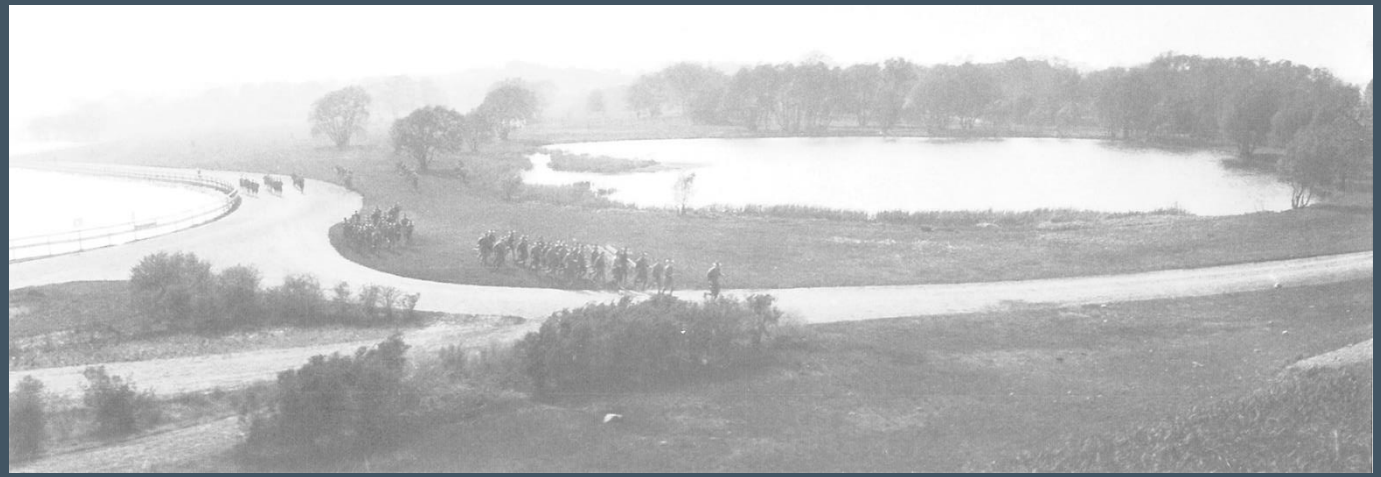
Black's Nook In-Pond Restoration Project



Fresh Pond Advisory Board
22 October 2020

CAMBRIDGE WATER DEPARTMENT

HATCH

AGENDA

1. Project Team
2. Black's Nook Pond – Restoration Goals
3. Data Collection and Key Findings
4. Next Steps

OUR TEAM

WATER QUALITY EXPERT – Ken Wagner, Ph.D., Limnologist, Certified Pond Manager

WILDLIFE SCIENTISTS – Ben Griffith and others, NORMANDEAU ASSOCIATES

WETLAND & RESTORATION ECOLOGISTS, GREEN INFRASTRUCTURE, LANDSCAPE ARCHITECTS, CERTIFIED ARBORIST – HATCH

STAKEHOLDER AND FPAB ENGAGEMENT

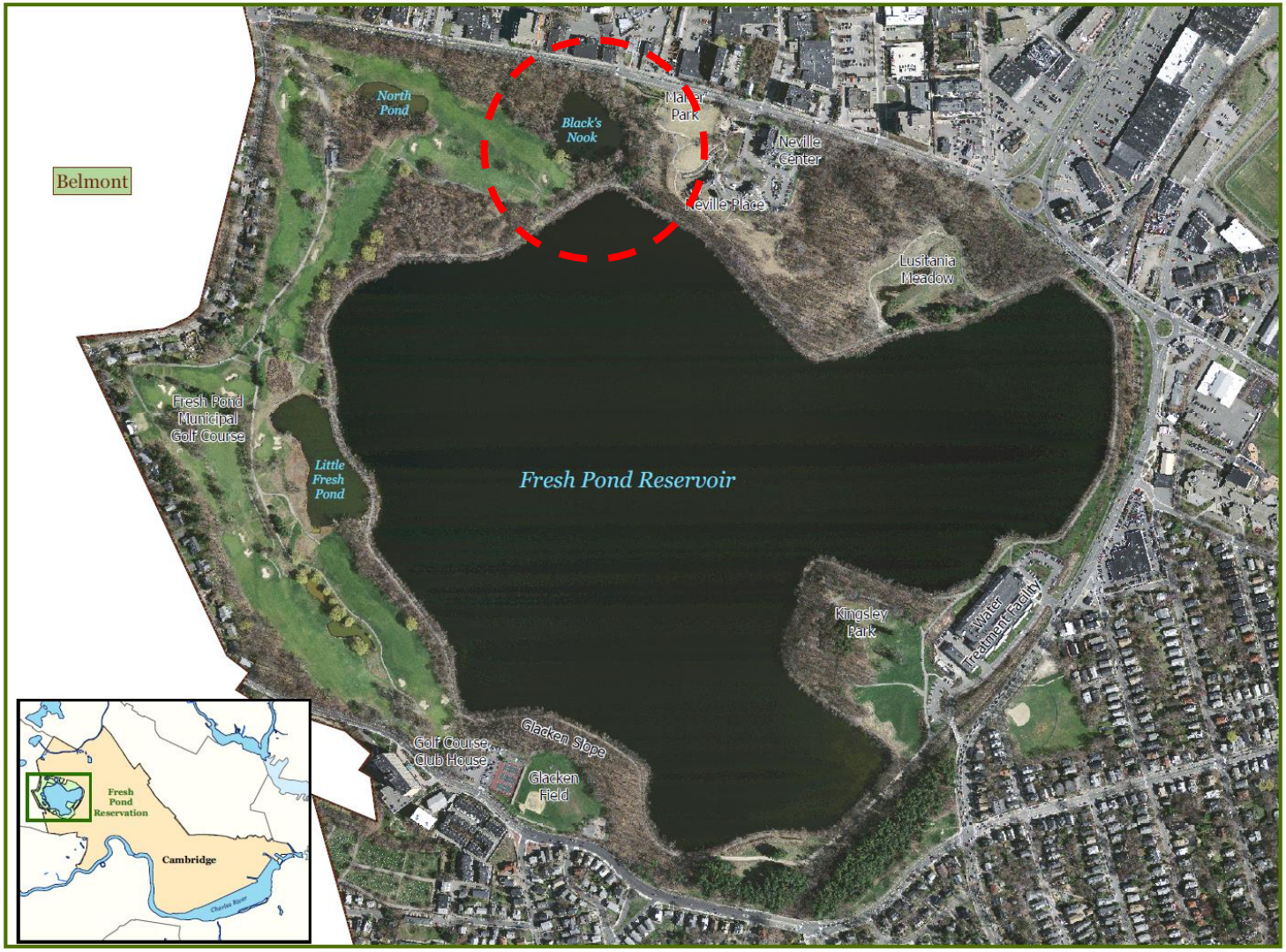
FP Advisory Board:

