Stevens Pond

North Andover

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Erika Haug, *Biologist*
Aquatic Control Technology

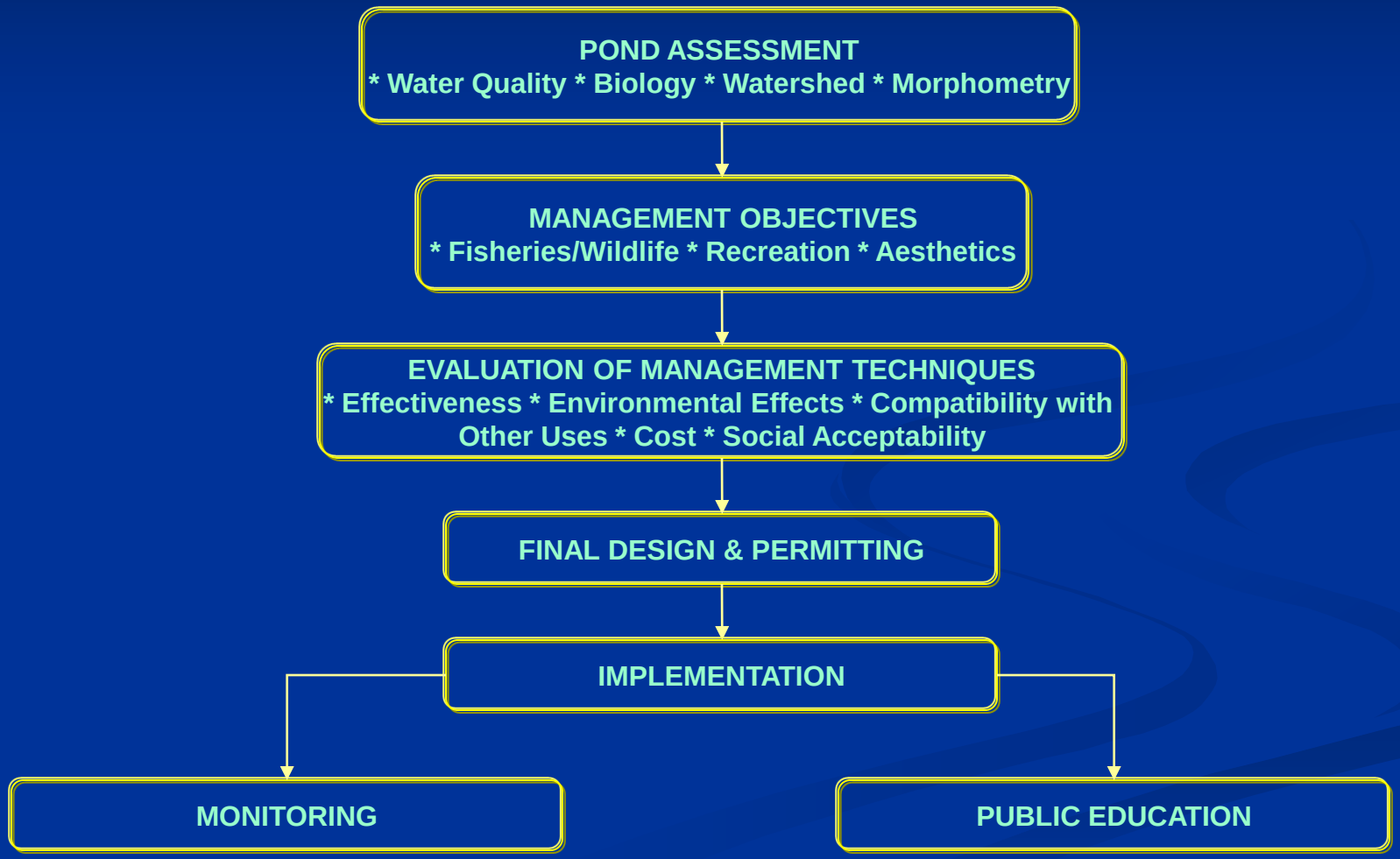
Public Meeting
to Discuss Management Options
January 30th 2013

