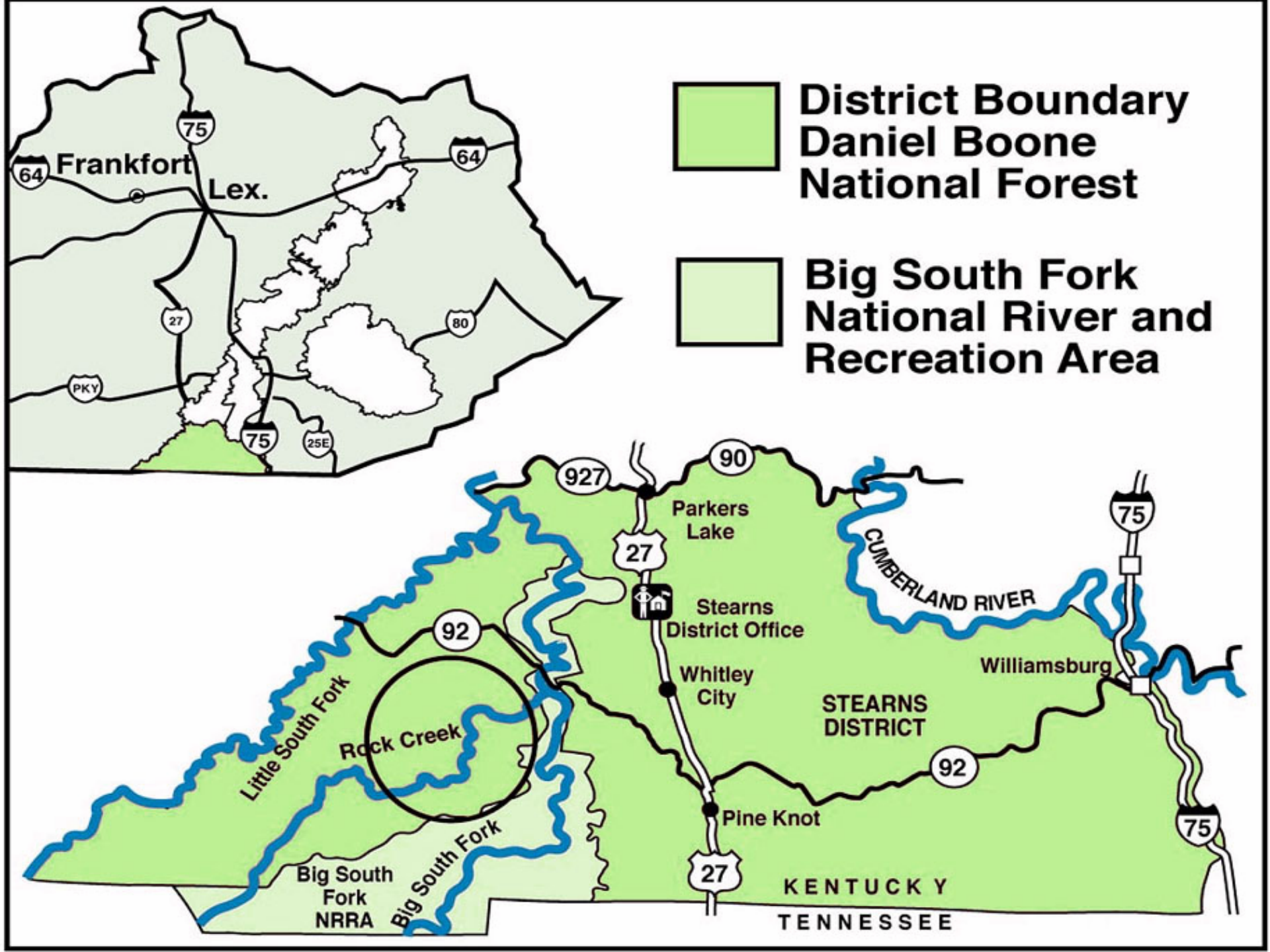
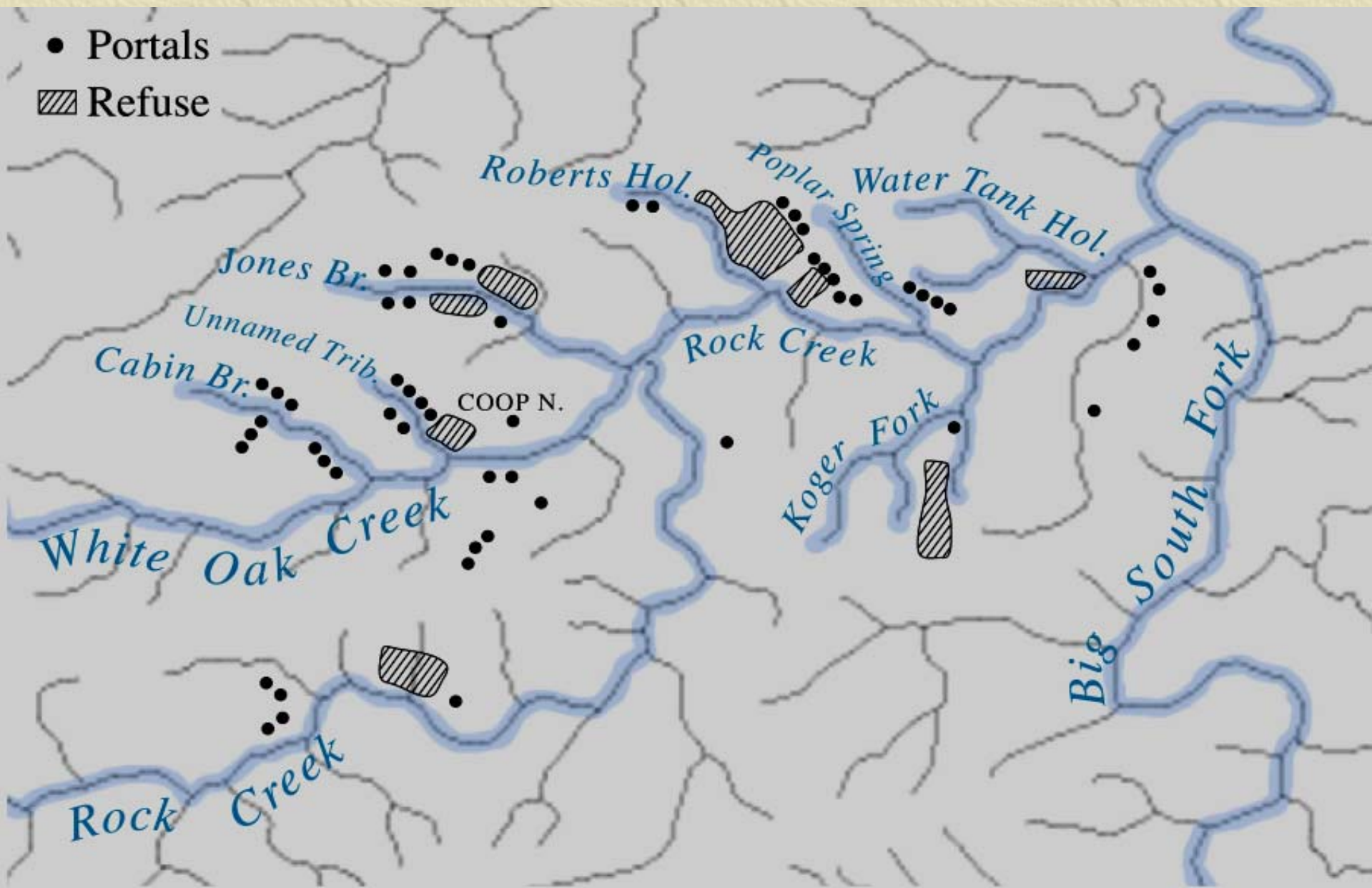
Passive Treatment of AMD with Open Limestone Channels in the Lower Rock Creek Watershed

McCreary County, Kentucky

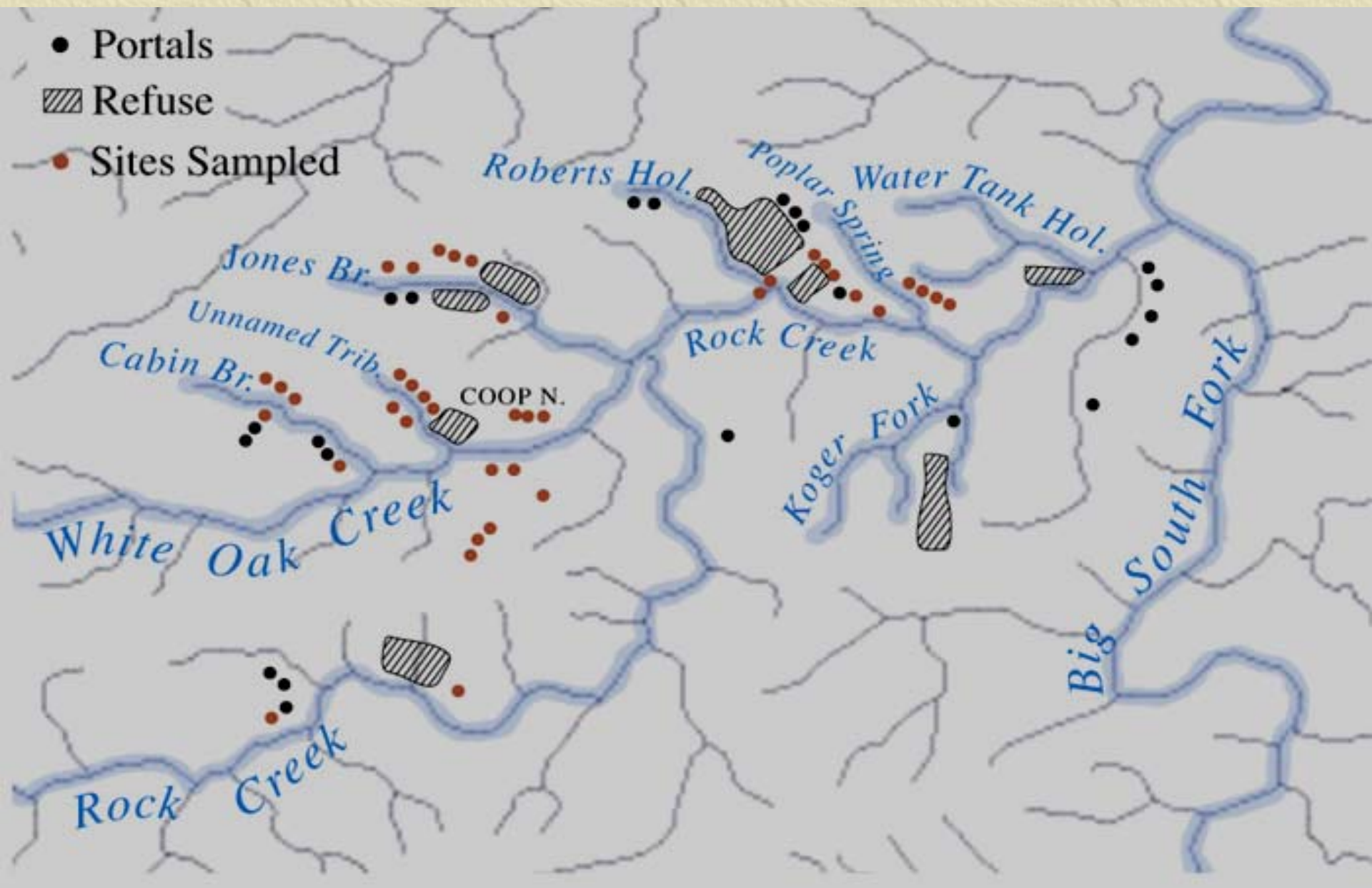

District Boundary
Daniel Boone
National Forest
Big South Fork
National River and
Recreation Area
Frankfort
Lex.
75
64
64
27
80
PKY
75
25E
927
90
Parkers
Lake
27
Stearns
District Office
CUMBERLAND RIVER
75
92
Whitley
City
Williamsburg
STEARNS
DISTRICT
Little South Fork
Rock Creek
92
Pine Knot
75
Big South
Fork
NRRA
Big South Fork
27
KENTUCKY
TENNESSEE

AMD Sources


Portals
Refuse
Roberts Hol.
Poplar Spring
Water Tank Hol.
Jones Br.
Unnamed Trib.
Cabin Br.
COOP N.
Rock Creek
Koger Fork
Big South Fork
White Oak Creek
Rock Creek

Spring 1995
Portal Sampling
and Analysis

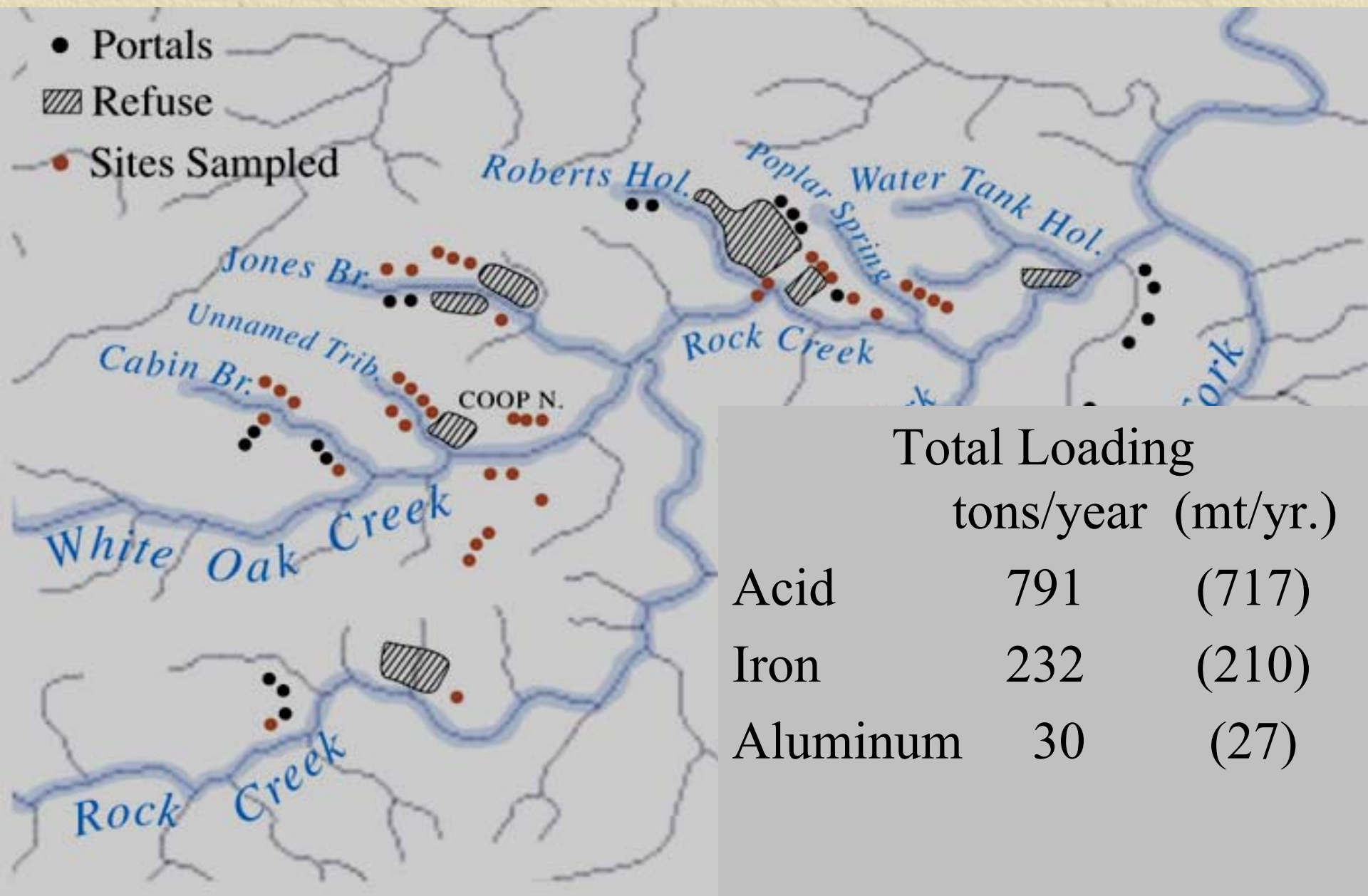
Sites Sampled



Rock Creek AMD Sites Characterized by

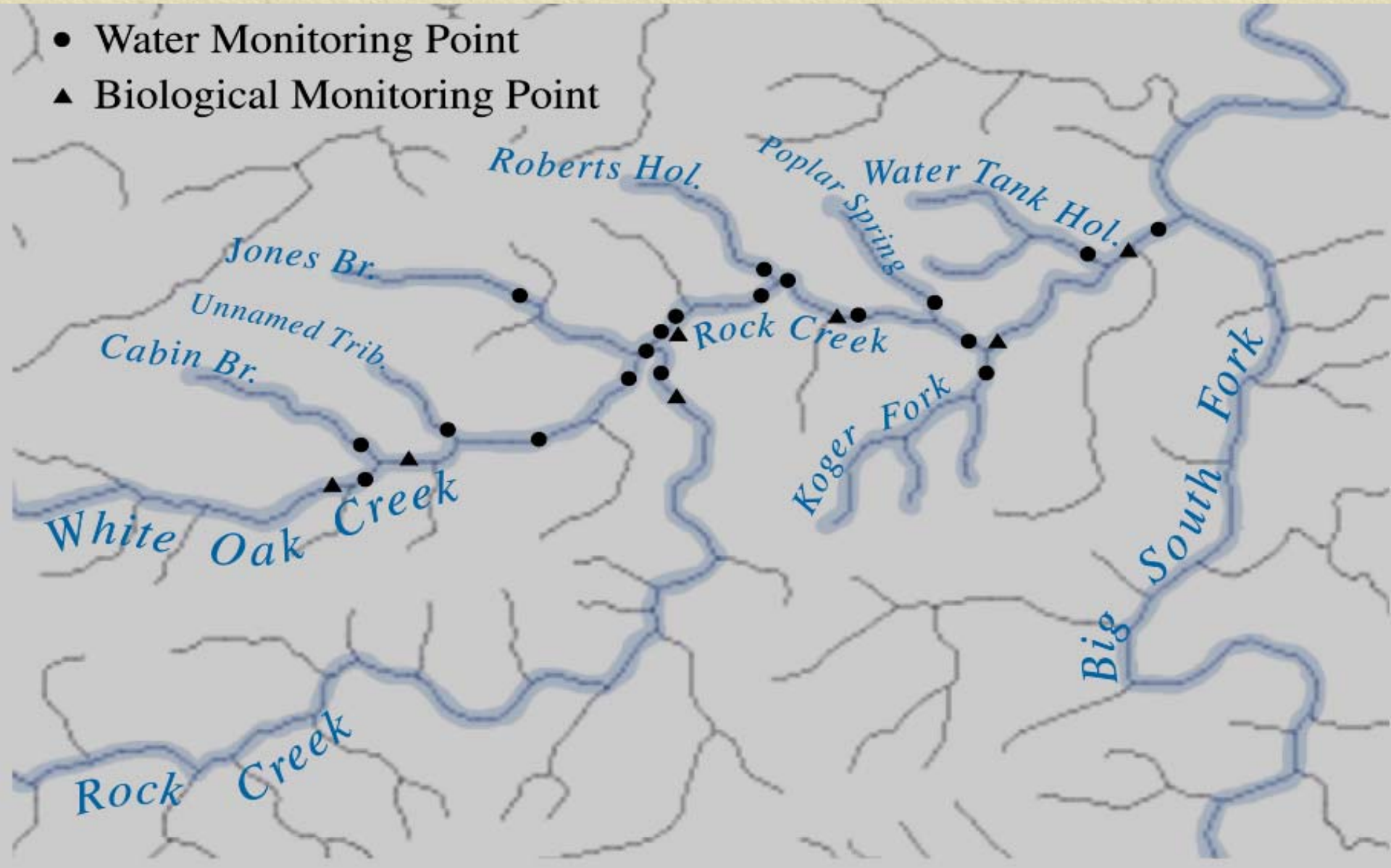
- Low pH
- High Acidity
- No Alkalinity
- High Iron Concentrations
- High Aluminum Concentrations

Annual Loading for All Sites Sampled



Total Loading	tons/year	(mt/yr.)
Acid	791	(717)
Iron	232	(210)
Aluminum	30	(27)

Monitoring Points



Passive Treatment Suitability Analysis

- Anoxic Limestone Drain
- Open Limestone Channel
- Aerobic Wetland
- Anaerobic Wetland
- Vertical Flow Wetland

Anoxic Limestone Drain Criteria

- Dissolved Oxygen less than 1 mg/l
- Ferric Iron less than 1 mg/l
- Aluminum less than 1 mg/l
- Maximum 300 mg/l Alkalinity Generated

Aerobic Wetland Criteria

- Net Alkaline Water
- Wetland Area Equal to 10 - 20 grams of Iron per Square Meter per Day

(Hedin et al 1994)

Example: Jones Branch = 5 acres

Anaerobic Wetland Criteria

- Net Acid Water
- Low Flow Rate
- Wetland Area Equal to 3.5 grams of Acidity per Square Meter per Day

(Hedin et al 1994)

Example: Jones Branch = 60 acres

Open Limestone Channel Criteria

- Slopes Greater Than 10% or High Flow Rates to account for plugging
- Slopes Allowing Long Lengths of Channel to account for armoring

AMD Abatement Techniques Utilized

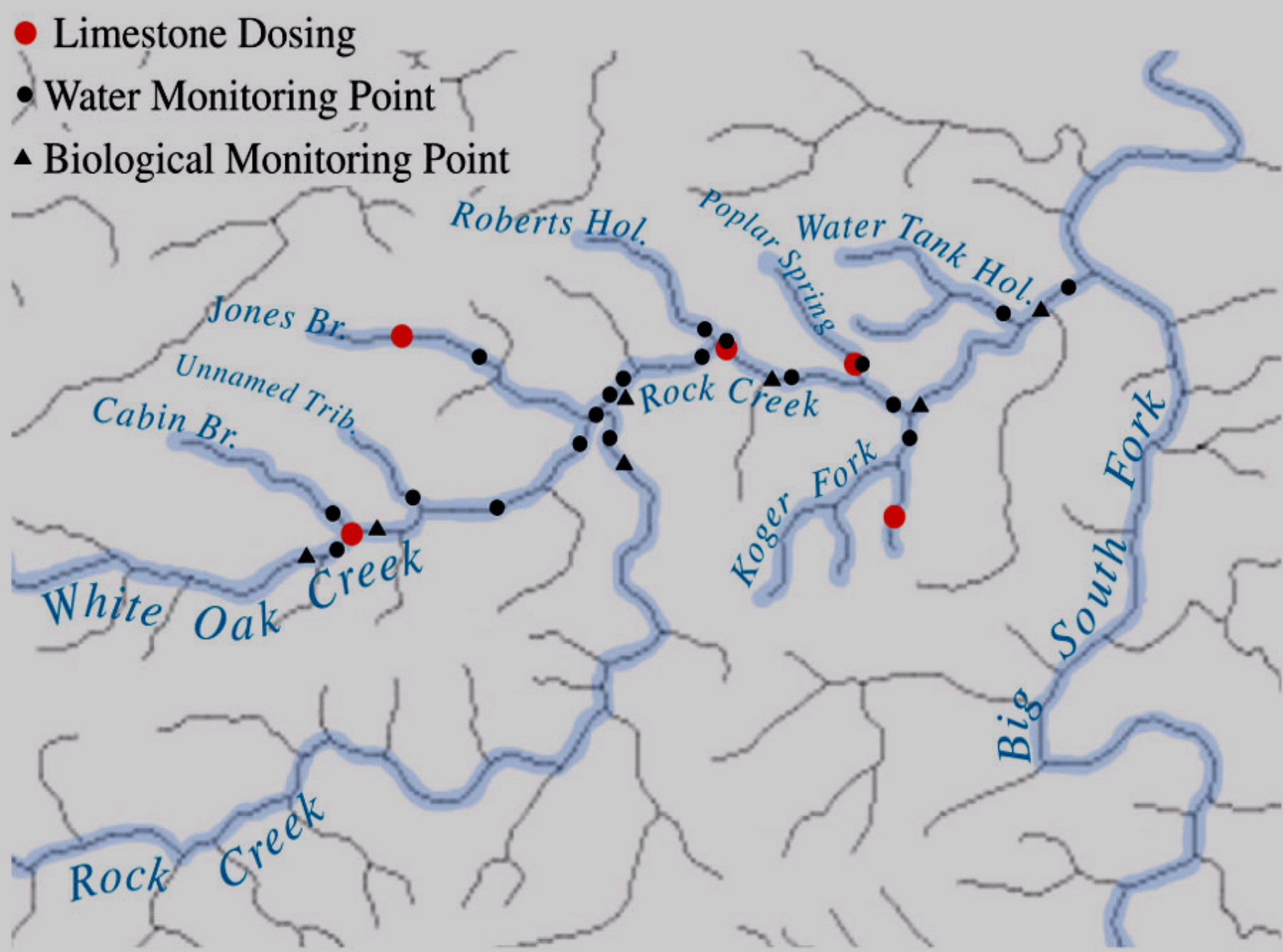
- Limestone Sand Dosing
- Refuse Removal and Treatment
- Open Limestone Channels
- Vertical Flow System

Rock Creek Project
AMD Abatement Methodology

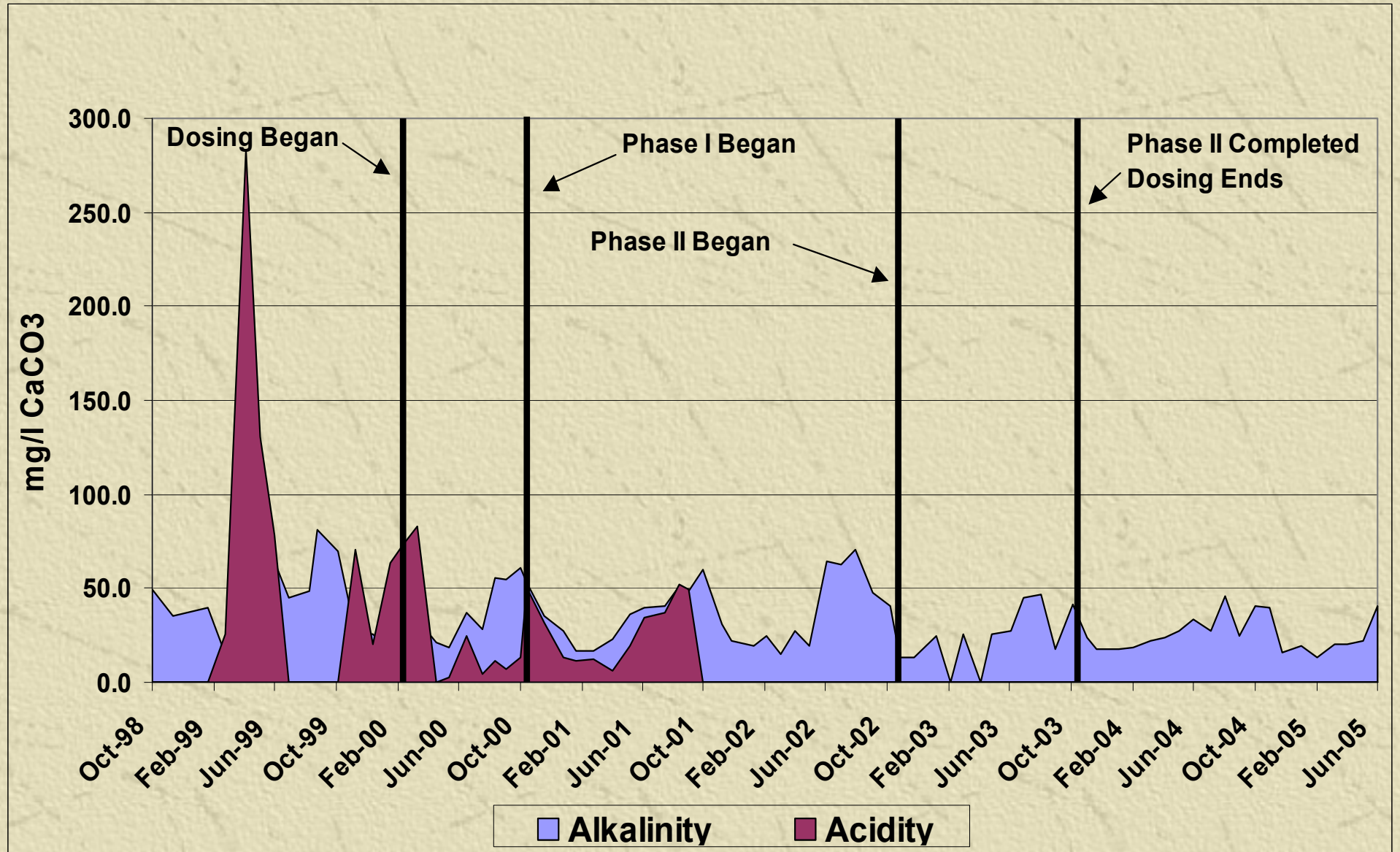
- Treat AMD with limestone sand at rates based on acid loading calculations
- Utilize passive treatment and mine reclamation techniques as funding allows
- Reduce limestone sand dosing as sites are reclaimed and passive treatment systems are installed

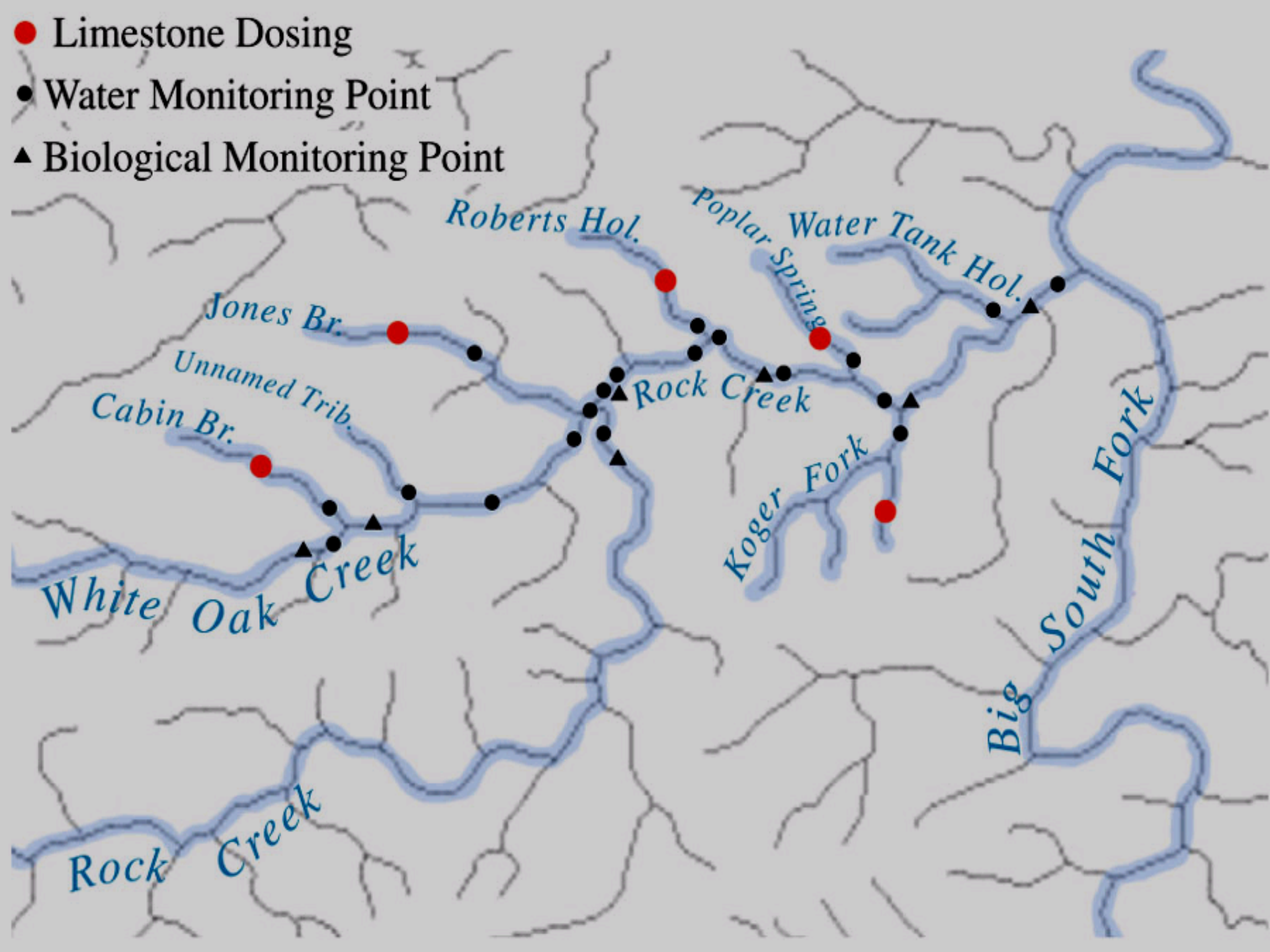
Project Construction

Limestone Sand Dosing


Limestone Dosing
Water Monitoring Point
Biological Monitoring Point
Roberts Hol.
Poplar Spring
Water Tank Hol.
Jones Br.
Unnamed Trib.
Cabin Br.
Rock Creek
Koger Fork
White Oak Creek
Big South Fork
Rock Creek