- Presentations at Inventory, Analysis, and Assessment/ Alternatives phases
- Site visit(s)
- Goal-setting critical
- City Working Group: Recreation, Public Works/Conservation Commission, CWD

Stakeholders:

- Cambridge Plant and Garden Club
- Maynard Ecology Center (MEC)
- Fayerweather School teacher and student volunteers
- Friends of Fresh Pond
- Audubon birding group

BLACK'S NOOK PROJECT AREA



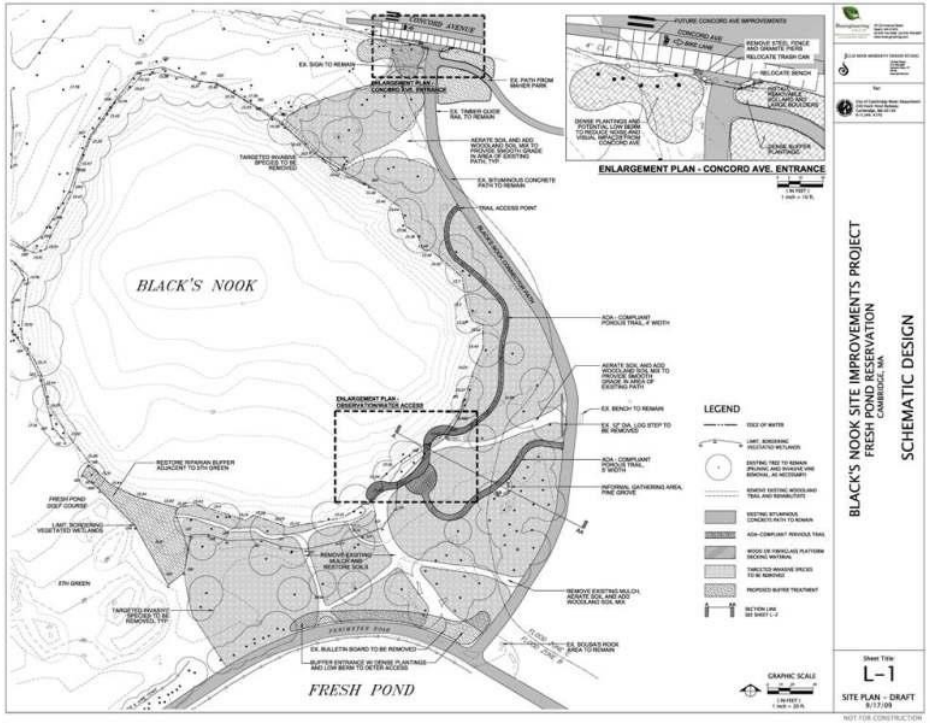
PREVIOUS PROJECTS – PHASES 1 & 2

- Inventory and Analysis
- Concept Designs
- Contract Documents
- Permitting
- Construction Oversight
- Vegetation Management Plan
- Phased Implementation

SIGNIFICANCE AT FRESH POND

Black's Nook as Unique Place:

- Passive recreation – birding, no dogs
- Permanent fence
- Diverse habitats
- Outdoor classroom
- Historical relevance
- FP Golf Course abutter



ASSESSMENT APPROACH

Preliminary Goal Setting:

1. Fresh Pond Reservation Master Plan Vision
    - Preserve water quality, natural green spaces, wildlife habitat and refuge from hectic urban life
2. Black's Nook Pond – Water Quality Goals
    - Slow cultural eutrophication;
    - Keep Black's Nook an open water body;
    - Address Category 5 impaired water body status on the State's 303(d) list; and
    - Meet Class B Water Quality standards.

ASSESSMENT APPROACH

Initial Characterization:

1. Understanding the source of nutrients very important to limiting their continued effect on pond eutrophication.
2. Value of aquatic plants & benthic community to existing fish and vertebrate community.
3. Understanding oxygen cycle critical.
4. Define Black's Nook within existing watershed and habitats – bigger picture.

ASSESSMENT APPROACH

Slow Cultural Eutrophication:

1. Determine the source(s) and magnitude of nutrient loading.
2. Engage FPGC as long-term partner and steward.
3. Improve water quality within Black's Nook Pond.

ASSESSMENT APPROACH

<u>Riparian Buffer:</u>

- FP Golf Course runoff.
- Mowing of pond buffer plantings.
- Changing maintenance crews.
- Geese.

