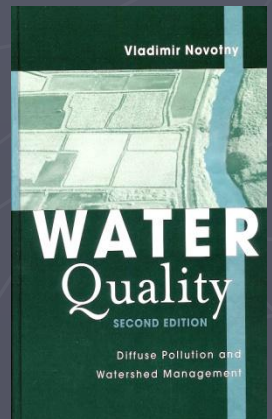


# Sewers, Ponds and Wetlands

Chapter 9  
Supplement

© Vladimir Novotny





# URBANIZATION

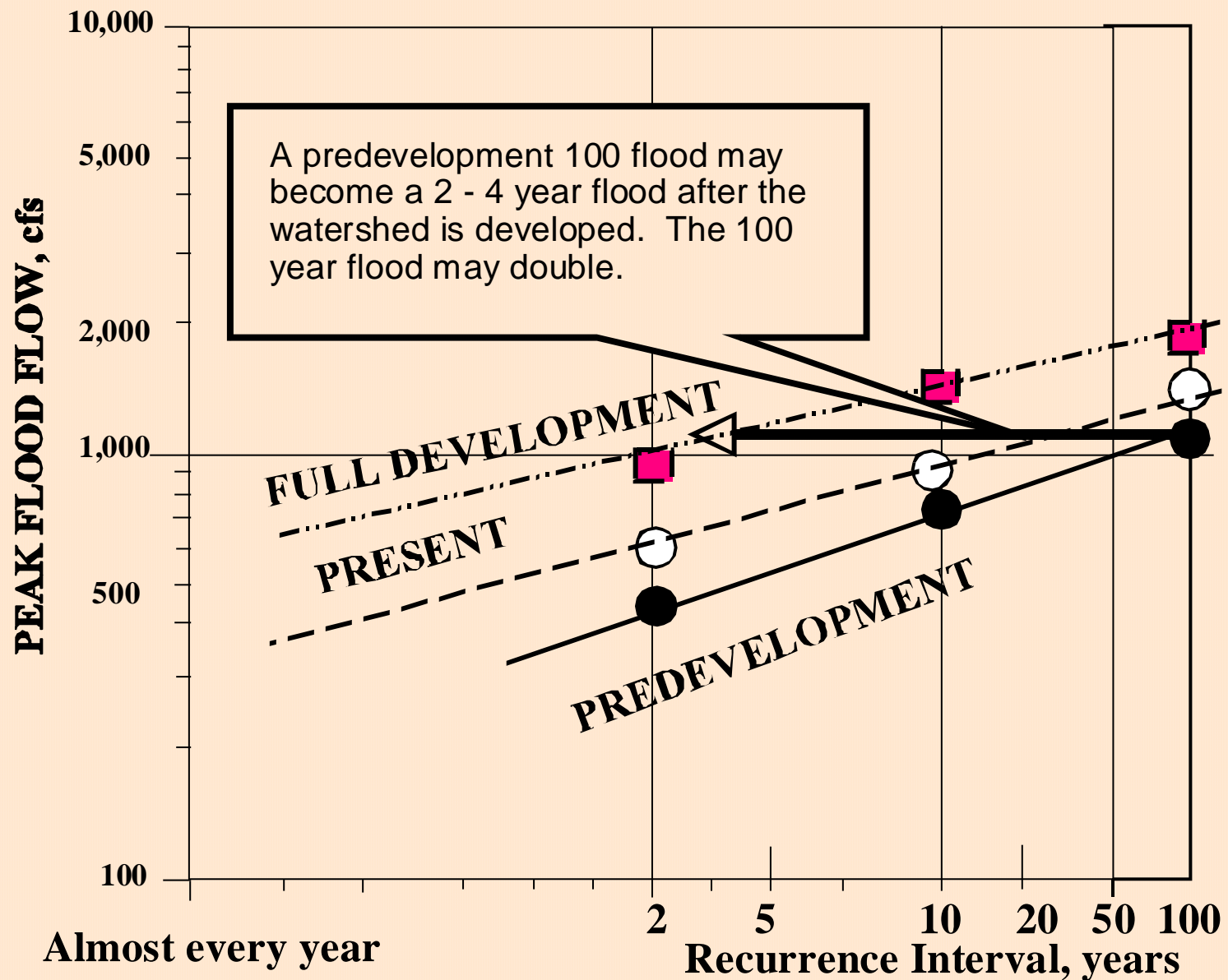
## INCREASES FLOODING

- Floodplain encroachment
- Property values
- Flood damages
- Disruption of life
- Loss of life

