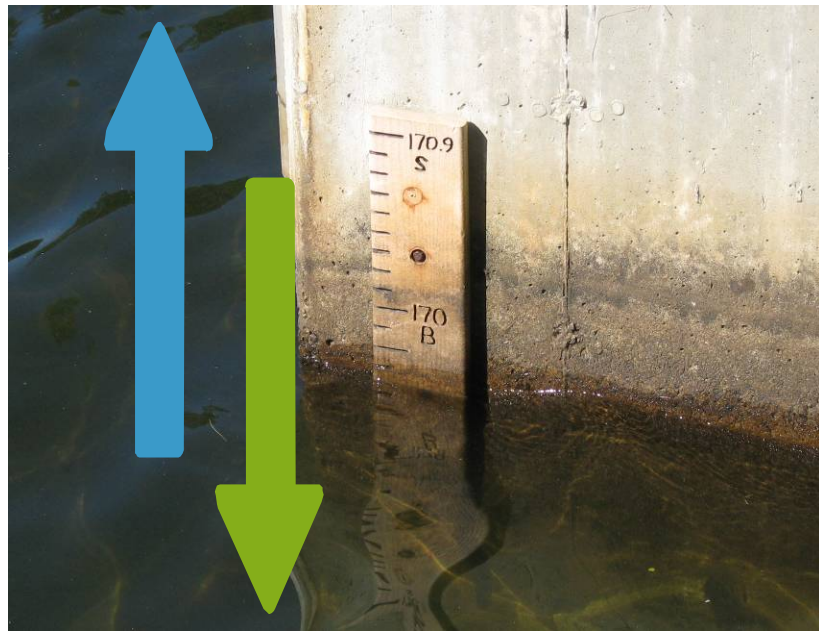


US EPA ARCHIVE DOCUMENT

The Ups and Downs of Winter Lake Drawdown as Part of a Long-term Invasive Weed Control Program in a Massachusetts Lake



