404 Wyman Street, Ste. 375
Waltham, MA 02451

T 781.419.7696
TRCcompanies.com

Revised November 20, 2023

Andrew Hultin
Conservation Administrator
Town Hall
75 Middle Street
Weymouth, Massachusetts 02189

Re: ***Annual Monitoring Report – 2023***
Whitman's Pond
Weymouth, Massachusetts
TRC Project No. 479512.0000.0000

Dear Mr. Hultin,

TRC is pleased to provide the Annual Monitoring Report for Whitman's Pond for the 2023 management season to the Town of Weymouth (Town).

A brief description of the pond is presented below, followed by the approach of this study, a summary of the results, and a preliminary assessment of management recommendations for implementation in 2024.

Overview of Whitman's Pond, showing water quality locations.

Setting

Whitman's Pond is approximately 186 acres and located entirely in the Town of Weymouth. The pond is comprised of three basins; the South Cove (located south of Washington Street), the West Cove (located west of Middle Street), and the Main Basin (located between Lake Street and Washington Street). The South Cove receives headwaters from Old Swamp River. The West Cove receives waters from two unnamed small ponds. Both the South and West Cove feed into the Main Basin. The Main Basin outlets to Weymouth Back River by Iron Hill Street, which eventually discharges into the Atlantic Ocean.

The pond supports outdoor recreation, wildlife habitat, and use as a drinking water supply (South Cove only). Whitman's Pond also provides spawning habitat for river herring and supports a large herring run. Adult river herring typically migrate upstream into Whitman's Pond in April, where they spawn in suitable habitats. After spawning, river herring leave the pond to return to coastal waters.

The goal of the Town is to better manage nuisance aquatic vegetation growth within Whitman's Pond while also protecting the resources of the pond.

Management Actions Implemented in 2023

The management actions undertaken in 2023 included the following:

1. **Mechanical harvesting using the Town-owned mechanical harvester**. This action was focused primarily on the western cove of the Main Basin. Starting in July 2023, the Town operated the harvester for 316 hours over the course of 44 days and removed 276 cubic yards of aquatic vegetation.
2. **Diver assisted suction harvesting (DASH)**. This action was focused entirely within a five-acre DASH Pilot Study Area located in the western cove of the Main Basin. The Town contracted with New England Aquatic Services to provide 70 hours of DASH over the course of eight days in August 2023. The result was the removal of 22.55 cubic yards of fanwort and variable-leaf milfoil from approximately 0.70 acres of the pond.

No other physical or chemical methods of aquatic vegetation management were implemented in 2023.

Actual area of pilot scale DASH operations completed at Whitman's Pond in August 2023, compared to DASH Pilot Study Area defined in 2023 Work Plan (hatched area in inset). An approximate area for mechanical harvesting operations also appears (stippled area in inset).
Source of actual DASH map: New England Aquatic Services

Approach

TRC completed field visits to Whitman's Pond on May 30, July 17, and September 15, 2023. During these visits, TRC conducted a field assessment of physical, biological, and water quality conditions in the pond. The approach used for the 2023 monitoring program is discussed in the following sections.

Aquatic Vegetation

On May 30 and September 15, 2023, TRC conducted mapping of aquatic plants, with a focus on identification of the extent and density of exotic and nuisance species.

TRC used plant rakes and direct observation to map the aquatic vegetative community composition, as well as cover and biovolume at more than 140 locations in Whitman's Pond. All vascular aquatic plants were identified to genus or species level in the field by qualified staff. Percent cover and biovolume were visually ranked using the following scale:

- 0 = 0% (no cover)
- 1 = 1-24%
- 2 = 25-49%
- 3 = 50-74%
- 4 = 75% or more.

All observed species, percent cover, and biovolume were recorded at each point and positions were collected with a GPS receiver.

Water Quality

TRC assessed water quality at five locations during each of the four field visits. The locations that were assessed included the outlet, South Cove, West Cove, and the surface and bottom of the Main Basin at the deep hole spot (Figure1). Water levels were sufficient for water quality sampling in all portions of Whitman's Pond in 2023.

The following parameters were measured in the field:

- Temperature
- Dissolved oxygen
- Specific conductance
- pH
- Turbidity
- Apparent color
- Transparency (Secchi disk)

Additionally, water quality samples were collected at each sampling location and sent to Phoenix Environmental Laboratories of Manchester, Connecticut for analysis of total nitrogen, total phosphorus, and dissolved phosphorus. Water quality samples collected for chlorophyll a and *E. coli* were sent to Alpha Analytical Laboratory (Alpha) of Westborough, Massachusetts for analysis. Chlorophyll a was only collected at the surface of the deep hole spot of the Main Basin.

The surface of the main basin was also sampled and analyzed for phytoplankton. Phytoplankton samples were sent to Aquatic Analysts for enumeration and identification.

Results

Aquatic Vegetation

Spring 2023 – Pre-Management Mapping

Aquatic plant growth was already extensive in Whitman's Pond at the time of the May 30, 2023 survey, covering approximately 102 acres, including all of the West Cove and South Cove (Figures 1 and 2). The majority of the aquatic plant growth observed was very dense (i.e., greater than 75% plant cover). Three exotic species were observed at this time, including fanwort (*Cabomba caroliniana*), variable-leaf milfoil (*Myriophyllum heterophyllum*), and curly-leaf pondweed (*Potamogeton crispus*).

Fanwort was present in all three basins of Whitman's Pond, including the entirety of the West Cove and substantial portions of the Main Basin and South Cove (Figure 3). Although the extent and density of growth was lower than observed in the 2022 aquatic plant survey, the primary reason for this is likely to be season. Fanwort tends to remain low in the water column until summer.

Variable-leaf milfoil was the dominant species in all three basins of Whitman's Pond, occupying nearly 100 acres, and was the most extensive species in the Main Basin (Figure 4). The extent and density of growth was higher than observed in the sole 2022 aquatic plant survey, which was conducted in August. However, this is likely due to increased competition with fanwort in summer.

Curly-leaf pondweed was also widespread in Whitman's Pond, covering a total of 81 acres and present in all three basins (Figure 5). Although density of curly-leaf pondweed was generally low, it locally reached moderate to high densities, especially in the West Cove.

Late Summer 2023 – Post-Management Mapping

Aquatic plant growth remained extensive in Whitman's Pond at the time of the September 15, 2023 survey, covering nearly 90 acres, including all of the West Cove and South Cove (Figures 6 and 7). The majority of the aquatic plant growth observed was very dense, although pockets of less dense vegetation were observed in portions of the western cove of the Main Basin that had been mechanically harvested or diver harvested using DASH. Two exotic species were observed at this time, including fanwort and variable-leaf milfoil.

Fanwort was present in all three basins of Whitman's Pond, including the entirety of the West Cove and substantial portions of the Main Basin and most of the South Cove (Figure 8). Compared to spring 2023, fanwort growth was much denser, leading it to become the dominant aquatic plant species in Whitman's Pond by September. The primary exception to this pattern was in areas where water lilies were dense enough to shade out fanwort (e.g., along the northern shoreline of the western cove of the Main Basin and the southern end of the South Cove), where DASH was used to directly remove fanwort from the DASH Pilot Study Area, and in the primary boating channel between the Middle Street access ramp and deep waters of the Main Basin.

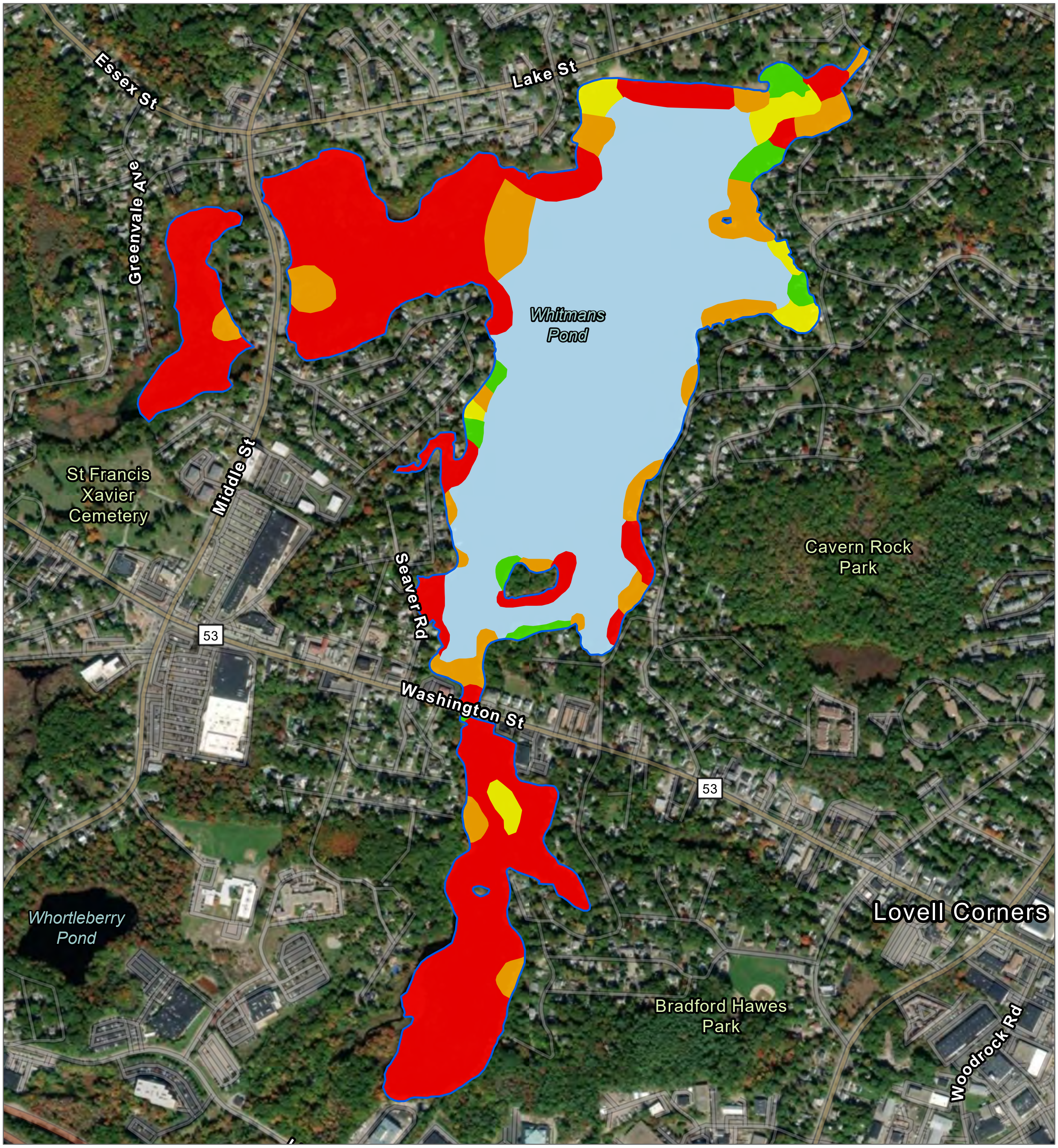
Variable-leaf milfoil was still present in Whitman's Pond during the September survey. However, its extent and density both dropped precipitously as fanwort growth surged (Figure 9). Some variable-leaf milfoil was also likely removed from the DASH Pilot Study Area, although the split between fanwort and variable-leaf milfoil was not explicitly tracked by the contractor. Overall, variable-leaf milfoil beds in September 2023 were similar in total extent to the August 2022 survey.

