CHICAGO SANITARY AND SHIP CANAL
(Main Channel)
(Main Channel Extension)
(Chicago Drainage Canal)
Extends 33.9 miles from Chicago to Lockport
Chicago
Cook County
Illinois

HAER IL-197
IL-197

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

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HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
U.S. Department of the Interior
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HISTORIC AMERICAN ENGINEERING RECORD

CHICAGO SANITARY AND SHIP CANAL
(Main Channel and Extension)
(Chicago Drainage Channel)

HAER No. IL-197

Location:	The Chicago and Sanitary Ship Canal extends 33.9 miles from Chicago to 2502 Channel Drive, Lockport, Will County, Illinois.
Dates of Construction:	1892-1900 (Main Channel); 1903-1907 (Main Channel Extension)
Engineer:	Sanitary District of Chicago
Builder:	Various, see report for individual contractors
Current Owner:	Metropolitan Water Reclamation District of Greater Chicago and the U.S. Army Corps of Engineers
Significance Statement:	To deal with Chicago's water supply and pollution issues, the engineers of the Sanitary District devised an innovative approach that involved diluting the city's sewage with water drawn from Lake Michigan and sending it downstream via a canal, thus protecting Lake Michigan, the source of the city's drinking water. The construction of this canal, known variously as the Main Channel and the Chicago Sanitary and Ship Canal, was a massive undertaking and required the contractors to devise large-scale earth moving techniques and machinery. In 1955, the American Society of Civil Engineers deemed the canal one of the "Seven Wonders of American Engineering." Finally, the Chicago Sanitary and Ship Canal is significant as a component of the Illinois Waterway, which opened in 1930 and created a navigable waterway connecting Chicago and Lake Michigan with the Mississippi River and beyond.
Historian:	Justine Christianson, HAER, 2009-2010
Project Information:	The Historic American Engineering Record (HAER) part of Heritage Documentation Programs, a division of the National Park Service, U.S. Department of the Interior, undertook the Chicago Sanitary and Ship Canal Recording Project during the summer of 2009. The project focused on a 2.2-mile-long section of the canal extending between Illinois Waterway River Miles 291.1 to 293.3. The U.S. Army Corps of Engineers sponsored the project with research assistance and access

provided by the Metropolitan Water Reclamation District of Greater Chicago. The field team consisted of Dana Lockett, HAER Architect and Project Leader; Nicole Martineau, HAER Intern; and Justine Christianson, HAER Historian. Jet Lowe, HAER Photographer, produced the large format photographs.

For additional information see:

Chicago Sanitary and Ship Canal, Lockport Controlling Works	HAER No. IL-197-A
Chicago Sanitary and Ship Canal, Butterfly Dam	HAER No. IL-197-B
Chicago Sanitary and Ship Canal, Lockport Power House and Dam	HAER No. IL-197-C
Chicago Sanitary and Ship Canal, Lockport Lock	HAER No. IL-197-D
Illinois Waterway, Lockport Lock, Dam and Power House	HAER No. IL-164-H
Lockport Historic District, Chicago Sanitary and Ship Canal, Butterfly Dam	HAER No. IL-16-C
Lockport Historic District, Chicago Sanitary and Ship Canal, Swing Bridge	HAER No. IL-16-D

Introduction
The Chicago Sanitary and Ship Canal, constructed from 1892 to 1907, reversed the flow of the Chicago River so that it ran away from Lake Michigan, the source of the city's drinking water. Most of the city's sewage had previously ended up in the Chicago River and ultimately Lake Michigan, causing polluted drinking water and resulting in disease. The canal carried the city's sewage downstream, diluting it with additional water drawn from Lake Michigan. Historian Martin Melosi points out that with the Chicago Sanitary and Ship Canal, "Chicago constructed the premiere sewerage system of the time, capturing the imagination of the public health and engineering communities in much the same way that Philadelphia had done with its water-supply system in 1801."[1] The reversal of the Chicago River and construction of the canal were major engineering feats at the time of their construction. The excavation of the canal resulted in the development of innovative machines and earth-moving techniques that became known as the "Chicago School of earth moving" and were written about extensively in engineering journals of the day. Finally, the Chicago Sanitary and Ship Canal became part of a navigable system connecting Chicago and the Great Lakes with the Mississippi River. It superseded the older, smaller Illinois & Michigan Canal and was eventually incorporated into the Illinois Waterway, which opened in 1930. The Illinois Waterway provided a navigable route from Chicago to the Mississippi River and beyond via the Chicago Sanitary and Ship Canal, Calumet-Sag Channel, and Des Plaines and Illinois rivers. Although the Chicago Sanitary and Ship Canal Recording Project focused on a 2.2-mile-long section of the canal, this report will provide an overview of the history, design and construction of the entire canal.

Description of Current Conditions
The Chicago Sanitary and Ship Canal was built in two sections, the result of separate pieces of legislation. The first section, called the Main Channel, was built from 1892 and 1900 and extends from Chicago to the Controlling Works at Lockport. The Main Channel Extension, constructed from 1903-1907, added about 4 miles to the channel, making its terminus the Lockport Power House, Dams, and Lock, with a tailrace to the Upper Basin at Joliet.[2]

The 33.9-mile Chicago Sanitary and Ship Canal extends between Illinois Waterway River miles 321.7 (Chicago) and 290.0 (Lockport, Des Plaines River). In terms of locations, the canal begins at Damen Avenue (formerly Robey Street in Chicago) and ends at the Lockport powerhouse

[1] Martin Melosi, *The Sanitary City: Urban Infrastructure in America from Colonial Times to the Present* (Baltimore: The Johns Hopkins University Press, 2000), 95.
[2] A note about the names of the canal: "Main Channel was the commonly used name for the channel constructed from 1892 to 1900 to reverse the flow of the Chicago River. For the first few years of this period, it was also referred to as the main drainage channel. The use of the Chicago Sanitary and Ship Canal appeared later in the decade on public documents…. Oddly, it does not appear in the Proceedings of the Board during this first decade. It eventually became the official name used on maps and public documents and included the four mile long Main Channel Extension built from 1903 to 1907. Main Channel continues to be used as a common name." In this report, Main Channel and Main Channel Extension will be used to differentiate between the two building campaigns, while Chicago Sanitary and Ship Canal will be used to refer to the entire length of the canal. See Richard Lanyon, " 'So They Reversed the River': A History of the Construction of the Main Channel and Improvements to the Chicago and Des Plaines Rivers from 1892 to 1900 for the Reversal of the Chicago River," 1999, p. vii. This typewritten manuscript is available at the Metropolitan Water Reclamation District headquarters in Chicago, Illinois, hereafter referred to as MWRD.

tailrace. The South Branch of the Chicago River feeds the channel, drawing water from Lake Michigan at Illinois Waterway River Mile 321.7, as well as the Calumet-Sag Channel, which feeds the channel at Illinois Waterway River Mile 303.4.[3]

The canal travels through a variety of geologic forms, which resulted in different dimensions and channel wall types. From its beginning at Damen Avenue (Illinois Waterway River Mile 321.7) and extending to River Mile 313.1, the channel is cut in earth. The current dimensions of this section are a bottom width of 162', a water line width of 234', and a 22' depth. From River Mile 313.1 to 307.8, the channel runs through a combination of earth and rock. The bottom width is 202', with a 299' water line width and a 22' depth. The channel in this section has walls constructed of both earth and limestone. Finally, from River Mile 307.8 to 290, the channel runs through rock, with a bottom width of 160' and 22' depth. (Recent repairs to sections of the channel walls by the U.S. Army Corps of Engineers will result in the widening of the channel's 162' water line width in some areas.) According to the recently completed National Register nomination, this section has "natural limestone walls" in some areas that are "relatively smooth vertical planes" while "slightly angled dry-laid limestone rubble and mortared stone walls were used when the bed rock was not near enough the surface for the structural demands of the channel."[4]

In addition to the channel, there are a number of extant structures associated with the Chicago Sanitary and Ship Canal. These include the Willow Springs Spillway at Illinois Waterway River Mile 307.3, consisting of a 1908 concrete spillway with twenty-two arched intakes that was used to discharge water from the Des Plaines River into the channel. This structure was taken out of use in 1955.[5] The Lockport Controlling Works (see HAER No. IL-197-A) is located on the west side of the channel at River Mile 293.2. The structure originally consisted of a bear-trap dam and sluice gates, although the dam has since been removed and replaced by an earthen dam. The remnants of the Butterfly Dam (see HAER No. IL-197-B) are located in the center of the channel at River Mile 293.1. The Controlling Works and Butterfly Dam were built as safeguards in the event of flooding or periods of heavy rain. Since the canal was basically at the same level as Lake Michigan until Lockport, where there was a nearly 40' change in elevation, Sanitary District officials feared potential flooding of Joliet and other cities downstream could occur. In addition, excess water could cause the flow of the canal to reverse back into Lake Michigan. The Controlling Works could discharge water from the canal into the nearby artificial channel constructed for the Des Plaines River, while the Butterfly Dam could stop water from flowing down the canal. Finally, the Lockport Power House, Dam, and Lock span the channel at River Mile 291.1. The powerhouse and two movable dams (see HAER No. IL-197-C) were built as part of legislation authorizing the generation of power by the Sanitary District. Lockport Lock (see HAER No. IL-197-D) was built to facilitate navigation on the channel since there is a nearly

[3] Branden K. Scott, "Chicago Sanitary and Ship Canal Historic District," National Register of Historic Places Nomination Form, May 2009, Section 7, Page 2.
[4] Branden K. Scott and Lowell Blikre, National Register of Historic Places Amended Multiple Property Submission and Nomination of the Chicago Sanitary and Ship Canal Historic District to the Illinois Waterway Navigation System Facilities, May 21, 2009, Section E, Page 4.
[5] Scott, "Chicago Sanitary and Ship Canal Historic District," Section 7, Page 12. The spillway is also known as the Des Plaines River Spillway.

40' change in elevation at this site, as well as allow boats to enter the channel from the Illinois & Michigan Canal (I&M Canal). The lock was soon superseded by an adjacent, larger lock built as part of the 1933 Illinois Waterway.

The original channel walls are undergoing rehabilitation in that portion of the channel from River Mile 291.1 to 293.3 on which this project focused. Both the east and west channel walls were deteriorating. In addition, there were seepage problems at the west wall, and testing revealed that the concrete of the east wall below the water level was compromised. The U.S. Army Corps of Engineers considered three methods of rehabilitating the east chamber walls and decided on the slurry cut-off walls. The first method, the "Roller Compacted Concrete (RCC) Wall," involved building another concrete wall between the original canal wall and Deep Run Creek to the east. The existing canal wall would be removed and the slopes regraded. The second method, "Panel Construction," had a precast concrete panel wall installed in front of the original canal wall. The top of the original concrete wall would be removed so the panels could be attached to a block of concrete, and a new top would be constructed. The Panel Construction alternative would result in a narrowing of the channel by 4'. Finally, the third method, "Slurry Cut-Off Wall Construction," consisted of building a slurry cut-off wall in the existing wall that would be anchored to a deadman wall. This would result in a slightly larger channel. During a summer 2009 field visit, a contractor was installing a slurry cut-off wall at the west channel wall to the east of the core wall. The "Panel Construction" method was used on the east wall.[6]

Historical Information

Early History

The topography of the land surrounding the city and on which the city stood is an important component of the story. The Valparaiso Moraine, a low ridge that runs parallel to and west of Lake Michigan, was created during the Wisconsin glacial period and creates two drainage systems. One system, which includes the Des Plaines River, flows to the Mississippi River. The other drains into Lake Michigan and includes the Chicago River. Aside from the moraine, the land surrounding Lake Michigan is basically flat with minimal elevation changes.[7] Chicago itself sits on "flat terrain" that rises "only slightly above the elevation of the Chicago River and Lake Michigan, and the soil and technically altered surfaces were so nonporous that absorption was virtually impossible and drainage confounding."[8] A gap in the Valparaiso Moraine offered portage from the Des Plaines River to the south branch of the Chicago River through a swampy area referred to as "Mud Lake." It was this area that would eventually be utilized in the development of a waterway system.[9]

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[6] Letter, Kenneth A. Barr, Chief, Economic and Environmental Analysis Branch, Rock Island District Corps of Engineers, to Ms. Anne Haaker, Deputy State Historic Preservation Officer, Illinois Historic Preservation Agency, November 6, 2008.
[7] A. Berie Clemensen, "Illinois and Michigan Canal National Heritage Corridor, Illinois, Historical Inventory, History and Significance" (Denver Service Center, National Park Service, July 1985), 1.
[8] Melosi, 96.
[9] Clemensen, 1.