Presentation to

**New England Association
of Environmental Biologists
34th Annual Meeting**

Newport, Rhode Island

March 18, 2010



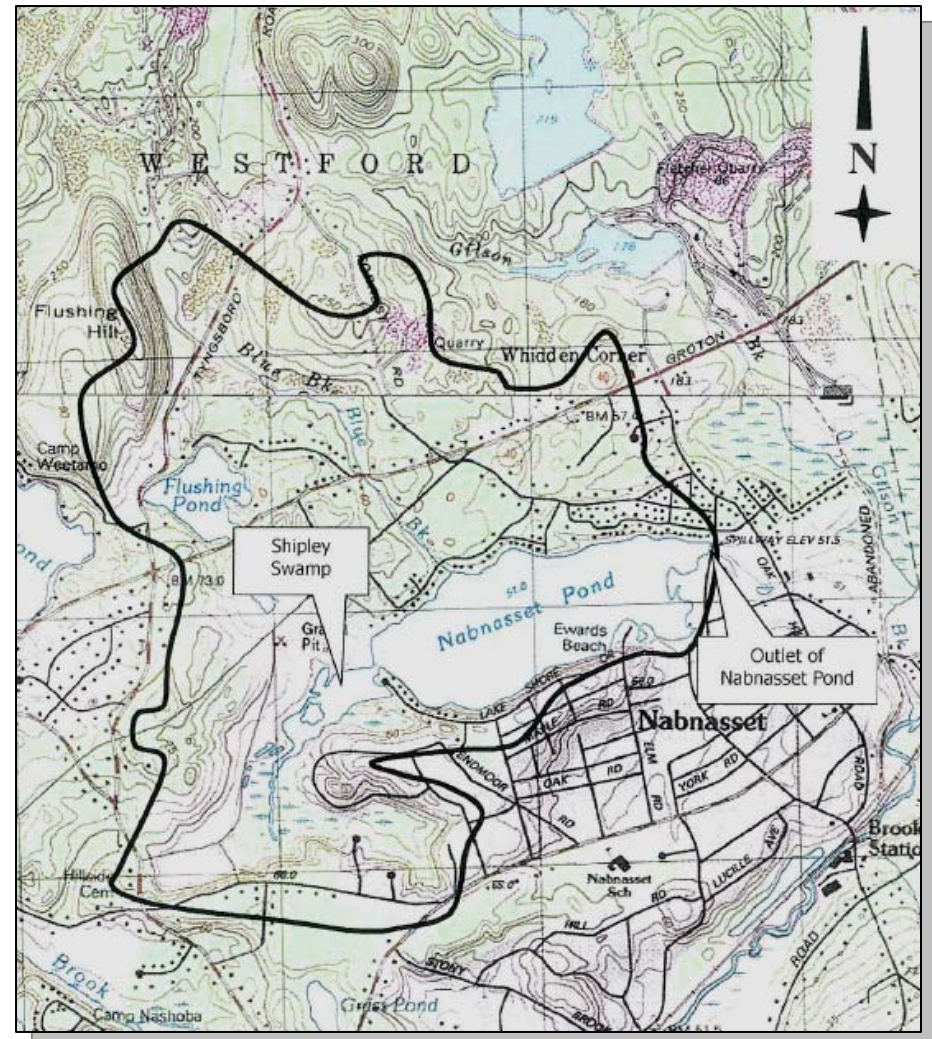
Engineers
Scientists
Consultants

Matt Ladewig
Carl Nielsen, CLM

www.essgroup.com

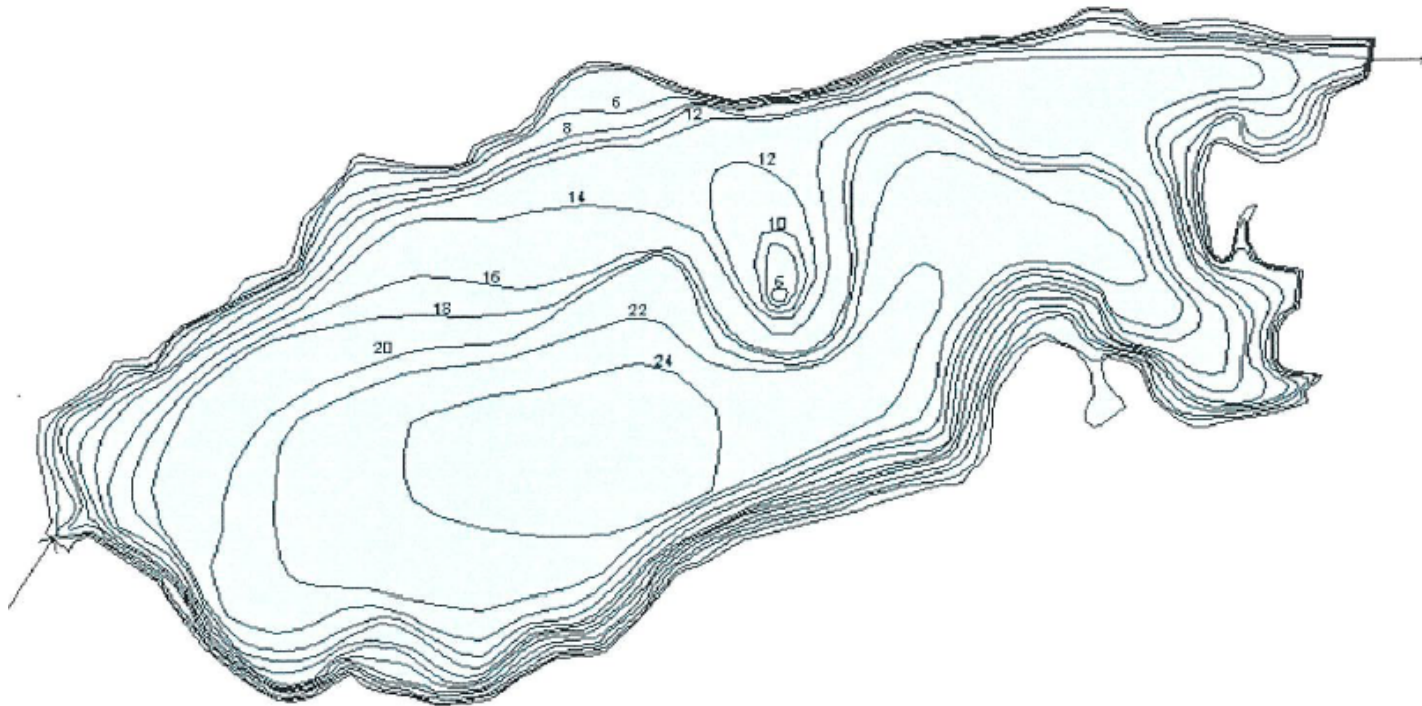
NABNASSET LAKE

- Located in the Merrimack River watershed in Westford, Massachusetts
- Small watershed (512 acres)
- 110 acre lake
- Hydrologically dependent wetland (Shipley Swamp)
- Town wells in watershed



