Dams Sector
Waterside Barriers Guide

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Distribution

This *Dams Sector Waterside Barriers Guide* is available on the CISA Dams Sector Publications page at cisa.gov/dams-sector-publications. For additional information and details, contact the Dams Sector Management Team at DamsSector@mail.cisa.dhs.gov.

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Publication History

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Table of Contents

Introduction

The *Dams Sector Waterside Barriers Guide* was developed to assist dam owners and operators to understand the possible need for waterside barriers as part of their overall security plan. It provides a cursory level of information on barriers and their use, maintenance considerations, and effectiveness factors—elements to be carefully taken into account when selecting waterside barriers. Technical references are included at the end of the guide.

The waterside barriers described in this guide include systems or technologies designed to help protect critical assets from attack by swimmers or water-borne vessels commonly found on rivers or reservoirs. Figure 1 depicts an example of such a barrier. Waterside markers installed as part of a dam safety program to demarcate dangerous areas and warn swimmers and boaters of the dangers of proceeding farther are outside the scope of this guide. For additional information on the use of such safety barriers, notifications, and associated procedures, refer to the Federal Emergency Management Agency's *Federal Guidelines for Dam Safety* and the Association of State Dam Safety Officials' *Model State Dam Safety Program Manual*.

Figure 1. Example of a waterside barrier (Source: DHS Photo)

Waterside barriers represent one component of a security program—the equipment, technology, personnel, and procedures designed to protect a facility against and respond to threats. Determining the need for security and protective measures starts with understanding which events could present a threat to personnel, operations, and information. This consideration therefore includes determining if a surface or subsurface barrier technology or barrier system is necessary and defining in the security plan the interdiction and use of force policies associated with the use of waterside barriers. When selecting barrier technology or a barrier system, consider the likelihood of effectiveness, purchase requirements or limitations, installation specifics, maintenance needs, and replacement costs related to the site-specific environment and the training and staffing of site security forces. For additional information on risk management, including conducting risk assessments and developing security plans, refer to the *Dams Sector Protective Measures Handbook*, available on the Homeland Security Information Network-Critical Infrastructure (HSIN-CI) Dams Portal (see Technical Reference 1).

Develop a Security Plan

A security plan is a formal document (or set of documents) to direct security operations at the dam and the project. Security plans are based on site-specific considerations and are intended to assist the facility in selecting, implementing, and evaluating appropriate protective measures and practices against identifiable security risks and threats and implementing appropriate response measures. As such, a security plan is typically coordinated with the facility's Emergency Action Plan to align areas of potential overlap, reduce redundancy, and eliminate inconsistencies.

Among other information (e.g., lists of restricted areas and critical assets, procedures for specific threats and for communications, and provisions for maintenance and upgrades), a security plan typically includes a description of the types and severity of threats to which the dam or other critical assets could be exposed and an overall plan for controlling access to the site to lessen the threat exposure. The measures included in the plan are selected based on a risk assessment and are commensurate with the facility's operational needs and financial resources. Depending upon site-specific situations, access control could be applicable for waterside—surface and subsurface—approaches as well as landside approaches.

Comprehensive access control measures to stop or forestall attacks from pedestrian or motor vehicle traffic have been installed at many dams. The use of barriers to stop or significantly delay the approach of swimmers or watercraft intent on doing harm is less common. This guide is intended to aid facilities interested in installing waterside barriers to determine the need and select the appropriate barriers.

Waterside Threats

Water-based attacks on critical infrastructure from World War II to the present day have featured combat swimmers (unaided or with vehicle support), small boats, mini-submarines, and large vessels relying on kinetic energy or explosives or both. The October 2000 attack on the USS Cole, during a refueling stop in Yemen, is an example of a waterside attack. The U.S. Navy, before and since the incident (depicted in Figure 2), developed capabilities for control of water-based access to its high-value assets.

