 3 inch by 12 inch planking laid two across, a 1-inch gap, to cover the width of the walkway. The planking is nailed onto the sections of 4 inch by 4 inch beams. The planking and the 4 inch by 4 inch beams of the lower sluiceway walkway are removable.[66]

KAUKAUNA CANAL

The Kaukauna Canal is approximately 7,000 feet long and is oriented along a WSW/ENE alignment. The canal incorporates the five Kaukauna locks and does not exceed a depth of 6 feet at any point along its length. The canal has been dredged periodically throughout its history. The width of the canal varies between 100 and 250 feet, thereby allowing vessels to pass one another at the wider points.[67] Three small, concrete-lined waste weirs are located along the canal, to the north of Lock #4 and to the south of Locks #3 and #5. These weirs are designed to carry water discharged from an upstream lock around the locks that are immediately below it.

KAUKAUNA GUARD LOCK

In 1891 a guard lock was constructed at the entrance to the U.S. Canal at Kaukauna. The guard lock can also be used to close a canal off during winter, thus facilitating the canal's drainage. Gate valves are used to reflood the canal in the spring. However, since the Kaukauna lock is inoperable, the canal is closed off at Kaukauna Lock 1. Improvements occurred in 1924 when the lock walls were raised, and in 1951 when new timber gates were installed. Since no plans are available, the following information on the Kaukauna guard lock is derived from the National Register of Historic Places registration form for the Kaukauna Locks Historic District.[68]

Oriented on a WNW/ESE axis, the guard lock consists of two quarried limestone abutments and two mitre gates. The lock opening is approximately 40 feet wide; the stone abutments are 50 feet long. The gates are constructed with squared wooden timbers that are laid horizontally atop one another and joined with structural ties. They are operated with the same crank and spar system used on all the locks in the system. The lock is thought to have butterfly valves either built into the floor under the gates, or in the gates themselves. The guard lock was designed to protect the other locks and canal from damage due to a sudden surge of water.

KAUKAUNA LOCK 1

Oriented slightly NW/SE, Kaukauna Lock 1 has changed little since its construction in 1882. The lock consists of a 138.3 foot by 35 foot quarried limestone lock chamber with wing walls at each end.[69]

Detailed design sheets specific to the Kaukauna first lock are not on file at the Corps of Engineers Fox River Project Office in Kaukauna, Wisconsin. However, since the Kaukauna first lock is

similar in design and construction to other locks in the Fox River system, the plans from these facilities were examined to provide information regarding the construction and design of the Kaukauna first lock. For example, Kaukauna Lock 1 and the Cedars lock are similar in design, and plans for the Cedars Lock can thus provide detailed information on design and construction of the Kaukauna Lock 1.

The lower wing walls, or those located at the downstream end of the lock, consist of a single construction section constructed of rubble masonry. The upper wing walls are located at the upstream end of the lock. Like the lower wing walls, the upper wing walls are constructed of rubble masonry.

The lock chamber of Kaukauna Lock 1 measures 138.3 feet in length. Additionally, there is a 33.5 foot upper gate section at the west end of the lock, and a 51.5 foot lower gate section at the east end of the lock. Including the upper and lower gate sections, the overall length of the lock is 223 feet.[70]

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 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 laid behind the cut blocks in order to reinforce the wall. The walls of the upper gate section are built on top of, and perpendicular to, the natural rock floor of the lock. Directly behind the lock gates, the interior faces of the upper gate section walls are recessed 2 feet in order to allow the gates to recess flush when fully opened.[71]

Design sheets specific to the Kaukauna Lock 1 are not on file at the Corps of Engineers Fox River Project Office. However, Kaukauna Lock 1 is similar in design and construction to other locks in the Fox River system, consequently, the plans from these facilities augmented by visual inspection of the Kaukauna facilities were used to compile information about the construction and design of the Kaukauna gates and valves.

The upper gate is constructed from squared pine timbers laid in horizontal courses and held together with vertical oak beams.[72] In addition to the oak beams, the horizontal timbers used in the upper 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 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 horizontal bar is inserted into a socketed hub attached to the vertical shaft and serves as a handle with which 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 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 and provide the 10.7 feet of lift required to reach the 652.76 feet above sea level elevation of the upper pool.[73]

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 fill the lock. 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 laid behind the cut blocks in order to reinforce the wall. The walls of the lower gate section are built on top of, and perpendicular to, the natural rock floor of the lock. Directly behind the lock gates, the interior faces of the lower gate section walls are recessed 2 feet in order to allow the gates to recess flush when fully opened.[74]

The lower gate is constructed from square horizontal pine timbers held together with vertical oak beams.[75] In addition to the oak beams, the horizontal pine timbers used in the lower gate construction 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 horizontal bar can be inserted into a socketed hub attached to the vertical shaft and serves as a handle with which 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 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.[76]

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 laid behind the cut blocks in order to reinforce the wall. The walls of the lower gate section are built on top of, and perpendicular to, the natural rock floor of the lock.

In recent years, the lock walls were repainted and the gates have been rebuilt. Apart from these superficial improvements and other, minor periodic repairs to the gates, valves, and stone walls, Kaukauna Lock 1 appears very much as it did when it was completed in 1882.

KAUKAUNA LOCK 2

Oriented slightly on a NW/SE, Kaukauna Lock 2 has changed little since its construction in 1903. The lock consists of a 138.3 foot by 35 foot quarried limestone lock chamber with wing walls at each end.[77]

Detailed design sheets specific to Kaukauna Lock 2 are not on file at the Corps of Engineers Fox River Project Office in Kaukauna, Wisconsin. However, Kaukauna Lock 2 is similar in design and construction to other locks in the Fox River system, thus the plans from these facilities can be used to provide information about the construction and design of Kaukauna Lock 2.

The lower wing walls, or those located at the downstream end of the lock, consist of a single construction section built of rubble masonry. Both walls are 14 feet 10 inches in height and are beveled toward the exterior of the lock. The northernmost lower wing wall is 53 feet 6 inches in length by 5 feet in width and the southernmost lower wing wall is 59 feet in length and 5 feet in width.[78]

The upper wing walls are located at the upstream end of the lock. Like the lower wing walls, the upper wing walls are constructed of rubble masonry and are beveled toward the exterior of the

lock. The northernmost upper wing wall is 20 feet by 6 feet long. The southernmost upper wing wall is constructed of three sections. The section adjacent to the upper gate section is 20 feet in length and 6 feet in width. The middle section of the southern upper wing wall is 11 feet in length and 6 feet in width. The third outermost construction section is aligned parallel to the channel of the Fox River and is 4 feet in length by 2 feet in width.[79]

The lock chamber at Kaukauna Lock 2 is 138.3 feet in length. Additionally, a 35.5 foot upper gate section is attached at the west end of the lock, and a 51.5 foot lower gate section is attached to the east end of the lock. Including the upper and lower gate sections, the overall length of the lock is 223 feet.[80]

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 approximately 35 feet apart, the interior walls of the upper gate section are composed of tiers of 19 inch thick quarried limestone blocks laid in horizontal courses to form the face of the wall. Rubble masonry has been laid behind the cut blocks in order to reinforce the wall. The walls of the upper gate section are built on top of, and perpendicular to, the natural rock floor of the lock. Directly behind the lock gates, the interior faces of the upper gate section walls are recessed 2 feet 10 inches in order to allow the gates to recess flush when fully open.[81]

Because design sheets specific to Kaukauna Lock 2 are not on file at the Corps of Engineers Fox River Project Office, a detailed discussion of the lock gates and valves of the Kaukauna Lock is based on information pertaining to other locks in the Fox River system. This data is augmented by information derived from visual inspection of Lock 2.

The upper gate is constructed from square pine timbers laid in horizontal courses and held together with vertical oak beams.[82] In addition to the oak beams, the horizontal pine timbers used in the upper 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 upper lock gates are closed by 28 foot 8 inch long horizontal spars that connect the inside of the gates to geared vertical shafts enclosed within steel tripods mounted on both sides of the lock wall.[83] A removable bar can be inserted in a socketed hub attached to a vertical shaft and serves as a handle with which 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 upper lock gates are closed and sealed, six butterfly valves located in the floor 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 9.62 feet of lift required to match the 642.5 feet above sea level elevation of the upper pool.[84]

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 fill the lock. Spaced approximately 35 feet apart, the interior walls of the lower gate section are made up of tiers of 19 inch thick quarried limestone blocks laid in horizontal courses to form the face of the wall. Rubble masonry has been laid behind the cut blocks in order to reinforce the wall. The walls of the lower gate section are built on top of, and perpendicular to, the natural rock floor of the lock. Directly behind the lock gates, the interior faces of the lower gate section walls are recessed 2 feet in order to allow the gates to recess flush when fully opened.[85]

The lower gate is constructed from squared pine timbers laid in horizontal courses and held together with vertical oak beams.[86] 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.

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 can be inserted into a socketed hub attached to the vertical shaft and serves as a handle with which 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 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.[87]

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

In recent years, the tripod platforms have been rebuilt of concrete and the lock walls have been repointed with concrete mortar. Apart from these superficial improvements and minor periodic repairs to the gates, valves, and stone walls, Kaukauna Lock 2 appears very much as it did when it was completed in 1903.

KAUKAUNA LOCK 3

Oriented slightly on a SW/NE, Kaukauna Lock 3 has changed little since its construction in 1878. The lock consists of a 138.3 foot by 36.6 foot quarried limestone lock chamber with wing walls at each end.[88]

Detailed design sheets specific to Kaukauna Lock 3 are not on file at the Corps of Engineers Fox River Project Office in Kaukauna, Wisconsin. However, since Kaukauna Lock 3 is similar in design and construction to other locks in the Fox River system, the plans from these facilities were examined in order to provide information regarding the construction and design of Kaukauna Lock 3.

The lower wing walls, or those located at the downstream end of the lock, consist of a single construction section constructed of rubble masonry. The upper wing walls are located at the upstream end of the lock. Like the lower wing walls, the upper wing walls are constructed of rubble masonry.

The lock chamber of Kaukauna Lock 3 is 138.3 feet in length. Additionally, a 33.5 foot upper gate section is attached to the west end of the lock, and a 51.5 foot lower gate section abuts the east end of the lock. Including the upper and lower gate sections, the overall length of the lock is 223 feet.[89]

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 approximately 35 feet apart,

the interior walls of the upper gate section are made up of tiers of 19 inch thick quarried limestone blocks laid in horizontal courses to form the face of the wall. A rubble masonry fill has been laid behind the cut blocks in order to reinforce the wall. The walls of the upper gate section are built on top of, and perpendicular to, the natural rock floor of the lock. Directly behind the lock gates, the interior faces of the upper gate section walls are recessed 2 feet in order to allow the gates to recess flush when fully opened.[90]

Design sheets specific to Kaukauna Lock 3 are not on file at the Corps of Engineers Fox River Project Office. However, since Kaukauna Lock 3 is similar in design and construction to other locks in the Fox River system, the plans from these facilities were examined in order to derive a description of the construction and design of the gates and valves.

The upper gate is constructed from squared pine timbers laid in horizontal courses and held together with vertical oak beams.[91] In addition to the oak beams, the pine timbers used in the upper 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 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.[92] A removable bar can be inserted in a socketed hub attached to the vertical shaft and serves as a handle with which 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 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 four upstream valves can fill the lock chamber to provide the 10.2 feet of lift required to match the 632.9 feet above sea level elevation of the upper pool.[93]

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 fill the lock. Spaced approximately 35 feet apart, the interior walls of the lower gate section are made up of tiers of 19 inch thick quarried limestone blocks laid in horizontal courses to form the face of the wall. A rubble masonry fill has been laid behind the cut blocks in order to reinforce the wall. The walls of the lower gate section are built on top of, and perpendicular to, the natural rock floor of the lock. Directly behind the lock gates, the interior faces of the lower gate section walls are recessed 2 feet so that they can accommodate the gates when they are open.[94]

The lower gate is constructed from square horizontal pine timbers held together with vertical oak beams.[95] In addition to the oak beams, the horizontal pine timbers used in the lower gate construction 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 horizontal bar is connected to the vertical shaft and serves as a handle with which 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 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 53 seconds.[96]

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. A rubble masonry fill has been laid behind the cut blocks in order to reinforce the wall. The walls of the lower gate section are built on top of, and perpendicular to, the natural rock floor of the lock.

In recent years, new gates have been built and installed and new concrete tripod platforms with steel cover plates were built. Apart from these superficial improvements and periodic repairs to the gates, valves, and stone walls, Kaukauna Lock 3 appears very much as it did when it was completed in 1878.