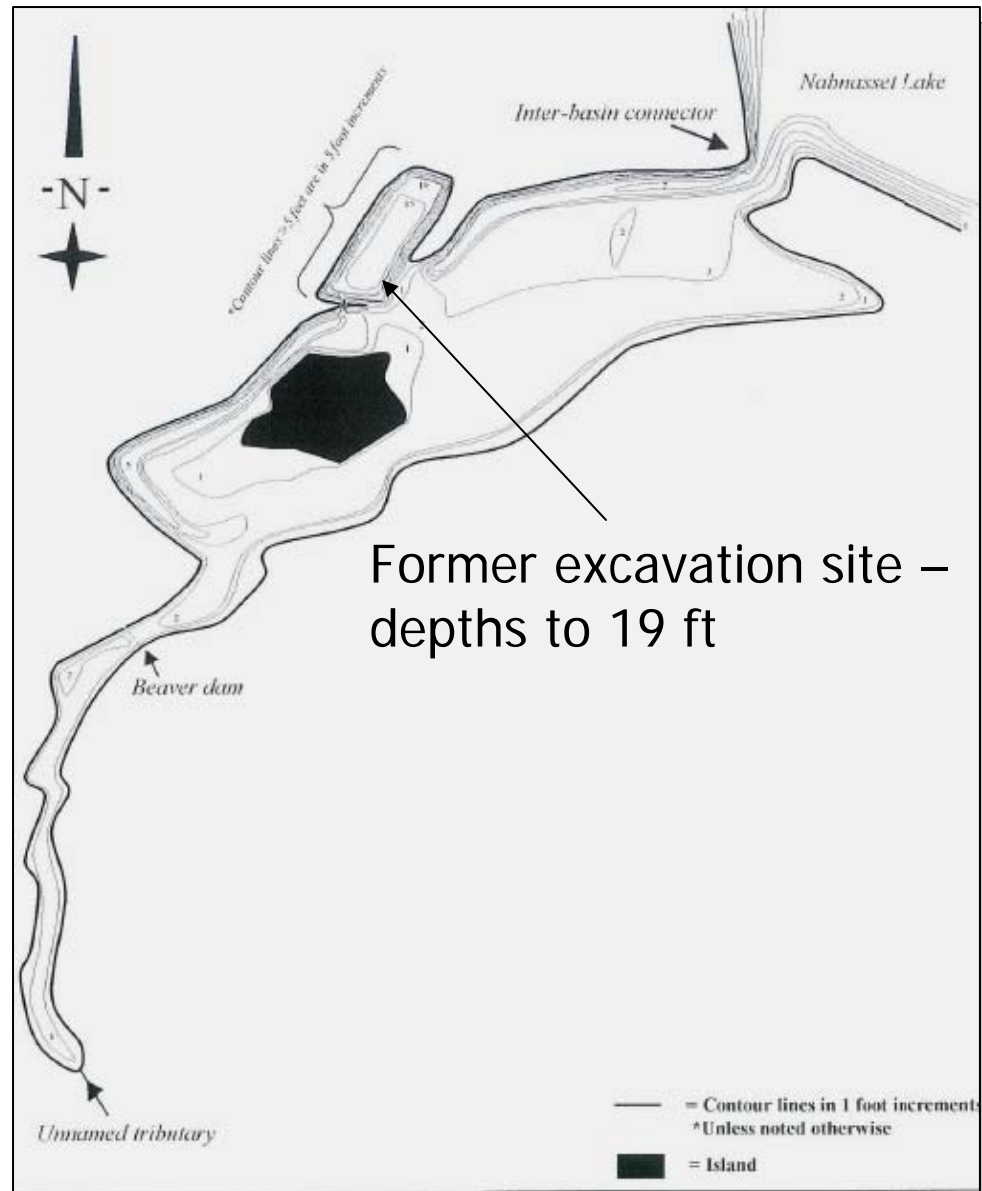
NABNASSET LAKE

- Moderately deep (average depth 15 ft)
- Deep hole depth of ~31 ft
- Developed shoreline
- No true public access
- Historically managed with a 2.2 ft winter drawdown



SHIPLEY SWAMP

- Connected wetland – mostly 3 ft deep or less

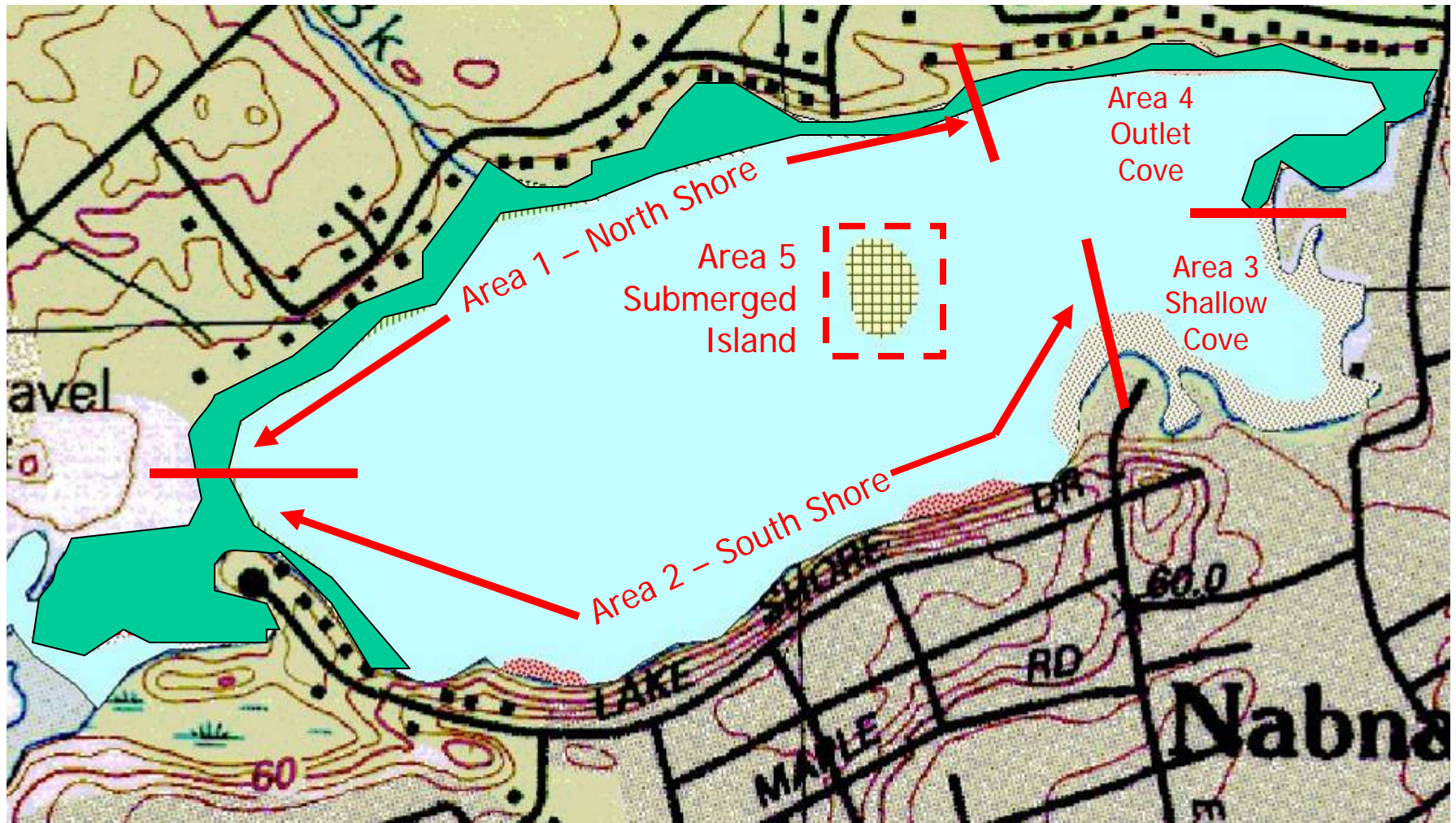


- Variable-leaf milfoil (*Myriophyllum heterophyllum*) present in the lake and Shipley Swamp for a number of years



- Lake association attempted herbicides, but found this to be unsustainable based on the need for repeated treatment (cost)
- 10 ft drawdown for dam repair in 1990 appeared to have side effect of controlling milfoil with no significant negative impacts on shoreline or town wells – could it work again?