## IMPAIRS INTEGRITY OF URBAN WATER BODIES

- Habitat destruction
- Water quality
- Contaminated sediments
- Bank erosion
- Change of surface and  
subsurface hydrology

# High flows in Oak Creek ( South Milwaukee)



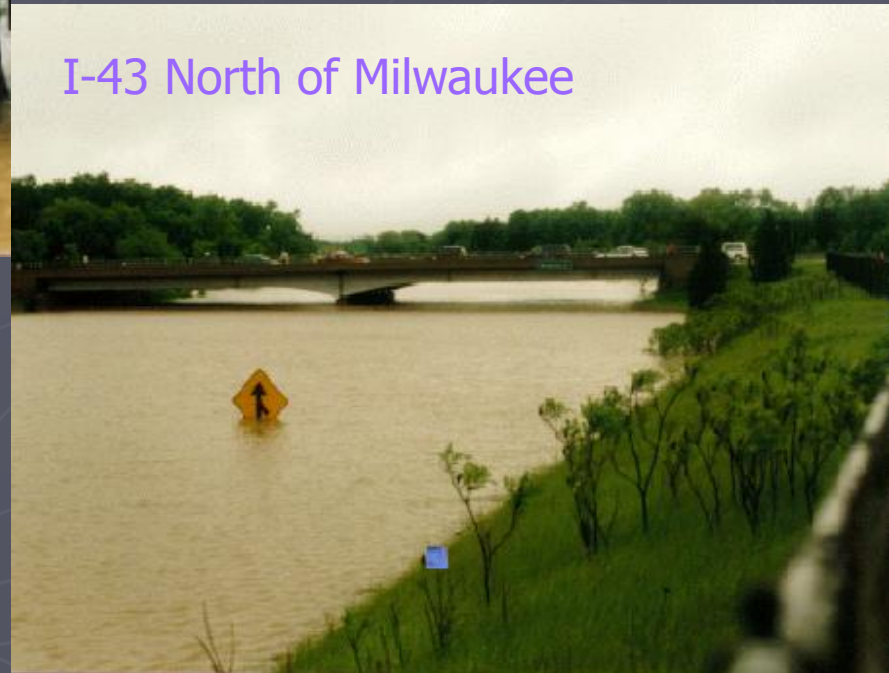
# Urban Flooding

Most urban watershed management projects are driven by flood control.  
The benefit/cost ratio for urban flood control projects is often  $<0.2$ .



Urban floods in the Milwaukee area in 1997 and 1998

I-43 North of Milwaukee



# Sources of Urban Stormwater Pollution

- ▶ Atmospheric deposition
  - ▶ Wet
  - ▶ Dry
- ▶ Urban erosion (construction sites)
- ▶ Litter deposition
- ▶ Leaves
- ▶ Trash and pet fecal matter
- ▶ Traffic emissions
- ▶ Application of deicing chemicals
- ▶ Lawn fertilizer and pesticide applications
- ▶ Chemical spills (gas stations) and car washing



# Pollutant Accumulation



# Urban Erosion





# Pollutant Washoff





# BEST MANAGEMENT PRACTICES (BMPs)

## Structural and Nonstructural

### ▶ SOURCE CONTROLS

- Erosion control and soil conservation
- Street sweeping

### ▶ HYDOLOGIC MODIFICATION

- Infiltration
- Increase of depression storage

### ▶ REDUCTION OF DELIVERY

- Grassed waterways

### ▶ STORAGE AND TREATMENT

- Ponds, wetlands, filters, in-line storage

# Mulching and hydroseeding



Erosion control BMPs that increase surface roughness by mulch and quickly established grass . Can be combined with burlap or other biodegradable meshes to keep straw and vegetation in place.