Shrub Scrub Wetland Buffer Planting

ASSESSMENT APPROACH

Retains Open Water Body:

1. What new data are critical for assessment?
2. Dredging analysis for different scenarios
3. Alternatives for maintaining open water (e.g. benthic barriers)
4. Habitat goals, in-pond and birds

DATA COLLECTION AND ASSESSMENT

Components (Physical, Chemical and Biological):

1. Pond Bathymetry and Sediments
2. Watershed and Groundwater Inputs
3. Water Quality and Aquatic Vegetation
4. Phytoplankton and Zooplankton
5. Benthic Community
6. Fish
7. Herptiles (Reptiles and Amphibians)
8. Birds and Bats

OVERVIEW OF APPROACH

Field Survey and Metrics:

1. Review all existing information – reports, studies and observances.
2. Use standard industry protocols for collecting, monitoring, surveying and recording data.
3. Influence In-Pond Restoration Alternatives based on established goals and metrics.

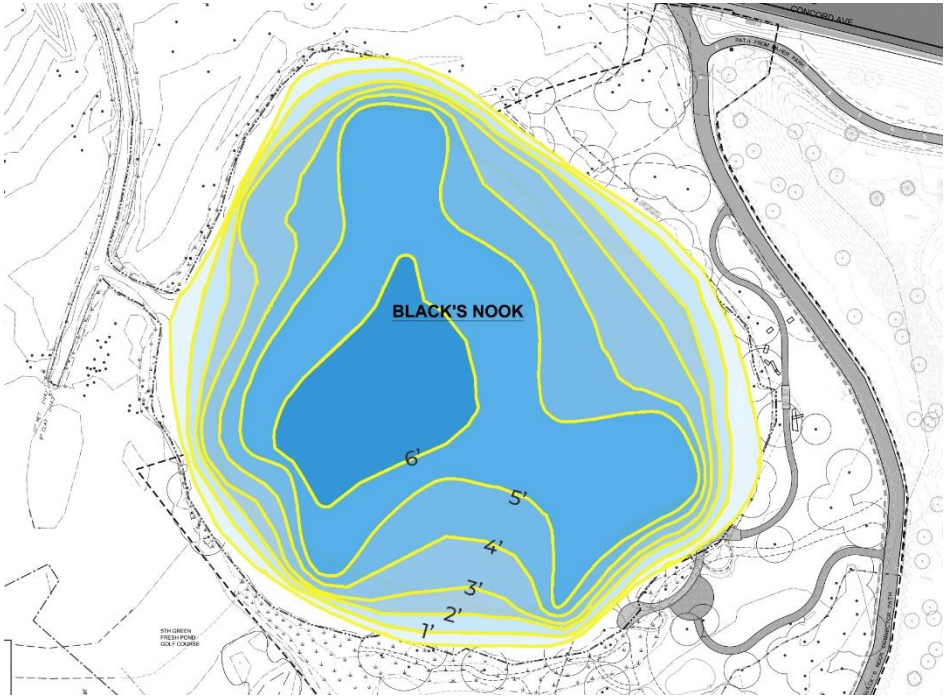
Engelmann's Umbrella Sedge

POND BATHYMETRY AND SEDIMENT CHARACTERIZATION

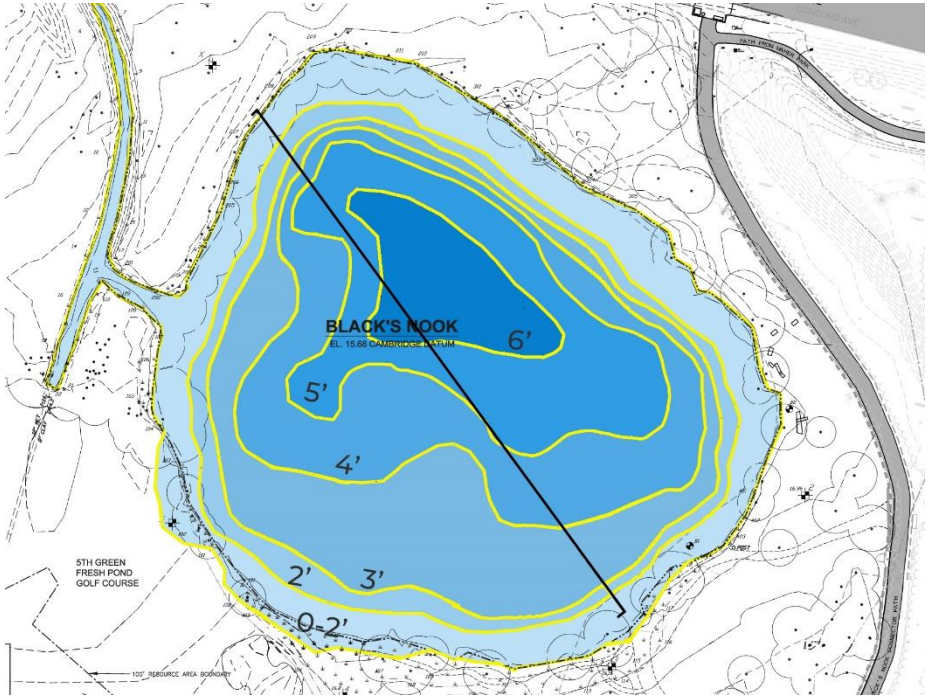
Field Survey and Metrics:

1. Bathymetric Survey –
   - Small boat, electronic instrumentation, hand probes, underwater camera, GPS unit
2. Sediment Characterization -
   - Sediment probes to evaluate depth and nature of sediment
   - Core samples (3) for sediment quality and for dredging feasibility assessment (0-1', 1'-2', and 2'-3' depths)