AQUATIC CONTROL TECHNOLOGY
POND AND LAKE MANAGEMENT SPECIALISTS

Presentation Overview

- Background
- Survey Results
- Management Techniques
- Discussion

DEVELOPMENT OF A COMPREHENSIVE AQUATIC MANAGEMENT PLAN



Background

- In 2012 blue-green algae were observed during a routine bacteria inspection at the town beach
- The beach was closed for the remainder of the season due to the presence of densities of blue-green algae species that exceeded the MA DPH Guidelines for Cyanobacteria in Freshwater Recreational Waterbodies in Massachusetts (>70,000 cells/ml)

Methods

- Initial Survey Conducted on October 4th 2012
- Transects Across Pond
- Throw-rake, AquaVu Underwater Camera
- Water Quality Samples Collected: Lake Cochichewick Outlet, Secondary Inlet, Mid-Pond Surface, Mid-Pond 1.5 meters, Outlet
- Follow-up Monitoring Planned Over the Summer of 2013.

Vegetation

- Robbin's pondweed (*Potamogeton robbinsii*)
- Elodea (*Elodea canadensis*)
- Largeleaf pondweed (*Potamogeton amplifolius*)
- Tapegrass (*Vallisneria americana*)
- Naiad (*Najas flexilis*)
- Fanwort (*Cabomba caroliniana*)

Vegetation

Legend
Robbin's pondweed dominant with lesser amounts of largeleaf pondweed and elodea (75-100% Cover)
Elodea dominant with lesser amounts of Robbin's pondweed, tapegrass, largeleaf pondweed and scattered naiad (75-100% Cover)
Robbin's Pondweed dominant with lesser amounts of tapegrass and elodea. (25-50% Cover)
Light cover of Robbins pondweed and elodea (10-25% Cover)
Scattered Robbin's pondweed patches and individual plants (0-25% Cover)
Tapegrass (0-25% Cover)
Emergent vegetation
Micro-scopic algal bloom in progress
N
0
250
500
Feet
Steven's Pond
North Andover, MA
2012 Vegetation Assemblages
FIGURE
SURVEY DATE
MAP DATE
2
10-04-12
11-20-12
AQUATIC CONTROL TECHNOLOGY, INC.
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Water Quality Sample Sites

Steven's Pond

North Andover, MA
Water Quality Sampling

FIGURE:	SURVEY DATE:	MAP DATE:
3	10-04-12	11-20-12

Legend

Water Quality Sample Site Locations

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Water Quality Results

Parameter	Units	Lake Cochichewick Outlet	Secondary Inlet	Mid- Pond Surface	Mid-Pond 1.5 meters	Outlet
pH	S.U.	6.41	7.67	8.17	6.56	7.02
Alkalinity	$CaCO_3$/L	17.0	40	26.0	27.0	27
Turbidity	NTU	0.600	2.5	1.50	2.30	1.60
Total Kjeldahl Nitrogen	mg/L	0.700	0.500	0.500	0.400	0.600
Ammonia Nitrogen	mg/L	<0.100	<0.100	<0.100	<0.100	<0.100
Nitrate nitrogen	mg/L	<0.100	<0.100	<0.100	<0.100	<0.100
Total Phosphorous	mg/L	0.0120	0.0250	0.0360	0.0390	0.0320
Dissolved Phosphorous	mg/L	<0.0100	<0.0100	<0.0100	<0.0100	0.0110
True Color	Pt-Co	10	35	10	20	10
Apparent Color	Pt-Co	10	40	15	25	15

Well Oxygenated

Secchi Disk Reading: 6.5 feet

Algae Results

- Blue-green algal species (*Cyanophytes*)
  - Microcystis
  - Coelosphaerium
  - Aphanizomenon
- green algae (*Chlorphytes*)
- golden algae species (*Chrysophytes*)
- diatoms (*Bacillariophytes*)
- euglenoids (*Euglenophytes*)

Algae Management

- Water Clarity / Algae Monitoring
- Aeration
- Chemical Treatment
  - Copper
  - Peroxides
- Nutrient Mitigation
  - Lanthanum
  - Alum
- Alternative Methods
- Watershed Management