# Education of citizens



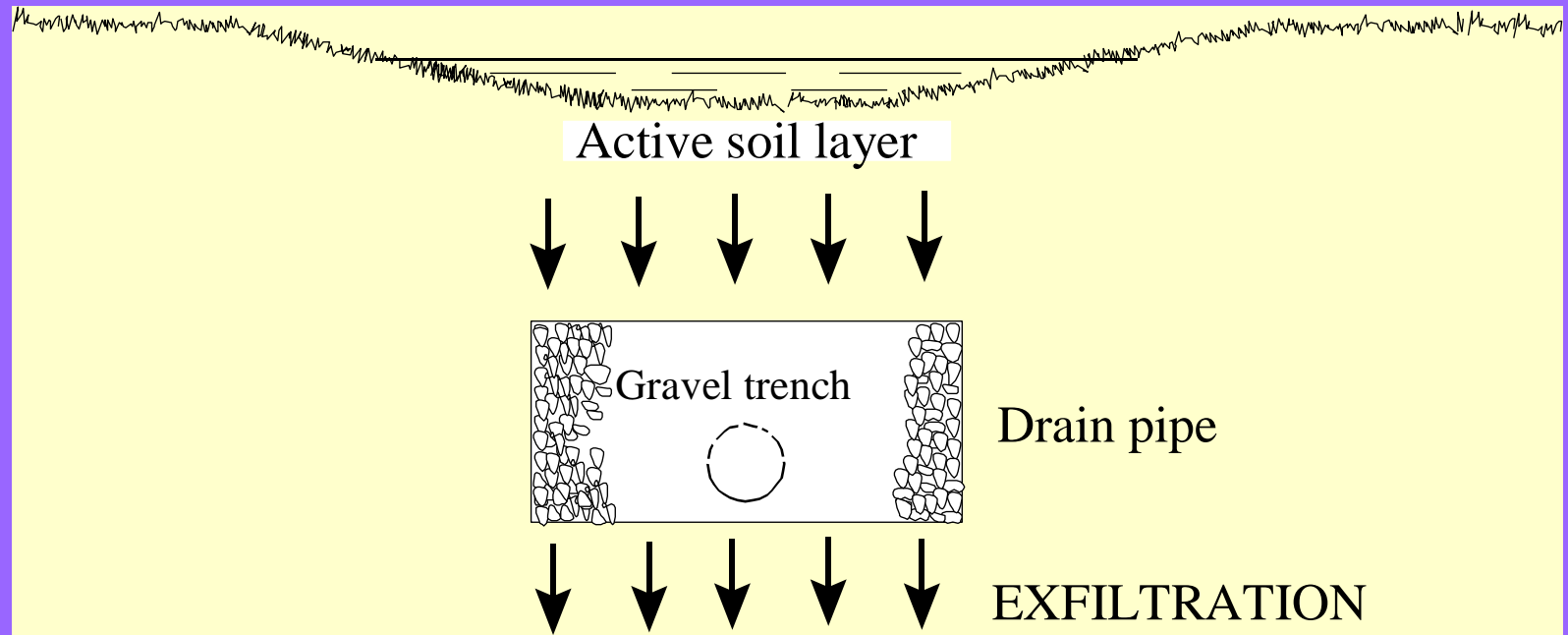


# Permeable U curb and pervious pavement in Tokyo



# Designed swale

Drainage