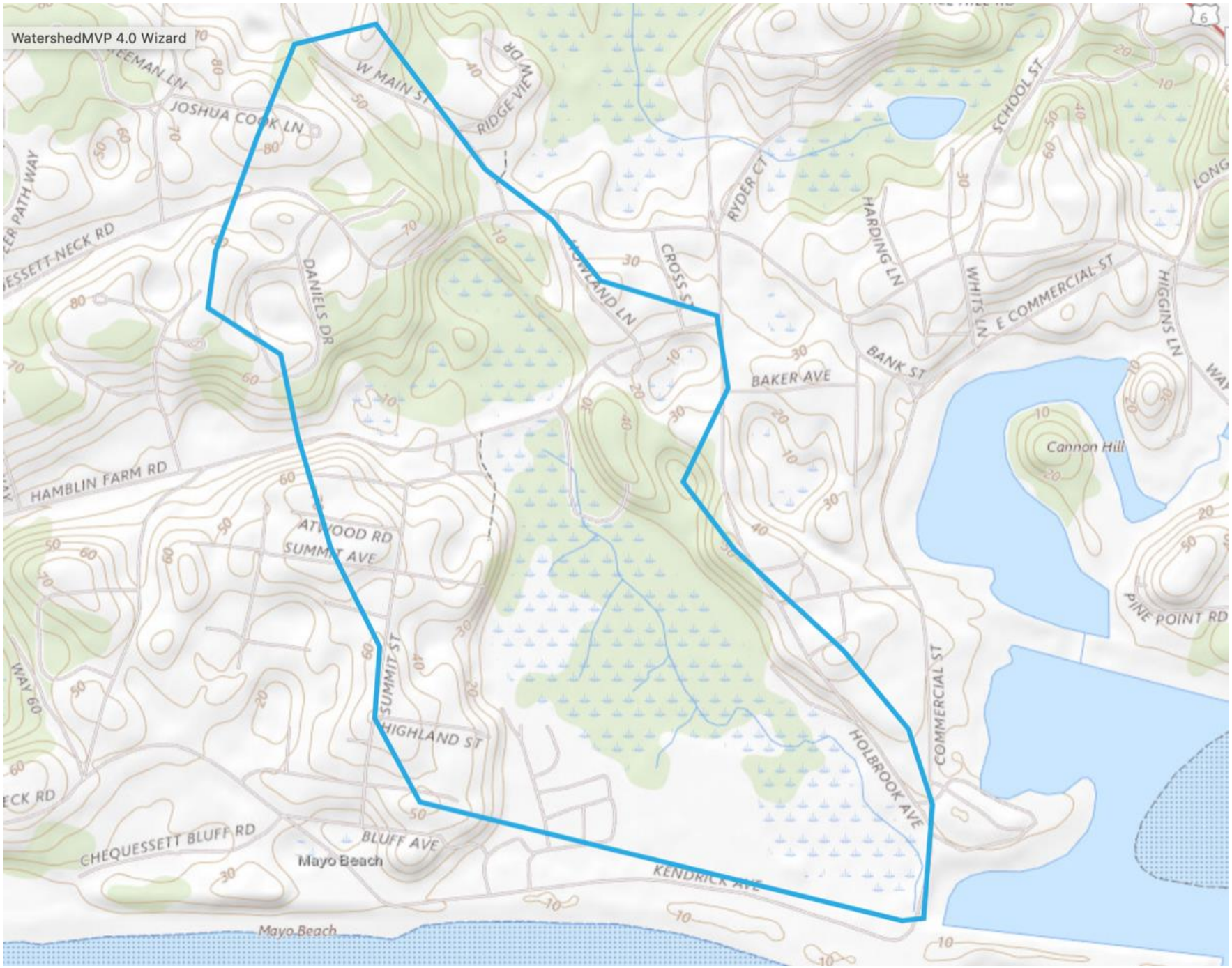