Rock Creek at Mouth

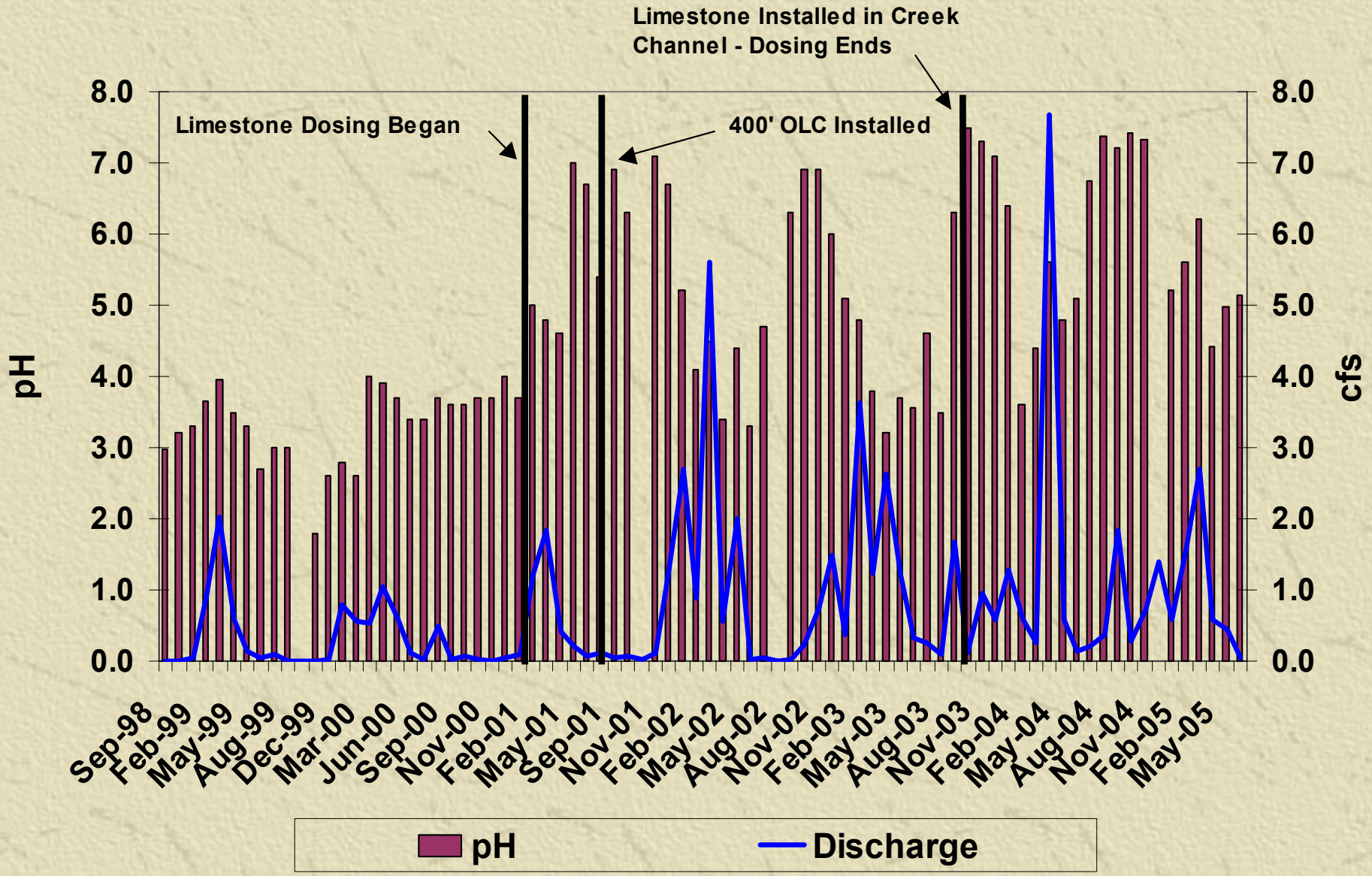



Limestone Dosing
Water Monitoring Point
Biological Monitoring Point
Roberts Hol.
Poplar Spring
Water Tank Hol.
Jones Br.
Unnamed Trib.
Cabin Br.
Rock Creek
Koger Fork
White Oak Creek
Big South Fork
Rock Creek

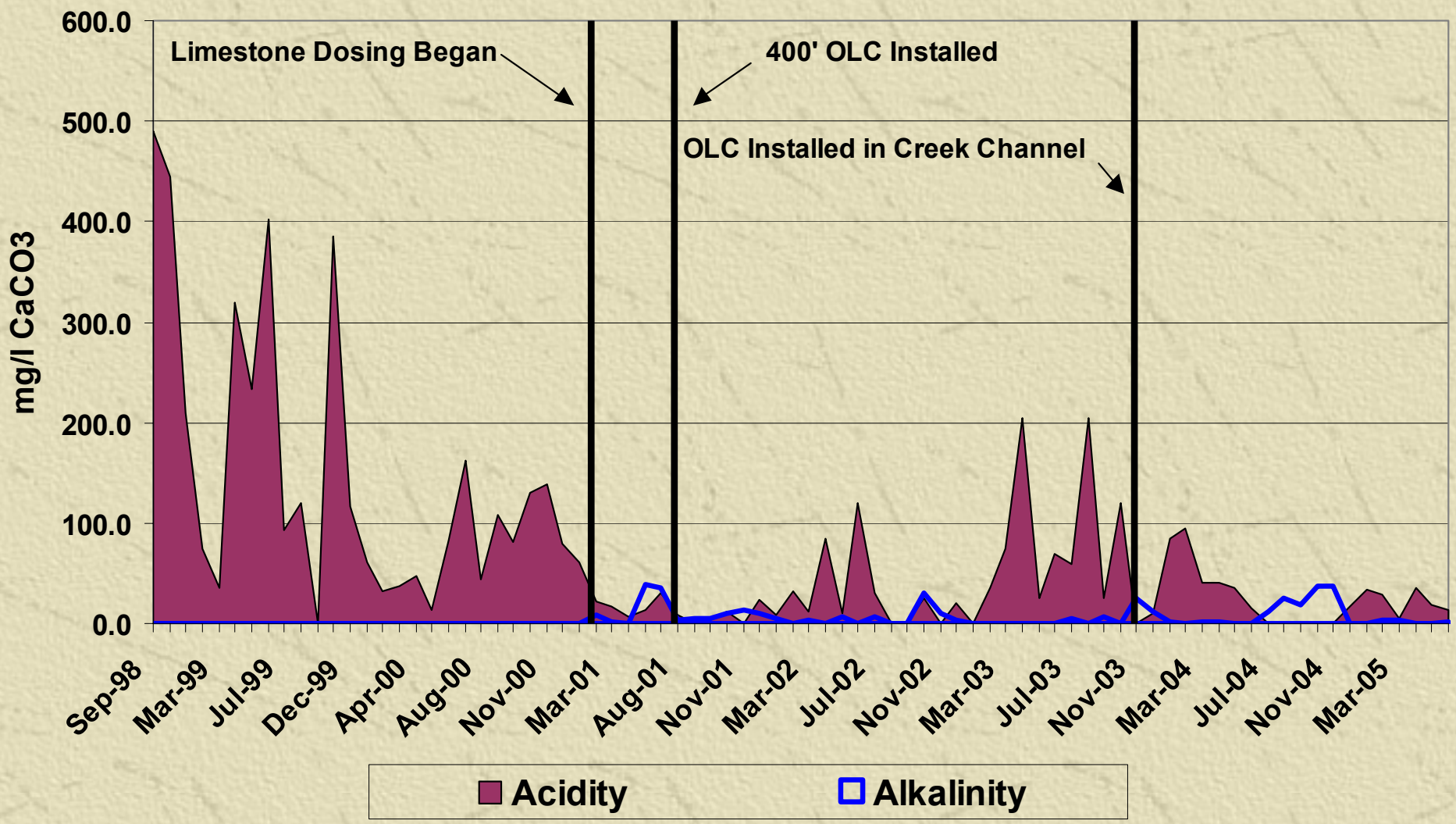
Open Limestone Channels

Cabin Branch

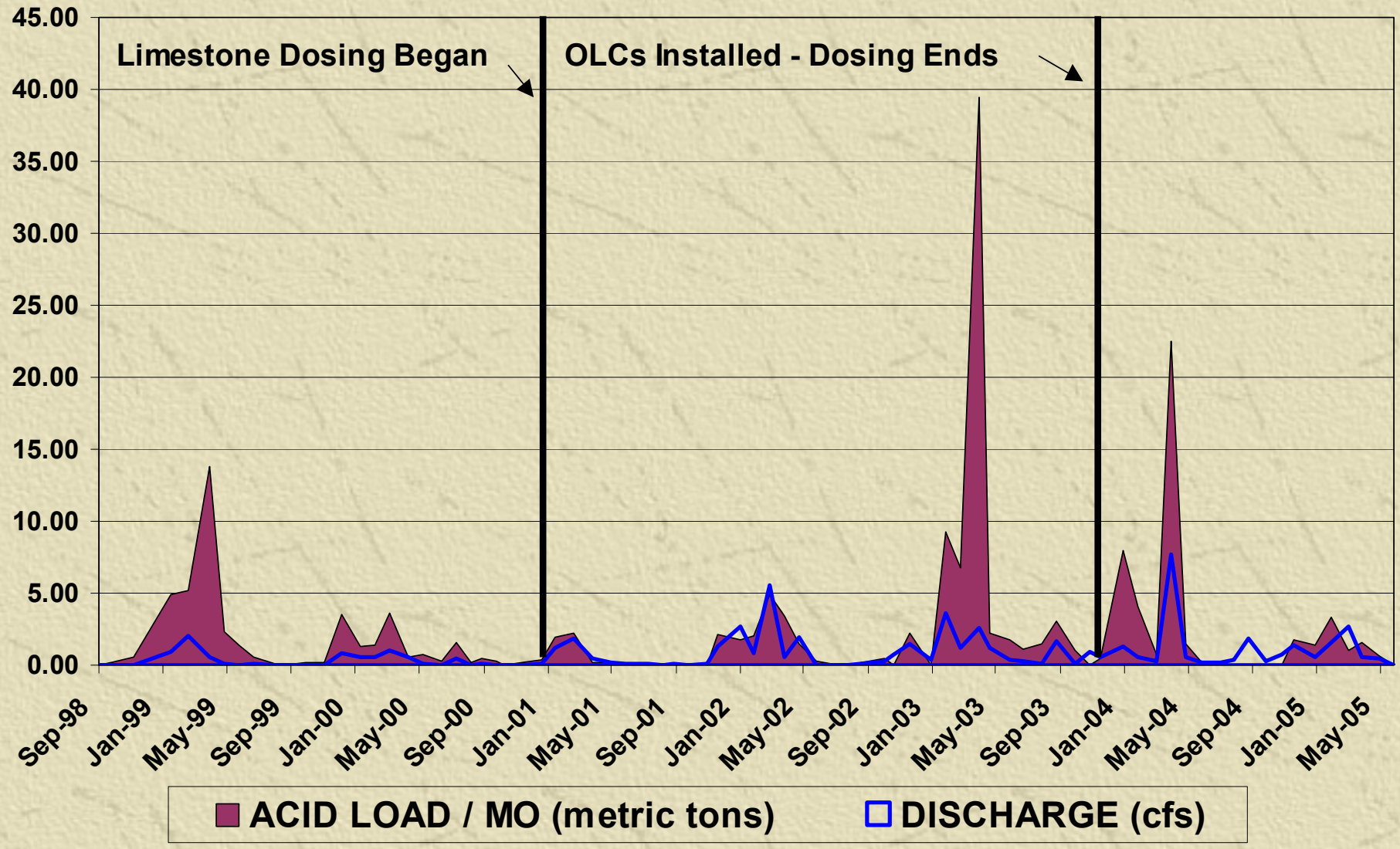
Cabin Br. median pH 5.6 after OLC



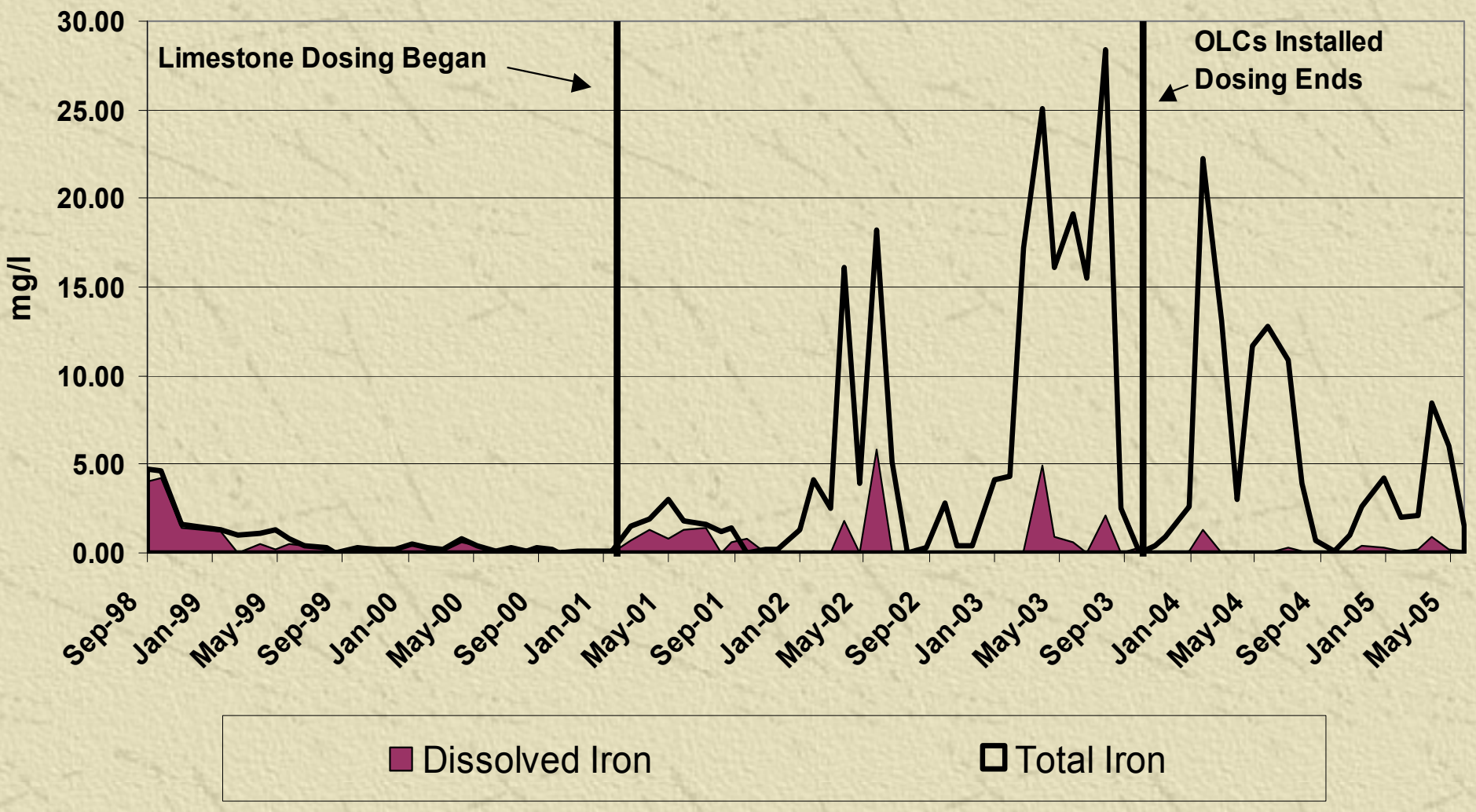
Cabin Branch Acidity reduced 85%



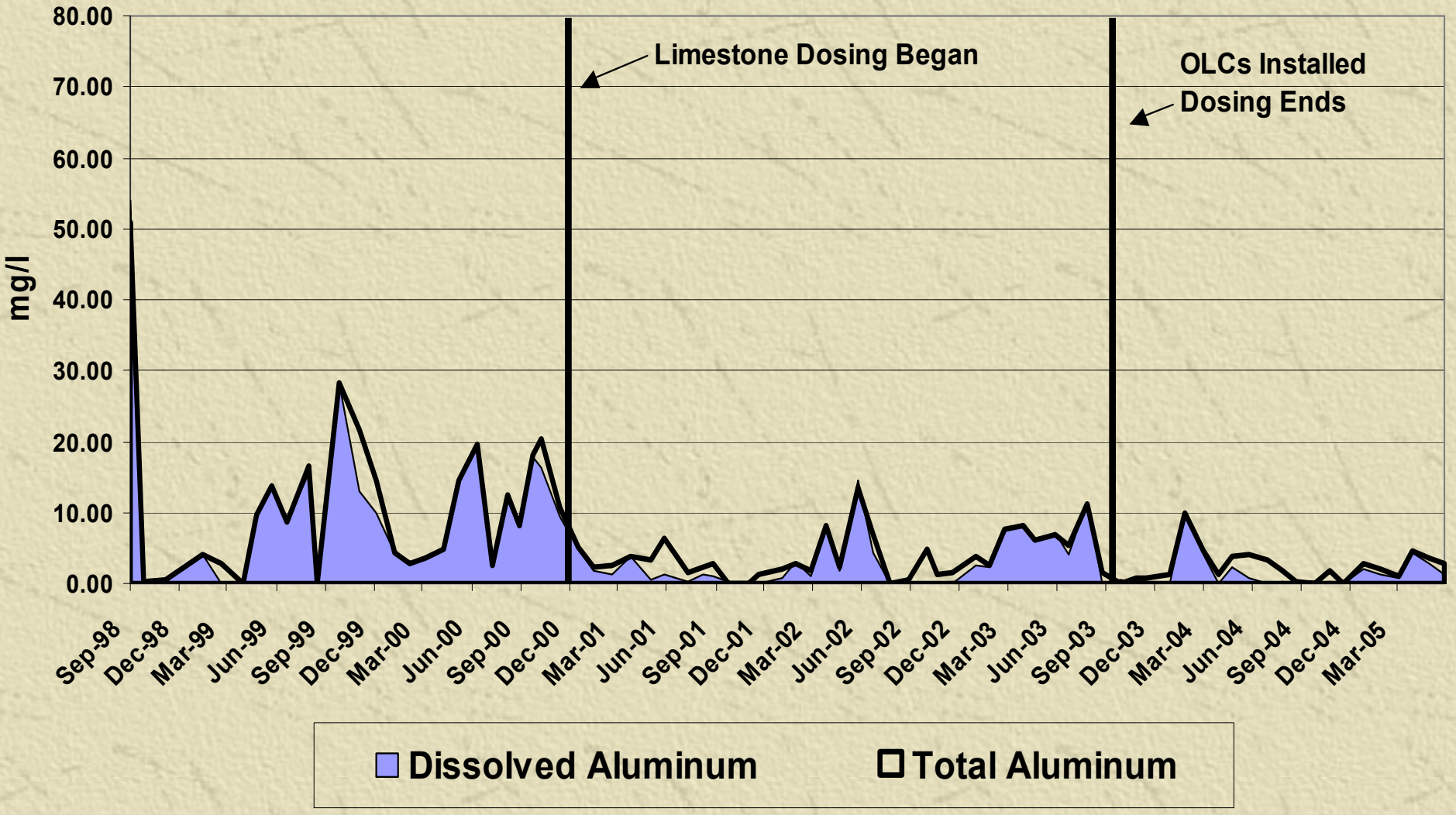
Cabin Branch Acid Load



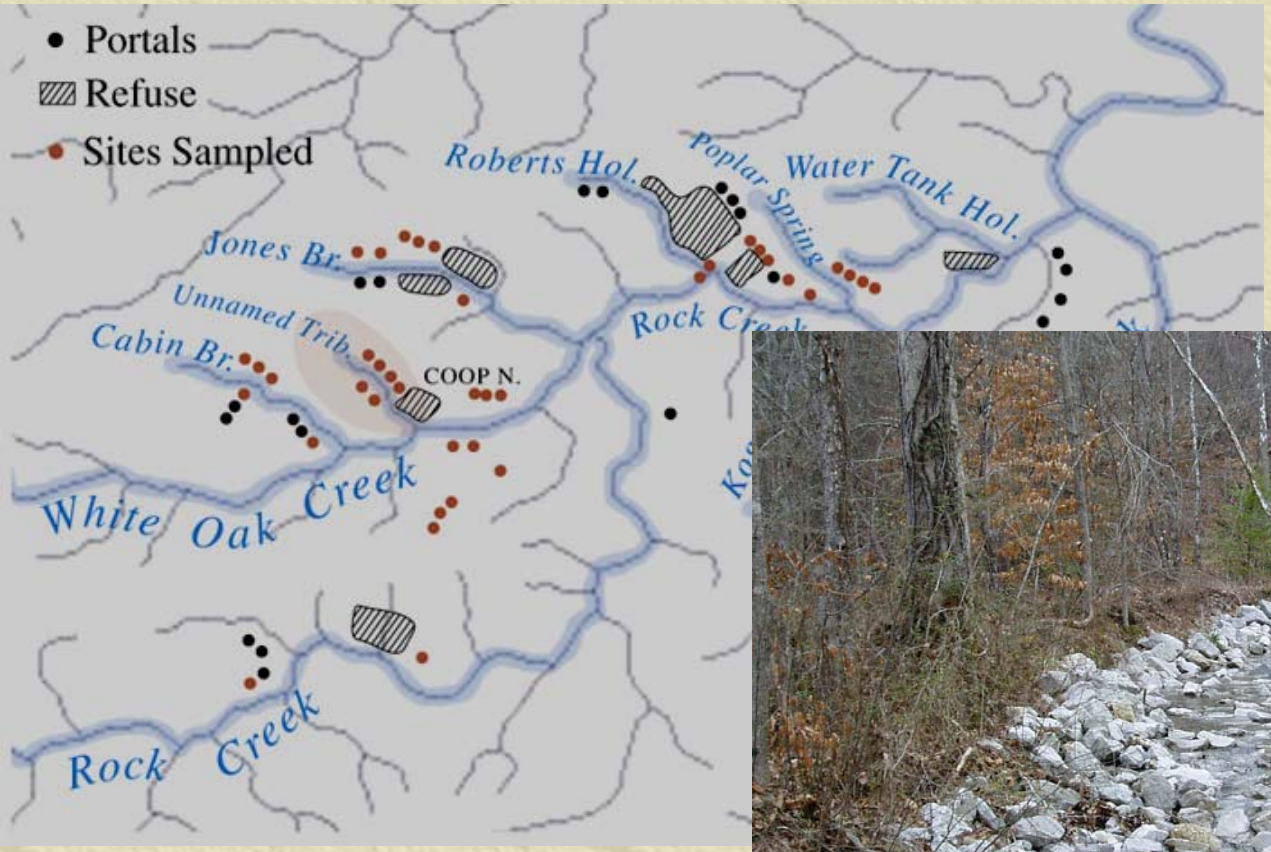
Cabin Br. Iron Concentrations



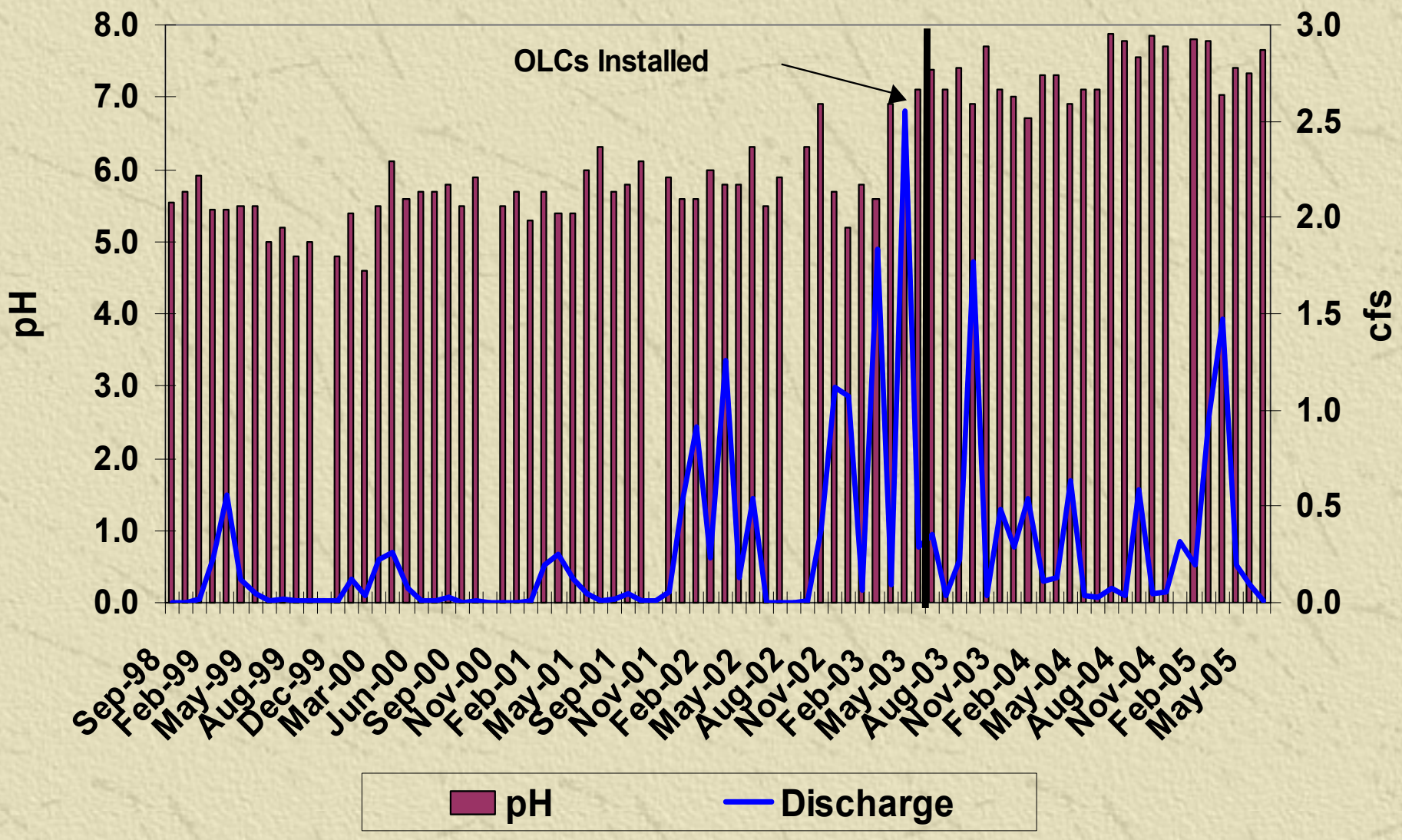
Cabin Br. Aluminum Concentrations



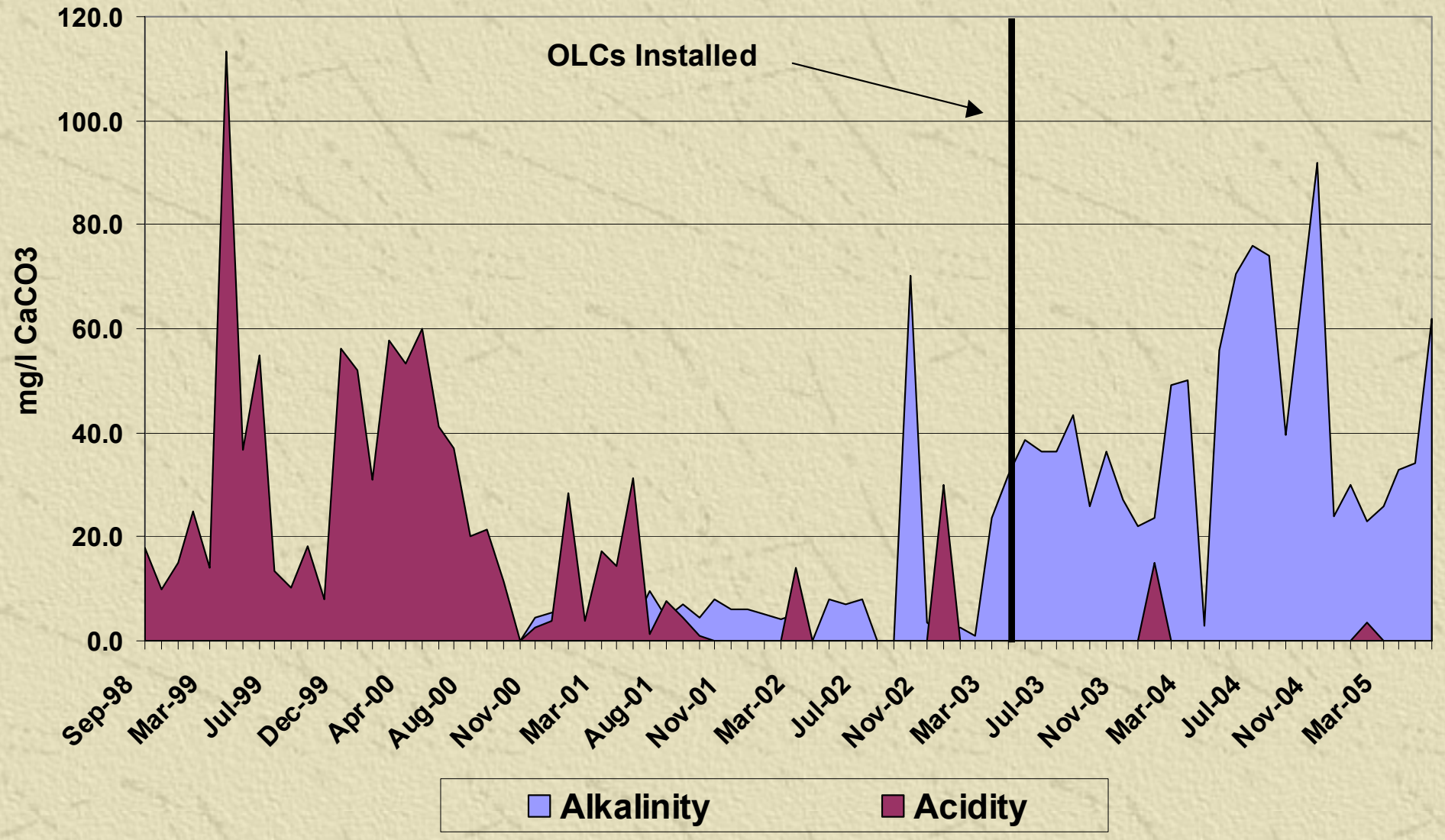
Unnamed Tributary to White Oak Ck.