is added to minimize standing water

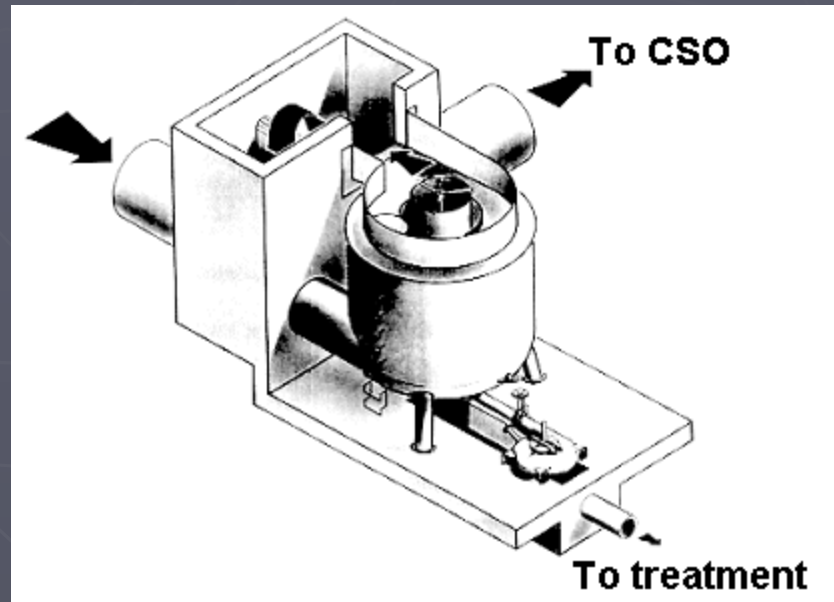


# Grass filters and grassed waterway





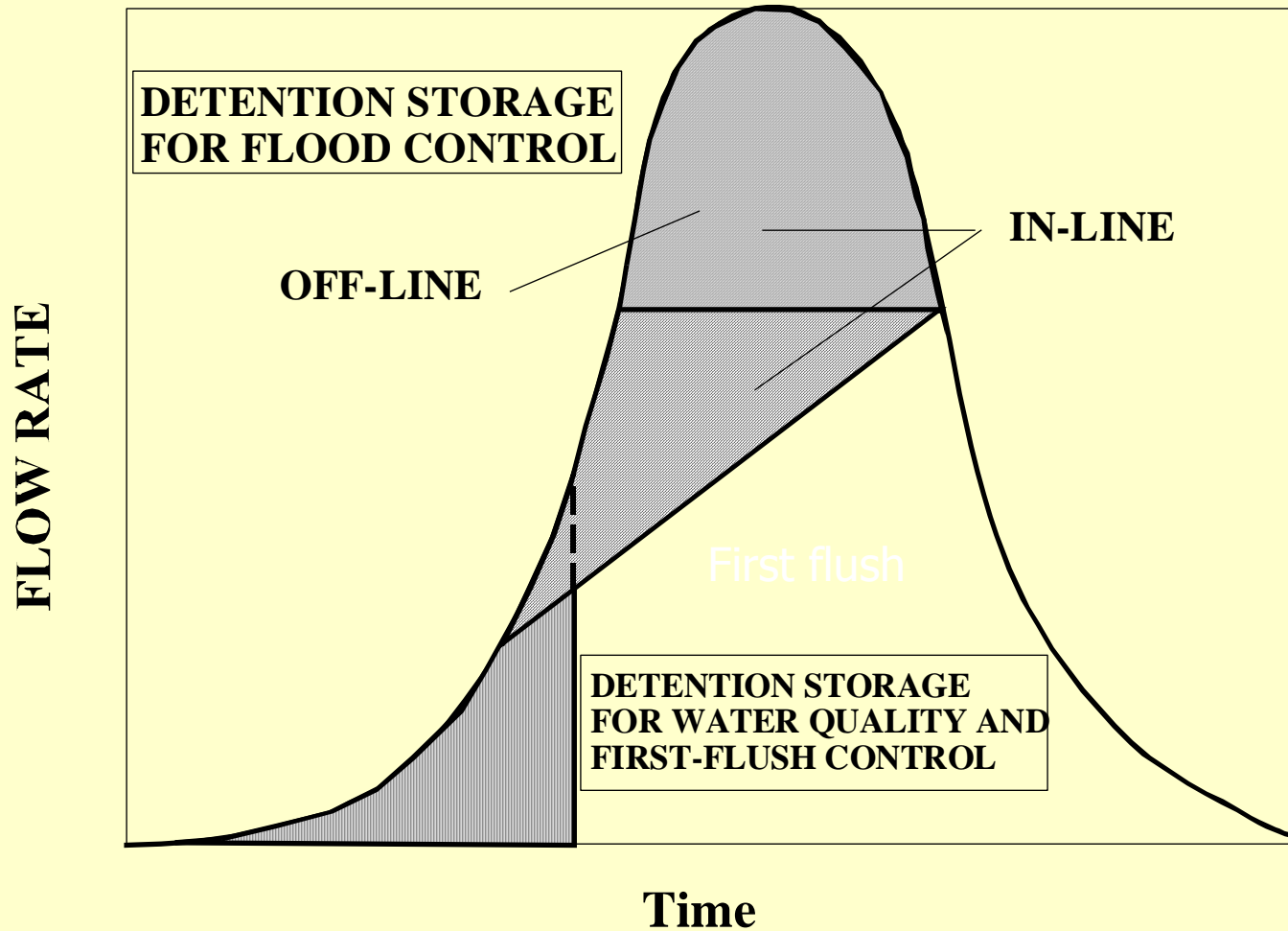