POND BATHYMETRY



Whitman & Howard 1986

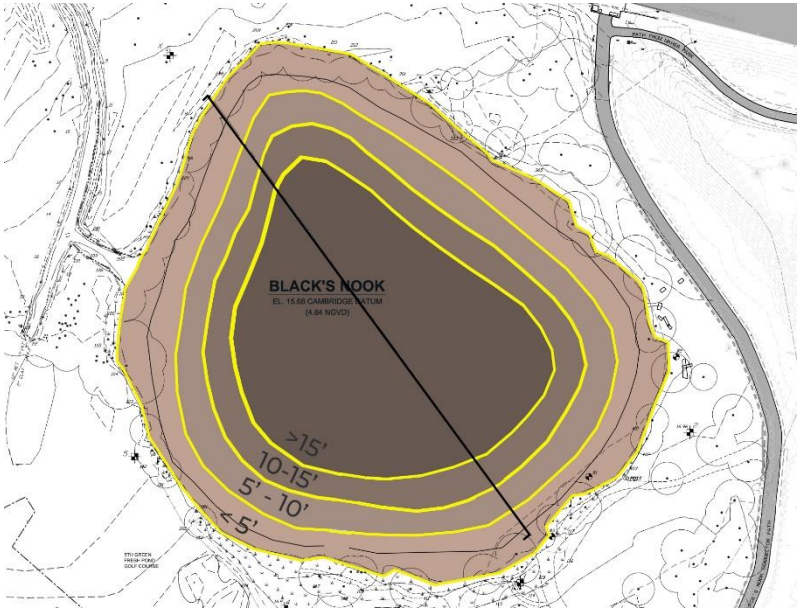


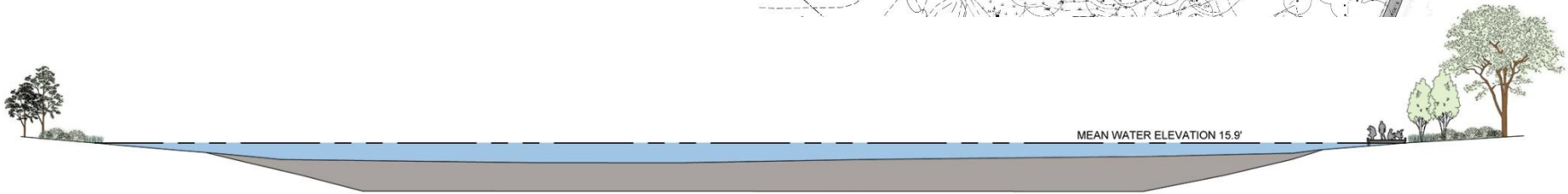
Year 2020

SEDIMENT CHARACTERIZATION

Field Survey and Metrics:

1. Bathymetric Survey.
2. Sediment Characterization.





Soft Sediment Section A-A’

SEDIMENT CHARACTERIZATION

Field Survey and Metrics:

1. Sediment probes used to evaluate depth and nature of sediment.
2. Core samples (3) for sediment quality and for dredging feasibility assessment (0-12”; 12”-24”; and 24”-36” depths).

SEDIMENT CHARACTERIZATION

0 to 12” Layer

Loose Organic Muck

12” to 24” Layer

Mixture of Organic Muck and Pure Peat

24” to 36” Layer

Pure Peat

SEDIMENT CHARACTERIZATION

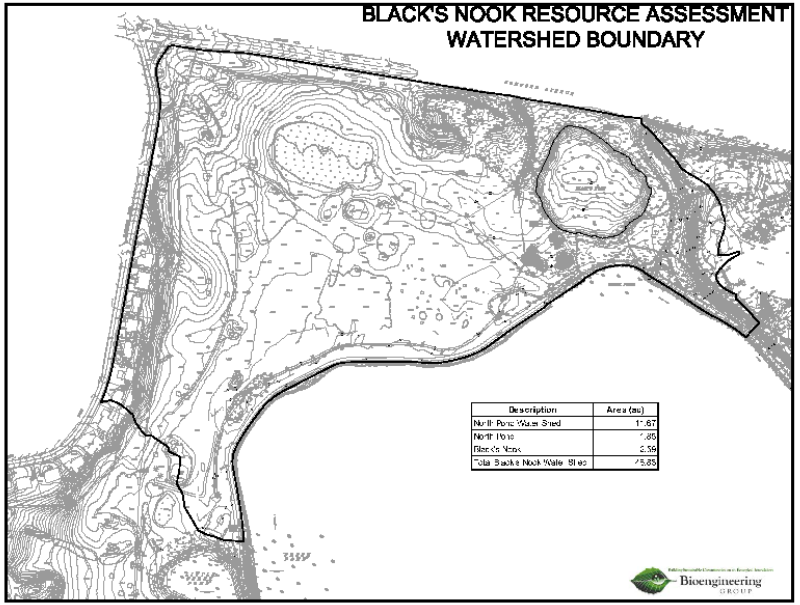
Key Findings:

1. Marked change in physical features with sediment depth.
2. Nearly all contaminants below standard or below detection limits.
3. Lead (Pb) in upper foot of 2 Stations exceeds most stringent standards.
4. Available phosphorus (P) is substantial, even in upper 2’ of sediment (high organic content).

WATERSHED & GROUNDWATER INPUTS

Field Survey and Metrics:

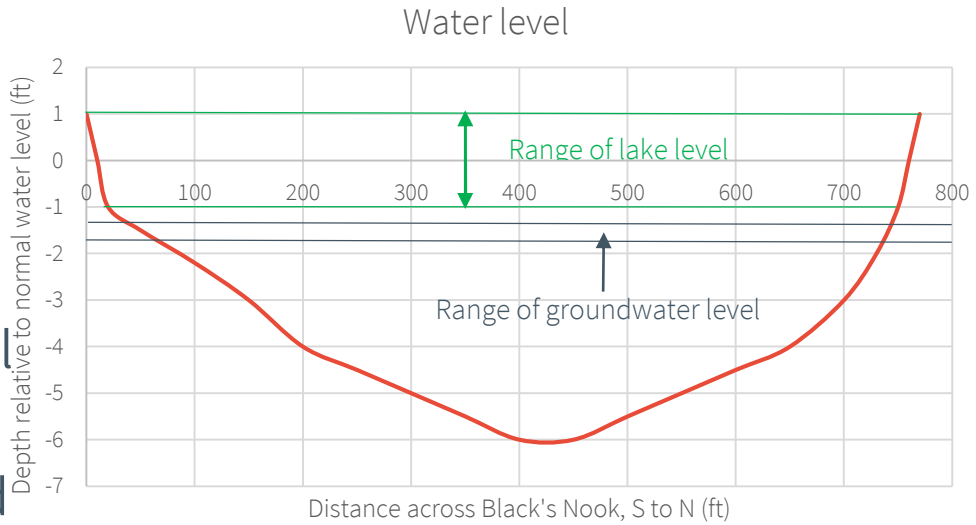
1. Confirm watershed boundaries.
2. Estimate runoff inputs and nutrient loading from watershed.
3. Locate existing groundwater wells and monitor levels relative to Black's Nook.
4. Estimate groundwater inflow and potential nutrient loading from contribution area.