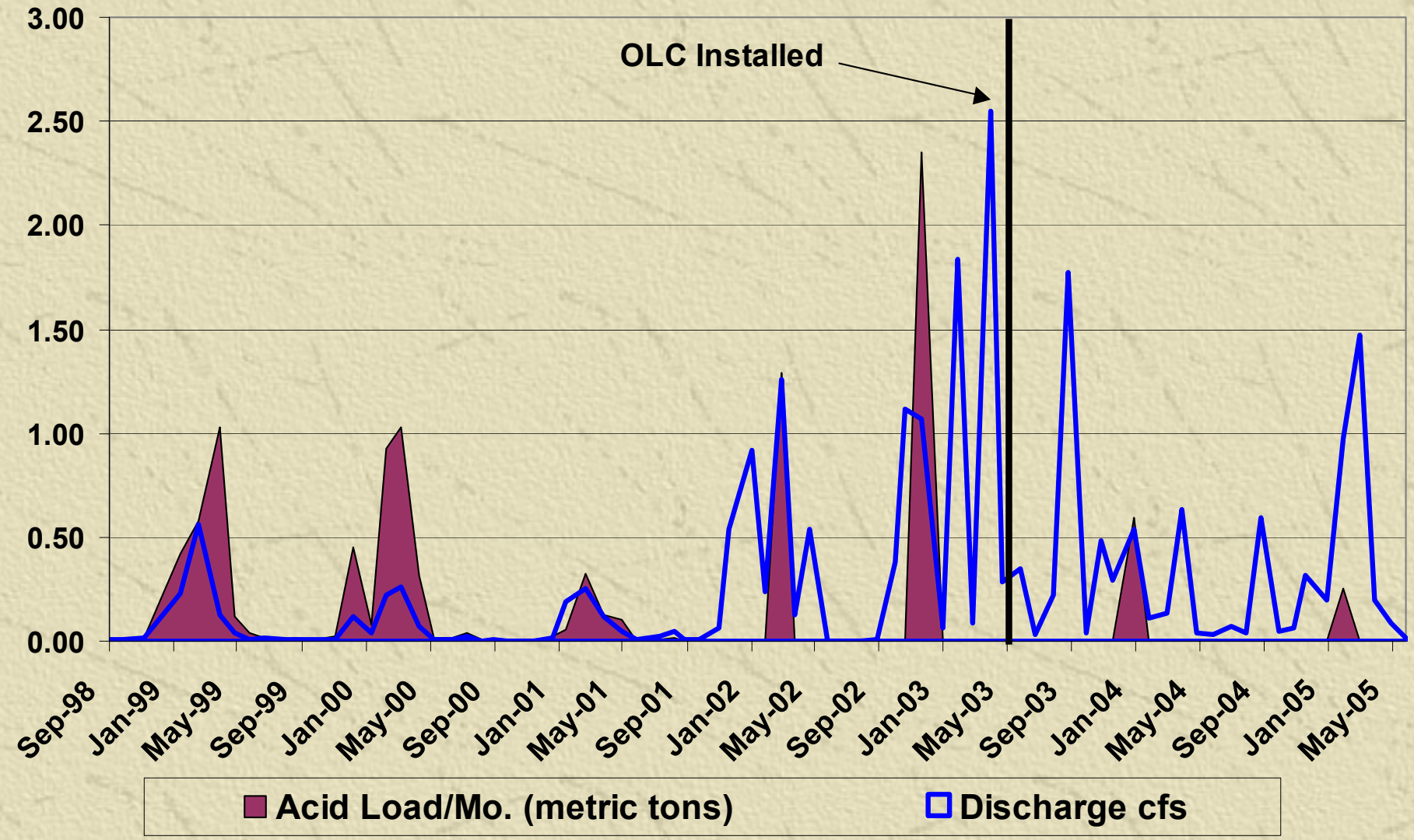
Unnamed Tb. median pH 7.3 after OLC



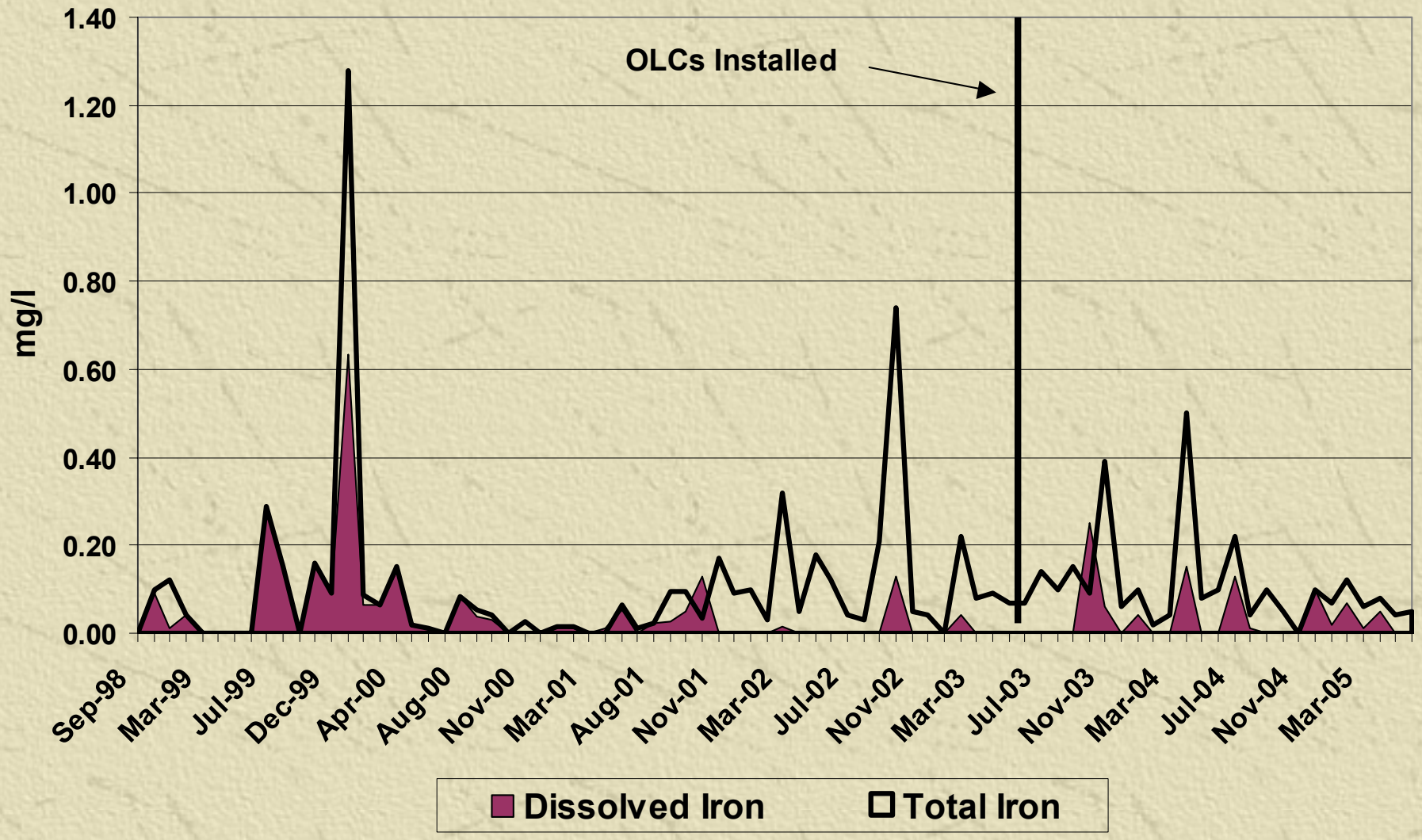
Unnamed Trib. Acidity reduced 95%



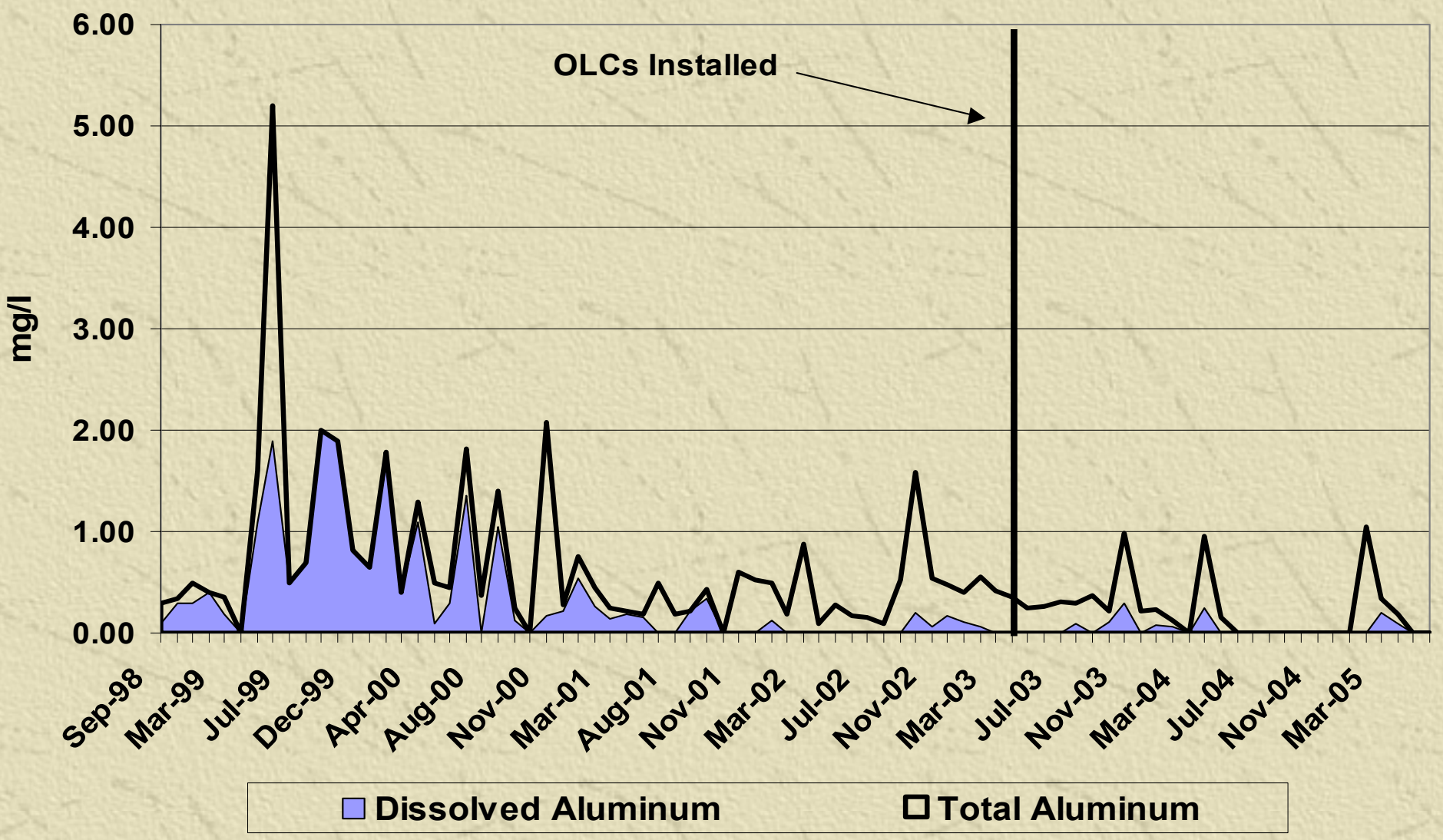
Unnamed Tb. Acid Load reduced 80%



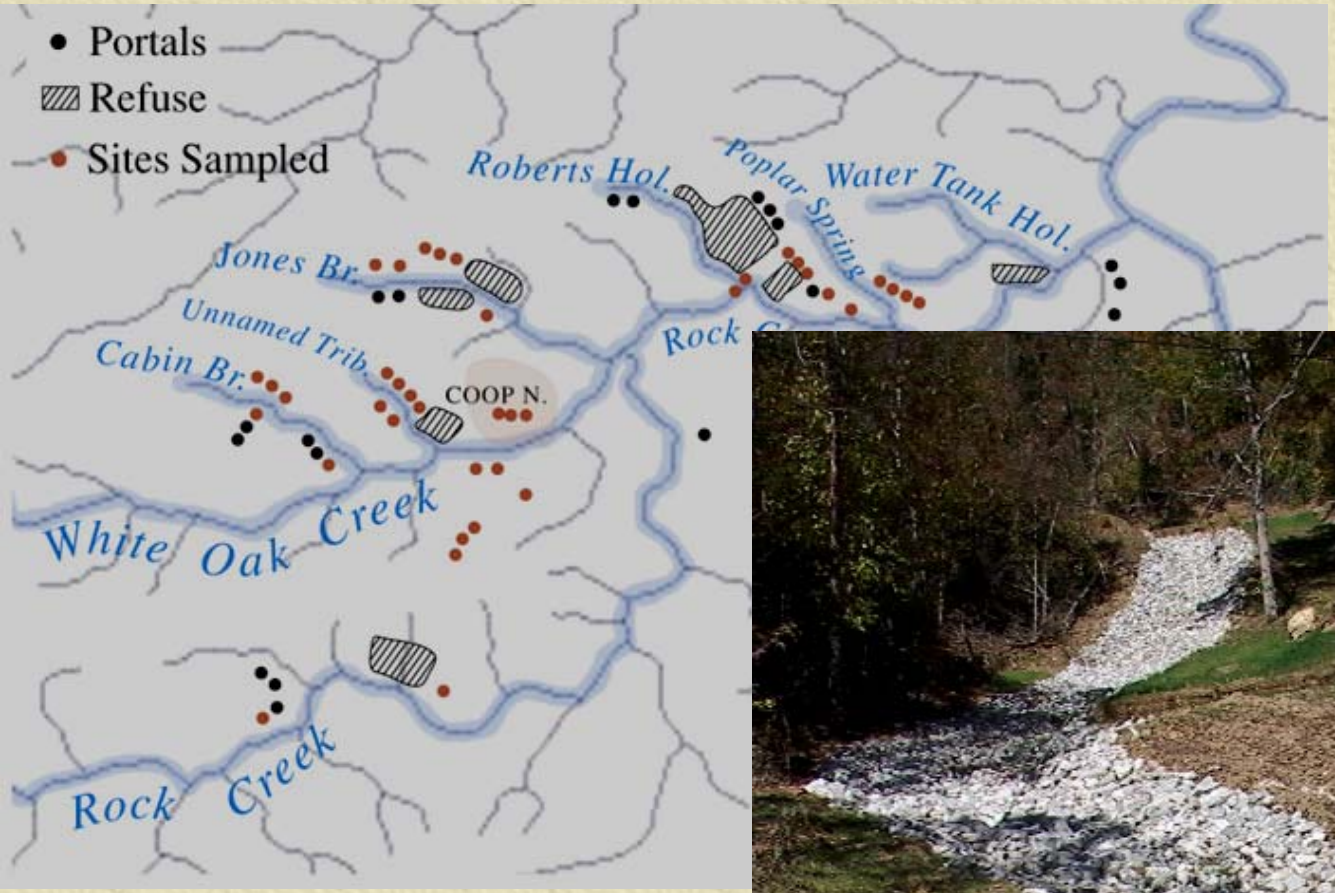
Unnamed Trib. Iron Concentrations



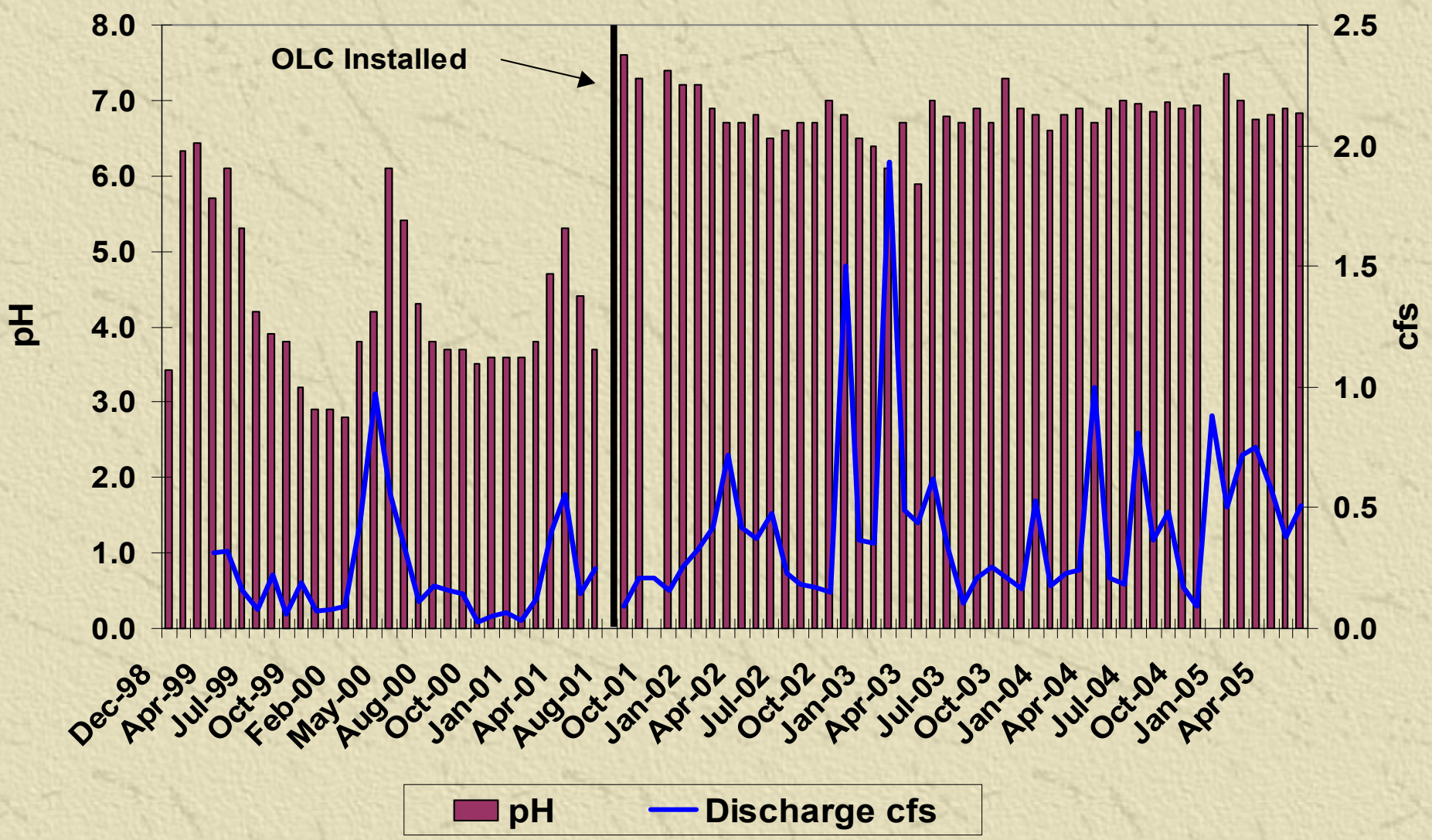
Unnamed Trib. Al Concentrations



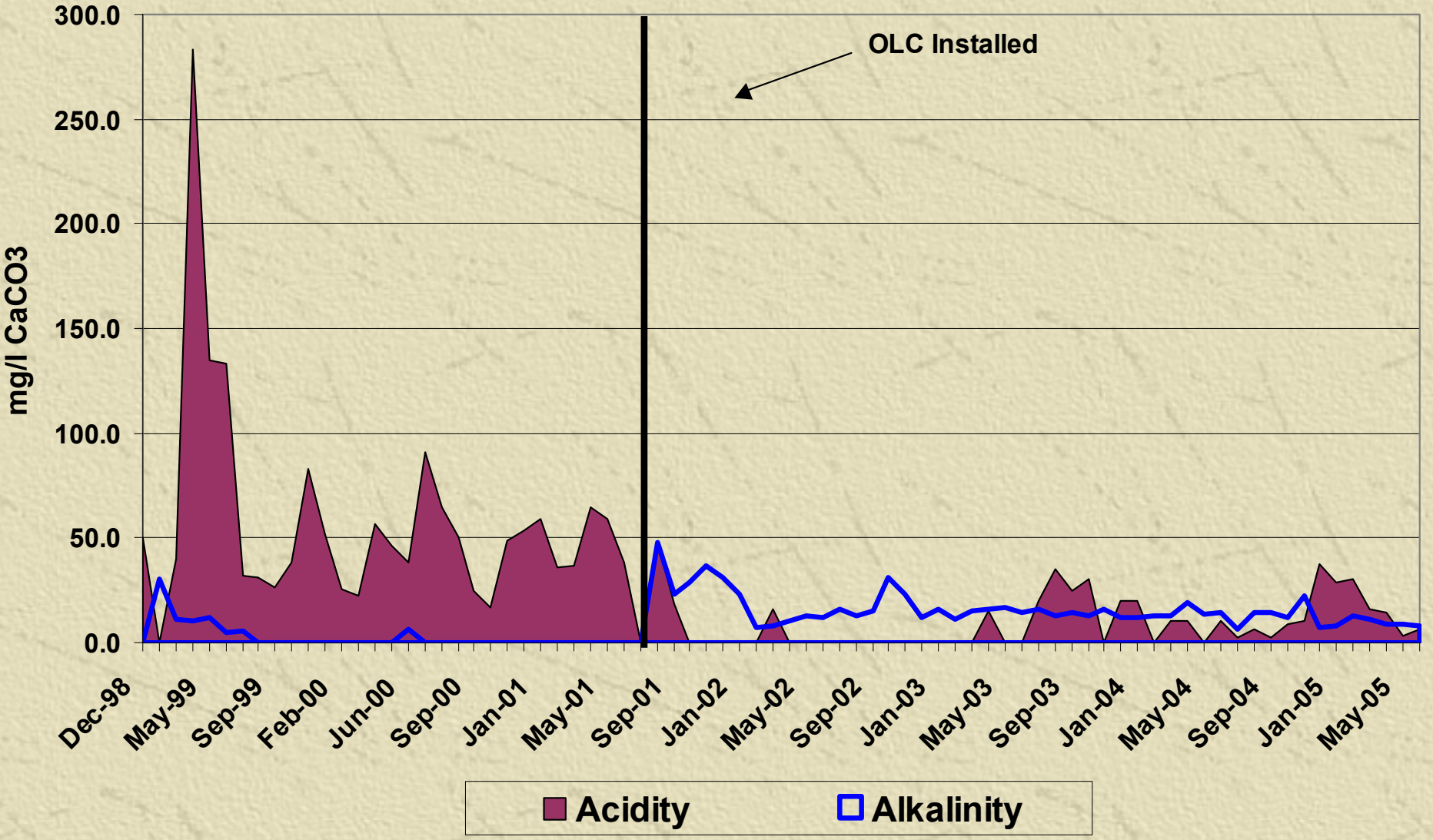
Cooperative North Portals



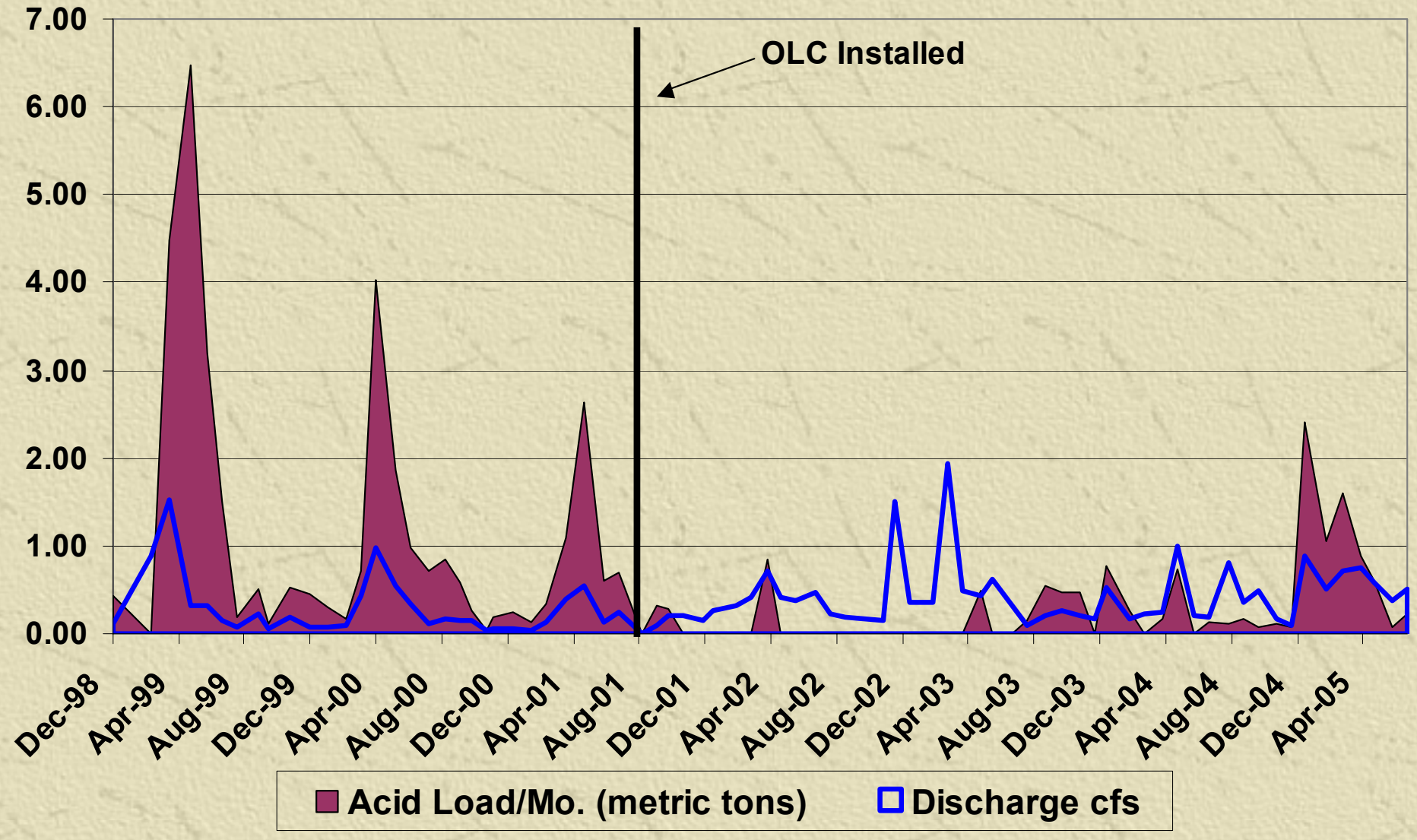
Coop North median pH 6.8 after OLC



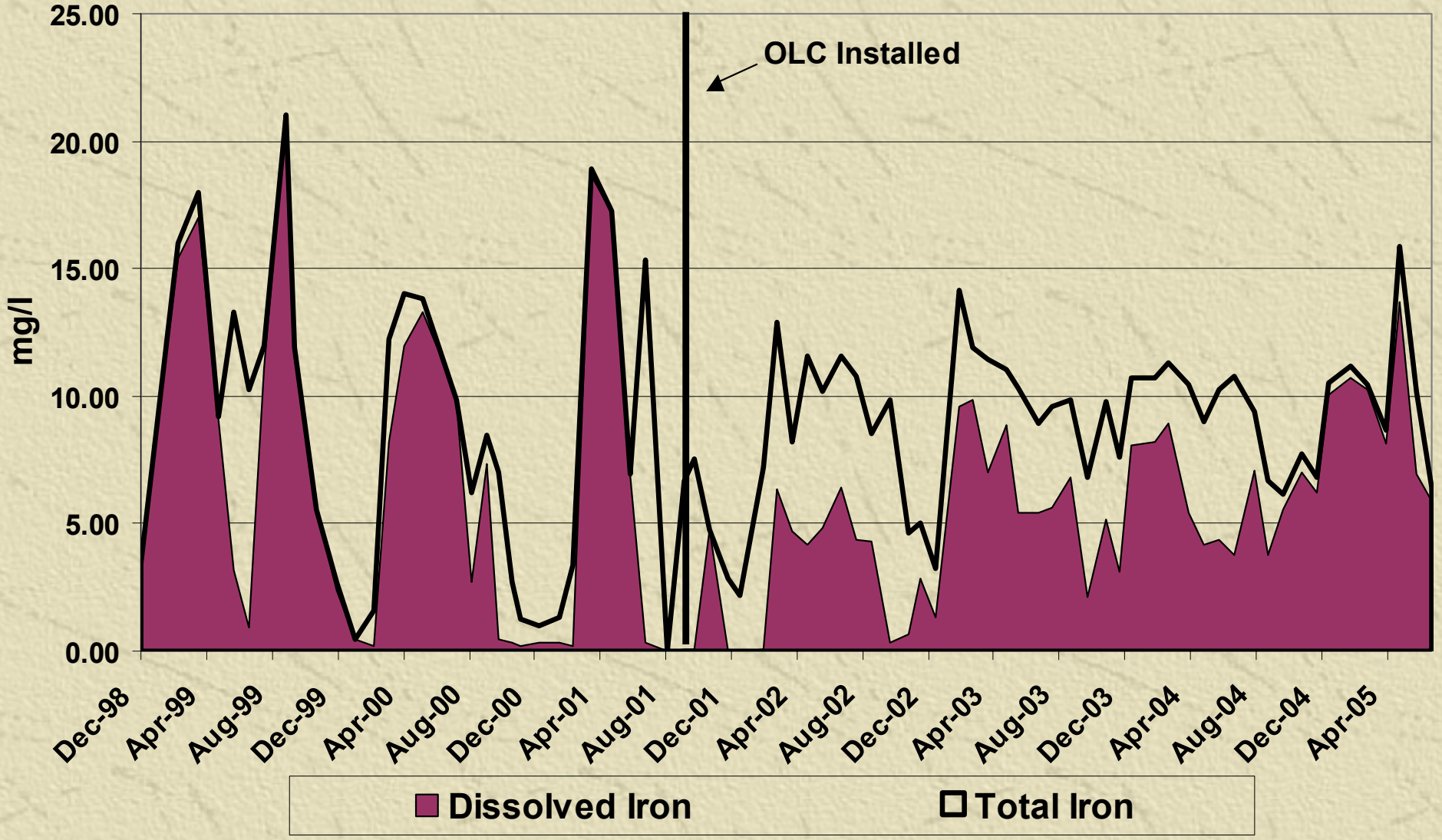
Coop North Acidity reduced 84%



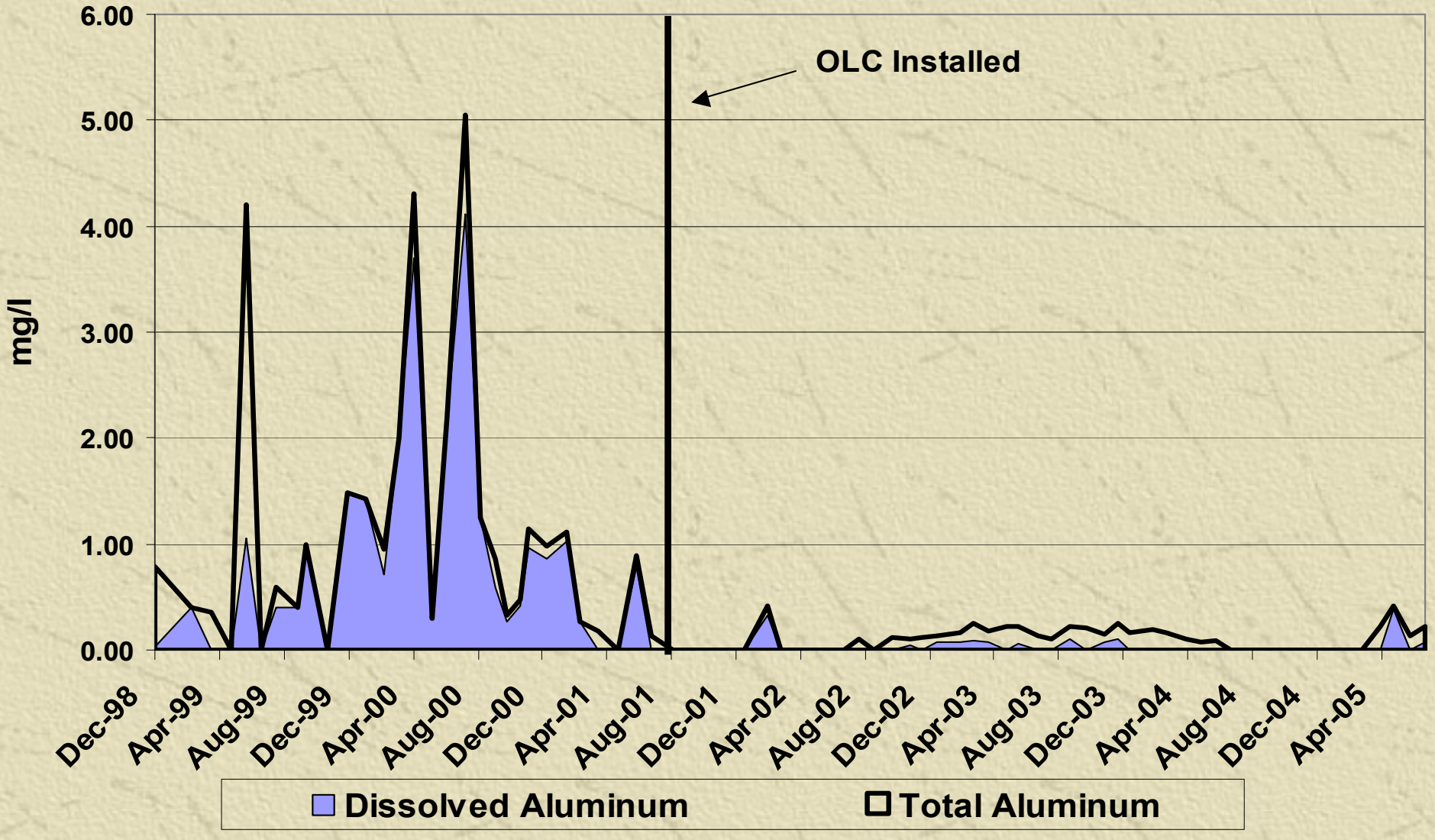
Coop North Acid Load reduced 75%



