
Water Management and Diversion Accounting Activities

2016 Annual Report

(October 2015 – September 2016)



**Hydrology and Hydraulics Section
Design Branch
Technical Services Division
Chicago District
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**US Army Corps
of Engineers** ®

2016 ANNUAL REPORT
WATER MANAGEMENT AND DIVERSION ACCOUNTING ACTIVITIES
(OCTOBER 2015 – SEPTEMBER 2016)
GREAT LAKES AND OHIO RIVER DIVISION
CHICAGO DISTRICT

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Chapter 1 – Introduction

Each year the Districts within LRD generate an annual report that provides pertinent information about the operation and activities of their reservoirs and similar projects within their boundaries for the reporting period, October 1 of the previous year through September 30 of the current year. This period is consistent with the USGS water year (WY) period. Although the Chicago District does not have any reservoirs within its boundaries, it is responsible for the Lake Michigan Diversion Accounting program. Accordingly, the Chicago District's annual report will reflect the implementation and activities of this program; the format for the report will deviate from that which is typically seen from the other Districts.

The Water Year (WY) 2016 Annual Report on Lake Michigan Diversion Accounting presents activities by the Corps of Engineers in accounting for the diversion from Lake Michigan by the State of Illinois. The accounting of the diversion is performed according to the guidelines established in the 1980 modified Supreme Court Decree concerning the diversion.

Presented in this report is the history of the diversion and its accounting, a description of the sources of the diversion, a description of the accounting procedures, and a summary of all significant activities that occurred during WY 2016.

Under the provisions of the U.S. Supreme Court Decree in the *Wisconsin, et al v. Illinois et al*, 388 U.S. 426, 87 S Ct. 1774 (1967) as modified 449 U.S. 48, 101 S. CT. 557 (1980), the Corps of Engineers monitors the measurement and computation of Lake Michigan diversion by the State of Illinois. The terms of the modified decree require the Corps of Engineers to prepare an annual report on the accounting of the Lake Michigan water diverted by the State of Illinois and actions taken by the involved agencies.

Chapter 2 – History of the Diversion

Water was first diverted from Lake Michigan at Chicago into the Mississippi River Basin with the completion of the Illinois and Michigan (I&M) Canal in 1848. The I&M Canal was primarily for transportation and diverted up to 500 cubic feet per second (cfs).

Development of the Chicago sewer system led to severe sanitation problems in the Chicago River by the mid to late 1800's. The newly constructed sewers moved water and wastes into the Chicago River, which until 1900 drained to Lake Michigan. The water quality of Lake Michigan deteriorated and contaminated the city's primary water supply.

As a solution to the sanitation and flooding problems, the Chicago Sanitary and Ship Canal (CSSC) was built. The construction reversed the flow direction of the Chicago River, as shown in Figure 2-1. The CSSC was completed in 1900 by the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC, formerly the Metropolitan Sanitary District of Greater Chicago, MSDGC). The Sanitary and Ship Canal followed the course of the older I&M Canal. This canal is much longer than the I&M Canal and can handle the Chicago River flow in addition to increased shipping. The Chicago River Controlling Works were constructed at the mouth of the Chicago River in the 1930s. The lock and sluice gates regulates the amount of Lake Michigan water allowed to pass into the river and restricts river flooding from entering Lake Michigan. The Lockport Lock and Dam controls the water level in the CSSC.

Between 1907 and 1910, the MWRDGC constructed a second canal called the North Shore Channel. It extended from Lake Michigan at Wilmette in a southerly direction 6.14 miles to the north branch of the Chicago River. The Wilmette Pumping Station, also known as the Wilmette Controlling Works, regulates the amount of Lake Michigan flow allowed down the channel through the use of one vertical lift gate, one 250 cfs pump (refurbished in 2002), and one 150 cfs pump (installed in 2010 during the rehabilitation of the structure). The MWRDGC uses the pumps to take discretionary flow from Lake Michigan due to the concern over Asian carp.