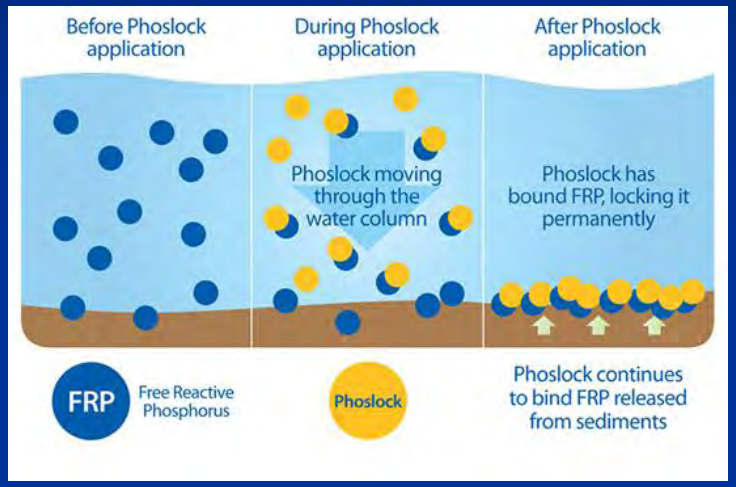
Aeration

- Breaks up thermal stratification, thereby reducing the build up of nutrients in the hypolimnion
- Helps with the aerobic breakdown of sediment

Chemical Treatment

- Copper Algaecide
  - Fast acting
  - Effective
  - Disrupts Cell Wall
- Peroxides
  - Sodium carbonate peroxyhydrate breaks down into sodium carbonate and hydrogen peroxide on contact with water.
  - Hydrogen peroxide then oxidizes algae cells
  - Breaks down into oxygen and water
  - Requires high application rates
  - Expensive
  - Alternative to copper algaecides

Nutrient Mitigation



- Phosphorus Precipitation
- Phosphorus Inactivation

Lake Characteristics

- Low flushing rate / long water retention time
- Deep with large percentage of bottom overlain with anoxic water
- High internal phosphorus loading
- Low external phosphorus loading

Products

- Buffered Alum
- Phoslock (Lanthanum)

Alternative Methods

- Sonic Solutions
  - ultrasonic frequencies disrupt algal structure and function
  - Breaks open vacuoles
- Barley Straw
  - Phenolic substances released during breakdown of straw
- Bacterial inputs
  - Helps to increase the breakdown of nutrient rich soil

Watershed Management

Watershed Management

Source Reduction

- Agricultural Best Management Practices
- Bank and Slope Stabilization
- Behavior Modifications
- Stormwater / Wastewater Management
- Zoning and Land Use Planning

Transport Mitigation

- Buffer Strips
- Catch Basins and Street Sweeping
- Created Wetlands for Infiltration
- Detention Ponds and Infiltration Systems

Preliminary Recommended Approach

- Low Dose Alum Treatment to Reduce In-pond Phosphorous
- Algal Density Monitoring
- Copper Algaecide Treatment as Needed
- Fanwort Management
- Continued Water Quality and Watershed Assessment

Discussion

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Town of North Andover

MASSACHUSETTS

Stevens Pond Hydraulic Analysis

Blake A. Martin, Senior Associate

Tara E. McManus, PE, Project Manager

- Site visit & bathymetric survey of Stevens Pond
- Review operations of Lake Cochichewick and Stevens Pond
- Hydraulic model development and calibration
- Findings

