Hydrologic Separation

U.S. ARMY CORPS OF ENGINEERS **Building Strong®**

ANS Control: Hydrologic Separation—Physical Barriers

Targeted Species: Hydrologic separation may be effective at preventing the transfer, via aquatic pathways, of all ANS of Concern – CAWS, up to and including the design event. See *General Effectiveness* and *Operating Constraints* for more information.

Selectivity: Hydrologic separation may prevent the transfer of any species via aquatic pathways, under normal flow regimes and some flood conditions. This Control is non-selective.

Developer/Manufacturer/Researcher: Not applicable

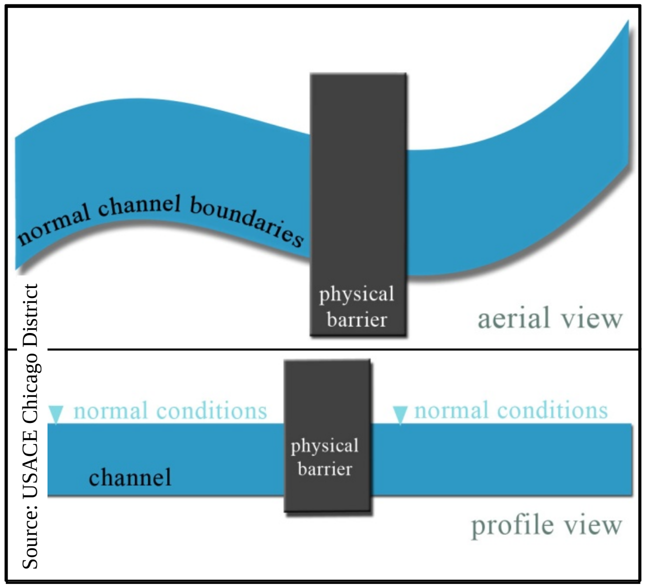

Figure 1. Hydrologic separation is the use of physical means to separate two, or more, watersheds

Brief Description: Hydrologic separation is the use of physical means to permanently separate two or more connected watersheds to prevent the mixing of all untreated surface waters between the watersheds (Figure 1). The design of the physical barrier would have to account for site-specific conditions and generally, would consist of a physical blockage constructed in a channel, river, lake, or wetland and possibly auxiliary structures outside of the water body. The structure would be designed to prevent the mixing of untreated water from disconnected watersheds.

Prior Applications: Hydrologic separation of the Great Lakes (GL) Basin from the Mississippi River (MR) Basin has been identified as a possible means to prevent the transfer of ANS through the CAWS (Aquatic Invasive Species Summit Proceedings Conference 2003, Great Lakes Commission 2011, Rasmussen 2002). Hydrologic separation has also been specifically identified as a means for preventing the transfer of Asian carp (bighead carp (*Hypophthalmichthys nobilis*), silver carp (*H. molitrix*), grass carp (*Ctenopharyngodon idella*) and black carp (*Mylopharyngodon piceus*)) into the Upper MR Basin via aquatic pathways (FishPro, 2004). USACE is evaluating hydrologic separation of the MR and GL basins as an alternative for GLMRIS.

General Effectiveness: The effectiveness of a permanent physical barrier to achieve hydrologic separation would be based on in-stream conditions and local topography. Generally, physical barriers are designed to prevent overtopping of flows created by flood events up to the design event. If the design (flood) event will flow outside the normal channel boundaries at the physical barrier location, then the physical barrier must extend past these channel boundaries and tie into high ground at the design elevation (Figure 2). If a storm produces flows that exceed the design event flows, the physical barrier will no longer act as a means of hydrologic separation. Instead, water will overtop (Figure 3a) or will flow around (bypass) the physical barrier (Figure 3b).