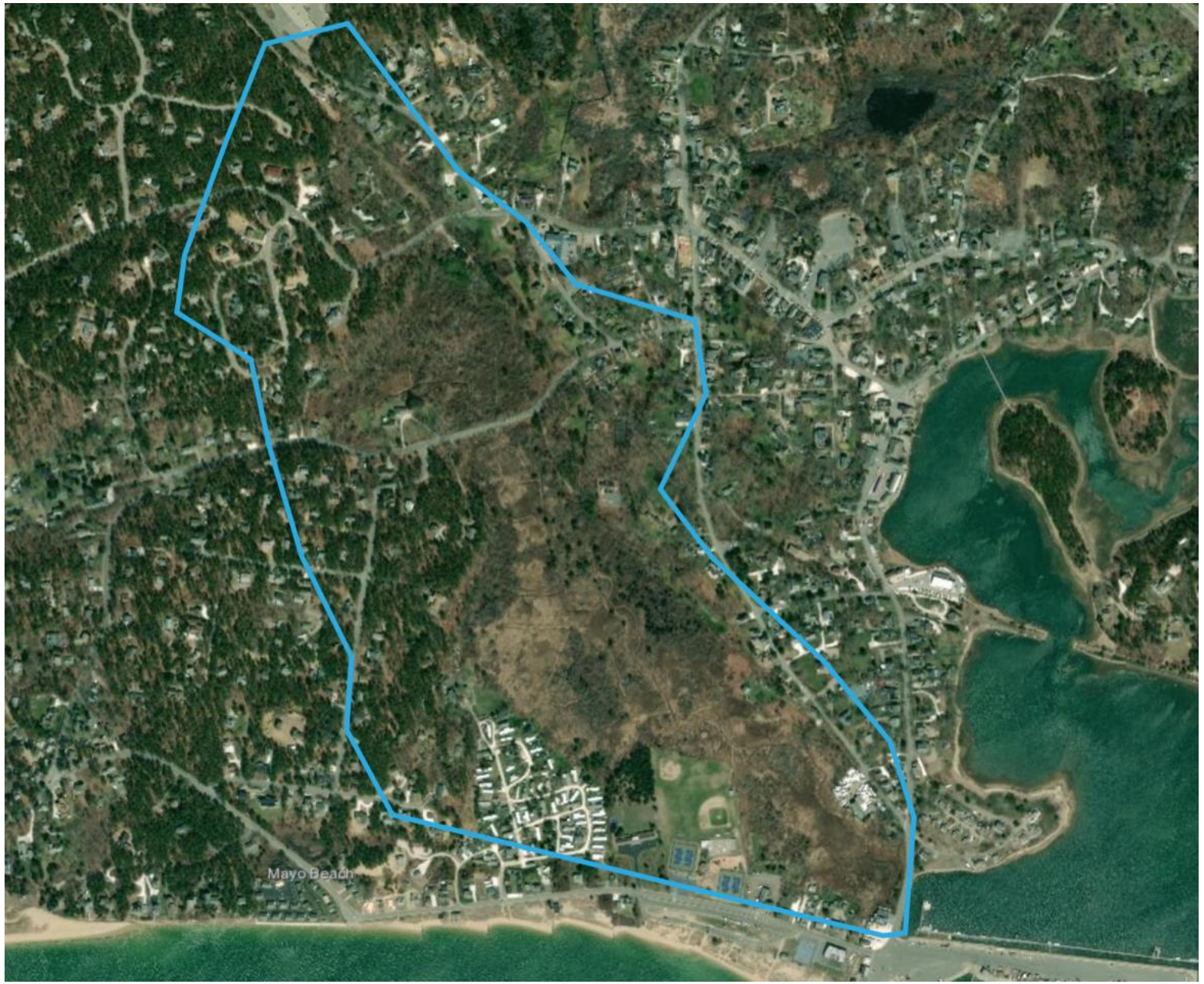
Presentation to the Town of Wellfleet