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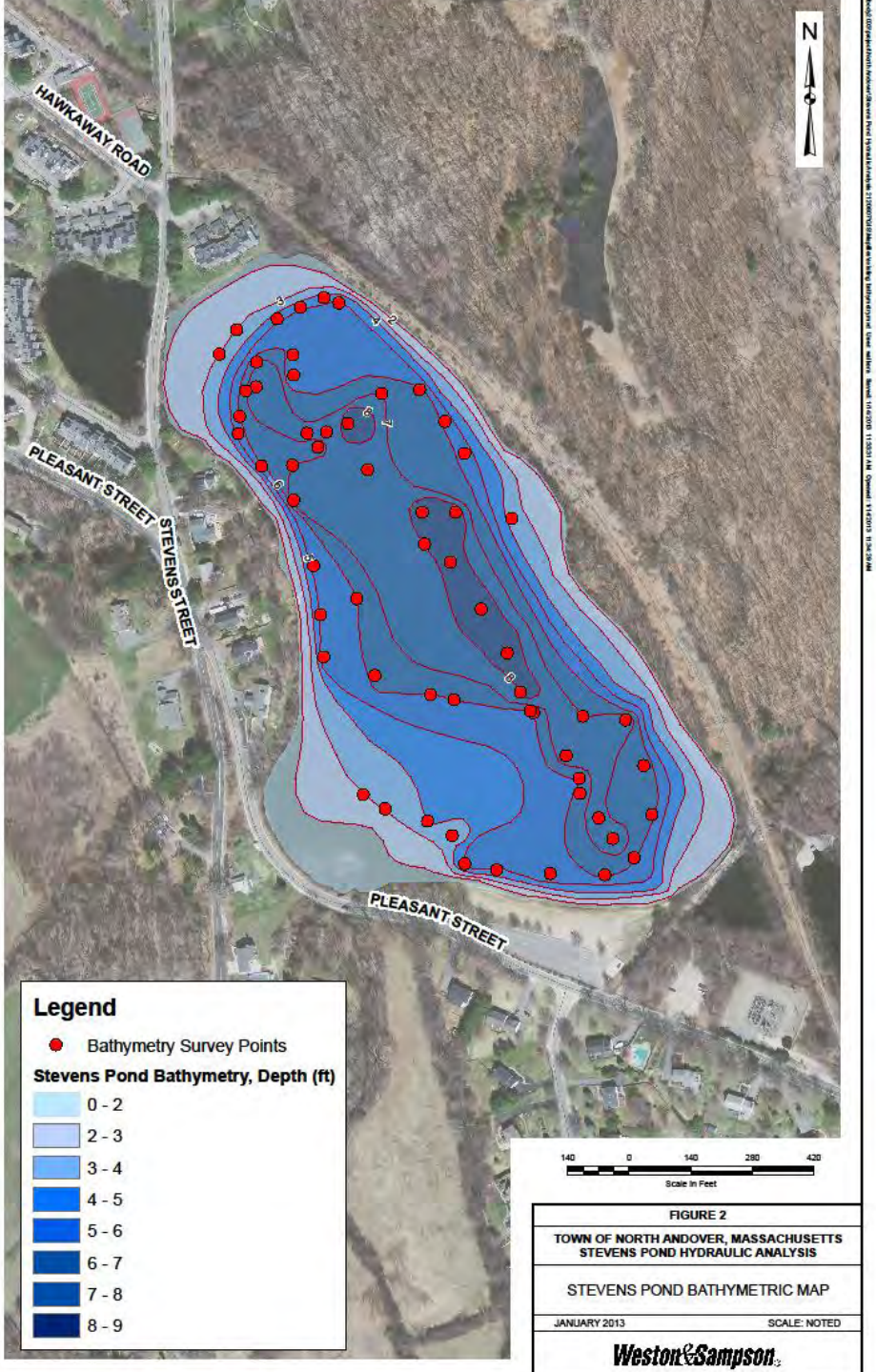

