

The United States Coast Guard (USCG) Aids to Navigation system marks waterways to assist boaters in navigation and alert them to obstructions and hazards. On waterways with Corps facilities, the Corps sign program complements the Aids to Navigation (ATON) system (see Section 14).

The Coast Guard provides guidance on the ATON system at the following website: <http://www.uscgbuoating.org/safety/aton/aids.htm>. There is more detailed information, including marking specifications, in the USCG's *Aids to Navigation Manual - Technical*, COMDTINST M16500.3A. You can get this document at a USCG District Office or at the following website: http://www.uscg.mil/ccs/cit/cim/directives/CIM/CIM_16500_3A.pdf.

The ATON system includes devices such as lights, sound signals, buoys, and dayboards. It is Corps policy that restricted areas and other hazards at our locks and dams and other waterway facilities may use a combination of buoys and dayboards with the USCG ATON symbols as the primary marking system. Signs as described in Section 14 are a compliment to this system.

Safety zones are determined in accordance with ER/EP 1130-2-520, Chapter 10, Restricted Areas for Hazardous Waters at Dams and Other Civil Works Structures.

Buoys and Dayboards

In the ATON system, buoys are typically used to delineate borders of regulatory areas or individual points on the waterway. The symbols and words on buoys are called daymarks. The Corps generally uses buoys to delineate the borders of restricted areas at its facilities and to mark other hazardous areas on waterways. Details including the size,

type, and mooring requirements of the various ATON buoys can be found in Chapter 2 of the USCG Technical Manual. General information on buoys is provided on page 15-7 of this manual.

Dayboards are signs that can be used as ATON. As with buoys, the symbols and words on dayboards are called daymarks. The Corps uses dayboards to mark the danger and restricted areas around the Corps locks and dams. The daymarks on dayboards are described in detail in Chapter 5 of the USCG Technical Manual. General information on dayboards is provided on page 15-8 of this manual.

Note that Corps policy on using buoys and dayboards does not eliminate the need for safety-critical, verbal waterway signs (see Section 14). It is the responsibility of the staff at each project, in coordination with the district Sign Program Manager and consistent with this manual, to determine the most effective mix of buoys, dayboards, and Corps signs.

ATON Design

An ATON design plan includes both the layout/placement and the technical design of the buoy mooring systems and the placement and installation of dayboards and their supports. When considering an ATON design, the USCG office in your area can be a valuable resource. The USCG will be familiar with the waterways and have experience with designs that will perform best in your area. The USCG is also a resource for supplying ATON on a cost basis. On waterways where the USCG has a significant presence, installation partnerships should be developed to reduce costs.

A conceptual approach to using ATON at Corps facilities is shown on pages 15-3 through 15-6.

USCG Review

The USCG requires that plans for local or private ATON, including Corps buoys and dayboards, be submitted for their review. The initial design of the ATON layout is the responsibility of the Corps. After the initial plan drawings have been prepared, submit them with a written request for review to the USCG Division Office.

Placement

As required with regular signage, the required viewing distance dictates the size and spacing of buoys and dayboards. The USCG uses the term "identification range" (equivalent to the Corps "viewing distance") to designate the distance at which the numbers and letters on a buoy or dayboard can be read and the meaning of symbols can be determined.

When marking restricted areas and other hazards around Corps locks and dams, the identification range/viewing distance (in feet) should be about 40 times the legend/symbol height (in inches). The great advantage of using the USCG ATON system at Corps locks and dams is that relatively small dayboards with symbols can convey the same message at the same distance as much larger (and therefore more expensive) verbal signs.

In considering placement of signs and ATON, remember that for overhead dams the superstructure becomes a detectable object at a large viewing distance, which by itself helps alert the boater to the hazard ahead. Submerged dams, on the other hand, may require more signs and/or ATON because the crest of the dam is difficult to detect from its surroundings.

For more detailed guidance on the sizing and placement of buoys and dayboards, see the discussions later in this section.