WATERSHED & GROUNDWATER INPUTS

Key Findings:

1. Pond fluctuates 1’ above and below normal water level (0).
2. Groundwater level less than normal pond elevation.
3. Existing peat layer restricts lateral groundwater flow.
4. Pond hydrology mainly impacted by precipitation (limited surface runoff; little groundwater input; and rare Stream A inflow).



WATER QUALITY

Field Survey and Metrics:

1. Temperature, dissolved oxygen, pH, conductivity, turbidity, & chlorophyll-a.
2. Total and dissolved phosphorus, Nitrate-N, Ammonium-N, TKN.
3. Surface and bottom samplings with field instruments and boat.
4. Stormwater sampling - Streams A and B (FPGC).
5. Samplings conducted October 2019, March and July 2020.

WATER QUALITY

Key Findings:

1. WQ data fairly consistent with 20-year historical CWD data.
2. Low dissolved oxygen (bottom) and high pH (surface) caused by excessive plant growth.
3. Large temperature gradient caused by high plant density restricting mixing and sunlight penetration.
4. Most water quality features are within normal ranges for ponds in acceptable condition.

WATER QUALITY (contd.)

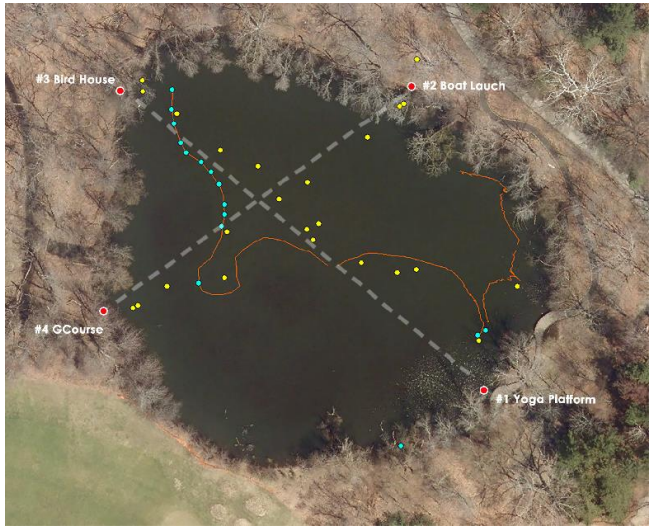
Key Findings:

5. Secchi transparency not measured due to density of aquatic plants.
6. High Ammonium levels cause potential for toxicity during summer months (elevated temperatures and pH).
7. Nitrate concentrations are low; Total Kjeldahl N levels are moderate.
8. Total Phosphorus levels elevated; very high at bottom; indicates internal loading from pond sediments.

AQUATIC VEGETATION

Field Survey and Metrics:

1. Floating, Emergent, and Submerged Aquatic Vegetation surveyed.
2. Rowboat, rake, right angle prism, GPS, and transects utilized.
3. Observations during two growing seasons in 2019 and 2020.
4. 2/3 pond area is floating and emergent vegetation.
5. 1/3 pond area is native coontail (dense submergent growth).



AQUATIC VEGETATION

Key Findings:

1. Aquatic plants not diverse but excessively abundant, filling entire water column.
2. Plant density is higher than desirable.
3. Dominant species include: water smartweed, coontail, and Indian lotus.
4. Indian lotus spread quickly in 2020; estimate 80-90% coverage in < 10 years.
5. Submergent species are gradually being eliminated due to floating leaves.
6. Indian lotus and water chestnut are only non-native species.

AQUATIC VEGETATION - SUBMERGED

Dominant:

1. **Coontail** (*Ceratophyllum demersum*) – native; dense growth over 0.75 acres; up to 6' water depth.

Rare:

1. **Brazilian Waterweed** (*Egeria densa*) – non-native.

AQUATIC VEGETATION - FLOATING

Dominant:

1. Indian Lotus (*Nelumbo nucifera*) – non-native; dense growth over 1.25 acres; up to 5’ depth.

Rare:

1. Duckweed (*Lemna minor*) – native; scattered growth.
2. Water Chestnut (*Trapa natans*) – non-native; invasive; scattered growth; active removal.
3. Blue Green Algae – native.

AQUATIC VEGETATION - EMERGENT

Dominant:

1. Water Smartweed (*Persicaria amphibia*) – native; surface growth over 0.75 acres; 0-5’ water depths.


Subdominant (near platform and shoreline):