# Swirl separator for CSO control



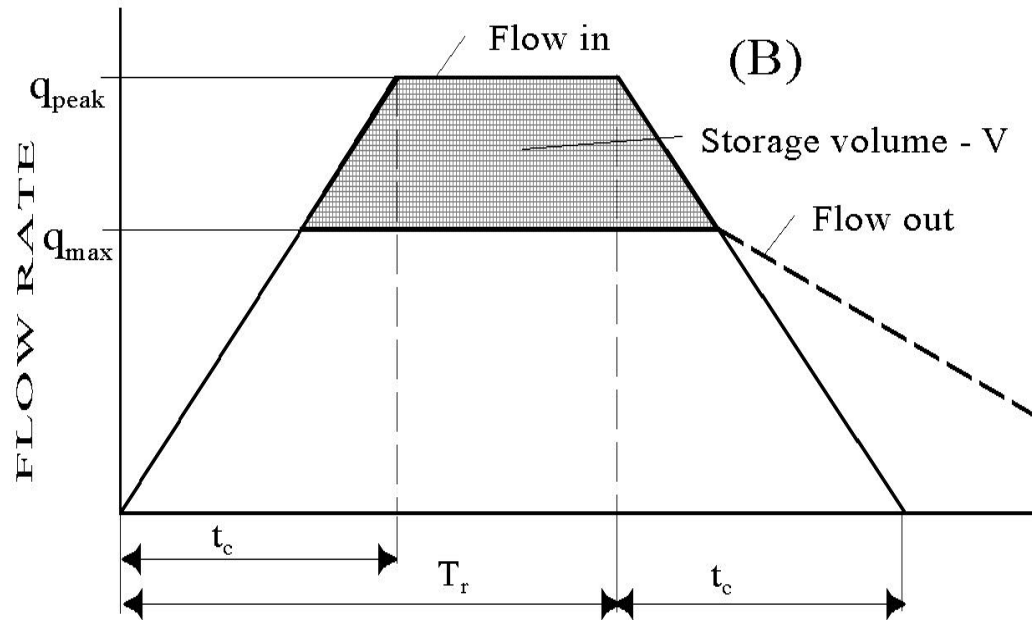
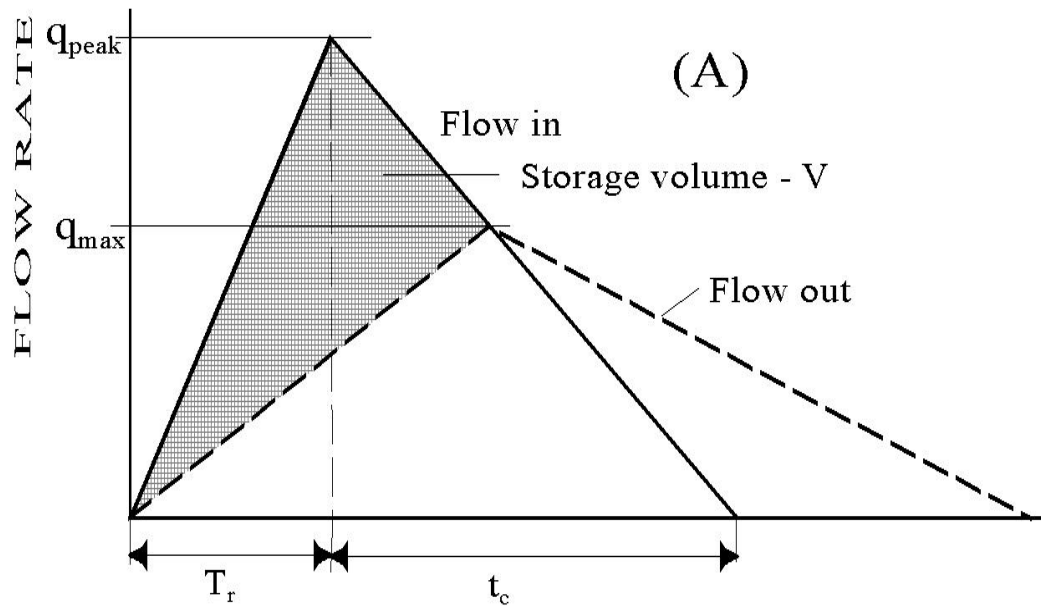
# Stream buffer



