Vol. No. 166 **January 2007**

US Army Corps of Engineers
Detroit District

Great Lakes Update

2006 Annual Summary

Water levels on all the Great Lakes began 2006 below average, and lower than the previous year. By the end of 2006 water levels were above 2005 levels on each lake, except for Lake Superior whose water level was approximately 12 inches lower than at the end of 2005. The water levels correlate well with the precipitation record. For 2006, precipitation on Lake Superior is more than five inches below average while the other basins are above average. Figure 1 shows 2006 precipitation across the Great Lakes basin compared with average.

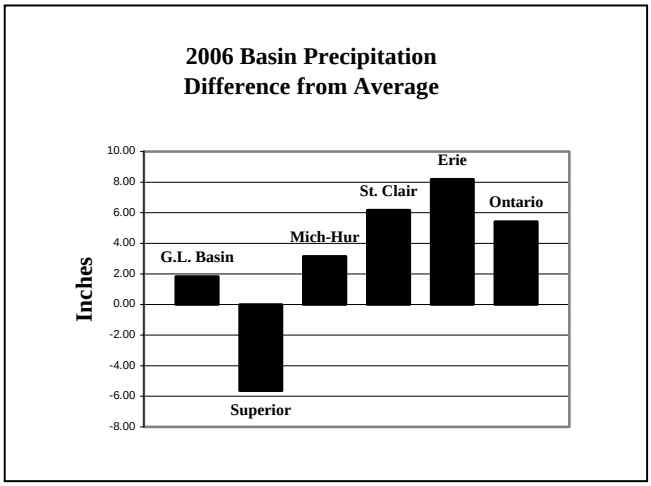

Figure 1: 2006 Great Lakes Precipitation

Hydrology

Ice cover in 2006 on the Great Lakes was at its maximum in early March. Figure 2 shows Lakes Erie and St. Clair were completely ice covered, Lake Huron had about 50% ice cover while the remaining lakes did not develop significant ice cover. Ice benefits water levels by preventing the loss of water to evaporation.

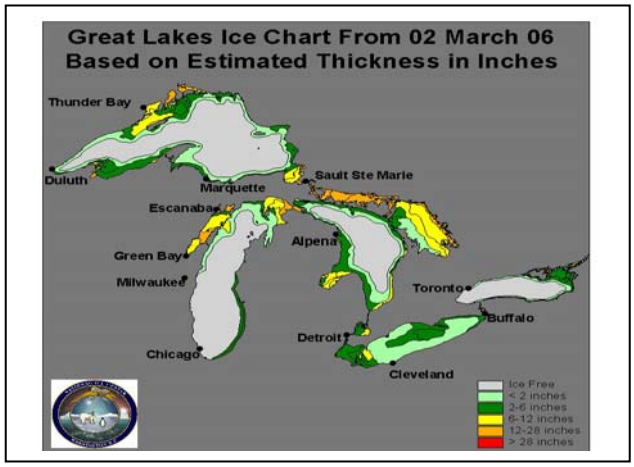

Figure 2: Great Lakes Ice-March 2, 2006

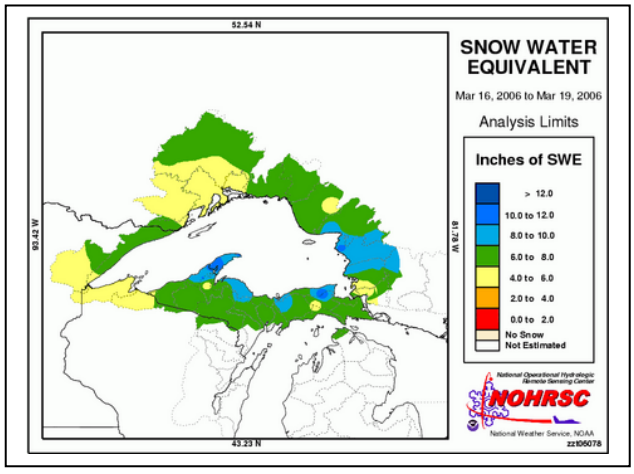

Figure 3: Snow Water Equivalent (SWE)

Figure 3 shows the snow water equivalent (SWE) across the upper Great Lakes basin. The 2006 average SWE was 40% higher than the

2005 average. During its peak in early March, SWE values were 8-11 inches in the major snowbelt regions and 4-8 inches across the northern shoreline of Lake Superior. The National Weather Service conducts snow surveys using low-flying aircraft over the Lake Superior drainage basin each year to help in predictions of water supplies to the Great Lakes. A similar survey will be made this winter and the results will be used to forecast water levels for the Great Lakes for the spring-autumn 2007 period.