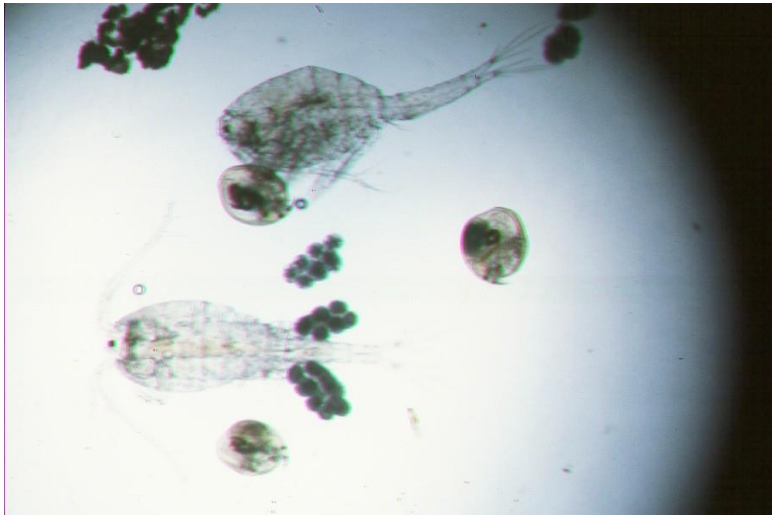
1. Pickerelweed (*Pontederia cordata*)
2. White Water Lily (*Nymphaea odorata*) – native; scattered surface growth
3. Yellow Water Lily (*Nuphar advena*) – non-native; scattered surface growth




PHYTOPLANKTON & ZOOPLANKTON

Field Survey and Metrics:

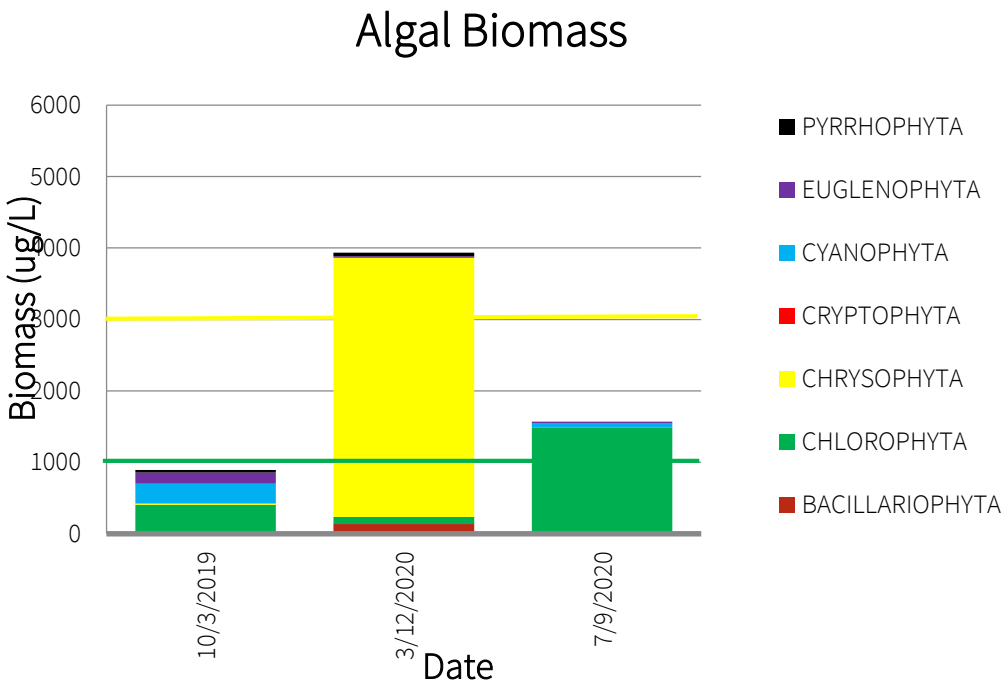
1. Qualitative and Quantitative Sampling.
2. Collected Algae and characterize Algae community in relation to desired uses.
3. Collected surface Phytoplankton and provide a count by taxon (at time of water quality sampling).
4. Collected Zooplankton (for entire water column) and provide a count by taxon.
5. Sampled October 2019, March and July 2020.



PHYTOPLANKTON

Key Findings:

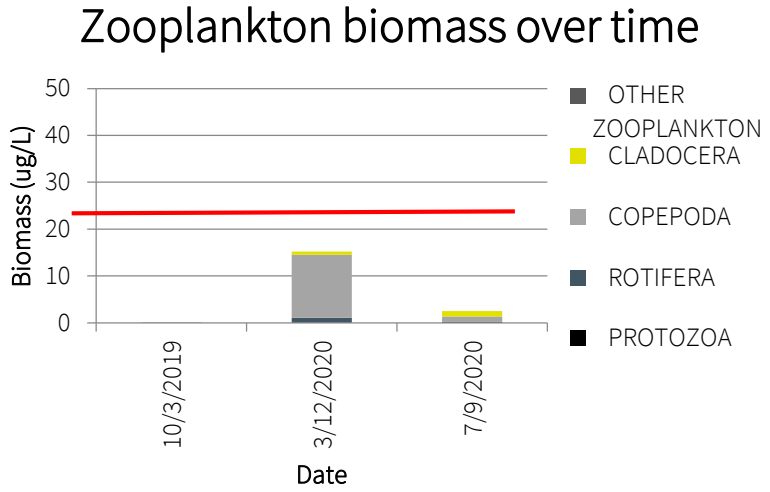
1. Algal biomass is not excessive, despite high Chlorophyll A readings.
2. Green and gold algae most abundant groups.
3. Cyanobacteria present in 2019/2020 but not dominant due to rooted plants.
4. Nutrient levels will support algal blooms if rooted plants are managed.