Curly-leaf pondweed was not observed in Whitman's Pond during the September survey. This observation is expected, given the fact that curly-leaf pondweed completes its life cycle early in the growing season (often by the end of June). It is also consistent with results from 2022, when it was observed only incidentally.

Table 1. Aquatic Invasive Species Coverage in Whitman's Pond - 2023

Basin	Density (%)	May			September	
		Fanwort (acres)	Variable-Leaf Milfoil (acres)	Curly-Leaf Pondweed* (acres)	Fanwort (acres)	Variable-Leaf Milfoil (acres)
Total (all pond areas) 186.22 acres	4 (76-100%)	4.5	16.4	0.0	48.9	0.1
	3 (51-75%)	13.3	10.0	1.4	15.8	0.0
	2 (26-50%)	35.7	63.5	3.5	4.9	0.5
	1 (1-25%)	29.7	5.2	76.1	5.3	9.6
	Total	**83.2**	**95.1**	**81.0**	**74.8**	**10.2**
Main Basin 148.22 acres	4 (76-100%)	4.5	7.3	0.0	28.6	0.1
	3 (51-75%)	11.3	8.4	0.0	11.8	0.0
	2 (26-50%)	22.7	37.0	1.2	2.1	0.5
	1 (1-25%)	6.7	4.4	41.8	5.3	3.6
	Total	**45.2**	**57.1**	**43.0**	**47.7**	**4.1**
West Cove 10.21 acres	4 (76-100%)	0.0	0.6	0.0	7.6	0.0
	3 (51-75%)	2.0	1.2	1.4	0.0	0.0
	2 (26-50%)	1.9	8.4	0.0	0.7	0.0
	1 (1-25%)	6.3	0.0	8.8	0.0	0.0
	Total	**10.2**	**10.2**	**10.2**	**8.2**	**0.0**
South Cove 27.79 acres	4 (76-100%)	0.0	8.5	0.0	12.8	0.0
	3 (51-75%)	0.0	0.3	0.0	4.0	0.0
	2 (26-50%)	11.1	18.1	2.2	2.1	0.0
	1 (1-25%)	16.7	0.8	25.6	0.0	6.0
	Total	**27.8**	**27.7**	**27.8**	**18.9**	**6.0**

*Curly-leaf pondweed completes its life cycle early in the growing season – typically by June – and was therefore only observed during the May surveys.



TOTAL PLANT COVERAGE

- 0% (83.43 ACRES)
- 1% - 25% (4.57 ACRES)
- 26% - 50% (5.28 ACRES)
- 51% - 75% (18.31 ACRES)
- 76% - 100% (74.22 ACRES)

BASE MAP: ESRI WORLD IMAGERY 2022
DATA SOURCES: TRC, GPS LOCATIONS, 2023

N

0 450 900
FEET
1:10,800 1" = 900'

PROJECT: **TOWN OF WEYMOUTH**
WHITMAN'S POND
WEYMOUTH, MASSACHUSETTS

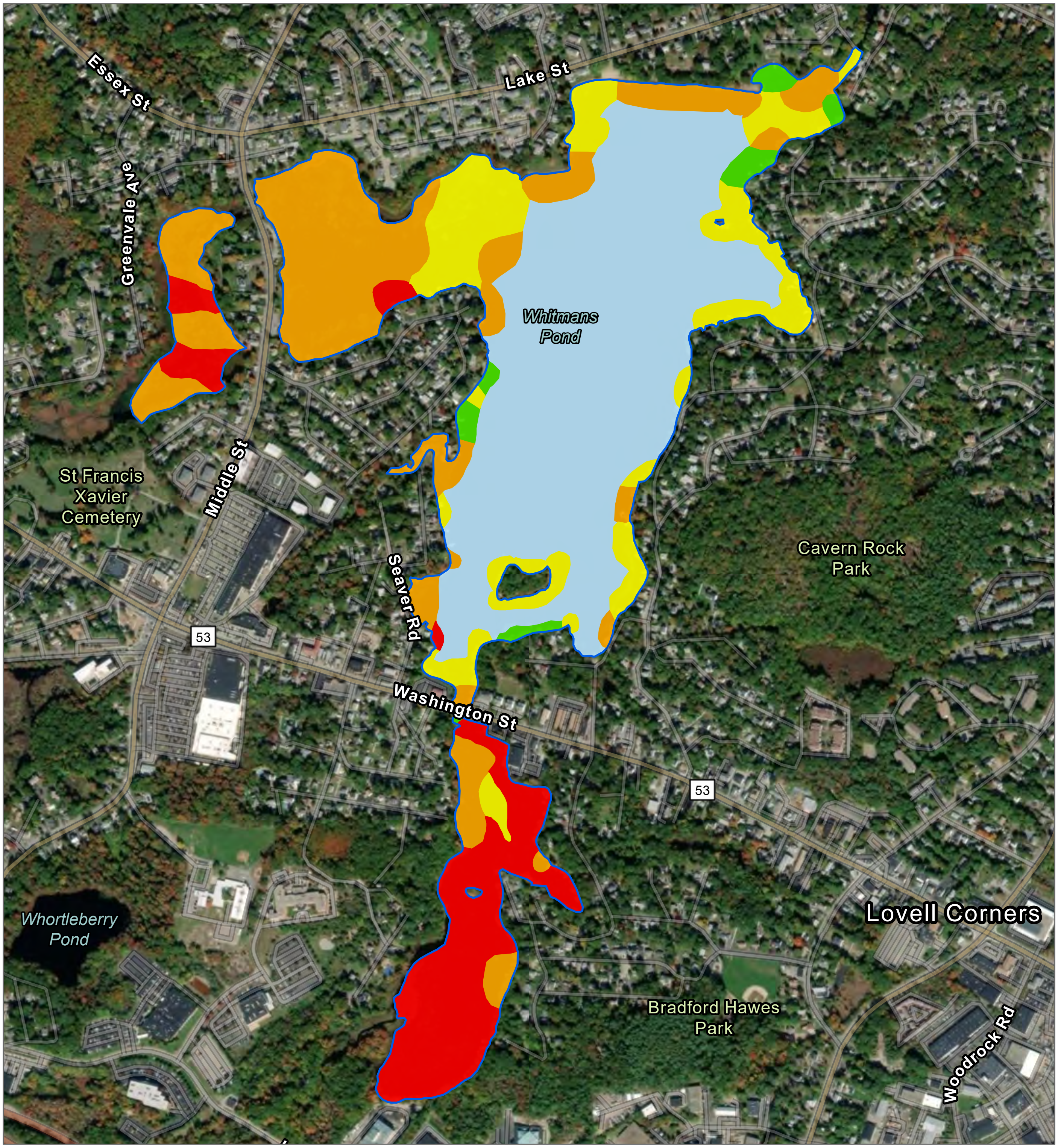
TITLE: **2023 PRE-TREATMENT TOTAL PLANT COVERAGE**

DRAWN BY:	J. BERTHERMAN	PROJ. NO.:	479512
CHECKED BY:	M. LADEWIG	**FIGURE 1**	
APPROVED BY:	M. LADEWIG		
DATE:	NOVEMBER 2023		

TRC
10 HEMINGWAY DRIVE
2ND FLOOR
EAST PROVIDENCE, RI 02915
PHONE: 401.330.1236

FILE: 479512_WHITMANSPOND_PRETREATMENT_2023

COORDINATE SYSTEM: NAD 1983 STATEPLANE MASSACHUSETTS MAINLAND FIPS 2001; MAP ROTATION: 0
-- SAVED BY: JBERTHERMAN ON 11/13/2023, 19:27:42 PM; FILE PATH: T:\1-PROJECTS\TOWNOFWEYMOUTH\479512_WHITMANS_POND\2-APRX\2023 PRE-TREATMENT\479512_WHITMANSPOND_PRETREATMENT_2023\479512_WHITMANSPOND_PRETREATMENT_2023.APRX; LAYOUT NAME: TOTAL COVER



TOTAL PLANT BIOVOLUME

- 0% (83.43 ACRES)
- 1% - 25% (4.09 ACRES)
- 26% - 50% (26.45 ACRES)
- 51% - 75% (45.22 ACRES)
- 76% - 100% (26.61 ACRES)

BASE MAP: ESRI WORLD IMAGERY 2022
DATA SOURCES: TRC, GPS LOCATIONS, 2023

N

0 450 900
FEET
1:10,800 1" = 900'

