Marina Flushing

Applicability

The Marina Flushing section primarily applies to new or expanding marinas. Marina flushing is typically addressed through the permitting process in Indiana.

Background

The water quality and biological health of marinas partially depend on how well water circulates and is flushed within the marina. Marina siting and design affect water circulation and flushing characteristics within its basin. In tidal waters, marina flushing is primarily driven by rising and falling tides. In non-tidal waters, such as the Great Lakes, wind drives water circulation. Circulation and flushing can be influenced by the basin's configuration and orientation to prevailing winds. Flushing may also be impacted by the water level of the lake. In rivers, water moves through the marina continuously if sited and designed properly. A marina located on a lake with many basins or a marina situated inland on a river can lead to decreased water circulation and flushing. This decrease in water circulation can lead to pollutants and debris concentrating in poorly flushed corners or in secluded areas protected from wind. The water may become stagnant with offensive odors. Biological activity may decrease and the area may become devoid of aquatic life. Inadequate flushing may also lead to the buildup of sediment within the marina, leading to increased cost for dredging.

The final design of a marina should represent a compromise of marina capacity, services, and access, while minimizing environmental impacts, dredging requirements, protective structures, and other site development costs. Marina siting and design should be done to ensure that marinas and their associated structures do not cause direct or indirect adverse water quality impacts or endanger wildlife and habitat both during and following marina construction.

Many factors influence the long-term impact a marina will have on water quality within the immediate vicinity of the marina and the adjacent waterway. Initial marina site selection is the most important factor. Selection of a site that has favorable hydro-geographic characteristics and requires the least amount of modification can reduce potential impacts.

Marina Flushing

Existing Federal and State Laws

As part of the permitting process, the Indiana Department of Environmental Management reviews potential water quality impacts for newly proposed or expanding marinas through the 401 Water Quality Certification Program. The Indiana Department of Natural Resources also reviews the potential impacts of newly proposed or expanding marinas through the Navigable Waterways Act (IC 14-29-1), the Sand and Gravel Permits Act (IC 14-29-3), and the Construction of Channels Act (IC 14-29-4). The U.S. Army Corps of Engineers utilize Section 10 of the River and Harbor Act of 1899 and Section 404 (permit application process) of the Clean Water Act to determine the impacts of proposed marinas.

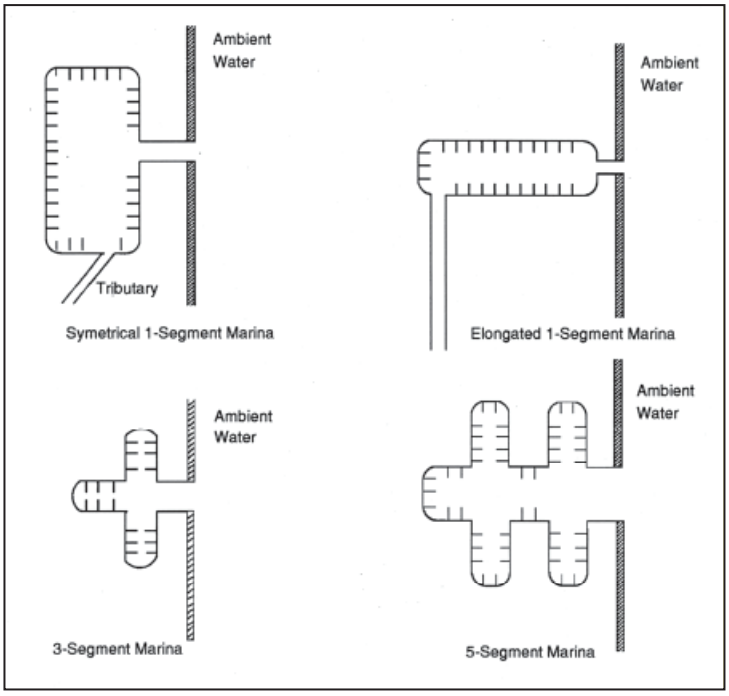
Best Management Practices

The U.S. Environmental Protection Agency has provided several best management practices that can be applied successfully to promote marina flushing. The following best management practices are described for illustrative purposes and to provide guidance for marinas that are in the planning stage or for those marinas that will be expanding.

- Site and design new marinas so that the bottom of the marina and the entrance channel are not deeper than adjacent navigable water, unless it can be demonstrated that the bottom will support a natural population of benthic organisms. Flushing rates in marinas can be maximized by proper design of the entrance channel and basins. For example, marina basin and channel depths should be designed to increase gradually toward open water to promote flushing. Otherwise, isolated deep holes may be created where water can stagnate and sediment can build up.
- Design new marinas with as few segments as possible to promote circulation within the basin. Flushing efficiency for a marina is inversely proportional to the number of segments. For example, a one-segment marina will not flush as well as a marina in open

water; a two-segment marina will not flush as well as a one-segment marina, and so forth (see figure below). Curved corners instead of a boxed design can lessen the risk of stagnant corner water or excess sediment buildup. Marina configurations that promote flushing exhibit, in general, higher levels of dissolved oxygen than those with restrictions, improper entrance channel design, bends, and square corners.

- Consider other design alternatives in poorly flushed water bodies (e.g., open marina basin over semi-enclosed design; wave attenuators over a fixed structure) to enhance flushing.
- Design and locate entrance channels to promote flushing. Entrance channel alignment should follow the natural channel alignment as closely as possible to increase flushing. Marina flushing rates are enhanced by wind action when entrance channels are aligned parallel to the direction of prevailing winds because wind-generated currents can mix basin water and facilitate circulation between the basin and the adjacent waterway.
- Establish two openings, where appropriate, at opposite ends of the marina to promote flow-through currents.
- Utilize mechanical aerators to improve water circulation and water quality where the marina basin and entrance channel cannot be configured in a manner to promote adequate flushing. Designate areas that are and are not suitable for marina development (i.e., provide advance identification of water bodies that do and do not experience flushing adequate for marina development).



Example marina designs (Source: U.S. EPA, 2001)

This page was intentionally left blank.