Figure 2. Waterside attack on the USS Cole (Source: DHS S&T Photo)

While dams are not necessarily subject to the same threats as the U.S. Navy, the following examples are relevant to the Dams Sector when considering the threats to which a dam or other critical asset(s) could be exposed:

- An individual gaining access via water to a restricted area, either by swimming or using a boat.
- Assault by a boat laden with explosives, similar to the USS Cole incident.
- A floating or submerged container filled with explosives, drawn into a water intake or placed in a sensitive area by a swimmer.

The extent and severity of damage from an explosive event is based on the size of the explosion, distance from the event, and the construction of the asset. Consequences will also vary based on actions the facility takes to prevent, mitigate, and respond to the threat.

Determine the Need for Waterside Barriers

One solution for mitigating the threat of an explosive device is to ensure the explosion occurs as far away from the asset as possible. This distance, from the asset to nearest point that an explosive device can approach from any side, assuming that all security measures are in place, is referred to as the standoff distance. Waterside barriers meant to provide for and enforce standoff distance can be divided into two general categories, based on the amount of delay they cause the adversary. Barrier systems allow for minimal delay of watercraft by pairing the barrier with rapid detection and interdiction capabilities to stop the adversary. Barrier technologies are designed to stop or incapacitate an adversary to such a degree that slow detection and interdiction is tolerable. This section of the guide describes each category, including common components, effectiveness factors, and considerations for effective implementation.

Barrier Systems

A waterside barrier system combines the capabilities of a barrier with detection and response equipment and protocols to enable personnel to detect, assess, delay, and interdict an adversary. As such, effective implementation of a surface or subsurface waterside barrier system requires consideration of the detection and response capabilities that are paired to the system, the detection point and standoff distances appropriate for the dam and the facility's detection and response capabilities, security personnel and equipment requirements, and the procedures necessary to establish and maintain the standoff distance.

- **Detection Capabilities:** Detection systems can consist of remote radar, sonar, or imaging systems that integrate low-light, color, closed circuit television cameras, and thermal imagers. The effectiveness of the selected detection technology or detection system lies in its ability to significantly aid in the identification and assessment of potential waterborne threats before they reach the minimum standoff distance.
- **Security Personnel and Procedures:** Because security relies on a combination of detection, assessment, delay, and interdiction, the adequacy of a barrier system is heavily dependent on trained staff that monitor the detection components and make quick decisions about the intent of watercraft operators or swimmers approaching the dam. Security personnel must also be appropriately trained and equipped to effectively engage a possible adversary once detected and before the barrier and any remaining delay(s) are defeated. A key element of security staff training is complete understanding of

and adherence to the standard operating procedures established in the security plan for warnings, interdiction, and use of force.

The effectiveness of a barrier system is dependent on the amount of delay time needed for the detection and interdiction capabilities to stop a threat. The system is effective if an adversary approaching the dam by swimming or by boat can be detected in sufficient time and at a sufficient distance to marshal the required security forces and allow them to act in a timely manner to avert the attack or minimize its impacts.

When designing a system, consider the appropriate distance between the detection point(s) and the standoff point to ensure that security forces can be alerted and mobilized. The design strategy utilized by the Department of Defense (DoD) for waterfront attacks (see Technical Reference 2) could be adapted for the selection and deployment of barrier systems. The strategy uses the defense-in-depth concept to identify four zones—assessment (beyond the property line), warning (just outside the property line), threat (between the property line and the barrier), and engagement (between the barrier and the asset)—based the system's detection capability, security force's response capability, and the desired level of protection for the asset. Signage and barriers demarcate the zones, with electronic security systems, personnel, and operational procedures providing the detection, delay, and response capabilities.

Barrier Technologies

Surface barrier technologies, sometimes referred to as vessel exclusion barriers, are equipment specifically designed to stop watercraft, including fast-moving boats. These barriers feature interconnected floating elements or anchored composites of netting (examples depicted in Figures 3 and 4). The anti-submarine nets used by the U.S. Navy during World War II are examples of subsurface barriers. The design of these technologies minimizes the need for rapid detection capabilities.