PROJECT: **TOWN OF WEYMOUTH**
WHITMAN'S POND
WEYMOUTH, MASSACHUSETTS

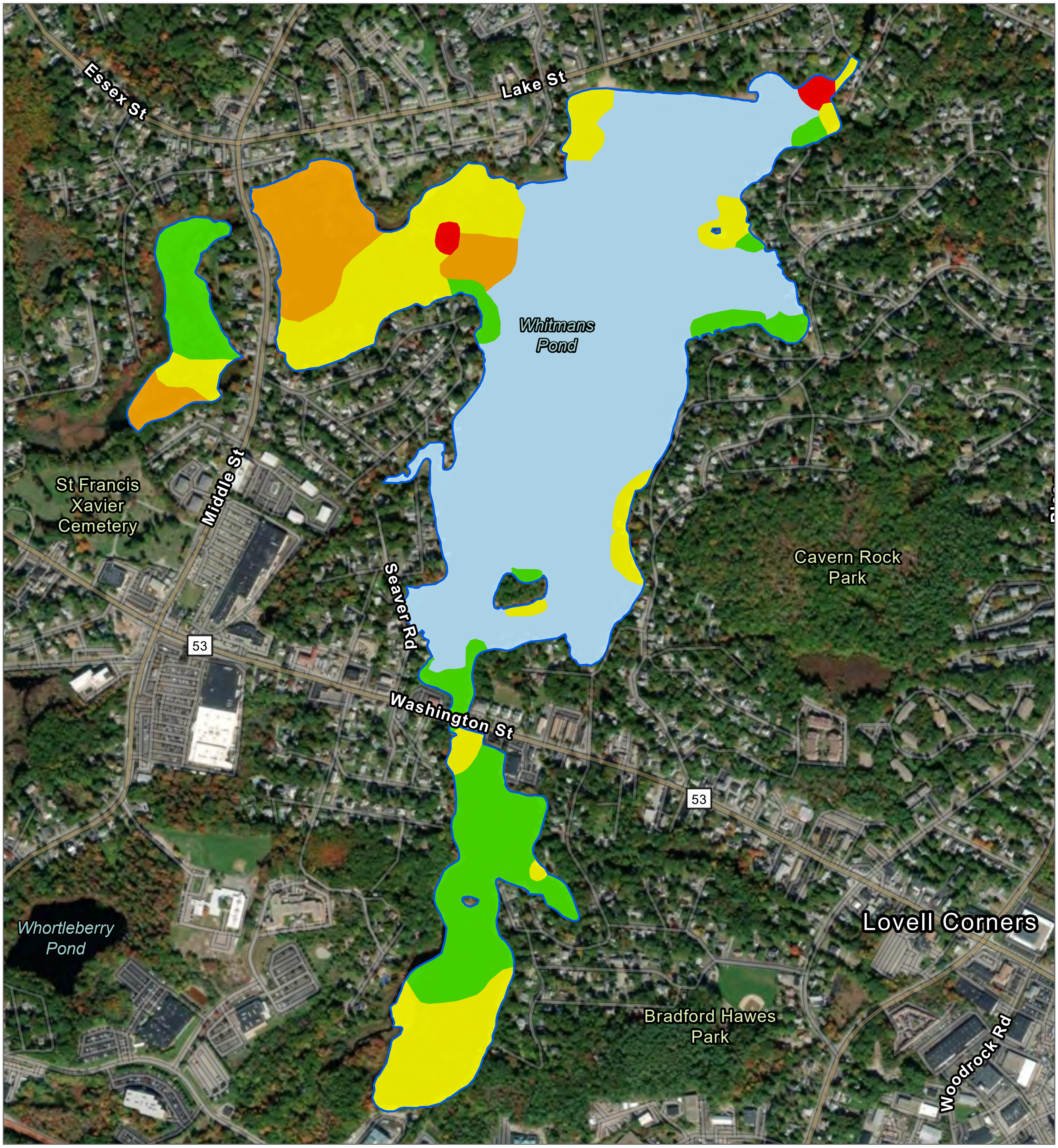
TITLE: **2023 PRE-TREATMENT TOTAL PLANT BIOVOLUME**

DRAWN BY:	J. BERTHERMAN	PROJ. NO.:	479512
CHECKED BY:	M. LADEWIG	**FIGURE 2**	
APPROVED BY:	M. LADEWIG		
DATE:	NOVEMBER 2023		

10 HEMINGWAY DRIVE
2ND FLOOR
EAST PROVIDENCE, RI 02915
PHONE: 401.330.1236

FILE: 479512_WHITMANSPOND_PRETREATMENT_2023

COORDINATE SYSTEM: NAD 1983 STATEPLANE MASSACHUSETTS MAINLAND FIPS 2001; MAP ROTATION: 0
– SAVED BY: JBERTHERMAN ON 11/13/2023, 19:37:41 PM; FILE PATH: T:\1-PROJECTS\TOWNOFWEYMOUTH\479512_WHITMANS_POND\2-APRX\2023 PRE-TREATMENT\479512_WHITMANSPOND_PRETREATMENT_2023\479512_WHITMANSPOND_PRETREATMENT_2023.APRX; LAYOUT NAME: BIOVOLUME



FANWORT COVERAGE

- 0% (102.58 ACRES)
- 1% - 25% (29.70 ACRES)
- 26% - 50% (35.99 ACRES)
- 51% - 75% (16.05 ACRES)
- 76% - 100% (1.49 ACRES)

BASE MAP: ESRI WORLD IMAGERY 2022
DATA SOURCES: TRC, GPS LOCATIONS, 2023

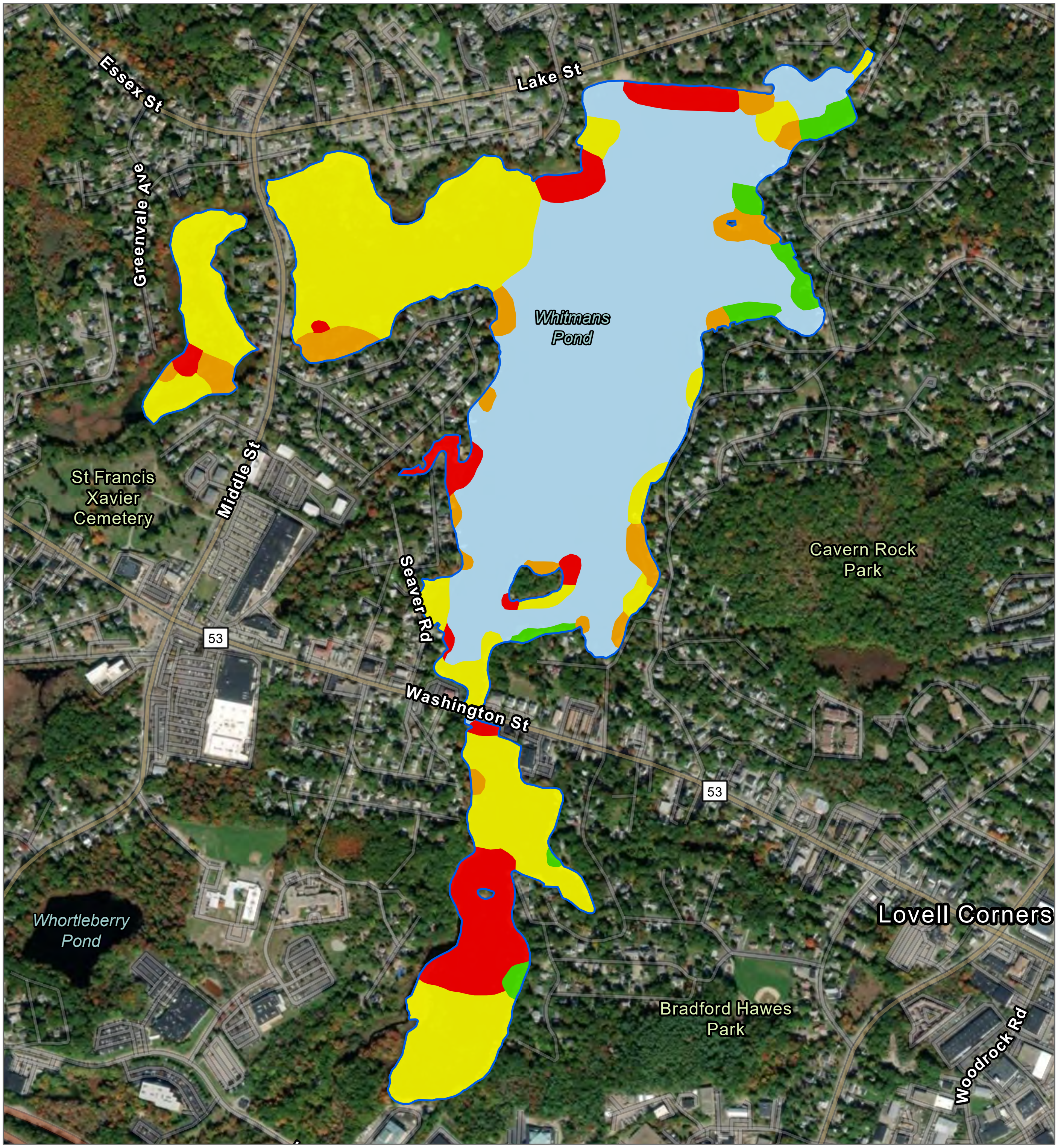
N

0 450 900
FEET
1:10,800 1" = 900'

PROJECT:	TOWN OF WEYMOUTH WHITMAN'S POND WEYMOUTH, MASSACHUSETTS
TITLE:	2023 PRE-TREATMENT FANWORT COVERAGE
DRAWN BY:	J. BERTHERMAN
PROJ. NO.:	479512
CHECKED BY:	M. LADEWIG
APPROVED BY:	M. LADEWIG
DATE:	NOVEMBER 2023
	FIGURE 3
FILE:	479512_WHITMANSPOND_PRETREATMENT_2023

TRC
10 HEMINGWAY DRIVE
2ND FLOOR
EAST PROVIDENCE, RI 02915
PHONE: 401.330.1236

COORDINATE SYSTEM: NAD 1983 STATEPLANE MASSACHUSETTS MAINLAND FIPS 2001; MAP ROTATION: 0
-- SAVED BY: JBERTHERMAN ON 11/13/2023, 19:40:09 PM; FILE PATH: T:\1-PROJECTS\TOWNOFWEYMOUTH\479512_WHITMANS_POND\2-APRX\2023 PRE-TREATMENT\479512_WHITMANSPOND_PRETREATMENT_2023\479512_WHITMANSPOND_PRETREATMENT_2023.APRX; LAYOUT NAME: FANWORT



VARIABLE-LEAF MILFOIL COVERAGE

- 0% (90.73 ACRES)
- 1% - 25% (5.19 ACRES)
- 26% - 50% (63.53 ACRES)
- 51% - 75% (9.99 ACRES)
- 76% - 100% (16.37 ACRES)

BASE MAP: ESRI WORLD IMAGERY 2022
DATA SOURCES: TRC, GPS LOCATIONS, 2023

N

0 450 900
FEET
1:10,800 1" = 900'