The Chicago River, described as a "narrow, sluggish inlet of Lake Michigan" and made up of two branches dividing Chicago into three parts, originally served as the city's sewer system.[10] As the city's population and manufacturing grew, the river became increasingly polluted. This was a pressing issue because, as already noted, the topography of the land was such that the river drained into Lake Michigan, the source of the city's drinking water. An inlet basin located about 3,000' from the Chicago River's mouth supplied the city's residents with drinking water in the 1850s.[11] The problematic location of this inlet was highlighted by an 1854 cholera epidemic in which one out of eighteen Chicagoans died. Historian Martin Melosi notes that the situation in Chicago was not unique. The development of engineered sewer systems in this country was slow between 1830 and 1880 for a variety of reasons despite increasing populations. Cities usually lacked funds for multiple infrastructure projects and chose instead to focus on the water supply. In addition, sewer systems had little revenue potential and thus were not particularly attractive to private investors. Finally, Melosi argues, "many people recognized the benefit of water service, which brought a valuable commodity into the house, but often failed to see the advantage of a system that evacuated something as unwanted as wastewater and sewage when other methods of disposal seemed adequate and available."[12] Cities were forced to deal with the sewage problem when numbers of residents with running water grew along with a comparable increase in waste water. The main intent behind the early sewage systems was simply "to evacuate those wastes from the city as quickly and efficiently as possible."[13] This intent can be seen in Chicago's ultimate decision to reverse the Chicago River and create a channel to move the city's sewage downstream.

In response to the 1854 cholera epidemic, the Illinois General Assembly authorized the establishment of the Chicago Board of Sewerage Commissioners in 1855. The board then hired Ellis S. Chesbrough, city engineer of Boston, to develop a water and sewer system. Chesbrough, born in 1813 in Baltimore County, Maryland, first trained as a railroad engineer, but in 1846, he accepted the position of chief engineer of the West Division of the Boston Water Works. By 1851, he had been promoted to the position of city engineer of Boston. Chesbrough's plan for Chicago called for building sewer mains about 800' apart. Laterals would drain the side streets and connect to the mains, which would discharge into the Chicago River. The city's drainage issues resulting from the flat topography would be resolved by elevating the city as much as 12' in areas to create a sufficient grade for drainage. Finally, to address the lingering problems of the suitability of using Lake Michigan for drinking water, tunnels extending 2 miles into the lake would be built and equipped with intake cribs to bring fresh water to city residents. In a time when cesspools were the common form of sewage disposal, Chesbrough's plan was innovative. Construction began in 1856 and lasted nearly twenty years, building what "amounted to the first comprehensive sewerage plan for a major city in the United States." Ultimately Chesbrough did not solve Chicago's pollution problem because the city's sewers still dumped into the Chicago River where the sewage accumulated before eventually draining into Lake Michigan. Moving

[10] "Methods of Work and Special Plant on the Chicago Drainage Canal, Part I," *The Engineering Record* XXXIII, no. 18 (April 4, 1896): 310.
[11] Melosi, 80.
[12] Melosi, 80, 90-91, 96. Quote from page 91.
[13] Melosi, 92.

the intakes further into the lake was also ineffective because the pollution simply followed. The city's sewage had to be disposed of in another way.[14]

Some officials saw the I&M Canal as one solution to the problem. Dating to 1848, the 97-mile-long canal ran from Bridgeport to La Salle via the Chicago, Des Plaines, and Illinois rivers. The canal had a "profound impact on commerce, manufacturing, and settlement," because "it made Chicago, not St. Louis, the favorite trading center."[15] Yet its impact was limited by the insufficient size of the canal and its locks, which were only 6' deep, 18' wide, and 110' long, and the variable flow of water. The Illinois River, extending from La Salle to Grafton (where it emptied into the Mississippi River) was a "stretch of sluggish river channel" that impeded navigation. Chicago, on the other hand, saw potential in the canal as a conveyor of sewage. The Illinois General Assembly approved the deepening of the canal in 1865, and for the next six years, the excavation of the channel took place. The completion of the deepened canal in 1871 resulted in the reversal of the Chicago River so that it carried sewage away from Lake Michigan.[16]

The I&M Canal soon proved incapable of handling the onslaught of sewage from the ever-growing city of Chicago, leading to complaints of odor and that the canal was a nuisance from residents of towns along its route. One problem was that the canal's elevation and the lake's elevation were so close that the current was quite slow and could be easily reversed if the lake level shifted slightly or if there was a heavy rainfall. A second problem was the tendency of the nearby Des Plaines River to overflow during periods of heavy rain into the canal. The Des Plaines River's natural outlet was near Summit, where it flowed into the Chicago River. When the Des Plaines overflowed, the excess water naturally drained into the Chicago River and pushed the contaminated water further into the lake. The Ogden-Wentworth Ditch was a third complicating factor. The ditch dated to the early 1870s when William B. Ogden and John Wentworth constructed a channel to drain their swampy lands near Summit. The resulting nearly 5-mile-long canal ran from the Des Plaines River to the West Fork of the South Branch of the Chicago River and drew the waters of the Des Plaines River away from the natural channel, down the ditch, and into the South Branch of the Chicago River.[17] (See Appendix B for a map of area waterways.)

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[14] Scott, "Chicago Sanitary and Ship Canal Historic District," Section 8, Pages 21-22; Charles Shattuck Hill, *The Chicago Main Drainage Channel: A Description of the Machinery Used and Methods of Work Adopted in Excavating the 28-Mile Drainage Canal from Chicago to Lockport, Ill.* (New York: The Engineering News Publishing Co., 1896), 1. Quote from Melosi, 96, see also 95-97.

[15] Clemensen, 25.

[16] Lanyon, "So They Reversed the River," 1-1 – 1-2; Clemensen, 33; "Methods of Work and Special Plant on the Chicago Drainage Canal, Part II," *The Engineering Record* XXXIII, no. 19 (April 11, 1896): 328.

[17] The Ogden-Wentworth Ditch was problematic as it practically diverted the Des Plaines River from its natural channel and pushed more water into Lake Michigan. At the suggestion of Chesbrough, a dam was built at the junction of the Ogden-Wentworth Ditch with the Des Plaines River, but the ditch still caused problems. See J. Seymour Currey, *Chicago: Its History and Its Builders, A Century of Marvelous Growth*, vol. 2 (Chicago: The S.J. Clarke Publishing Company, 1912), 194-195; Hill, *Chicago Main Drainage Channel*, 2-3; Lanyon, 1-2.

In response to these problems and complaints, the Bridgeport pumping station was re-established in 1884 to counteract the Des Plaines River and bring more water into the I&M Canal to dilute the sewage. Located at the junction of the canal with the South Branch of the Chicago River, the pumping station had initially been established in 1871 during a period of low water in the canal. Workers operating the new station allegedly "noted to their astonishment that Chicago's sewage was moving downstream and that the Chicago River had been reversed."[18] The pumping station had an 80,000-gallon capacity, but it quickly became apparent that it could only insure adequate flow in the canal for vessels. This was proven after a huge rainstorm on August 2-3, 1885, resulted in 6.15" of rain flooding the system. The heavy rainfall flooded the Des Plaines River, which overflowed at Summit and caused a rush of water down the Ogden-Wentworth Ditch that engulfed the West Fork of the South Branch of the Chicago River and finally flowed into Lake Michigan.[19]

After these failures, the Citizens Association of Chicago issued a report demanding that the city's sanitary problems be resolved. As a result, the City of Chicago Common Council established the Commission on Drainage and Water Supply in January 1886 with Lyman Cooley, a civil engineering professor from Northwestern University, at its head. The Commission on Drainage and Water Supply developed three proposals to deal with the sanitation problem. The first was to continue discharging sewage into Lake Michigan while also building "large conveyance systems to bring fresh water from north of Evanston into the city and to convey waste to the lake to the south in the Calumet region." The second idea was to dispose of sewage on land, an idea that was soon dismissed as too expensive due to the sheer volume. The third solution was to dispose of sewage via the Des Plaines River, which ran away from Chicago and Lake Michigan. This idea would end up forming the basis of the Chicago Sanitary and Ship Canal.[20]

Sanitary District

The city of Chicago was at its legal debt limit, so it was unable to immediately act on the solutions provided by the Commission on Drainage and Water Supply. The state legislature proposed establishing another local government unit to manage sewage and water, but the legislation failed to pass in 1885 and 1887. In May 1887, a legislative commission known as the Commission of Five and made up of the Mayor of Chicago, two members of the House, and two members of the Senate was established. In February 1889, this group brought a bill before the state legislature that created a channel to carry sewage diluted by Lake Michigan water away from the city and its source of drinking water. To appeal to constituents living downstream from Chicago, not only would the sewage be diluted by lake water, but also the channel itself would be considerably larger than the I&M Canal and thus able to handle a greater variety of vessels. There was great interest in a navigable route connecting Chicago and the Great Lakes with the

[18] Louis P. Cain, "Unfouling the Public's Nest: Chicago's Sanitary Diversion of Lake Michigan Water," *Technology and Culture* 15, no. 4 (October 1974): 595.
[19] Ward Walker, "The Story of the Metropolitan Sanitary District of Greater Chicago: The Seventh Wonder of America," np: nd, 6-7, available at the Chicago Public Library-Harold Washington Library Center, Chicago, Illinois; Lanyon, "So They Reversed the River," 1-1 – 1-2; "Millions of Money," *Chicago Daily Tribune*, July 23, 1893, 25.
[20] Lanyon, "So They Reversed the River," 1-3 - 1-4, quote from 1-3; Scott, "Chicago Sanitary and Ship Canal Historic District," Section 8, Page 22.

Mississippi River and beyond, so focusing on this aspect of the proposal distracted attention from the fact that Chicago would be sending its sewage downstream where other cities and waterways would be affected. Ultimately, the proposal appealed to Illinois legislators who established the Sanitary District by an Act of the General Assembly of the State of Illinois on May 29, 1889. The law authorized "the incorporation of a sanitary district with trustees who have the power to develop and build channels for drainage (encompasses sewage) and build/lease/maintain docks and control any water power resulting from the building of channels." In November 1889, the establishment of the Chicago Sanitary District was approved by popular vote.[21]

The Drainage Boundary Commission, consisting of three Cook County judges, established the initial boundaries of the Sanitary District in November 1899. The district encompassed all of Chicago north of 87th Street, as well as the incorporated towns of Cicero, Lyons, and part of Lyons Township. The boundaries were the lakefront to the east, 87th Street to the south, Harlem Avenue to the west, and Devon Avenue to the north for a total of 185 square miles.[22] With the boundaries established, the Sanitary District could begin fulfilling its mission, which was "to provide for the disposal of sewage of the District by dilution and outlet into the Illinois River, and to provide such other sewage disposal as shall preclude contamination of Lake Michigan water supply."[23]

To fulfill the mandate of disposing of sewage, the act specified that the Sanitary District would construct "a main drainage channel of sufficient size and capacity to produce and maintain at all times a continuous flow of not less than 80,000 cubic feet a minute, to be of a depth of not less than fourteen feet, with a current not exceeding three miles an hour."[24] The district built a system of channels, intercepting sewers, and pumping stations based on the dilution method of sanitation, which was the standard and least expensive way to deal with sewage disposal. As historian Melosi points out, "American cities relied on their vast water resources to serve as sinks for many years," and Chicago was no exception.[25] The dilution method relied on the idea that running water purified itself, although more scientific measures were taken. Rudolph Hering and others involved in planning the Chicago Sanitary and Ship Canal developed standards of the rate of flow based on population. Hering recommended for the canal a minimum of 3.3 cubic feet per second per 1,000 people.[26] Lyman Cooley, who served as Chief Engineer, was authorized to survey the route for the canal and provide four alternatives in June 1890.[27]

Main Channel

The Sanitary District's Board of Trustees considered four routes for the canal, taking into consideration the glacial drift and solid limestone through which the canal would have to travel.

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[21] Lanyon, "So They Reversed the River," 1-5 – 1-6; quote from "Methods of Work and Special Plant on the Chicago Drainage Canal, Part I," 311; The Sanitary District of Chicago, "Engineering Works," August 1928, 9.
[22] Lanyon, "So They Reversed the River," 3-1.
[23] The Sanitary District of Chicago, "Engineering Data on the Sanitary District of Chicago," (June 1910), 4.
[24] "Millions of Money," 25.
[25] Melosi, 163.
[26] Melosi, 162-164; Sanitary District, "Engineering Works," 7; Lanyon, 3-2.
[27] Cooley did not serve long as the Chief Engineer due to differences with the board. A series of men held the position of Chief Engineer during the planning stages. See Lanyon, "So They Reversed the River," for details.