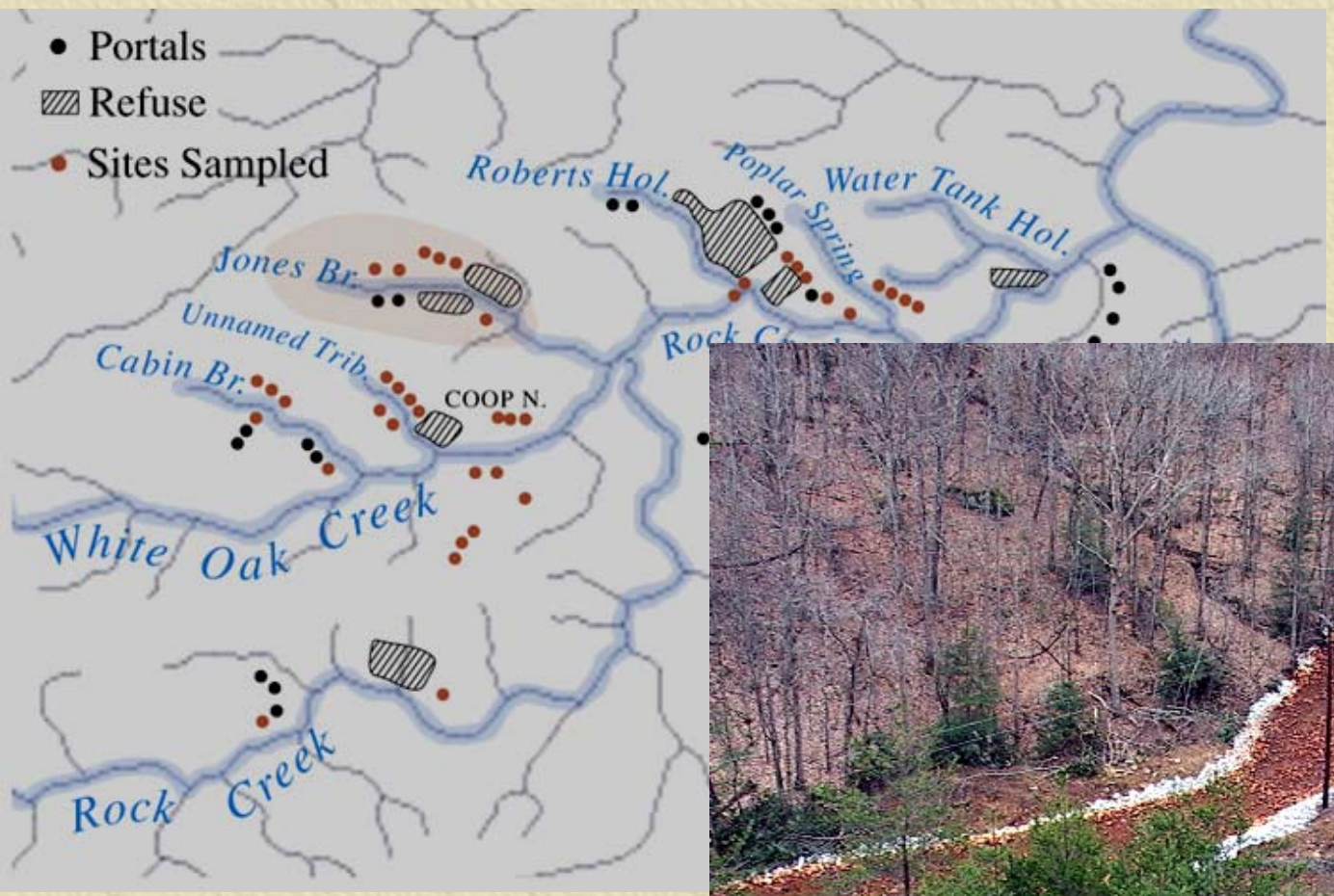
Cooperative North Iron Concentrations



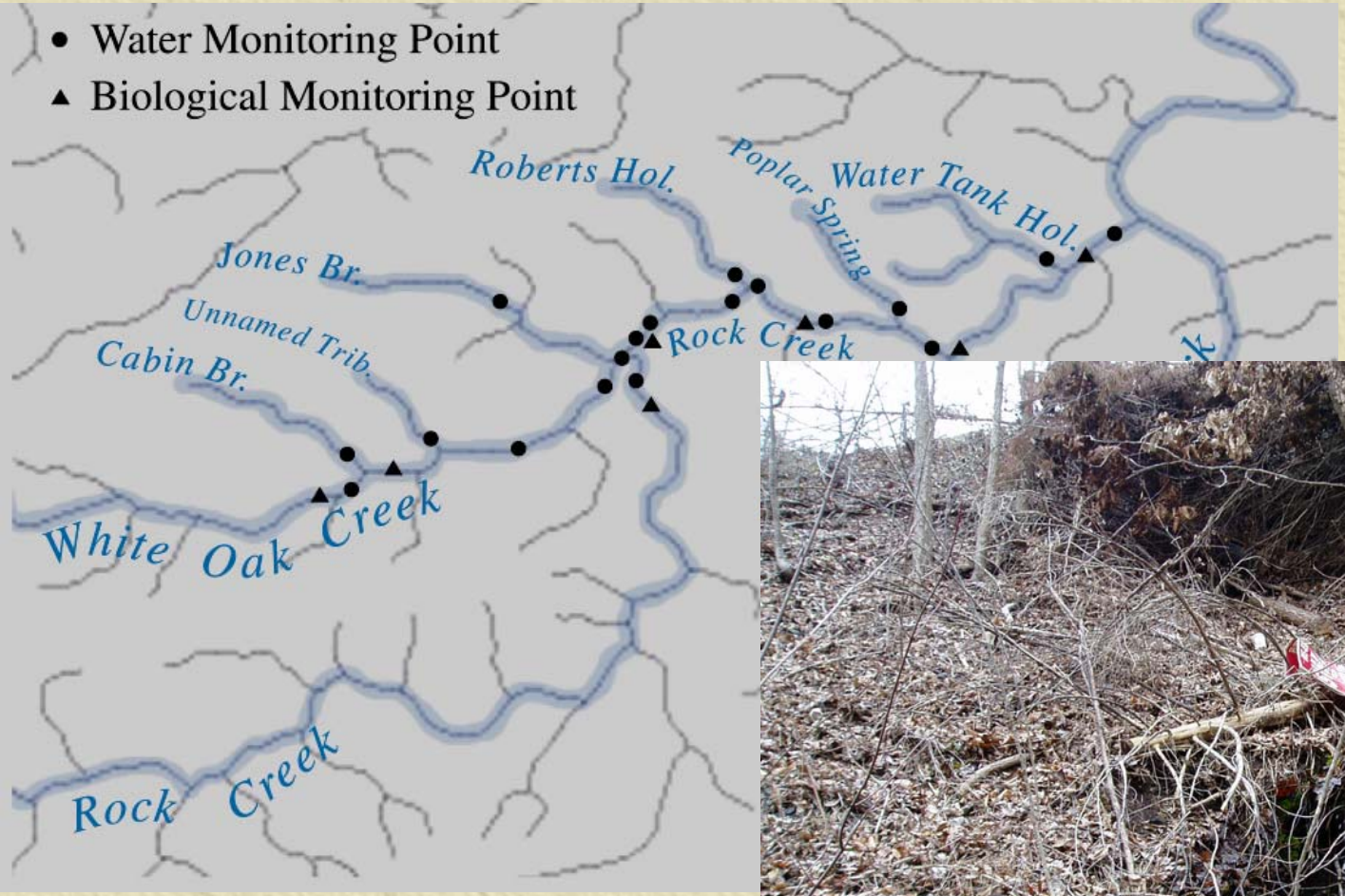
Coop North Aluminum Concentration



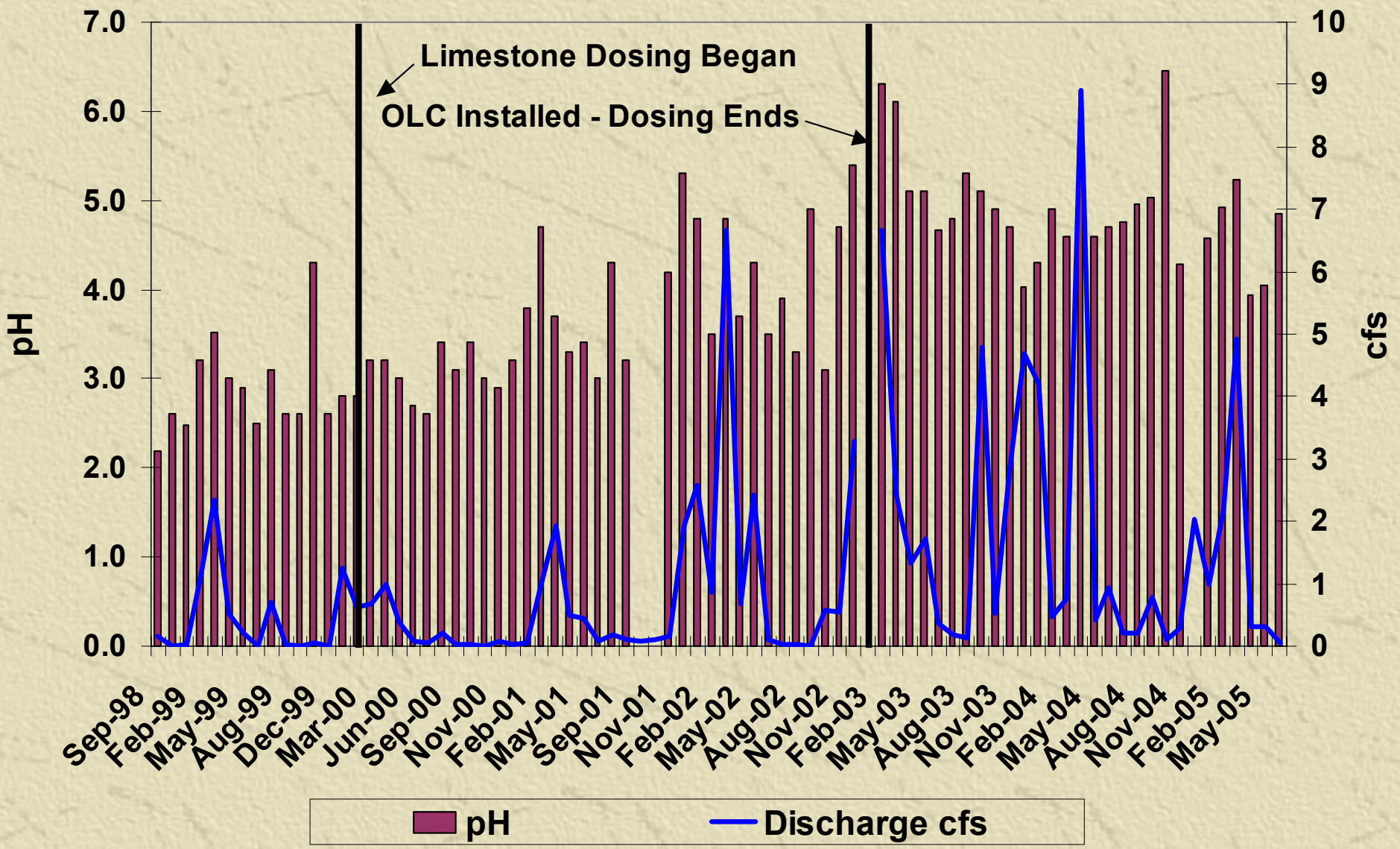
Jones Branch



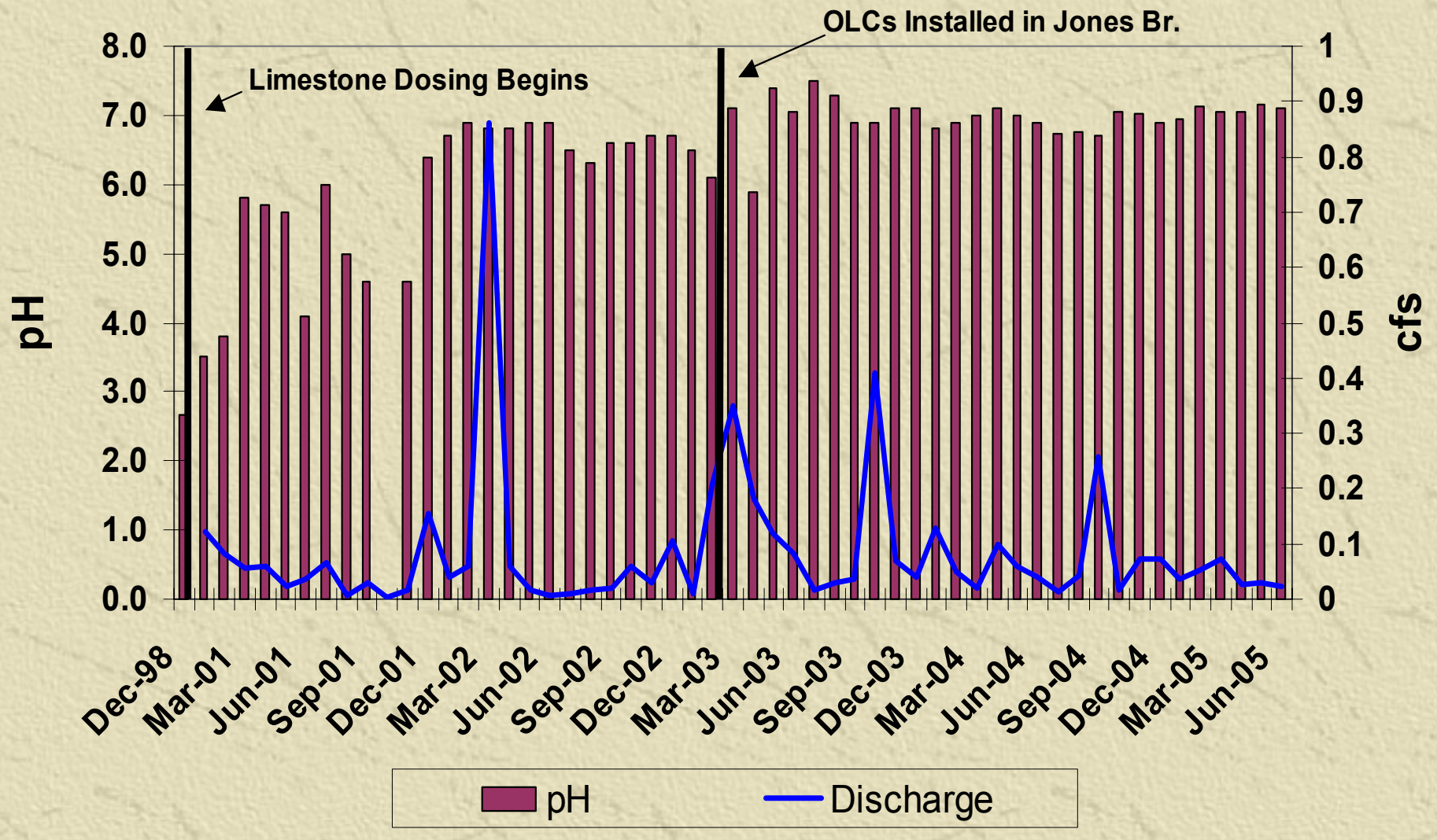
Jones Branch Spring



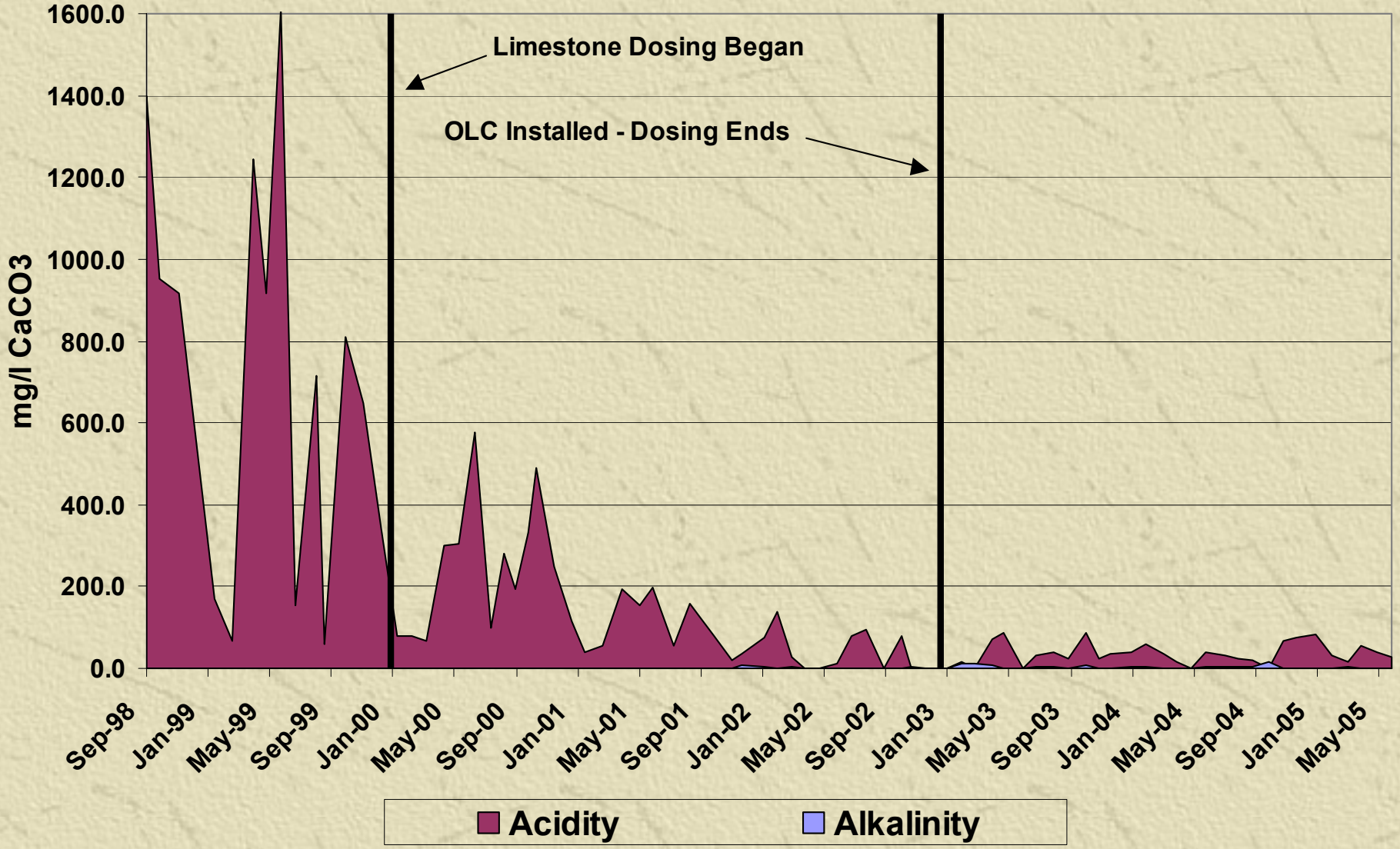
Jones Br. median pH 4.8 after OLC



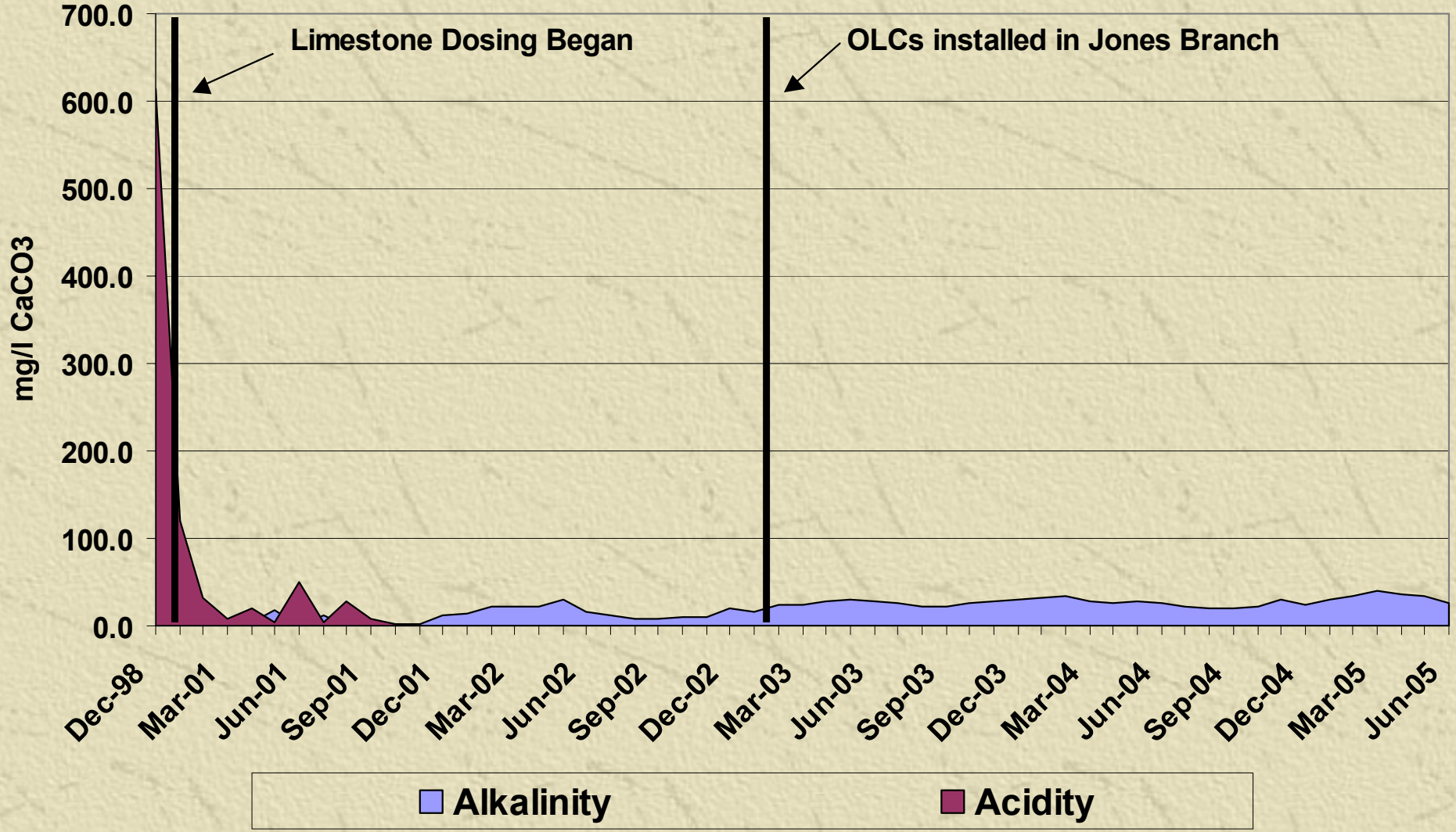
Jones Br. Sp. median pH 7.0 after OLC



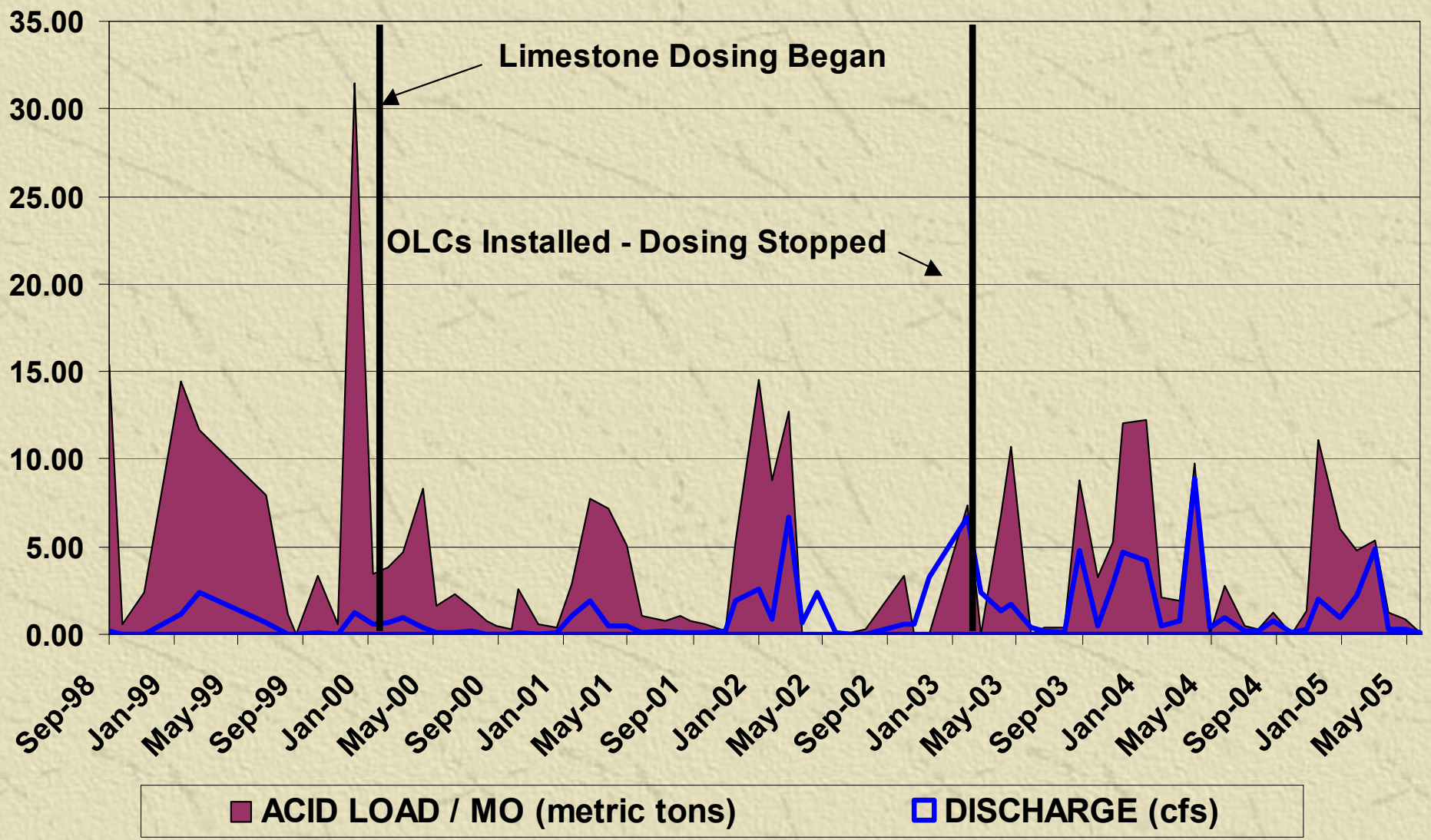
Jones Branch Acidity reduced 95%



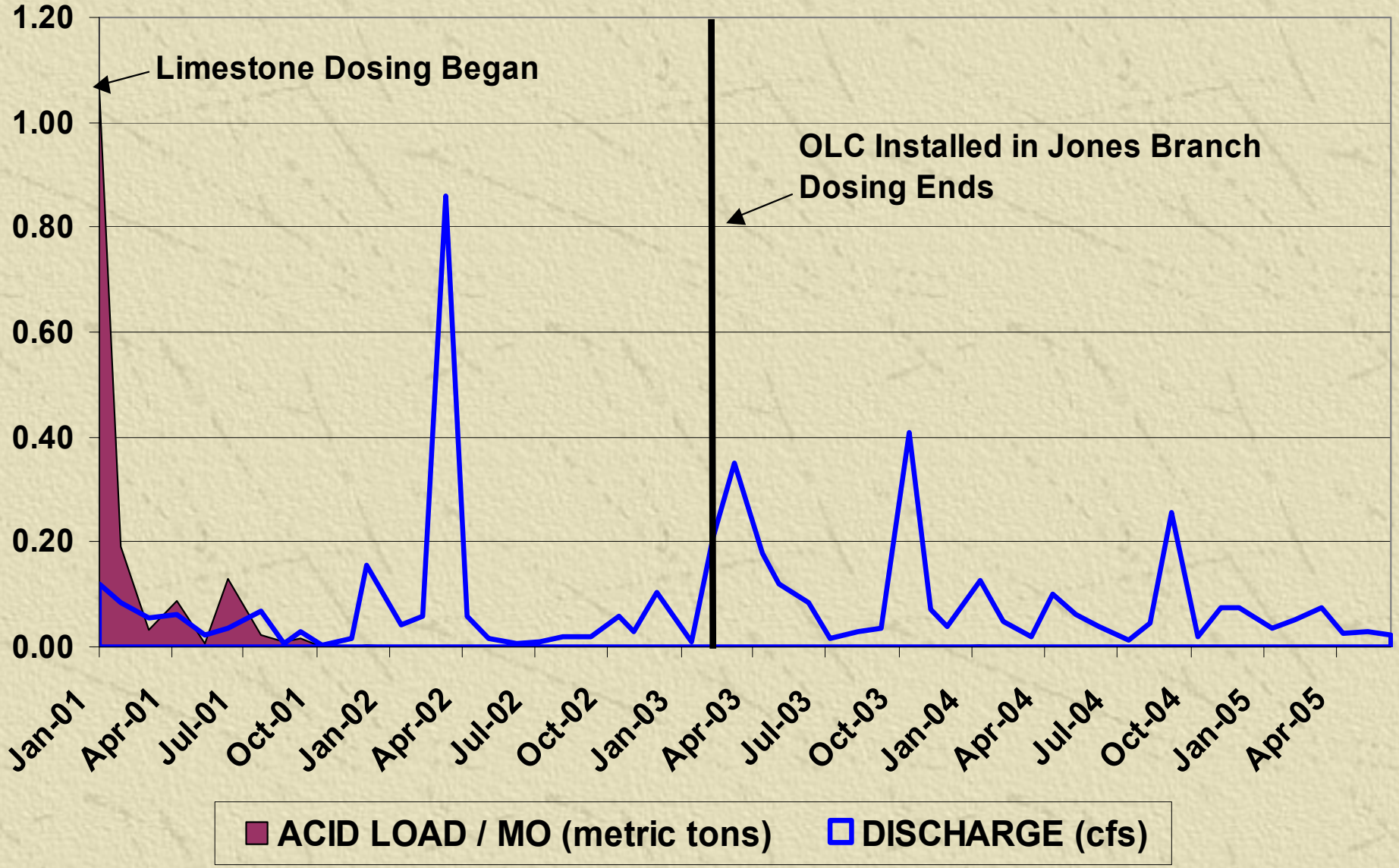
Jones Branch Spring Acidity



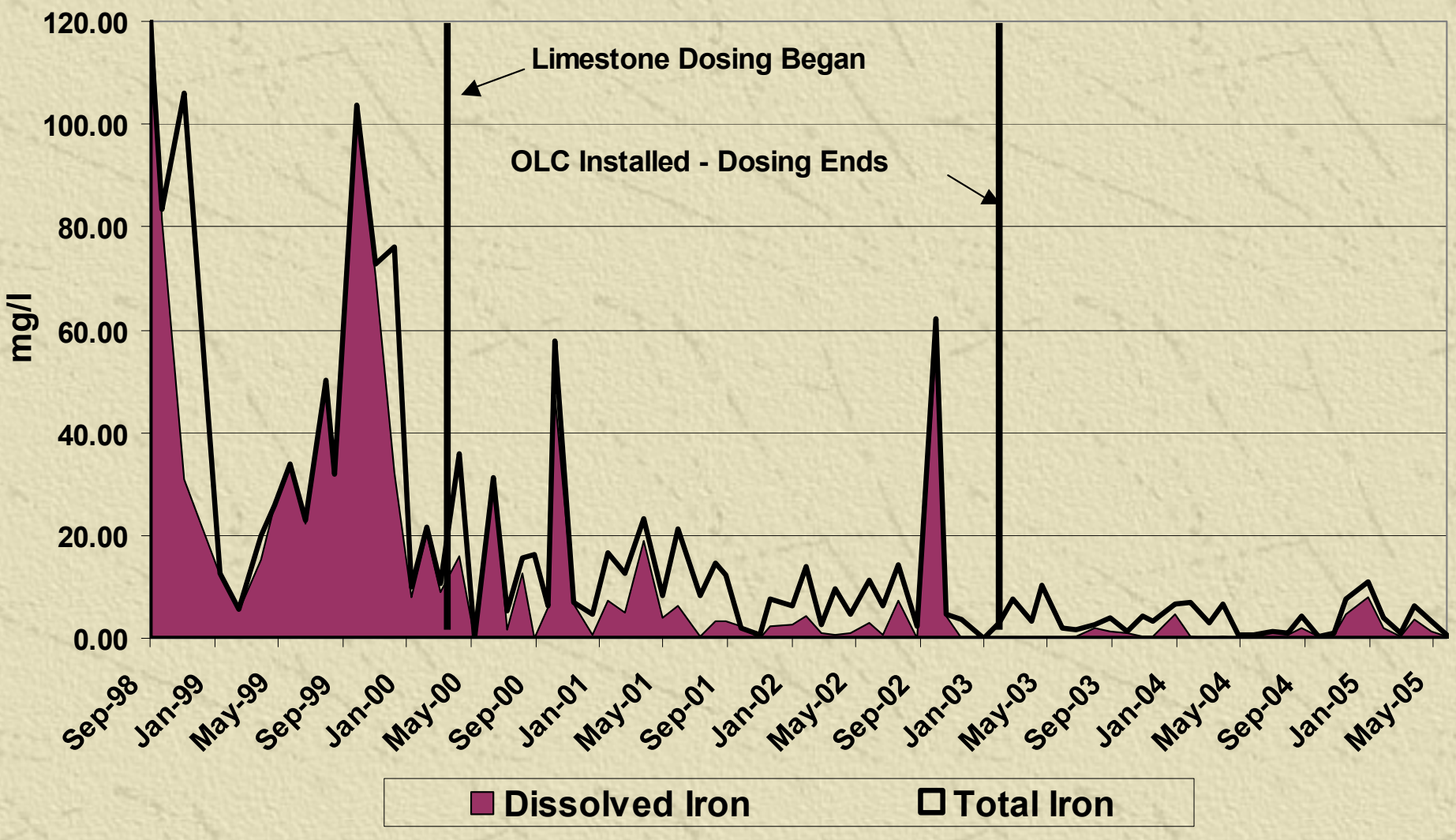
Jones Branch Acid Load reduced 48%