PROJECT: **TOWN OF WEYMOUTH**
WHITMAN'S POND
WEYMOUTH, MASSACHUSETTS

TITLE: **2023 PRE-TREATMENT VARIABLE-LEAF MILFOIL COVERAGE**

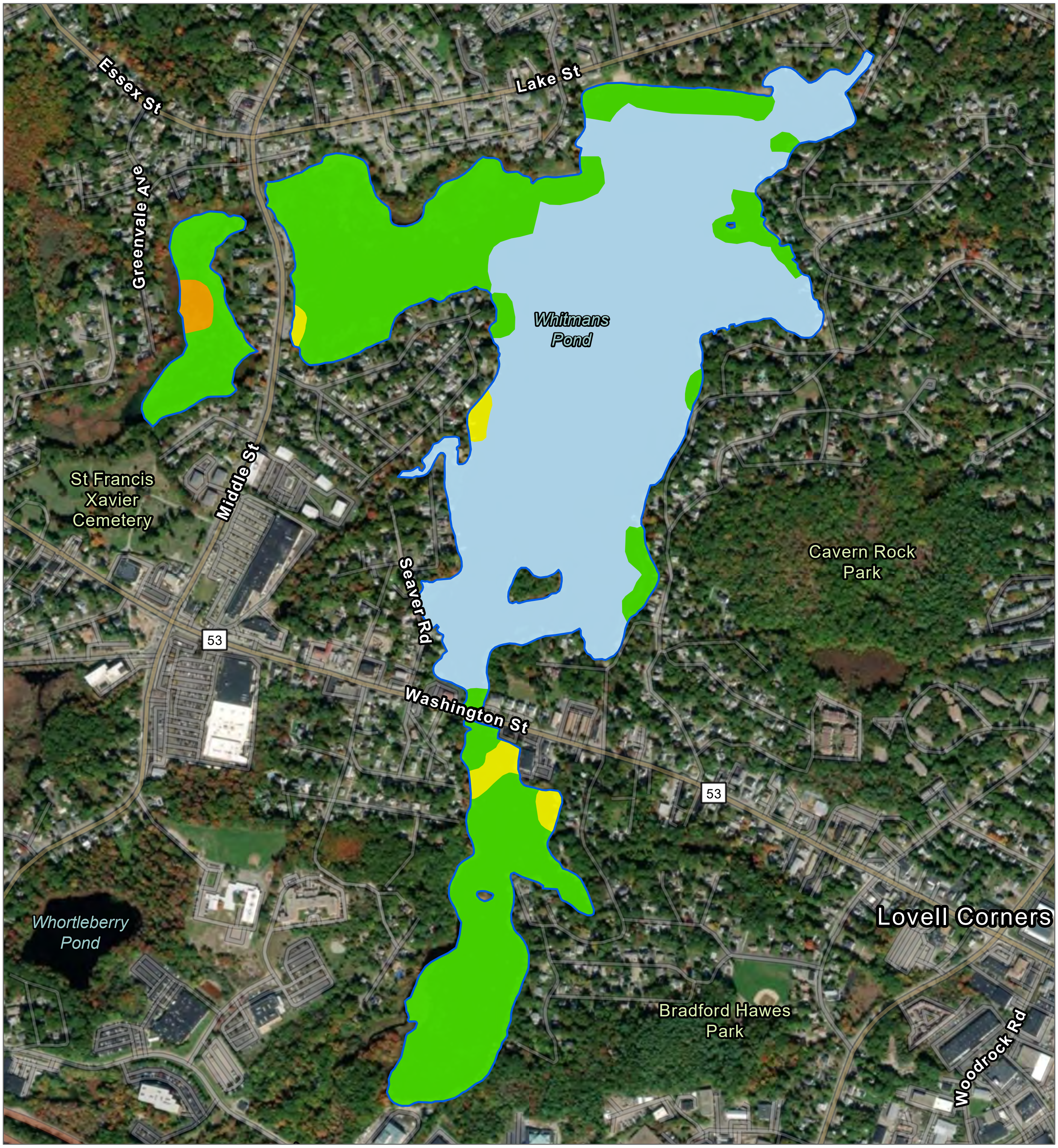
DRAWN BY:	J. BERTHERMAN	PROJ. NO.:	479512
CHECKED BY:	M. LADEWIG	**FIGURE 4**	
APPROVED BY:	M. LADEWIG		
DATE:	NOVEMBER 2023		

TRC

10 HEMINGWAY DRIVE
2ND FLOOR
EAST PROVIDENCE, RI 02915
PHONE: 401.330.1236

FILE: 479512_WHITMANSPOND_PRETREATMENT_2023

COORDINATE SYSTEM: NAD 1983 STATEPLANE MASSACHUSETTS MAINLAND FIPS 2001; MAP ROTATION: 0
– SAVED BY: JBERTHERMAN ON 11/13/2023, 19:43:55 PM; FILE PATH: T:\1-PROJECTS\TOWNOFWEYMOUTH\479512_WHITMANS_POND\2-APRX\2023 PRE-TREATMENT\479512_WHITMANSPOND_PRETREATMENT_2023\479512_WHITMANSPOND_PRETREATMENT_2023.APRX; LAYOUT NAME: VARIABLE-LEAF



CURLY-LEAF PONDWEED COVERAGE

- 0% (104.81 ACRES)
- 1% - 25% (76.10 ACRES)
- 26% - 50% (3.47 ACRES)
- 51% - 75% (1.42 ACRES)
- 76% - 100% (0 ACRES)

BASE MAP: ESRI WORLD IMAGERY 2022
DATA SOURCES: TRC, GPS LOCATIONS, 2023

0 450 900
FEET
1:10,800 1" = 900'

PROJECT: **TOWN OF WEYMOUTH**
WHITMAN'S POND
WEYMOUTH, MASSACHUSETTS

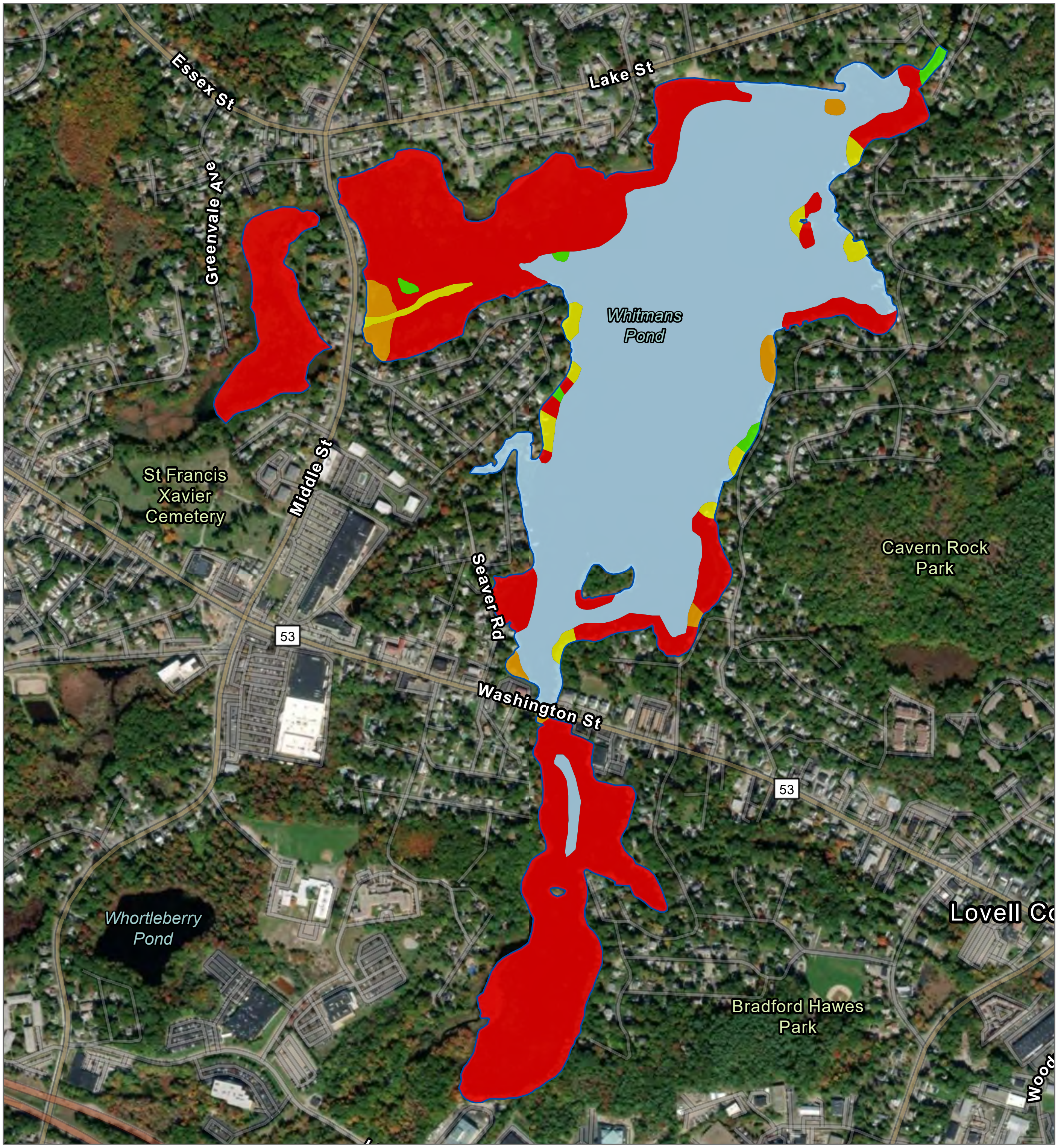
TITLE: **2023 PRE-TREATMENT CURLY-LEAF PONDWEED COVERAGE**

DRAWN BY:	J. BERTHERMAN	PROJ. NO.:	479512
CHECKED BY:	M. LADEWIG	**FIGURE 5**	
APPROVED BY:	M. LADEWIG		
DATE:	NOVEMBER 2023		

10 HEMINGWAY DRIVE
2ND FLOOR
EAST PROVIDENCE, RI 02915
PHONE: 401.330.1236

FILE: 479512_WHITMANSPOND_PRETREATMENT_2023

COORDINATE SYSTEM: NAD 1983 STATEPLANE MASSACHUSETTS MAINLAND FIPS 2001; MAP ROTATION: 0
-- SAVED BY: JBERTHERMAN ON 11/14/2023, 10:25:58 AM; FILE PATH: T:\1-PROJECTS\TOWNOFWEYMOUTH\479512_WHITMANS_POND\2-APRX\2023 PRE-TREATMENT\479512_WHITMANSPOND_PRETREATMENT_2023\479512_WHITMANSPOND_PRETREATMENT_2023.APRX; LAYOUT NAME: TOTAL COVER1



PLANT COVER

- 0% (99 ACRES)
- 1% - 25% (0.99 ACRES)
- 26% - 50% (3.5 ACRES)
- 51% - 75% (2.8 ACRES)
- 76% - 100% (80 ACRES)

BASE MAP: ESRI WORLD IMAGERY 2022
DATA SOURCES: TRC, GPS LOCATIONS, 2023

N

0 450 900
FEET
1:10,800 1" = 900'