There was dissent among the board members over the route of the channel, particularly the idea of extending it all the way to Joliet. A majority of members advocated a "minimal approach," such as using the I&M Canal's channel. This was probably seen as a cost-saving measure and a way to keep taxes low.[28] An article in *Engineering Record* detailed this approach: "with the terminals of the canal fixed at Chicago and Joliet naturally enough the route of the Illinois & Michigan Canal, already existing between these two cities, was a base line, more or less, for the line of the new channel. In fact it was seriously proposed to adopt this location entirely, and only pecuniary and political considerations decided the selection of the present route."[29]

The first proposed route had the canal beginning at the West Fork of the Chicago River at Western Avenue and following the Ogden-Wentworth Ditch. The second proposed route started at the South Fork of the Chicago River at Ashland Avenue and ran alongside the I&M Canal. The third alternative began at the West Arm of the South Fork of the Chicago River near Western Avenue and extended west along 39th Street to the I&M Canal where it used that canal's channel. Finally, the fourth route followed a similar trajectory as the third route, except it crossed the canal and continued northwesterly to the Ogden-Wentworth Ditch where it used that ditch's channel. In July 1891, the board selected the fourth route, but further discussion was required to minimize the rock excavation and decide what to do with the rock spoil.[30]

By June 1892, the board had settled on a route and bidding started on the various construction contracts. (See Appendix B for map of canal and other area waterways.) The final route and work required was described as: "Push the Des Plaines River to the west side of its valley. Dig a new drainage canal from the Chicago River at Robey Street to the Des Plaines River at Lockport, 28 miles of new canal, much of it through solid rock. Make the Chicago River and the new canal flow away from the lake. Build intercepting sewers along the lakefront designed to carry their load into the drainage canal."[31] The act incorporating the Sanitary District required the new channel to have a flow of 300,000 cubic feet/minute and a capacity of double that at 600,000 cubic feet/minute as well as a velocity of no more than 3 miles per hour (mph). A flow of 20,000 cubic feet had to be provided for every 100,000 residents.[32]

The variable rate of flow of the Des Plaines River precluded its use for the channel of the new canal. According to one article, "at some seasons its whole discharge would pass through a six-inch pipe, and at other times its volume reaches 800,000 cubic feet a minute, and frequently floods the entire valley."[33] Another article described the variations of the Des Plaines' flow as ranging from "the stream from a fire-engine to a flood."[34] A new, 13-mile channel was built for the Des Plaines River that paralleled the canal. In addition, 19 miles of levees built of spoil from channel excavation were constructed "to divorce the waters of the Desplaines watershed from the

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[28] Lanyon, "So They Reversed the River," 4-1.
[29] "Methods of Work and Special Plant on the Chicago Drainage Canal, Part I," 312.
[30] Lanyon, "So They Reversed the River," 4-3 – 5-1; "Bridgeport to Joliet," *Chicago Daily*, July 23, 1891, 9; "It Will Save Millions," *Chicago Daily*, July 26, 1891, 1.
[31] Walker, 7.
[32] "Methods of Work and Special Plant on the Chicago Drainage Canal, Part I," 312.
[33] "Engineers' Feat in Big Channel," *Chicago*, January 2, 1900, 11.
[34] "Methods of Work and Special Plant on the Chicago Drainage Canal, Part I," 312.

channel which is to receive the waters of Lake Michigan and pass them into the Mississippi by way of the lower Desplaines and Illinois Rivers."[35] The levees were necessary because the Des Plaines River was at a higher elevation than the canal for almost the entire length to Lockport, which would have caused the river water to enter the canal during periods of flooding.[36]

The mammoth undertaking of excavating a channel for the canal as well as one for the re-routed Des Plaines River through miles of rock resulted in what became known as the "Chicago school of earth moving" as contractors devised "some of the greatest labor and time-saving machines in the history of mechanical engineering."[37] According to one contemporary article, "the mechanical work on the canal has evoked the wonder and admiration of engineers throughout the world. A majority of the great machines used in construction and excavation were invented as a result of the demands made on the contractors by the conditions of the work, and engineers predict that these inventions will soon result in wonderful progress in the work of connecting oceans, lakes and rivers, to the benefit of commerce and the advancement of civilization."[38] The difficulty of excavation was primarily due to the amount of rock to be excavated. Nearly 15 miles of channel from Willow Springs to the Controlling Works at Lockport was in rock, primarily Niagaran dolomite limestone located close to or at the surface, while another 5 miles from Summit to Willow Springs ran through a mixture of earth and rock.[39]

Construction of the Main Channel was divided into three main sections (earth, earth and rock, and rock) based on the geological character of the land through which the channel traveled. The sections were determined by 3"-diameter borings made along the channel line, which later proved to be problematic because "an entirely misleading idea was obtained of the hardness of the glacial drift on certain sections."[40] These sections were further divided into discrete segments that were put under individual contracts. The division of the channel into approximately one-mile stretches was done to make the work manageable for contractors. If a particular contractor was unable to complete the work, it would not slow completion of a large portion of the channel. In addition, the Sanitary District created four administrative divisions, each of which was headed by a Sanitary District engineer. Beginning at the eastern end, the divisions were Summit (extending 7-½ miles from the beginning point at Robey Street to Section G's west end), Willow Springs (extending 7-½ miles from Section F's east end to Section 1's west end), Lemont (extending about 7 miles from Section 2's east end to Section 8's west end), and Lockport (beginning at Section 9's east end and running to Section 15 for 7 miles).[41]

The rock section extended 14.95 miles from Willow Springs to the Controlling Works at Lockport. The channel in this section had a bottom width of 160' and depth of 24'. The Sanitary District divided the rock section into fourteen contracts, each of which were about a

[35] "Methods of Work and Special Plant on the Chicago Drainage Canal, Part I," 312. Quote from "Engineers' Feat," 11.
[36] Lanyon, "So They Reversed the River," 5-9.
[37] "Engineers' Feat," 11.
[38] "Engineers' Feat," 11.
[39] Lanyon, "So They Reversed the River," 5-1.
[40] Hill, *Chicago Main Drainage Channel*, 9.
[41] Hill, *Chicago Main Drainage Channel*, 11-12, 25, 50, 79.

mile long and were numbered one through fourteen. Sections 1 through 6 were underlaid with solid rock with a fair amount of earth and had masonry walls. Sections 7 through 14 were in solid rock and had vertical channeled sides. Sections 1 through 14 were under contract by July 1892 (see Appendix A for list of sections and contractors). Section 15 was the last under contract on August 27, 1894. This section was located at the terminus of the Main Channel. Largely built in rock, it extended the channel 4,000' from its original terminus to nearly 1/3 mile north of 9th Street in Lockport. The first 1,000' of the section measured the typical 160' wide, but the remainder gradually widened to form a "windage basin" that allowed vessels to turn around.[42]

The channel above Willow Springs was split into two parts in August 1892 because the board had not yet decided upon the final route. The two sections were Willow Springs to Summit, which extended 5.3 miles through a combination of earth and rock, and Summit to Chicago, which was a 7.8 mile channel through earth.[43] The Willow Springs to Summit section generally followed the Des Plaines River and I&M Canal in a northeast-southwest direction. The construction of this section required excavation in glacial drift with some rock.[44] The work was divided into six contracts, labeled A-F, and each measured about a mile long. These sections required excavation of over 7 million cubic yards of earth and 95,000 cubic yards of rock. Sections A through E had a bottom width of 202', a depth of 24', and 2:1 side slopes.[45] At Section F, the channel narrowed to a 110' bottom width. In addition to constructing the canal, the Des Plaines River had to be confined within a diversion channel that "begins as soon as the Des Plaines River flows under the Santa Fe tracks, just south of today's 47th Street and west of Harlem Avenue." A levee separated the two channels.[46]

The earth segment of the canal extended 7.8 miles from Summit at Harlem Avenue to the West Fork of the South Branch, just west of Robey Street (now Damen Avenue) in Chicago. It was divided into eight contracts designated G through O, skipping J. The lengths of the sections varied from 2,853' to 7,078'. The bottom width of the earth section was 110' with a 24' depth, and 2:1 side slopes.[47]

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[42] Isham Randolph, "The Sanitary District of Chicago, and the Chicago Drainage Canal: A Review of Twenty Years of Engineering Work," 1909, 5; "Engineers' Feat in Big Channel," 4, 11; "Methods of Work and Special Plant on the Chicago Drainage Canal, Part III," *Engineering Record*, XXXIII, no. 20 (April 18, 1896): 346; Lanyon, "So They Reversed the River," 5-11; Sanitary District, "Engineering Data on the Sanitary District of Chicago," (June 1910), 5; Hill, *Chicago Main Drainage Channel*, 6.
[43] The contracts encompassing these two sections were labeled A-O, skipping J.
[44] According to the Sanitary District specifications quoted by Hill in *Chicago Main Drainage Channel*, glacial drift consisted of "the top soil, earth, muck, sand, gravel, clay, hardpan, boulders, fragmentary rock displaced from its original bed, and any other material that overlies bed rock." In addition, "these materials are found in all degrees of intermixture, from soft black muck, which can be pumped with centrifugal pumps, to a conglomerate of sand, gravel, clay, and boulders cemented together with almost the hardness of rock, and only to be excavated by means of the strongest steam shovels, and sometimes even requiring blasting to break it up." See page 6.
[45] Sanitary District, "Engineering Works," 15; Sanitary District, "Engineering Data" 5; "Methods of Work and Special Plant on the Chicago Drainage Canal, Part III," 346.
[46] Lanyon, "So They Reversed the River," 6-2.
[47] Lanyon, "So They Reversed the River," 7-1 – 7-4; Sanitary District, "Engineering Data," 5.

The Sanitary District decided that work should begin on the rock section first, since it would be the most difficult and time consuming to excavate. In July 1892, the Sanitary District awarded sections 1 through 14 to six contractors. Only McArthur Brothers of Chicago submitted bids for every contract.[48] (See Appendix A for list of contractors for each section.) Work on the channel began on September 3, 1892, known as "shovel day," with a ground breaking ceremony at Lemont.[49]

Sections A through F were under construction by early 1892 while Sections G through M were contracted in December 1893. Sections N and O were awarded in May 1893, and Section 15 was the last in 1894.[50] At the end of 1893, N.W. Weston, Superintendent of Construction for the Sanitary District, reported,

> the river diversion is practically completed. It has involved many changes of the bed of the Desplaines River, by means of which this stream has not only been removed from the site of the main channel of the canal, but its course has been straightened, as well as deepened, and its carrying capacity largely increased thereby. These changes have been made at six different points between Lyons, Cook County, and Romeo Road, Will County, and aggregate thirteen and three-tenths miles of newly constructed river channel 200 feet wide, required the excavation of about 1,600,000 cubic yards of glacial drift and 240,000 cubic yards of solid rock.[51]

Originally, the Sanitary District had predicted completion of the Main Channel on April 3, 1896, but construction continued until 1900.[52]

The completion date was overly optimistic given the amount and nature of the channel excavation, but disputes between the various contractors and the Sanitary District also contributed to the delays. The most problematic sections, not surprisingly, were the earth/rock and rock sections. For example, the contracts for sections 2 through 4, located in the earth/rock portion were originally let to McArthur Brothers. These three contracts covered the construction of 3 miles of channel below Willow Springs and were estimated to require excavation of

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[48] The *Chicago Daily Tribune* included a list of bidders for the project: McDonald Bros & Co. of Grand Rapids, Michigan; E.J. Gaynor & Son of Pottsville; E.D. Smith & Co. of Baltimore, Maryland; Thomas H. Riley of Joliet, Illinois; The Heidenrich Company of Chicago; Mason, Hoge & Company of Frankfort, Kentucky; Green & Butler of Petoskey, Michigan; Michael Lilly of Detroit, Michigan; John Griffith of Chicago; Thomas Rock of Chicago; Lynch-Phelps, Schaefer & Harding of Monmouth, Illinois; O'Hearn, Loo & Strange of Kansas City, Missouri; Agnew & Company of Chicago; John Scott & Son of St. Louis, Missouri; H.B. Herr & Co. of Chicago; Winston Bros. & McMullen of Minneapolis, Minnesota; R.F. Wilson of Chicago; John Shields of Kentucky; M.J. Condon & Company of Knoxville, Tennessee; McArthur Bros of Chicago; Darwin & Dugan of Owego, New York; Quigley & Moore of St. Louis, Missouri; Streeter, McGarick & Company of Denver, Colorado; Lydon & Dress of Chicago; McCormick Construction Company of St. Louis and Alfred Harley of Chicago. See "Figures Are Given," *Chicago Daily Tribune*, June 9, 1892, 4.
[49] "Drainage Canal's Legal Work," *Chicago Daily*, January 2, 1900, 10.
[50] Randolph, "The Sanitary District of Chicago, and the Chicago Drainage Canal," 4; Hill, *Chicago Main Drainage Channel*, 117.
[51] "Report on the Canal," *Chicago Daily*, December 21, 1893, 6.
[52] "Drainage Canal's Legal Work," 10.