Construction of a third canal, the Calumet Sag Channel, was completed in 1922. The canal connects Lake Michigan through the Grand Calumet River to the CSSC. The Calumet Sag Channel was constructed to carry sewage from South Chicago, Illinois and East Chicago, Indiana. The Blue Island Lock and Dam controlled flow through the canal. The O'Brien Lock and Dam, which replaced the Blue Island Lock and Dam, was completed in 1967 and is located on the Calumet River. The O'Brien Lock and Dam regulates the flow of Lake Michigan waters down the Calumet Sag Channel.

Figure 2-1 shows the affected watershed. Figure 2-2 shows the location of the lakefront structures relative to the boundary of the diverted portion of the Lake Michigan watershed.

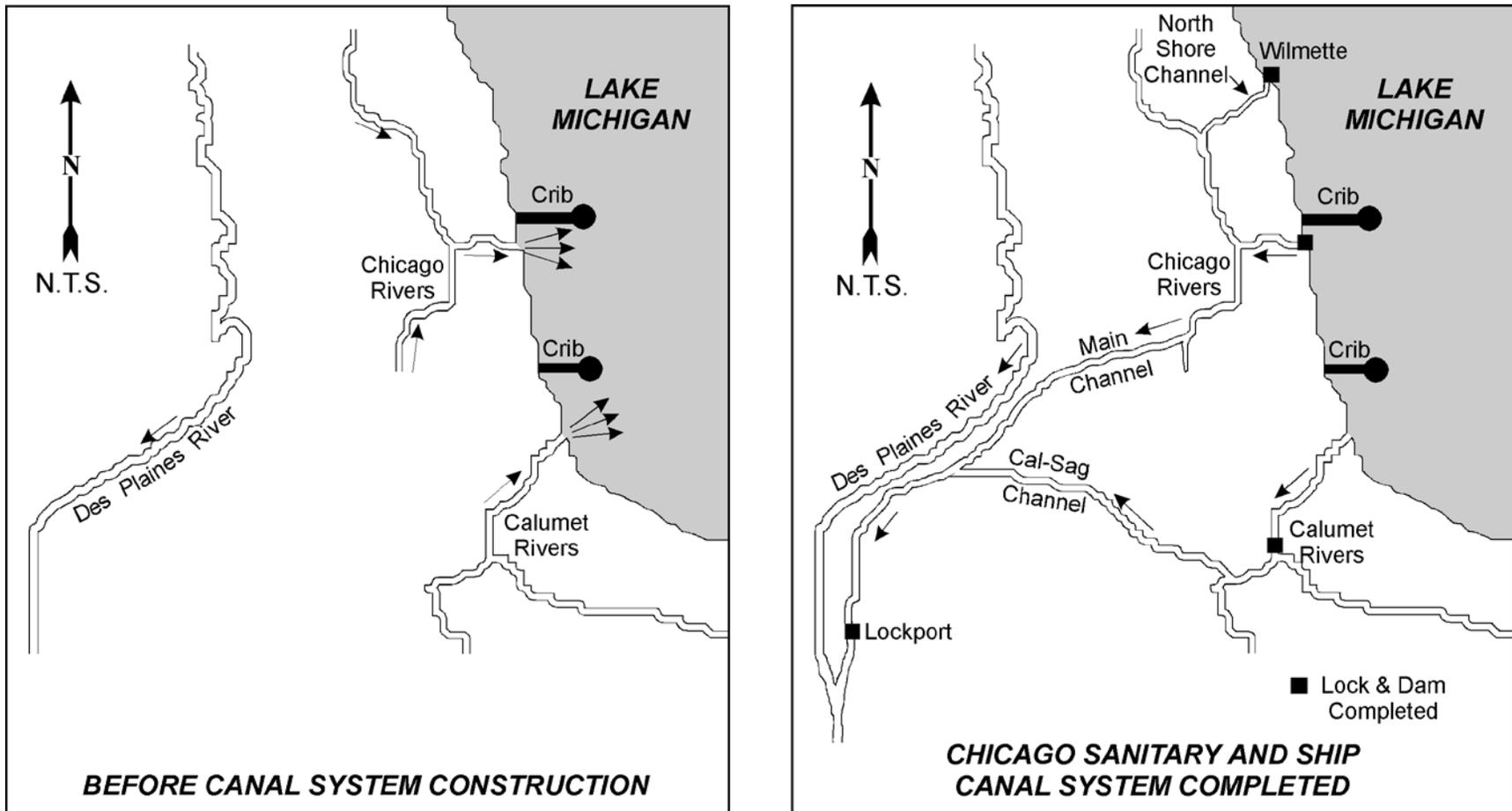


FIGURE 2-1 DEVELOPMENT OF THE CHICAGO SANITARY AND SHIP CANAL SYSTEM

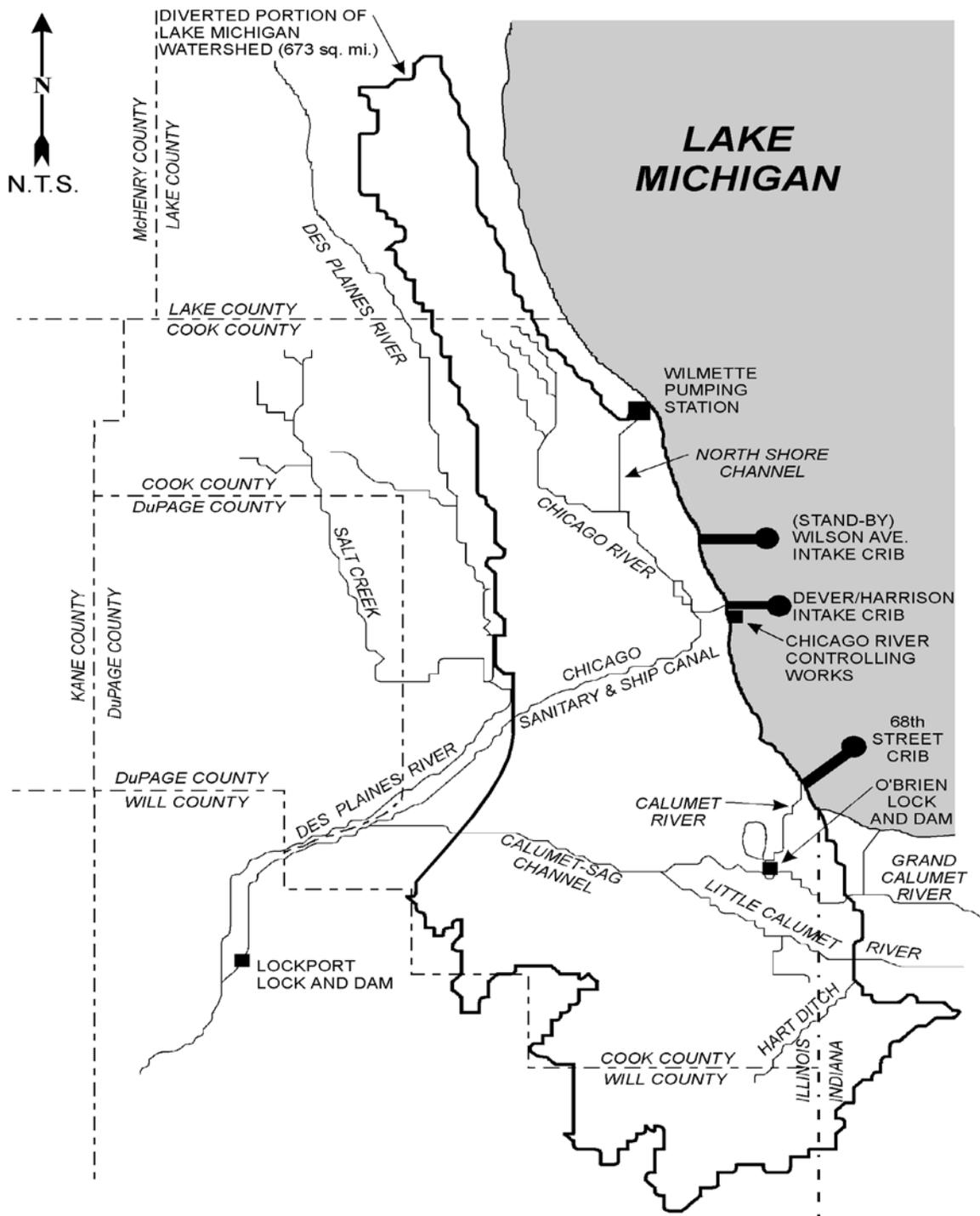


FIGURE 2-2 LOCATION PLAN - LAKE MICHIGAN DIVERSION AT CHICAGO

Chapter 3 – Significant Hydrologic Events

During WY 2016, an average total of 37.56 inches of precipitation fell at the 25 Illinois State Water Survey (ISWS) raingages that make up the Lake Michigan Diversion Accounting raingage network (Westcott, 2015). The WY 2016 average total precipitation of 37.56 inches was about 102 percent of the 26-year (1990-2015) average of 36.66 inches for the 25 raingage network. Table 3-1 tabulates the recorded monthly rainfall data during WY 2016, and the deviation from the ISWS 26-year annual and monthly average precipitation.

Table 3-1 WY 2016 Monthly and Annual Precipitation (inches)
Illinois State Water Survey Average Across the 25 Raingage Network

Month	2016	1990 - 2015	Deviation	Average
	Precipitation	Precipitation		
Oct-15	1.48	3.14	-1.65	47%
Nov-15	3.66	2.62	1.04	140%
Dec-15	5.52	2.03	3.49	272%
Jan-16	0.85	2.08	-1.24	41%
Feb-16	1.48	1.89	-0.41	78%
Mar-16	3.04	2.31	0.73	131%
Apr-16	2.60	3.63	-1.03	72%
May-16	4.38	4.02	0.36	109%
Jun-16	1.90	4.06	-2.17	47%
Jul-16	6.13	3.59	2.54	171%
Aug-16	5.15	4.22	0.92	122%
Sep-16	1.38	3.07	-1.68	45%
Annual	37.56	36.66	0.90	102%

There were 123 precipitation events in Water Year 2016. Of the 123 precipitation events, ten included at least one site at which the storm total exceeded one-year recurrence.

During WY 2016, one backflow event occurred, as described in Table 3-2.

Table 3-2 WY 2016 Backflows to Lake Michigan through Lakefront Structures

Date	O'Brien		CRCW		Wilmette P.S.		Total Backflow	
	(MG)	(cfs)	(MG)	(cfs)	(MG)	(cfs)	(MG)	(cfs)
7/24/2016	0.0	0.0	0.0	0.0	34.01	63.2	34.01	63.2

Chapter 4 – Status of Accounting Reports

Lake Michigan diversion flow data is summarized in accounting reports prepared on an annual basis as flows are certified. Since implementation of the modified Supreme Court Decree of 1 December 1980 and before this report, the Corps of Engineers has certified diversion flows for WY 1981 through WY 2013. The computations for WY 2014 and WY 2015 are currently underway, although are currently delayed pending the receipt of additional observational data from the State of Illinois. An anticipated time of completion is not available as of the time of publication of this report.

The running average diversion for the period WY 1981 through WY 2013 is 3,095 cfs, 105 cfs less than the 3,200 cfs 40 year average diversion specified by the modified decree. Also, the annual average diversion has exceeded the 3,680 cfs annual limit three times, once more than the maximum number of times allowed in the decree. Additionally, the absolute annual maximum of 3,840 cfs has been exceeded during the WY93 accounting period. The cumulative deviation, the sum of the differences between the annual average flows and 3,200 cfs, is 3,474 cfs-years at the end of WY 2013. The positive cumulative deviation indicates a cumulative flow surplus. The decree specifies a maximum allowable deficit of -2,000 cfs-years over the first 39 years of the 40-year averaging period.