Dry Dock

The dry dock, located about 35 feet NNW of Kaukauna Lock 3 consists of a roughly pentagonal basin excavated adjacent to the north side of Lock 3. The basin of the dry dock is designed to be flooded in order to allow vessels to be floated into the dry dock. Once inside, the basin entrance can be sealed by wooden mitre gates and the impounded water discharged through a downstream culvert to facilitate repairs to vessel sides, hulls, and propulsion systems.[97]

The dry dock is approximately 120 feet in length and about 175 feet wide.[98] The portion that can be flooded to float vessels for repair comprises about 3,650 square feet. The dry dock basin rests on a poured concrete foundation supporting cut limestone block walls. Short concrete pillars rise from the basin floor at irregular intervals. These pillars provide support for dry docked vessels undergoing repair.[99] The walls of the dry dock basin are encircled by a rather massive earthen berm approximately 4 feet high and 15 to 20 feet wide.[100]

Paired wooden mitre gates are located at the south (upstream) end of the dry dock adjacent to the northern most upstream wing wall of Lock 3. The mitre gates are angled outward at an included angle of 20° to meet in the center of the 35 foot wide dry dock inlet. Each gate is 20 feet 7 inches wide and 9 feet 6 inches in height. Gates consist of a 12 inch by 14 inch by 20 foot 7 inch squared pine timber laid horizontally to form the base of the gate. Two 12 inch by 12 inch by 20 foot 7 inch long timbers are laid one atop the next above the base timber. Eight additional courses of 10 inch by 10 inch by 20 foot 7 inch timbers are then laid one above the other and topped with a 10 foot by 14 inch by 20 foot 7 inch timber that forms the top of the gate. The horizontal courses of timbers are secured by two sets of 4 inch by 9 foot 6 inch soft steel plates bolted to opposite gate faces by 3/4 inch button head bolts and nuts. Gates are further reinforced by three 1 1/4 inch by 9 foot 6 inch Norway iron rods that pass through holes bored vertically from gate top to bottom. Rod ends are threaded to accommodate washers and nuts that can be tightened to provide vertical tensioning of each gate.[101]

The heel post of the hinged side of each mitre gate rotates in a cast iron heel post shoe fastened to the gate sill. The upper hinge point rotates within a cast iron support column fastened to the gate wall on each side of the dry dock inlet. The support column is anchored to the exterior of the gate wall by a strap and turnbuckle which in turn connects to a diagonal backstrap and tumbuckle fastened to the exterior face of each gate. The mitre gates are operated by a maneuvering gear system consisting of a steel capstan, spars and lines.[102]

Each gate is equipped with a 16 inch by 16 inch oak gate valve designed to allow the dry dock basin to be flooded when the mitre gates are closed.[103], The 12 inch square inlet port is centered

about 28 inches above the base of the gate and 6 feet from the hinged gate end. Each valve is operated by a 1 1/2 inch diameter iron valve shaft with square threads cut three per inch. The valve shaft is attached vertically to the exterior gate face directly above the inlet valve. The valve is opened and closed by turning a 2 foot diameter cast iron hand wheel attached to the upper end of the valve shaft. Gates are finished off with a wooden handrail constructed from 2 inch by 6 inch pine lumber bolted to the top most horizontal gate timber.[104]

The dry dock is drained by a 16 inch wide by 22 inch high culvert that discharges from the north (downstream) end of the basin. The outlet is equipped with a wooden gate valve and vertical shaft with handwheel supported by wooden scaffolding attached to the top of the dry dock wall. The outlet valve was designed to be constructed identically to the inlet valves. When opened the outlet valve allows impounded water to discharge through the outlet culvert into an open outlet ditch which connects with the Kaukauna Lock Canal downstream of Lock 3.[105]

Currently, the Kaukauna Dry Dock remains functional. With the exception of removal of the wooden handrails, little has changed since the dry dock was initially completed by 1900.[106]

Kaukauna Lock 3 - Weir

A waste, or overflow, weir flows parallel with the lock on its southern side, and parallel with the southeast shoreline of the canal at Kaukauna Lock 3. These canals are designed to carry water discharged from an upstream lock around downstream locks. The concrete weir is bounded by 1 foot 5 inch limestone walls. Approximately 290 feet long, the upstream spillway is 27 feet wide quickly narrowing to a width of 10 feet.[107]

KAUKAUNA LOCK 4

Oriented slightly SW/NE, Kaukauna Lock 4 has changed little since its construction in 1878. The lock consists of a 138.3 foot by 35.6 foot quarried limestone lock chamber with wing walls at each of its ends.[108]

Detailed design sheets specific to Kaukauna Lock 4 are not on file at the Corps of Engineers Fox River Project Office in Kaukauna, Wisconsin. However, Kaukauna Lock 4 is similar in design and construction to other locks in the Fox River system. The plans from these facilities can be used to provide information regarding the construction and design of Kaukauna Lock 4.

The lower wing walls, or those located at the downstream end of the lock, consist of a single construction section built of rubble masonry. The upper wing walls are located at the upstream end of the lock. Like the lower wing walls, the upper wing walls are constructed of rubble masonry.

The lock chamber of the Kaukauna Lock 4 measures 138.3 feet. Additionally, there is a 33.5 foot upper gate section at the west end of the lock, and a 51.5 foot lower gate section at the east end of the lock. Including the upper and lower gate sections, the overall length of the lock is 223 feet.[109]

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 approximately 35 feet apart, the interior walls of the upper gate section are consist of tiers of 19 inch thick quarried limestone blocks laid in horizontal courses to form the face of the wall. A rubble masonry fill has been laid behind the cut blocks in order to reinforce the wall. The walls of the upper gate section are built on top of, and perpendicular to, the natural rock floor of the lock. Directly behind the lock gates, the interior faces of the upper gate section walls are recessed 2 feet in order to allow the gates to recess flush when opened.[110]

The upper gate is constructed from squared pine timbers laid in horizontal courses and held together with vertical oak beams.[111] In addition to the oak beams, the horizontal pine timbers used in the upper 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 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.[112] A removable bar inserted into a socketed hub attached to a vertical shaft serves as a handle with which 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 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 10.2 feet of lift required to match the 622.7 feet above sea level elevation of the upper pool.[113]

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 fill the lock. Spaced approximately 35 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. A rubble masonry fill has been laid behind the cut blocks in order to reinforce the wall. The walls of the lower gate section are built on top of, and perpendicular to, the natural rock floor of the lock. Directly behind the lock gates, the interior faces of the lower gate section walls are recessed 2 feet in order to allow the gates to recess flush when opened.[114]

The lower gate is constructed from squared pine timbers laid in horizontal courses and held together with vertical oak beams.[115] In addition to the oak beams, the 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, 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.[116] A removable bar inserted into a socketed hub attached to a vertical shaft serves as a handle with which 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 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 43 seconds.[117]

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. A rubble masonry fill has been laid behind the cut blocks in order to reinforce the wall. The walls of the lower gate section are built on top of, and perpendicular to, the natural rock floor of the lock.

In recent years, new gates have been built and installed and new concrete tripod platforms with steel cover plates were built. Apart from these superficial improvements and periodic repairs to the gates, valves, and stone walls, Kaukauna Lock 4 appears very much as it did when it was completed in 1878.

Kaukauna Lock 4 - Weir

A 2,150 foot long waste weir flows parallel to the northwestern shoreline of the Kaukauna canal. The weir originates near the spillway adjacent to the upstream entrance to Kaukauna Lock 4 downstream to the downstream the entrance of Kaukauna Lock 5. The weir was designed to carry water discharged from an upstream lock around downstream locks. From an approximately 20 foot wide spillway, the concrete weir quickly narrows to approximately 8 feet wide, contained by limestone walls. Beyond the lock the weir canal is not contained by walls, and widens slightly.[118]

KAUKAUNA LOCK 5

Built during the 1850s, Kaukauna Lock 5 is the only remaining Fox River lock constructed prior to 1872 when the USACOE assumed management of the Fox River system. In addition, Lock 5 is the only remaining example of a lock built utilizing a composite construction incorporating both masonry and wooden planking. Lock 5 is oriented SW/NE and is approximately 198 feet in length and 35 feet 6 inches in width. The lock consists of an upper gate section, a lock chamber, and a lower gate section built using a composite construction. Masonry wings wall are attached to both the upstream and downstream gate sections.[119]

The upper wing walls are attached to the upstream end of the lock and are constructed of quarried limestone blocks. The northern wing wall tapers in thickness away from the lock and angles outward from the breast wall at an included angle of about 130°. The southern wing wall arcs outward following a gentle curve and narrows away from the lock.[120]

The upper gate section is that part of the lock into which the upper gates open and that contains the upper valve mechanisms used to flood the lock. The upper gate section is approximately 36 feet wide and 28 feet long.[121]

The lock chamber of Kaukauna Lock 5 is 148 feet in length. The lock is 35 feet wide at the bottom of the lock chamber and 35.6 feet wide at the top of the chamber. [122]

The lower gate section is that part of the lock that contains the lower valve mechanisms used to fill the lock. The interior walls of the lower gate section are spaced approximately 36 feet apart; and rise to 617.18 feet above sea level. The walls taper outward from an approximate width of 6 feet 6 inches at the the top to approximately 12 feet at the wall's base. The walls of the lower gate section are built on top of, and are perpendicular to, the ledge rock bottom of the Fox River.[123]

The lower wing walls are attached to the downstream end of the lock and are constructed of quarried limestone blocks. The lower wing walls are constructed in two construction sections which angle outward from the lower gate walls. The section adjacent to the lower gate wall is 28 feet long and 4 feet 6 inches wide. This section rises to a height of 617.18 feet above sea level or approximately 21 feet above the bed of the Fox River. The top of the section steps down in a series of nine 12 inch risers to descend to the 608.0 feet above sea level elevation of the top of the second construction section. The second construction section angles upward from the first section and is 27 feet long and 5 feet wide.[124]

A composite construction was utilized to erect the walls of the upper gate section, the lock chamber, and the lower gate section of Kaukauna Lock 5. The lockward side of the composite

walls of Kaukauna Lock 5 are attached to a 12 inch by 12 inch sill plate anchored to the bed of the river by 1 1/4 inch by 22 inch split anchor bolts. Wooden 8 inch by 10 inch timbers are attached to the sill plate and rise vertically the height of the wall. Two 10 inch by 12 inch timbers are laid horizontally across the 8 inch by 10 inch studs so as to divide the wall into three vertical sections. The wall frame is topped by a 12 inch by 14 inch timber. The timber frame is covered by a double layer of 2 inch by 12 inch wooden planking laid in horizontal courses and edge-butted together. Joints of the outer layer are staggered to prevent leakage. The planking is fastened to the frame by 5 inch and 7 inch boat spikes.[125]

Dry stone fill is laid behind the timber framing in irregular courses. Stone used is roughly size-graded so that the lower third of the wall is composed of the largest blocks, the middle section contains slightly smaller pieces, and the upper third includes the smallest blocks used. The dry stone fill tapers outward from an approximate width of 6 feet 6 inches at the the top to approximately 12 feet at the wall's base.[126]

The shoreward side of each wall is reinforced by a gridwork of steel anchor channels. The steel channels are secured by 1 1/4 inch diameter tie rods which pass through the 10 inch by 12 inch horizontal timbers of the lockward frame and are fastened on the landward side with 1 1/4 inch hex nuts backed by beveled washers. The exterior face of the dry stone fill is clad in cement mortar. At irregular intervals along the wall 2 foot square sections of the exterior face have been left free of mortar to provide weepholes. The exterior surface of the wall is further supported by fill dirt back filled along the wall's entire length. Clay drainage tiles encased in washed gravel filters are emplaced about 8 feet below ground surface and extend the length of the lock chamber wall.[127]

The upper gate is constructed from squared pine timbers laid in horizontal courses and held together with vertical oak beams.[128] In addition to the oak beams, the horizontal pine timbers used in the upper 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 upper lock gates are closed by long 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.[129] A bar is inserted into a socketed hub attached to the vertical shaft and serves as a handle with which 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 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 10.4 feet of lift required to match the 612.5 feet above sea level elevation of the upper pool.[130]

The lower gate is constructed from squared pine timbers laid in horizontal courses and held together with vertical oak beams.[131] 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 in height.

Operation of the lower gates is similar to that described for the upper gates. 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 58 seconds.

In recent years, new concrete tripod platforms and rebuilt gates were installed at Kaukauna Lock 5. In addition, the lock was relined and several other minor repairs were undertaken to strengthen the original lock. Apart from these repairs Kaukauna Lock 5 has remained the same since it was first built in the 1850s.

Kaukauna Lock 5 - Weir

A 20 foot wide waste weir flows 70 feet north of, and parallel to, the northern side of Kaukauna Lock 5. The weir originates at the upstream end of Kaukauna Lock 4 and rejoins the Fox River at the downstream entrance to Kaukauna Lock 5. The weir was designed to carry water discharged from an upstream lock around downstream locks.[132]

SIGNIFICANCE

The Kaukauna Locks and Dam Complex is a part of the Lower Fox River Waterway System constructed by private companies between 1850 and 1860 and rebuilt by the United States Army Corps of Engineers between 1872 and 1941. Conceived as part of the larger Fox River Waterway, the Lower Fox River System operated between Green Bay and Lake Winnebago. The locks and dam combination at the Kaukauna Locks and Dam Complex provides passage around rapids in the city of Kaukauna created by a rather precipitous 50 foot drop in elevation in the Fox River. Further, facilities at the Kaukauna Locks and Dam Complex, Kaukauna Lock 3 serve as the USACOE, Fox River Project Office. The Kaukauna Locks and Dam Complex serves as an integral part of the operation of the Lower Fox River Waterway System. In addition, Kaukauna Lock 5 is the sole remaining example of a lock built using a composite construction typical of earlier pre-USACOE lock construction.