Introduction: The Corps Use of Aids to Navigation (cont'd)

General guidelines from Section 14, Placement of Water-Viewed Safety Signs, pages 14-59 through 14-61, should be used except as follows:

Dayboards: (A), capital letter height, shall be taken as the Uniform State Waterway Marking System (USWMS) symbol height.

Buoys: (A), capital letter height, shall be taken as the USWMS symbol height.

Where (A) is the main legend height, which equals $V/40$; where, V = viewing distance. Secondary legend or other wording shall be as specified in COMDTINST M 16500.3A. The following are viewing distances for USCG dayboards and a typical regulatory buoy.

Practical Dayboard Example:

From USCG 16500.3, Aids to Navigation - Technical Manual: A warning mark dayboard sign with a 3-nautical mile nominal visual range classification has a 72 by 72 inch symbol with a primary legend height of 10 inches and any other wording with a legend height of 6 inches.

	Height (inches)	USCG Identification Range (feet)
Symbol	72	2,880
Primary Legend	10	400
Other	6	240

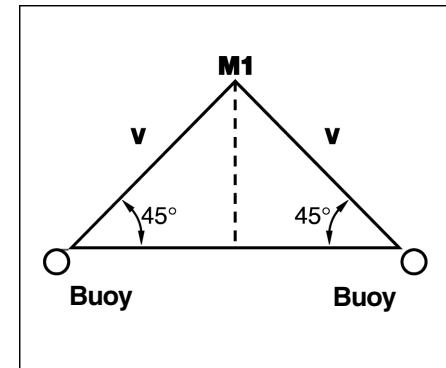
Practical Regulatory Buoy Example: Using a Class 5 or 6 buoy with a visual range of about 1/2 nautical mile, typical symbols have a 2-inch orange border strip with a symbol height of 12 inches and 3-inch black letters.

	Height (inches)	USCG Identification Range (feet)
Symbol	12	480*
Primary Legend	3	120

*Assuming symbol and word legend legibility is similar.

Required buoy spacing is based on V, viewing distance and any other specific site conditions.