1,484,703 cubic yards of solid rock and 2,179,524 cubic yards of glacial drift. During excavation, McArthur Brothers found the area contained a great deal of glacial drift comprised of hard clay that was difficult to remove using a steam shovel. Consequently, the contractor requested that the Sanitary District pay the rate assigned for solid rock excavation. The district refused, so McArthur Brothers stopped work in response. The contracts were re-advertised, but in 1896, the *Engineering Record* notes that the contracts for Sections 2 and 4 were re-let to McArthur Brothers, while Section 3 had been awarded to Gilman & Company.[53] The Sanitary District's Board of Trustees and McArthur Brothers had come to an agreement on the excavation price for those two sections because McArthur Brothers' bid was still lower than any of the other submissions. Sections 5, 6, 7, 8, and 9 provide another example of contractor problems. Agnew & Company, the original contractor, was so far behind schedule that the Sanitary District deemed their contracts delinquent. Their work on Section 5 had even been condemned.[54] By 1896, Section 5 had been re-let to the Qualey Construction Company while sections 6, 7, and 8 went to Mason, Hoge & Company. Section 9 was re-let to Halverson, Richards & Company.[55]

There were problems with the earth portion of the Main Channel construction as well. The most problematic area seems to have been sections E and F for a number of reasons. Ricker, Lee & Company of Galveston, Texas, had originally been awarded the contract for Section F in November 1892, but the company quickly asked the Board of Trustees to amend the contracted price of excavation because the borings had not indicated this section contained hard glacial drift.[56] In addition, there was flooding on Section E when the Des Plaines River breached the levees. Ricker, Lee & Company protested after the Sanitary District refused to adjust the contracts for the different material. The district re-advertised the contract and awarded it to Weir & McKechney of Cincinnati. Section E was also re-let to Angus & Gindele after Streeter & Kenefick protested about the contracted construction prices. Ultimately, Section F had three contractors before it was completed in 1899, and Section E had four.[57]

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[53] "Methods of Work and Special Plant on the Chicago Drainage Canal, Part XX," *The Engineering Record* XXXV, no. 3 (December 19, 1896): 48; "Methods of Work and Special Plant on the Chicago Drainage Canal, Part XXI," *The Engineering Record* XXXV, no. 4 (December 26, 1895): 70; "Methods of Work and Special Plant on the Chicago Drainage Canal, Part XXII," *The Engineering Record* XXXV, no. 11 (February 13, 1897): 225; Hill, *Chicago Main Drainage Channel*, 50.
[54] Agnew & Company is also referred to as Agneu.
[55] "Report on the Canal," 6; "Methods of Work and Special Plant on the Chicago Drainage Canal, Part XXIII," *The Engineering Record* XXXV, no. 15 (March 13, 1897): 313; "Methods of Work and Special Plant on the Chicago Drainage Canal, Part XXIV," *The Engineering Record* XXXV, no. 20 (April 17, 1897): 422; "Methods of Work and Special Plant on the Chicago Drainage Canal, Part XXV," *The Engineering Record* XXXVI, no. 7 (July 17, 1897): 136; "Methods of Work and Special Plant on the Chicago Drainage Canal, Part XXVI," *The Engineering Record* XXXVI, no. 11 (August 14, 1897): 224; "Methods of Work and Special Plant on the Chicago Drainage Canal, Part XXVII," *The Engineering Record* XXXVI, no. 15 (September 11, 1897): 316.
[56] Hill, *Chicago Main Drainage Channel*, 25. Hill describes the nature of the material as consisting of a top soil of "soft prairie loam" that holds more clay in the deeper layers. This clay had to be blasted with explosives, which resulted in large blocks that had to be blasted again into smaller pieces for removal. The contractor also discovered beds of quick-sand under the clay that were referred to as "bull liver," because when touched by the foot, the sand would "shake, jelly-like, for a considerable distance around the point of pressure." (See page 27.)
[57] "Methods of Work and Special Plant on the Chicago Drainage Canal, Part X," *The Engineering Record* XXXIV, no. 7 (July 18, 1896): 120; "Methods of Work and Special Plant on the Chicago Drainage Canal, Part XI," *The Engineering Record* XXXIV, no. 9 (August 1, 1896): 158; "Methods of Work and Special Plant on the Chicago

The excavation of the Main Channel could be divided into three classes, wet in earth, dry in earth, and rock, and each required different excavation methods. For the wet in earth excavation, dredges were generally used. The two eastern sections consisted of clay and thus dipper dredges were used, while the muck removed from the Des Plaines River channel required hydraulic suction dredges.[58] For the dry in earth excavation, steam shovels were indispensable and constituted the "prime factor in the extraordinarily economical handling of large quantities of earth." Most of the steam shovels were provided by five manufacturers: Bucyrus Steam Shovel & Dredge Company of South Milwaukee, Wisconsin; Marion Steam Shovel Company of Marion, Ohio; Osgood Dredge Company of Albany, New York; Vulcan Iron Works of Toledo, Ohio, and Chicago, Illinois; and Toledo Foundry & Machine Company of Toledo, Ohio.[59] Since the spoil banks were generally located near the channel, various types of conveyors based on an incline type and using a single car or a train were used to remove the excavated material from the channel. The Mundy Hoisting Engine Works and W.A. Crook & Brothers Company, both of Newark, New Jersey, supplied the hoisting engines for removal of the materials from the channel.[60] To excavate the rock, channeling, drilling, blasting, and loading were generally required. To haul the excavated rock out of the channel, the stationary cable incline, the Lidgerwood traveling cableway, and the Brown cantilever hoist were the most used machines. The cantilever crane manufactured by the Brown Hoisting & Conveying Machine Company of Cleveland, Ohio, had been used for moving coal, ore, and pig iron, so it was well suited for the rock hauling.[61]

In order to efficiently excavate the material along the channel, the contractors developed new earth-moving machines. On the earth section of the channel, the top soil was methodically removed by scrapers or teams. Subsequent layers were generally removed by steam shovel and hauled away by dump cars with locomotives or some type of conveyor (either belt, incline or double cantilever). The excavated material was placed in spoil banks that were usually located along the channel. On Section H, however, the nature of the soil "was such as to induce the contractors to consider some very radical departures from previous practice in the design and operation of apparatus used for excavating and conveying spoil. The leading idea was to secure a constant and uninterrupted removal of earth in a practically automatic manner with the least possible handwork."[62] To accomplish this, the contractor, Hoover & Mason, used "an enormous machine of novel construction, which consisted of a bridge spanning the channel with cantilever arms projecting over the spoil area" that had been designed by Arthur J. Mason and Frank K.

Drainage Canal, Part XII," *The Engineering Record* XXXIV, no. 11 (August 15, 1896): 197-198; Lanyon, "So They Reversed the River," 6-7.
[58] Hill, *Chicago Main Drainage Channel*, 109.
[59] Hill, *Chicago Main Drainage Channel*, 39.
Marion Steam Shovel Company had more than twenty machines in use on the channel by various contractors while Bucyrus Steam Shovel & Dredge Company supplied at least twenty-six steam shovels. See Hill, *Chicago Main Drainage Channel*, "Advertisements," L, M
[60] Hill, *Chicago Main Drainage Channel*, 110, and "Advertisements," P, Q.
[61] Hill, *Chicago Main Drainage Channel*, 75, 111-112.
[62] "Methods of Work and Special Plant on the Chicago Drainage Canal, Part VIII," *The Engineering Record* XXXIII, no. 25 (May 23, 1896): 437.

Hoover of Kansas City, Missouri.[63] This double cantilever conveyor had a 320'-long bridge with a 148'-long cantilever to the south and a 172'-long cantilever to the north, making the total structure length 640'. Cars on the ends of the main span supported the structure and ran along tracks on either side of the channel. A steel belt passed over drums at each end of the cantilevers, moving the excavated material out of the channel. The machine had to be rebuilt after it fell over, and the redesign only had one cantilever to the north.[64]

On the earth and rock section, steam shovels were used to excavate the earth layer. Contractors then channeled, drilled, and blasted the rock into smaller pieces, which were removed from the channel by inclines, cantilever conveyors or cableways. Much of this excavated rock was used to build the channel walls. On Section 1, the contractor used Brown cantilever conveyors: "the machine is built on lines familiar in conveying apparatus….This conveyor differs from traveling cranes in being supported at the center and having two balanced overhanging arms instead of being supported at the two ends as is usual in yard and shop crane girders."[65] The Lidgerwood Manufacturing Company of New York designed the Lidgerwood cableway used on Section 2 of the channel. Twenty of these traveling cableways were used in the construction of the channel. The innovative cableway consisted of two towers mounted on cars that ran along tracks paralleling the excavated channel. A carrying cable spanned the 700' between the towers. The cableway brought the excavated rock up from the channel and deposited it into spoil banks. [66]

The rock portion of the channel required channeling and drilling. The blasted rock was then removed via cantilever conveyors and inclines. McMyler cantilever conveyors were used on Section 7. This cantilever conveyor "consists essentially of a tower running on a pair of longitudinal tracks on the beam and supporting two balanced transverse arms, with a united extension from the center of the canal to or beyond the center of the spoil bank."[67] Glacial drift was removed by hand loading it into dump cars and carts with some steam shovel use. The work on Section 15 reveals some details about how contractors handled excavating and removing the rock of this section. First, Ingersoll-Sergeant channelers were used to channel the rock.[68] Then

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[63] "Methods of Work and Special Plant, Part VIII," 437.
[64] "Methods of Work and Special Plant on the Chicago Drainage Canal, Part IX," *The Engineering Record* XXXIV, no. 5 (July 4, 1896): p. 82; Hill, *Chicago Main Drainage Channel*, 20-21.
[65] "Methods of Work and Special Plant on the Chicago Drainage Canal, Part XIX," *The Engineering Record* XXXIV, no. 26 (November 28, 1896): p. 480. The Brown Hoisting & Conveying Machine Company touted they were "Engineers, Designers and Manufacturers of Complete Systems for Handling of Materials." Hill, *Chicago Main Drainage Channel*, "Advertisements," K.
[66] "Methods of Work and Special Plant on the Chicago Drainage Canal, Part XX," 45-46.
A Lidgerwood Manufacturing Company advertisement noted that twenty Lidgerwood Traveling Cableways were sold and in use on the canal and stated "Our Devices are especially adapted for Canal and Trench Excavation, Dam and Bridge Construction, and are also extensively used for Mining, Quarrying, Logging, General Railroad and Contract Work, Pile Driving, Dock Work, Loading and Discharging Vessels, Cargoes, etc." See Hill, *Chicago Main Drainage Channel*, "Advertisement," J.
[67] "Methods of Work and Special Plant on the Chicago Drainage Canal, Part XXV," 137.
[68] Sullivan Machinery Company claimed that more of their channeling machines were used than any other in the channel's construction. According to a company advertisement, eighty-eight channelers were used, of which fifty-four were Sullivan. See Hill, *Chicago Main Drainage Channel*, "Advertisements," D.