# Schema of storage

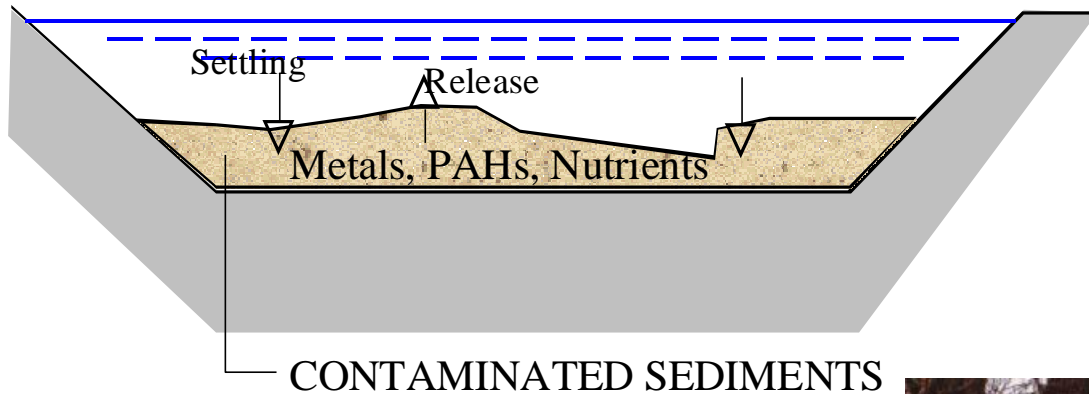






In-line and  
off-line  
storage  
volume  
calculation

# LEGACY OF LONG TERM USE OF PONDS



PONDS FILLED  
WITH  
CONTAMINATED  
SEDIMENTS IN  
WAUWATOSA, WI  
Menomonee River  
Watershed

Research is needed to address long term use of ponds for removal of sediments and pollutants from runoff, especially in contaminated areas.