Runoff from melting snow combined with increased spring rainfall brings on the period of seasonal rise on the Great Lakes. While the total SWE was above average on the Lake Superior basin, below average precipitation, especially since August, has worked to increase the rate of the seasonal decline bringing the lake to its lowest levels since the mid 1920's.

Forecast

The Climate Prediction Center (CPC) of the National Weather Service issues seasonal outlooks for both temperature and precipitation conditions. The CPC's latest winter outlooks for the Great Lakes region indicate an increased chance for above average temperature and equal chances for above, normal or below average precipitation conditions. These outlooks are mostly based on neutral sea surface temperatures in the Pacific Ocean. Neutral sea surface temperatures indicate El Nino will be a significant factor in determining weather patterns this winter.

The latest *Monthly Bulletin of Lake Levels for the Great Lakes* predicts lower water levels on Lake Superior and Lakes Michigan-Huron when compared to 2006. Lake St. Clair is expected to be near the level of last year while Lake Erie and Lake Ontario are forecasted to be above their early 2006 levels.

Water Levels

The "*Monthly Bulletin of Lake Levels for the Great Lakes*" displays water levels on the Great Lakes for the years 2005 and 2006. The following discussion is based on monthly mean levels.

Lake Superior levels started 2006 at 601.2 feet, about 4 inches below its January long-term average (LTA). Levels peaked in July at 601.4 feet about 8 inches below its July LTA. Lake Superior levels ended the year at 600.3 feet, about 17 inches below its December LTA.

Lakes Michigan-Huron began the year at 577.0 feet, about 18 inches below the January LTA. The lakes peaked in June and July at 577.9 feet, about 18 inches below the July LTA. The year ended with the level at 577.4 feet, 15 inches below the December LTA.

Lake St. Clair levels started the year at 573.3 feet, about 4 inches below its January LTA. Levels peaked in July and August at 574.2 feet, about 7 inches below the July LTA. Lake St. Clair levels ended the year at 573.7 feet, about 2 inches below the December LTA.

Lake Erie began 2006 at 570.8 feet, its LTA. It peaked in July at 571.8 feet, about 1 inch below its LTA. The year ended with levels at 571.4 feet, about 7 inches above the December LTA.

Lake Ontario started the year at 244.8 feet, about 3 inches below the January LTA. Levels peaked in July at 246.0 feet, its July LTA. The year ended with December levels at 245.5 feet, about 12 inches above its LTA.

Lake Superior Regulation

During 2006 Lake Superior outflows continued to be set by the International Lake Superior Board of Control (Board) using Regulation Plan 1977-A. The Board is a bi-national body that reports to the International Joint Commission (IJC) on boundary water management issues

including the management of Lake Superior outflows. Flow changes resulting from monthly Lake Superior regulation are accomplished by varying the amount of water allocated to hydropower production and, when necessary, opening or closing gates in the Compensating Works at the head of the St. Marys Rapids.

Water supplies to Lake Superior were significantly below average for 2006. Only the January and December supplies were above average. The annual precipitation over the Lake Superior basin was well below average during 2006. Only March and July had above average precipitation. A one-half gate open setting was maintained during 2006 in the Compensating Works in order to maintain minimum flow requirements in the St. Marys Rapids and to support spawning in the fishery. Flow measurements to support gate recalibration were done from June 7th through June 12th at the Compensating Works. Measurements were made with four gates (Gates 7 through 9) set at 8 to 11 inches open and with one gate (Gate 9) set half open to evaluate the equivalency of four gates partially open to one gate at a one-half open setting. The one-half gate open setting was maintained through the month, therefore the flow measurements had minimal impact on the water levels of lakes Superior and Michigan-Huron.

Flow variations due to peaking and ponding operations by the hydropower plants at Sault Ste. Marie, Michigan and Ontario cause St. Marys River water levels downstream from the plants to fluctuate. When Lake Superior levels and outflows are below average, these fluctuations can be of concern to commercial navigation. Outflows and monthly mean water levels were lower than those of 2005 in all months.

In March 2006 the IJC approved continuation of peaking and ponding operations by the hydropower entities for an indefinite period under the Board's supervision and subject to its approval each month. The Board may suspend ponding operations on weekends and holidays for 8 hours each day if operations are expected to cause sustained weekend levels at the U.S. Slip Gauge to be below chart datum. The Board suspended weekend and holiday ponding operations during April and May and from October through December because St. Marys River levels at U.S. Slip Gauge were expected to be, or were, below chart datum.