Ingersoll-Sergeant drills bored holes about 20' apart in either lines or zigzags.[69] Either forcite (a gelatin dynamite) or Aetna and Atlas powders were used as explosives. Steam shovels loaded the rock onto cars, which were removed by locomotives.[70]

The Main Channel contained one major structure: the Lockport Controlling Works (see HAER No. IL-197-A). The structure was built to regulate the flow of the Main Channel and discharge excess water into the Des Plaines River. Chief Engineer Williams identified the need for a regulating works in March 1893 since the channel was at the same level as Lake Michigan with a precipitous drop at Lockport. The controlling works would serve as a way to divert water from the channel into the Des Plaines River channel during periods of high water or heavy rainfall. Chief Engineer Isham Randolph and his assistant, T.T. Johnston, had visited other regulating works, such as one at Minneapolis on the Mississippi River and a lock and dam near Sault Ste. Marie. In addition, the Nevers Dam, consisting of three bear-trap dams on the St. Croix River, inspired Randolph and Johnston because it only required one operator.[71] As designed, the Lockport Controlling Works consisted of fifteen sluice gates and a 160' long bear-trap dam. Only seven Stoney sluice gates measuring 30' wide and having a 20' vertical travel were actually installed; the other eight bays were left open for future use. The Lockport Controlling Works had been completed by summer 1899 at a cost of $373,000.[72] A tailrace channel extending from the Controlling Works south for about 14,100' (or 2.7 miles) to a point above the Joliet and Eastern Railroad Crossing was built as Section 16.[73]

When completed, a little more than 26 million cubic yards of glacial drift and 12 million cubic yards of solid rock had been excavated for the Main Channel. The total amount of material excavated for the river diversion was a little more than 2 million cubic yards plus the more than 1 million cubic yards excavated at Lockport, Joliet and the controlling works. The excavated amount totaled more than 42 million cubic yards. The cost of construction of the Main Channel was $23.3 million.[74]

Opening the Main Channel

The Board of Trustees of the Sanitary District learned in December 1899 that the State of Missouri planned to seek an injunction in federal court to prevent the canal from opening. St. Louis officials were afraid of Chicago's waste ending up in the Mississippi River and thus impacting St. Louis' water supply. Before such an injunction could be ordered, the Sanitary District's board ordered the needle dam keeping back the waters of the Chicago River be

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[69] An advertisement for the Ingersoll-Sergeant Drill Company in Hill, *Chicago Main Drainage Channel*, "Advertisements," B, states that 134 rock drills, thirty-four channelers, and seven air compressors were used on the channel. Rand Drill Company, whose products were used in mines, quarries, machine shops and deep well pumping, supplied 150 Little Giant drills and eight air compressors. See also Hill, *Chicago Main Drainage Channel*, "Advertisements," E.
[70] Hill, *Chicago Main Drainage Channel*, 93-94.
[71] Lanyon, "So They Reversed the River," 5-13.
[72] Lanyon, "So They Reversed the River," 5-12 - 5-14; Sanitary District, "Engineering Data on the Sanitary District of Chicago," 7; Sanitary District, *Engineering Works*, 21.
[73] Lanyon, "So They Reversed the River," 8-4, map 8-13.
[74] Randolph, "Sanitary District of Chicago, and the Chicago Drainage Canal," 7; Sanitary District, "Engineering Data on the Sanitary District of Chicago," 5.

knocked down on January 2, 1900. Just a couple of weeks later, on January 16, the Sanitary District then ordered the controlling gates lowered, which allowed water from Lake Michigan to be diverted down the newly-constructed channel. The suit filed by St. Louis was dismissed on February 19, 1906, although there continued to be various lawsuits regarding the amount of water diverted from Lake Michigan.[75]

Construction of Extension

An Act of the General Assembly provided for the Main Power Extension and Water Power Development to be built between the Controlling Works and the Upper Basin at Joliet on July 14, 1903. In addition to the construction of a 10,600' extension, this legislation also authorized the Sanitary District to establish a water power plant at Lockport. As with the Main Channel, the extension was divided into sections, known as Water Power Sections 1, 2, 3, and 4. The Main Channel Extension (often referred to as the "water power extension") took the channel through Lockport to Joliet. The channel extension maintained a 160' bottom width and measured 10,600' long before ending in a wide basin at the head bay of the powerhouse. The tailrace was 11,500' long with 5,000' creating a new channel for the Des Plaines River. It extended from the Lockport Power House to Joliet. The cost of constructing the head and tailrace from the Lockport Controlling Works through Joliet was $4.7 million, and the Lockport Power House, Lock, and Dams cost an additional $800,000.[76]

In 1903, the Sanitary District began advertising the contract for "constructing certain works for the conservation of water power on the channel of the Sanitary District of Chicago and the Desplaines River." By October, five bids had been received.[77] Although there was discussion among board members regarding re-advertising the contracts due to the low number of bids received and irregularities, the board decided to award Joseph J. Duffy the contracts for sections 1, 2, and 3. Lorimer & Gallagher Company won the contract for Section 4.[78]

Work began on the Main Channel Extension on October 29, 1903. The contract for sections 1 and 2 had to be extended to October 1, 1906, and for Section 3 to July 1, 1906.[79] The contracts covered excavating the channel and depositing the material in embankments. Concrete retaining walls, as well as earth and rock embankments "extending from the end of the Controlling Works Basin on the west side of the line of the extension of the Main Channel down to the site of the junction of the earth and rock embankment with the embankment having a concrete core wall"

[75] Walker, 17-18, 21.

[76] "The Water Power Development of the Sanitary District of Chicago," November 12, 1914, 1771; "Water Power Development on the Chicago Drainage Canal," *Engineering News* LIII, no. 2 (January 12, 1905): 25; *Proceedings of the Board of Trustees of the Sanitary District of Chicago, January 1, 1903 to December 31, 1903* (Chicago: John F. Higgins, Printer, 1904), 9566; Sanitary District, "Engineering Data on the Sanitary District of Chicago," 5-6.

[77] *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, 1903, 9544.

[78] Crilly & McMahon submitted a bid, but the board found it "irregular" and thus did not consider it. Other bidders were Joseph J. Duffy of Chicago and Lorimer & Gallagher Company of Chicago who both bid on all four sections. Mason & Hoge Company of Frankfurt, Kentucky, bid on the first two sections, and Roemheld & Gallery of Chicago bid only on Section 4. *Proceedings of the Board of Trustees of the Sanitary District of Chicago,* 1903, 9544, 9555.

[79] "Water Power Development of the Sanitary District of Chicago," 1771.

would be built as well.[80] Lockport Road (9th Street) and Division Street (16th Street) had to be raised and graded, and crossing bridges were necessary.[81]

Engineering News described the Duffy construction plant in a 1905 article. The company had drills, channeling machines, and pumps, all of which were operated by a compressed air plant consisting of about 10 miles of air pipe and two Rand duplex compound compressors, each with a 2,000 cubic foot capacity. They also had four 70-ton steam shovels, thirty-two Rand "Little Giant" drills, and four track channelers. There were two stone crushers each with a capacity of 8,000 yards a day, two portable concrete mixers, fourteen locomotives, 150 dump cars, 15 miles of track, two hoisting engines, fifteen suction pumps, two centrifugal pumps, four boilers, an electric light plant, and a machine and blacksmith shop. Nearly 500 men were employed on the project.[82]

The Sanitary District had issues with Duffy's work and ordered the company to stop work on June 9, 1906, after "controversies arose respecting the progress and character of the work." The Chief Engineer of the Sanitary District then took over the work. By August 1907, construction had almost been finished. Lorimer & Gallagher completed Section 4 in November 1905.[83]

Walls of concrete with earth embankments were built to enclose the Main Channel Extension. The east bank from the Controlling Works to the end of the Upper Basin at Joliet consisted of a "natural cement concrete" wall facing the channel with a rock-fill embankment behind. The embankment measured nearly 50' wide at the top. The concrete wall was nearly 37' high and 15' wide at the base, narrowing to 6' wide at the top. The side of the wall facing the embankment was stepped with a 9" tread and 24" rise. The west bank of the channel from the Controlling Works to about 400' north of Wire Mills Road had a clay core with rock-fill embankments on either side. Another source states this was an earth core measuring 5' wide on top with side slopes of 1-½:1. The rock fill on either side each measured about 22-½' wide with slopes of 1:1, so the wall as a whole measured 50' across. The remainder of the west wall consisted of an earth and clay embankment with rock fill on the land side and riprap on the water side. A "natural cement concrete" core was at the center of the wall where there was a high earth bank. The west wall's dimensions and materials differed from those of the east wall because it separated the channel from the Des Plaines River.[84]

The contracts for the construction of the channel included material specifications. The concrete core for the west wall would consist of "one (1) part Portland cement, two and one-half (2 ½) parts sand and five (5) parts screened broken stone" and would be made with a mechanical mixer. The rock excavated from the channel would be used in the retaining walls and embankments, as well as on nearby roads.[85] The concrete facing on the channel walls would "be

[80] *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, 1903, 9565.
[81] *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, 1903, 9565.
[82] "Water Power Development on the Chicago Drainage Canal," 26.
[83] "Water Power Development of the Sanitary District of Chicago," 1771.
[84] "Water Development of the Sanitary District of Chicago," 1772; *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, 1903, 9566; Water Power Development on the Chicago Drainage Canal," 25.
[85] *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, 1903, 9567.

coped with three (3) inches of Portland cement mortar, and faced with mortar of the same kind and thickness for a depth of fourteen (14) feet measured from the top of the wall." The facing mortar would consist of "one (1) part of Portland cement and two and one-half (2 ½) parts clean, sharp sand." In addition, the specifications required that "the Portland cement mortar facing and coping shall be applied before the native cement concrete has taken its initial set."[86]

Bridges

To accommodate 9th Street (also known as Lockport Road) and 16th Street (also known as Division Street), which crossed over the Main Channel Extension, the Sanitary District specified swing bridges to permit travel across the channel while not blocking canal navigation. The American Bridge Company designed the bridges, which had steel superstructures built "according to the specifications of Theodore L. Cooper for suburban bridges of Class B, edition 1901" and Portland cement concrete substructures. The bridge roadways were 18' wide with 30' approach roads topped with broken stone from the channel excavation. By May 1904, the Sanitary District had reached an agreement with the Town of Lockport on the construction of the bridges. [87]

In October 1904, the board reviewed the bids to construct the superstructures of the 9th and 16th Street bridges and recommended accepting the bids of Lafayette Engineering Company for both.[88] The contracts called for Lafayette Engineering Company to supply the materials and labor and build "complete in place, ready for operation and use for traffic, the entire superstructure, with counterweight, hand operating machinery, latches, cast iron curbing, anchor bolts, wooden floor, walks, railings, etc., with the necessary spikes, bolts and washers, and all paint."[89] Materials used in the construction of the bridge superstructures included phosphor bronze, medium steel, yellow pine and oak, broken stone, and Portland cement. The bridge roadway would consist of two layers of planking, the bottom layer of which would be creosoted yellow pine measuring 8" wide and placed diagonally at an angle to the floor beams. Railroad spikes would attach the planks to the stringers. The top layer would consist of 2" white oak measuring 6"-10" wide and laid perpendicular to the stringers. A 2'-wide "oiling walk" built of yellow pine planks and equipped with a handrail would be located under the bridge floor,

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[86] *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, 1903, 9567-69.

[87] *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, 1903, 9606; *Proceedings of the Board of Trustees of the Sanitary District of Chicago, January 1, 1904 to December 31, 1904* (Chicago: John F. Higgins, Printer, 1905), quote from 9606, 9616-9617; Scott, "Chicago Sanitary and Ship Canal Historic District," Section 7, Page 8.

[88] Lafayette bid $32,300 for the 9th Street Bridge and $29,008 for the 16th Street Bridge. See *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, 1904, 10206-10207 and 10234-10235. Bidders for the 16th Street bridge included: Wisconsin Bridge and Iron Company of Milwaukee, Wisconsin; Penn Bridge Company of Beaver Falls, Pennsylvania; The King Bridge Company of Cleveland, Ohio; Horace E. Horton of Chicago; The Lafayette Engineering Company of Lafayette, Indiana; Charles L. Strobel of Chicago; Morava Construction Company of Chicago; The Joliet Bridge and Iron Company of Joliet, Illinois; The Mount Vernon Bridge Company of Mount Vernon, Ohio; Jackson & Corbett Bridge and Steel Works of Chicago; and Roemheld & Gallery of Chicago. Wisconsin Bridge and Iron Company, Penn Bridge Company, King Bridge Company, Horace E. Horton, Lafayette, Charles Strobel, Morava, Joliet Bridge, Mount Vernon, Jackson & Corbett, and Roemheld also submitted proposals for the 9th Street Bridge.