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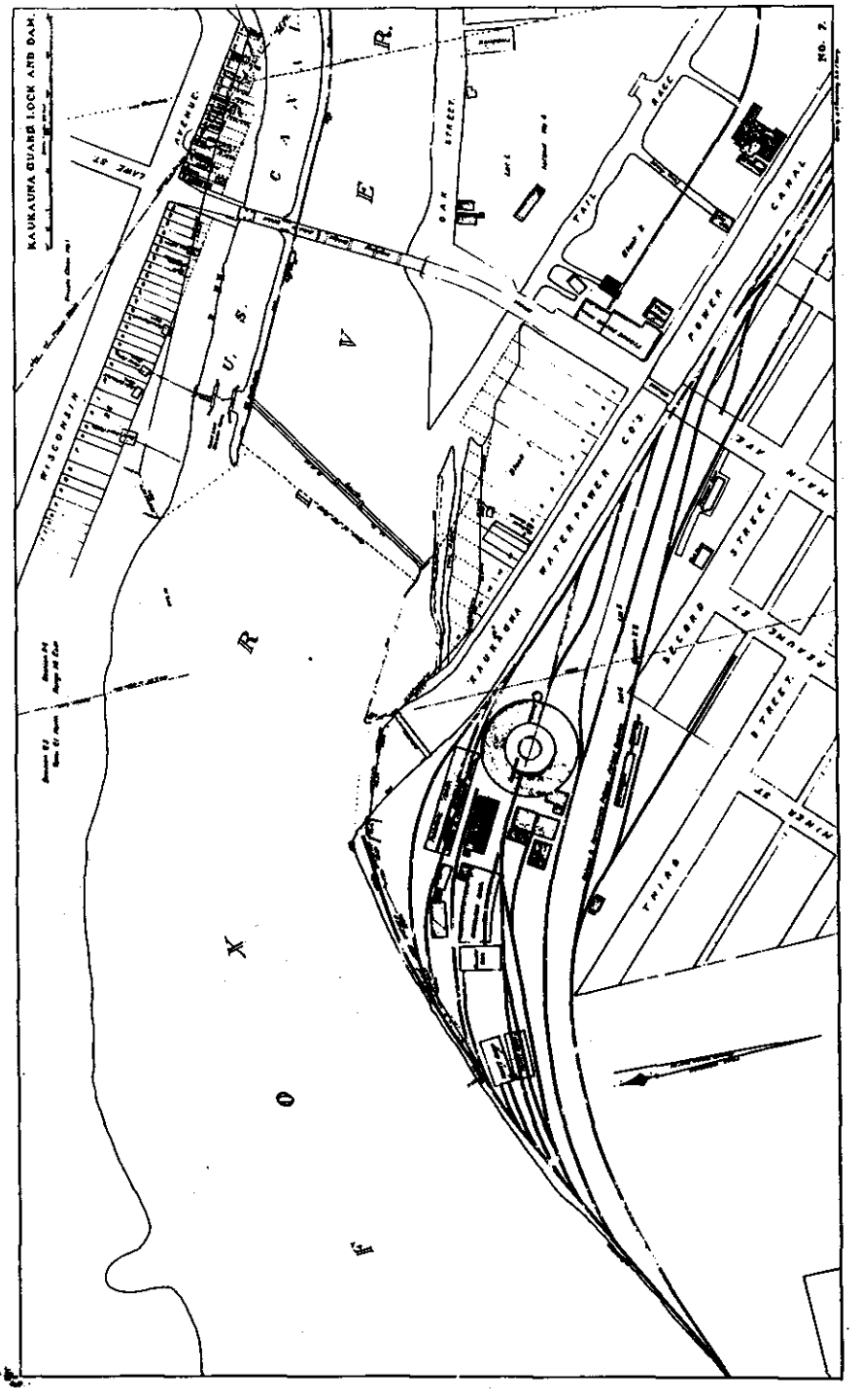

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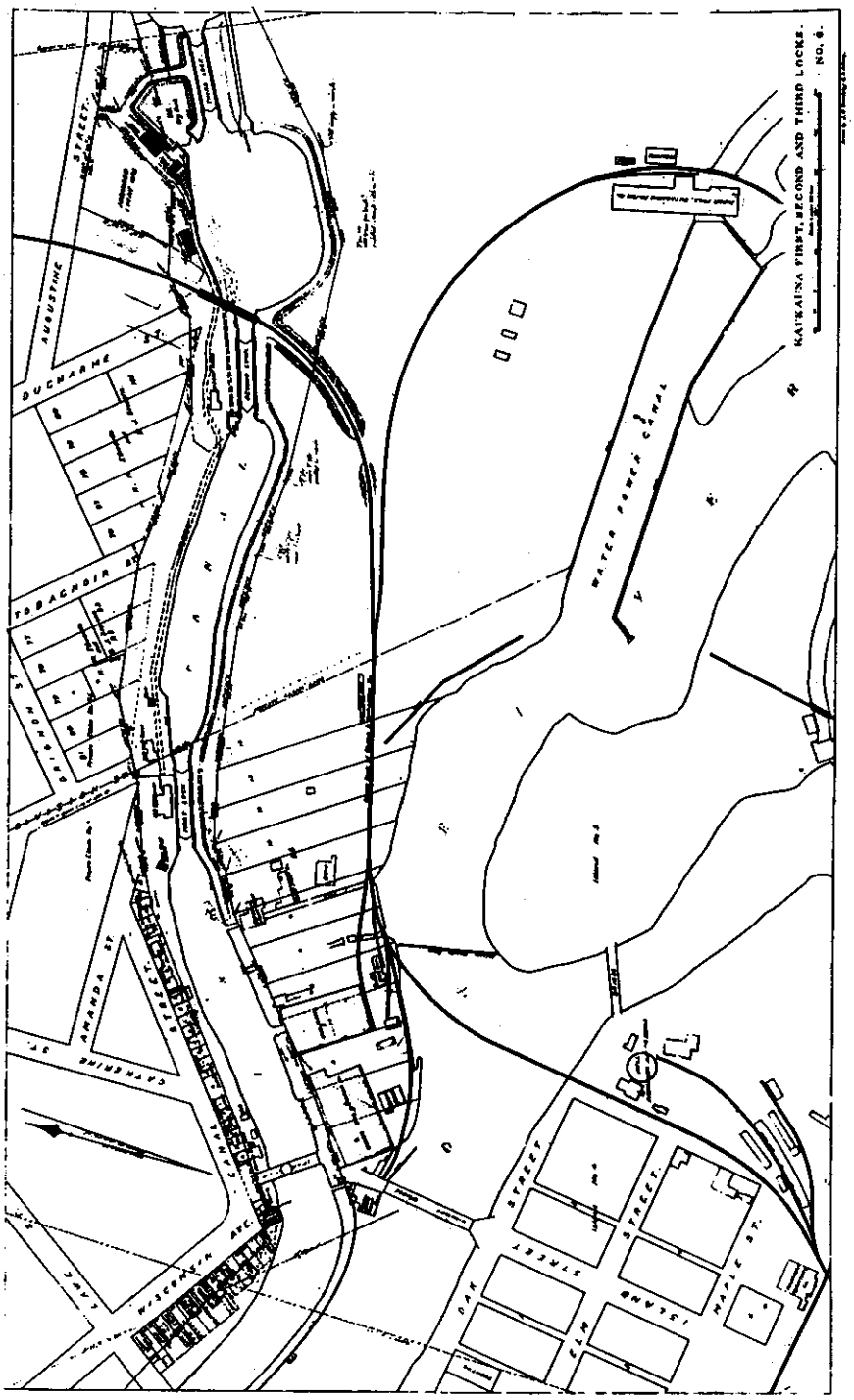

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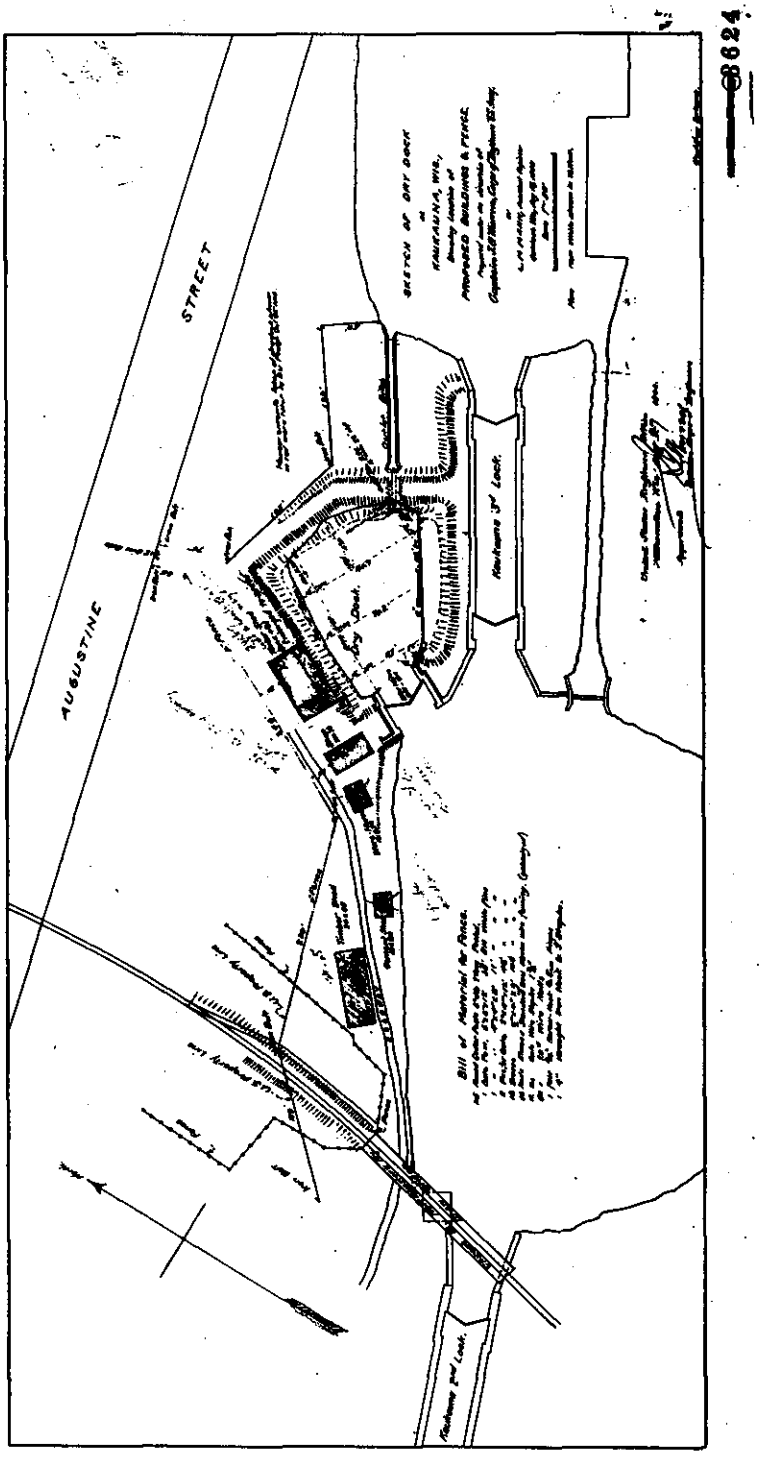