Outflows were 12% below average in 2006, ranging from a low of 55,100 cubic feet per second (cfs) in December to a high of 77,000 cfs in August. Figure 4 compares the monthly Lake Superior outflows in 2006 to long-term average flows for the 1900-1999 period of record.

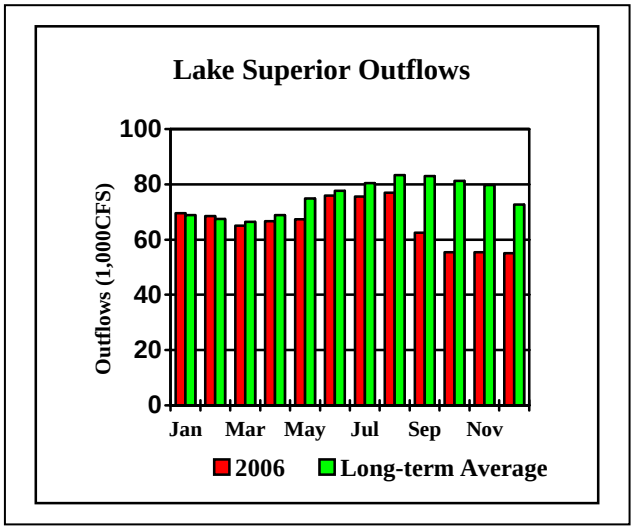

Figure 4: Lake Superior Outflows

Lake Ontario Regulation

As part of its operations, the International St. Lawrence River Board of Control (Board) continuously assesses the hydrologic conditions in the Lake Ontario – St. Lawrence River system to formulate an outflow regulation strategy. As of December 12, 2005, the level of Lake Ontario was 244.62 feet, 1.2 inches above its long-term average, and exactly the same as one year prior, with 1.6 inches of water conserved on Lake Ontario. The Board reviewed conditions and decided to maintain its strategy of outflows specified by Plan 1958-D, with provisions to vary outflows in order to assist the ice formation process. Over-discharges were authorized, to maintain the level on Lake St. Louis above 67.6

feet and meet critical needs of navigation and hydropower.

On December 20th, just prior to the 2005-2006 winter season, Lake Ontario reached its low level of 244.45 feet, 0.8 inches below its long-term average. By the end of December 2005, Lake Ontario was at 244.55 feet, a fall of 2.4 inches during the month. The Lake Ontario level normally rises about 0.4 inches in December. During December, outflows were generally as specified by Plan 1958-D except for the third week, when flows were above those specified by the plan in order to moderate the decline in downstream flows and levels. By the end of December, the net result of all previous over- and under-discharges was 1.5 inches of water stored on Lake Ontario.

Ice cover formation in the Beauharnois Canal near Montreal began on December 31 and, due to fluctuating cold and mild weather, continued throughout the month of January and early February, progressing for a few days and then deteriorating. During this period the flow was maintained at 220,000 cfs. As of January 2, 2006, the level of Lake Ontario was 244.58 feet, 0.4 inches above average but 2.8 inches below the year ago level.

During January Lake Ontario's level rose 9.4 inches to 245.34 feet. The January rise is normally 1.6 inches. The daily levels at Montreal harbour were above chart datum and outflows from the Ottawa River were above average during the month of January. Outflows were as specified by Plan 1958-D during January. Total accumulated outflow deviations from Plan 1958-D, as of January 31, remained equivalent to 1.5 inches of water stored on Lake Ontario. The amount of water accumulated in the snowpack on the Ontario basin was less than average, with much of the precipitation falling as rain rather than snow in January.

Although a small amount of ice began to form upstream of Moses-Saunders in mid-January, this was short-lived and the main channel of the international section remained ice free as of February 2nd. At that time, about 4.7 miles of fragile ice cover remained in the 13.6 miles long Beauharnois Canal. There was concern that a flow increase could cause the ice cover to collapse and restrict flow. As part of normal operations, the Board may vary the Lake Ontario outflow to promote formation of a smooth, stable ice cover on the St. Lawrence River during the winter season. Rough ice cover increases the resistance to water flow and a weak cover risks ice jams, which could be problematic for outflow regulation during the winter. Flow deviations (under-discharges) were authorized by the Board February 4-6 to aid in ice stabilization. Mild weather the first week of February caused the loss of most of the ice in the Beauharnois Canal and permitted an increase in the flow between February 6-10 to counter the effects of a high Lake St. Lawrence level. The gates of Iroquois Dam were partially closed from February 7th to 10th due to the high Lake St. Lawrence level. By this time, the net total accumulated deviation was increased to 1.8 inches of water stored on Lake Ontario.