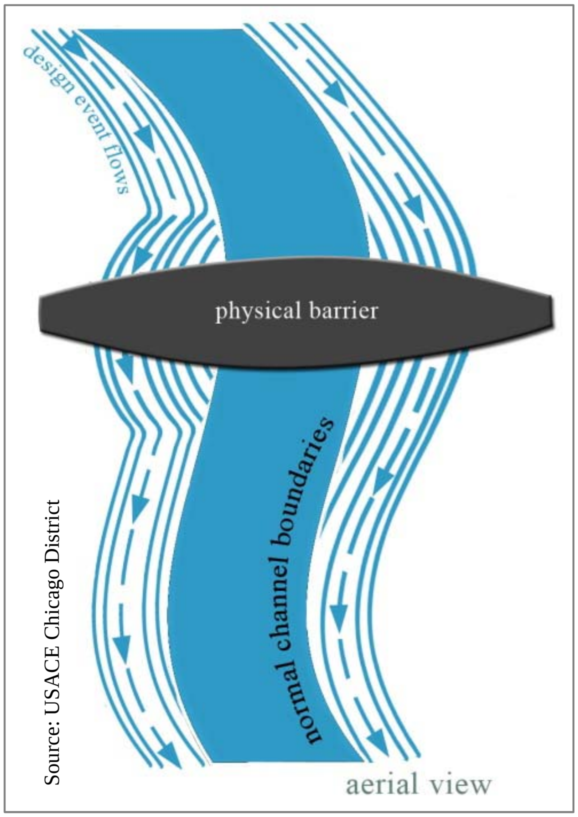

Figure 2. Barrier extends outside normal channel boundaries to separate design event flows

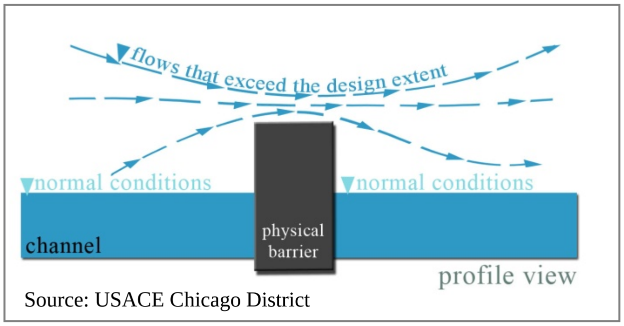

Figure 3a. Flood flows overtop physical barrier

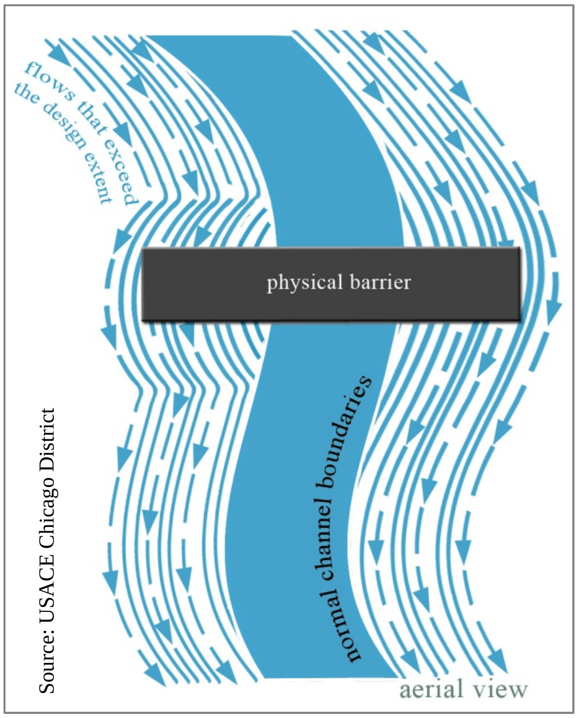

Figure 3b. Flood flows bypass physical barrier

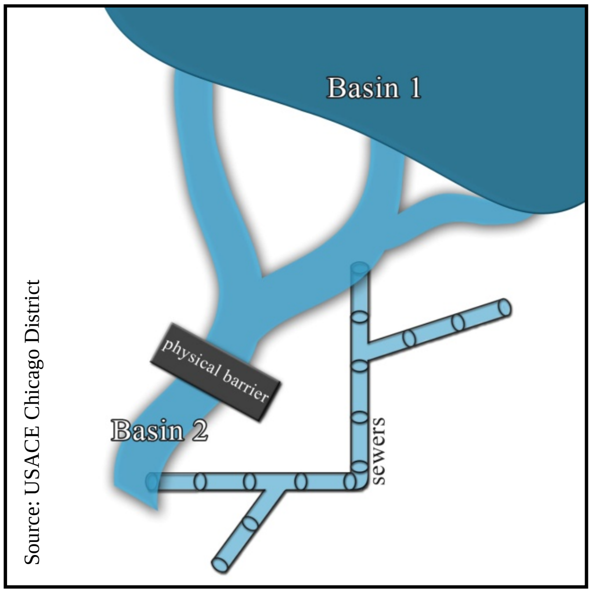

Figure 4. Water from Basin 1 could circumvent the physical barrier through the sewer system and discharge to Basin 2