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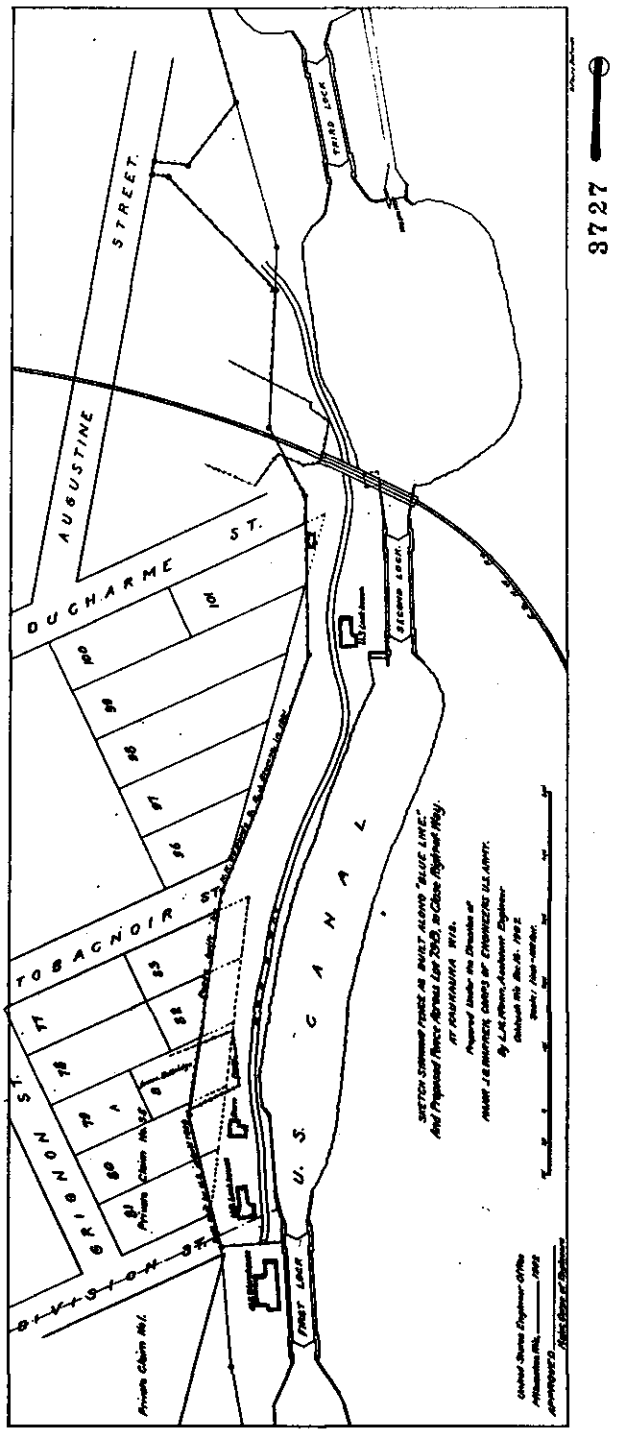

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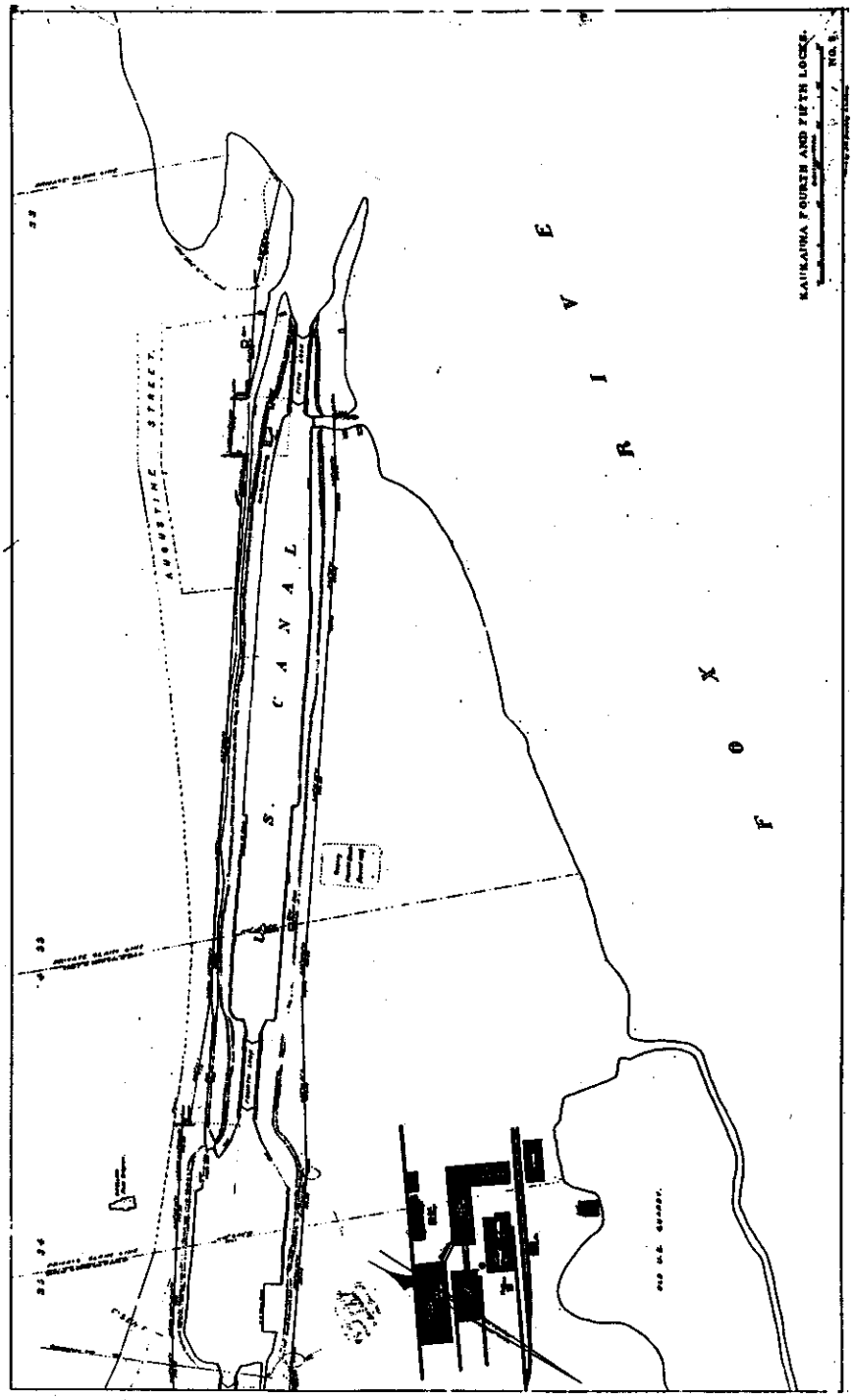

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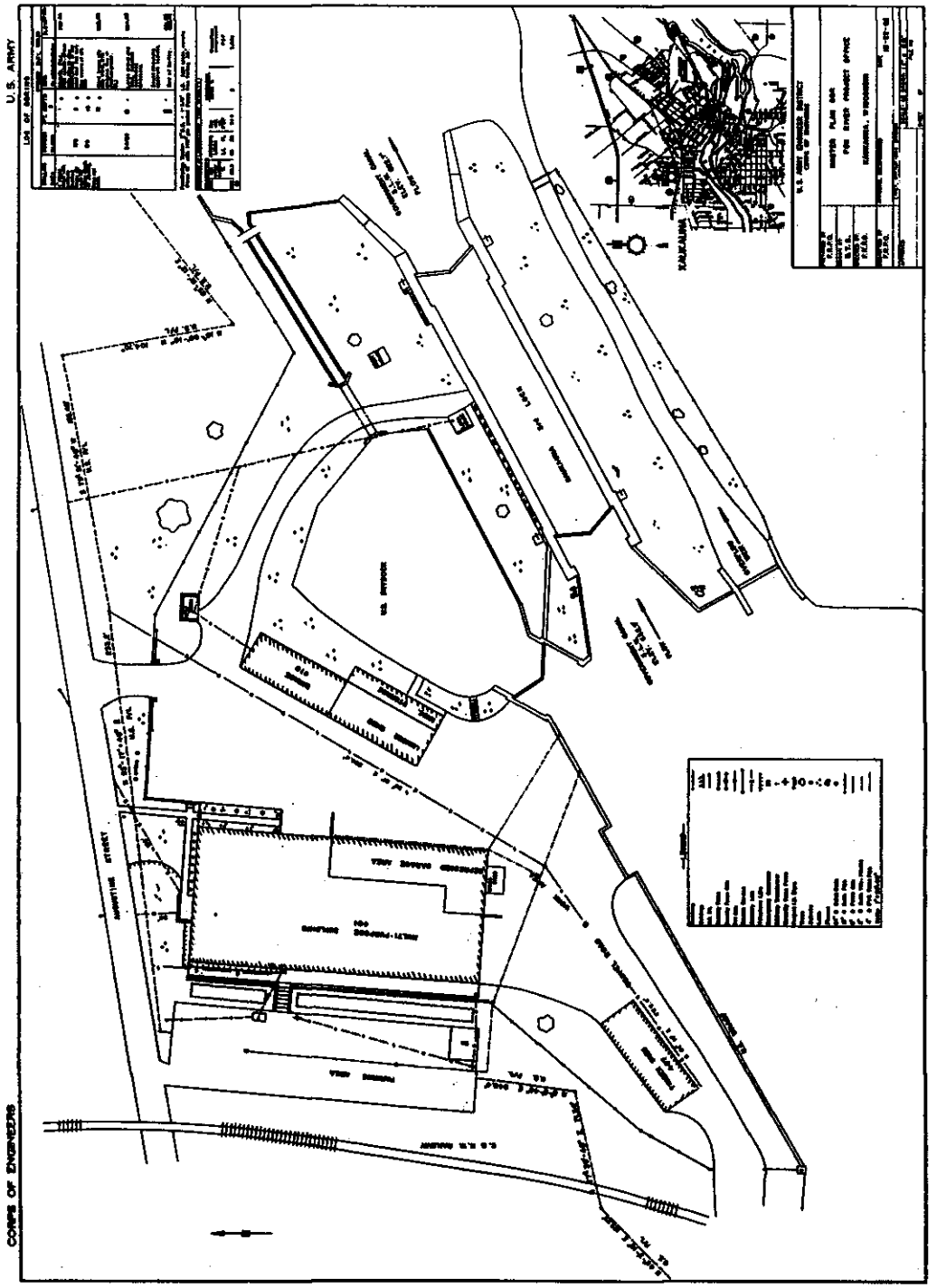

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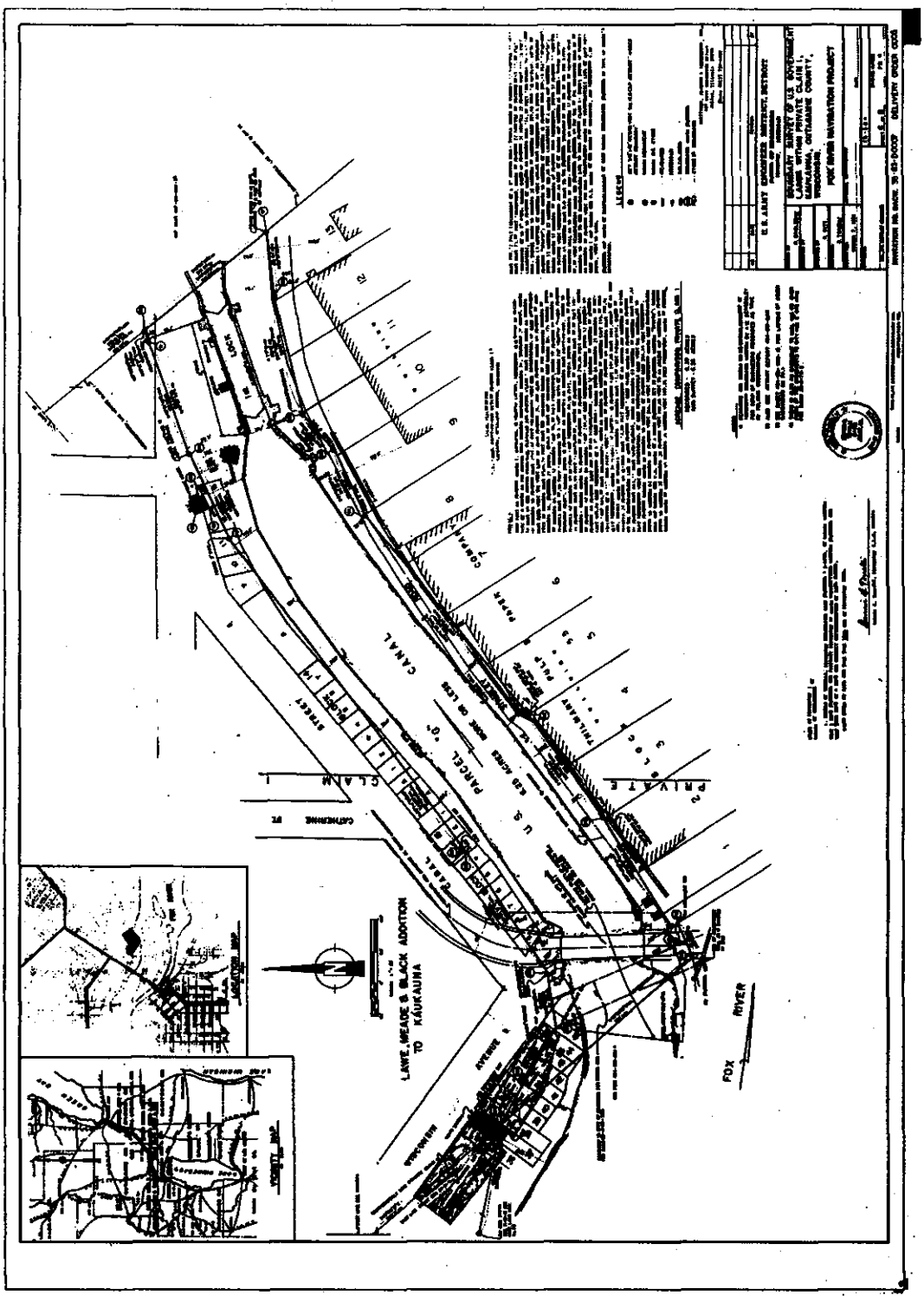