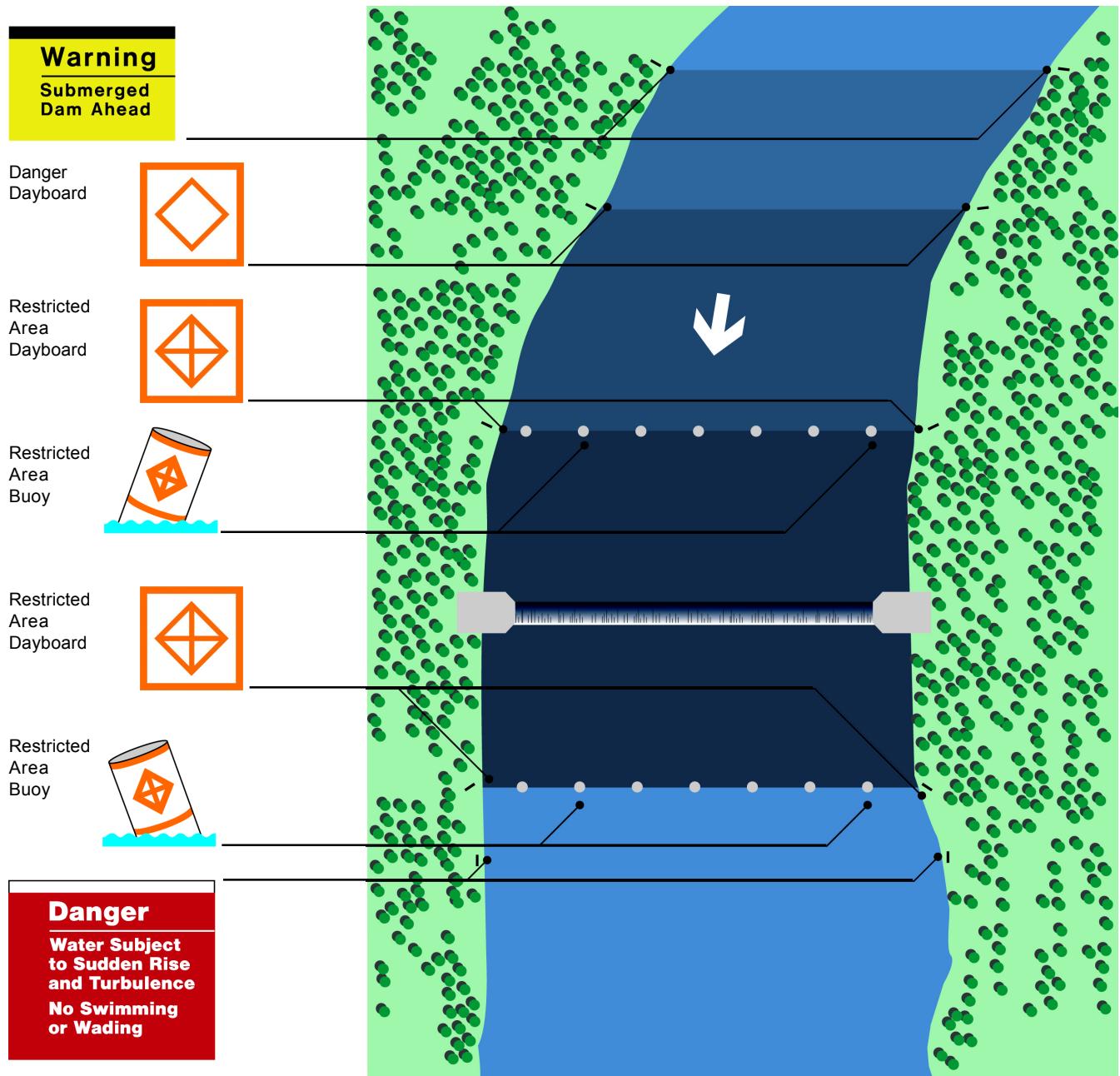
Diagram 1



Referring to Diagram 1, using the USCG identification range as V, the viewing distance (480 feet), the maximum buoy spacing is 680 feet ($2 \times 0.707 \times 480$).

This is considered an upper limit on buoy spacing. Site-specific conditions for the waterway or its users will often dictate a shorter spacing and higher aid density. This is especially true for very hazardous areas, as it is common for the upstream area of a submerged/fixed-crest dam to have buoy spacing of less than 100 feet.