PROJECT: **TOWN OF WEYMOUTH**
WHITMAN'S POND
WEYMOUTH, MASSACHUSETTS

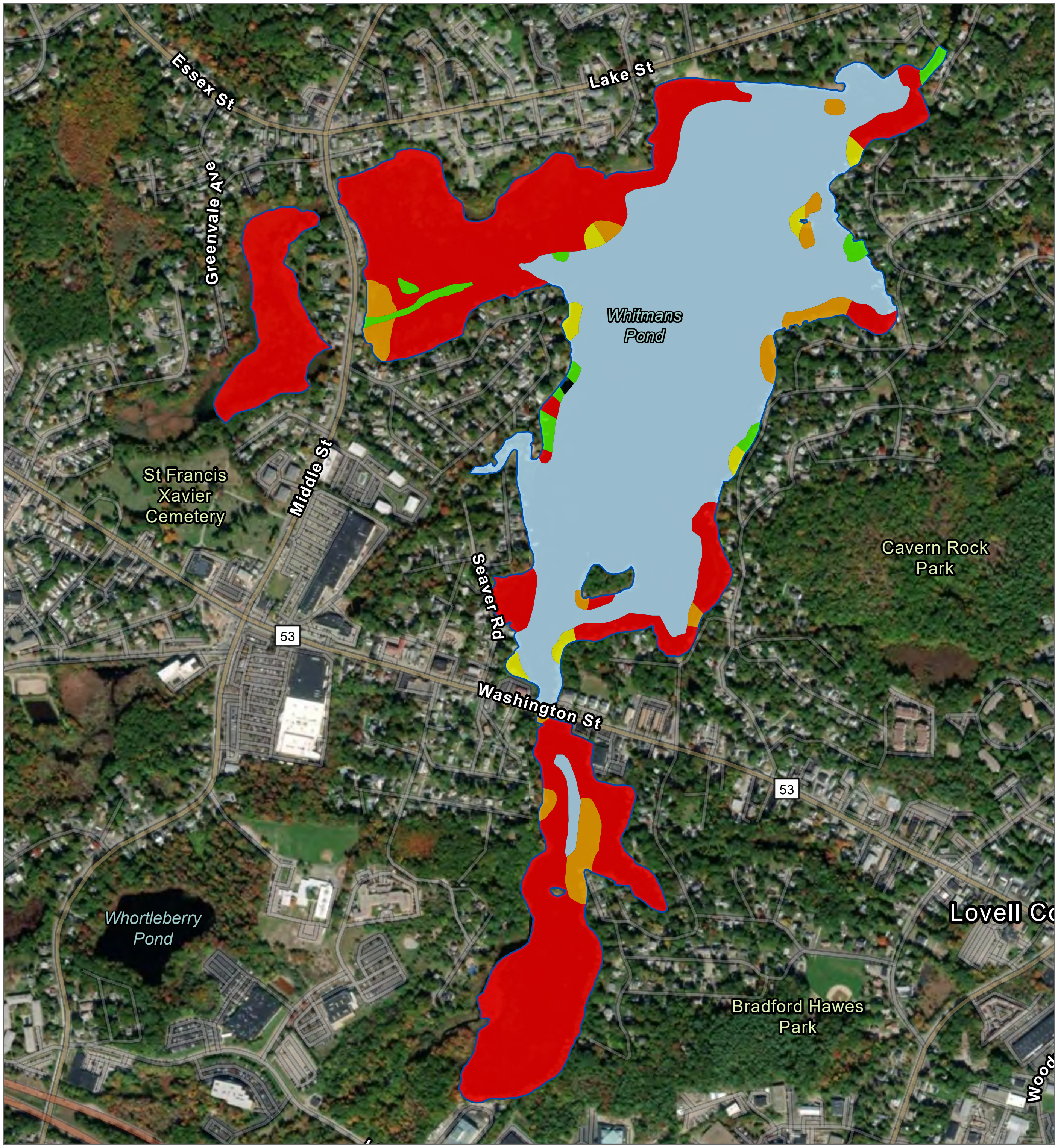
TITLE: **2023 POST-TREATMENT TOTAL PLANT COVERAGE**

DRAWN BY:	K. BACHAND	PROJ. NO.:	479512
CHECKED BY:	A. OCHS	**FIGURE 6**	
APPROVED BY:	M. LADEWIG		
DATE:	NOVEMBER 2023		

TRC
10 HEMINGWAY DRIVE
2ND FLOOR
EAST PROVIDENCE, RI 02915
PHONE: 401.330.1236

FILE: 479512_WHITMANSPOND_POSTTREAT_FIGS

COORDINATE SYSTEM: NAD 1983 STATEPLANE MASSACHUSETTS MAINLAND FIPS 2001; MAP ROTATION: 0
-- SAVED BY: JBERTHERMAN ON 11/13/2023, 17:17:39 PM; FILE PATH: T:\1-PROJECTS\TOWNOFWEYMOUTH\479512_WHITMANS_POND\2-APRX\479512_WHITMANSPOND_POSTTREAT_FIGS\479512_WHITMANSPOND_POSTTREAT_FIGS.APRX; LAYOUT NAME: 479512_WHITMANSPOND_POSTTREAT_FIG01_COVER



BIOVOLUME

- 0% (99 ACRES)
- 1% - 25% (2.7 ACRES)
- 26% - 50% (2.2 ACRES)
- 51% - 75% (6.7 ACRES)
- 76% - 100% (75 ACRES)

BASE MAP: ESRI WORLD IMAGERY 2022
DATA SOURCES: TRC, GPS LOCATIONS, 2023

N

0 450 900

FEET

1:10,800 1" = 900'

PROJECT: TOWN OF WEYMOUTH
WHITMAN'S POND
WEYMOUTH, MASSACHUSETTS

TITLE: 2023 POST-TREATMENT
TOTAL PLANT BIOVOLUME

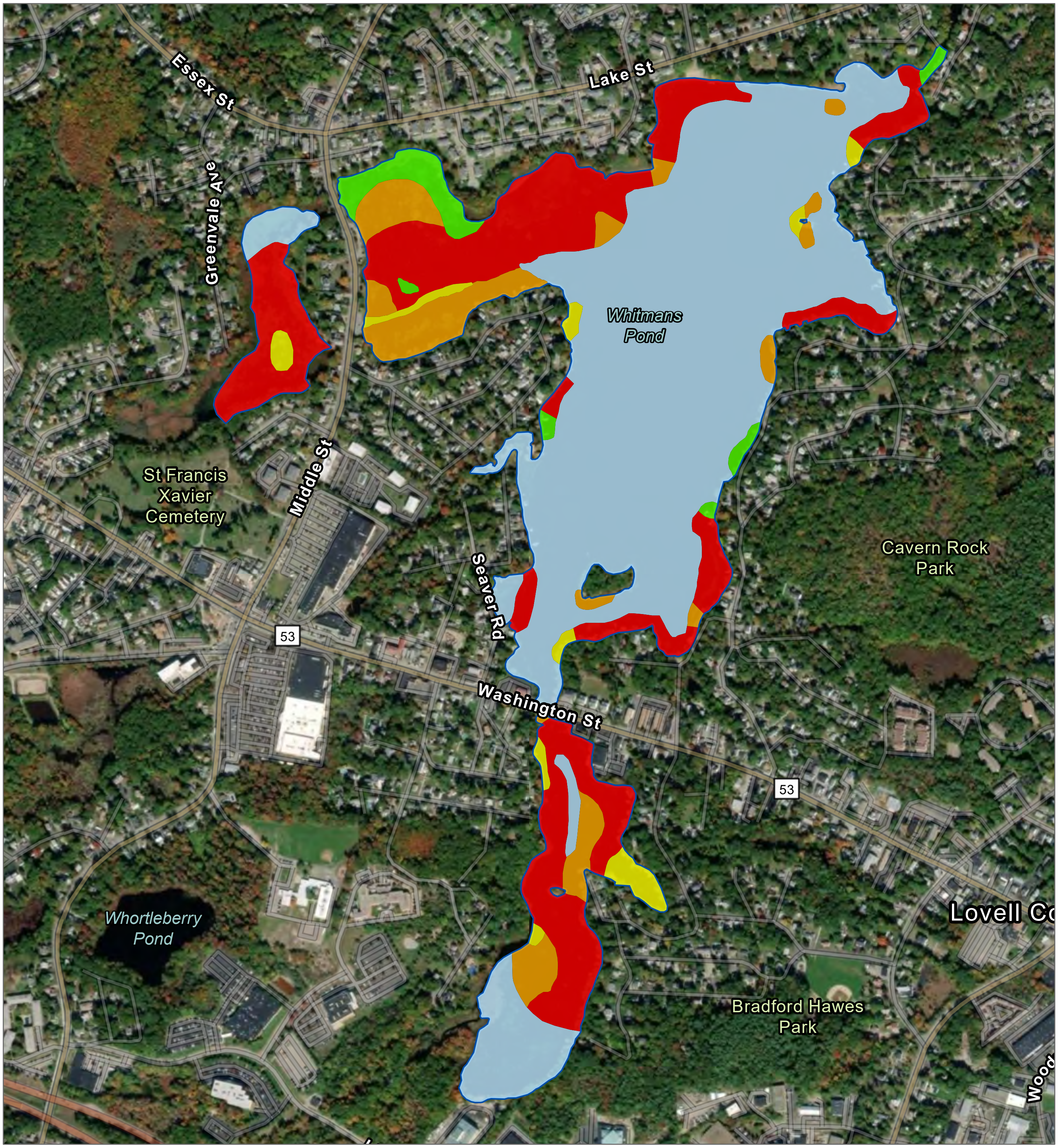
DRAWN BY:	K. BACHAND	PROJ. NO.:	479512
CHECKED BY:	A. OCHS	FIGURE 7	
APPROVED BY:	M. LADEWIG		
DATE:	NOVEMBER 2023		

TRC

10 HEMINGWAY DRIVE
2ND FLOOR
EAST PROVIDENCE, RI 02915
PHONE: 401.330.1236

FILE: 479512_WHITMANSPOND_POSTTREAT_FIGS

COORDINATE SYSTEM: NAD 1983 STATEPLANE MASSACHUSETTS MAINLAND FIPS 2001; MAP ROTATION: 0
– SAVED BY: JBERTHERMAN ON 11/13/2023, 17:17:39 PM; FILE PATH: T:\1-PROJECTS\TOWNOFWEYMOUTH\479512_WHITMANS_POND\2-APRX\479512_WHITMANSPOND_POSTTREAT_FIGS\479512_WHITMANSPOND_POSTTREAT_FIGS.APRX; LAYOUT NAME: 479512_WHITMANSPOND_POSTTREAT_FIG02_BIOVOL



FANWORT COVER

	0% (111 ACRES)
	1% - 25% (5.3 ACRES)
	26% - 50% (4.9 ACRES)
	51% - 75% (16 ACRES)
	76% - 100% (49 ACRES)

BASE MAP: ESRI WORLD IMAGERY 2022
DATA SOURCES: TRC, GPS LOCATIONS, 2023

N

0 450 900
FEET
1:10,800 1" = 900'

