



# Manmade Lake Planning & Design

## Manmade Lake Benefits



Manmade lakes create picturesque and inviting community focal points for residential communities, retail/business centers, and park and public settings. In addition to the inherent visual, recreational, and monetary value, lakes can also create value in the form of cost savings by solving significant engineering challenges such as grading, site drainage, stormwater treatment, environmental mitigation and more. PACE provides planning and design of manmade lakes to optimize benefits such as:

- ◆ Aesthetics
- ◆ Land Value
- ◆ Recreational Opportunities
- ◆ Flood Conveyance and Detention
- ◆ Stormwater Treatment
- ◆ Water Conservation
- ◆ Natural Open Space
- ◆ Community Amenity
- ◆ Irrigation Storage



# Lake Planning & Design Checklist



The following checklist contains elements that should be considered in the project planning phase to set guiding principals for the design.

## Lake Goals / Objectives

- ✦ Single Use
- ✦ Multi-Use
- ✦ Recreation (Incidental Body Contact)
- ✦ Body Contact (Swimming)
- ✦ Water Treatment
- ✦ Stormwater / Flood Control
- ✦ Park / Open Space
- ✦ Irrigation
- ✦ Residential / Commercial / Retail

## Site Constraints

- ✦ Geotechnical
- ✦ Groundwater Elevation
- ✦ Watershed Hydrology
- ✦ Topography / Elevation Differential
- ✦ Roadway
- ✦ Utilities

## Water Source / Quality

- ✦ Water Balance / Usage
- ✦ Water Source / Quality
- ✦ Groundwater
- ✦ Reclaimed
- ✦ Temperature
- ✦ Flushing / Water Turnover
- ✦ Dissolved Oxygen

## Regulatory

- ✦ Water Rights
- ✦ Dam Safety
- ✦ Environmental Permits
- ✦ CEQA (CA)
- ✦ RWQCB (CA)
- ✦ Vector Control

## Design Issues

- ✦ Safety
- ✦ Emergency Outlet
- ✦ Waves / Erosion
- ✦ Sediment Deposition
- ✦ Storm Drain Outlets
- ✦ Flood Storage Surcharge
- ✦ Inflow Pretreatment

## Lake Layout

- ✦ Surface Area
- ✦ Perimeter
- ✦ Geometry
- ✦ Minimum / Maximum Depth
- ✦ Storage Volume
- ✦ Side Slope
- ✦ Minimum Width
- ✦ Lake Circulation / Pattern / Plug Flow
- ✦ Lot Pad Elevation Differential

## Lake Design Features

- ✦ Liner / Leakage
- ✦ Circulation
- ✦ Aeration
- ✦ Lake Biology / Vegetation
- ✦ Biofilters
- ✦ Pretreatment Wetlands / Planters
- ✦ Edge Treatment
- ✦ Shoreline Land Planning
- ✦ Urban Design Elements
- ✦ Landuse Compatibility
- ✦ Landscape Buffer
- ✦ Lake View Locations
- ✦ Entry Features
- ✦ Marina / Boating
- ✦ Pedestrian Access / Walkway



Public Access / View Corridors



Private Access



Shoreline

# Stormwater / Water Quality Management Systems

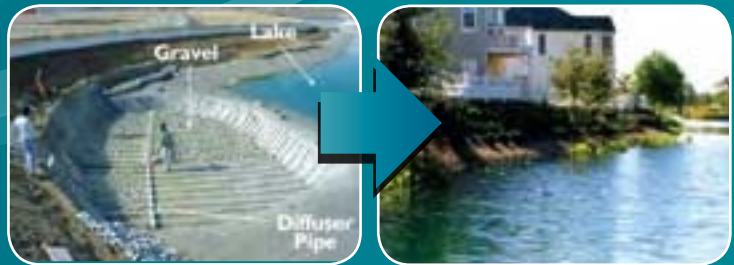


Lakes (even manmade lakes) are living ecosystems naturally containing all the elements necessary to maintain a balanced, healthy aquatic environment. PACE's philosophy is to design lake water quality management systems that optimize existing naturally occurring biological systems. This approach produces lake ecosystems with healthy circulation, appropriate levels of nutrient consumption to prevent algae blooms, and high oxygen levels to ensure water clarity.

## Lake Water Quality Treatment

### Biofilters

A biofilter is a submerged gravel bed unapparent from the water's surface where naturally occurring bacteria grow and consume nutrients residing in lake water. A biofilter's purpose is to provide a balance between nutrients and algae in the water and provide overall circulation to promote a healthy and balanced aquatic environment.



### Aeration

Aeration is a natural process in which wind creates movement on the surface of water, adding dissolved oxygen and promoting healthy water quality. The PACE designed aeration system optimizes this natural process by placing fine bubble diffusers at the bottom of the lake to vertically circulate water from the bottom to the surface to expose it to the aeration process.