Stevens Pond Bathymetric Survey Map

Weston&Sampson

Model Inputs & Outputs Development

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	Year	Month	# Days	Parker Flow	Precip	PET	Lake C Q	Lake C P	Lake C PET	Lake C W	Lake C Hatch	Lake C GW	Lake C Net	Lake C ΔS	Lake C ΔWL	Lake C WL_{t-1}	Lake C WL_t	Lake C Historic WL	WL Error	Date
2				*(cfsm)*	*(cfsm)*	*(cfsm)*	*(MG)*	*(MG)*	*(MG)*	*(MG)*	*(MG)*	*(MG)*	*(MG)*	*(MG)*	*(ft)*	*(ft. NGVD29)*	*(ft. NGVD29)*	*(ft. NGVD29)*	*(ft)*	
160	2008	2	29	6.00	7.09	0.00	478.48	121.77	0.00	-67.37	-117.49	17.00	432.39	432.39	2.86	123.85	126.70	112.79	13.91	2/1/2008
161	2008	3	31	5.88	4.34	0.71	500.92	79.59	-12.98	-73.24	-134.77	18.00	377.51	377.51	2.50	126.70	129.20	112.60	16.60	3/1/2008
162	2008	4	30	2.40	2.14	1.64	197.99	38.04	-29.11	-76.27	-137.73	19.00	11.93	11.93	0.10	129.20	129.30	112.76	16.54	4/1/2008
163	2008	5	31	1.51	1.45	1.88	128.68	26.58	-34.57	-98.07	-142.60	20.00	-99.98	-99.98	-0.64	129.30	128.66	112.45	16.21	5/1/2008
164	2008	6	30	0.46	2.90	2.39	38.07	51.41	-42.44	-121.96	-136.17	21.00	-190.08	-190.08	-1.23	128.66	127.42	111.98	15.44	6/1/2008
165	2008	7	31	1.12	7.38	2.48	95.39	135.46	-45.49	-121.20	-136.99	22.00	-50.82	-50.82	-0.32	127.42	127.10	112.10	15.00	7/1/2008
166	2008	8	31	1.55	3.37	2.31	131.93	61.92	-42.32	-103.37	-136.01	23.00	-64.85	-64.85	-0.41	127.10	126.69	111.88	14.81	8/1/2008
167	2008	9	30	1.30	7.25	2.20	107.25	128.78	-39.07	-97.89	-130.39	24.00	-7.32	-7.32	-0.03	126.69	126.66	112.10	14.56	9/1/2008
168	2008	10	31	1.43	1.93	1.66	122.19	35.34	-30.44	-80.19	-134.63	25.00	-62.75	-62.75	-0.40	126.66	126.26	111.70	14.56	10/1/2008
169	2008	11	30	2.20	4.60	1.20	181.89	81.66	-21.38	-72.91	-129.08	26.00	66.16	66.16	0.45	126.26	126.71	112.50	14.21	11/1/2008
170	2008	12	31	5.03	2.77	0.00	428.67	50.78	0.00	-74.76	-134.79	27.00	296.89	296.89	1.97	126.71	128.67	111.89	16.78	12/1/2008
171	2009	1	31	2.54	2.66	0.00	216.77	48.87	0.00	-77.38	-140.77	28.00	75.49	75.49	0.51	128.67	129.19	111.72	17.47	1/1/2009
172	2009	2	28	2.64	1.64	0.00	203.13	27.22	0.00	-66.09	-128.52	29.00	64.74	64.74	0.44	129.19	129.63	111.67	17.96	2/1/2009
173	2009	3	31	3.95	1.85	0.83	336.93	33.90	-15.28	-73.41	-143.58	30.00	168.56	168.56	1.13	129.63	130.76	111.08	19.68	3/1/2009
174	2009	4	30	3.80	3.73	1.67	313.49	66.22	-29.58	-75.30	-142.09	31.00	163.73	163.73	1.10	130.76	131.85	112.74	19.11	4/1/2009
175	2009	5	31	1.60	3.76	1.98	136.80	68.92	-36.33	-97.31	-149.92	32.00	-45.84	-45.84	-0.28	131.85	131.57	112.62	18.95	5/1/2009
176	2009	6	30	1.58	5.93	2.19	130.42	105.38	-38.97	-98.23	-144.32	33.00	-12.72	-12.72	-0.06	131.57	131.51	113.00	18.51	6/1/2009
177	2009	7	31	3.76	6.96	2.31	320.69	127.66	-42.41	-99.11	-148.95	34.00	191.87	191.87	1.28	131.51	132.79	112.66	20.13	7/1/2009
178	2009	8	31	1.85	3.88	2.42	157.91	71.15	-44.50	-131.12	-152.51	35.00	-64.07	-64.07	-0.40	132.79	132.39	112.10	20.29	8/1/2009
179	2009	9	30	0.98	2.38	2.12	80.53	42.18	-37.63	-107.19	-146.53	36.00	-132.63	-132.63	-0.85	132.39	131.54	111.90	19.64	9/1/2009