PROJECT: **TOWN OF WEYMOUTH**
WHITMAN'S POND
WEYMOUTH, MASSACHUSETTS

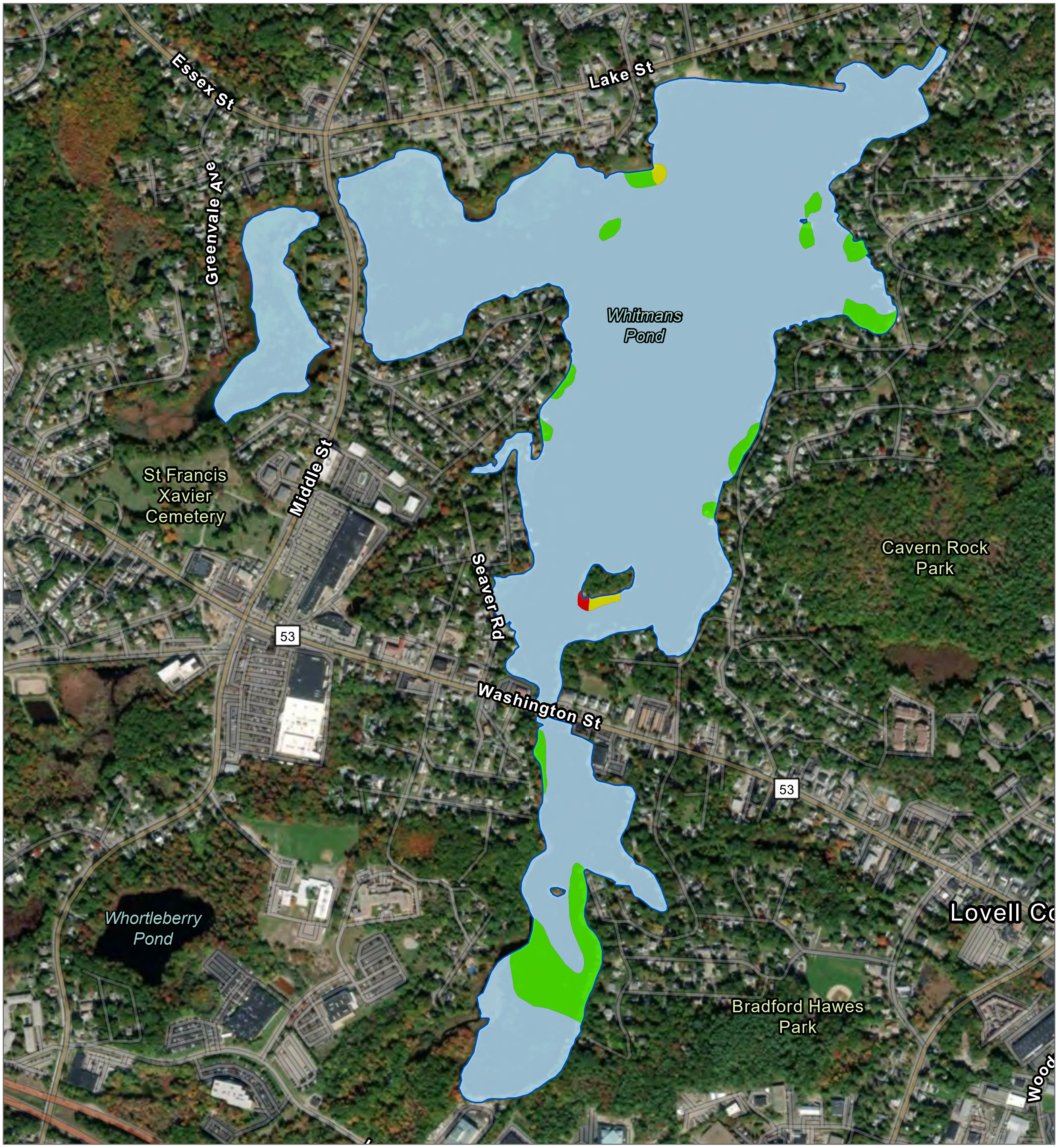
TITLE: **2023 POST-TREATMENT FANWORT COVERAGE**

DRAWN BY:	K. BACHAND	PROJ. NO.:	479512
CHECKED BY:	A. OCHS	**FIGURE 8**	
APPROVED BY:	M. LADEWIG		
DATE:	NOVEMBER 2023		

10 HEMINGWAY DRIVE
2ND FLOOR
EAST PROVIDENCE, RI 02915
PHONE: 401.330.1236

FILE: 479512_WHITMANSPOND_POSTTREAT_FIGS

COORDINATE SYSTEM: NAD 1983 STATEPLANE MASSACHUSETTS MAINLAND FIPS 2001; MAP ROTATION: 0
– SAVED BY: JBERTHERMAN ON 11/13/2023, 17:22:36 PM; FILE PATH: T:\1-PROJECTS\TOWNOFWEYMOUTH\479512_WHITMANS_POND\2-APRX\479512_WHITMANSPOND_POSTTREAT_FIGS\479512_WHITMANSPOND_POSTTREAT_FIGS.APRX; LAYOUT NAME: 479512_WHITMANSPOND_POSTTREAT_FIG04_FANWORT



VARIABLE LEAF MILFOIL COVER

- 0% (176 ACRES)
- 1% - 25% (9.6 ACRES)
- 26% - 50% (0.46 ACRES)
- 51% - 75% (0 ACRES)
- 76% - 100% (0.13 ACRES)

BASE MAP: ESRI WORLD IMAGERY 2022
DATA SOURCES: TRC, GPS LOCATIONS, 2023

N

0 450 900
FEET
1:10,800 1" = 900'

Boston
Providence

PROJECT: TOWN OF WEYMOUTH
WHITMAN'S POND
WEYMOUTH, MASSACHUSETTS

TITLE: 2023 POST-TREATMENT VARIABLE-LEAF MILFOIL COVERAGE

DRAWN BY:	K. BACHAND	PROJ. NO.:	479512
CHECKED BY:	A. OCHS	FIGURE 9	
APPROVED BY:	M. LADEWIG		
DATE:	NOVEMBER 2023		

TRC
10 HEMINGWAY DRIVE
2ND FLOOR
EAST PROVIDENCE, RI 02915
PHONE: 401.330.1236

FILE: 479512_WHITMANSPOND_POSTTREAT_FIGS

COORDINATE SYSTEM: NAD 1983 STATEPLANE MASSACHUSETTS MAINLAND FIPS 2001; MAP ROTATION: 0
-- SAVED BY: JBERTHERMAN ON 11/13/2023, 17:20:51 PM; FILE PATH: T:\1-PROJECTS\TOWNOFWEYMOUTH\479512_WHITMANS_POND\2-APRX\479512_WHITMANSPOND_POSTTREAT_FIGS\479512_WHITMANSPOND_POSTTREAT_FIGS.APRX; LAYOUT NAME: 479512_WHITMANSPOND_POSTTREAT_FIG03_VLMILFOIL

In addition to the exotic aquatic plants, 13 native aquatic plant species were observed in Whitman's Pond over the course of the two pond-wide vegetation surveys. The primary native species included coontail (*Ceratophyllum demersum*), Canadian waterweed (*Elodea canadensis*), white (*Nymphaea odorata*) and yellow (*Nuphar variegata*) waterlilies, floating pondweed (*Potamogeton natans*), and common bladderwort (*Utricularia vulgaris*). Both white and yellow waterlilies were observed to grow at nuisance levels in some places (e.g., the western cove of the Main Basin). A complete list of the species observed is described in Table 2.

*Exotic curly-leaf pondweed (*Potamogeton crispus*) and variable-leaf milfoil (*Myriophyllum heterophyllum*) on May 30, 2023.*

Excessive vegetation can have many adverse impacts on an aquatic ecosystem, such as the depletion of dissolved oxygen levels, alteration of predator/prey interactions, and an acceleration of eutrophication (pond infilling). The presence of non-native, invasive aquatic plants exacerbates these problems.

Table 2. List of Aquatic Plants Observed at Whitman's Pond

Scientific Name	Common Name	Growth Form	Status	Aug 22	May 23	Sep 23
Cabomba caroliniana	Fanwort	Submerged-rooted	Invasive	●	●	●
Ceratophyllum demersum	Coontail	Submerged-floating	Native	●	●	●
Elodea canadensis	Canadian waterweed	Submerged-rooted	Native	●	●	●
Heteranthera dubia	Grass-leaved mud plantain	Submerged-rooted	Native	●		
Lemna minor	Common duckweed	Floating	Native	●	●	●
Myriophyllum heterophyllum	Variable-leaf milfoil	Submerged-rooted	Invasive	●	●	●
Myriophyllum humile	Low milfoil	Submerged-rooted	Native		●	
Najas flexilis	Bushy naiad	Submerged-rooted	Native	●		●
Najas guadalupensis	Southern naiad	Submerged-rooted	Native	●		
Najas minor	Brittle naiad	Submerged-rooted	Invasive	●		
Nuphar variegata	Yellow water lily	Floating- leaved	Native	●	●	●
Nymphaea odorata	White water lily	Floating- leaved	Native	●	●	●
Potamogeton bicupulatus	Snailseed pondweed	Submerged-rooted	Native	●		

Scientific Name	Common Name	Growth Form	Status	Aug 22	May 23	Sep 23
Potamogeton crispus	Curly-leaf pondweed	Submerged-rooted	Invasive	●	●	
Potamogeton epihydrus	Floating-leaf pondweed	Submerged-rooted	Native	●		
Potamogeton natans	Floating pondweed	Submerged-rooted	Native		●	●
Potamogeton perfoliatus	Clasping-leaf pondweed	Submerged-rooted	Native	●		
Potamogeton pusillis	Thinleaf pondweed	Submerged-rooted	Native	●	●	●
Potamogeton robbinsii	Robbins' pondweed	Submerged-rooted	Native	●		
Potamogeton spirillus	Spiral pondweed	Submerged-rooted	Native	●		
Utricularia purpurea	Purple bladderwort	Submerged-floating	Native		●	
Utricularia vulgaris	Common bladderwort	Submerged-floating	Native	●	●	●
Vallisneria americana	Water celery	Submerged-rooted	Native	●	●	●
Wolffia sp.	Water meal	Floating	Native	●		●

Water Quality

Water quality results for Whitman's Pond from the four sampling events are discussed by parameter in the following sections. Surface water quality parameters are compared to Class A Surface Water Standards (310 CMR 4.05(3)(a)) based on the fact that the South Cove of Whitman's Pond serves as a backup water supply reservoir. However, it should be noted that the water quality presented in this report represents a single snapshot of water quality in the pond and a select group of parameters. Each of these parameters should be expected to vary on a daily, seasonal, and interannual basis.