### Vegetated Wetlands

Lake water quality is further enhanced by submergent and emergent wetland vegetation located along the lake edge. The roots and soils in wetland vegetation promote bacteria to grow and consume excess nutrients in water, while the wetland plants provide a natural appearing lake edge that clearly defines the boundary of the lake and surrounding elements.

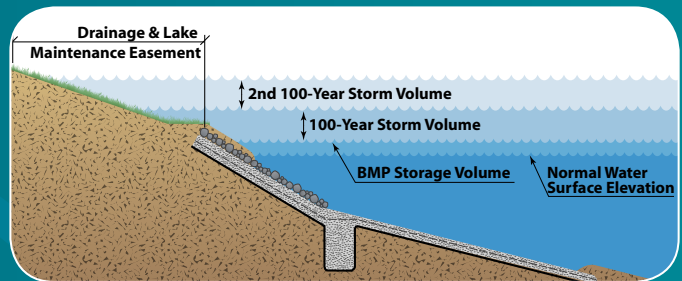


## Stormwater Management / Treatment

In addition to serving as unique aesthetic and environmental amenities, manmade lake systems also have the potential to serve as stormwater infrastructure solutions.

### Conveyance & Retention / Detention

Lakes offer a unique stormwater management solution by mitigating effects from increased runoff from development and also functioning as the primary drainage infrastructure. Surge storage above the normal operating lake level can provide sufficient volume to function as temporary detention or permanent retention of project surface runoff volume instead of providing separate facilities which would encumber additional land.



### Pre-Treatment Wetland Water Quality Filters

Wetland water quality filters are designed to collect runoff from nuisance flow and retain it long enough for the majority of the pollutants within the runoff to be removed. These pollutants, introduced into the runoff through overland flow, are substantially reduced within water quality filters through the process of sedimentation, absorption, and filtration.



### Recharge / Reuse

Urban runoff from development can be completely recycled within the lake system by providing a make-up water source for the lake or withdrawn from the lake into a non-potable water irrigation system for the project. Additionally, groundwater recharge elements can be designed into the lake.

## Lake Planning & Design Benefits & Issues

With proper planning and design, manmade lakes create immense value. Lakes offer numerous opportunities to reduce community infrastructure costs, solve engineering/environmental challenges and increase land value. Benefits can be maximized through early consideration and planning of lake elements as they relate to the overall community. Such benefits include:

- ◆ Increase lake front lot premiums
- ◆ Reduce development infrastructure costs
- ◆ Solve infrastructure challenges
- ◆ Minimize site grading
- ◆ Maximize lake views
- ◆ Appropriate layout for recreational uses
- ◆ Wildlife habitat
- ◆ Integration to serve as a focal point of a community
- ◆ Integrated lake and off lake vegetation landscaping



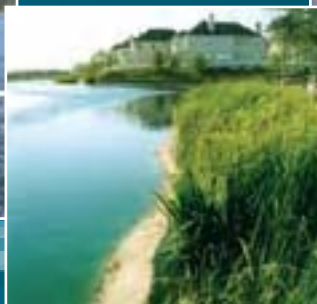
Original Layout - Waterfront Lots: 91  
Lake Area: 28 acres

PACE Revised Layout - Waterfront Lots: 142  
Lake Area: 24 acres

## Management & Renovation Consulting

Over time, both manmade and natural lakes in urban settings require support to operate effectively. PACE offers consulting to improve water quality, minimize operations cost and maximize aesthetic and recreational benefits. Consulting services include issues related to:

- ◆ Operation equipment (pumps, blowers, aerators, etc.)
- ◆ Irrigation supply, pumping and filtration
- ◆ Shoreline stabilization
- ◆ Algae management
- ◆ Aquatic plant management
- ◆ Fisheries management
- ◆ Waterfowl control
- ◆ Water source balance
- ◆ Source water quality
- ◆ Pollution runoff
- ◆ Water seepage / leaks
- ◆ Drainage facilities
- ◆ Water quality management
- ◆ Trash / debris control
- ◆ Recirculation
- ◆ Liner
- ◆ Discharge permitting & reporting
- ◆ Water quality monitoring
- ◆ Uses (swimming, fishing, boating, etc.)



## **PACE Lake Design & Planning Services**

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- ◆ Lake Layout Planning
- ◆ Grading
- ◆ Stormwater Infrastructure Integration
- ◆ Hydraulics
- ◆ Pumping Equipment
- ◆ Controls and Instrumentation
- ◆ Biological Management
- ◆ Recreational / Ski Lakes
- ◆ Recirculation Systems
- ◆ Water Quality Management Systems
- ◆ Aquatic Vegetation Planning
- ◆ Water Filtration
- ◆ Water Supply
- ◆ Streams, Water Falls, Entry Features
- ◆ Manmade Rock Work
- ◆ Swim Lagoons

**PACE**  
PACIFIC ADVANCED  
CIVIL ENGINEERING, INC.

714-481-7300  
[www.p-a-c-e.com](http://www.p-a-c-e.com)