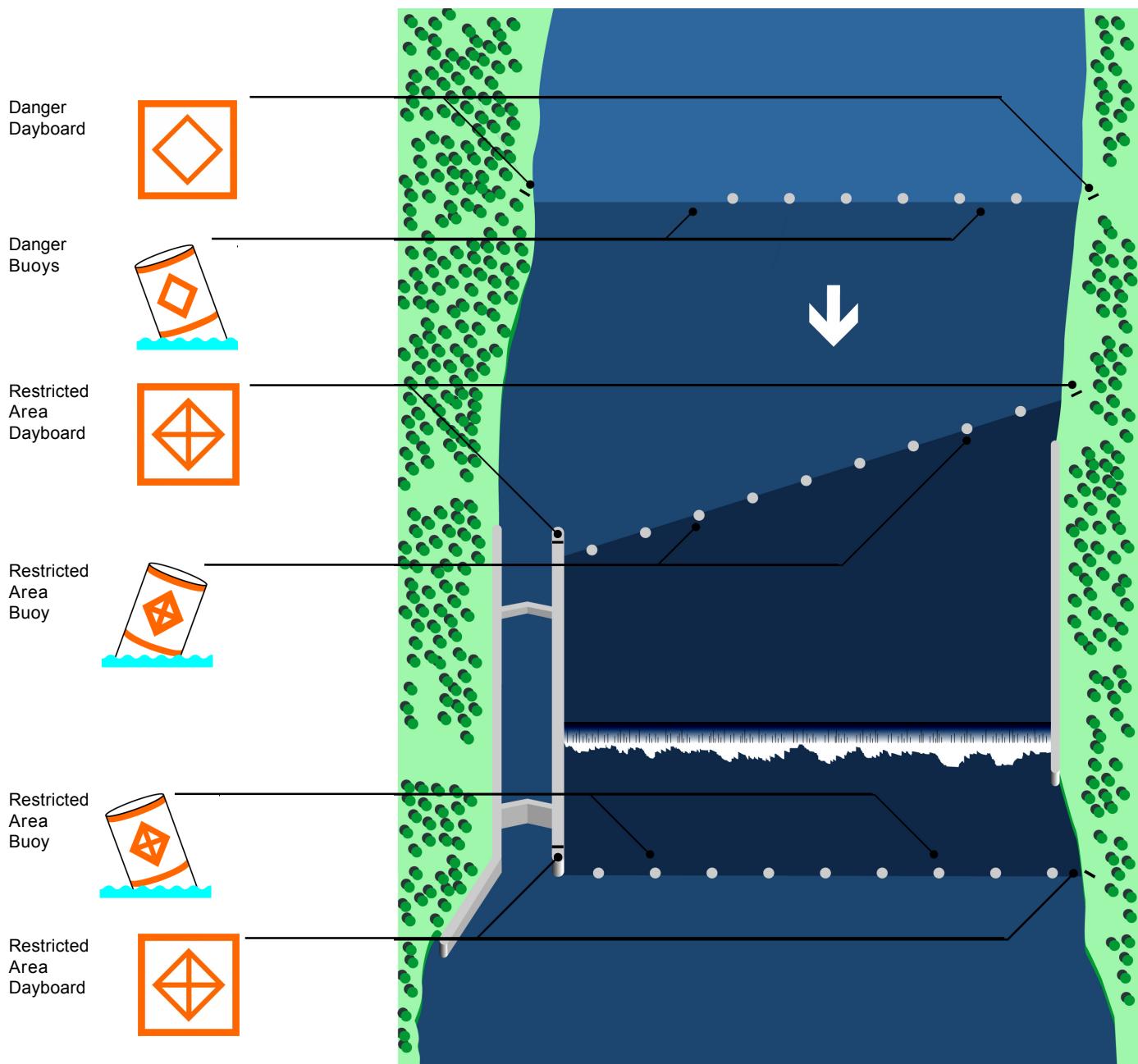
Illustrated below is a typical ATON plan for a submerged or fixed-crest dam that is not part of a commercially navigable waterway. The danger and restricted zones are delineated using dayboards and buoys. Because this type of structure can be very hazardous to pleasure boaters in kayaks or canoes and small fishing boats, care should be given to placement and maintenance of ATON. Where required, warning zones could be delineated using the Warning signs in Section 14.



Illustrated below is a typical ATON plan for submerged or fixed-crest dam with a navigable lock. The effective placement of ATONs becomes more complex because the river is generally wider and the navigable channel must remain clear for boat passage.