- Disposal of highly contaminated sediments

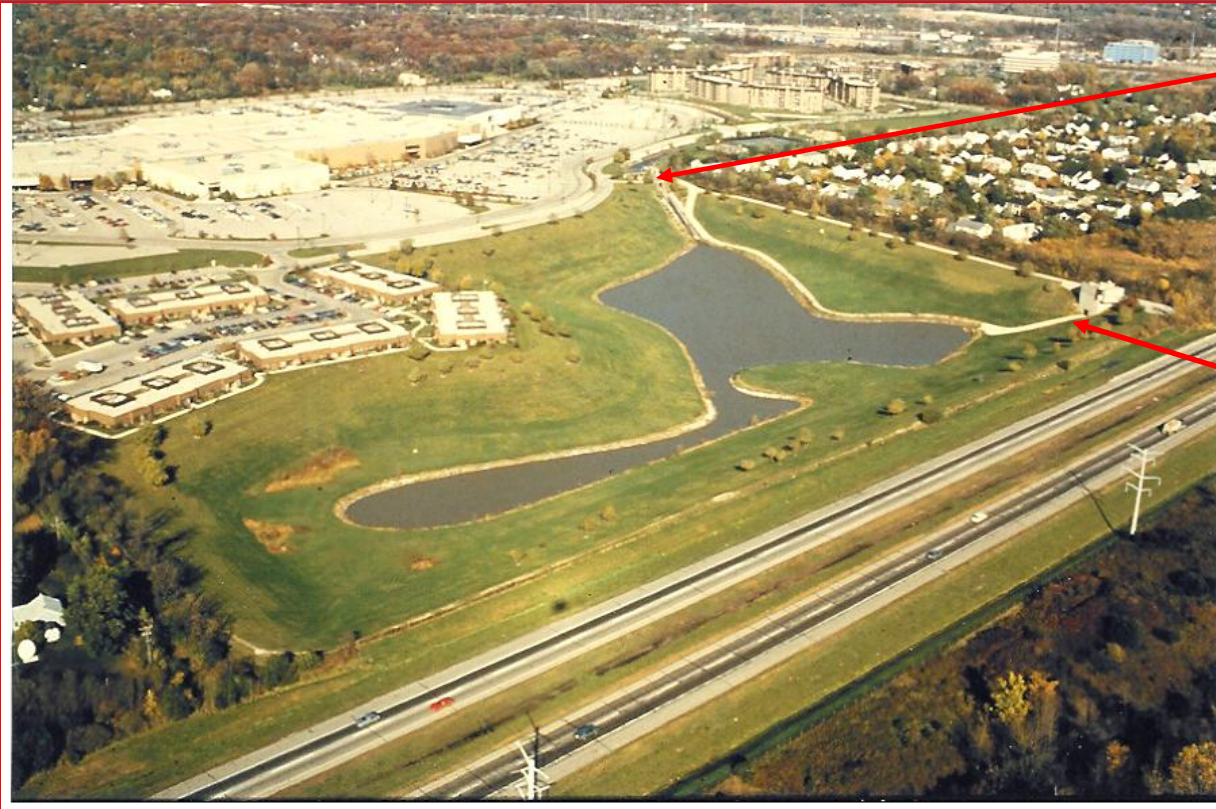
- Inactivation of pollutants

- Preventing release (winter snowmelt with high salinity)

- Final disposal - dredging or abandoning



# Detention pond in Chicago



Inlet sluiceway

Outlet control by  
pumping



# Pond wetland combination in Milwaukee



## MULTIPURPOSE FLOOD RETENTION BASIN ON NEYA RIVER IN OSAKA



Off-line overflow retardation basins and ponds do not provide significant water quality benefits.

Research is needed to find a retrofit that would provide removal of pollutants from flows that are smaller than the critical overflow flow.



Floodwater overflowing Spill Levee (Heavy Rainfall, Sept. 3, 1989)