180	2009	10	31	1.30	2.75	1.63	110.82	50.46	-29.95	-84.18	-149.04	37.00	-64.88	-64.88	-0.41	131.54	131.13	112.25	18.88	10/1/2009
181	2009	11	30	3.37	2.26	1.48	277.74	40.11	-26.35	-76.97	-143.12	38.00	109.41	109.41	0.74	131.13	131.87	112.50	19.37	11/1/2009
182	2009	12	31	4.19	2.34	0.00	356.82	42.98	0.00	-80.61	-149.97	39.00	208.22	208.22	1.39	131.87	133.26	112.50	20.76	12/1/2009
183	2010	1	31	2.58	1.14	0.00	220.02	21.01	0.00	-79.83	-153.80	40.00	47.40	47.40	0.33	133.26	133.59	112.55	21.04	1/1/2010
184	2010	2	28	3.50	3.85	0.00	269.12	63.83	0.00	-69.90	-139.73	41.00	164.33	164.33	1.10	133.59	134.70	113.60	21.10	2/1/2010
185	2010	3	31	12.79	9.78	1.26	1,089.94	179.39	-23.10	-79.13	-157.66	42.00	1051.45	1051.45	6.94	134.70	141.64	115.00	26.64	3/1/2010
186	2010	4	30	6.14	0.66	1.78	506.76	11.78	-31.68	-78.96	-169.47	43.00	281.43	281.43	1.88	141.64	143.52	112.00	31.52	4/1/2010
187	2010	5	31	1.25	1.22	2.10	106.36	22.44	-38.48	-108.23	-179.56	44.00	-153.46	-153.46	-0.98	143.52	142.54	111.95	30.59	5/1/2010
188	2010	6	30	0.31	0.53	2.42	25.18	9.39	-43.00	-127.60	-171.55	45.00	-262.58	-262.58	-1.70	142.54	140.85	111.20	29.65	6/1/2010
189	2010	7	31	0.02	0.81	2.55	1.81	14.80	-46.80	-181.22	-173.22	46.00	-338.63	-338.63	-2.20	140.85	138.65	109.95	28.70	7/1/2010
190	2010	8	31	0.05	1.92	2.45	4.18	35.18	-44.93	-165.17	-167.82	47.00	-291.56	-291.56	-1.89	138.65	136.76	109.22	27.54	8/1/2010
191	2010	9	30	0.01	1.80	2.34	0.77	31.99	-41.64	-124.30	-157.78	48.00	-242.95	-242.95	-1.57	136.76	135.19	108.55	26.64	9/1/2010
192	2010	10	31	0.12	3.76	1.74	10.55	68.92	-32.01	-91.83	-158.95	49.00	-154.30	-154.30	-0.99	135.19	134.19	108.38	25.81	10/1/2010
193	2010	11	30	0.99	1.75	1.33	81.71	31.04	-23.54	-79.58	-151.27	50.00	-91.64	-91.64	-0.58	134.19	133.61	108.48	25.13	11/1/2010
194	2010	12	31	1.38	1.73	0.00	117.72	31.68	0.00	-90.52	-154.75	51.00	-44.88	-44.88	-0.27	133.61	133.34	108.80	24.54	12/1/2010
195	2011	1	31	1.35	1.01	0.00	115.29	18.62	0.00	-83.87	-154.01	52.00	-51.98	-51.98	-0.32	133.34	133.02	109.35	23.67	1/1/2011
196	2011	2	28	1.91	2.38	0.00	147.03	39.48	0.00	-74.26	-138.32	53.00	26.92	26.92	0.20	133.02	133.22	110.20	23.02	2/1/2011
197	2011	3	31	6.62	1.71	0.89	564.25	31.36	-16.38	-80.35	-153.68	54.00	399.20	399.20	2.65	133.22	135.87	112.60	23.27	3/1/2011
198	2011	4	30	3.51	2.79	1.67	289.52	49.50	-29.69	-80.15	-155.55	55.00	128.65	128.65	0.87	135.87	136.74	113.10	23.64	4/1/2011
199	2011	5	31	2.01	2.54	2.01	171.71	46.64	-36.95	-99.26	-162.98	56.00	-24.84	-24.84	-0.14	136.74	136.60	113.10	23.50	5/1/2011
200	2011	6	30	1.43	3.41	2.38	117.85	60.65	-42.28	-125.03	-157.38	57.00	-89.19	-89.19	-0.56	136.60	136.04	113.00	23.04	6/1/2011
201	2011	7	31	0.79	1.19	2.53	66.98	21.81	-46.51	-160.60	-161.18	58.00	-221.49	-221.49	-1.43	136.04	134.60	112.10	22.50	7/1/2011
202	2011	8	31	0.50	4.06	2.45	42.22	74.50	-45.00	-133.68	-157.41	59.00	-160.37	-160.37	-1.03	134.60	133.57	111.80	21.77	8/1/2011
203	2011	9	30	1.10	4.45	2.35	90.35	78.95	-41.78	-103.48	-149.65	60.00	-65.61	-65.61	-0.41	133.57	133.16	112.70	20.46	9/1/2011
204																				