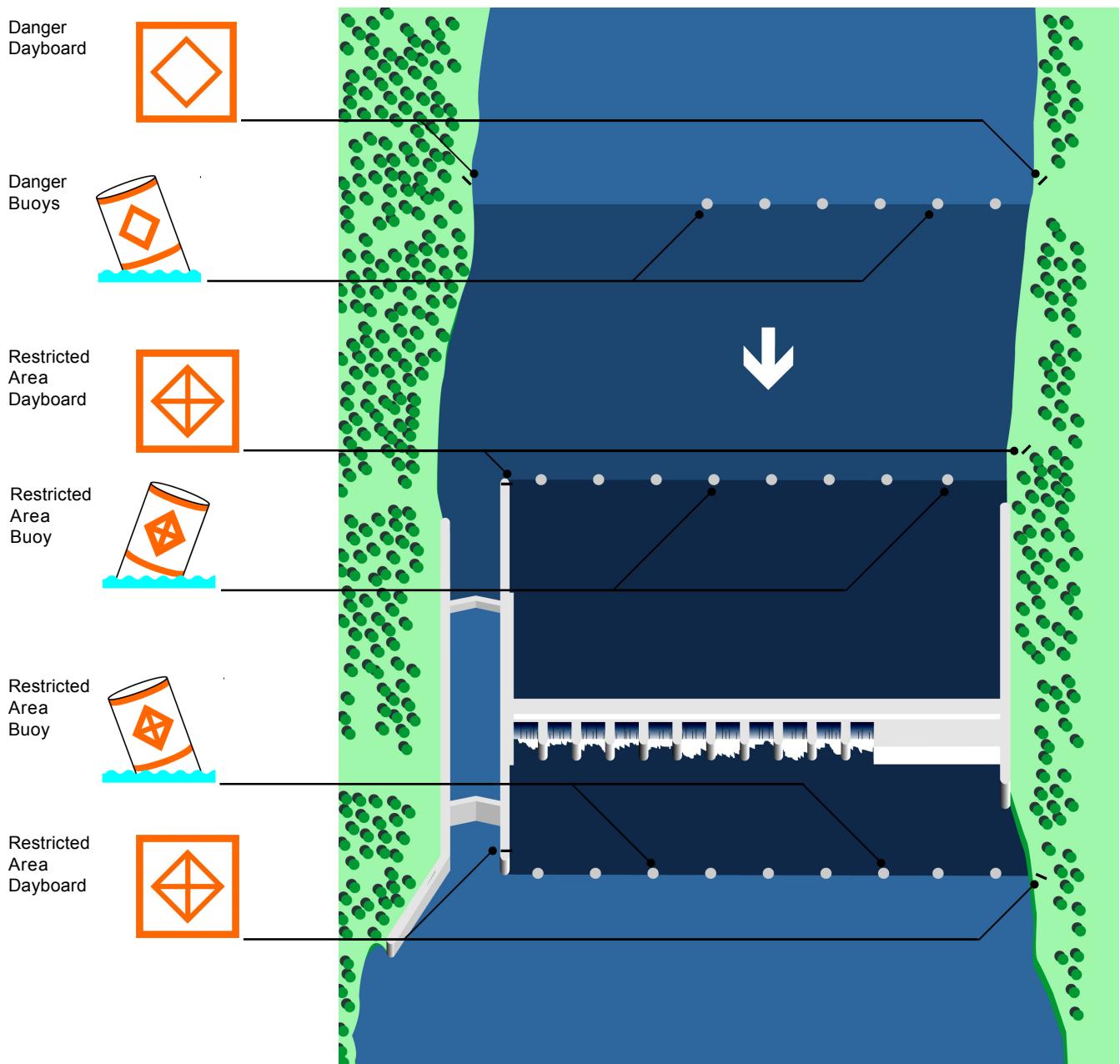
The restricted and danger areas are delineated using buoys and dayboards. Because this type of structure can be very

hazardous to pleasure boaters and small fishing boats, a tethered buoy line can be used as an extra precaution to keep boaters out of the restricted area. This is especially applicable to higher head dams with high flows. As with other submerged dams, care should be given to placement and maintenance of ATON. Where deemed necessary, upstream warning zones could be delineated using the Warning signs in Section 14.



Illustrated below is a typical ATON plan for an overhead gated dam with a navigable lock. The effective placement of ATON becomes more complex because the river is generally wider and the navigable channel must remain clear for boat passage. The restricted and danger areas are delineated using dayboards and buoys.