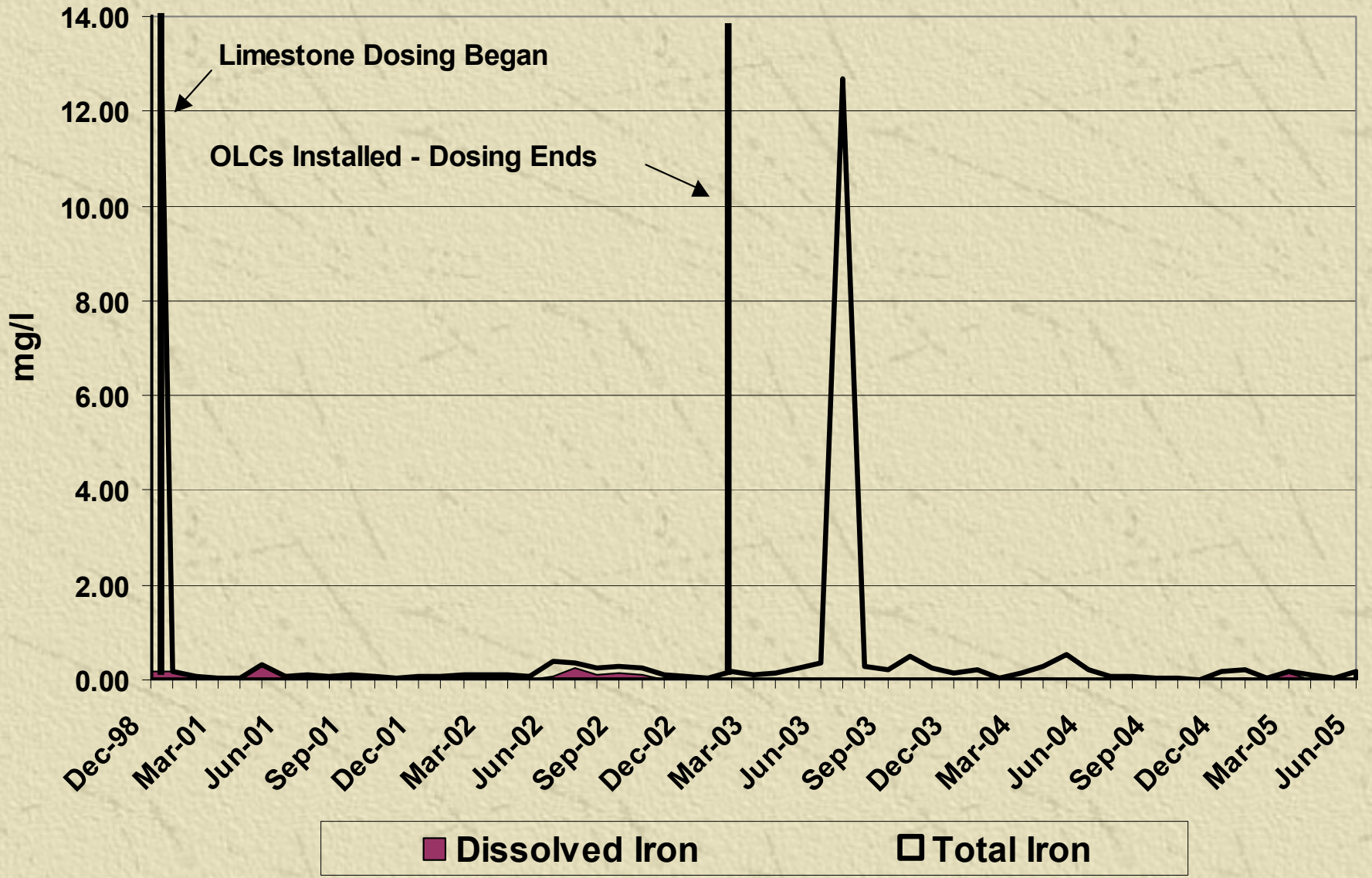
Jones Branch Spring Acid Load



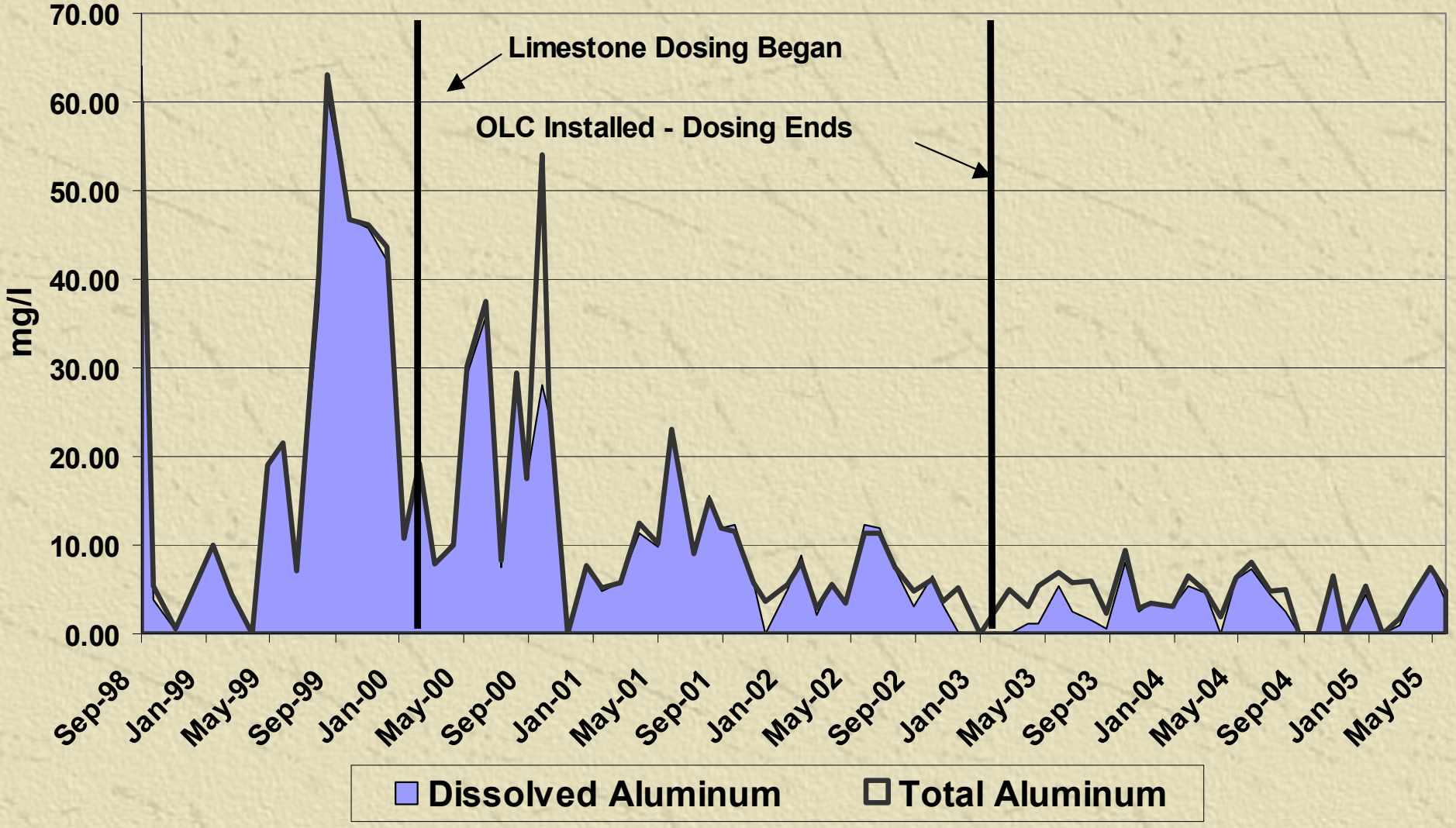
Jones Branch Iron Concentration



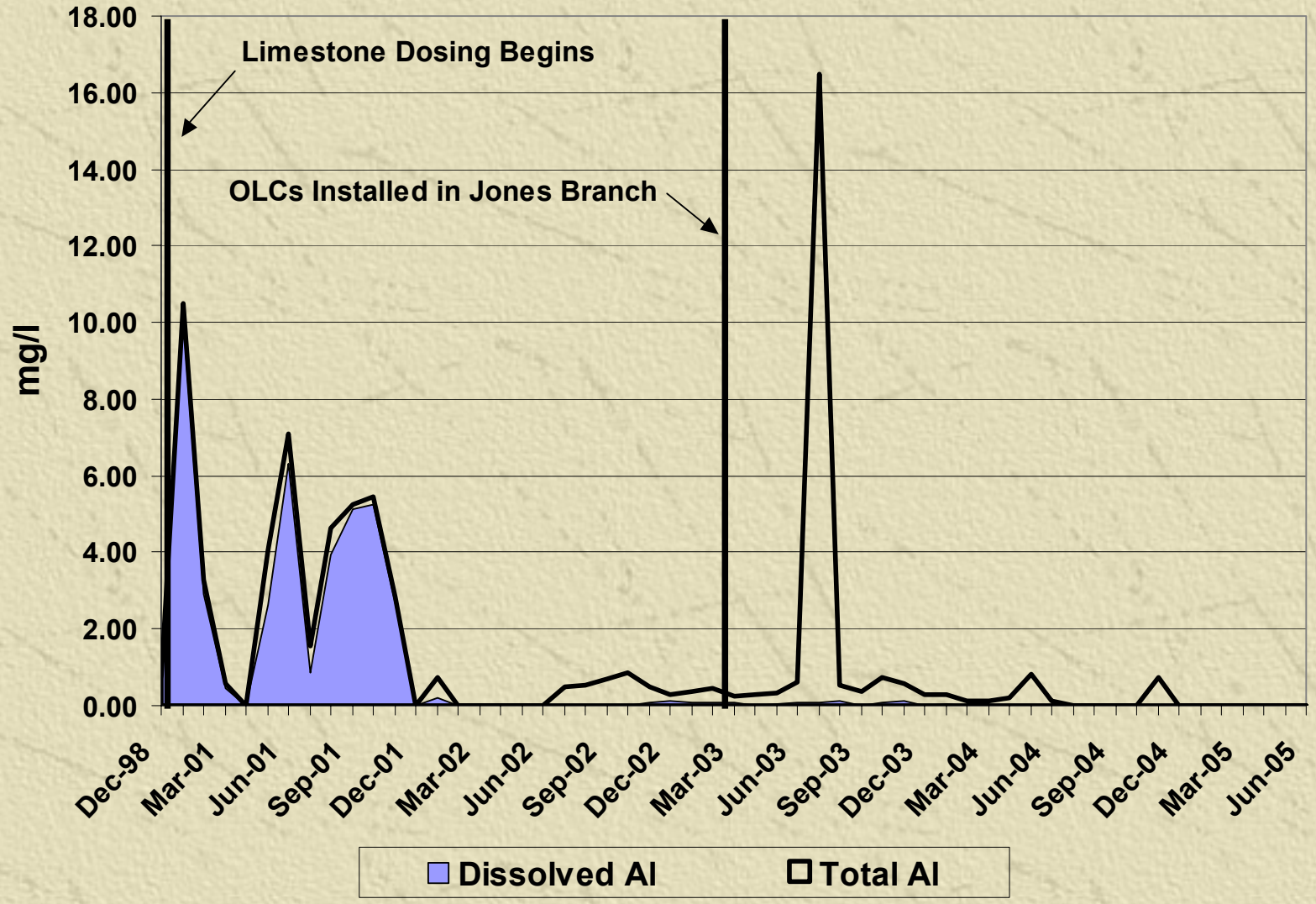
Jones Br. Spring Iron Concentrations



Jones Br. Aluminum Concentrations



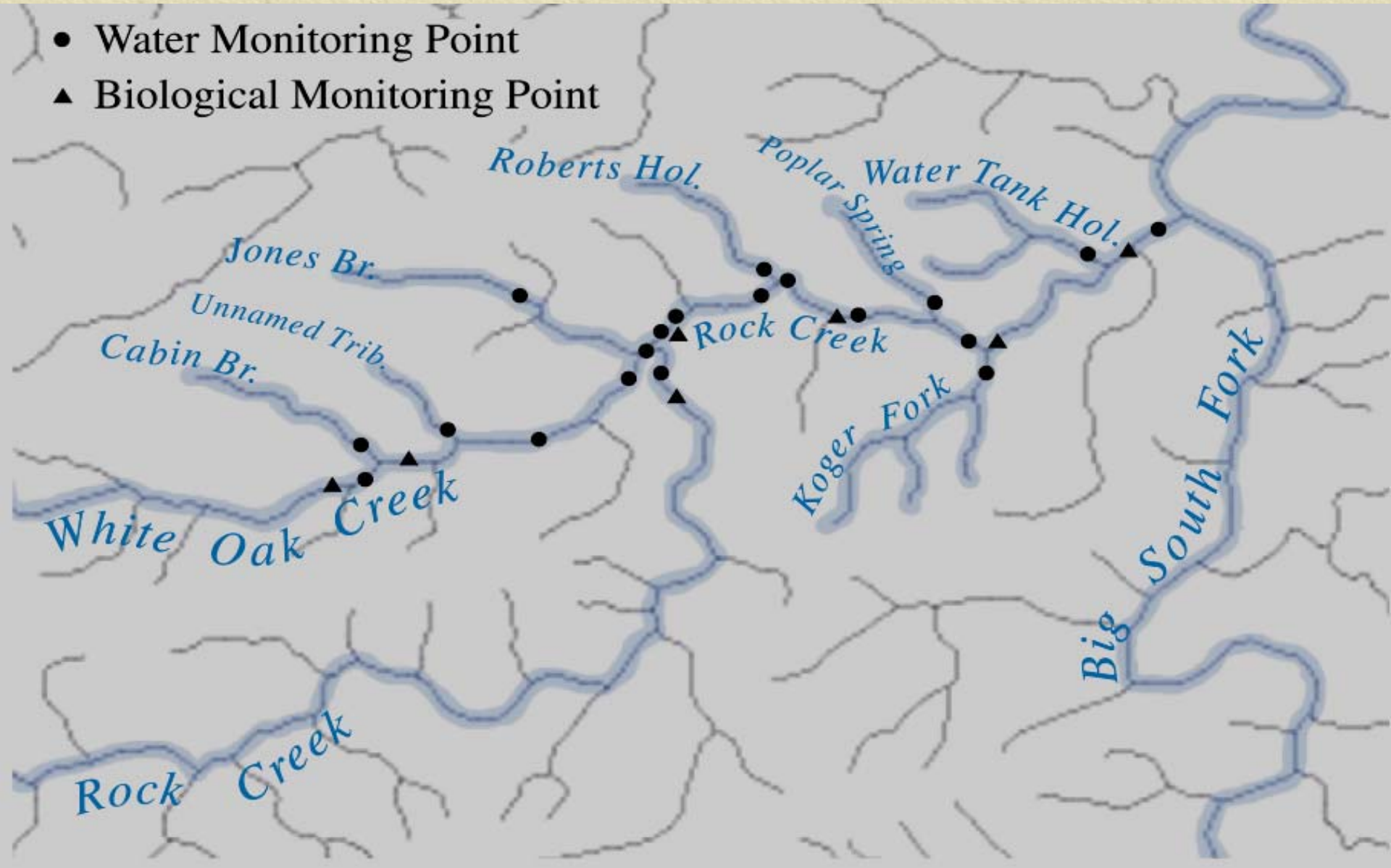
Jones Br. Spring Aluminum Conc.



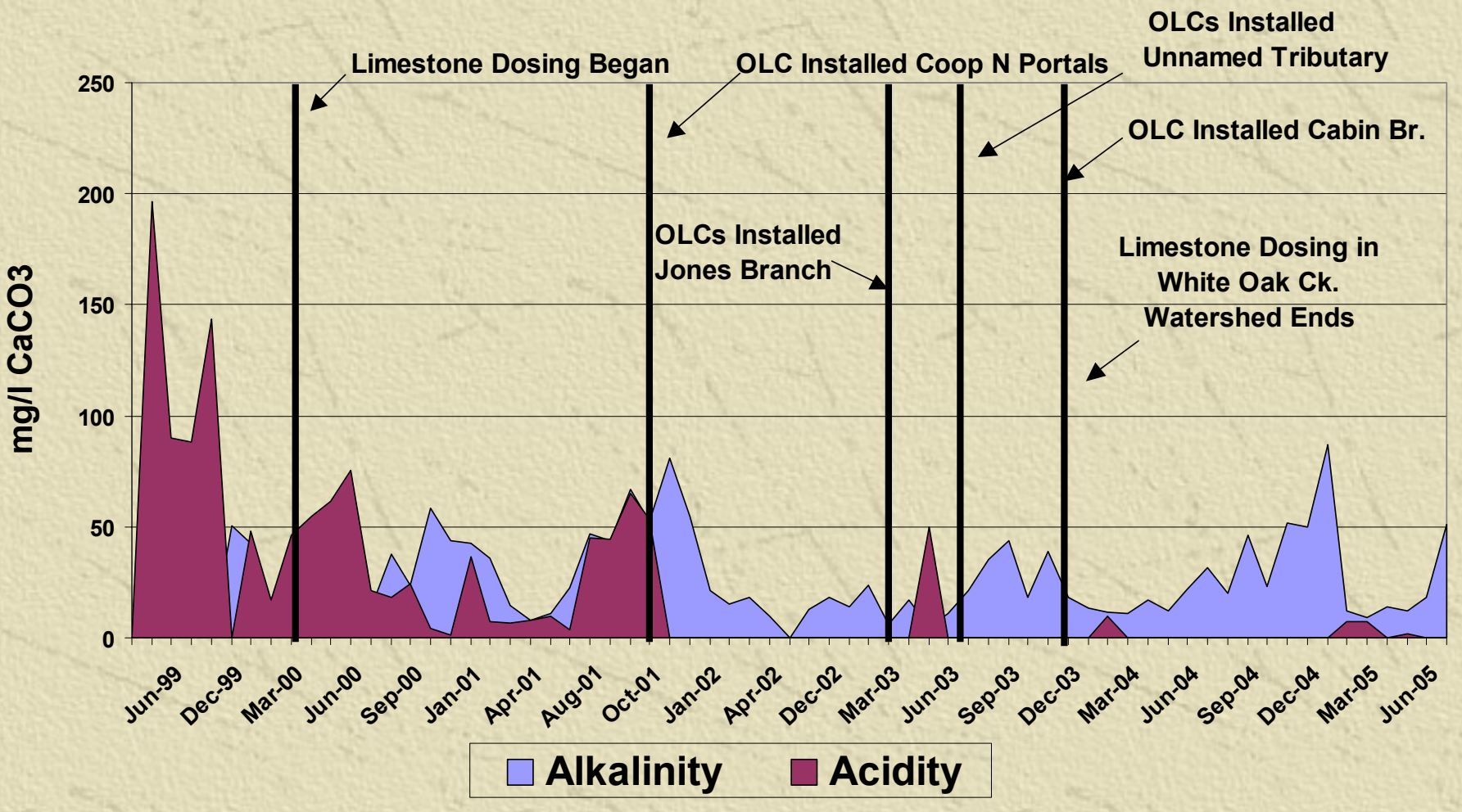
Open Limestone Channels Installed In White Oak Ck. Watershed

Cabin Branch	4000	feet
Unnamed Trib.	2000	feet
Coop North Portal	500	feet
Jones Branch	8000	feet

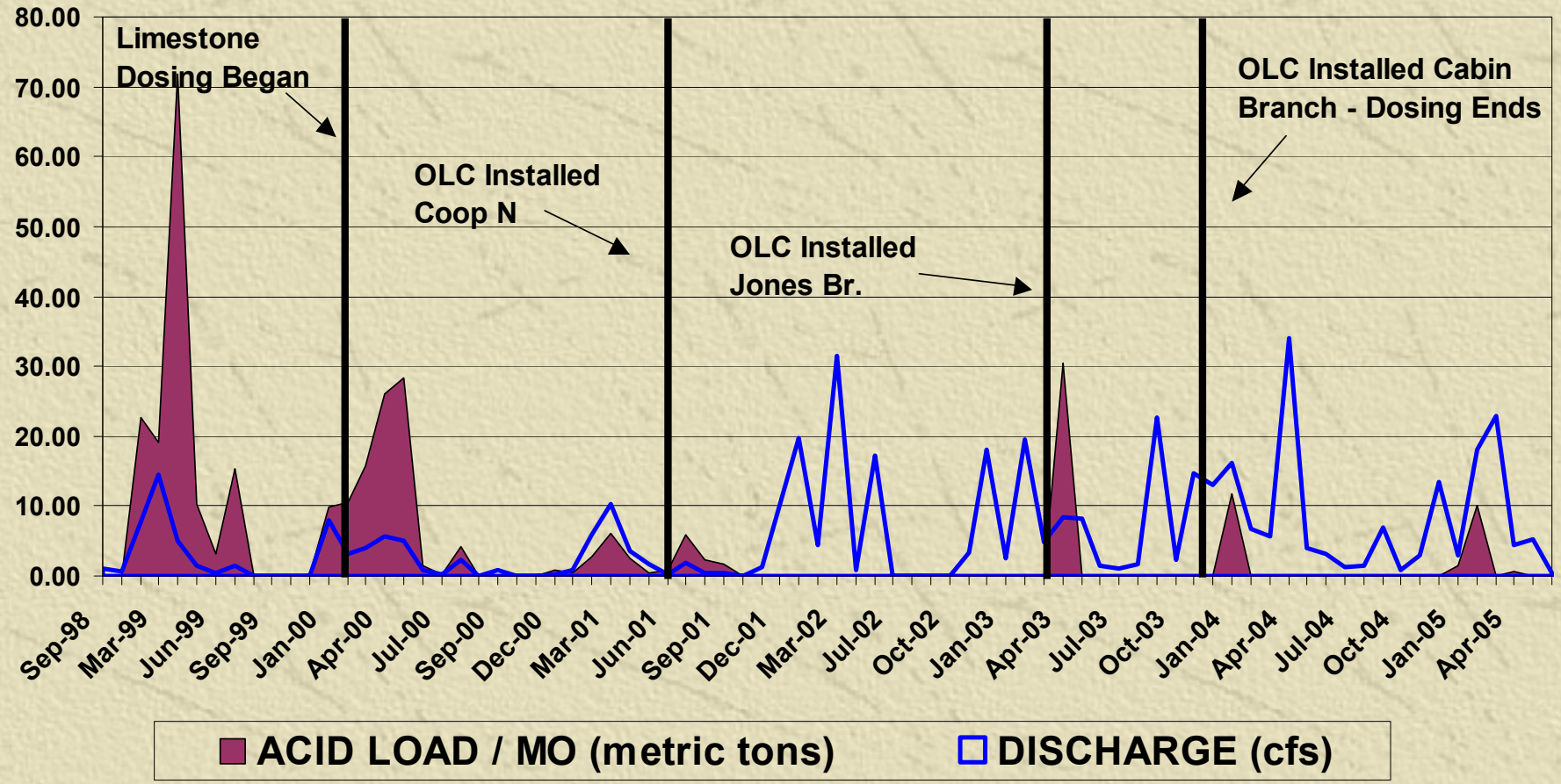
Monitoring Points



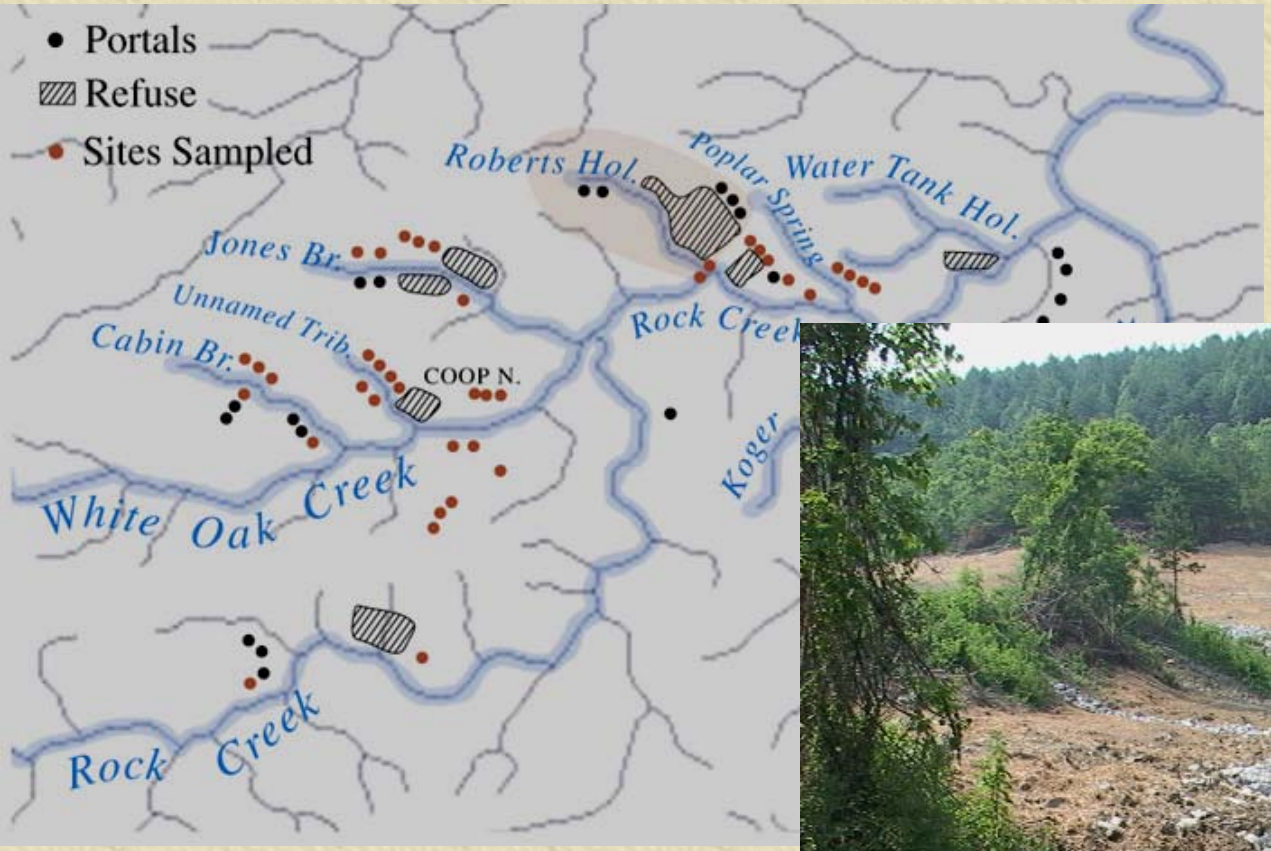
White Oak Creek Mouth Acidity reduced 95%