Additional design considerations include an evaluation of all aquatic pathways around the proposed physical barrier site. Design engineers would consider current local drainage patterns, which may have been altered through the process of urban development. These modifications could include modified terrain, channelized rivers and streams, filled wetlands, sewer networks and flood detention/retention areas. Depending on the location of the physical barrier, untreated water from one watershed could be collected, routed, and discharged into the second watershed, inadvertently bypassing a physical barrier intended to hydrologically separate the watersheds (Figure 4) through natural or man made connections.

Operating Constraints: For hydrologic separation, a physical barrier would be designed to separate two or more watersheds up to the design event. This design would correspond to a particular elevation. To assure flows up to the design event do not overtop (Figure 3a) or flow around the physical barrier (Figure 3b), the physical barrier must terminate or tie into high ground that is at or above the design level's particular elevation (Figure 2). If water on either side of the physical barrier overtops or flows around, the physical barrier would no longer provide for hydrological separation of the watersheds.

For design events that flow outside of normal channel boundaries (Figure 2), the physical barrier's design must include structures such as flood walls, levees or berms. These structures will connect the in-channel physical barrier to high ground that is outside the normal channel boundaries and is at the design elevation. In areas where terrain is fairly flat, the length of structures (flood walls, levees or berms) outside of the channel will likely increase as the size of the design event increases.

Depending on the location of the physical barrier and the frequency of the interbasin connection - either a continuous connection or intermittent connection during flood events - various users of the connected waterways may be impacted. Waterway users include, but are not limited to: natural resources, communities that use the waterway for storm flow relief, commercial and recreational navigation, water users and dischargers, and recreational users.

Cost Considerations:

Implementation: Implementation costs may include the physical barrier design, permitting and construction of the physical barrier. Planning and design activities in this phase may include research and development of this Control, modeling, site selection, site-specific regulatory approval, plans and specifications, and real estate acquisition. Design will also include analysis of this Control's impact to existing waterway uses including, but not limited to, flood risk management, natural resources, navigation, recreation, water users and dischargers, and required mitigation measures.

Operations and Maintenance: Depending on the method and frequency of interbasin connection, debris may need to be cleared from the physical barrier. A plan would need to be implemented to monitor the effectiveness of this Control and, if necessary, modify its operation.

Mitigation: Design and cost for mitigation measures required to address impacts as a result of implementation of this Control cannot be determined at this time. Mitigation factors are based on site-specific and project-specific requirements that will be addressed in subsequent evaluations.

Citations:

Aquatic Invasive Species Summit Proceedings Conference May 14-15, 2003. Summary Report. Chicago, Illinois

FishPro Consulting Engineers & Scientists. 2004. *Feasibility Study to Limit the Invasion of Asian Carp into the Upper Mississippi River Basin.* Prepared for the Minnesota Department of Natural Resources in cooperation with the Wisconsin DNR and the U.S. Fish and Wildlife Service (Region 3).

HDR, 2012. Evaluation of Physical Separation Alternatives for the Great Lakes and Mississippi River Basins in the Chicago Area Waterway System, Technical Report to the Great Lakes and St. Lawrence Cities Initiative, Great Lakes Commission and the Great Lakes and St. Lawrence Cities Initiative.

Rasmussen, Jerry L. 2002. *The Cal-Sag and Sanitary and Ship Canal: A Perspective on the Spread and Control of Selected Aquatic Nuisance Fish Species.* U.S. Fish and Wildlife Service. U. S. Army Corps of Engineers, Great Lakes and Mississippi River Interbasin Study,