[89] *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, 1904, 10249

"extending from the side of the bridge to the main operating pinion engaging the rack."[90] The bridges were both built between 1904 and 1905.[91]

Drawings provide some information as to the design of the 16th Street (and 9th Street) Bridge. The bridge pivoted on a concrete pier measuring 27'-6" wide. The pier was located off-center in the channel with the machinery house containing a 30-horsepower motor powering the gears, bearings, and pinions required to operate the bridge on top. The walls and roof of the building were clad in galvanized metal with wood sliding doors providing access. Eight panels totaling 182'-6" extended over the Main Channel Extension from the pier. On the other side of the pier were four panels measuring 97'-6" long. The bridge's vertical members were 24', 33'-2", 44', and 27'-9" high. In 1958, the 16th Street Bridge was rehabilitated. The work involved removing the existing 6' x 12" flooring and timber curb and replacing it with open grate flooring and steel curbing. The machinery house was replaced, and the toilet house was removed.[92]

The 16th Street Bridge was removed in 1986. (See HAER No. IL-16-D for images of the 16th Street Bridge prior to its removal.) The 9th Street Bridge dates to the same time period, but it was removed in the early 1960s.[93]

Butterfly Dam

The Butterfly Dam was built below the Controlling Works in the center of the extension to shut off the flow of water in times of emergency (see HAER No. IL-197-B for additional information). The design and construction of the structure was in response to residents downstream who were concerned about the large volume of water held upstream and at a higher elevation. The Butterfly Dam had a 30'-high x 184'-long rotatable leaf located between concrete piers that could be swung across the channel on a central pivot. Its design was based on the principles of the butterfly valve.[94]

Lockport Powerhouse Site

The construction of the Main Channel Extension allowed the Sanitary District to generate water power. In order to do this, a powerhouse, two movable dams, and a lock to accommodate the 40' drop in elevation from Lockport to Joliet downstream were built. (For more information see Chicago Sanitary and Ship Canal, Lockport Power House and Dam, HAER No. IL-197-C and Chicago Sanitary and Ship Canal, Lockport Lock, HAER No. IL-197-D.) The concrete powerhouse measured 385' long x 70' wide x 47' high and originally housed seven 6,000-

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[90] *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, 1904, 10255.
[91] *Proceedings of the Board of Trustees of the Sanitary District of Chicago, January 1, 1906 to December 31, 1906* (Chicago: Fred Klein Company Printers, 1907), 11459-60.
[92] The Metropolitan Sanitary District of Greater Chicago, Rehabilitation of Machinery for the 16th Street Bridge, Main Channel Extension, Lockport, Illinois, Contract 57-38 MCB-St, "General and Location Plan," March 1958, Sheet No. S1; The Metropolitan Sanitary District of Greater Chicago, Rehabilitation of Machinery for the 16th Street Bridge, Main Channel Extension, Lockport, Illinois, Contract 57-38 (MCB-ST), "Machinery House and Bearings," March 1958, Sheet No. S8; and The Metropolitan Sanitary District of Greater Chicago, Rehabilitation of Machinery for the 16th Street Bridge, Main Channel Extension, Lockport, Illinois, Contract 57-38 (MCB-ST), "Machinery House," March 1958, Sheet No. A1, all available from MWRD
[93] Scott, "Chicago Sanitary and Ship Canal Historic District," Section 7, Page 8.
[94] Sanitary District of Chicago, "Engineering Works," 23.

horsepower horizontal water turbines that drove 4,000-kva direct-connected generators. There were also three exciters with 350-kilowatt capacity powered by turbines, and twenty-one transformers. The powerhouse connected to a transmission line that could send 34,000 volts to a terminal station at Western Avenue where the power was stepped down to 12,000 volts. The powerhouse opened for use in 1907.

At first the Sanitary District sold the power generated by the Lockport Power House for use in street lights. After 1928, the power was used to operate the West Side Treatment Works. In 1939, the Sanitary District began selling the power to Commonwealth Edison for credits for its electric usage.[95]

Two movable dams were located between the powerhouse and the original lock at Lockport, which was 22' wide x 130' long and had a nearly 40' lift. When the Illinois Waterway went into operation in the 1930s, the original Lockport Lock (in use starting July 13, 1910) was abandoned in favor of the new one located next to it that had been built for use on the waterway. The newer lock, measuring 110' x 600', could accommodate larger vessels, thereby relegating the original lock to auxiliary status.[96]

Opening the Extension
In August 1907, the Main Channel Extension was filled with water. The cost of constructing the channel from the Lockport Controlling Works to the Lockport Power House totaled $4,773,000. The Butterfly Dam cost $242,000, and the Lockport Power House, Lock and Dams cost $800,000.[97]

Post-Construction
In 1908, the Willow Springs Spillway was built a mile below Willow Springs Road on the northwest bank of the channel. The spillway, constructed of concrete and equipped with twenty-two arched intakes, allowed extra water from the Des Plaines River into the channel to boost power generation.[98] The channel was capable of handling the extra volume of water because it had mistakenly been built with a larger capacity than originally envisioned. This was fortuitous because the Des Plaines River channel periodically flooded, sending excess water into the Chicago River and Lake Michigan. The spillway provided a good solution to the problem of the Des Plaines River flooding.[99]

Criticism of the design and work done on the Main Channel Extension began even before its construction. The City of Joliet requested a review of the work be conducted, which was done in 1906. The following year, another review was done for the Sanitary District, and again in 1913 at the direction of the State Senate. While defects in the work and design were noted and some

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[95] Hill, *The Chicago River*, 133.
[96] Sanitary District of Chicago, *Engineering Works*, 25, 27.
[97] "Water Power Development of the Sanitary District of Chicago," 1771; "Engineering Data on the Sanitary District of Chicago," 5-7.
[98] Hill, *The Chicago River*, 134.
[99] Chicago Sanitary District, Board of Trustees, "President's Annual Message and Annual Reports of Clerk, Attorney, Treasurer and Chief Engineer," 1908, 24, 26.

repairs were made, no large scale reconstruction was done since officials anticipated changes to the channel with the planned construction of what would become the Illinois Waterway.[100]

By 1924, the disintegration of the channel walls had to be addressed. The Sanitary District awarded a contract to repair 2,500' of the east wall extending from the controlling works to the powerhouse to Green & Sons Company. According to the board's minutes, "the wall has disintegrated to such an extent that portions of the face and top have failed and have fallen into the channel. The wall is backed by a loose stone embankment." The repairs would necessitate excavating the embankment before the upper portions and other defective sections of the wall could be removed. Finally, the contractor would rebuild the body of the wall and apply a reinforced concrete face.[101]

Drawings of the 1924 repairs show engineers suggested it be done in the "wet," with steel sheet piling reinforced with I-beams erected. The new concrete would be poured into wood forms bolted to Bethlehem girders. The drawings appear to indicate that in some places the whole concrete wall facing the channel would be replaced, while in other sections, only the top portions required new concrete.[102] Three years later, in 1927, repairs were made to the channel walls, including adding new concrete at the site of the new lock at Lockport, at the 12' dam, the tailrace below the dams, and various other locations.[103]

In 1938, the Works Progress Administration (WPA) approved Sanitary District Project No. 25. The items included in the project were: removing and replacing the bear-trap dam with a 160' concrete dam, improving 5,000 linear feet of roadway, building shoulders and a rubble retaining wall from the 9th Street Bridge to the powerhouse, installing riprap on 5,000' of canal bank, and grading and landscaping around the powerhouse. The estimated total cost of the project was $122,710, with the federal government supplying $94,256 and the Sanitary District the remaining amount. The project required an estimated 400 men and began in September 1938. Additional work, including erecting extra lengths of rubble wall, demolishing more "obsolete" machinery and the operating houses at the Controlling Works, and building a section of earthen dam with a concrete wall, was approved for a total of $68,463. The federal government contributed $51,349 while the Sanitary District provided the remaining $17,114.[104] The removal of the bear-trap dam at the Controlling Works and the later removal of the Butterfly Dam were probably due to the 1936-38 construction of the Chicago Harbor Lock at the junction of the Chicago River and Lake Michigan.

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[100] "The Water Power Development of the Sanitary District of Chicago," 1726.
[101] *Proceedings of the Board of Trustees of the Sanitary District of Chicago, January 1, 1924 to December 31, 1924* (Chicago: Fred Klein Company, Printers, 1925), 476.
[102] The Sanitary District of Chicago, "Suggested Method for the Repairing of Part of the Main Channel Wall at Lockport, Illinois," January 25, 1924, Sheet No. obscured, and The Sanitary District of Chicago, "Suggested Method for the Repairing of Part of the Main Channel Wall at Lockport, Illinois," February 7, 1924, Sheet No. obscured, both available at MWRD.
[103] The Sanitary District of Chicago, "Details, Constructing Main Channel Wall Near Lockport, Illinois, Contract No. 3," July 28, 1927, Sheet No. 4, available at MWRD.
[104] *Proceedings of the Board of Trustees of the Sanitary District of Chicago, January 1, 1938 to December 31, 1938* (Chicago: F.J. Riley Printing Company, 1939), 1953-54.

Diversion Issues

The issue of the city of Chicago diverting water from Lake Michigan for its own use was a contentious one. As noted in a contemporary publication, "the engineering questions and legal questions which have grown and are likely to grow out of the Chicago Drainage Canal are of absorbing interest, because to a large degree they are largely unprecedented."[105] The Main Channel was designed to handle a flow of 10,000 cubic feet/section (cfs). Initially, the volume would be 5,000 cfs, which could then be increased to the full 10,000 cfs, although the capacity of the channel ended up being nearly 40 percent more than expected. This rate of flow represented 15 percent of the total outflow of Lake Michigan. Questions were raised about the impact of the diversion on the level of Lake Michigan, so the federal government appointed a commission to study the issue. The Sanitary District believed that the full 10,000 cfs was necessary to properly dilute the sewage, but the War Department denied requests to increase the diversion. Originally, War Department officials had only expressed concern about the level of the Chicago River, but their attention shifted to the level of Lake Michigan as well.[106]

In addition, initially little attention was paid to the sewage flowing out of Chicago and moving downstream. This was probably due to the fact that the Illinois River was primarily a commercial waterway. Although about 70 percent of the state's population lived in the Illinois River basin, "most river towns were constructed with their backs to the river." Indeed, "Chicago's diversion was welcomed in that the increased water volume would ensure against low-water navigational hazards." Residents of St. Louis, however, were extremely concerned about Chicago's sewage. In 1899, a committee appointed by the mayor of St. Louis issued a report characterizing the Main Channel as a "pollution threat." As a result, "in January 1900 the state of Missouri petitioned the U.S. Supreme Court to enjoin the state of Illinois and the Sanitary District of Chicago from discharging sewage into the Main Channel," but it was not granted.[107]

The growth of the area encompassed by the Sanitary District led to increasing amounts of sewage. As a result, Sanitary District officials considered applying the dilution method used on the Chicago Sanitary and Ship Canal on other waterways, like the Calumet-Sag Channel. This channel was built from 1911-1922 and extended between the Calumet River and the Chicago Sanitary and Ship Canal. The International Waterways Commission, made up of U.S. and Canadian members, was tasked with studying the water levels in the Great Lakes and the effects of diversion. The resulting report issued in 1907 concluded that diversion should be limited. In the case of Chicago, the commission recommended a diversion of no more than 10,000 cfs, which was actually larger than the 5,000 cfs authorized by the War Department.[108]

By 1909, the district had begun developing waste treatment as an alternative to the dilution method, and by 1922, sewage treatment plants were being planned and built. Litigation over the Sanitary District's diversion of Lake Michigan continued and "climaxed with injunction

[105] Hill, *Chicago Main Drainage Channel*, 124.
[106] Cain, 596-601; Scott, "Chicago Sanitary and Ship Canal Historic District," Section 8, Page 25.
[107] Cain, 601-602.
[108] Cain, 604.

proceedings which the state of Wisconsin brought before the Supreme Court early in 1922."[109] The Supreme Court heard the case in 1926, and on April 30, 1930, rendered its verdict. The decision limited the amount of water the Sanitary District could divert over a period of eight years. By December 31, 1938, the Sanitary District was only allowed 1,500 cfs.[110] Louis Cain argues in an article that "when the Supreme Court's decision limited the District's diversion and rendered the dilution method ineffective, sewage treatment had to become the primary feature of the District's disposal technique. Yet the District had been moving in this direction for two reasons: population pressure from within and federal attempts from without to control the diversion."[111] Despite the Supreme Court's ruling limiting the diversion, the issue continues to be a controversial one in the region.

Current Ownership
In 1984, the Department of the Army and the Metropolitan Sanitary District of Greater Chicago (later Metropolitan Water Reclamation District of Greater Chicago) signed a memorandum of agreement dividing authority of the canal. The Department of Army was given responsibility of operating and maintaining the lock and associated guide walls and maintaining the canal banks, levees, and retaining walls. The Department of Army also agreed to remove the butterfly dam. The Sanitary District agreed to operate the controlling works, dam, and powerhouse.

Conclusion
The Chicago Sanitary and Ship Canal was part of a larger movement at the beginning of the twentieth century as urban areas developed strategies for dealing with sanitary and water supply issues. Chicago's population and manufacturing had resulted in growing amounts of pollution finding its way into Lake Michigan, the source of the city's drinking water, in the second half of the eighteenth century. The Chicago Sanitary and Ship Canal reversed the flow of the Chicago River and diverted water from Lake Michigan, causing the city's sewage to be diluted by lake water and pushed downstream. The construction of the canal was a massive undertaking and required the development of innovative earth moving machinery to handle the vast amounts of rock to be excavated. As noted in one account of the canal's construction, "to a greater extent, perhaps, than on any other large waterway, the engineering difficulties on the drainage channel have been due to the vastness of the undertaking; the mere magnitude of the physical change to be brought about." Rather than design and engineering problems, the real issue facing engineers "has been a constructional problem—a problem of how to dig quickly and cheaply a channel through miles of earth and rock."[112] In 1955, the American Society of Civil Engineers deemed the canal one of the "Seven Wonders of American Engineering."

In addition to its importance in sanitation, the canal is also significant as a navigable waterway. In conjunction with the Illinois Waterway (opened in 1933), the two waterways provided a navigable route from Chicago and Lake Michigan, down the Des Plaines and Illinois rivers to the Mississippi River and beyond. The Lockport Lock, Dam and Power House Historic District is already listed in the National Register of Historic Places. A nomination has been drafted for the

[109] Cain, 608.
[110] Walker, 21.
[111] Cain, 610-611.
[112] Hill, *Chicago Main Drainage Channel*, 109.