Outlet control by V-notch weir

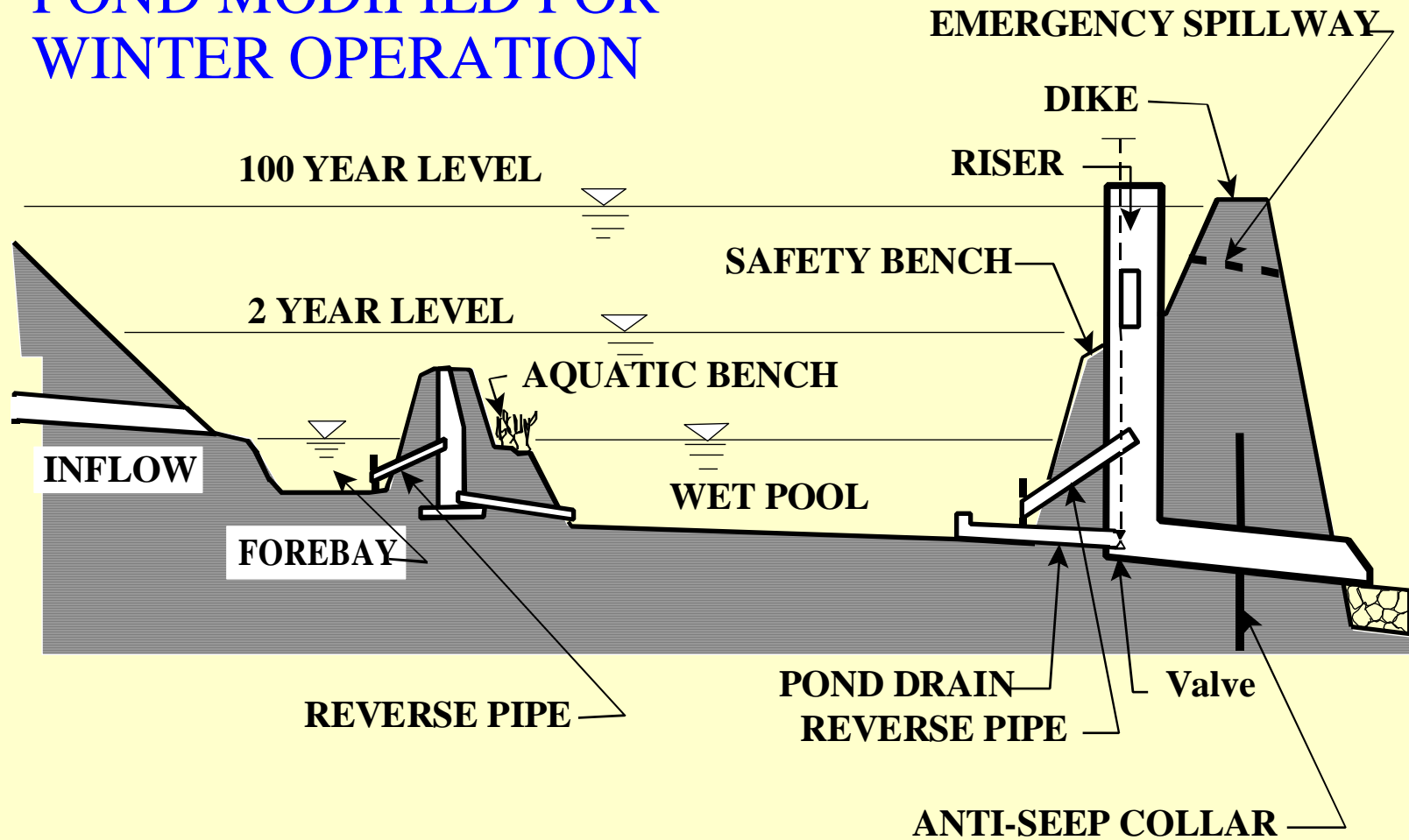
INLET

# WET PONDS IN BROOFIELD (WI) AND EDINGBURG





# POND MODIFIED FOR WINTER OPERATION



# Underground Storage



## Milwaukee, WI (USA)

- o Population served 1.3 million
- o Underground tunnel storage 1.5 million m<sup>3</sup> for storing CSOs and SSOs – cost of the entire plan \$2.5 billion
- o Overflows reduced from 40 to about 2-4 per year
- o In 2004, because of excessive inputs of clean water into sewers, two very large overflows occurred that in minds of citizen represented an unacceptable failure.
- o Milwaukee River in downtown still does not meet the goals of CWA



# RIPARIAN WETLAND CREATION AND RESTORATION

Ca' di Mezzo wetland in Venice

Professor Bendoricchio Memorial



# Wetland in Scotland



This wetland has three compartments

1. Storage and settling in a shallow pond
2. Treatment
3. Polishing

# Wetland Restoration

In many states and countries, wetlands are being restored.

Wetlands remove more than 90 percent of suspended solids, BOD and nitrate nitrogen. They are less effective for removing ammonium and phosphates. In colder climates, wetlands are dormant during winter and are inefficient for removing pollutants. Metals and some organic chemicals are effectively immobilized due to reducing conditions in the substrate that also denitrify nitrates.

Created wetland construction in Florida