THE INVASION: MILFOIL COVER



LAKE MANAGEMENT GOALS

1. Actively manage growth of exotic aquatic plants for
 - Habitat enhancement
 - Primary/secondary recreational use
2. Maintain the ecological integrity of Nabnasset Lake and Shipley Swamp by
 - Ensuring the maintenance of a balanced aquatic plant community dominated by native plants
 - Minimizing potential impacts to fish and wildlife through management actions

- Drawdown program designed to target a 6' every other winter (at most) but with the objective of spacing drawdowns as far apart as possible based on milfoil regrowth patterns
- Butterfly valve/flashboard dam controls
- Shoreline protection drawdowns of 2.2' every year
- 6' winter drawdowns began in 2003
 - 2003/4 – **drawdown**
 - 2004/5 – no drawdown
 - 2005/6 – no drawdown
 - 2006/7 – **drawdown**
 - 2007/8 – no drawdown
 - 2008/9 – no drawdown
 - 2009/10 - **drawdown**



MANAGEMENT OPTIONS

- Volunteer hand-pulling in shallow areas (<6 ft) to extend time between drawdowns
- Volunteer diver hand pulling in deep areas (>6 ft) to minimize use of herbicides
- Herbicides applied as needed to manage large patches of milfoil in areas > 6 ft



THE TROUBLE WITH PERMITTING

- Original permit application for drawdown filed by another consultant on behalf of the lake association
- Rejected by the Town and DEP based on a lack of detailed information on Shipley Swamp (bathymetry, habitat, flora, fauna, etc.)
- ESS was hired in 2002 to evaluate previous work and permitting and to fill in the data gaps.
- Our goal was to provide a comprehensive analysis to the Town related to the potential for impacts from winter drawdown.
- ESS was subsequently retained to file a new permit with the Town based on our data and analysis. This permit was approved.

DRAWDOWN CONCERNS



- Vocal opposition from a few area residents (not lake residents).
- Concerns included:
 - ability to re-fill lake
 - water quality (nutrients, sediment, algal blooms)
 - impacts to water supplies (town well)
 - invertebrates
 - freshwater mussels
 - wading birds
 - wetland plants
 - herpetofauna

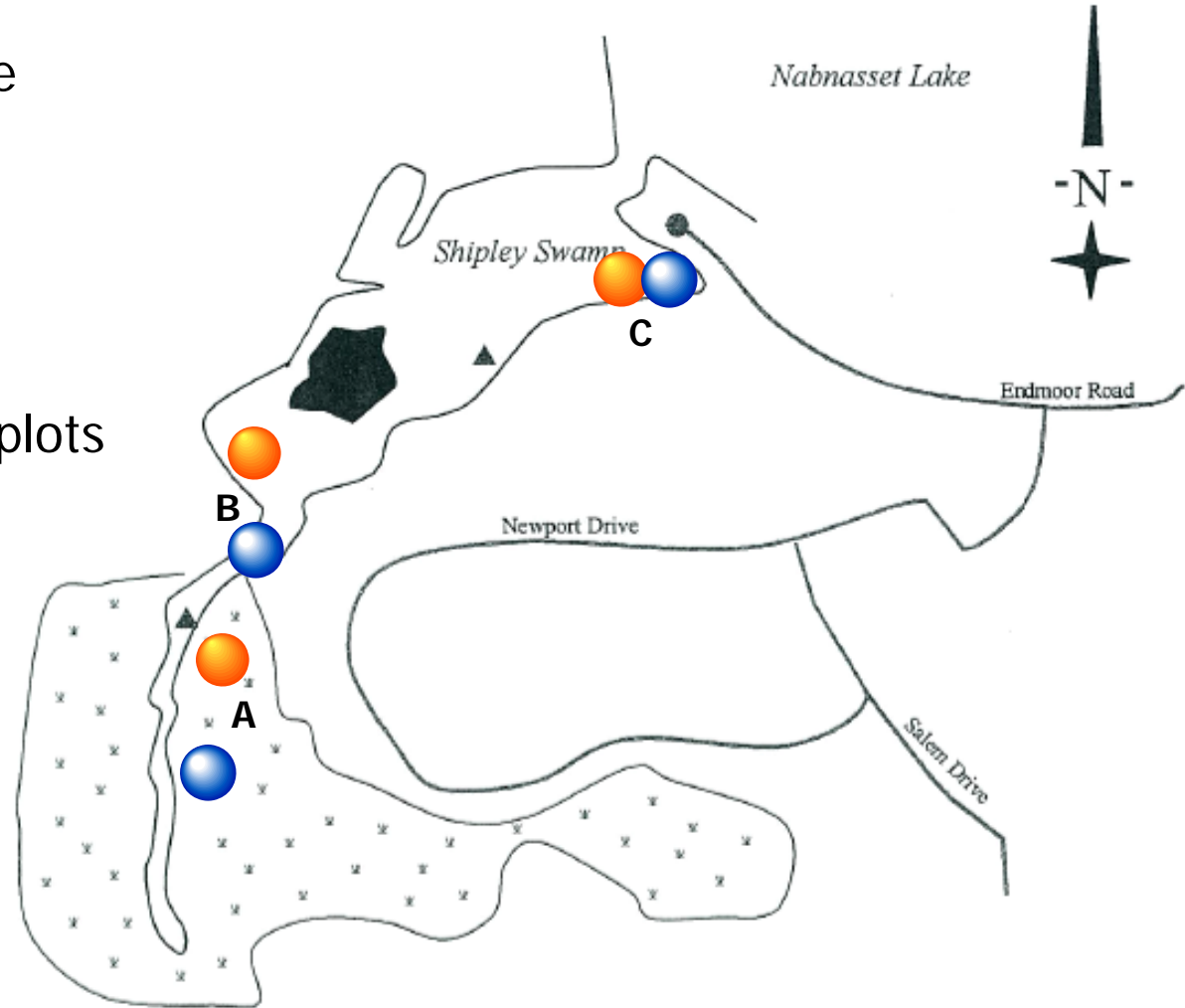


- Monitoring of the potentially impacted resources was a requirement of the permit:
 - Plant plots within Shipley Swamp
 - Macroinvertebrate community assessment in Swamp and Lake
 - Water quality assessment in lake and the outlets from swamp and lake
 - Aquatic plant community assessment in lake and swamp
 - Bank erosion inspections in outlet channel downstream of lake
- ESS was retained by the lake association and Town to obtain baseline data (pre-drawdown) and to conduct annual monitoring and reporting per the permit conditions.