Scott Horsley, Water Resources Consultant

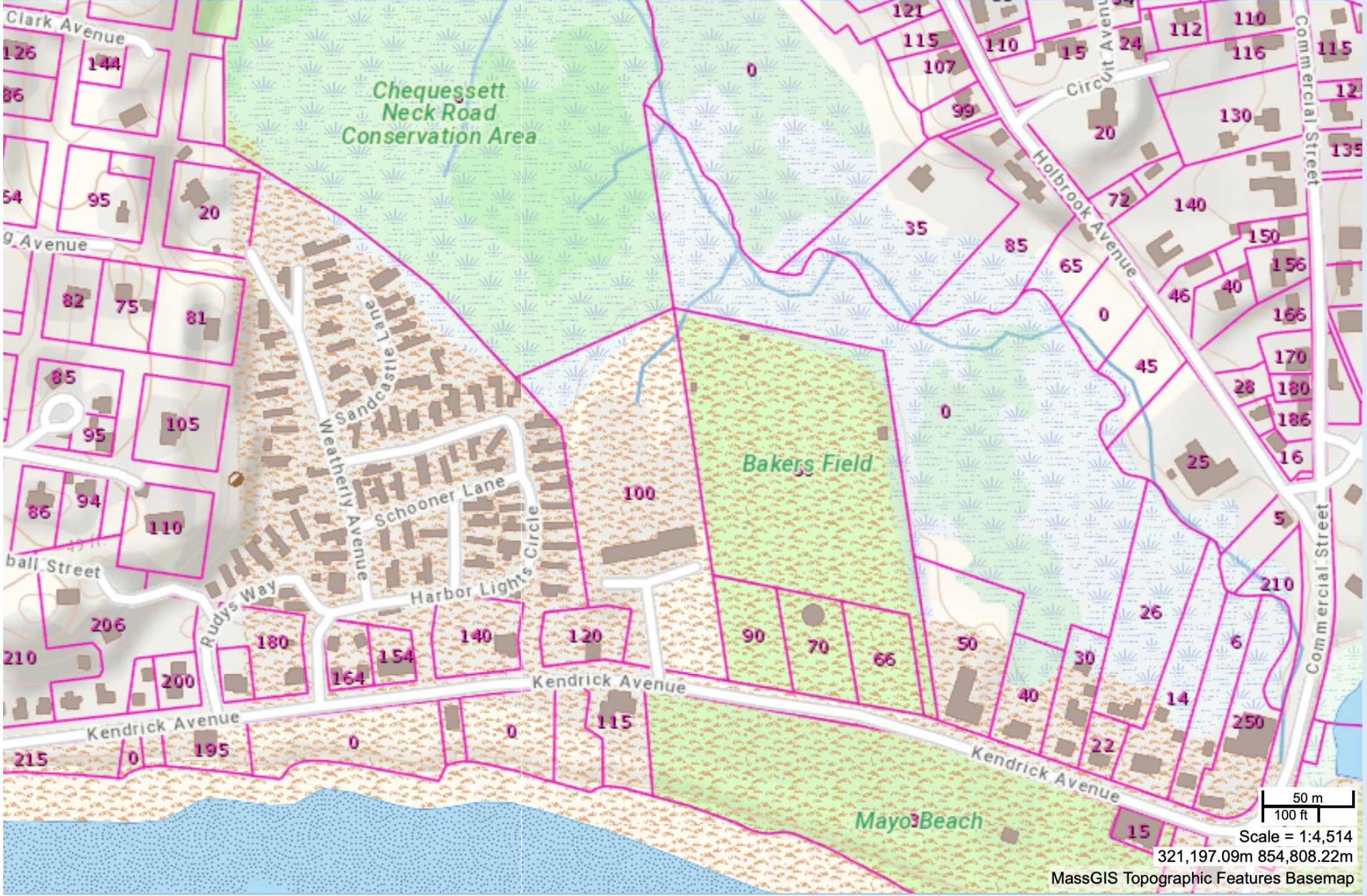
30 July 2020



Mayo Creek Watershed

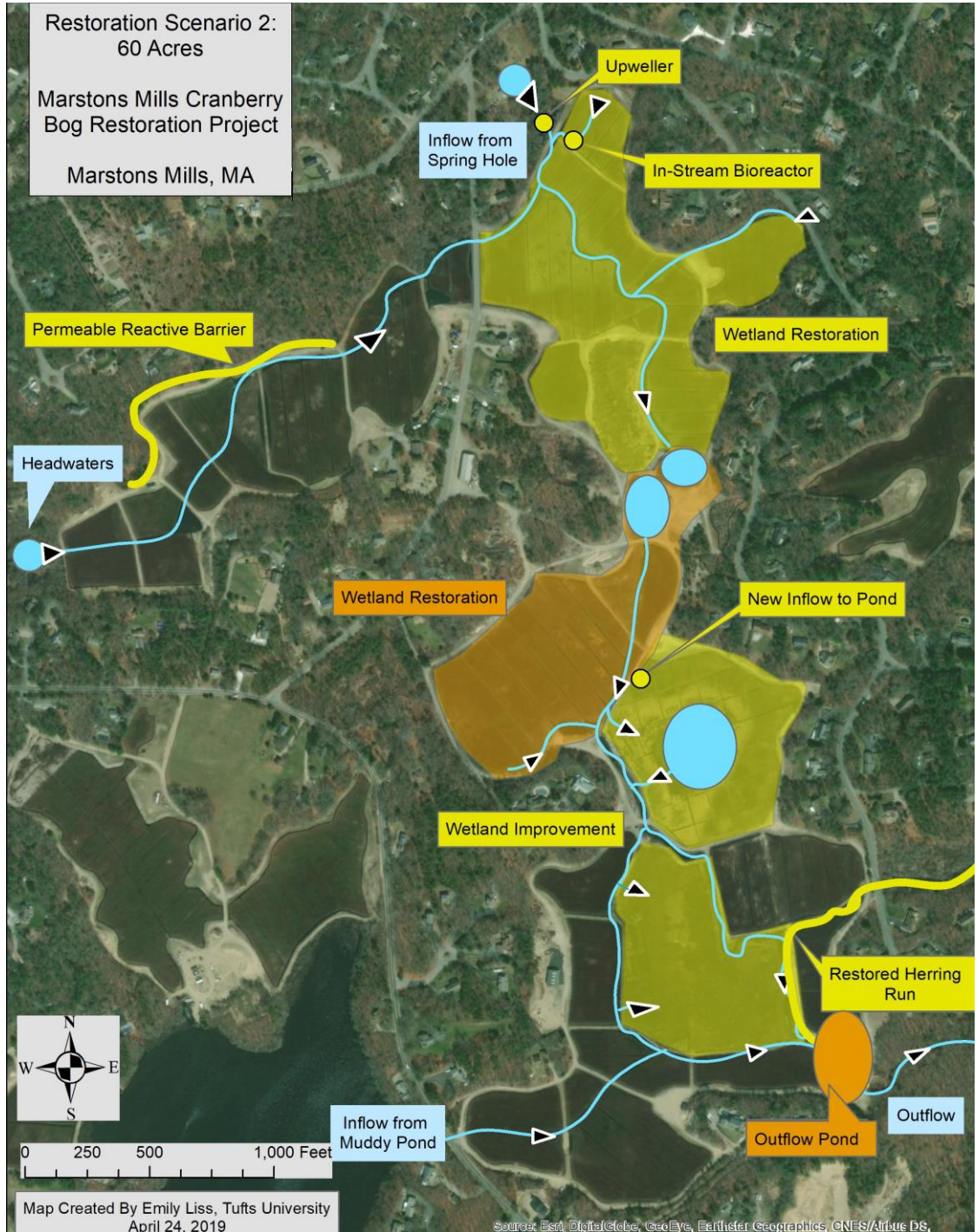

Mayo Beach

MAYO CREEK - ESTIMATED NITROGEN LOADS & ATTENUATION					
Flow Rate		0.51	cfs	Woods Hole Group (2011)	
N conc		1.88	mg/liter	Amy Costa (2017-2018)	
Existing N load		856	kg/year	calculated	
watershed		257	acres	Watershed MVP	
wetlands		47	acres		
recharge rate		24	in/year	USGS, 2004 (Masterson)	