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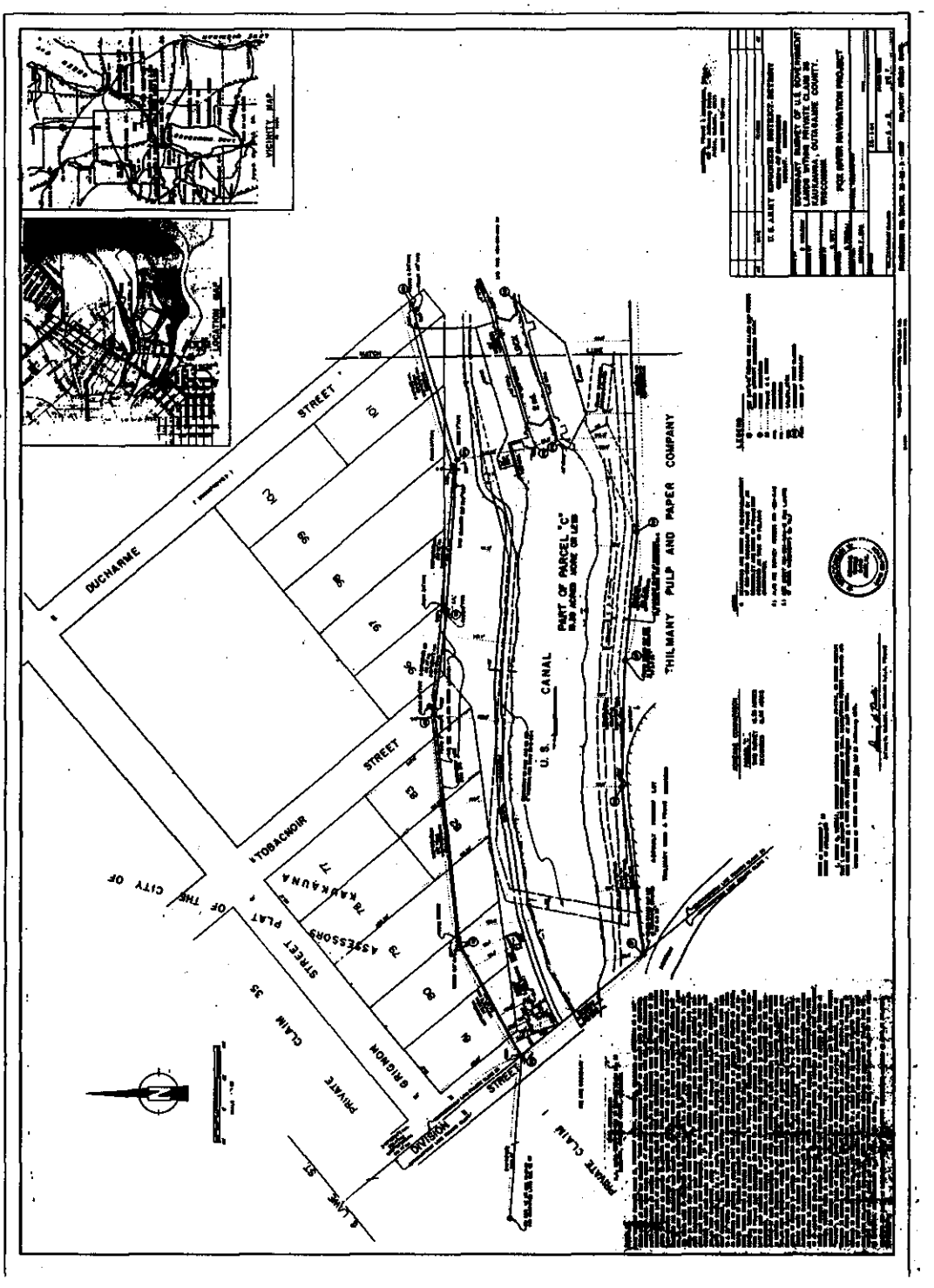

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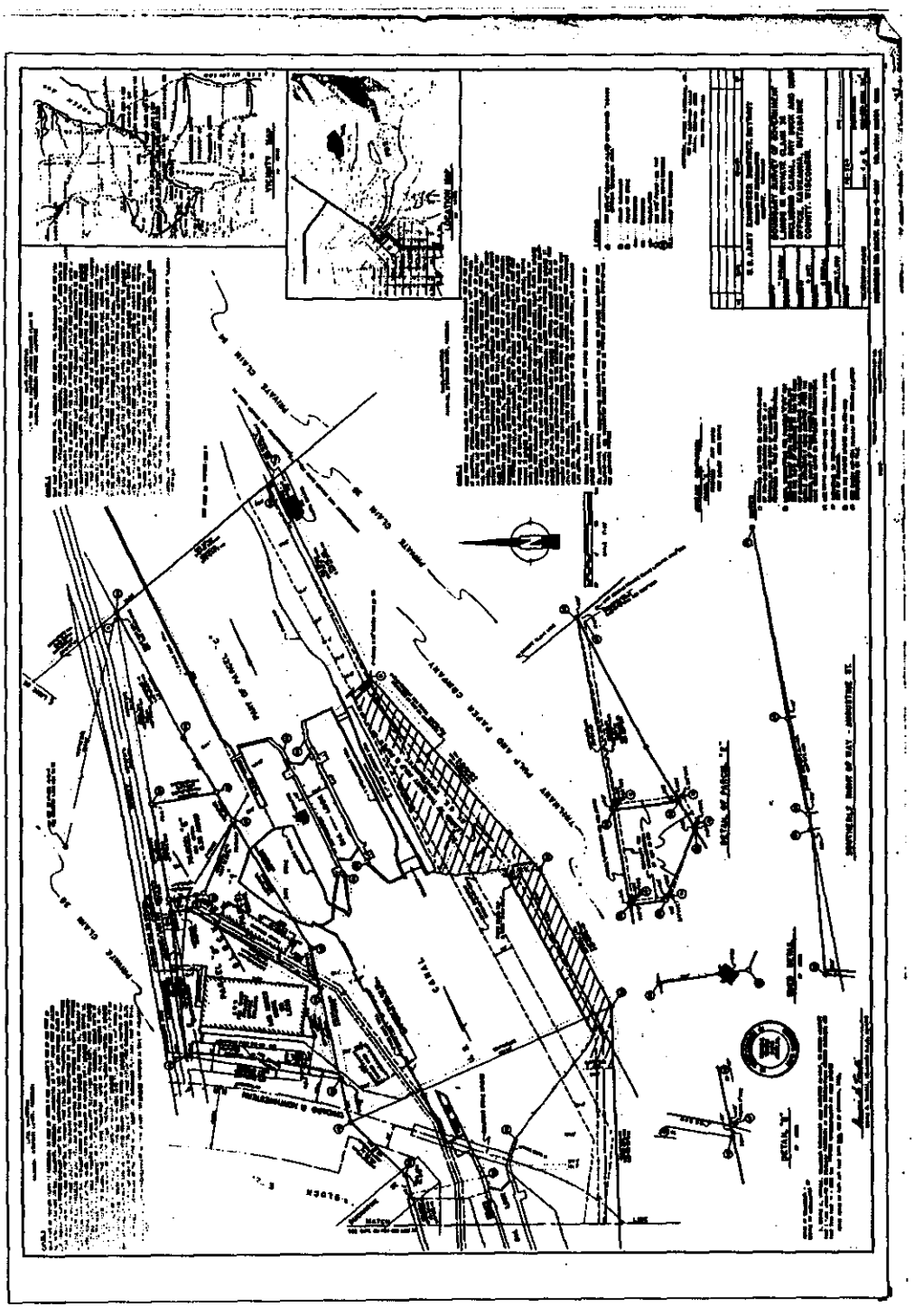

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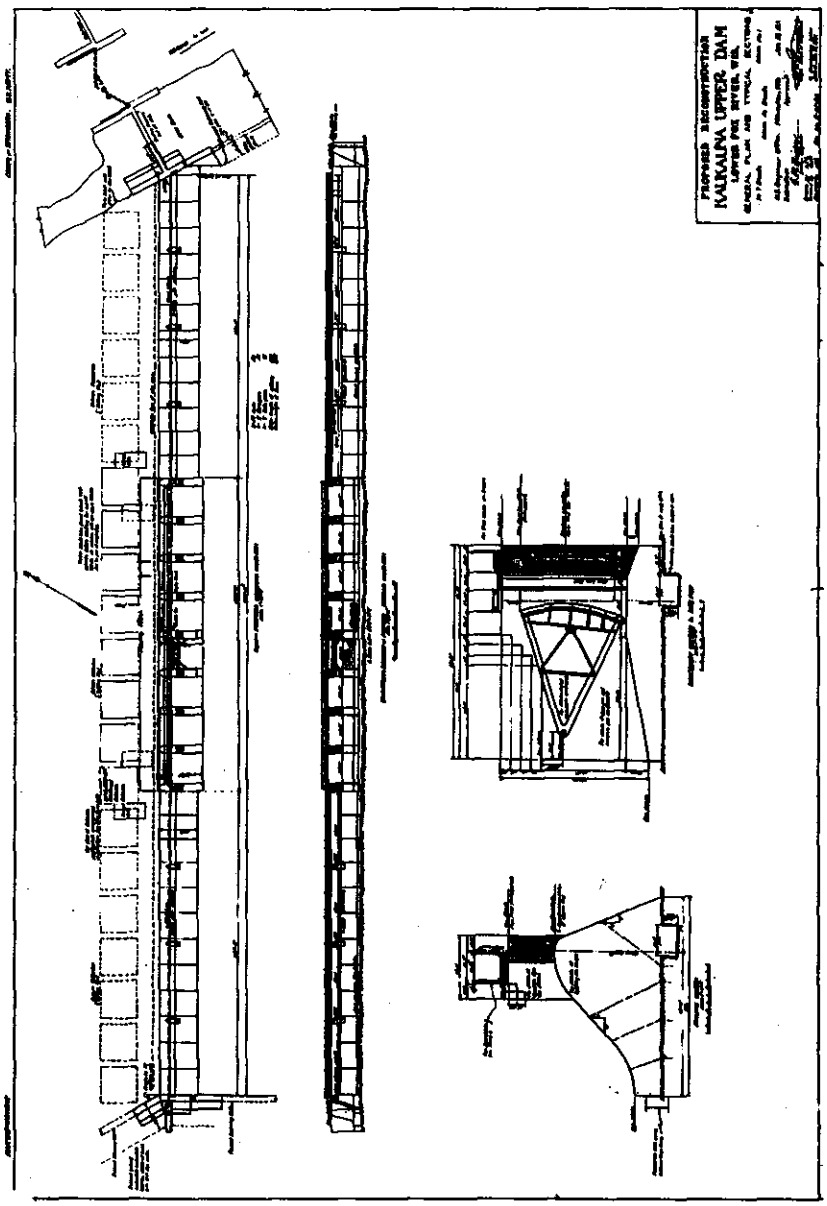