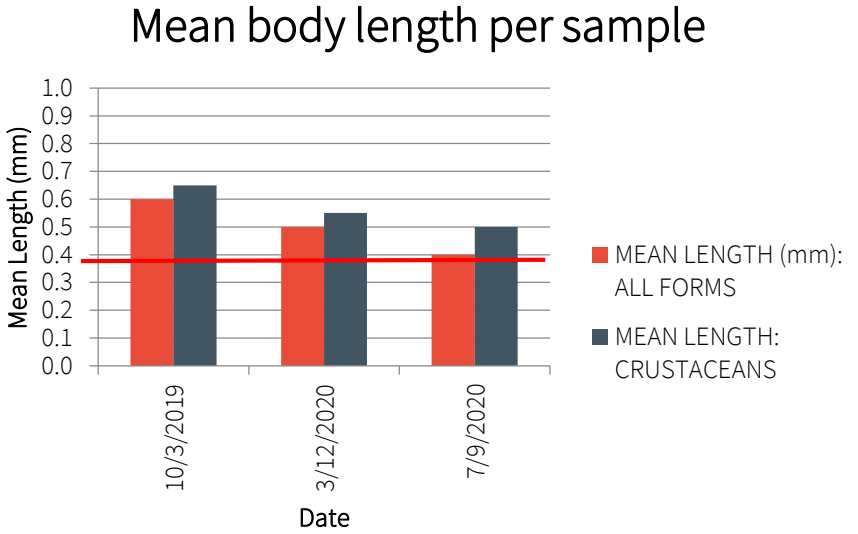


ZOOPLANKTON

Key Findings:

1. Zooplankton not abundant (under 25 ug/L); preferred values of 100 ug/L or greater.
2. Lack of Open Water limits zooplankton habitat.
3. Average zooplankton size is moderate but desirable.
4. Larger-bodied species preferred by fish not abundant.

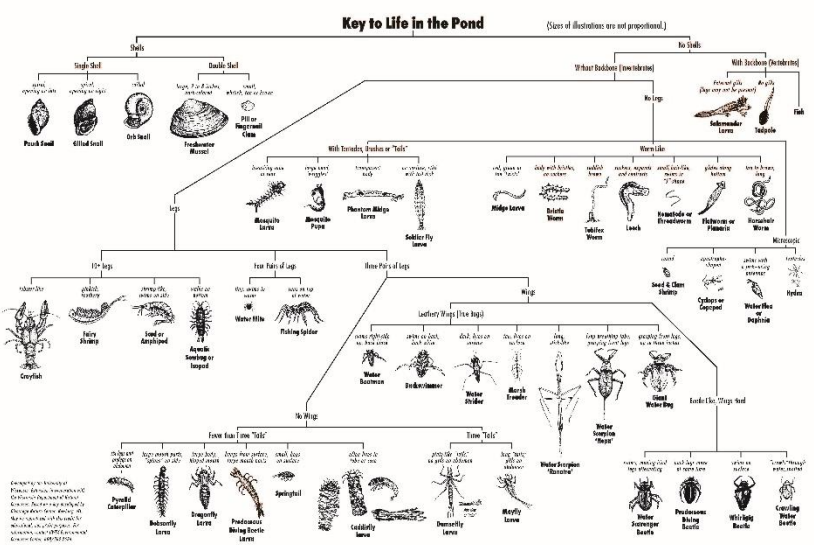




BENTHIC COMMUNITY

Field Survey and Metrics:

1. Benthos (Aquatic Macroinvertebrate) Collecting.
2. Also identify water depth, temperature, Secchi disk reading (clarity).
3. Rowboat, grab sampler (mini hand dredge), kick net, GPS unit.
4. Lab sampling, photographs, collection.
5. Species list, richness, population density, diversity, relative abundance, & community composition.



BENTHIC COMMUNITY

Key Findings:

1. Kick Net Sampling:
   - 51 Species
   - Diversity Index 2.39 (Moderate)
2. Ponar Sampling:
   - 30 Species
   - Diversity Index 2.57 (High)
3. Most species tolerant of low water quality.

Most Abundant Species - Kick Net Sampling

Taxon	Common Name	Tolerance
Dero nivea	naiad worm	High
Caenis sp.	mayfly	High
Corynoneura sp	midge	Moderate
Enallagma sp.	damselfly	High

Most Abundant Species – Ponar Sampling

Taxon	Common Name	Tolerance
Chironomus sp.	midge	10
Dero sp.	naiad worm	10
Dero nivea	naiad worm	10
Dicrotendipes sp.	midge	8
Paranytarsus sp.	midge	6

FISH SURVEY

Field Survey and Metrics:

1. Shallow pond observance/net capture.
2. Electro-capture (deeper) – temporarily immobilizes for study in live well before releasing.
3. Richness, diversity, and relative abundance.
4. Community composition.
5. Incidence of disease or parasitism.
6. Size class (reproduction indicator).
7. Water quality relevance.

FISH SURVEY

Key Findings:

1. Four species detected.
2. Tolerant of Degraded Habitat.
3. Primarily young fish – low survivorship/high reproduction.

Species	Native Distribution (in relation to Northeast)	Occurrence in Northeast (common to rare)	Water Class (General Habitat preference)	Water temperature preference	Trophic Class	Tolerance to degraded habitat
Spottail Shiner	Native/Introduced[1]	common	Rivers to Lakes	warmwater	Water Column	Intermediate
Golden Shiner	Native	common	Streams to Lakes	warmwater	Generalist Feeder	Tolerant
Goldfish	introduced	common	Rivers to Lakes	warmwater	Generalist Feeder	Tolerant
Pumpkinseed	Native	common	Streams to Lakes	warmwater	Generalist Feeder	Intermediate

HERPTILE SURVEY

Field Survey and Metrics:

1. Breeding and Basking Study for Reptiles & Amphibians .
2. Breeding frogs and toads – recorded calls and surveys.
3. Turtles, snakes, salamanders, and newts - disturbing cover observations and surveys.
4. Includes North Pond, Little Fresh Pond, and north shore of Fresh Pond.
5. Late April - June 2020.

HERPTILE SURVEY

Key Findings:

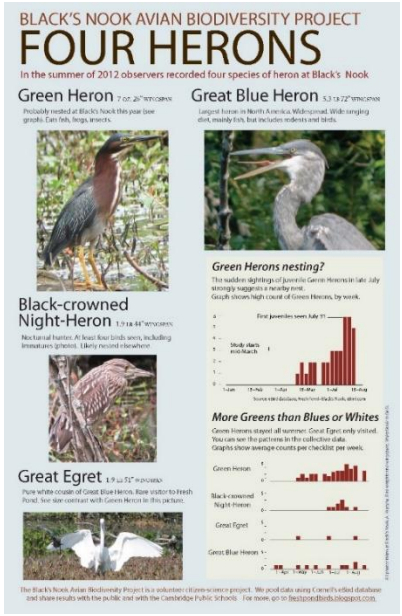
1. 3 Species Detected.
2. Only Bullfrog presently abundant.
3. Peepers may be the result of reintroduction effort.