recharge rate		22389840	CF/year		
rainfall		40	inches/year		
rainfall volume		37316400	CF/year		
flow rate (recharge)		0.71	CFS		
built parcels		122	buildings	Watershed MVP	
septic		631	kg/year	Watershed MVP	
fertilizers		70	kg/year	MEP	
stormwater		5	kg/year	MEP	
roof infiltration		3	kg/year		
direct precip on wetland		189	kg/year		
total controllable load		899	kg/year	kg/year	
existing attenutation/load		5%	43	kg/year	calculated
salt marsh attenutation		40%	359	kg/year	MEP
estimated net reduction			317	kg/year	calculated

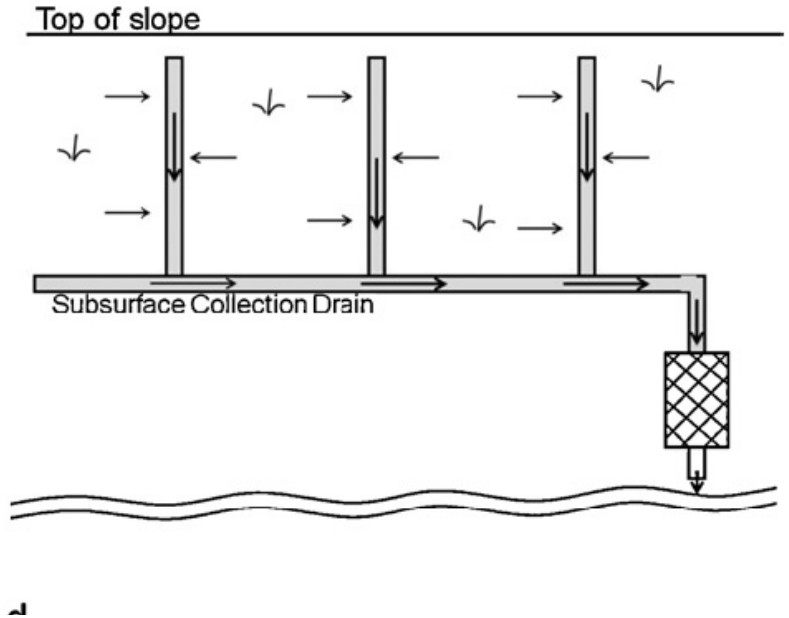

Chequessett Neck Road Conservation Area
Bakers Field
Mayo Beach
Clark Avenue
Circuit Avenue
Holbrook Avenue
Commercial Street
Sandcastle Lane
Weatherly Avenue
Schooner Lane
Harbor Lights Circle
Rudys Way
Kendrick Avenue
50 m
100 ft
Scale = 1:4,514
321,197.09m 854,808.22m
MassGIS Topographic Features Basemap