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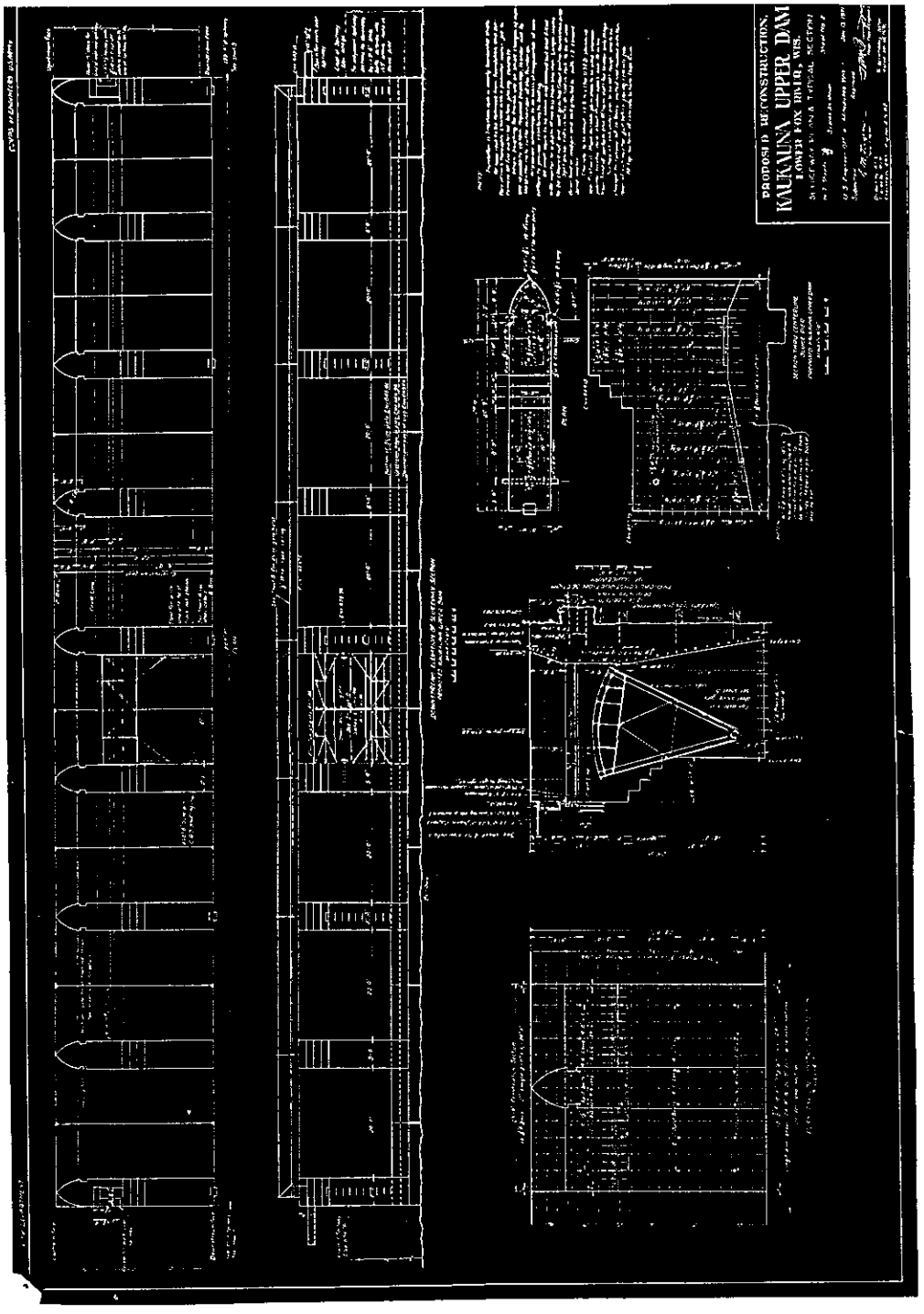

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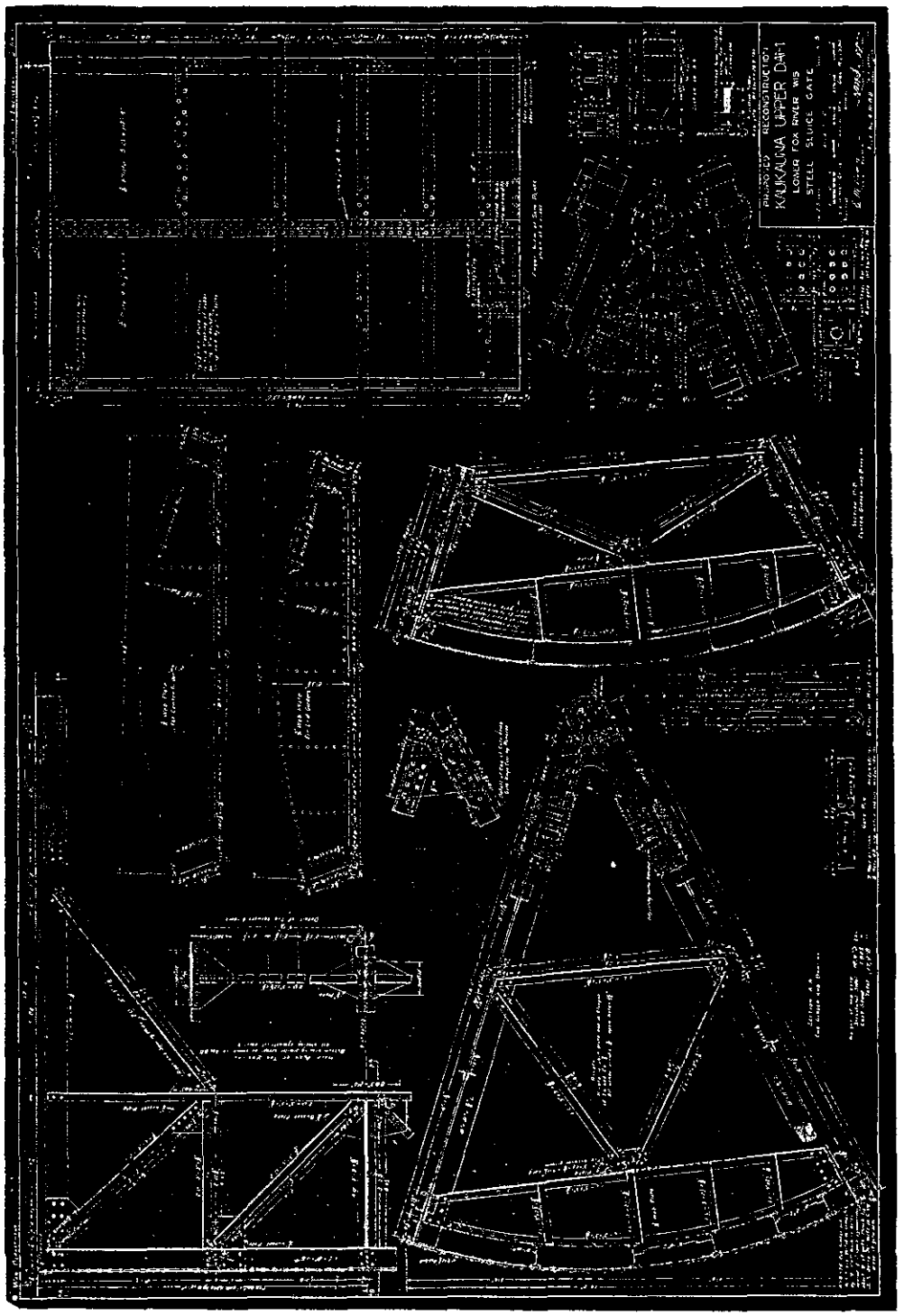

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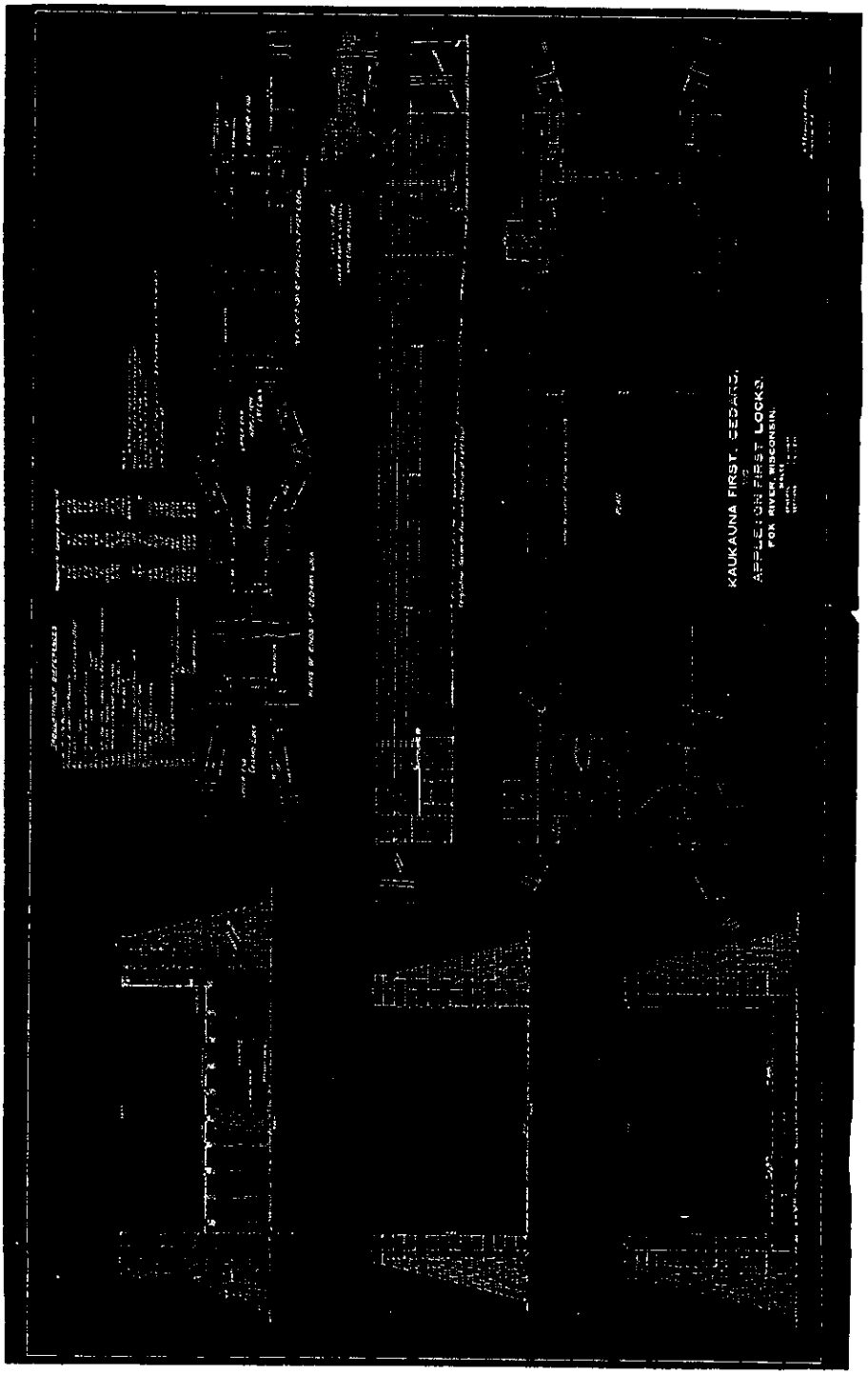

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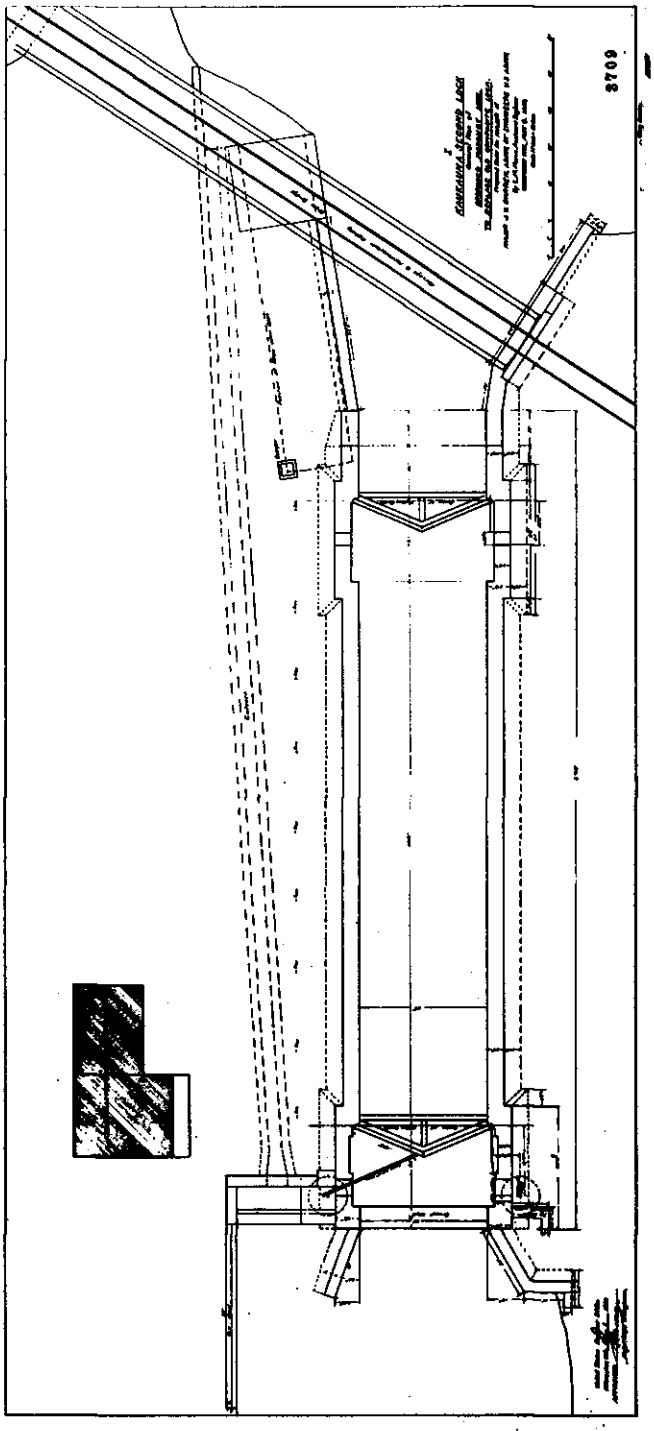