Species	Scientific Name	Black's Nook (N)	Black's Nook (S)	Fresh Pond	Little Fresh Pond
Bullfrog	Lithobates catesbeianus	Abundant	Abundant	0	Abundant
Green Frog	Lithobates clamitans	Uncommon	Uncommon	0	0
Spring Peeper	Pseudacris crucifer	Common	0	0	0

BREEDING BIRD SURVEY

Field Survey and Metrics:

1. Standardized census methods and Breeding Bird Atlas.
2. Post migration period - May 25th
3. Recorded calls, observed behavior, & survey (seen and heard).
4. List of breeding birds, diversity, habitat dependence.
5. Late May – June 30, 2020.



BREEDING BIRD SURVEY

Key Findings:

1. 34 Species Detected.
2. 9 Species Confirmed Nesting, 7 Probable.
3. Aquatic insects and riparian vegetation important contributors of pond to bird community.

Pond Use by Bird Species at Black's Nook

Diet: Aquatic Insects	Diet: Aquatic Vertebrates	Diet: Aquatic Vegetation	Breeding Habitat
American Redstart	Black-crowned Night-Heron	Canada Goose	Common Grackle
Cedar Waxwing	Green Heron	Mallard	Eastern Kingbird
Chimney Swift	Great Blue Heron		Great Crested Flycatcher
Common Grackle			Orchard Oriole
Eastern Kingbird			Baltimore Oriole
Gray Catbird			Red-winged Blackbird
Great Crested Flycatcher			Warbling Vireo
Red-winged Blackbird			Yellow Warbler
Tree Swallow			

ACOUSTIC BAT SURVEY

Field Survey and Metrics:

1. Confirms presence of bats and identifies species present.
2. Automated high-frequency recording devices (USFWS and N.A. Bat Monitoring Program specifications).
3. Eight (8) consecutive nights.
4. Recorded calls, observed species, & weather data.
5. Mid May – June 30, 2020.

ACOUSTIC BAT SURVEY

Key Findings:

1. 6 Species Detected (9 Total in MA).
2. Two Listed Species – both rare at the site.
3. Potentially significant bat foraging habitat.

Little Brown Bat

N. Long-eared Bat

Species	Scientific Name	Total Calls	State Status	Federal Status
Big Brown Bat	Eptesicus fuscus	566	-	-
Eastern Red Bat	Lasiurus borealis	4	-	-
Hoary Bat	Lasiurus cinereus	483	-	-
Silver-haired Bat	Lasionycterus noctivagans	650	-	-
Little Brown Bat	Myotis lucifugus	3	Endangered	-
Northern Long-eared Bat	Myotis septentrionalis	10	Endangered	Threatened

POND REHABILITATION STRATEGIES

1. Increase oxygen levels, especially in summer.
2. Stop spread of aquatic vegetation.
3. Maximize benefits through efficient removal of sediment.
4. Create emergent wetland vegetation habitat and maintain/enhance the riparian buffer.
5. Improve fish and herptile communities.
6. Promote Sustainable Management practices (low maintenance).

NEXT STEPS

2020 and 2021:

1. Issue draft report – Data Collection.
2. Resource Area Delineation, if necessary.
3. Develop Rehabilitation Alternatives and Cost Analysis.
4. FPAB Meeting – Rehabilitation Alternatives and Preferred Alternative (January 2021).
5. Develop Phased Approach.

	4	5
Method	Dredging	Drawdown
How does it Work?	Sediment is physically removed, also removing accumulated nutrients and organic material	Lowering water level will dry sediments and allow sediments to oxidize and compact.
Potential Benefits	Reduced internal nutrient supply, increases water depth, can reduce sediment oxygen demand	May alter nutrient availability. Opportunity for shoreline cleanup.
Potential Drawbacks	Expensive if disposal site not nearby. Temporary turbidity, removes macroinvertebrates, temporarily interferes with recreation. Might reduce ponds' natural capacity for denitrification and thus allow more soluble nitrogen to make its way to coastal embayments.	Possible impacts on contiguous wetlands, may change habitat for amphibians. Ponds with water level controls may be managed for herring. Temporary loss of waterfowl habitat. Potential to create highly unappealing aesthetic conditions for neighbors.
Data gaps to make decision	Quality of sediments (affects disposal options and costs), detailed bathymetry to estimate volumes and costs.	Water level control needed, therefore not feasible for most ponds
Costs (Relative)	$15,000 - $50,000/acre *	<$100/acre if structures adequate*
Permitting issues	Requires permit for dredging and disposal Conservation Commission approval needed.	Permit required, complexity depends on impacts on wetland and other ponds. Conservation Commission approval needed.
Longevity	Moderate to long	Moderate to long
Ponds that might be appropriate for this alternative	Lovers, Stillwater, Emery	Cranberry

REHABILITATION OPPORTUNITIES

Considerations:

1. Do Nothing.
2. Selective Dredging.
3. Mechanical Harvesting of Plants.
4. Benthic Barriers.
5. Extensive Dredging.

QUESTIONS & INPUT

ASSESSMENT APPROACH

Modeling Approach (Standard):

- Define existing water quality and habitat conditions
- Identify pollutant(s) responsible for degraded water quality and/or habitat conditions
- Define targets that will support desired use
- Quantify acceptable loads
- Identify contributing point and nonpoint sources of pollution
- Quantify transport and attenuation
- Develop a strategy for source reductions targets