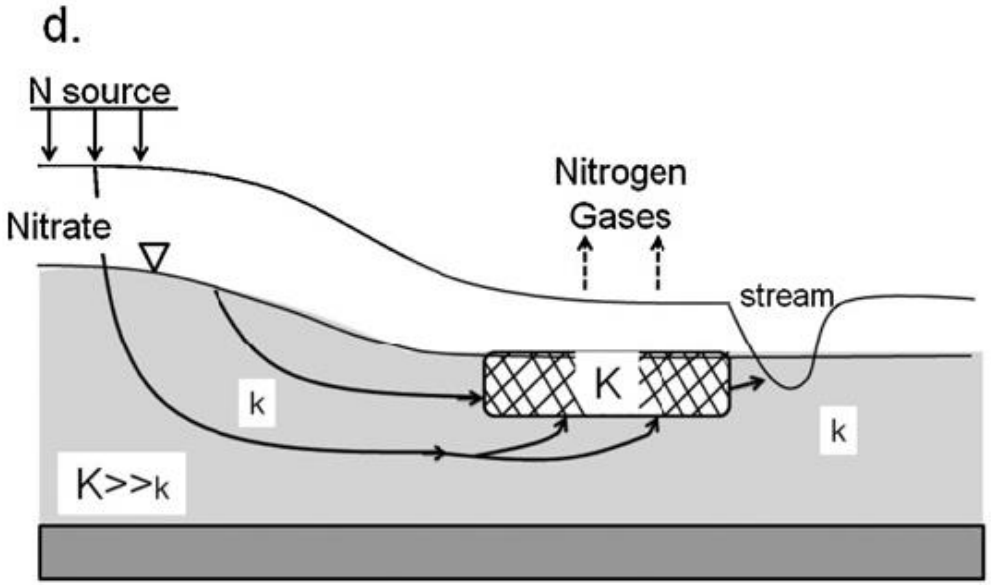
Mayo Creek Restoration Plan
Woods Hole Group (2016)

Figure 12. **Schematic showing channel lowering (red) and added channels (yellow) for improved drainage.**

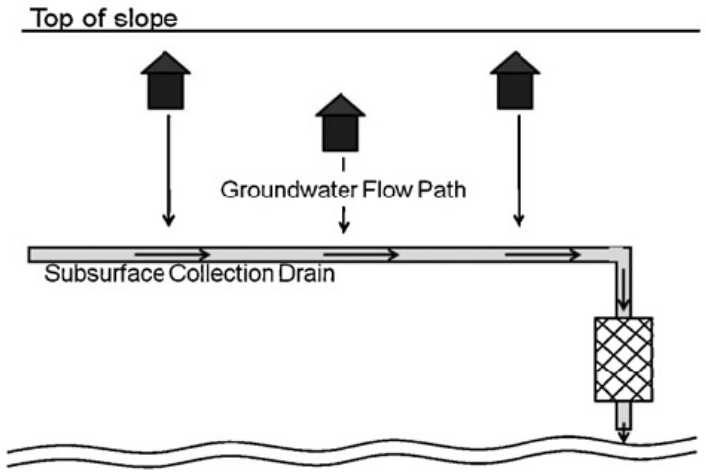


Wetland Restoration Project
Marstons Mills River
Hamblin Cranberry Bogs





c.



Denitrifying bioreactors—An approach for reducing nitrate loads to receiving waters

Louis A. Schipper[a,*], Will D. Robertson[b], Arthur J. Gold[c], Dan B. Jaynes[d], Stewart C. Cameron[e]