Dissolved Oxygen

As in terrestrial ecosystems, oxygen is required to support respiration in most life associated with aquatic ecosystems, including plants, algae, fish, invertebrates, and many other life forms. Oxygen dissolves in water at a rate inversely related to temperature; solubility increases with decreasing water temperature.

Additionally, the concentration of dissolved oxygen impacts chemical processes in water. Metals, such as iron and manganese, may become more soluble in their reduced forms, which dominate under anoxic conditions. Similarly, nutrients like phosphorus may be released at a higher rate from bottom sediments when dissolved oxygen is low.

In Massachusetts, the state instantaneous dissolved oxygen standard for support of warmwater fisheries in Class A waters is 5.0 mg/L (or as naturally occurs).

At Whitman's Pond Main Basin, dissolved oxygen values were within the standard at the surface but did not meet the standard at the bottom of the water column any of the 2023 monitoring events (Figure 10). This suggests dissolved oxygen conditions remain insufficient to support aquatic life at depth during the summer. Dissolved oxygen values were highest at all sampling locations in May and lowest in September (Table 3). Dissolved oxygen concentrations at the outlet and in the South Cove met the standard during the May and July sampling rounds but did not during the September monitoring event. West Cove dissolved oxygen was below the standard in both July and September.

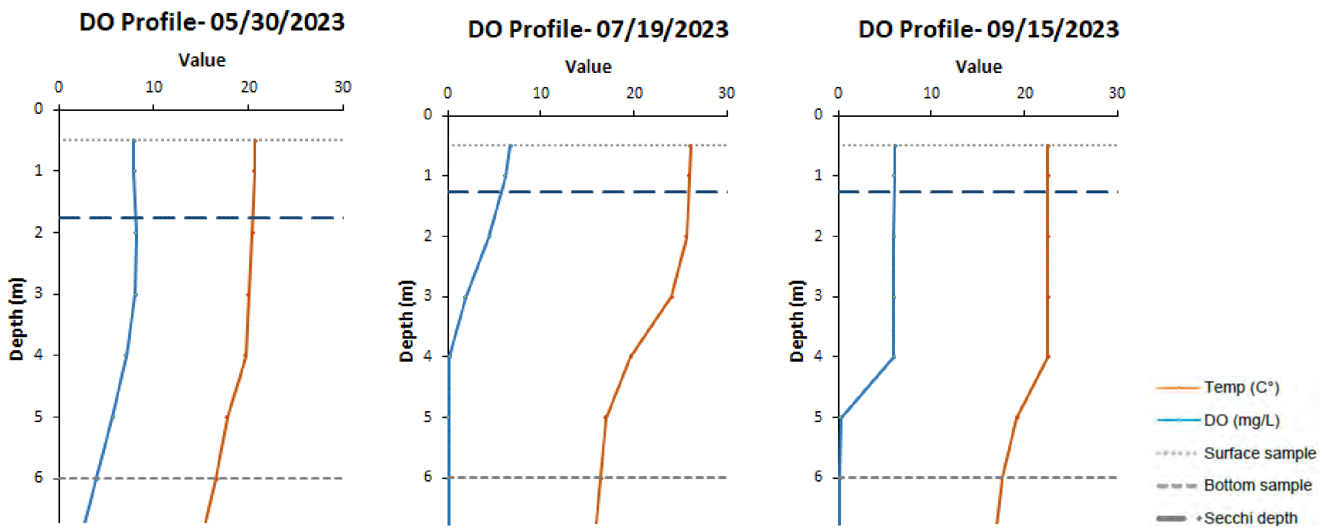


Figure 10. Dissolved oxygen and temperature profiles from the three site visits collected at the deep hole spot of the Main Basin in 2023.

Specific Conductance

Conductivity is a measure of dissolved ions (salts) in the water. Although there are no state numerical standards for conductivity, measurements above 100 µS/cm appear to be associated with human impact in eastern Massachusetts, except near the immediate coast or limestone outcrops. Pavement deicing is one of the most obvious sources of human-derived conductivity, although landscape practices (such as liming and fertilization), septic systems, and treated wastewater discharges, among other contributions may also serve as sources.

Measurements of specific conductance throughout the pond were generally high (greater than 300 µS/cm) indicating human activity, such as dissolved ionic pollutants (i.e. salts), continues to have an impact on water quality in the pond (Table 3). As in 2022, specific conductance was highest in the West Cove, likely due to the higher degree of stormwater influence on water in that basin. However, specific conductance levels were generally lower in 2023 than in 2022, possibly reflecting the greater dilution by higher water levels.

pH

The pH of water indicates whether it is acidic (< 7 SU), circumneutral (~7 SU), or basic (> 7 SU). As with dissolved oxygen, pH may vary substantially over distances and over time (even a single day). Therefore, a single snapshot of pH (as collected in this study) should be interpreted with caution.

In Massachusetts, the state standard in Class A waters is 6.5 SU to 8.3 SU and not more than 0.5 SU outside of the natural background range.

The Main Basin, South Cove, West Cove, and outlet had pH values within the state standard for Class A waters. This is in contrast to observed conditions in 2022, when pH for the West Cove was generally below the standard, indicating slightly acidic conditions within the cove.

Turbidity

Turbidity is a measure of light scattering by matter in the water column. Some waterbodies are naturally turbid.

There is no numerical standard for turbidity in Massachusetts Class A waters, although the narrative standard indicates that they shall be free of turbidity in concentrations that are aesthetically objectionable or would impair any use assigned to this class.

Generally, turbidity values greater than 1 NTU above background are considered excessive. Six out of the fifteen turbidity values at Whitman's Pond were below 1 NTU (Table 3). Nine turbidity values were above this level. However, no extreme turbidity values were recorded in 2023.

Transparency

Water transparency is often expressed as the depth at which a Secchi disk just becomes visible. Low transparency measurements indicate poor transmission of light through the water column, although this may be due to a variety of causes including, but not limited to, natural staining, suspended sediments, algal growth, and manmade pollutants. Some waterbodies are naturally less transparent than others and low transparency does not necessarily indicate poor water quality. Higher transparencies are generally considered to be more aesthetically pleasing but also allow aquatic plants to grow at greater depths.

Transparency at Whitman's Pond ranged from 1.25 to 1.75 meters (4.1 to 5.7 feet) in the Main Basin and at the outlet (Table 3). Secchi disk readings were highest in May and declined over the season. Transparency measured at the South Cove and the West Cove were somewhat limited by shallow water and/or plant cover, though less so than during the 2022 drought. West Cove transparency was not measured higher than 0.5 meters (1.6 feet). South Cove transparency started the season near 1.0 m (3.3 feet). However, transparency declined to 0.5 m (1.6 feet) over the course of the summer.

Apparent Color

Water color can be impacted by several factors including materials from decaying organic matter, vegetation, or inorganic matter such as sediment. There is no numerical standard for color in Massachusetts Class A waters, although the narrative standard indicates that they shall be free of color in concentrations that are aesthetically objectionable or would impair any use assigned to this class.

Apparent color is the measure of color for the entire water sample and includes both dissolved and suspended components of color. This parameter was measured in the field using a calibrated color wheel. Apparent color was measured to be 15 or below at all locations, with little variability over the course of the season (Table 3).

Table 3. Field-Measured Water Quality Parameters – 2023

Sample	Visit Date	Temp (ºC)	Dissolved Oxygen (mg/L / % saturation)	Specific Conductance (µS/cm)	pH (SU)	Turbidity (NTU)	Apparent Color (PCU)	Secchi Disk (m)
Main Basin, Surface	**5/30**	20.7	7.93/89.0	517	7.7	0.05	10	1.75
	7/19	26.1	6.72/83.1	436	7.6	0.95	15	1.25
	9/15	22.5	6.07/69.7	351	7.3	2.05	10	1.25
Main Basin, Bottom	**5/30**	15.1	2.20/21.4	546	7.3	1.83	10	N/A
	7/19	15.8	0.09/0.9	584	7.6	0.50	15	N/A
	9/15	16.8	0.17/1.7	603	8.0	3.18	10	N/A
Outlet	**5/30**	18.8	7.10/75.0	526	7.5	1.53	10	1.7
	7/19	26.8	7.27/91.0	462	7.6	0.64	10	1.5
	9/15	22.1	3.26/37.2	324	7.1	1.94	10	1.25
South Cove	**5/30**	20.2	7.50/85.3	527	7.8	0.02	10	1.0
	7/19	25.0	6.96/84.0	323	7.5	0.24	10	0.75
	9/15	20.5	3.14/35.1	325	6.8	1.95	10	0.5
West Cove	**5/30**	18.6	1.42/16.5	909	7.2	3.64	10	0.5
	7/19	24.3	0.47/5.7	733	7.3	1.27	10	0.5
	9/15	19.3	0.29/3.2	624	6.8	1.67	10	0.5

.

Nutrients

High levels of nutrients (e.g., nitrogen and phosphorus) in the water column can lead to undesirable biological consequences. For example, floating plants like duckweed and water meal may grow to excessive levels when soluble inorganic nitrogen (e.g., nitrate, ammonia) and phosphorus are present at high concentrations. Likewise, high levels of these nutrients may also trigger excessive algal growth, leading to bloom conditions and, under certain conditions, dominance by harmful species of cyanobacteria. Phosphorus tends to be the limiting nutrient in freshwater reservoirs while nitrogen is more likely to be limiting in brackish or salt waters, although this can vary between water bodies and over time at the same water body. Co-limitation by phosphorus and nitrogen can also occur.

Phosphorus is an essential nutrient for aquatic life but high levels of phosphorus can result in rapid growth of algae and lead to eutrophication, particularly in freshwater waterbodies. Excessive phosphorus may also encourage cyanobacteria blooms to develop, which can result in odor issues or production of cyanotoxins, such as microcystin. Total phosphorus values include dissolved phosphorus in addition to the phosphorus found in or bound to sediment and organic compounds. Dissolved phosphorus is readily available for uptake by aquatic organisms and an elevated dissolved phosphorus values may be indications of leaching of fertilizer, or human or animal waste.

Although there is no statewide phosphorus standard for Class A waters, lower concentrations are preferable and concentrations in excess of 0.025 mg/L are typically considered excessive.

The total phosphorus concentrations observed in Whitman's Pond were generally in excess of 0.025 mg/L. The bottom total phosphorus concentrations at the Main Basin were higher than the surface total phosphorus concentrations in July and particularly in September (Table 4). This pattern of increasing total phosphorus over the course of the summer suggests that phosphorus is being released from the sediments. This can occur where sediment phosphorus is primarily bound to iron, which is redox-sensitive and becomes soluble once dissolved oxygen has been depleted. Total phosphorus concentrations at the South and West Cove were also generally in excess, with the West Cove reporting the highest average total phosphorus concentration, a pattern that is similar to what was observed in 2022.