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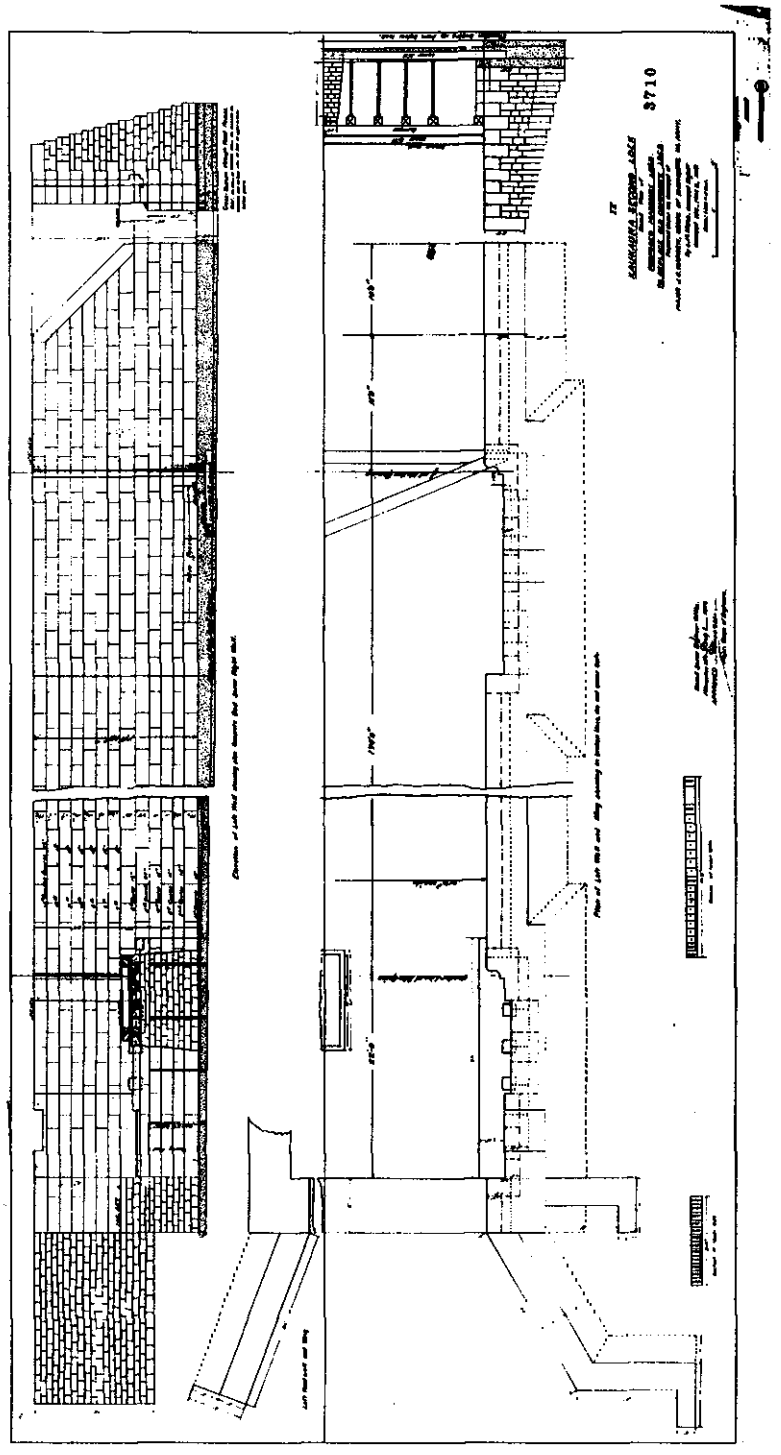

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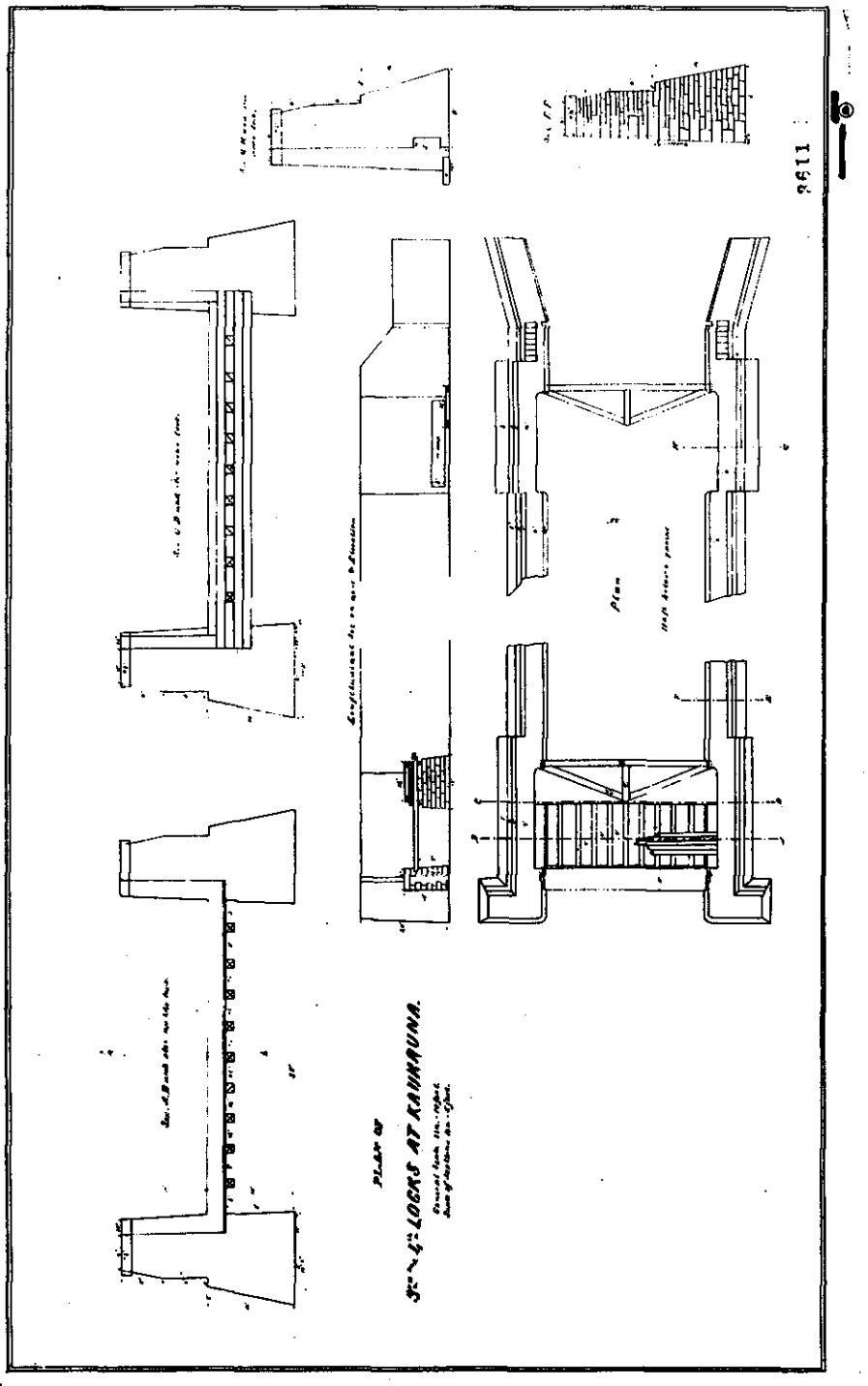

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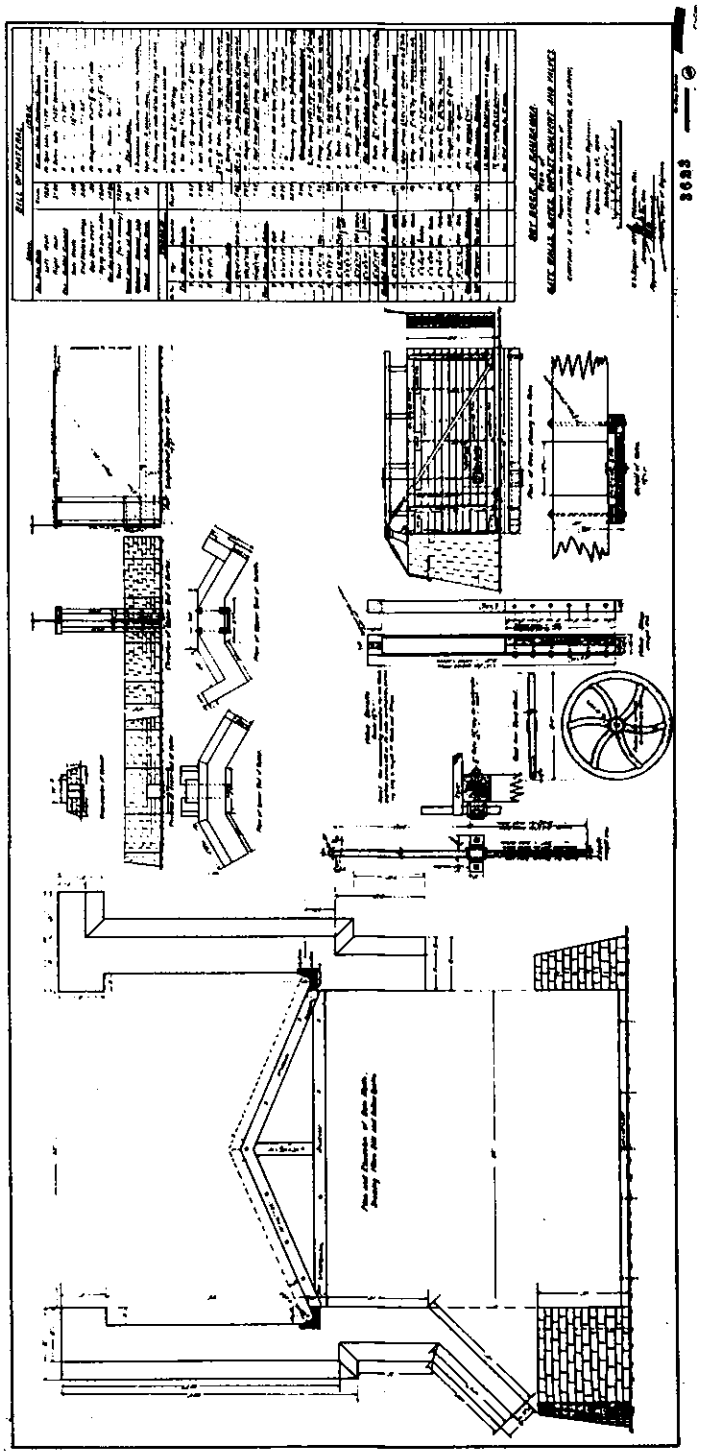

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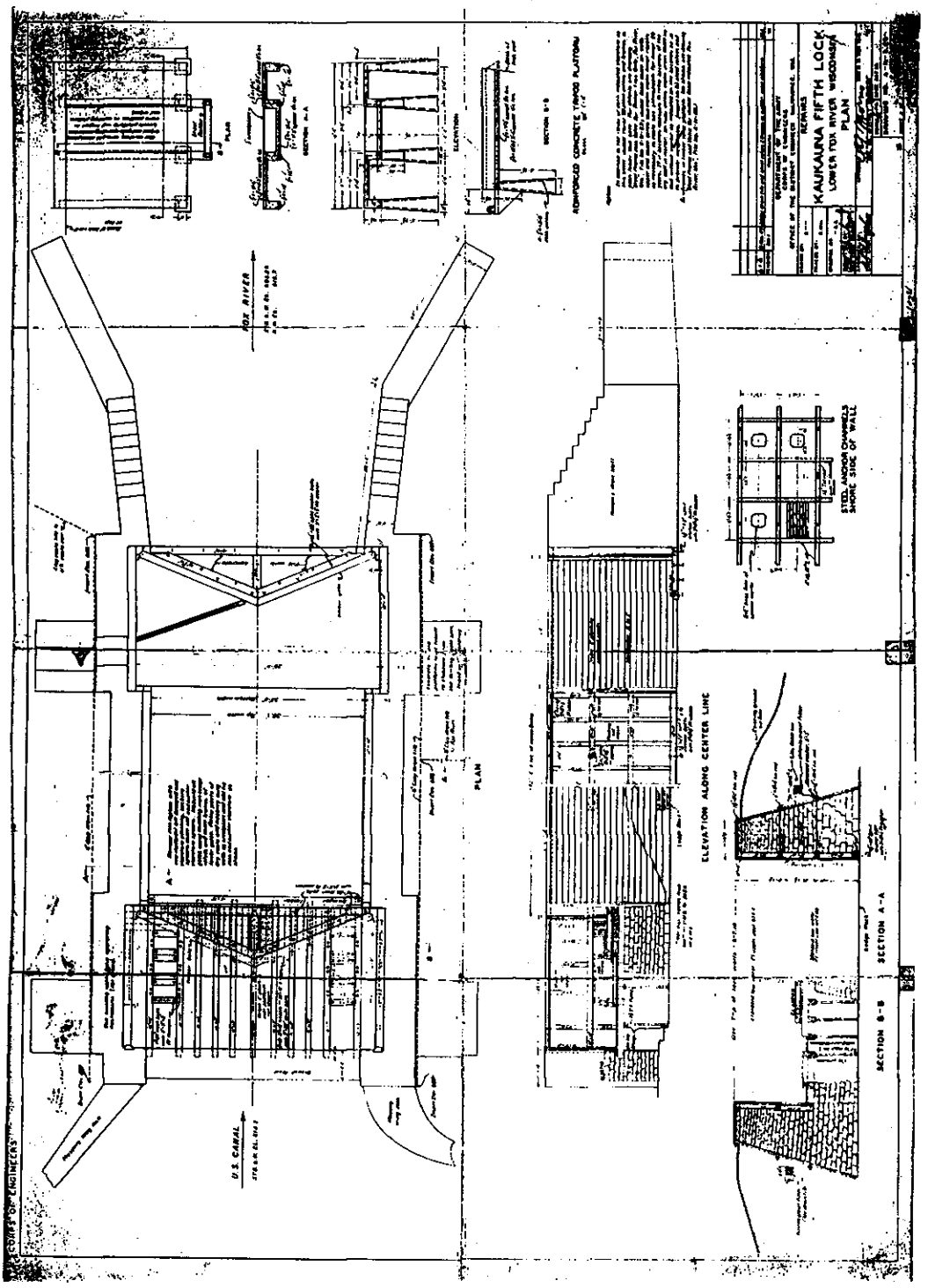