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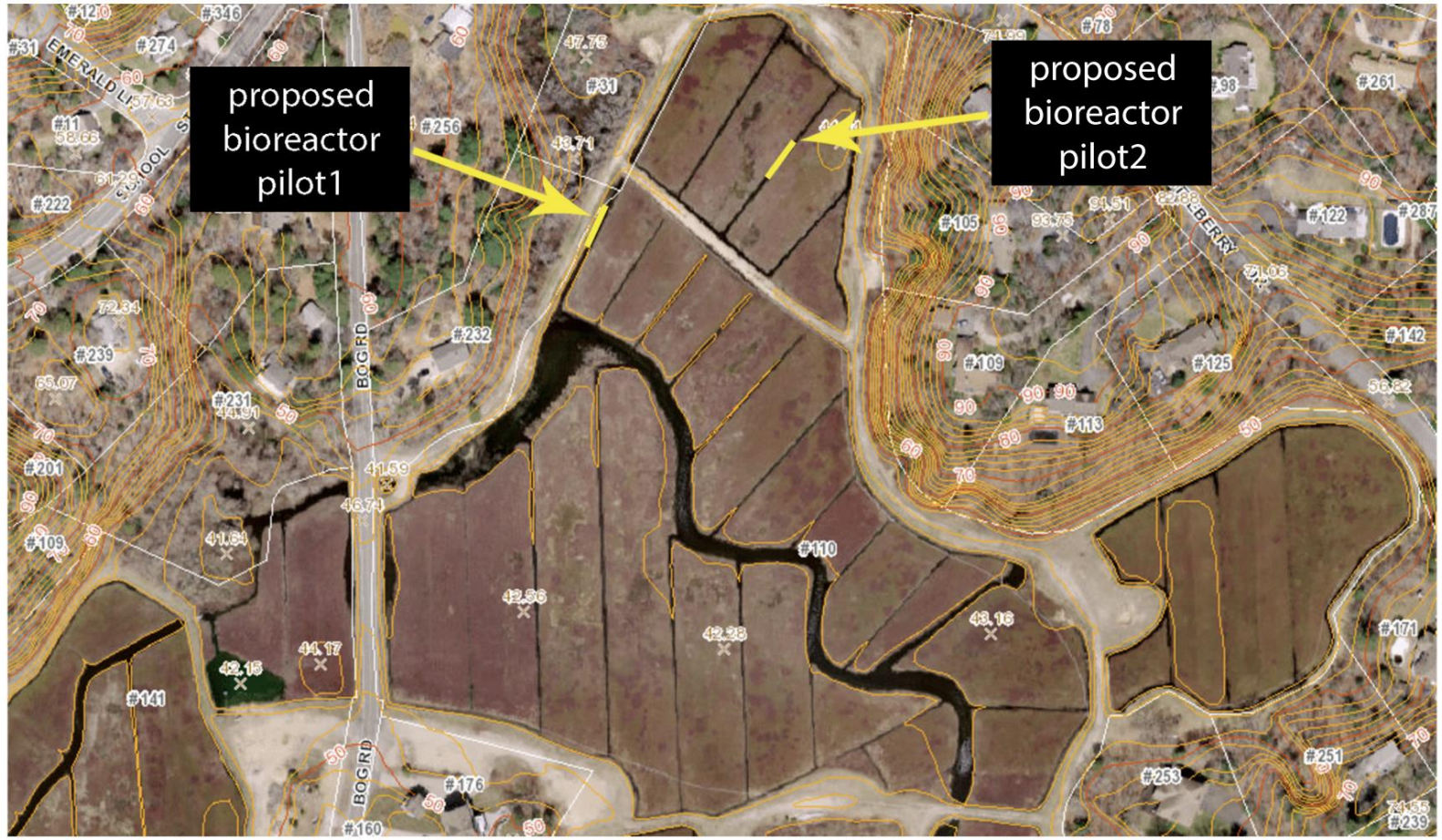
[b] *Department of Earth and Environmental Sciences, University of Waterloo, Waterloo, ON N2L 3G1, Canada*
[c] *Department of Natural Resources Science, University of Rhode Island, Kingston, RI 02881, USA*
[d] *National Laboratory for Agriculture and the Environment, USDA-ARS, 2110 University Blvd, Ames, IA 50011-3120, USA*
[e] *GNS Science, Private Bag 2000, Taupo, New Zealand*