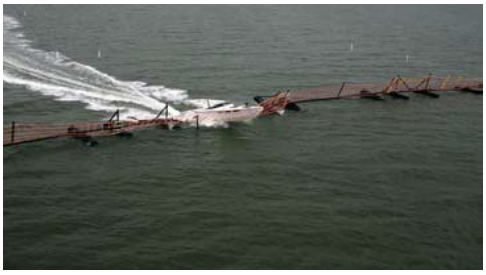

Figure 3. Example of a net boat barrier (Source: *Existing Barrier and Less than Lethal Technologies*, University of Kentucky, 2012)

The effectiveness of a barrier technology designed to stop a fast-moving boat is measured by its ability to stop a boat of a certain size at a certain speed. Because such barriers are costly, the decision to install a waterside barrier should be based on a site-specific risk assessment to ensure investments in protective measures align to the evaluated risk.

Figure 4. Example of a net boat barrier (Source: Bureau of Reclamation)

Effective implementation of surface or subsurface waterside barrier technologies requires consideration of public notification of the barrier, security personnel training, and the procedures necessary to establish and maintain the standoff distance.

- **Public Notification:** Install warning signs to alert boaters to the presence of the barrier technology.
- **Security Personnel and Procedures:** The decision to implement a barrier technology requires full consideration of the organization's use of force policies. Ensure security staff are appropriately trained and equipped to respond to situations in which the barrier technology has been breached or has successfully ensnared an adversary.

The American Society for Testing and Materials (ASTM) International developed a multi-level standard for waterside barriers ("Standard Test Method for Boat Barriers", ASTM F2766-11 (2020)), available for purchase (see Technical Reference 3). Because ASTM standards are widely used for the development and deployment of products within the United States, this waterside barrier standard has become a commonly used measure for certifying waterside barrier effectiveness. Similarly, the U.S. Navy developed a five-level rating system for barriers based on the ability to stop a specific combination of vessel size and speed. The availability of the publication outlining these criteria ("Waterfront Boat Barrier Design Criteria", 2023 NFESC TR-6050-OCN) is limited within the DoD community.

Barrier Maintenance

Maintaining a waterside barrier to ensure its maximum effectiveness may make the lifecycle cost of the barrier(s) higher than the initial cost of procurement and installation. Weather and other environmental factors can lead to repetitive maintenance needs and/or maintenance problems. Consider the following maintenance considerations when selecting a waterside barrier:

- **Impacts from Weather and Debris:** Surface and subsurface barriers are subject to constant forces from wind, waves, currents, and possibly ice and ice flows. They will also intercept and possibly become entangled in floating debris, such as that resulting from upstream floods. Debris accumulations can add additional stress to barrier components and may marginalize the barrier's effectiveness. The detection technologies that comprise the waterside barrier system are also subject to the harshness of weather, which can affect performance.
- **Impacts from Continuous Movement:** Barriers usually consist of a line of individual floating elements connected by cables or other devices. These connections are subject to continuous movement, possibly resulting in fatigue damage and failure of the connections. Metal components of a barrier system are subject to corrosion.
- **Authorized Access:** In addition to maintaining the barrier, consideration must be given to providing approved entry through or around the barrier, while maintaining the integrity and security of the system. This entry may be required during normal maintenance, such as accessing an intake tower or during emergencies.

Technical References

1. CISA Dams Sector Protective Measures Handbook (FOUO) (January 2023)
   This publication is available for download from the HSIN-CI Dams Portal, which allows for information sharing among federal, state, and local agencies and private sector owners and operators. For access requirements for HSIN-CI, contact the Dams Sector Management Team at DamsSector@mail.cisa.dhs.gov.

2. Department of Defense Security Engineering Facilities Planning Manual, United Facilities Criteria (UFC) 4-020-01 (September 2008)
   wbdg.org/ffc/dod/unified-facilities-criteria-ufc/ufc-4-020-01

3. ASTM Standard Test Method for Boat Barriers, F2766-11 (July 2020)
   astm.org/Standards/F2766.htm