

CEMVN-ED-T

MEMORANDUM FOR Chief, Planning Division (CEMVN-PF-PFR/ Louise Williams)

SUBJECT: IHNC Lock Replacement General Re-evaluation Report, Determination of Sill Depth for Shallow Draft Lock

1. Reference the enclosed assessment dated 29 April 2015 outlining the technical considerations used to determine the sill elevation for the proposed IHNC shallow draft lock. This assessment relies heavily on USACE engineering manuals and studies completed between 1997 and 2009.
2. It is recommended that the General Re-evaluation Report assume a sill elevation of EL. -22.0 NGVD for the alternatives investigated to determine the Tentatively Selected Plan (TSP). This elevation provides the appropriate level of safety for vessels navigating the lock and allows for acceptable filling and emptying of the chamber. This elevation is compatible with the existing channel and will require minimal excavation and backfill during construction. Additionally, the 1997 Evaluation Report showed limited construction cost savings from shallower sill elevations. The sill elevation will be adjusted to the NAVD88 datum in a later phase of the study.
3. At the request of Mark Wingate, Senior Project manager, a quantitative cost comparison will be made between a sill elevation of EL. -22.0 NVGD and EL. -16.5 NGVD to validate the cost finding of the 1997 Evaluation Report. This comparison will be documented in the Chief's Report, but is not expected to change the recommendation.
4. Points of Contact for this assessment are Malene Henville, x2425, David Lovett, x2680, and Leslie Campbell, x1334.

Encl
as


JOHN BIVONA, P.E.
Acting Chief, Engineering Division

PROJECT(S): IHNC Lock Replacement General Re-evaluation Report

Date: 29 April 2015

Issue: Determination of Floor Depth for Shallow Draft Lock

Background:

One of the primary issues addressed during previous IHNC Lock Replacement studies was the determination of the appropriate sill elevation for the new lock. Sector gate locks are traditionally flat floored with the chamber and sill set to the same elevation. This elevation is determined by balancing the upfront cost of constructing a deeper structure against the long term benefits from faster lockage times.

The 1997 Evaluation Report included a comparison between a shallow draft lock with the floor at EL. -22.0 NGVD and a shallow draft lock with the floor at EL. -18.0 NGVD, similar to other structures along the GIWW. The analysis showed limited construction cost savings and longer operating times for the lock with the shallower sill. The recommended sill elevation from this study was EL. -22.0 NGVD.

Summary of Technical Considerations:

1. Adequate Clearance for Design Vessel:

- Sill and chamber depth are set to prevent tows from striking the lock floor and permit reasonable entrance and exit times.
- Per EM 1110-2-1604, a sill depth that is 1.5 to 2 times the vessel draft allows for a safe entrance into and exit from the lock. The design draft for a fully loaded liquid tank barge is 11 feet.
- According to the 1997 Evaluation Report, a sill set at EL. -22.0 NGVD will provide a water depth that is equal to or greater than 2 times the draft depth 95% of the time. This sill will provide a water depth that is equal to or greater than 1.82 times the draft depth 100% of the time.

2. Limiting Hawser Forces on Vessels during Lockage:

- Hawser forces are the stresses in the mooring lines during lockage. Per EM 1110-2-1604, this force cannot exceed 5 tons for a barge. Hawser forces can be reduced by increasing the distance between the bottom of the vessel and the lock floor or by increasing filling and emptying times.
- With a sill set at EL. -22.0 NGVD, Hawser forces on the vessels can be limited to the allowable range and provide acceptable filling and emptying times.

3. Constructability:

- The existing IHNC channel is maintained to EL. -32.0 NGVD. By setting the sill of the new structure at EL. -22.0 NGVD, minimal excavation or backfill will be required for construction of the new lock.

Recommendation:

Based on the findings of previous studies and requirements from USACE engineering manuals, Engineering Division recommends proceeding with a sill elevation of -22.0 NGVD in the General Re-evaluation Report. This is a conservative recommendation and must be validated by a physical model during PED.

In a future phase of this study, this sill elevation will be adjusted slightly to reference the current datum in North America, NAVD88. The NAVD88 sill elevation will be determined based on the criteria outlined above and provide similar levels of safety and efficiency. It is expected that the final sill elevation will be between EL. -22.0 and EL -24.0 NAVD88.

References:

Effects of Lock Sill and Chamber Depths on Transit Time of Shallow Draft Navigation (ERDC/CJL TR-00-13), S.T. Maynard, August 20116

Hydraulic Design of Navigation Locks (EM 1110-2-1604). US Army Corps of Engineers, 1 May 2006

Layout and Design of Shallow Draft Waterways (EM 1110-2-1611). US Army Corps of Engineers, 31 Dec. 1980

New Locks and Connecting Channels, Evaluation Report, March 1997