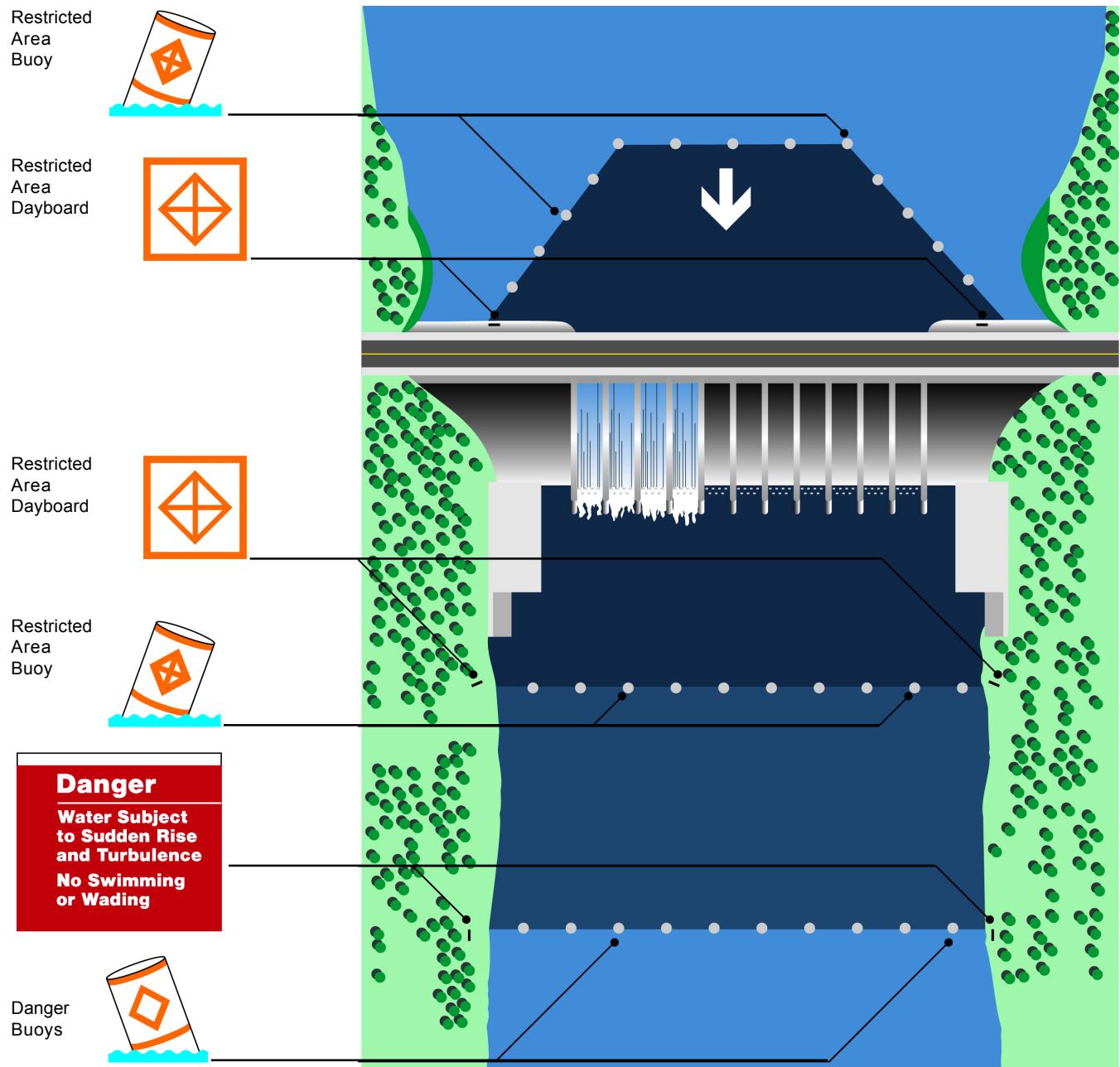
There are critical safety hazards below the dam as turbulent discharge from the dam, side currents adjacent to the lock, and reversing eddies that may require other site-specific Warning signs. The dam structure is generally visible from long distances upstream, and in most cases, a warning zone is not necessary. Where deemed necessary, warning zones could be delineated using the Warning signs in Section 14.