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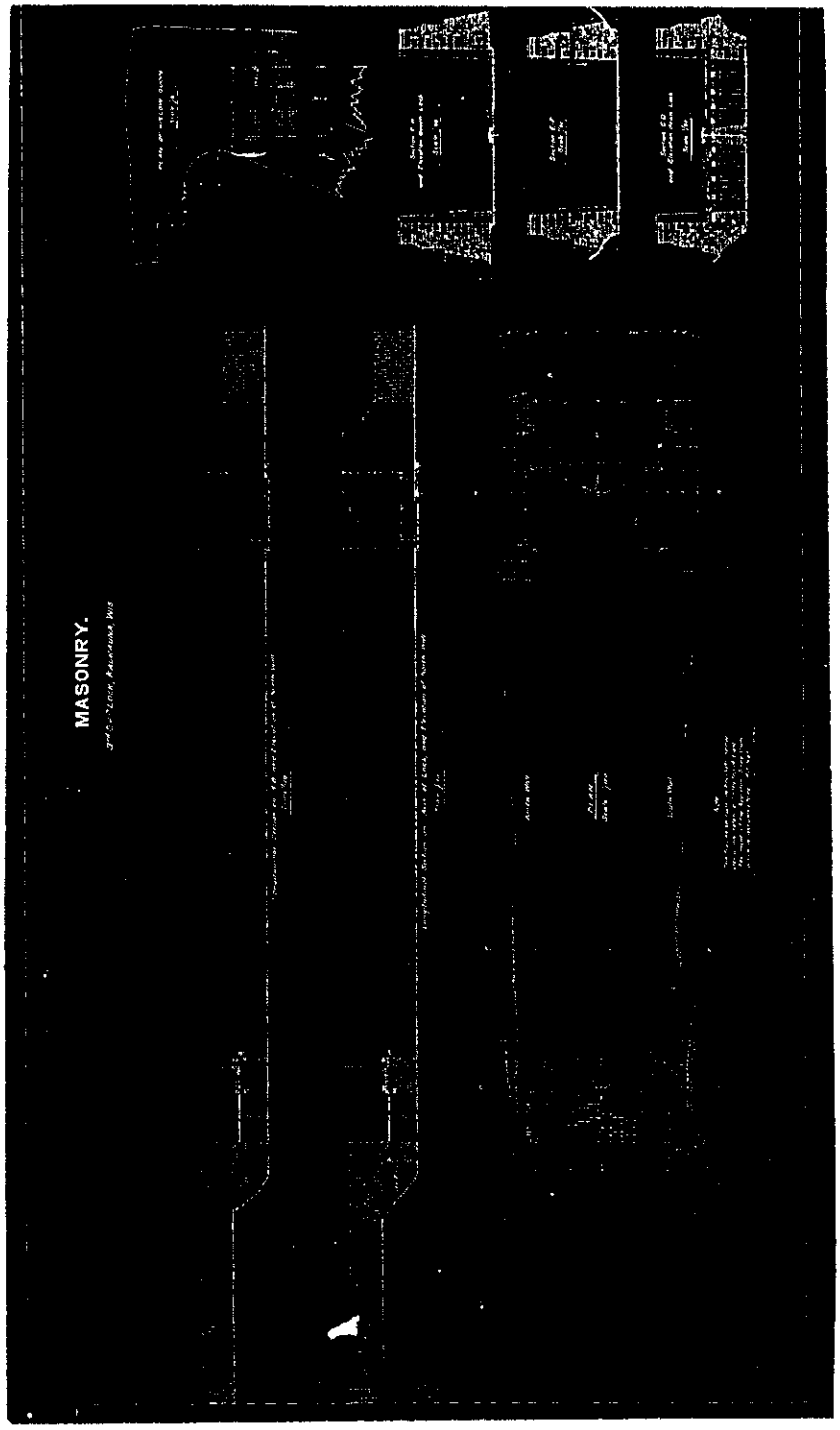

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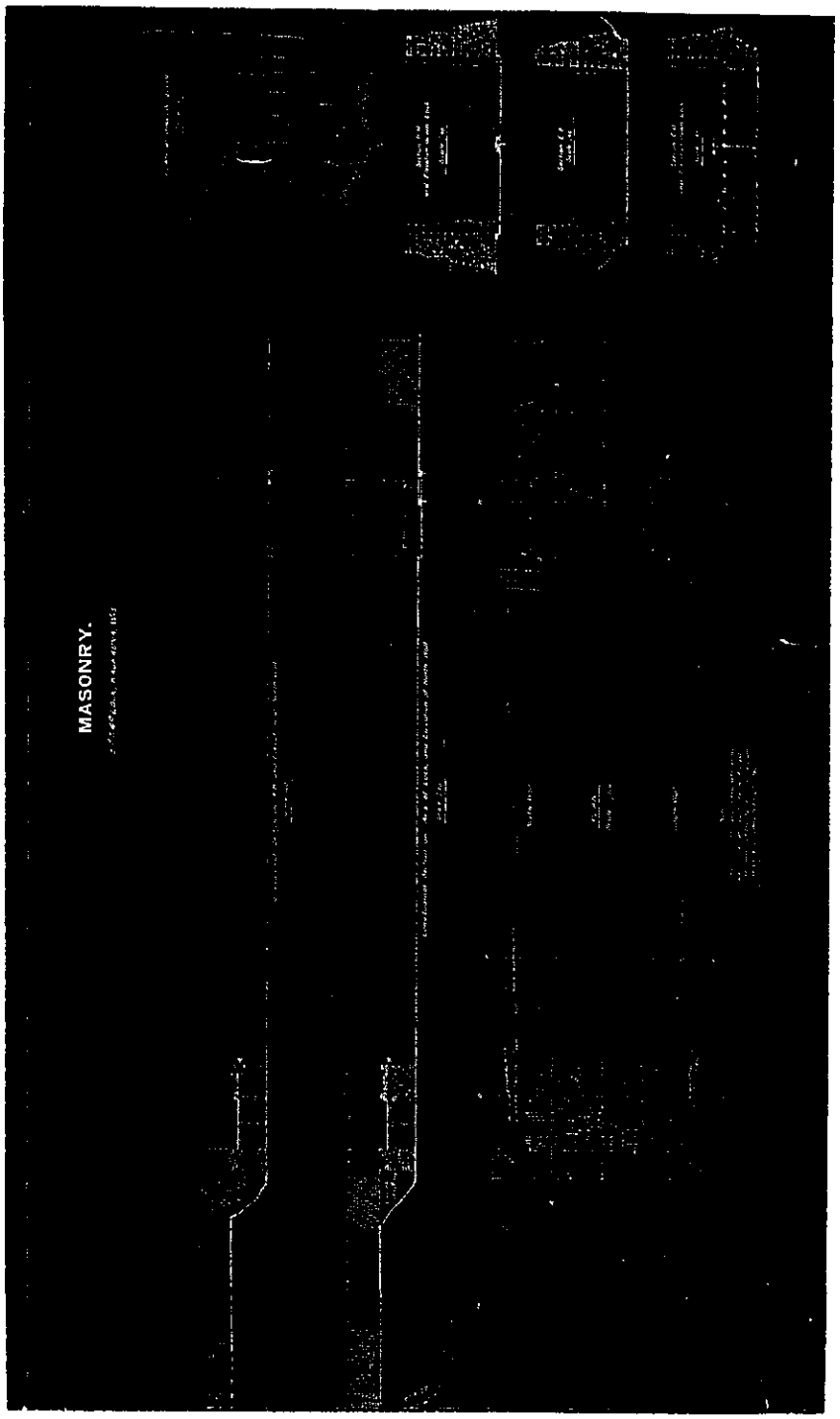

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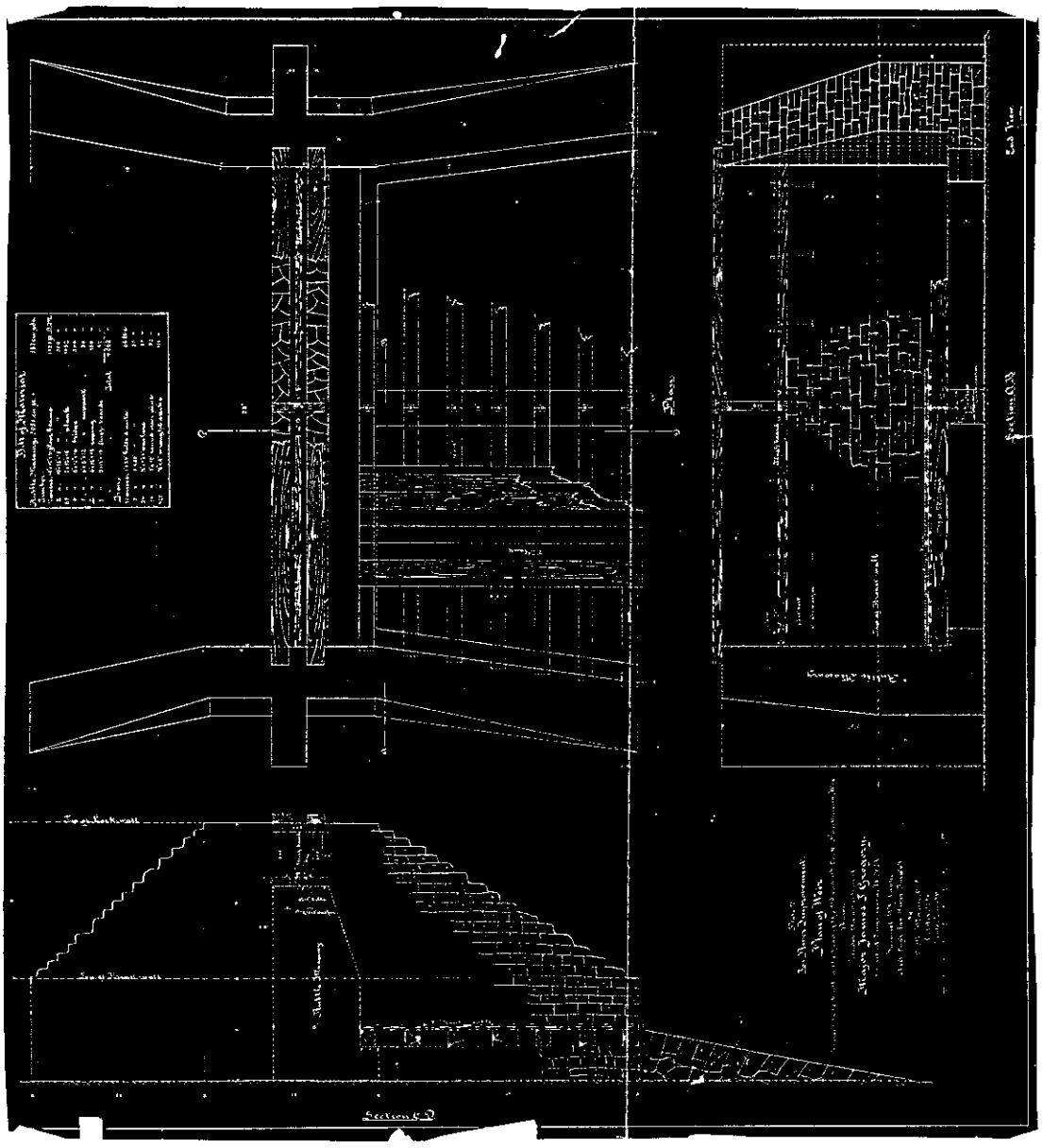

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