



**US Army Corps
of Engineers®**
New York District

Storm Surge Barrier Sub-Appendix

Annex E – Considerations for the Orchestration of Storm Surge Barrier Operations for HATS

DRAFT

New York – New Jersey Harbor and Tributaries Coastal Storm Risk Management Feasibility Study

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1 Synopsis

The Tentatively Selected Plan (TSP) under USACE’s NY/NJ Harbor and Tributaries Study (HATS) for comprehensive flood mitigation in the New York-New Jersey area includes a combination of several Storm Surge Barriers (SSBs) and land-based measures along critical shorelines. SSBs are operable floodgates typically at entrances to bays or other partially enclosed waterbodies, designed to offer some level of flood protection to their landward side from offshore surge threats. Closure of an SSB is typically initiated only when the offshore still water level is expected to reach a prescribed elevation called the Closure Criterion. The proposed SSBs on the deep draft navigation channels under the TSP for HATS are mostly floating sector gates similar to the Maeslant storm surge barrier in the Netherlands. Figure 1 shows a photograph of the Maeslant barrier. Barrier closure operations also of course affect navigation activities and require a significant level of logistical coordination to plan, communicate, and execute a successful operation in response to a potential surge threat.



Figure 1-1: Maeslant Barrier, The Netherlands

Every operation involves a sequence of decision points and actions that would need to be performed in a timely manner to successfully identify and respond to possible approaching surge threats. The following provides a high-level description of the “closure and opening orchestration” of the proposed large storm surge barriers under the HAT Study and is based on some general information available for the Maeslant storm surge barrier.

2 Anticipating closure event and potential timeline

The first step in a planned SSB operation involves identification of an upcoming predicted meteorological event as a potential local surge threat large enough to meet the Closure Criterion of the SSB. The time needed to successfully orchestrate a barrier closure means that any decision to close the barrier would need to be made well in advance of a potential approaching threat. Depending on the accuracy of the forecast which may only be determined in hindsight, a potential threat may fail to materialize at the predicted level or predicted time resulting in avoidable costs and disruptions, or worse may exceed predictions or arrive sooner than expected, leaving the system potentially unprepared to deal with the flood hazard. Therefore, it is recognized that there may be some risk of inefficiencies inherent in a decision to close the storm surge barrier. Improving scientific and technical knowledge leading to increased reliability of forecasts may reduce this risk to some extent, although not eliminate it. Once an upcoming meteorological event has been identified communication protocols would be activated such that State and city emergency managers, the US Coast Guard as well as Port Authority leadership and stakeholders stay informed of a potential upcoming closure.

Once a potential threat is deemed to likely meet the criteria for closure, the first step in the SSB closure orchestration would be to alert the relevant operating staff for coordinating and executing the closure. For a successful operation, this may need to occur at least as early as about 24 hours prior to the anticipated initiation of closure to allow sufficient time for mobilization, preparation, and performance of that action.

In addition to the forecast surge, other anticipated environmental factors like tidal conditions, winds, or currents may also influence the planned time of initiation of closure due to possible operational or structural considerations. For example, the timing of the closure initiation during low tide may be preferred to minimize reverse head acting across the barrier. Factoring in such considerations may require even more advance planning and preparation time.

3 Navigational considerations

Once the anticipated time of barrier closure is set, ships would need to be warned in advance of the upcoming navigation constraint. Sufficient time would need to be provided for vessels to reach safe harbor or divert. Adequate time must be set aside within the closure timeline to bring all navigation activities across the barrier to a safe halt. For example, under a closure timeline for the Maeslant barrier ships are warned about 6 hours prior to the time of anticipated closure and then given about 3 hours to plan and take alternative course. It should be noted that at this 6-hour mark, depending on the severity of the storm and associated wind conditions in the NY/NJ Harbor, other navigation restrictions may be in place already. Very soon after the broadcasted time of shipping stoppage, mechanical closure is initiated.

4 Mechanical gate closure

The precise details and timeline of the mechanical closure operation would depend on the type of barrier deployed. Mechanical closure for floating sector gates starts with rotation of the two gate leaves about their ball joints until they almost meet at the center of the navigation channel, at which point the navigation lane is completely obstructed. In the case of the Maeslant Barrier this is initiated at about 2 hours 20 minutes prior to time of closure and takes 20 minutes. The sector gates, which are floating at this point, are then gradually sunk up to about 3 feet (1 m) above the bottom sill by filling them with water. Some time is then allowed for any silt over the sills to be cleaned out by the rapid flow beneath the gates. The gates then gradually drop down to a smaller gap of about 1.5 ft (0.5 m) when they are ready to align with the sill. This process initiated with the sinking of the sector gates about 2 hours prior to planned closure operation takes about 2 hours to complete. At the time of closure, the barrier is dropped down to align with the sill and allow no hydraulic flow across, and then the barrier is deemed fully closed.