Illustrated below is a generalized ATON plan for a flood control dam or hydro-power dam with a reservoir. Typically, the critical area to be marked is the tailwater area. Since the tailwater is subject to sudden rise and violent turbulence as turbines are operated, buoys may prove impractical. Large dayboards and

Danger or Restricted signs may be the only practical way to mark the tailwater area. The size of the danger or restricted area depends on the local operating conditions.

The upstream restricted area is delineated with buoys and fixed dayboards.



Buoys are unmanned, floating ATON moored to the riverbed or tethered in some manner.

Detailed information about buoys, including the size, type, and mooring requirements, can be found in Chapter 2 of the USCG Technical Manual.

The mooring requirements are somewhat subjective, as there are several factors to consider (water depth, current, debris, ice, etc.). Typically, the mooring system is selected over time, on a trial and error basis. If the USCG has worked in the area, their experience is invaluable in selection of a buoy mooring system.

The USCG has cataloged several standard buoy designs for different performance criteria. The size is unlimited, but standard buoys generally range from 1 to 9 feet in diameter and are up to 36 feet tall.

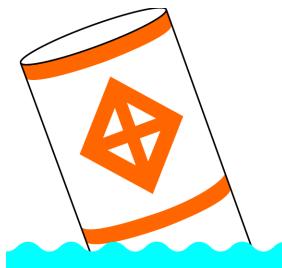
Proper buoy selection requires consideration of the environmental conditions, operational characteristics, and physical characteristics of the buoys available.

The USCG Technical Manual has specific guidance for buoy selection and the exposures they can withstand. The buoys can be removed during the winter and reinstalled each spring. A spar buoy is used during the winter to minimize damage to the mooring line from ice.

Performance of the buoys varies between the upstream and downstream sides of structures. The upstream buoys are likely to remain usable and in good condition longer than the downstream or tailwater buoys. This is expected, as the downstream side typically has a more severe exposure.

Practical Buoy Example:

Using a Class 5 or 6 buoy, typical symbols have a 2-inch orange strip forming the edges of the symbol, with a symbol height of 12 inches and (if used) 3-inch black letters. A typical buoy is shown below.

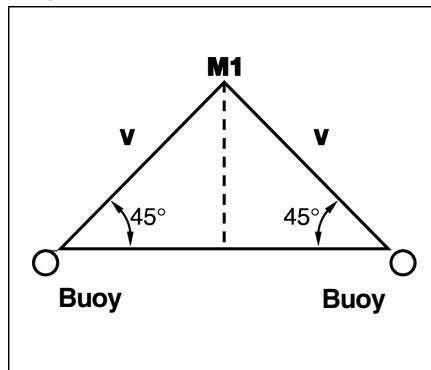


This buoy's daymark is the standard USCG symbol meaning "no boats beyond this point." The diamond is a general mark of warning, and the cross inside is equivalent to the word "Restricted" on a Corps sign.

Assuming each side of the diamond is 12 inches, this buoy has a viewing distance of 480 feet.

Required buoy spacing is based on the viewing distance and any other specific site conditions.

Diagram 1



Referring to Diagram 1, with the viewing distance V being 480 feet, the maximum buoy spacing is 680 feet ($2 \times 0.707 \times 480$). This is considered an upper limit on buoy spacing. Site-specific conditions for the waterway or its users will often dictate a shorter spacing and higher buoy density. This is especially true for very hazardous areas. For instance, it is common to mark the restricted area upstream of a submerged/fixed-crest dam with buoys spaced less than 100 feet apart.

Dayboards

Dayboards are essentially signs that can be used for ATON. As with buoys, the symbols and legends are called daymarks.