Chicago Sanitary and Ship Canal Historic District with nine contributing resources identified: the Main Channel, Lockport Controlling Works, Butterfly Dam remnant, Willow Springs Spillway, Chicago Sanitary District Lock, New Lock, Lockport Power House, Lockport Dam and Lockport Controlling Station.[113]

[113] Scott, "Chicago Sanitary and Ship Canal Historic District," Section 7, Page 2.

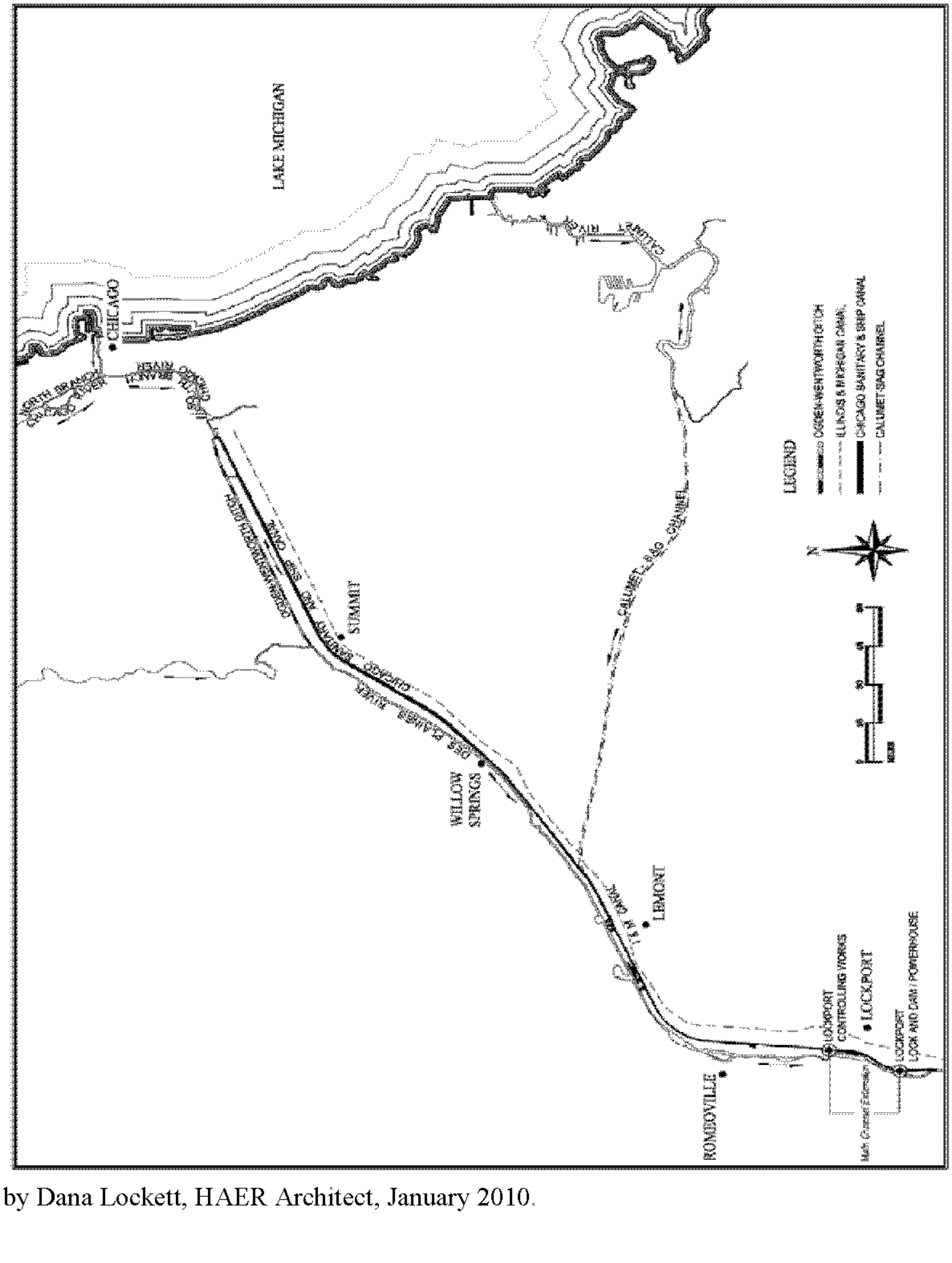
Appendix A: Contracts for Construction of Main Channel and Contractors

This list is compiled from Charles Shattuck Hill, *The Chicago Main Drainage Channel: A Description of the Machinery Used and Methods of Work Adopted in Excavating the 28-Mile Drainage Canal from Chicago to Lockport, Ill* (New York: The Engineering News Publishing Company, 1896), 7; "Methods of Work and Special Plant on the Chicago Drainage Canal. Part III: General Description, Conditions and Data," *The Engineering Record* XXXIII, no 20 (April 18, 1896): 346; and *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, various years.

Section	Length	Material	Contractor
O	7,022'	Earth	McMahon & Montgomery Co., Chicago
N	4,511.1'	Earth	Hayes Brothers, Chicago
M	2,858'	Earth	The Heidenreich Co., Chicago
L	4,215.8'	Earth	The Heidenreich Co., Chicago
K		Earth	Christie & Lowe, Chicago
I		Earth	Christie & Lowe, Chicago
[sections K and I were done as one section with total length of 8,690']			
H		Earth	Gahan & Byrne, Chicago
G		Earth	Gahan & Byrne, Chicago
[sections H and G had total length of 10,046']			
F	4.429'	Earth	Ricker, Lee & Co., Summit, IL
			Re-let to Weir & McKechney, Cincinnati
E		Earth	Angus & Gindele, Summit, IL
			[originally let to Streeter & Kenefick]
D	5,212'	Earth	E.D. Smith & Co., Summit, IL
C	5,000'	Earth	Western & Improvement Co., Summit, IL
			[also known as Western Dredging & Improvement Company]
B	5,000'	Earth	Heldmaier & Neu., Mount Forest, IL
A	7,300'	Earth	Heldmaier & Neu., Mount Forest, IL
			[later article says it was L.D. Connor & Co.]

Section	Length	Material	Contractor
1	6,000’	Earth/Rock	Griffith & McDermott, Chicago [originally let to Alfred Harley]
2	5,000’	Earth/Rock	McArthur Brothers, Chicago
3	5,000’	Earth/Rock	Gilman & Co., Willow Springs [originally let to McArthur Brothers]
4	5,000’	Earth/Rock	McArthur Brothers, Chicago
5	5,000’	Earth/Rock	The Qualey Construction Co., Chicago [originally let to Agnew & Company, also spelled Agneu]
6	5,000’	Earth/Rock	Mason, Hoge & Co., Romeoville, IL [originally let to Agnew & Company]
7	4,700’	Rock	Mason, Hoge & Co., Romeoville, IL [originally let to Agnew & Company]
8	5,800’	Rock	Mason, Hoge & Co., Romeoville, IL [originally let Agnew & Company]
9	5,800	Rock	Halvorsen, Richards & Co., Minneapolis [originally let to Agnew & Company]
10	6,000’	Rock	E.D. Smith & Co., Romeoville, IL
11	5,200’	Rock	Mason, Hoge & Co., Romeoville, IL
12	5,000’	Rock	Mason, Hoge & Co., Romeoville, IL
13	5,000’	Rock	Mason, Hoge & Co., Romeoville, IL
14	6,000’	Rock	Smith & Eastman, Lockport, IL
15	4,000’	Rock	Wright, Meysenberg, Sinclair & Carry

Appendix B: Map of Area Waterways



Delineated by Dana Lockett, HAER Architect, January 2010.

Bibliography

Primary Sources:

"Bids for Canal Work." *Chicago Daily*, October 5, 1893, 9.

"Bridgeport to Joliet." *Chicago Daily*, July 23, 1891, 9.

Chicago Sanitary District, Board of Trustees. "President's Annual Message and Annual Reports of Clerk, Attorney, Treasurer and Chief Engineer," 1908.

"Drainage Canal's Legal Work." *Chicago Daily*, January 2, 1900, 10.

"Engineers' Feat in Big Channel." *Chicago*, January 2, 1900, 11.

"Figures are Given." *Chicago Daily Tribune*, June 9, 1892, 4.

"For River Improvements." *Chicago Daily*, April 22, 1891, 3.

Hill, Charles Shattuck. *The Chicago Main Drainage Channel: A Description of the Machinery Used and Methods of Work Adopted in Excavating the 28-Mile Drainage Canal from Chicago to Lockport, Ill.* New York: The Engineering News Publishing Co., 1896.

"It Adopts a Route." *Chicago Daily*, June 19, 1892, 12.

"It Will Save Millions." *Chicago Daily*, July 26, 1894.

"Methods of Work and Special Plant on the Chicago Drainage Canal. Part I: History of the Project, Design of Section." *The Engineering Record* XXXIII, no. 18 (April 4, 1896): 310-312.

"Methods of Work and Special Plant on the Chicago Drainage Canal. Part II: Working Organization of the Sanitary District, Engineering and Police Departments, the Ship-Canal Project, Comparison with Other Ship Channels." *The Engineering Record* XXXIII, no. 19 (April 11, 1896): 328-330.

"Methods of Work and Special Plant on the Chicago Drainage Canal. Part III: General Description, Conditions, and Data." *The Engineering Record* XXXIII, no. 20 (April 18, 1896): 346-347.

"Methods of Work and Special Plant on the Chicago Drainage Canal. Part IV: Sections O and N, Excavation of Soft Material, Dredges and Excavators, Auxiliary Terminal Channel, General Map and Cross-Section." *The Engineering Record* XXXIII, no. 21 (April 25, 1896): 364-365.

"Methods of Work and Special Plant on the Chicago Drainage Canal. Part V: Sections M and L, Steam Shovels and Tipple Inclines for Excavation of Glacial Drift." *The Engineering Record* XXXIII, no. 22 (May 2, 1896): 381-383.

"Methods of Work and Special Plant on the Chicago Drainage Canal. Part VI: Sections K and I, Excavation of Glacial Drift by Steam Shovels in Transverse Cuts with Bridge Conveyors and Automatic Side-Dump Cars; Maps, Sections, Profiles, and Details." *The Engineering Record* XXXIII, no. 23 (May 9, 1896): 400-403.

"Methods of Work and Special Plant on the Chicago Drainage Canal. Part VII: Sections G and H, Original Map and Profile, Typical Cross-Section and Location of Plant, General Description of Special Method of Handling Clay with Belt Conveyor, Tipple Inclines, and Cantilever Conveyor." *The Engineering Record* XXXIII, no. 24 (May 16, 1896): 420-422.

"Methods of Work and Special Plant on the Chicago Drainage Canal. Part VIII: Sections G and H Continued. Details of Construction of the Tipple Incline of the Belt Conveyor." *The Engineering Record* XXXIII, no. 25 (May 23, 1896): 436-438.

"Methods of Work and Special Plant on the Chicago Drainage Canal. Part IX: Description of the Hoover & Mason Excavator and Conveyor; Diagrams of Construction and Method of Operations." *The Engineering Record* XXXIV, no. 5 (July 4, 1896): 82-84.

"Methods of Work and Special Plant on the Chicago Drainage Canal. Part X: Section F. Description of Excavation in Cemented Boulders and Hard Clay, Loosening Glacial Drift with Explosives, Records of Large Test Pit, Profile of Strata, Dispute Regarding Classification, Location Map, Profile and Cross Section." *The Engineering Record* XXXIV, no. 7 (July 18, 1896): 120-121.

"Methods of Work and Special Plant on the Chicago Drainage Canal. Part XI: Final Contract for Section F, Arrangement and Operation of Excavating Plant, General Map of Plant, Details of Conveyor, Classification of Labor and Machinery." *The Engineering Record* XXXIV, no. 9 (August 1, 1896): 158-160.

"Methods of Work and Special Plant on the Chicago Drainage Canal. Part XII: Section E, Character of Excavation and Methods Employed, Work on Disputed Contracts for Refractory Glacial Drift, Diagram Profile, Diagram Cross-Sections, Description and Operation of 55-Foot Boom Steam Shovel, View of Steel Conveyor Incline and Tipple, Map and Cross-Section of Plant, Location, Description Map of River Diversion, Plans and Details of Spillway." *The Engineering Record* XXXIV, no. 11 (August 15, 1896): 197-199.