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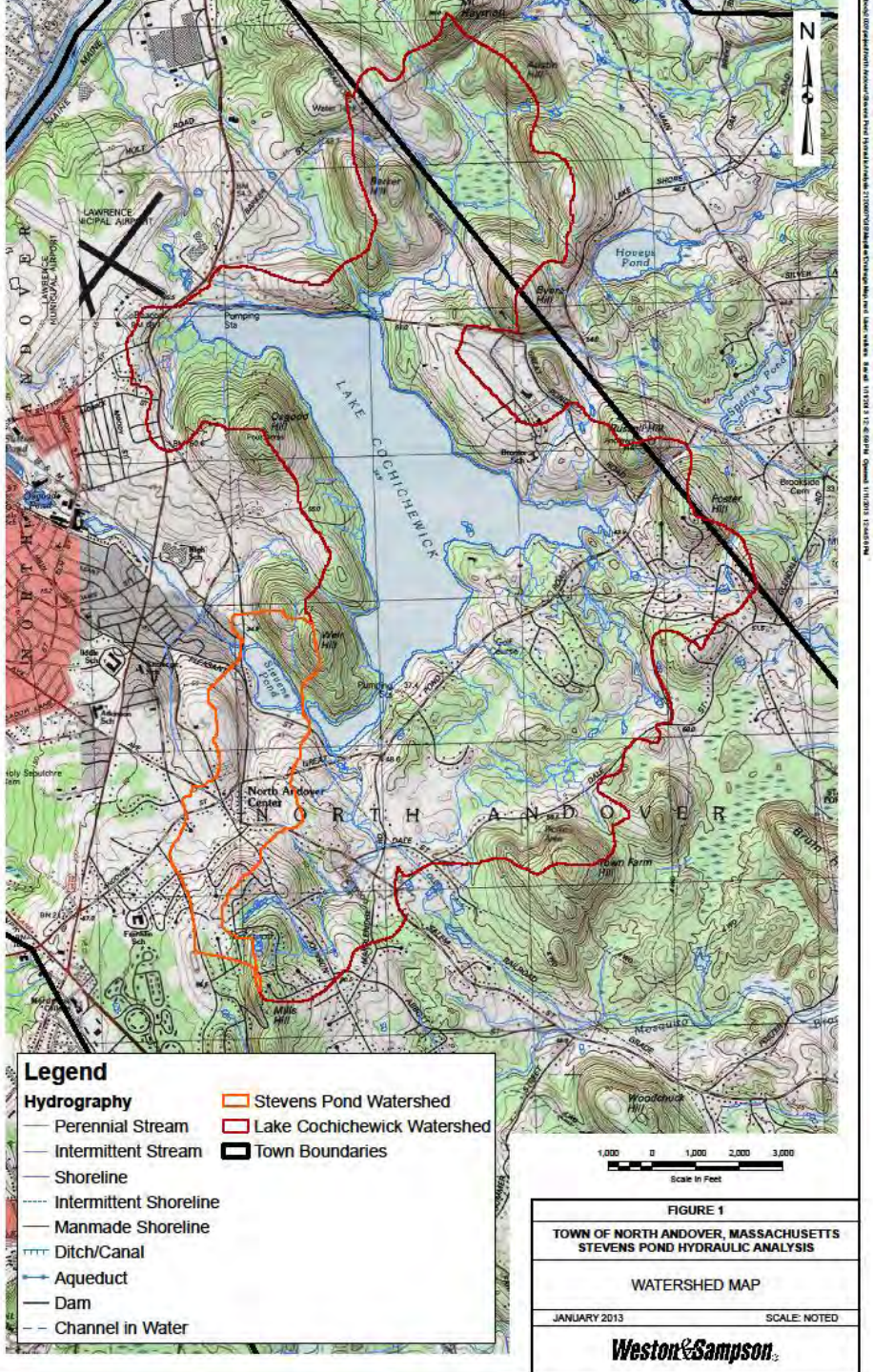