SHIPLEY SWAMP MONITORING

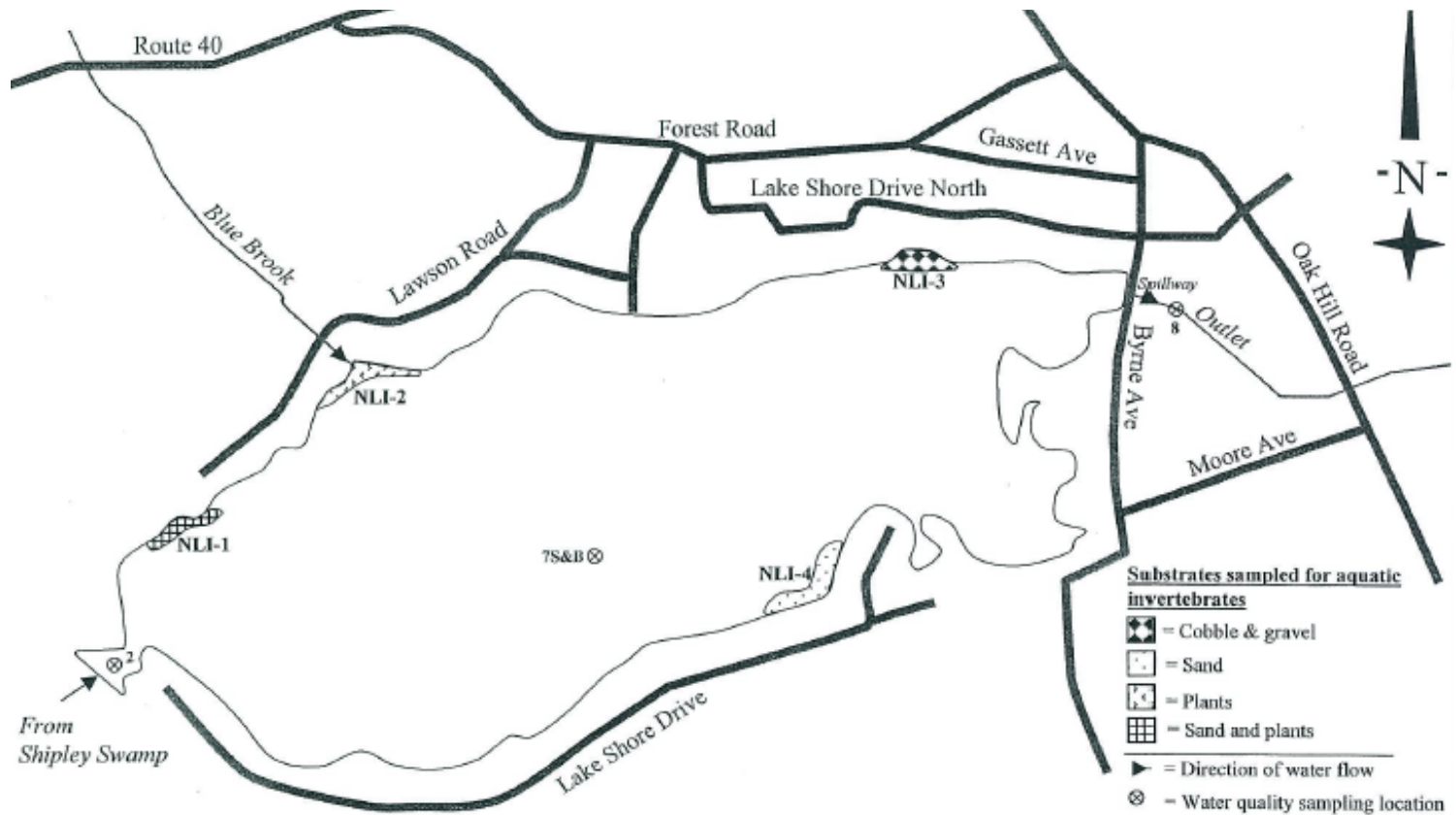
- Vegetation plots were relocated in 2004