The Coast Guard classifies the daymarks on dayboards as warning, information, or regulatory marks, depending on their purpose. The basic mark of warning in the ATON system is an orange diamond. It can be combined with words or another symbol to explain the hazard being warned against or to convey a regulatory message, such as the presence of a restricted area.

It is recommended that the daymarks on Corps dayboards be kept simple. Those used to delineate danger and restricted areas around locks and dams will usually be the plain orange warning diamond or the diamond with a cross inside. A one or two word informational legend may be used with the daymarks to explain the warning.

Size and Viewing Distance

The USCG has three standard symbol sizes for daymarks: 36-inch, 48-inch, and 72-inch. For the diamond warning symbol, the square dimension (i.e., the length of one side) of the symbol should be used. For the circle symbol (used to convey caution), the outside diameter should be used.

The required viewing distance shall be used for determining daymark sizes. The viewing distance (feet) shall be 40 times the symbol size (inches). As required, larger than standard daymark sizes can be specified. See Chapter 5 of the USCG Technical Manual for detailed information about daymarks.

The sign panels for dayboards are rectangular and based on USCG requirements as specified for waterway information and regulatory marks.

Dayboards shall be sized for viewing the symbol from mid-channel with a minimum angle of vision of 45 degrees. The required viewing distance = $(0.5 \text{ river width})/\cos 45 \text{ degrees}$. A minimum daymark symbol size for restricted areas shall be 36 inches.

Practical Dayboard Example

According to Chapter 5 of the USCG Technical Manual, a daymark with a 72-by 72-inch orange diamond warning symbol has a 3-nautical mile nominal visual range. (The 72-inch measurement is along one side of the diamond.)

Note that the USCG manual relates the size of symbols to a "nominal visual range" that is measured in nautical miles. This measurement is generally not useful for planning signs and ATON at Corps facilities. It is recommended that Corps sign managers adhere to the concept of "viewing distance" when placing signs and ATON.

If words are used along with the symbol, the letter height of the primary legend would be 10 inches, and the letter height of any other wording would be 6 inches. The symbol on the dayboard represented by the table below is considered by the Coast Guard to have an "identification range" of 2,880 feet. Using Corps terminology, this corresponds to a viewing distance of 2,880 feet.

It's very important to note that the viewing distance of the symbol by itself is much greater than that of any verbal legend that might be added. Sign managers should weigh carefully the advantages of adding words versus the costs of more and/or larger ATON. If a symbol by itself is adequate to alert boaters to hazards, it may be unnecessary to add words. Always consult the USCG, your district Sign Program Manager, and your Office of Counsel when marking hazards around locks and dams.

Dayboard with an orange diamond daymark:

	Height (inches)	Viewing Distance (feet)
Symbol	72	2,880
Primary Legend	10	400
Other	6	240

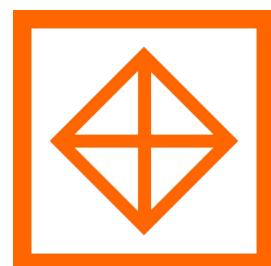
Mounting

Dayboards can be mounted on typical sign structures, any structural surface, and standardized USCG structures.

The standardized USCG structures are intended for dayboards placed on the shoreline. Each of these structures consists of a small radio tower truss embedded in a concrete block. A dayboard sign panel is attached to the top of the truss. These structures are economical to replace and can be reset easily after a large water event.



This dayboard conveys the message "Warning, there are dangerous boating conditions." The nature of the danger may be indicated inside the diamond shape, such as rock, dam or dam ahead, etc.



This dayboard conveys the following message "Warning, boats keep out because of dangerous conditions beyond this point."



This dayboard conveys the message "Restricted Operations" or "Controlled Area". An example is a Slow No Wake zone.



This dayboard conveys the message "Warning, Immediate Danger". The nature of the danger may be indicated with informational wording placed above and/or below the word DANGER.