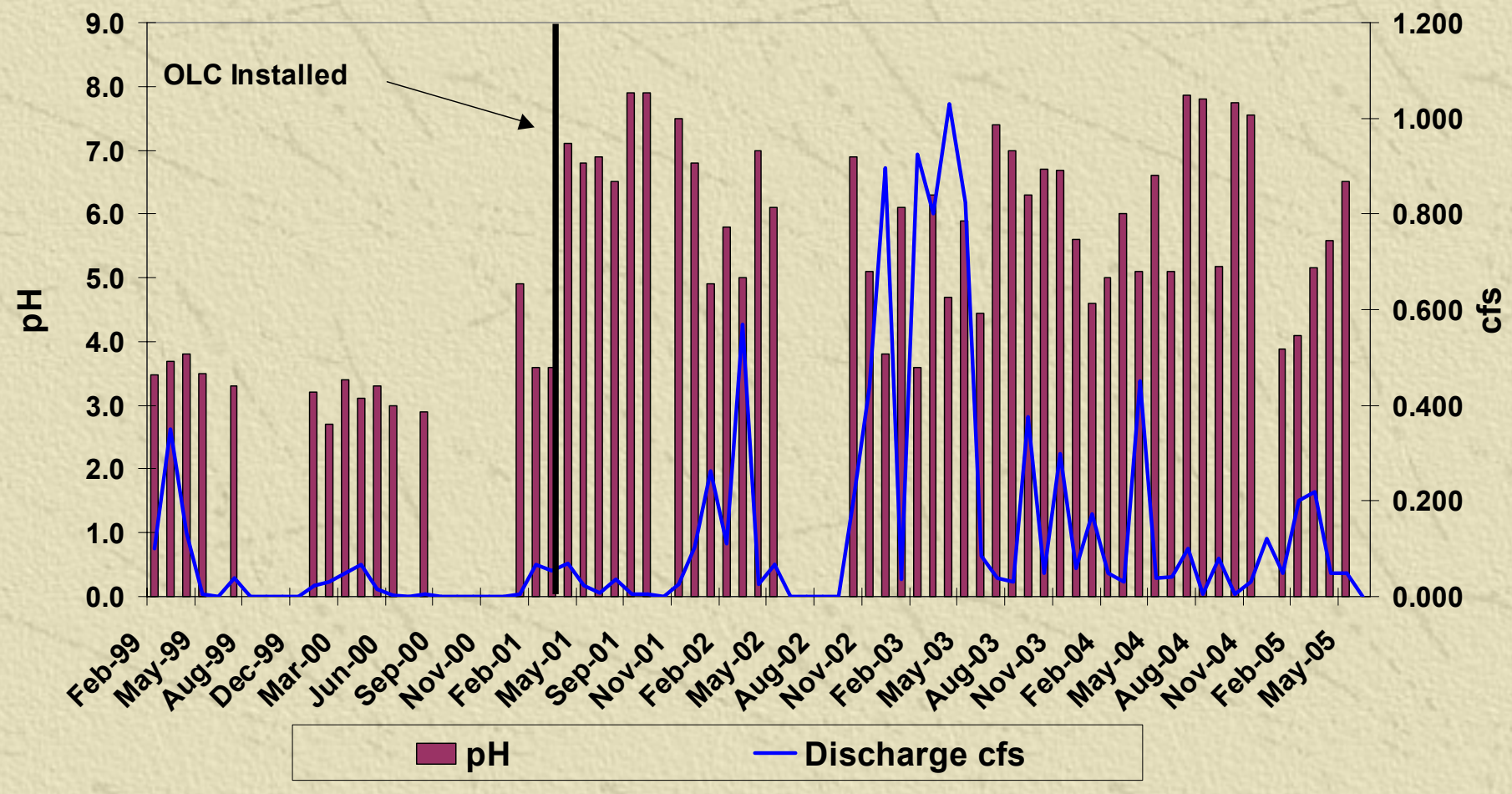
White Oak Ck. Mouth Acid Load reduced 86%



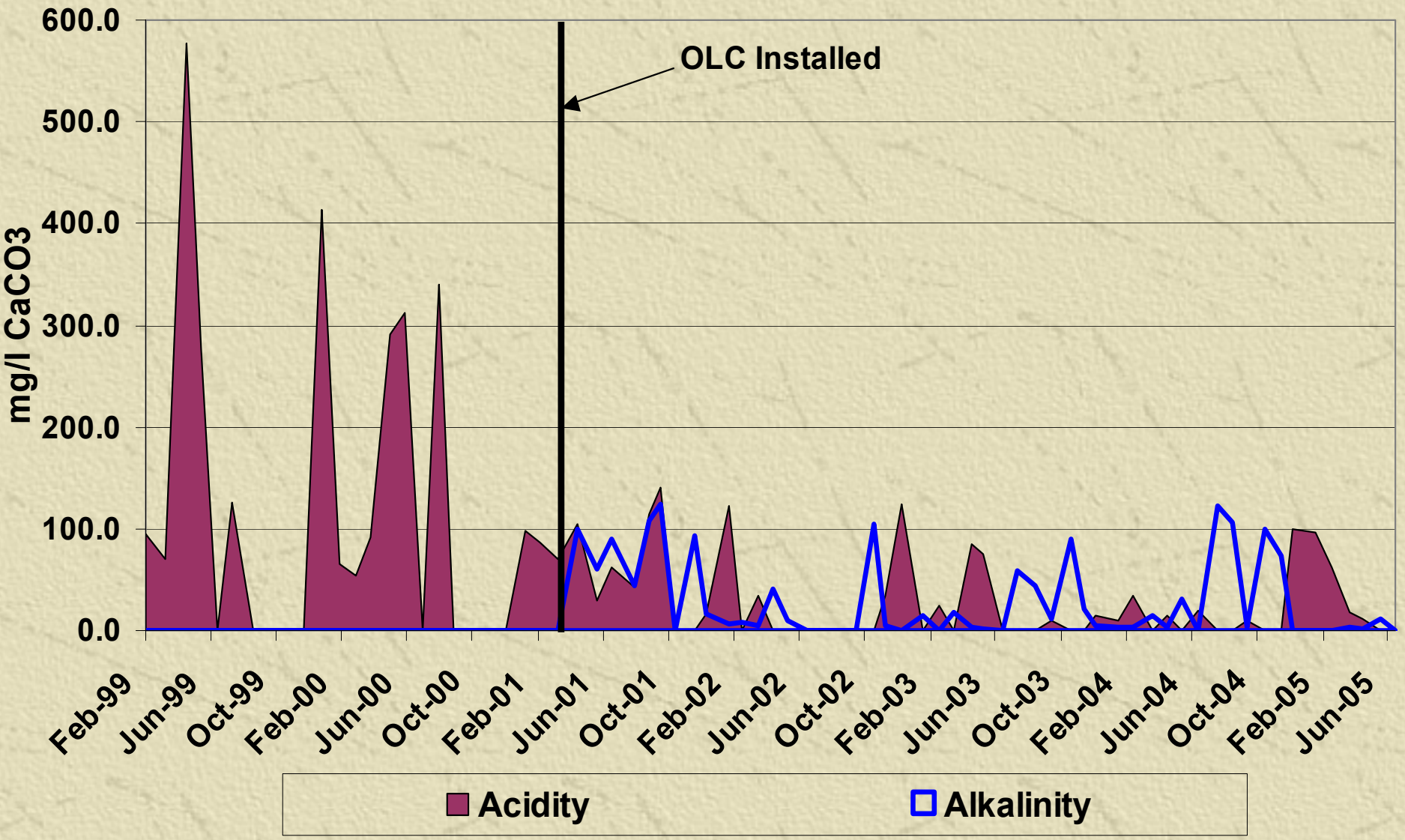
Tributary at Roberts Hollow



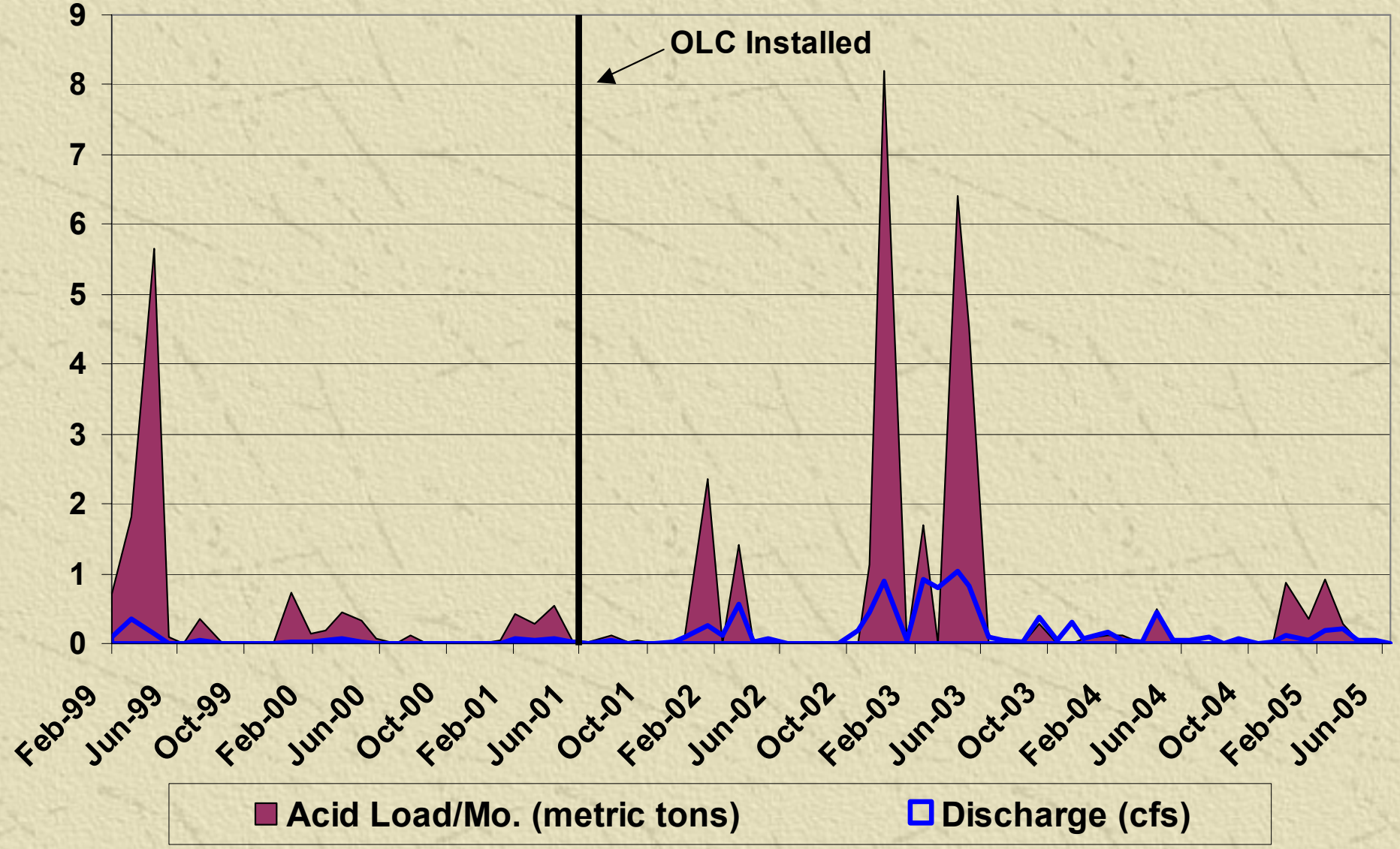
Tributary At Roberts Hollow median pH 6.1 after OLC



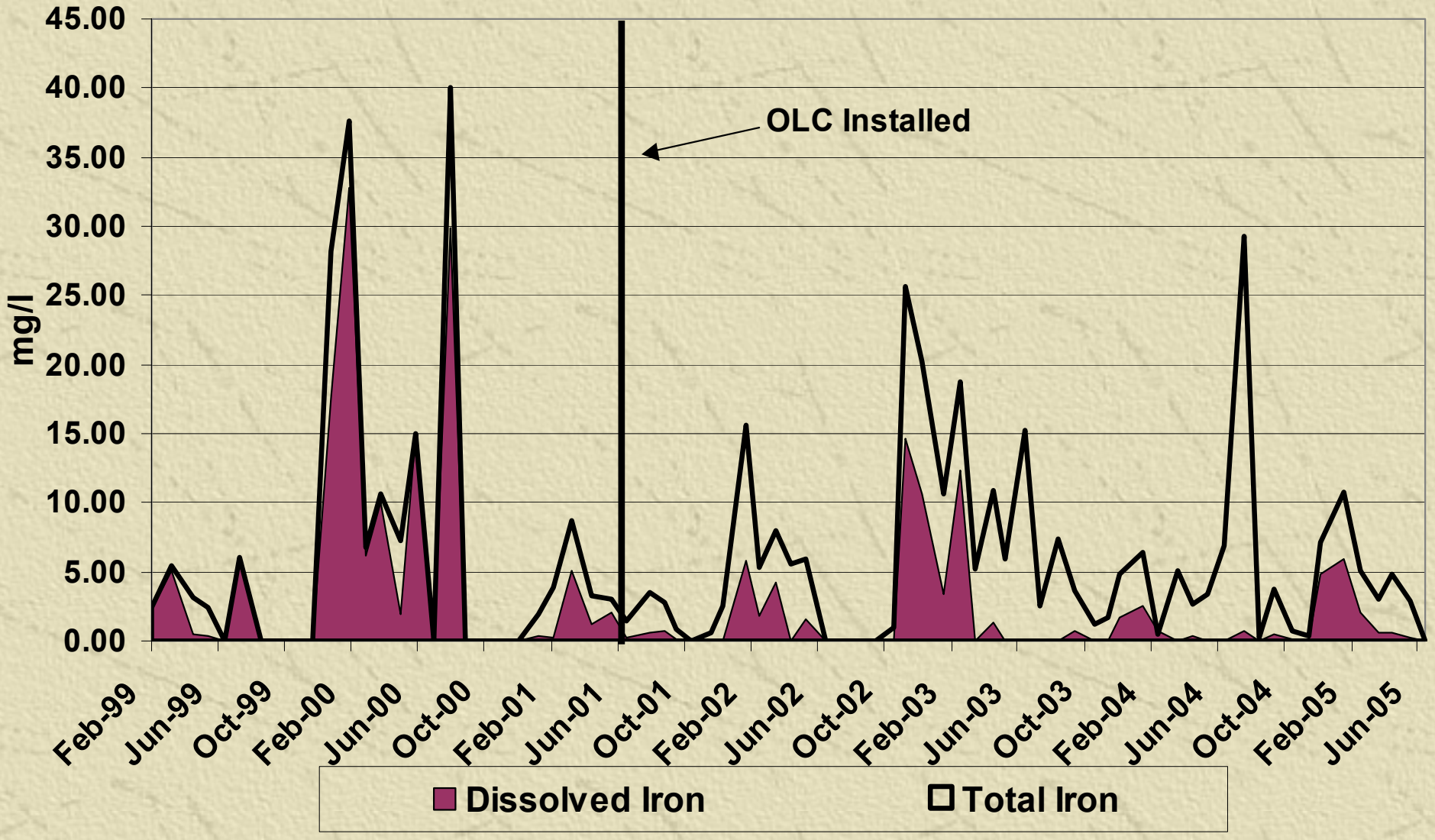
Trib. At Roberts Acidity reduced 89%



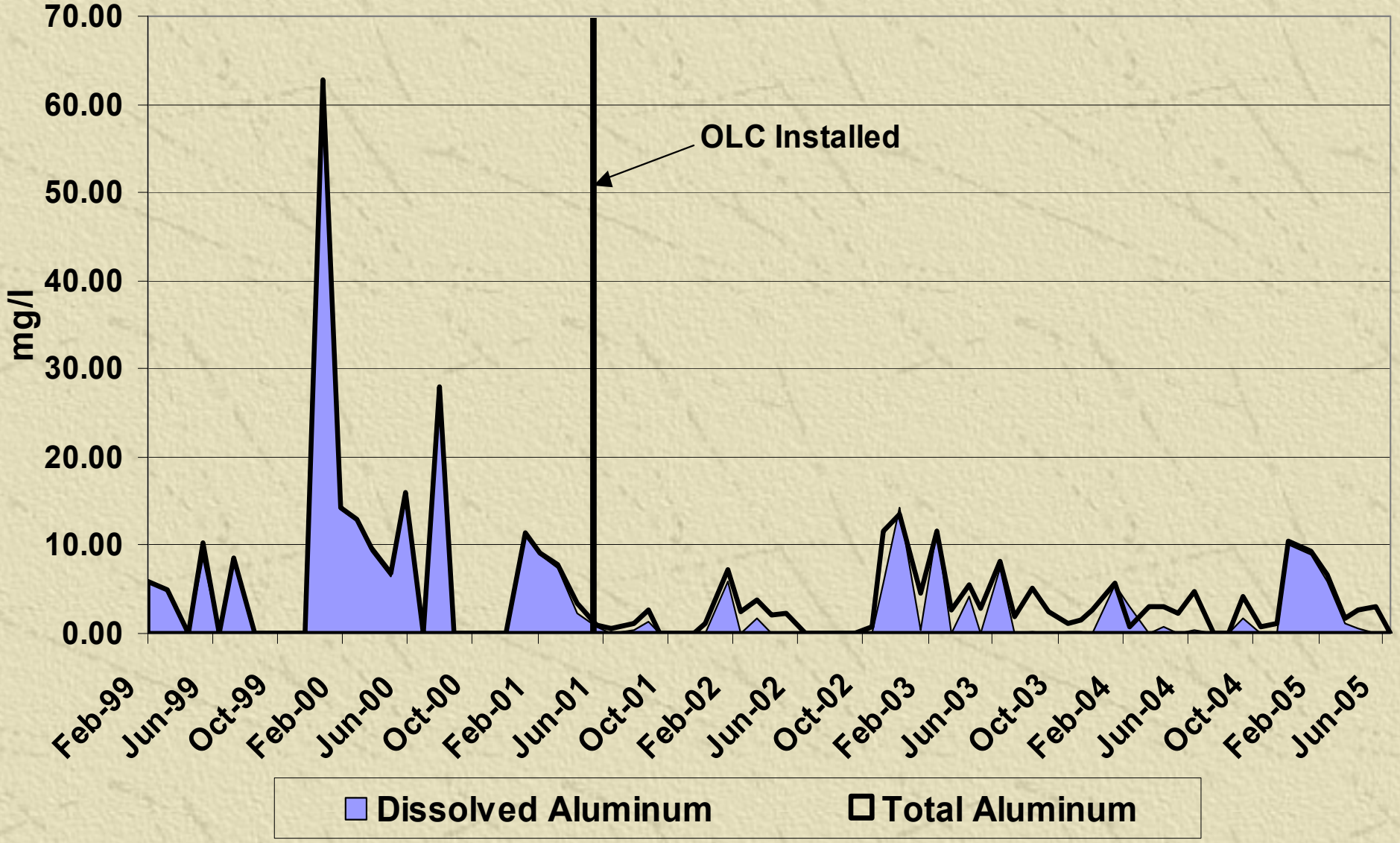
Trib. At Roberts Hollow Acid Load



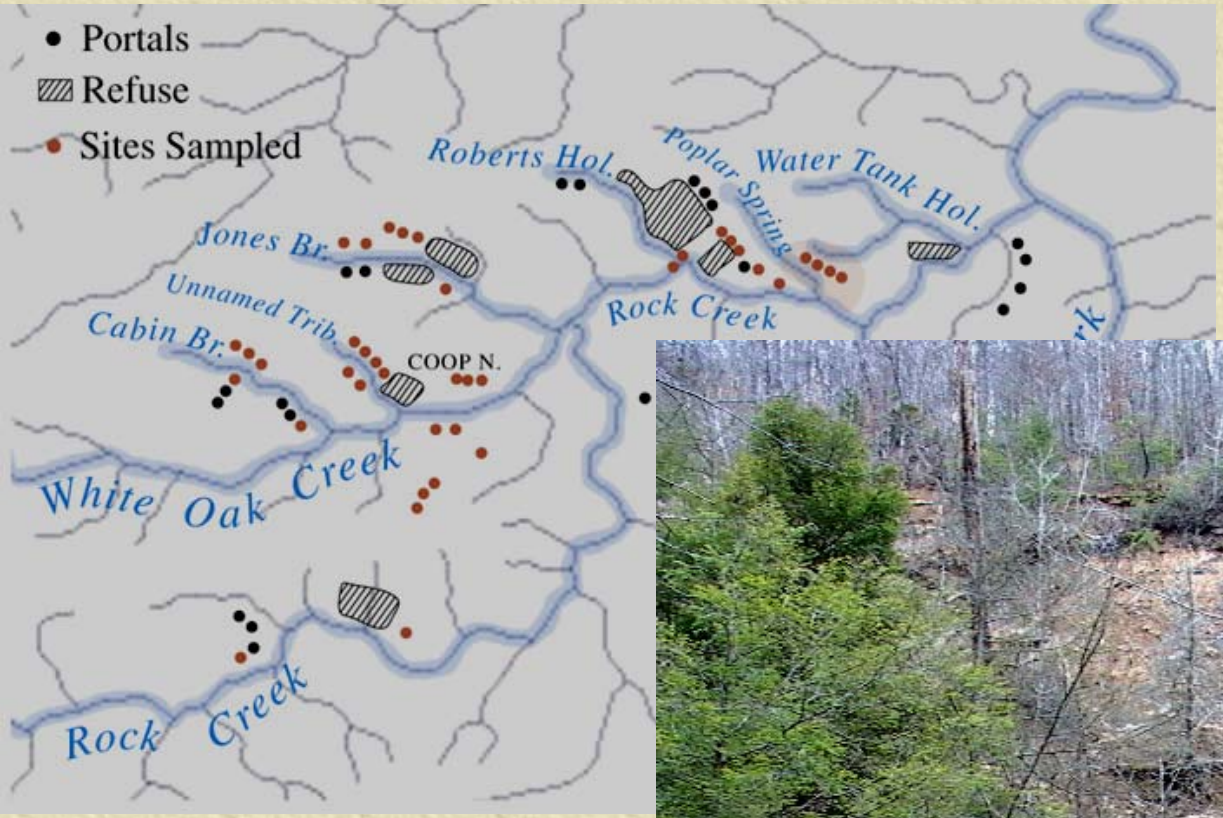
Trib. At Roberts Hollow Iron Conc.



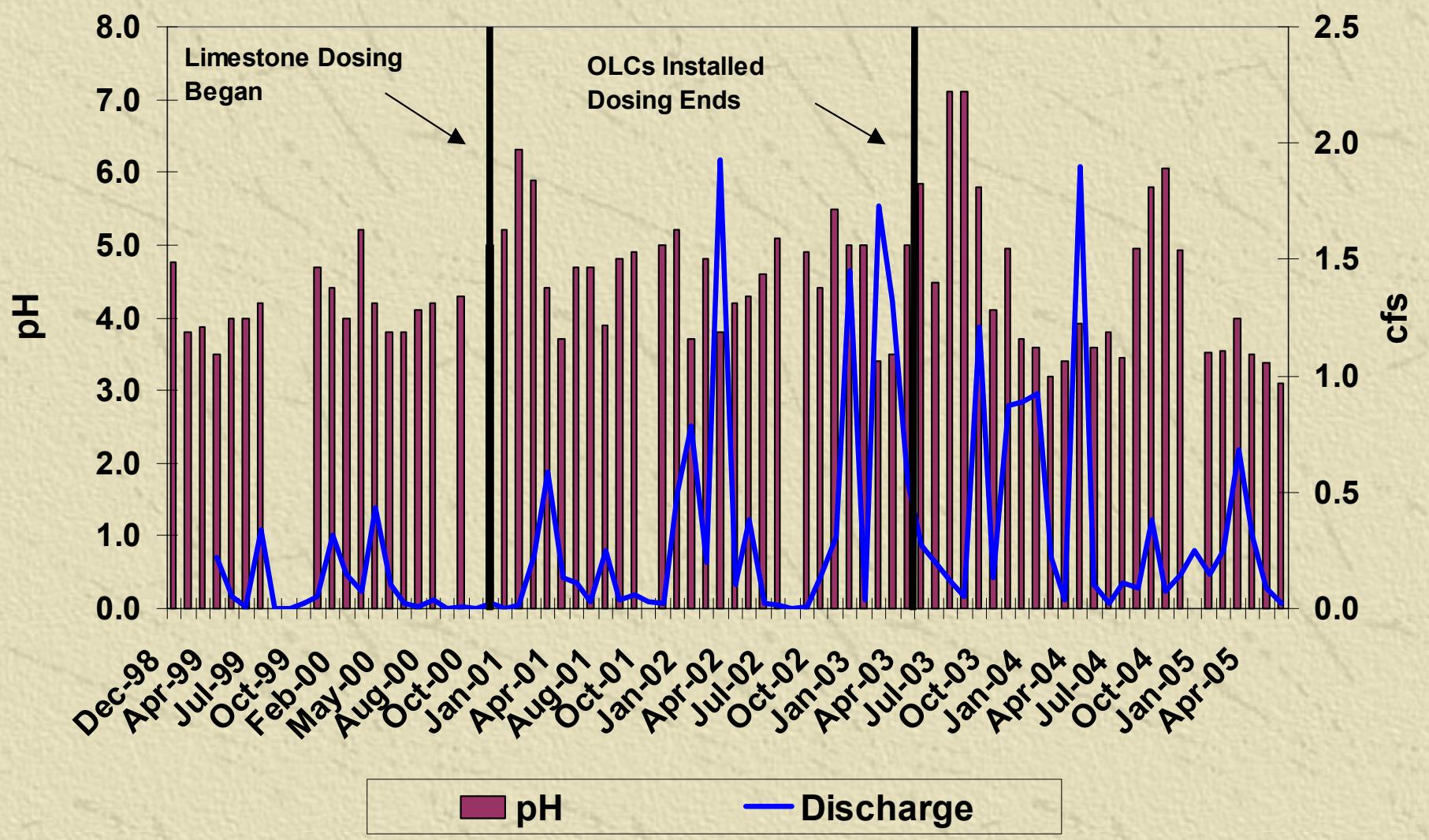
Trib. At Roberts Hollow Al. Conc.



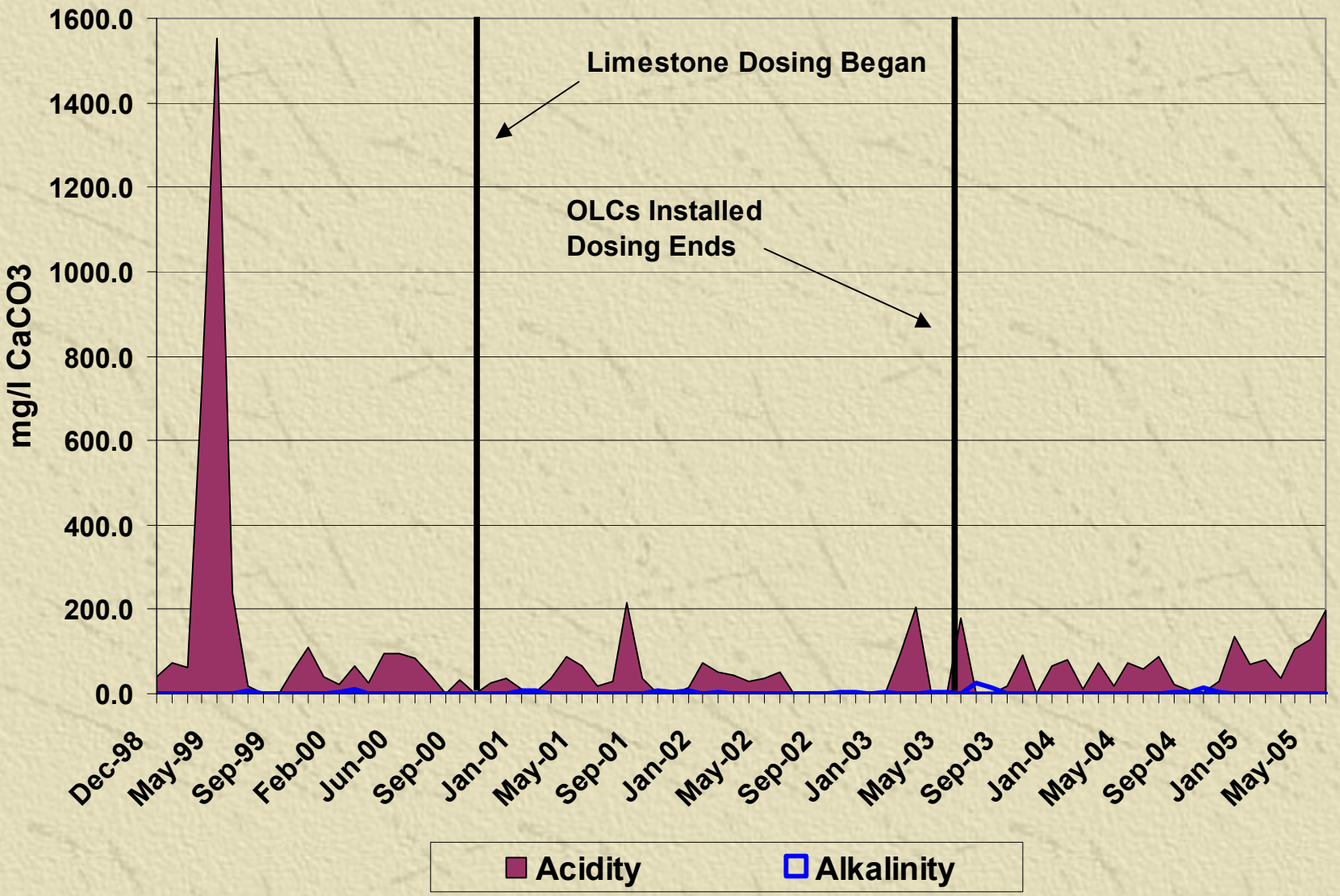
Poplar Spring Hollow Portals



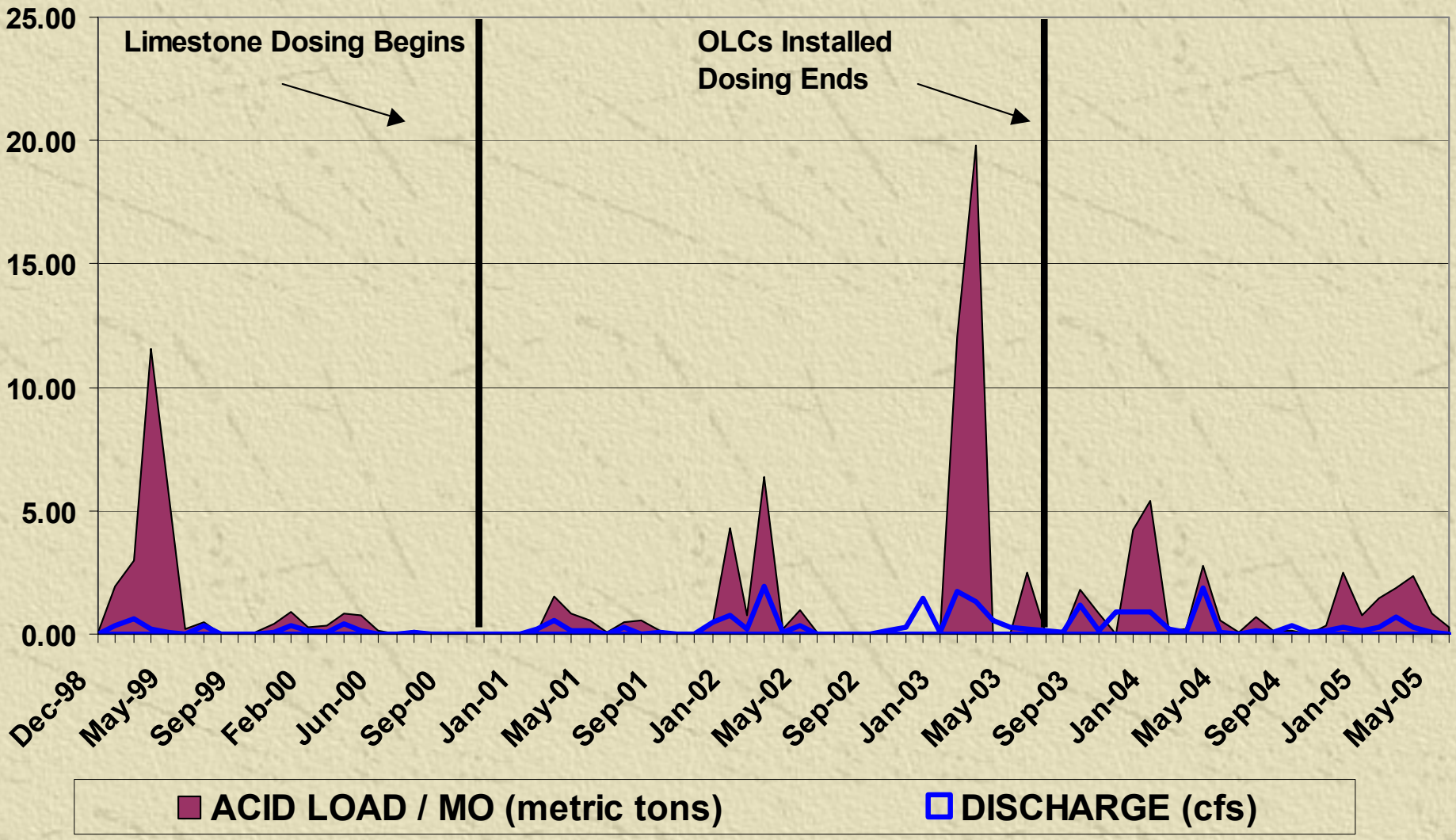
Poplar Spring Hollow
pH 3.1 to 7.1 after OLC