"Methods of Work and Special Plant on the Chicago Drainage Canal. Part XIII: Section D, Excavation of Glacial Drift by Steam Shovels and Scrapers, Conveying Spoil by Locomotives and Carts, and Building of Adjacent Levee; General Map, Diagram and Profile and Cross-Section of Typical Steam-Shovel Cuts." *The Engineering Record* XXXIV, no. 12 (August 12, 1896): 218-219.

"Methods of Work and Special Plant on the Chicago Drainage Canal. Part XIV: Section C, Excavation of Refractory Glacial Drift Overlaid by Submerged Alluvial Deposit, Details of Hydraulic Dredge Apparatus with Mining Jets; Maps, Diagrams, and Profile. Sequences of Steam-Shovel Cuts, Blasting and Efficiency of Plant." *The Engineering Record* XXXIV, no. 14 (September 5, 1896): 254-256.

"Methods of Work and Special Plant on the Chicago Drainage Canal. Part XV: Sections A and B, General Data and Description, Location Map and Profile, Revision of Contracts, Difficult Levee Building, Displacement of Muck, Description, Plans, Details, and Efficiency of Hydraulic Dredge, Enumeration and Location of Plant, Tracks, Etc., Cross-section of Steam-Shovel Cuts, Blasting Glacial Drift; Drawings, Views, Descriptions, and Records of Special Slope Hoisting Apparatus." *The Engineering Record* XXXIV, no. 16 (September 19, 1896): 290-293.

"Methods of Work and Special Plant on the Chicago Drainage Canal. Part XVI: Sections A and B Continued. Instability of Muck, Difficulty from its Flow, Description, General Plans, Views and Details of Special Conveyor Travelers, Details and Operation of Special Dump Car, Upheaval of Muck, Description and Data of Special Steam Shovels, View of Slope and Revetment Work." *The Engineering Record* XXXIV, no. 18 (October 3, 1896): 326-329.

"Methods of Work and Special Plant on the Chicago Drainage Canal. Part XVII: Western Half of Canal Embracing Rock Cuts, General Description and Data of Rock; Requirements for Excavation, Retaining Wall, Back Filling, Etc.; Operations on Section 1; Drainage; Methods of Earth and Rock Excavation; Blasting Glacial Drift; Location Map, Profile, Plant, Diagram, Elevations of Inclines, Etc.; Junction of Walled and Sloped Sections." *The Engineering Record* XXXIV, no. 22 (October 31, 1896): 400-402.

"Methods of Work and Special Plant on the Chicago Drainage Canal. Part XVIII: Section 1 Continued; Elevation and Details of Steel Tipple Incline Conveyor; Radiating Pit Tracks; Pit Derricks; Pneumatic Pit Hoist; Home-Made Turntable; Special Iron Car; View of Inclines." *The Engineering Record* XXXIV, no. 25 (November 21, 1896): 458.

"Methods of Work and Special Plant on the Chicago Drainage Canal. Part XIX: Section 1 Concluded: Methods of Cutting, Drilling, Blasting and Handling Solid Rock; Detail Descriptions of Drilling and Channeling Processes and Machinery; Explosives; Tables of Efficiency Add Cost of Rock Cutting; Diagrams of Cantilever Conveyor; View of Channeler; Summary of Plant on Section 1." *The Engineering Record* XXXIV, no. 26 (November 28, 1896): 480-481.

"Methods of Work and Special Plant on the Chicago Drainage Canal. Part XX: Character and Methods of Earth and Rock Excavation; Incline Planes; Special Steam Shovels; Description and Illustration of Cableway System of Conveyors; Original Location Map and Profile; Location of Plant; Section of Steam; Shovel Cuts, and General View of Work in Glacial Drift." *The Engineering Record* XXXV, no. 3 (December 19, 1896): 48-51.

"Methods of Work and Special Plant on the Chicago Drainage Canal. Part XXI: Section 3 Estimates; Progress; Description of Material; Slopes, Cableways; Map; Profiles; Plant, Location, Diagram, View of Blast." *The Engineering Record* XXXV, no. 4 (December 26, 1895): 70-71.

"Methods of Work and Special Plant on the Chicago Drainage Canal. Part XXII: Section 4 General Description, Map, Profile, Location of Plant; Inclined Planes, Hoists and Hoisting Engines on Cars; Tunneling; Electric Light Suspension Cables; Organization; Description of Quarrying and Wall Building." *The Engineering Record* XXXV, no. 11 (February 13, 1897): 225-227.

"Methods of Work and Special Plant on the Chicago Drainage Canal. Part XXIII: Section 5, Description of Section; General Map, Profile and Plant Location Diagram; Special Traveling Derricks for Excavating and Wall Building; Illustrations, Descriptions and Theories of Landslides." *The Engineering Record* XXXV, no. 15 (March 13, 1897): 313-315.

"Methods of Work and Special Plant on the Chicago Drainage Canal. Part XXIV: Section 6, General Description, Conditions and Organization; Map, Profile and Location Diagram of Plant; Design, Operation and Efficiency of Vivian Steam Scraper and Vivian Hydraulic Dredge; View of Glacial Drift Encountered." *The Engineering Record* XXXV, no. 20 (April 17, 1897): 422-424.

"Methods of Work and Special Plant on the Chicago Drainage Canal. Part XXV: Section 7 General Data, Location and Plant Diagrams, Profile and Sections; Illustrations and Descriptions of McMyler Derrick and Cantilever Car and Carriage; View of Canal and Picture of Results of Last Blast." *The Engineering Record* XXXVI, no. 7 (July 17, 1897): 136-139.

"Methods of Work and Special Plant on the Chicago Drainage Canal. Part XXVI: Section 8 History, Progress of Work, and Efficiency of Plant; Preliminary Location Map and Profile; Distribution of Plant; Plan of Special Transverse Inclined Plane Hoists and Details of Dump Cars." *The Engineering Record* XXXVI, no. 11 (August 14, 1897): 224-226.

"Methods of Work and Special Plant on the Chicago Drainage Canal. Part XXVII: Section 9 Preliminary Location Map, Profile; Plant Distribution Diagram; Illustrations; Details and Description of Oblique Inclined Plane, Hoists, Special Narrow-Gauge Dump Cars; McMyler Traveling Low-Level Derricks and Conveyor Inclines and Data of Efficiencies, Operation and Cost; General Views of Canal and Plant." *The Engineering Record* XXXVI, no. 15 (September 11, 1897): 316-318.

"Methods of Work and Special Plant on the Chicago Drainage Canal. Part XXVIII: Section 10 General Description; Location Map, Profile; Plant Diagram; Details of Construction and Operation of Special Incline, Hoists and Cars, and General View." *The Engineering Record* XXXVI, no. 20 (October 16, 1897): 422-423.

"Methods of Work and Special Plant on the Chicago Drainage Canal. Part XXIX: Sections 11, 12, and 13 General Data; Location Map and Profile; Diagram of Distribution of Plant; Operation of Inclines; View of Rock Dump from Cantilever; View of Front of Cantilever, of Incline Tracks and of Blast." *The Engineering Record* XXXVI, no. 22 (October 30, 1897): 466-469.

"Methods of Work and Special Plant on the Chicago Drainage Canal. Part XXX: Section 14 General Data; Preliminary Location Map and Profile; Distribution of Plant; Views and Description of Six Double Boom High Power Large Derricks; View of Oblique Rock Face." *The Engineering Record* XXXVI, no. 23 (November 6, 1897): 488-491.

"Methods of Work and Special Plant on the Chicago Drainage Canal. Part XXXI: Section 15 General Description and Data; Preliminary Location Map and Profile, Section of Canal; Distribution and Enumeration of Plant; Descriptive Illustrations, Details, Operation, Design and Efficiency of Six Double-Boom Large High Power Derricks; Steam Shovel Excavating Solid Rock; General Conclusion and Comparisons of Methods and Costs on Canal." *The Engineering Record* XXXVI, no. 24 (November 13, 1897): 511-512.

"Millions of Money." *Chicago Daily Tribune*, July 23, 1893, 25.

Proceedings of the Board of Trustees of the Sanitary District of Chicago, January 1, 1903 to December 31, 1903. Chicago: John F. Higgins, Printer, 1904.

Proceedings of the Board of Trustees of the Sanitary District of Chicago, January 1, 1904 to December 31, 1904. Chicago: John F. Higgins, Printer, 1905.

Proceedings of the Board of Trustees of the Sanitary District of Chicago, January 1, 1906 to December 31, 1906. Chicago: Fred Klein Company Printers, 1907.

Proceedings of the Board of Trustees of the Sanitary District of Chicago, January 1, 1924 to December 31, 1924. Chicago: Fred Klein Company Printers, 1925.

Proceedings of the Board of Trustees of the Sanitary District of Chicago, January 1, 1938 to December 31, 1938. Chicago: F.J. Riley Printing Company, 1939.

"The Protest of St. Louis Against the Chicago Canal." *The Engineering Record* 39, no. 22 (April 20, 1899): 489-490.

Randolph, Isham. "The Sanitary District of Chicago, and the Chicago Drainage Canal: A Review of Twenty Years of Engineering Work." 1909. Also in *Engineering News* 62, no. 4 (July 22, 1909): 90-94.

"Report on the Canal." *Chicago Daily*, December 21, 1893, 6.

The Sanitary District of Chicago. "Engineering Data on the Sanitary District of Chicago." June 1910.

____________. "Engineering Works." August 1928.

"Water Power Development on the Chicago Drainage Canal." *Engineering News* LIII, no. 2 (January 12, 1905): 25-27.

"Will Cut the Rock." *Chicago Daily Tribune*, June 30, 1892, 9.

"Work on Section 13." *Chicago Daily*, August 30, 1894, 12.

Drawings, available from Metropolitan Water Reclamation District of Greater Chicago, Chicago, Illinois

The Sanitary District of Chicago. "Main Channel Extension and Water Power Development, Lockport to Joliet." July 1914.

____________. "Suggested Method for the Repairing of Part of the Main Channel Wall at Lockport, Illinois." January 25, 1924, Sheet No. obscured.

____________. "Suggested Method for the Repairing of Part of the Main Channel Wall at Lockport, Illinois." February 7, 1924, Sheet No. obscured.

____________. "Details, Constructing Main Channel Wall Near Lockport, Illinois, Contract No. 3." July 28, 1927, Sheet No. 4.

The Metropolitan Sanitary District of Greater Chicago. Rehabilitation of Machinery for the 16th Street Bridge, Main Channel Extension, Lockport, Illinois, Contract 57-38 (MCB-ST), "General and Location Plan." March 1958, Sheet No. S1.

____________. Rehabilitation of Machinery for the 16th Street Bridge, Main Channel Extension, Lockport, Illinois, Contract 57-38 (MCB-ST), "Machinery House and Bearings." March 1958, Sheet No. S8.

____________. Rehabilitation of Machinery for the 16th Street Bridge, Main Channel Extension, Lockport, Illinois, Contract 57-38 (MCB-ST), "Machinery Houses." March 1958, Sheet No. A1.

U.S. Army Corps of Engineers, Rock Island District. "Concrete Wall Rehabilitation Sections 1." January 16, 2004, Plate 13.

Secondary Sources:

Cain, Louis P. "Unfouling the Public's Nest: Chicago's Sanitary Diversion of Lake Michigan Water." *Technology and Culture* 15, no. 4 (October 1974): 594-613.

Clemensen, A. Berie. "Illinois and Michigan Canal National Heritage Corridor, Illinois, Historical Inventory, History and Significance." Denver Service Center, National Park Service, July 1985.

Currey, J. Seymour. *Chicago: Its History and Its Builders, A Century of Marvelous Growth.* Vol. 2. Chicago: The S.J. Clarke Publishing Company, 1992.

Hill, Libby. *The Chicago River: A Natural and Unnatural History.* Chicago: Lake Claremont Press, 2000.

Lanyon, Richard. " 'So They Reversed the River': A History of the Construction of the Main Channel and Improvements to the Chicago and Des Plaines Rivers from 1892 to 1900 for the Reversal of the Chicago River." 1999. Typewritten manuscript. Available at the Metropolitan Water Reclamation District headquarters, Chicago, Illinois.

Melosi, Martin. *The Sanitary City: Urban Infrastructure in America from Colonial Times to the Present.* Baltimore: The Johns Hopkins University Press, 2000.

Scott, Branden K. and Lowell Blikre. National Register of Historic Places Amended Multiple Property Submission and Nomination of the Chicago Sanitary and Ship Canal Historic District to the Illinois Waterway Navigation System Facilities. Draft, May 21, 2009.

Scott, Branden K. "Chicago Sanitary and Ship Canal Historic District." National Register of Historic Places Nomination Form. Draft, May 2009.

Walker, Ward. "The Story of the Metropolitan Sanitary District of Greater Chicago: The Seventh Wonder of America." Np: nd. Available at the Chicago Public Library-Harold Washington Library Center, Chicago, Illinois.