-  2002 veg plots
-  2004-2009 veg plots



IN-LAKE MONITORING

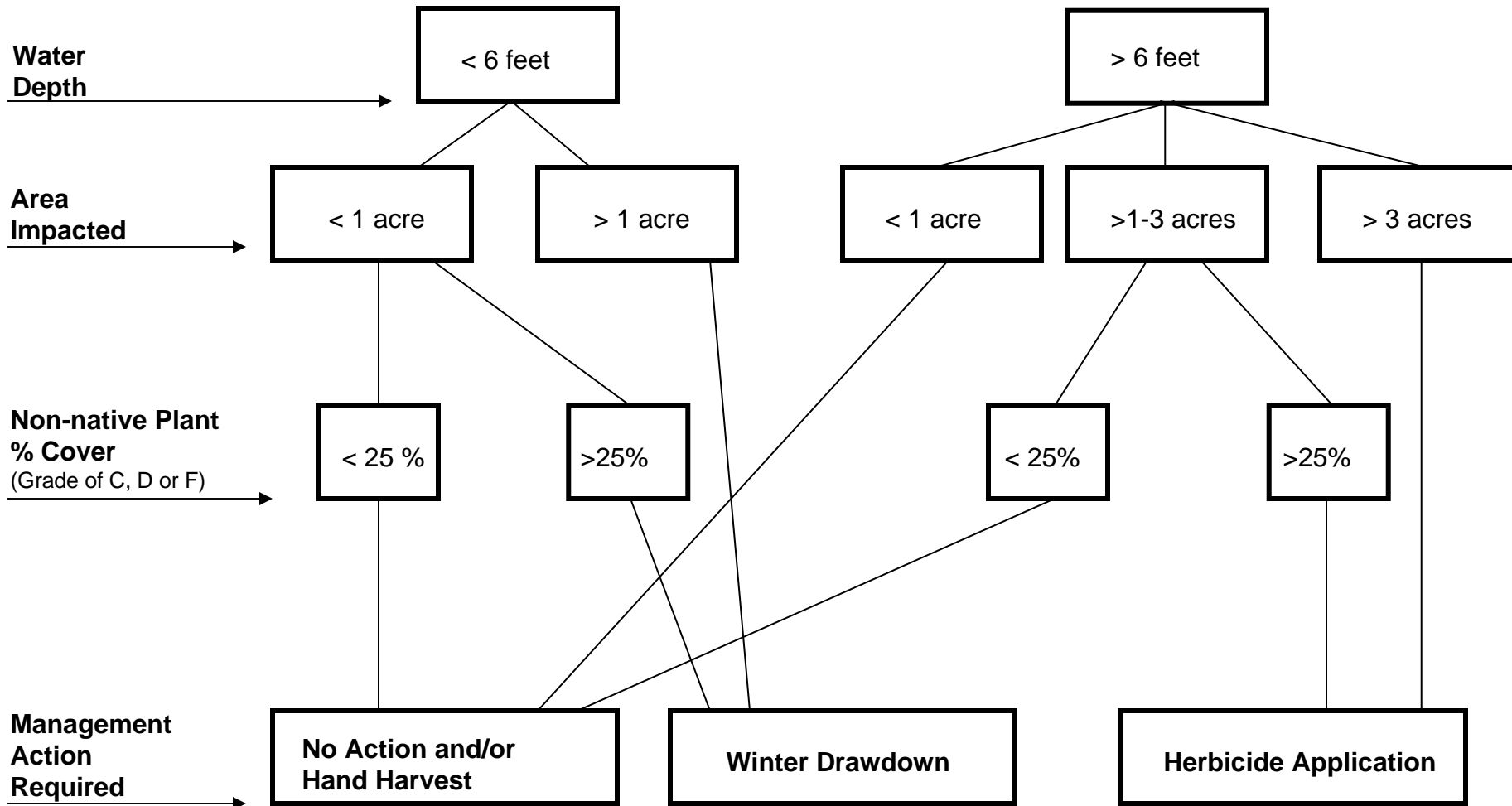
- Macroinvertebrate monitoring locations chosen for each type of shallow water habitat in Nabnasset Lake



MANAGEMENT PROGRAM ADJUSTMENTS

- Order of Conditions amended in 2006 (during renewal) to require use of a management decision matrix and annual report card going forward
- Allows a 6 ft drawdown to be performed on an “as needed” basis rather than on a biannual schedule
- “A program of vegetation control is a balancing act between controlling undesirable effects of invasive vegetation while protecting desirable flora and fauna and water quality.”

DECISION MATRIX



Note: This is intended to serve as a guideline, not a set of absolute choices. Decisions may be refined based on condition of other Report Card criteria (water quality, macroinvertebrates, native plant community, etc.).

ANNUAL REPORT CARD - LAKE

RESOURCE	A	B	C	D	F	GRADE
Nabnasset Lake						
Plant Community (<6' deep)						
Aquatic Native Plants	Dominant	Common	Occasional	Rare	Absent	
Emergent Native Plants	Dominant	Common	Occasional	Rare	Absent	
Aquatic Exotic/Invasive Plants	Absent	Rare	Occasional	Common	Dominant	
Emergent Exotic/Invasive Plants	Absent	Rare	Occasional	Common	Dominant	
Plant Community (>6' deep)						
Submerged Aquatic Native Plants	Dominant	Common	Occasional	Rare	Absent	
Emergent Native Plants	Dominant	Common	Occasional	Rare	Absent	
Aquatic Exotic/Invasive Plants	Absent	Rare	Occasional	Common	Dominant	
Emergent Exotic/Invasive Plants	Absent	Rare	Occasional	Common	Dominant	
Invertebrate Community (<6' deep)						
Freshwater Mussels	>0.5/ft ²	0.2-0.5/ft ²	0.1-0.2/ft ²	0-0.1/ft ²	Absent	
Other Macroinvertebrates	>8 taxa	6-8 taxa	3-5 taxa	1-2 taxa	Absent	
Invertebrate Community (>6' deep)						
Freshwater Mussels	>0.5/ft ²	0.2-0.5/ft ²	0.1-0.2/ft ²	0-0.1/ft ²	Absent	
Other Macroinvertebrates	>8 taxa	6-8 taxa	3-8 taxa	1-2 taxa	Absent	
Water Quality						
Clarity (turbidity/Secchi depth)	<1 NTU or >4 m	1-2 NTU or 3-4 m	2-5 NTU or 2-3 m	5-10 NTU or 1.2-2 m	>10 NTU or <1.2 m	
Phosphorus Concentration (mg/L)	<0.01	0.01-0.02	0.02-0.03	0.03-0.05	>0.05	
Nitrogen Concentration (mg/L)	<0.5	0.5-0.8	0.8-1.0	1.0-2.0	>2.0	
Dissolved Oxygen @ surface (mg/L)	>10.0	7.0-10.0	6.0-7.0	5.0-6.0	<5.0	
Erosion						
Shoreline	No evidence	Wave erosion only	Undercut banks	Bank failures	Numerous bank failings	
Downstream of Dam	No evidence	Limited undercut banks	Extensive undercut banks	Loss of minor shoreline vegetation	Loss of trees and roots	