Data collection and compilation for the WY 2014 and WY 2015 accounting report were done by the Corps. Hydrologic and hydraulic modeling and diversion accounting for WY 2014 and WY 2015 were also performed by the Corps.

Chapter 5 – Data Collection Program

The Chicago District data collection program is responsible for collecting the information necessary to successfully implement its water management and diversion accounting missions. This chapter describes the manner in which the data is collected and who collects the data.

a. Water Management and Diversion Accounting Data Collection

i. Sources

Data from hydrologic gages for water management and diversion accounting are obtained from various sources, including National Weather Service (NWS), U.S. Geological Survey (USGS), and National Oceanic and Atmospheric Administration (NOAA). The NWS provides current weather conditions, one to five day forecasts, precipitation reports, river level data, and special hydrological forecasts including flood warnings. Products available on various websites range from raw data (i.e. precipitation and temperature) to upper air maps and forecast products containing “value-added” graphics.

ii. Data Storage

Data used by the Chicago District is stored by the federal agency from which it originates. Certain data is collected and retained in the Data Storage System (DSS) developed by the Hydrologic Engineering Center (HEC) for use in the diversion accounting program.

b. Cooperative Streamgaging Program

Chicago District's cooperative streamgaging program is implemented through the USGS. The USGS' activities are funded through the Cooperative Streamgaging Program executed by the Chicago District's water management program manager. The Cooperative Streamgaging Program provides financial support to two USGS Water Science Centers within the Chicago District footprint for operation and maintenance of multiple streamgaging stations. The USGS Water Science Centers are Illinois and Indiana. Table 5-1 shows the costs of these programs and illustrates the funding trend over time since 2013.

Table 5-1 Cost of USGS Cooperative Streamgaging Program

Fiscal Year	District	Total	% Change
2013	Chicago	\$238,825	-
2014	Chicago	\$246,800	3.3%
2015	Chicago	\$253,600	2.8%
2016	Chicago	\$253,600	0.0%

Chapter 6 – Activities for FY 2016

a. LMDA Data Collection & Computations

Data collection for WY 2014 and 2015 continued through to the end of the fiscal year.

The review of the WY 2013 report was completed in August 2016, while publication and distribution of the WY 2013 report was completed in September 2016.

b. Supporting Studies

The USGS continued its analysis of the uncertainty within the HSPF modeling approach used by the LMDA program, specifically within the runoff volumes due to imprecision in precipitation input data. This analysis reveals the range of simulated runoff volumes that would be anticipated if more realistic precipitation patterns were used as input to the LMDA HSPF models, as compared to runoff volumes generated with the conventional practice of the Thiessen method. This study will continue into FY17 and is expected to be completed in FY18.

The USGS continued the first phase of a study entitled, “Uncertainty Analysis of an Index Velocity Meter and Discharge Computations at the Chicago Sanitary and Ship Canal near Lemont, Illinois”. This effort in response to a 7th Technical Committee recommendation to characterize the uncertainty in the LMDA process. This study will continue into FY17.

The USGS completed its “Analysis of Long-term Trends in Streamflow, Precipitation, and Runoff Coefficients in Northeastern Illinois”. This study provides a summary of the assessment of the changes in precipitation and streamflow at long-term streamgages in northeastern Illinois, and changes in the runoff coefficients (Q/P).

Based on a recommendation of the 7th Technical Review Committee, the USGS initiated a study comparing gaged and ungaged areas of the diverted watershed to evaluate their hydrologic similarity using current digital spoil mapping and GIS. The results of this study will be used to inform further refinement of the input parameters into the LMDA HSPF model. This study will begin and is expected to be completed in FY17.

c. Technical Review Committee

No activities relating to the Technical Review Committee occurred during FY 2016.

d. Water Control Manual

No activities relating to the Chicago Harbor Lock water control manual occurred during FY 2016.