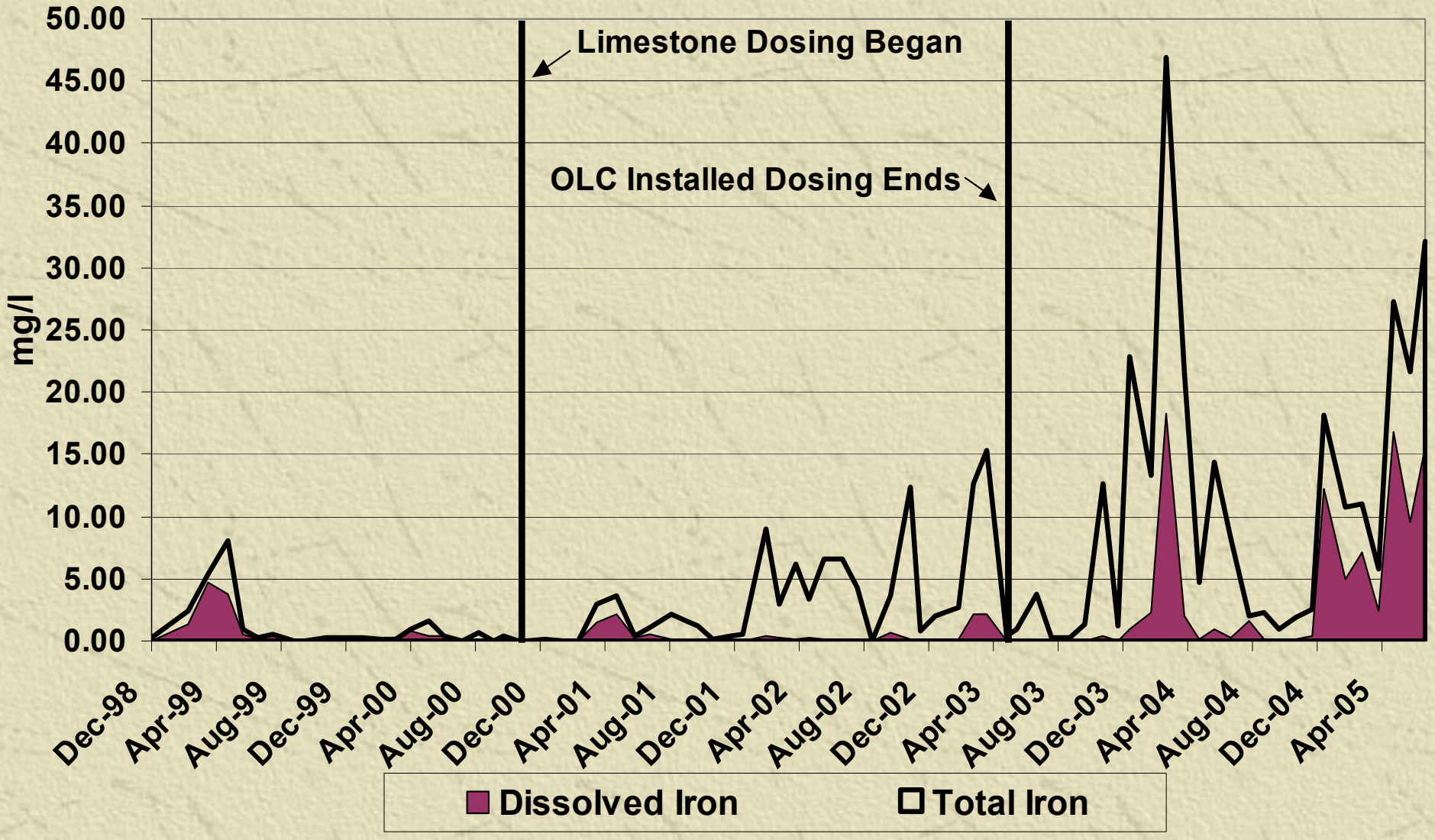
Poplar Spring Hollow Acidity



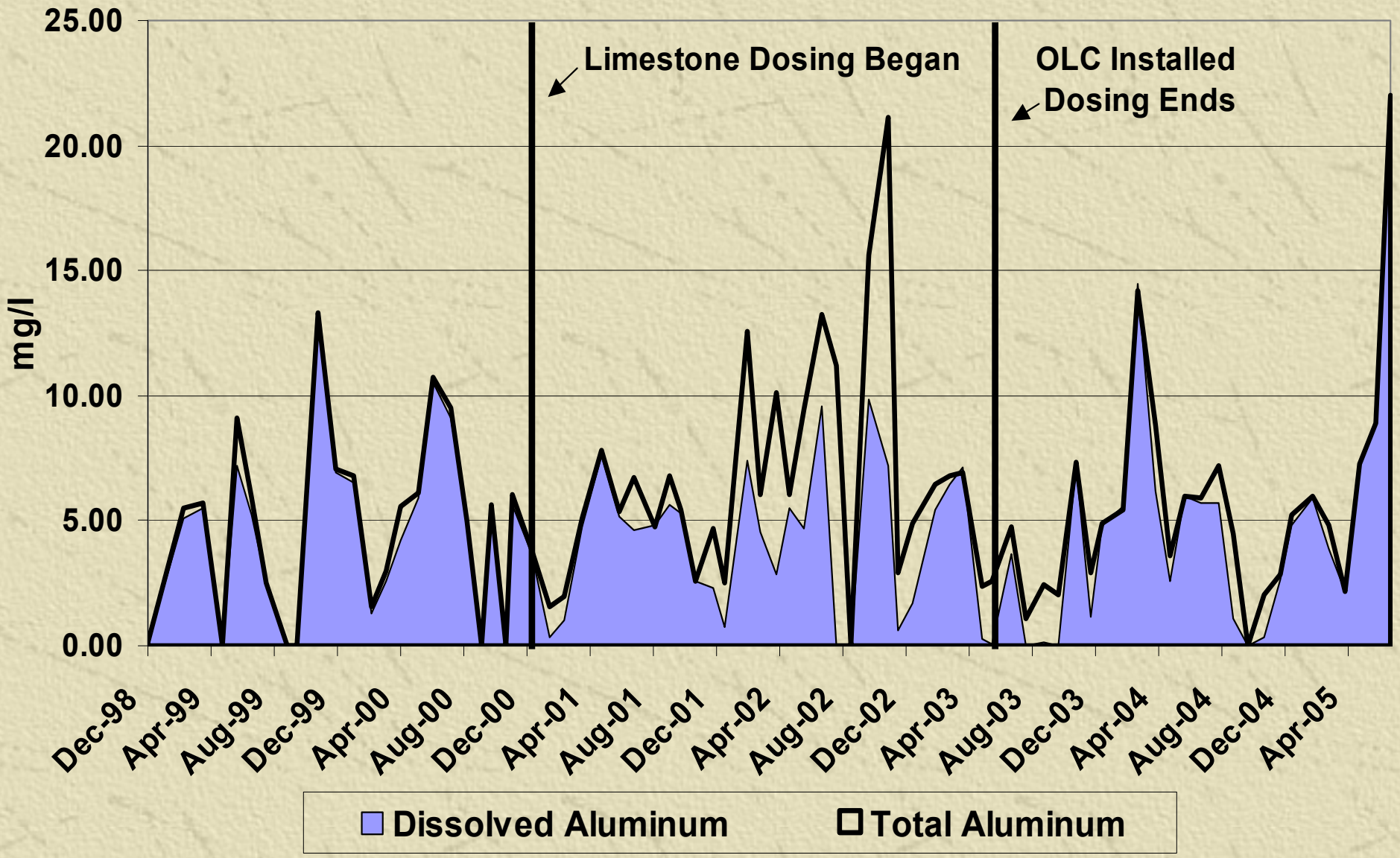
Poplar Spring Hollow Acid Load



Poplar Spring Hollow Iron Conc.



Poplar Spring Hollow Aluminum Conc.

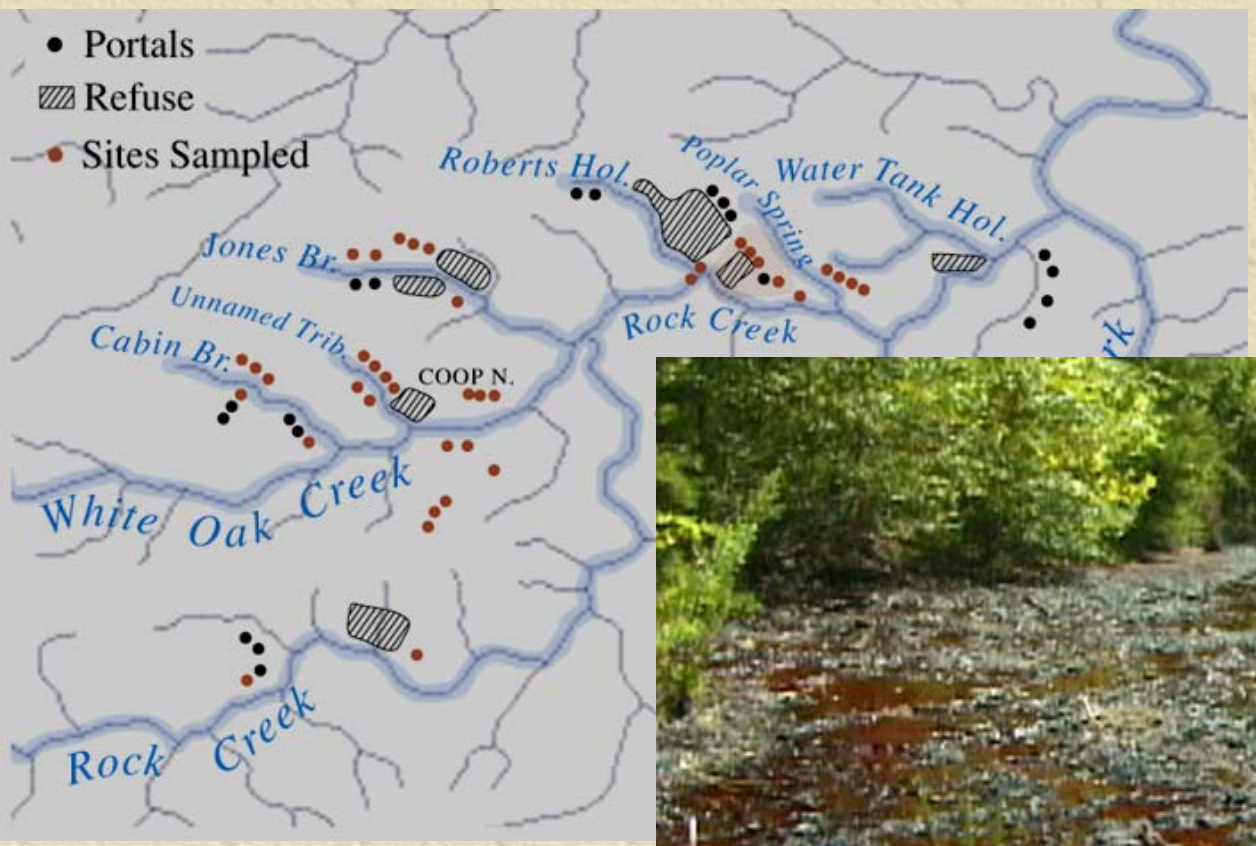


Portal Acidity > 1600 mg/l
Discharge Acidity 134 mg/l

Open Limestone Channels Installed Below White Oak Creek Watershed

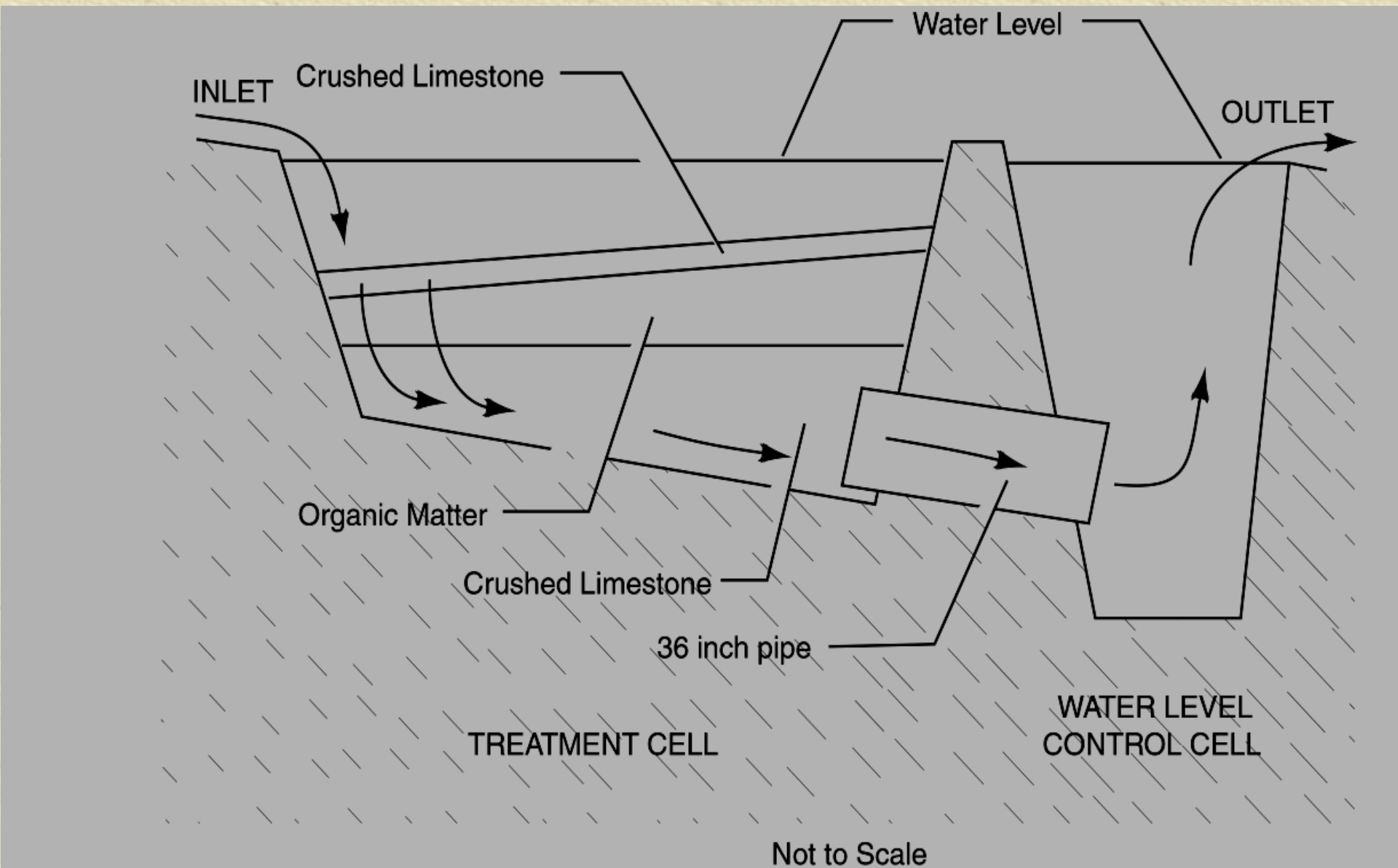
- Roberts Hollow 2500 feet
- Paint Cliff 2000 feet
- Poplar Spring 2500 feet
- Water Tank Hollow 800 feet

Paint Cliff Portals and Refuse



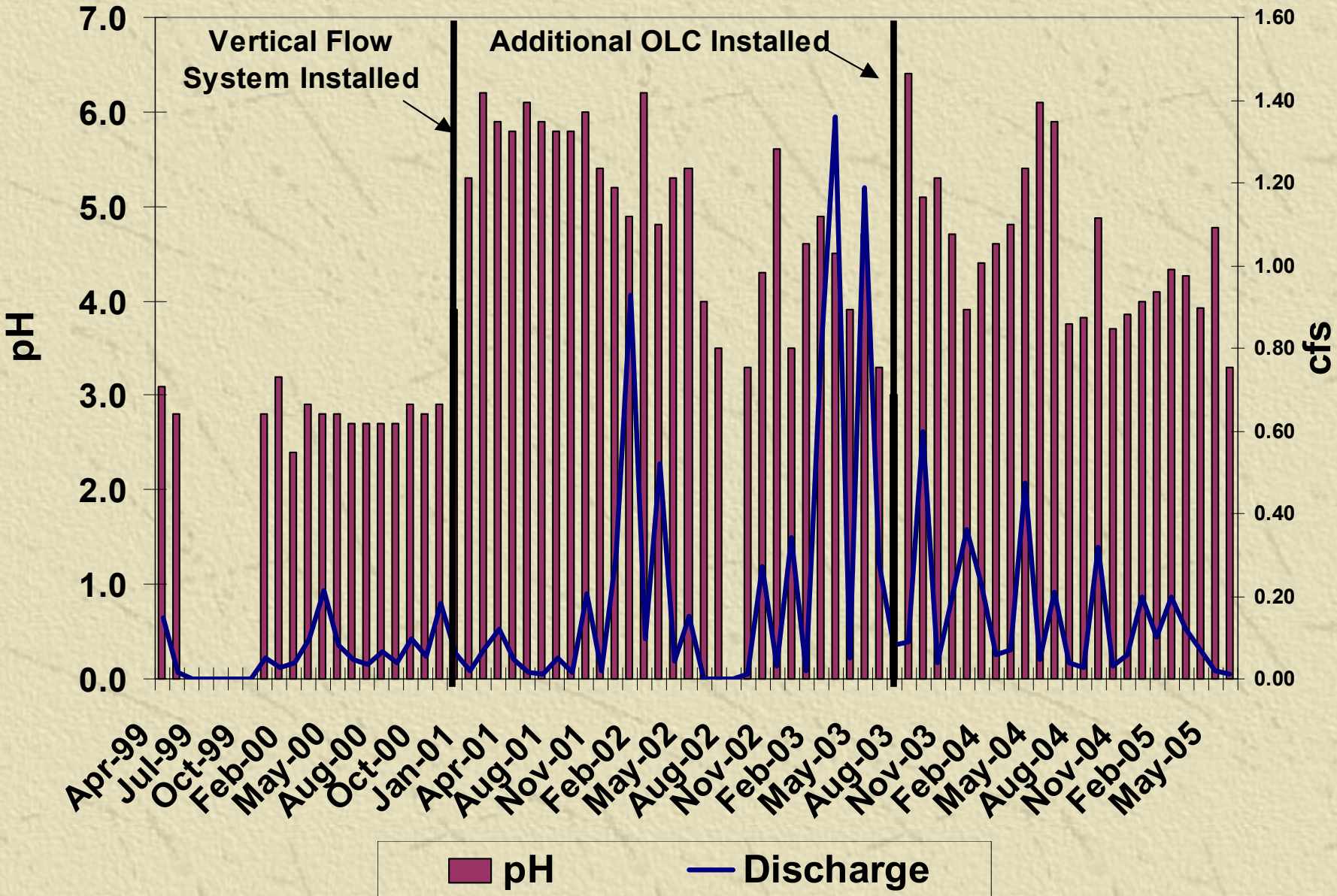
Acidity	350 to 1000	mg/l
Aluminum	10 to 80	mg/l
Iron	20 to 270	mg/l

Modified Vertical Flow System

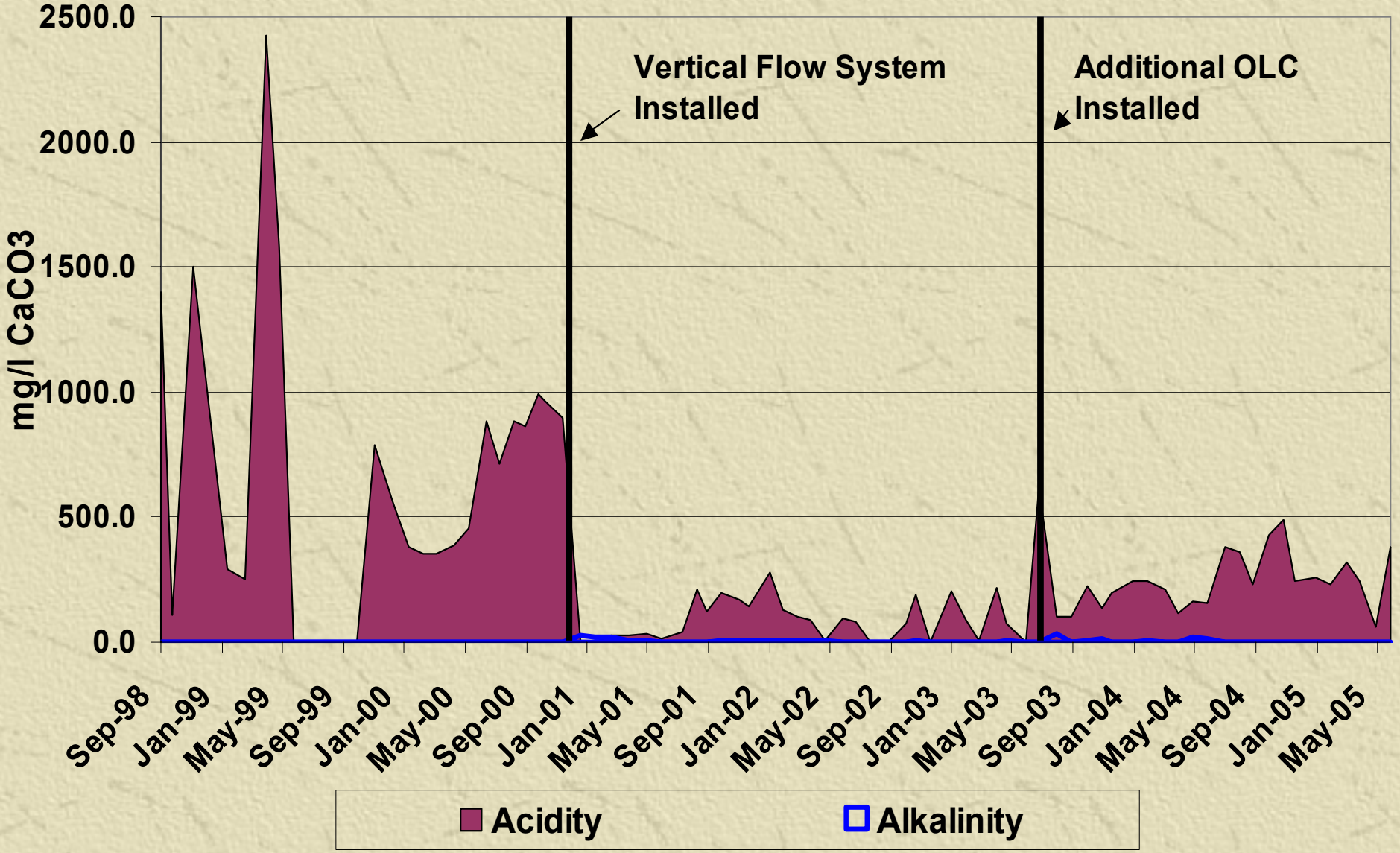


Open Limestone Channel
Water Level Control Cell
Treatment Cell
Sediment Basin
Open Limestone Channel