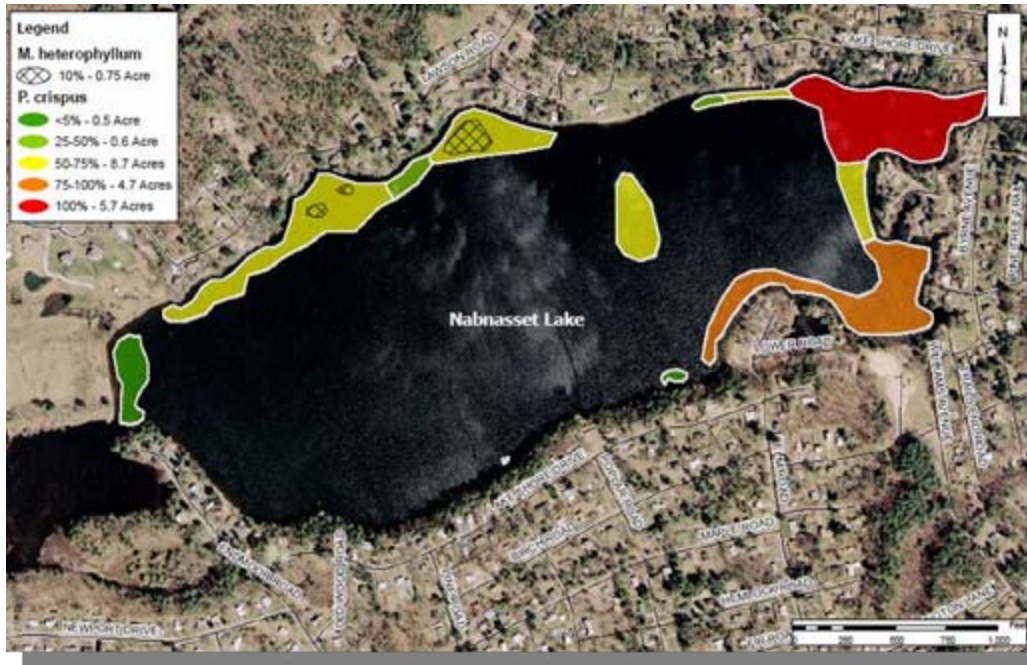
- Completed in summer by a qualified lake manager

ANNUAL REPORT CARD – SHIPLEY SWAMP

RESOURCE	A	B	C	D	F	GRADE
Shipley Swamp						
Plant Community (<6' deep)						
Aquatic Native Plants	Dominant	Common	Occasional	Rare	Absent	
Emergent Native Plants	Dominant	Common	Occasional	Rare	Absent	
Aquatic Exotic/Invasive Plants	Absent	Rare	Occasional	Common	Dominant	
Emergent Exotic/Invasive Plants	Absent	Rare	Occasional	Common	Dominant	
Plant Community (>6' deep)						
Aquatic Native Plants	Dominant	Common	Occasional	Rare	Absent	
Aquatic Exotic/Invasive Plants	Absent	Rare	Occasional	Common	Dominant	
Invertebrate Community (<6' deep)						
Freshwater Mussels	>0.5/ft ²	0.2-0.5/ft ²	0.1-0.2/ft ²	0-0.1/ft ²	Absent	
Other Macroinvertebrates	>8 taxa	6-8 taxa	3-8 taxa	1-2 taxa	Absent	

2007 - THE INVASION CONTINUES

- Curly-leaf pondweed (*Potamogeton crispus*)
- Previously present but occupied no more than 1.5 acres
- In 2007, >20 acres of *P. crispus*