Dissolved phosphorus, which represents the portion of total phosphorus that is most likely to be available for biological uptake, also exceeded 0.025 mg/L on most dates at most locations (Table 4). The lowest average dissolved phosphorus was observed at the surface of the Main Basin deep hole sampling location. However, even here, it averaged greater than 0.025 mg/L.

The nitrogen cycle is somewhat more complex than that of phosphorus. As with phosphorus, nitrogen compounds can be added to a reservoir via atmospheric deposition, inputs of plant matter from shoreline vegetation, and transport of nitrogen into a reservoir through runoff, other surface flows, or groundwater movement. However, unlike phosphorus, otherwise stable elemental nitrogen can be converted into more available forms of nitrogen and added to the reservoir system when it is "fixed" by cyanobacteria. Likewise, nitrogen can be removed from the reservoir system through the process of denitrification, in which microbes convert nitrate back to inert gaseous nitrogen. A measurement of total nitrogen is the sum of nitrate-nitrogen, nitrite-nitrogen, and total Kjeldahl nitrogen (TKN).

Although there is no statewide nitrogen standard for Class A waters, lower concentrations are generally preferable and total nitrogen concentrations in excess of 1.0 mg/L are often indicative of excessive anthropogenic sources.

In Whitman's Pond, the total nitrogen values are nearly entirely comprised of TKN, which includes organic and ammonia nitrogen, with only a small fraction of the total attributable to nitrate-nitrogen. Nitrite-nitrogen was found to be below the laboratory reporting limit at all locations. Total nitrogen concentrations greater than 1.0 mg/L were consistently observed in the South Cove (Table 4). Additionally, occasional values greater than 1.0 mg/L were observed in the West Cove and the bottom of the Main Basin.

E. Coli

Fecal coliform bacteria, including *E. coli*, occur in the intestines of humans and other warm-blooded animals. Although these bacteria may not directly cause illness, they serve as indicators of fecal contamination and possible pathogens. Possible sources of *E. coli* in surface water include sewage or animal waste contamination.

For Class A waters, excluding waters at water supply intakes and bathing beaches, no single *E. coli* sample shall exceed 235 MPN/100 ml (310 CMR 4.05(3)(a)(4)).

All locations were below the single-sample 235 MPN/100 ml standard for all sampling events (Table 4). *E. coli* concentrations were generally lowest during the May 30 sampling event, with increased levels observed during warmer weather in July and September.

Chlorophyll A

Algal density can be inferred by measuring chlorophyll a, the primary photosynthetic pigment found in most algal cells. Although there is no statewide chlorophyll a standard for Class A waters, high chlorophyll a levels are generally considered undesirable because they are associated with elevated algal production and eutrophic conditions.

The chlorophyll a concentration in Whitman's Pond ranged from 6.45 to 15.9 mg/m^3 (Table 4). While not extreme, these values continue to reflect elevated algal growth within the pond.

Table 4. Lab-Analyzed Water Quality Parameters

Sample	Visit Date	Nitrite-N (mg/L)	Nitrate-N (mg/L)	TKN (mg/L)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	Dissolved Phosphorus (mg/L)	*E. coli* (MPN/100ml)	Chlorophyll a (mg/m^3)
Main Basin, Surface	**5/30**	<0.010	0.06	0.63	0.69	0.046	0.025	3.06	11.0
	7/19	<0.010	<0.02	0.65	0.65	0.040	0.022	49.54	15.9
	9/15	<0.010	0.06	0.63	0.69	0.054	0.037	24.05	6.45
Main Basin, Bottom	**5/30**	<0.010	0.07	0.62	0.69	0.038	0.022	11	--
	7/19	<0.010	<0.02	0.88	0.88	0.043	0.031	48.82	--
	9/15	<0.010	<0.02	1.60	1.60	0.184	0.169	74.91	--
Outlet	**5/30**	<0.010	0.07	0.60	0.67	0.039	0.028	54.61	--
	7/19	<0.010	<0.02	0.64	0.64	0.031	0.019	32.25	--
	9/15	<0.010	0.08	0.77	0.85	0.068	0.058	204.59	--
South Cove	**5/30**	<0.010	0.02	1.42	1.44	0.050	0.028	3.06	--
	7/19	<0.010	0.07	1.00	1.07	0.055	0.037	40.22	--
	9/15	<0.010	0.15	1.09	1.24	0.092	0.055	113.7	--
West Cove	**5/30**	<0.010	<0.02	0.60	0.60	0.064	0.034	11	--
	7/19	<0.010	<0.02	1.12	1.12	0.113	0.063	128.09	--
	9/15	<0.010	<0.02	0.97	0.97	0.229	0.060	55.55	--

Phytoplankton

The phytoplankton samples collected from Whitman's pond contained a diverse assemblage, from seven distinct taxonomic groups including cryptophytes, chrysophytes, cyanobacteria (blue green algae), diatoms, dinoflagellates, euglenoids, and green algae (Table 5). Diatoms were abundantly observed across all site visits but were particularly common in May and July, when they dominated the phytoplankton community. Euglenoids replaced diatoms as the most abundant group in September. Cyanobacteria were only observed in the September 15 sample, when they comprised just 15.9% of the algal community within the sample. Cyanobacteria can be potentially toxigenic and affect the taste and odor of the water. However, it does not appear as though indications of a cyanobacteria bloom at Whitman's Pond were recorded in the samples collected over the 2023 field season.

Table 5. Phytoplankton Collected from Whitman's Pond

Group	% Contribution		
	May 30	July 19	Sep 15
Chrysophyte	2.2	1.4	1.5
Cryptophyte	23.8	17.2	6.7
Cyanobacteria	Not observed	Not observed	15.9
Diatom	66.6	78.9	10.5
Dinoflagellate	2.7	0.3	Not observed
Euglenoid	2.5	1.7	58.8
Green	2.2	0.6	6.6

Conclusions

Water levels were substantially higher in Whitman's Pond during 2023 than 2022, which allowed collection of more thorough and representative data, particularly in the West Cove and South Cove. Additionally, the initiation of both spring (pre-management) and late summer (post-management) vegetation surveys in 2023 provided a better opportunity to capture the seasonal changes in dominance of the three primary aquatic invasive species in Whitman's Pond.

No wholesale changes in aquatic plant growth or water quality were observed in 2023 and observed conditions suggest that aquatic life in Whitman's Pond continues to be stressed. The pond's ability to support a healthy aquatic ecosystem as well as recreational and water supply uses may be impacted by the following:

- Low dissolved oxygen or anoxic conditions, which were most widespread in July and September.
- Excessive nutrient levels, especially phosphorus, but also nitrogen at times.
- Low water transparency, likely related to dissolved and particulate organic matter as well as high biovolumes of phytoplankton.
- Excessive growth of aquatic plants, including several invasive species.

The DASH pilot project, which included 70 hours of effort in 2023, appeared to have been successful in substantially reducing biomass over approximately 0.7 acres of the western cove of the Main Basin. No variable-leaf milfoil was observed in this area post-management and only a few scattered stems of fanwort were found. However, these gains were limited to a very small area and can be expected to begin filling in due to spread from surrounding beds in 2024, if not persistently managed.

Recommendations for 2024

The only management conducted during the 2023 field season included mechanical harvesting of nuisance plant growth in a swath along the western portion of the Main Basin and a small (<1 acre) area of DASH just to the north of this swath. Both activities were conducted under a valid Superseding Order of Conditions (MassDEP File No. 081-1300).

In response to the conditions observed in Whitman's Pond during the 2023 monitoring program, TRC recommends the following management actions be implemented in 2024:

- Consider implementation of an herbicide treatment in the West Cove to control growth of aquatic invasive plants using fluridone (Sonar) or flumioxazin (Clipper). This may require blocking off the West Cove early in the season to prevent the movement of river herring into that basin. Consultation with DMF is recommended to clarify this process prior to finalizing the annual work plan.
- Consider implementation of an herbicide treatment in the western cove of the Main Basin to control aquatic invasive plants using flumioxazin (Clipper).
- Continue mechanical harvesting, as needed, to maintain a clear channel from the Middle Street boat launch to deeper water of the Main Basin. Consider using mechanical harvesting as a means to pre-clear an area in preparation for DASH. As indicated by the Town's DASH contractor in their 2023 report, this reduction in biomass would allow divers to improve their efficiency.
- Consider expansion of DASH, as budget allows, to provide targeted control of fanwort and variable-leaf milfoil. Given the minimal progress made with 70 hours of diver effort in 2023, the Town would need to substantially expand the level of effort to achieve noticeable control of even a small area for 2024. DASH would be expected to become more efficient as control of the target species is achieved over time. Additionally, some economies of scale could also be expected to come into play with a larger project size. However, as indicated in the 2022 *Whitman's Pond Management Strategy*, DASH is only practical over small areas and cannot be expected to provide pond-wide control. It must either be focused on key recreational areas or used in combination with other, more efficient management tools to achieve control over a broader area. The aforementioned use of targeted herbicide to weaken variable-leaf and fanwort beds the year prior to DASH and/or mechanical harvesting a few days prior to DASH pre-clear an area may also help to improve efficiency of DASH operations.
- Consider installation of benthic barriers over a small portion of the pond bottom near the Middle Street boat launch.
- Hydroraking is not recommended for implementation in 2023, in order to allow the Town to specifically focus on other control efforts in 2024. However, it may be considered for future use.

Additionally, TRC recommends the following monitoring activities for 2024:

- At least three water quality events at the five established monitoring stations. These events should be spread out over the growing season to include at least one pre-management sampling event prior to July and at least one post-management sampling event. Additional supplemental water quality monitoring may be advisable or required as part of DMF's recommendations for the use of herbicides.

- Pre- and post-management aquatic plant mapping events should be completed pondwide. The pre-management event should be completed in May or June to reassess the level of target species growth in Whitman's Pond. The post-management event should generally be completed within one month of the end of management activities or no later than October 15, whichever is earlier.

These recommended actions will be further defined with respect to location, extent, timing, and control measures as part of the annual work plan, which will be provided to the Weymouth Conservation Commission at least 60 days prior to implementation of any management work in 2024.

Sincerely,

TRC ENVIRONMENTAL CORPORATION

Matt Ladewig, CLM
Project Director

Cc: Gregory J. DeCesare, Massachusetts Department of Environmental Protection

Brad Chase, Massachusetts Division of Marine Fisheries