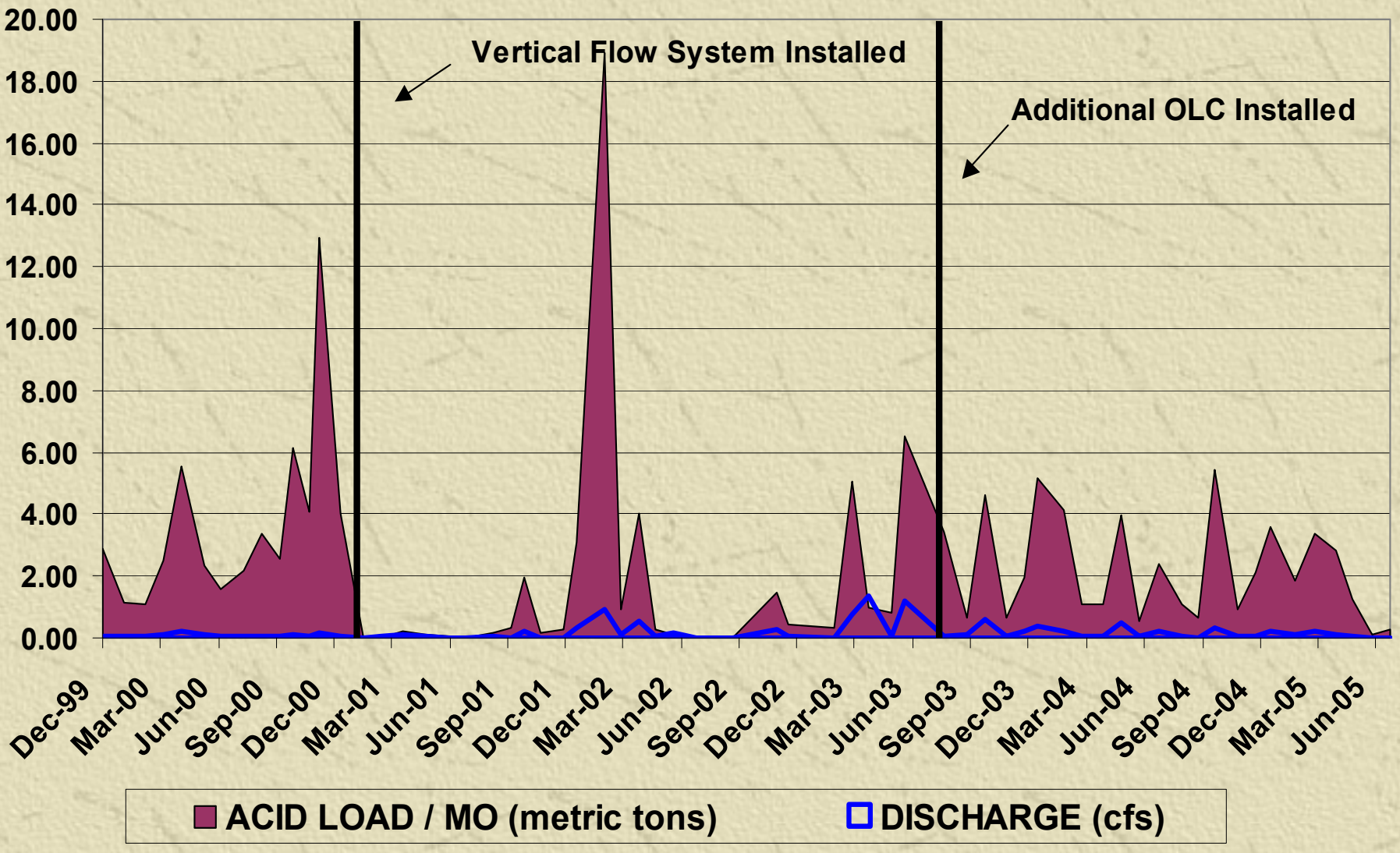
Paint Cliff median pH 4.3 after OLC



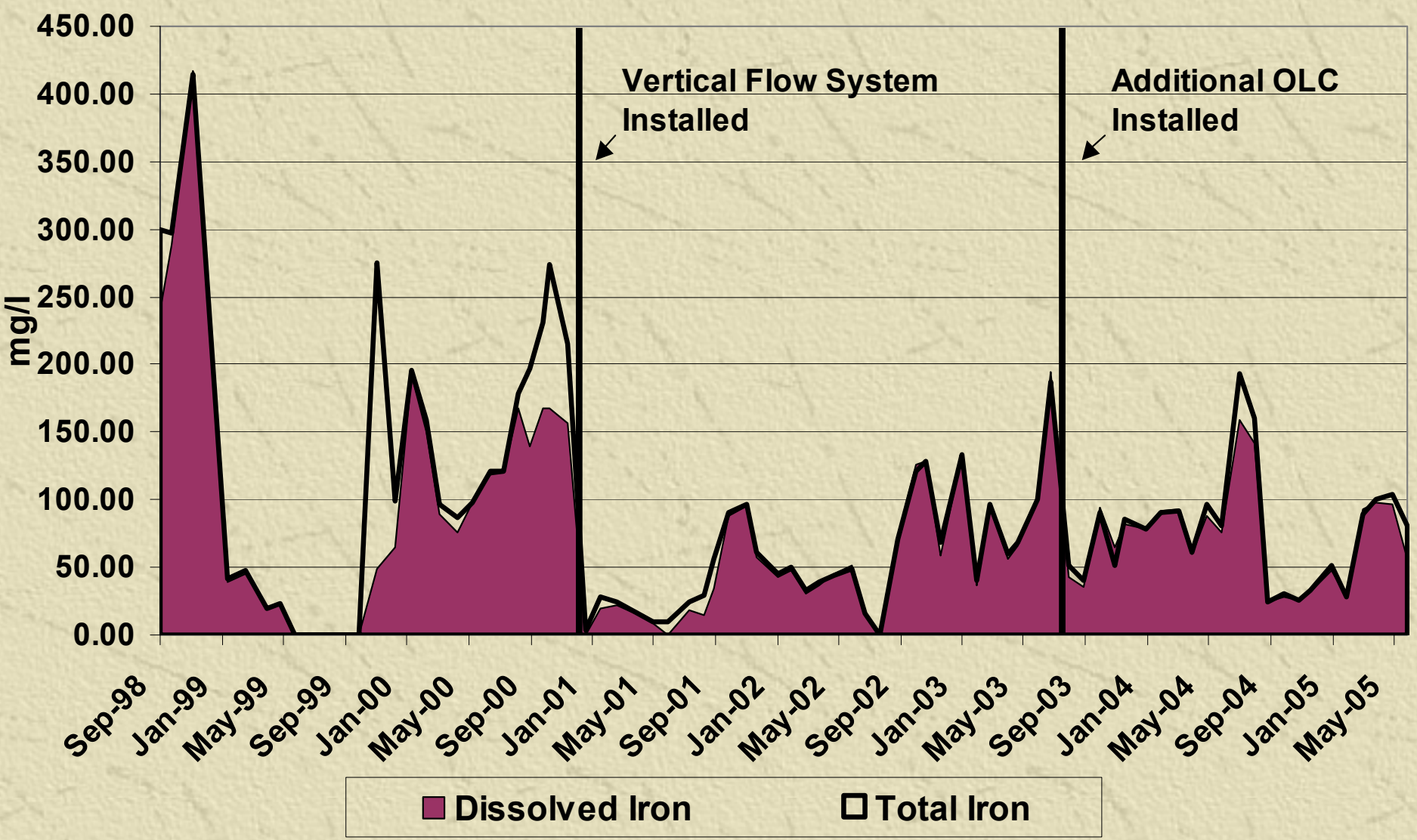
Paint Cliff Acidity reduced 71%



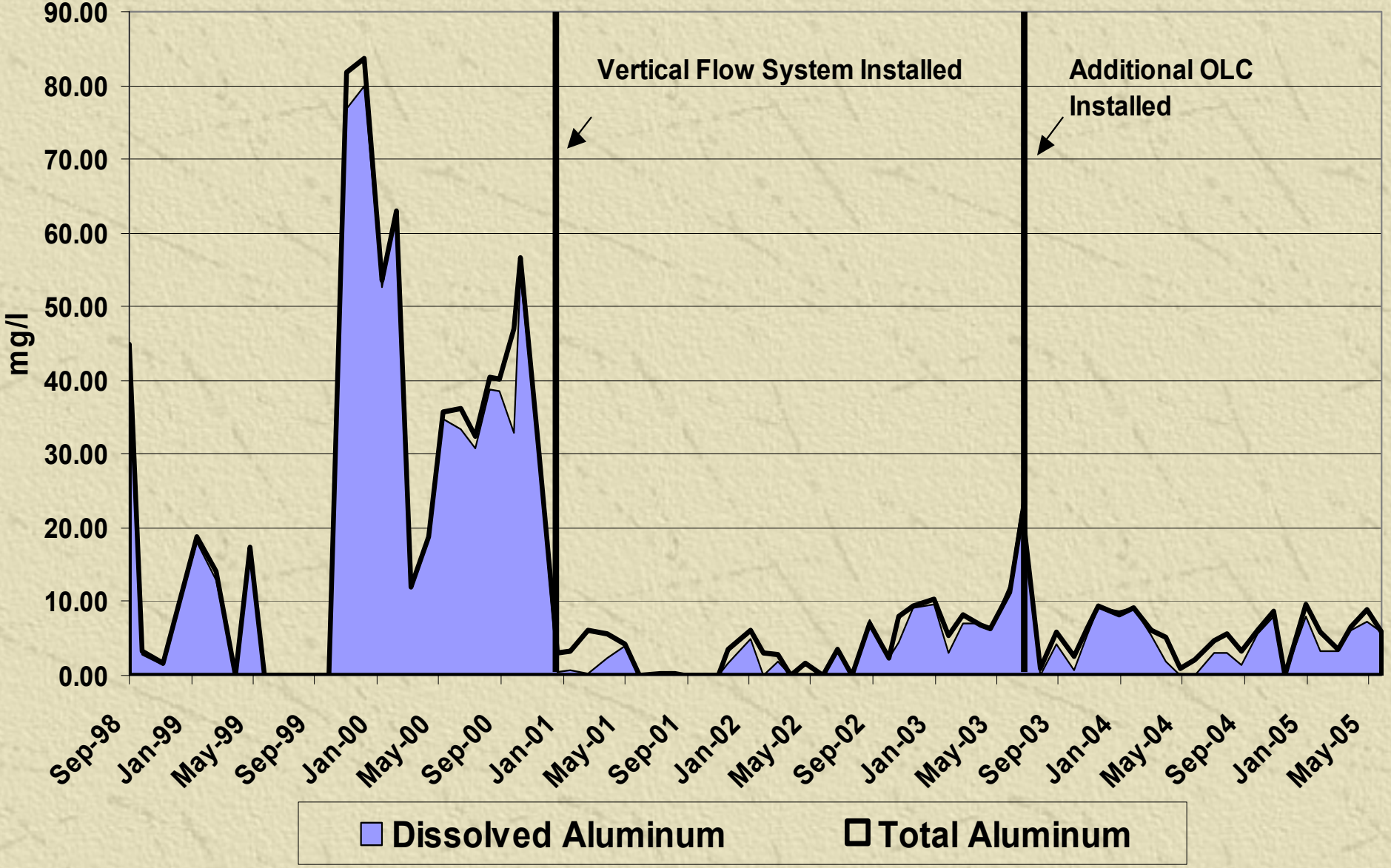
Paint Cliff Acid Load reduced 53%



Paint Cliff Iron Concentration

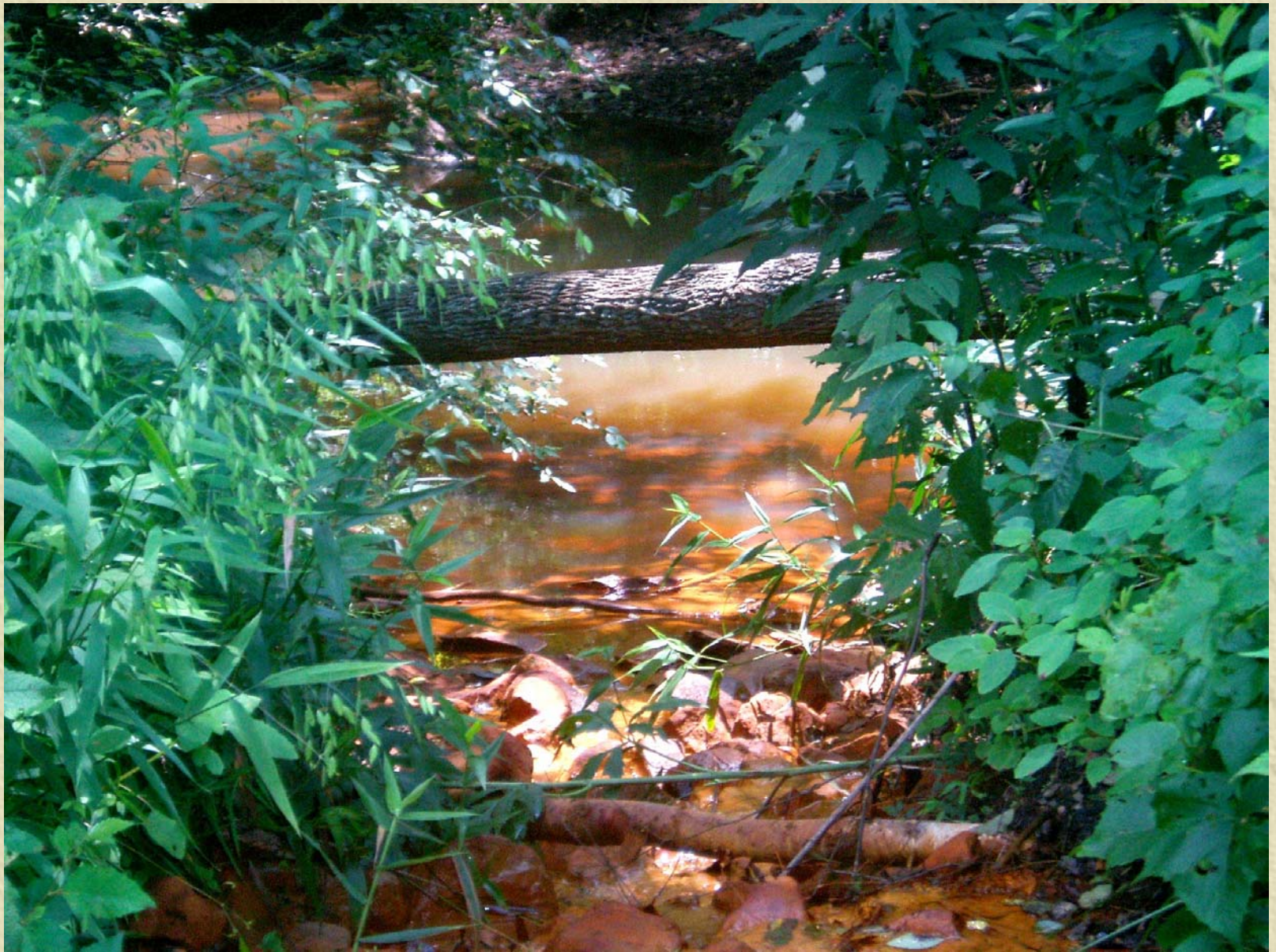


Paint Cliff Aluminum Concentration

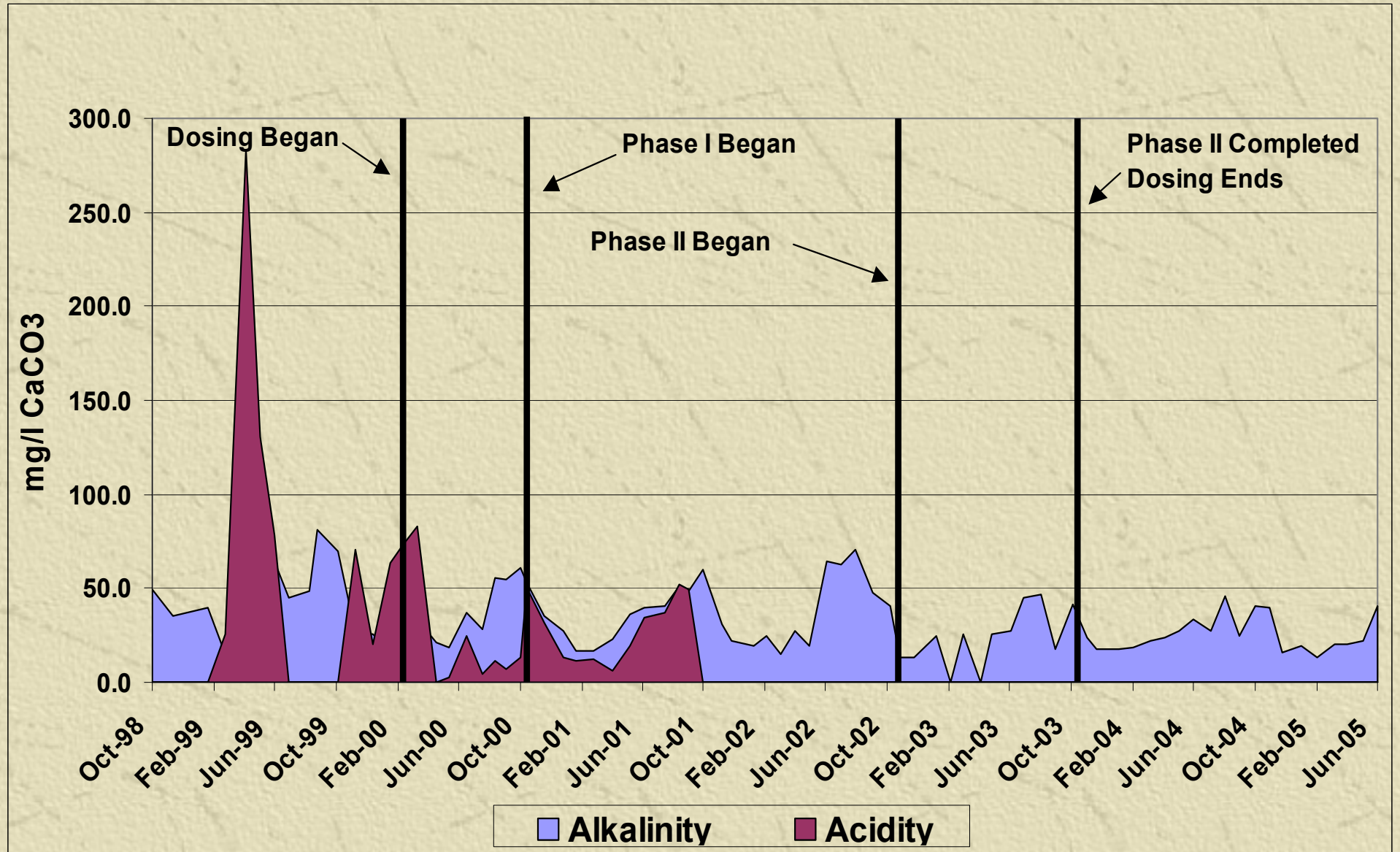


Inlet Acidity 1531 mg/l

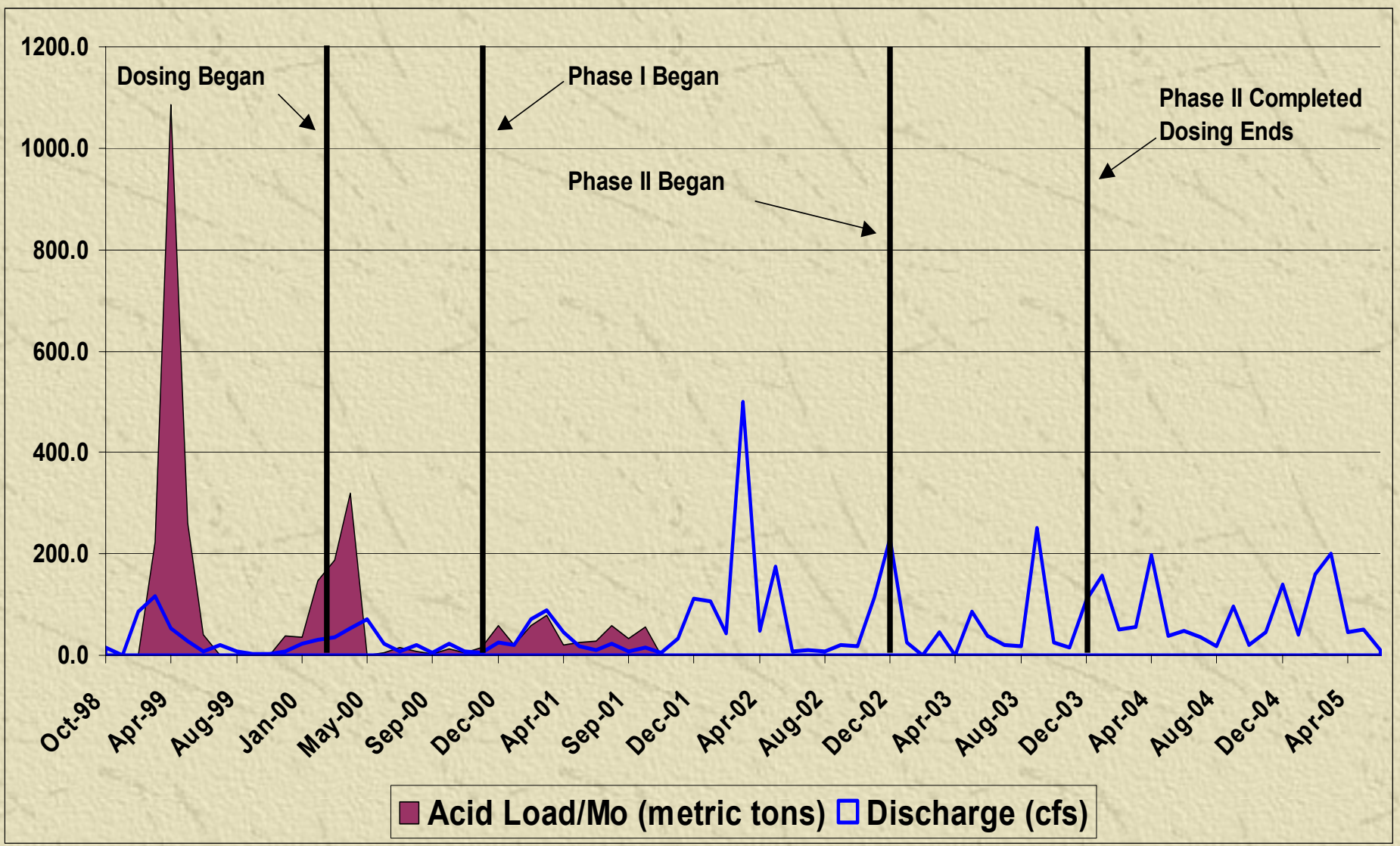
Discharge Acidity 70 mg/l



Rock Creek at Mouth

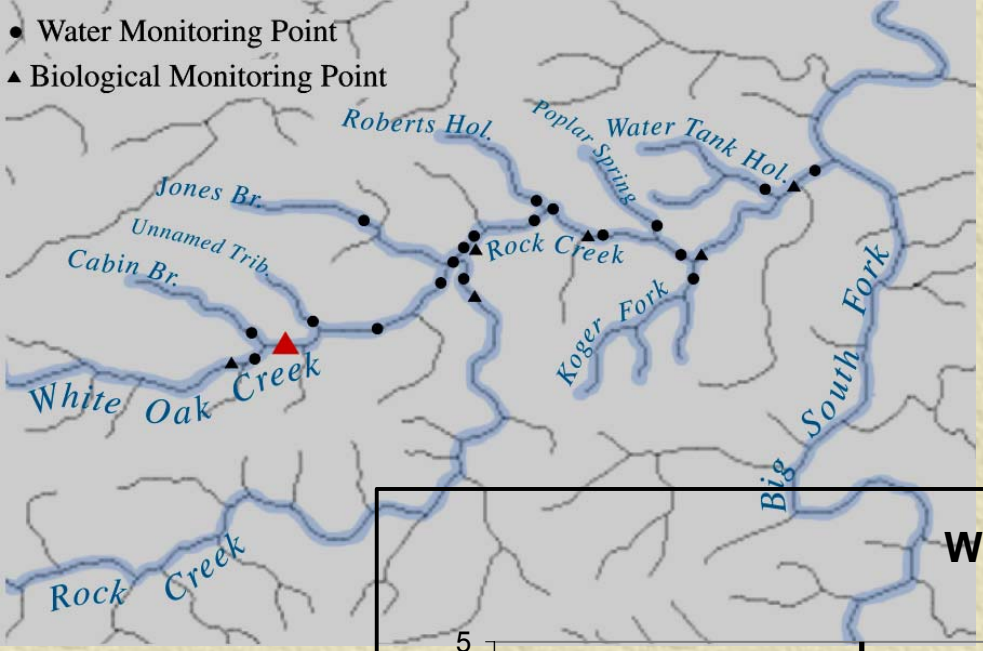


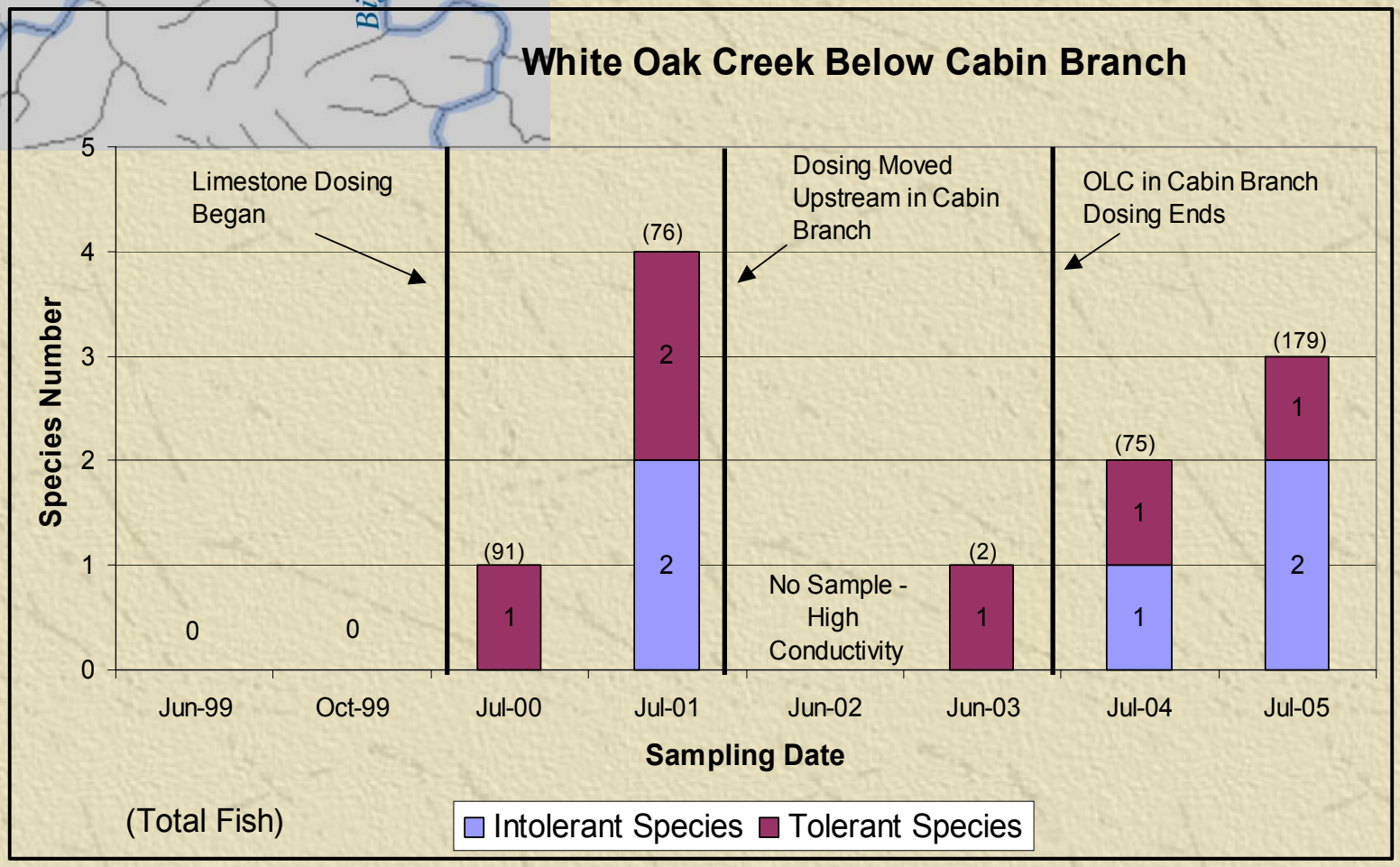
Rock Creek Acid Load at Mouth

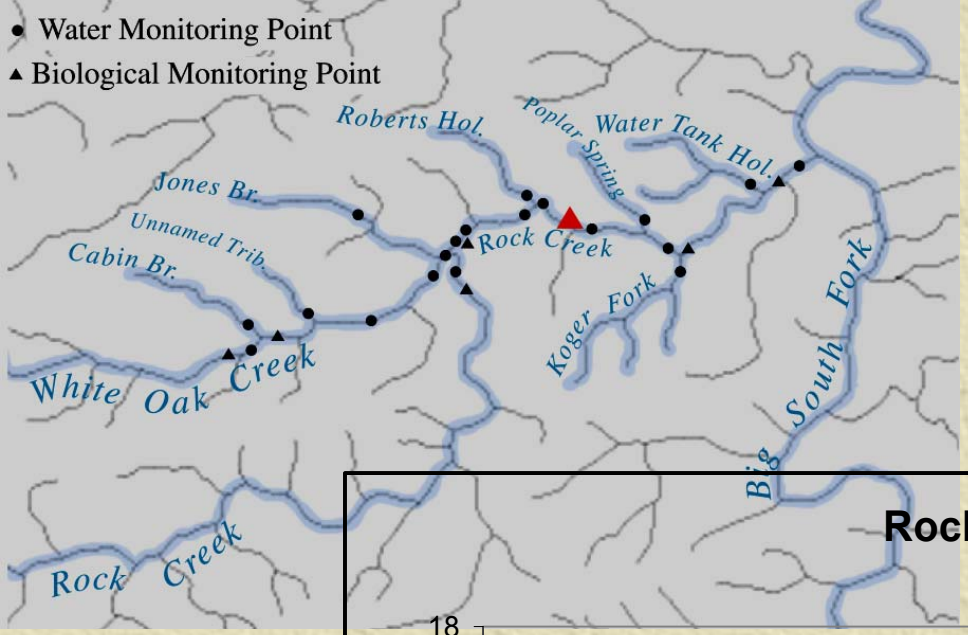


Biological Monitoring

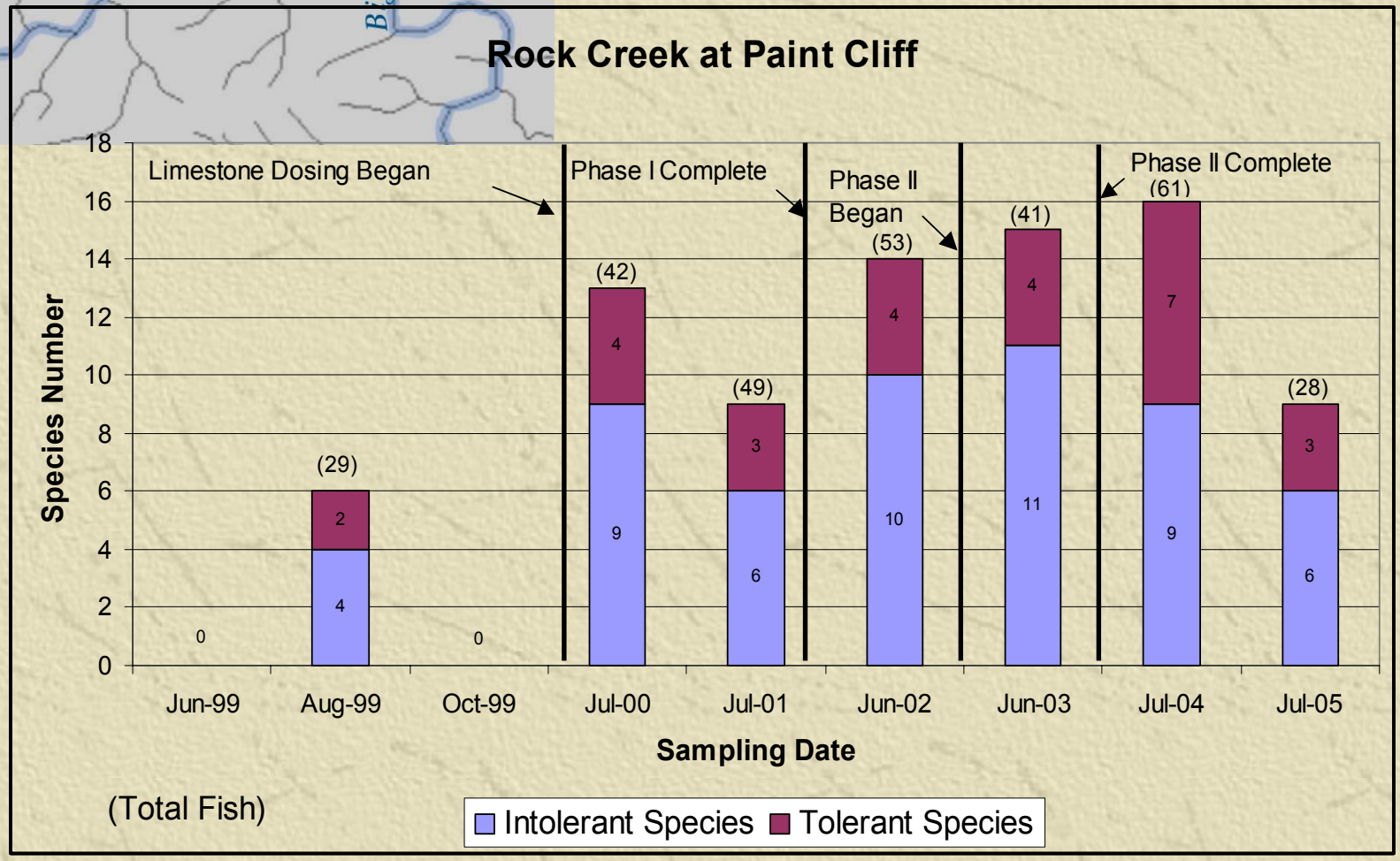
Fish Species



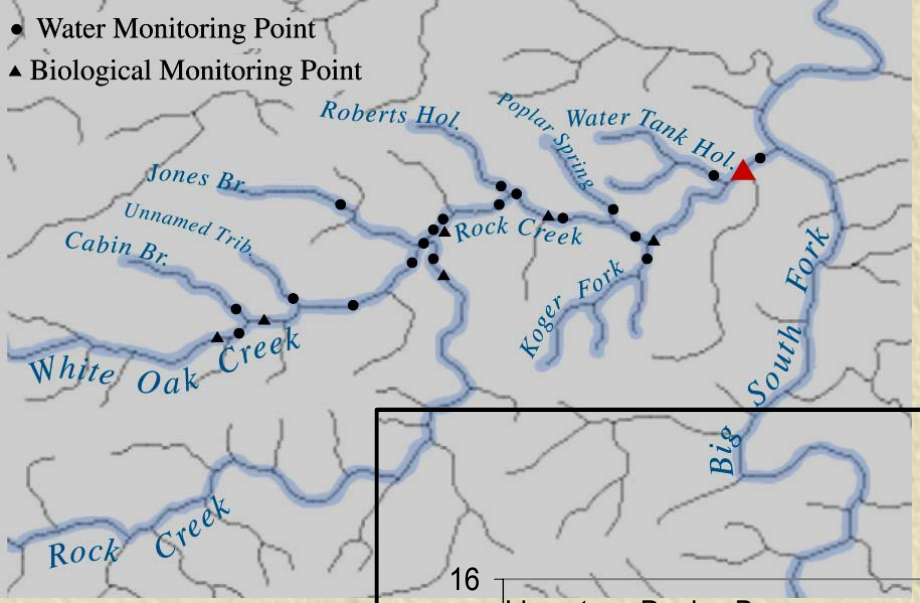


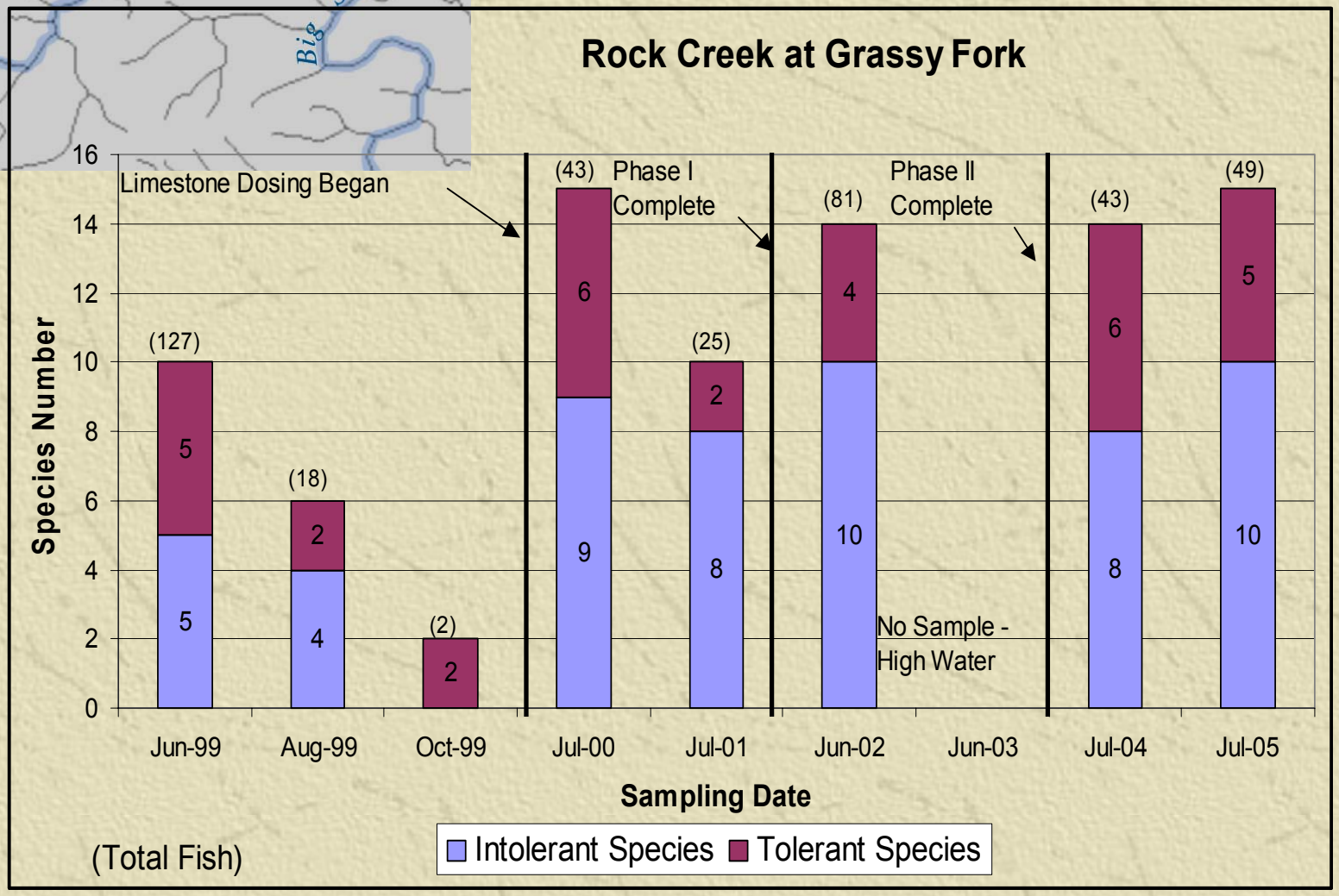


Fish Species



Fish Species





Project Summary

80,000 Tons of Limestone Installed in Lower Rock Creek Watershed

20,000 feet of Limestone Channel Installed

Limestone Sand Dosing Ceased at 3 of 5 Sites after Phase II

Fish Populations are Increasing in Numbers and Diversity

Acid Loading into Big South Fork reduced from 1400 tons annually to zero

Project Design Consultation Provided by the National Mine Reclamation Center through the OSM/National Mine Reclamation Center Cooperative Agreement