The Board authorized additional flow deviations (under-discharges) February 11-14 to aid in ice stabilization. Lake Ontario was 245.60 feet by the end of the month, a rise of 3.1 inches. Lake Ontario normally rises by 1.2 inches in February. Lake Ontario's outflow was less than specified by Plan 1958-D during the second week of February to assist ice formation. With no significant ice formation occurring, the flow was increased to plan flow on February 14th.

After February 18th a significant amount of ice again began to form. The last two weeks of February, Hydro Quebec limited the flow in the Beauharnois Canal to better manage the forming ice and released a larger portion of the total flow from Lake St. Francis through their Les Cedres plant. Ice also began forming rapidly upstream at this time. The first day of ice cover in the international section occurred on February 20th reaching upstream to the Ogden Island channel

the first week of March. The ice cover had dissipated by March 11th.

Flows higher than those specified by Plan 1958-D were released between March 4-6 and 20-24, to reduce the amount of conserved water on Lake Ontario. The maintenance of downstream levels below flood alert level, the availability of hydropower capacity to allow flow discharges without spilling through open channels and the prevailing ice conditions all contributed to allowing the over-discharges to take place safely. By March 24, the net accumulated deviations were decreased to 1.9 inches of water stored on Lake Ontario.

At the end of March the Board met and decided to closely follow the outflows prescribed by regulation Plan 1958-D, except for small deviations to manage Lake St. Lawrence levels. They decided that the 1.9 inches of water stored on Lake Ontario, relative to the Plan 1958-D level, be retained to help meet future needs. Several factors contributed to this decision. Because there was virtually no snow pack left on the Lake Ontario basin, runoff was expected to be below normal. While considerable snow remained on the Ottawa River basin, the spring runoff was well underway. Lake Ontario outflows would be reduced to less than the amounts specified by Plan 1958-D, if needed, to avoid flooding in the Montreal area.

In response to low water supplies and lower than average outflows, the Iroquois Dam gates were partially closed on July 5 to reduce water levels on Lake St. Lawrence that had risen due to the relative low outflows. On August 3 and 4, in order to lower the high Lake St. Lawrence levels, an over-discharge of 0.04 inches of water was made from Lake Ontario reducing the net accumulated deviations to 1.8 inches of water stored on the lake. With Lake St. Lawrence levels declining the Iroquois Dam gates were raised to the fully open position at the end of July. By August 8, 1.8 inches of water had been stored on Lake Ontario. The Board's long-term strategy was to maintain the water to assist with any critical needs later in the year and make other minor deviations from Plan flows to assist with other critical water level situations that may arise.

The September and October supplies to Lake Ontario were well above average resulting in a 1.6 inch rise in levels by the end of October, whereas it normally falls 4.7 inches in October. The end of October Lake Ontario level was 245.41 feet.

November 8, the Board reviewed conditions and decided to slightly modify the regulation strategy that had been in place since March 29 in anticipation of the transition to winter flows in December.

November was the second consecutive month of wet conditions. The regulation plan had responded with successive weeks of flow increases resulting in the highest outflows for that time of year since 1997. Lake Ontario's level was generally steady during the month of November. As of December 1, the level of Lake Ontario was 245.44 feet, a rise of 0.4 inches while normally it falls 1.2 inches in November. The lake was 11.0 inches above its long-term average, and 8.3 inches above the level of one year ago, with a total of 1.8 inches of water conserved on Lake Ontario.

On December 2-3, heavy rain and high winds caused Lake St. Louis levels to peak at 72.31 feet, start dropping and then to rise again to 72.70 feet, 2.4 inches above flood alert level of 72.50 feet. Lake Ontario's outflow was decreased to reduce high Lake St. Louis levels. A second higher peak of 72.78 feet was reached and held a considerable time before falling slowly.

December 2-5 under-discharges resulted in an additional 0.1 inches of water being conserved on Lake Ontario. As of December 8, the level of Lake Ontario was 245.54 feet, 12.2 inches above its long-term average, and 10.2 inches above the level of one year ago, with a total of

approximately 2.0 inches of water conserved on Lake Ontario.