Map of Lake Cochichewick & Stevens Pond Watersheds

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Original Wooden Hatch

New Stainless Steel Hatch

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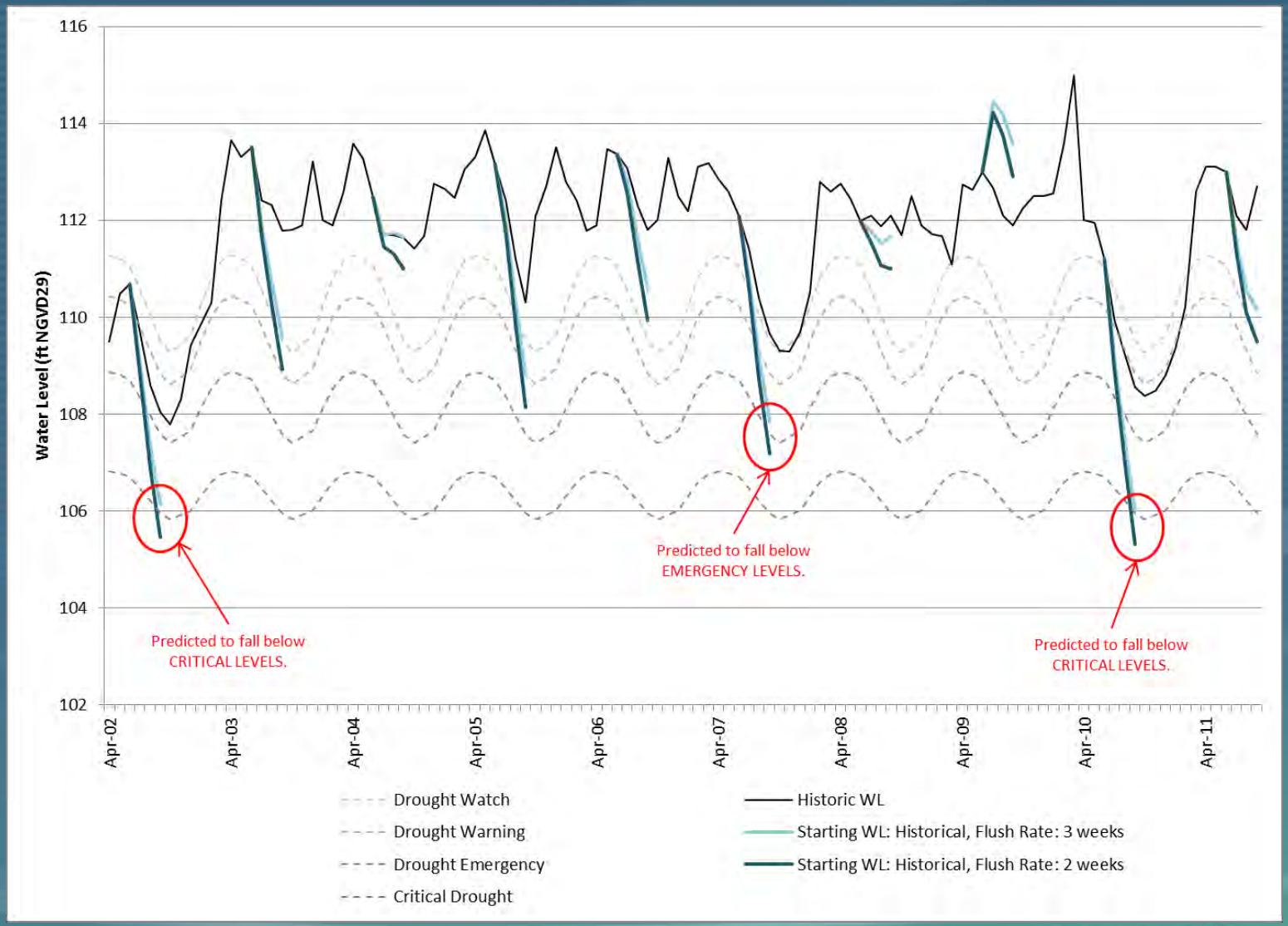
Simulated Summertime Lake Levels with Flushing of Stevens Pond



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- *planning*
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- *construction*
- *operation*
- *maintenance*
- *forensic engineering*

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