5 Gate reopening

Reopening of the gate is initiated when the hydraulic head across the gate approaches zero due to falling offshore water levels following the peak of a storm. Drainage and other inflows within the basin may influence the time at which this may occur, and therefore some real-time monitoring of the environmental conditions would have to inform the decision to reopen the gates at a given point in time. Depending on the SSB design, auxiliary gates may also be available to be opened relatively quickly to ease out possible large head accumulation from drainage behind the barriers during the main closure period.

For floating sector gates, reopening would start with de-watering the gates so that they are once again in floating position. The leaves of the gate would then be swung open until they are back in their resting positions, at which point navigation can be fully restored. These decisions impacting navigation would also need to be communicated in a timely manner to ensure expedited restoration of normal navigation activities.

6 Summary

A schematic of a timeline for preparation and completion of closure of a sector gate-type Storm Surge Barrier for a tropical storm event and subsequent reopening is shown in Figure 2. Successful operation of a SSB hinges on a reliable forecast providing sufficient time for planning, preparation and execution of the barrier closure. The timing and sequence of operations for the mechanical execution of barrier closure may vary depending on the type of barrier deployed. An appropriate closure timeline would need to be adopted to take all the relevant details into account.

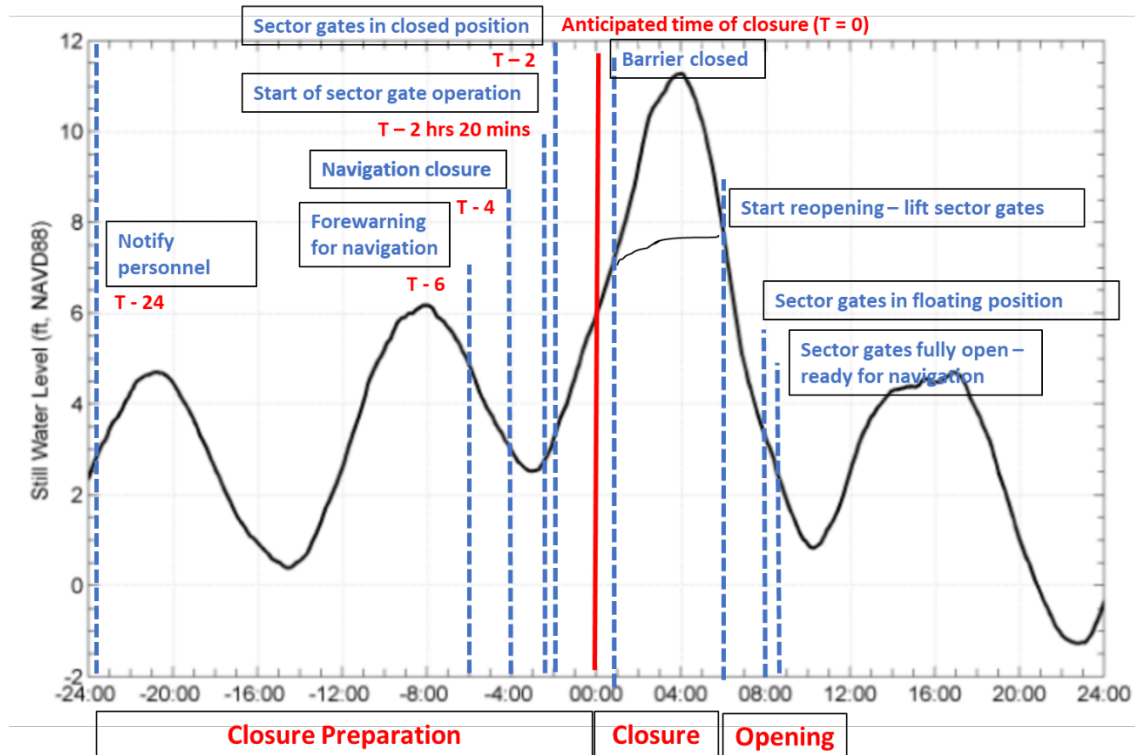


Figure 2: Schematic of a SSB closure timeline