Lake Ontario ended December at 245.5 feet, 12 inches above its LTA with about 2 inches of water conserved on the lake.

Figure 5 below compares 2006 Lake Ontario outflows with period of record (1900-1999) monthly LTA outflows. Further information on ILSBC activities can be found on the internet at: *http://www.islsrbc.org/*.

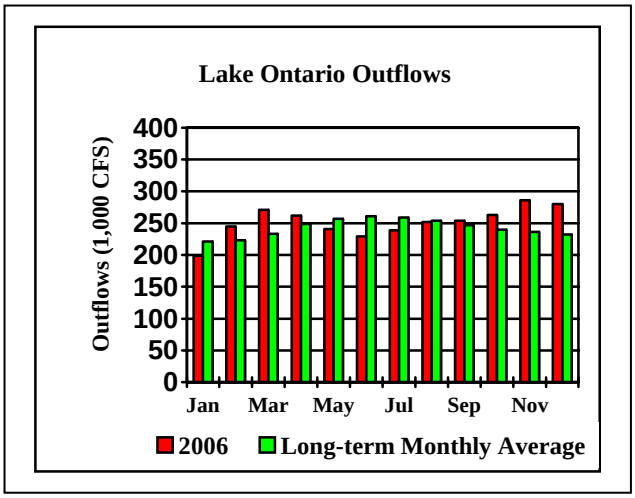

Figure 5: Lake Ontario Outflows

Public Concerns

Concern continues to be expressed about the impacts of below average water levels on shipping, access, shoreline property, wetlands, businesses, erosion and water quality. The news media continues to follow up on the above situations.

Upper Great Lakes Plan of Study

In May 2006, IJC formally announced that it is starting a major study of the upper Great Lakes. The study area includes lakes Superior, Michigan, Huron and Erie, and their interconnecting channels (St. Mary's River, St. Clair River, Lake St. Clair, Detroit River and Niagara River), up to Niagara Falls.

This study, for which the IJC has now received letters of support from the governments of Canada and the United States, will help determine whether the regulation of Lake Superior outflows can be improved to address the evolving needs of the upper Great Lakes, and whether the IJC needs to update its Order of Approval at the St. Marys River between Sault Ste. Marie, Michigan, and Sault Ste. Marie, Ontario.

Major topics for investigation include determining the factors that affect water levels and flows, developing and testing the performance of potential new regulation plans including climate change scenarios, and assessing the impacts of these potential plans on the ecosystem and human interests. Physical changes in the St. Clair River will be investigated early in the study as one factor that might be affecting water levels and flows.

In early 2007, the IJC will appoint a bi-national study board and public advisory group. Next, the various study working groups will be set up to begin the study tasks. The governments of the United States and Canada have committed to providing funding in 2007. The study is expected to take five years to complete and cost $14.6 million (U.S.). These costs will be split equally by the two governments. For more information, visit the IJC's website at: http://www.ijc.org.

The International Lake Ontario-St. Lawrence River Study Report Continues to be Evaluated by the IJC

On May 31, 2006, the International Lake Ontario-St. Lawrence River Study Board released its final report to the IJC. The report is the culmination of the five-year, $20 million (U.S.) study which has improved understanding of how regulation affects the environment, recreational boating, flooding, shoreline erosion, navigation, hydropower production and municipal and industrial water uses from Niagara

Falls, New York and Ontario, to Trois-Rivières, Quebec.

The Study Team was a bi-national group of diverse experts from government, academia, native communities and interest groups representing the geographical, scientific and community concerns of the Lake Ontario-St. Lawrence River system.

The Team involved the public throughout the study by asking for their opinions, considering their input and incorporating their concerns with the scientific work of the technical workgroups to deliver recommendations for new criteria and plan options for water level and flow regulation to the IJC.

After five years' work, the Team narrowed the options down to three plans for regulating the outflows from Lake Ontario through the international hydropower project at Cornwall, Ontario and Massena, New York. Each of the plans could be considered as a change to the IJC's existing regulatory regime, each of which provides net economic and environmental improvements to the existing plan.

The IJC is now considering the future of water level and flow regulation for the Lake Ontario-St. Lawrence River system. With the release of the Study Team's report on May 31, the Commission started a public comment period, which ended on September 15. Throughout the later half of 2006, the Commission has continued to evaluate the candidate plans. It expects to hold public hearings on its draft decision before it makes its final decision.