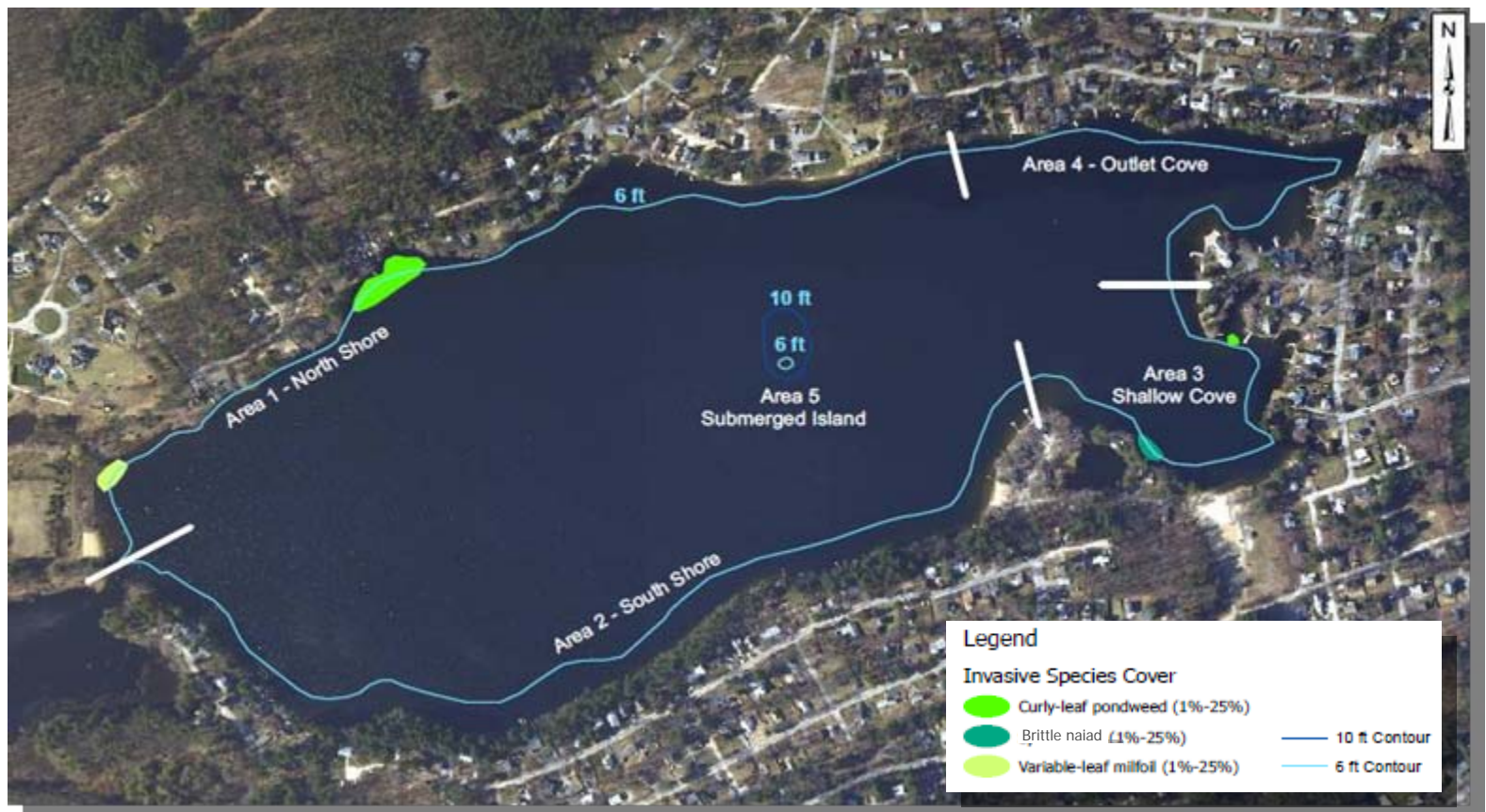
2007 - THE INVASION CONTINUES

- *P. crispus* a challenge to manage with winter drawdown alone
 - Spreads primarily via seed formation rather than vegetative
 - Management requires removal prior to seed formation, which typically occurs in early June
- Herbicides were applied to control curly-leaf in spring 2008 – successful into 2008/2009



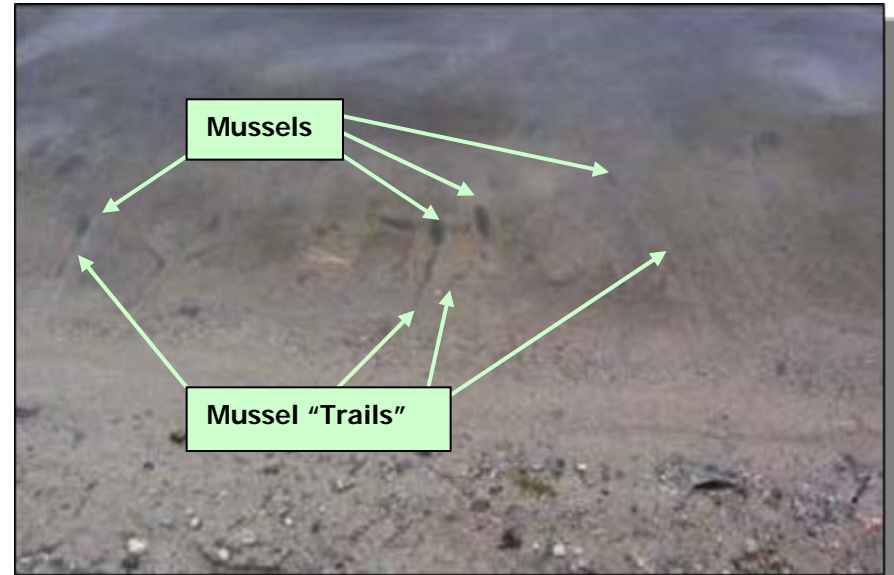
WHERE ARE WE NOW?

- Minimal coverage of nuisance species – Significant in Areas 1 and 3 ONLY
- Biological community OK
- Water quality continues to hold steady or improve
- Recommended winter drawdown (2009/2010) with hand-harvesting/spot herbicides before June 2010 to prevent curly-leaf pondweed expansion



WHERE ARE WE NOW?

Concern	Results/Response
Water Quality	<ul style="list-style-type: none">•No problems with algae blooms or turbidity•Nutrient levels steady
Water Supply	<ul style="list-style-type: none">•No problems – Town can pump from satellite well, as needed
Invertebrate Community	<ul style="list-style-type: none">•Diversity/composition has held steady
Freshwater Mussels	<ul style="list-style-type: none">•Some losses during drawdown•Drawdown over more than one month allows most to escape to deepwater refugia•Reproduction continues
Wading Birds	<ul style="list-style-type: none">•Drawdown conducted outside foraging season



WHERE ARE WE NOW?

Concern	Results/Response
Wetland Plants	<ul style="list-style-type: none">•No sign of increase in purple loosestrife•Curly-leaf pondweed in lake (not Shipley Swamp) – alternative treatments used to control
Fish	<ul style="list-style-type: none">•No fish kills•Deepwater refugia appear to provide sufficient winter habitat
Herpetofauna	<ul style="list-style-type: none">•Drawdown scheduled to commence prior to hibernation
Ability to Refill Lake	<ul style="list-style-type: none">•No problems to date•Controls sufficient to raise water level to normal while meeting downstream flow requirements



- Other lake associations currently view the approach applied at Nabnasset Lake as a model for successful invasive weed control.
- Winter drawdown can be a cost-effective means for controlling growth of **some** invasive species in **some** lakes. Must be evaluated on a lake-by-lake basis and then carefully monitored on at least an annual basis once implemented. Therefore a smart drawdown program is not “free” or automatic.



- Development of a management decision matrix/annual report card is a useful tool that can be understood by lay people and regulators alike. It establishes the “rules” for future management actions and can facilitate the permitting process.
- Lake management plans that include winter drawdown may still need complementary strategies to maintain control of drawdown resistant (seed bearing) species, problem spots, small pioneer invasions, or during years when the weather does not cooperate.

QUESTIONS