For further updates check the IJC's website: *http://www.ijc.org.*

Meetings with the Public

The International Lake Superior Board of Control hosted a multi-city conference call for the public on May 24, 2006 between Sault Ste. Marie, Michigan, Duluth, Minnesota and Parry Sound, Ontario.

The International Niagara Board of Control (INBC) held its annual meeting with the public on October 3, 2006 in Niagara Falls, New York. For more information on activities of the INBC visit: *http://www.ijc.org/conseil_board/niagara/en/niagara_home_accueil.htm*

The St. Lawrence River Board of Control held its annual meeting with the public on June 20, 2006 in Alexandria Bay, New York. Two public telephone conferences were held. The first was held on March 21, 2006 in Rochester, NY and Montreal, QC, and the second on September 19, 2006 in Oswego, NY and Cornwall, ON.

Commercial Navigation

The Soo Locks opened the 2006 shipping season on March 25, 2006 as scheduled. Through November 2006, the estimated tonnage passing through the Soo Locks at Sault Ste. Marie, Michigan was about 1.6% above the comparable 2005 tonnage. U.S. and Canadian vessels carried 53.45 and 14.42 million short tons (MST) of cargo respectively, as compared to respective 2005 tonnages of 52.61 and 14.30 MST. Foreign flagged vessels carried about 4.05 MST, up 18% from the 2005 tonnage of 3.44 MST.

Through November 2006 an estimated total of 7,301 vessels had transited the locks as compared to 7,201 vessels the previous year. Cargo vessels totaled 3,828 compared to 3,651 the year before. There were 2,291 U.S. flagged vessels, 1,109 Canadian flagged vessels and 428 foreign flagged vessels (ocean going or "salties"). Other vessels transiting the locks such as pleasure craft, tour boats, Coast Guard and scientific research vessels numbered 3,473. The U.S. Locks will close on January 15, 2007 and reopen on March 25, 2007.

The Canadian lock at Sault Ste. Marie, Ontario opened on May 15, 2006. By season-end on October 15, 2006, a total of 2,305 vessels carrying 75,125 passengers had transited the locks. The vessels were primarily pleasure craft

and tour boats, as well as some commercial and government vessels. The lock is expected to reopen on May 15, 2007.

Preliminary figures through November 2006 indicate the tonnage passing through the Lake Ontario-Montreal section of the St. Lawrence Seaway was up about 16% from 2005 at about 32.5 million metric tons (MMT). Vessel traffic was up about 10.6% over 2005 at 2,701 (combined lake and ocean) vessels.

Preliminary data on the type of cargo transiting the Seaway through November 2006 include iron ore up 6.4% to about 8.7 MMT; iron and steel up 36.5% to about 3.2 MMT; grain up 23.2% to about 10.1 MMT; Coal up 7.4% to about 0.68 MMT; general cargo up 41.7% to about 4.3 MMT; and petroleum products up 11.5% to about 1.5 MMT. For additional details on Seaway activities visit their website on the Internet at: http://www.greatlakes –seaway.com/. The St. Lawrence Seaway Development Corporation provided these figures.

New Lock

A new "Poe-sized" lock is proposed to replace the existing Davis and Sabin Locks at the Soo Locks complex at Sault Ste. Marie, MI. The purpose of this project is to provide for more efficient movement of waterborne commerce. The Assistant Secretary of the Army for Civil Works (ASA (CW)) has reviewed the Limited Reevaluation Report (LRR). The revised LRR that includes responses to the ASA (CW) comments was forwarded to Headquarters USACE on September 30, 2005. On August 30, 2006 the revised LRR along with letters of support from the Departments of Transportation and Homeland Security were provided to the ASA (CW) for approval. Upon approval of the LRR, execution of the Project Cooperation Agreement (PCA) with the non-Federal sponsor, the Great Lakes Commission (GLC), could be completed in FY 07. Detailed design of the channel deepening/guide walls and lock chamber continue while awaiting LRR approval.

2005 Great Lakes Updates

The following reports were published in 2006:

2005 Annual Summary, Vol. No. 162, January 2006.

Short Term Water Level Changes on the Great Lakes. Vol. No. 163, April 2006.

Great Lakes Navigation, Vol. No. 164, July 2006.

Great Lakes Water Level Collection, Vol. No. 165, October 2006.

Previous Great Lakes Update articles are available at:
http://www.lre.usace.army.mil/glhh/news

General Notes

All elevations shown in this article are referenced to the IGLD 1985 datum. Information about the Great Lakes water levels, outflows, and weather is available at: *http://www.lre.usace.army.mil/glhh.*