Scott Horsley
Water Resources Consultant
65 Little River Road
Cotuit, MA 02635

Pilot Project
Cranberry Bog Restoration
w/Woodchip Bioreactor
Conceptual Plan

Bog Road
Marstons Mills, MA

May 1 , 2020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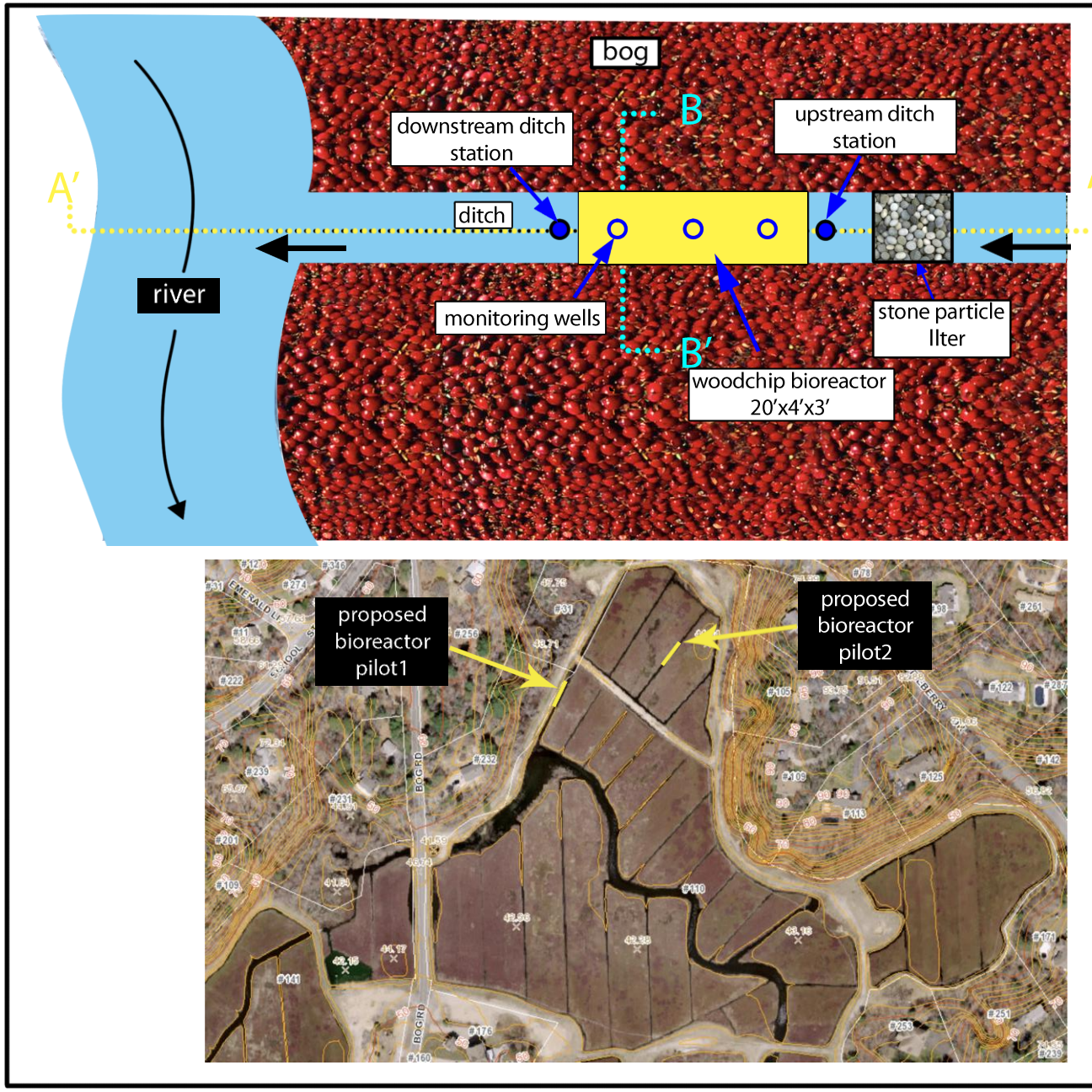
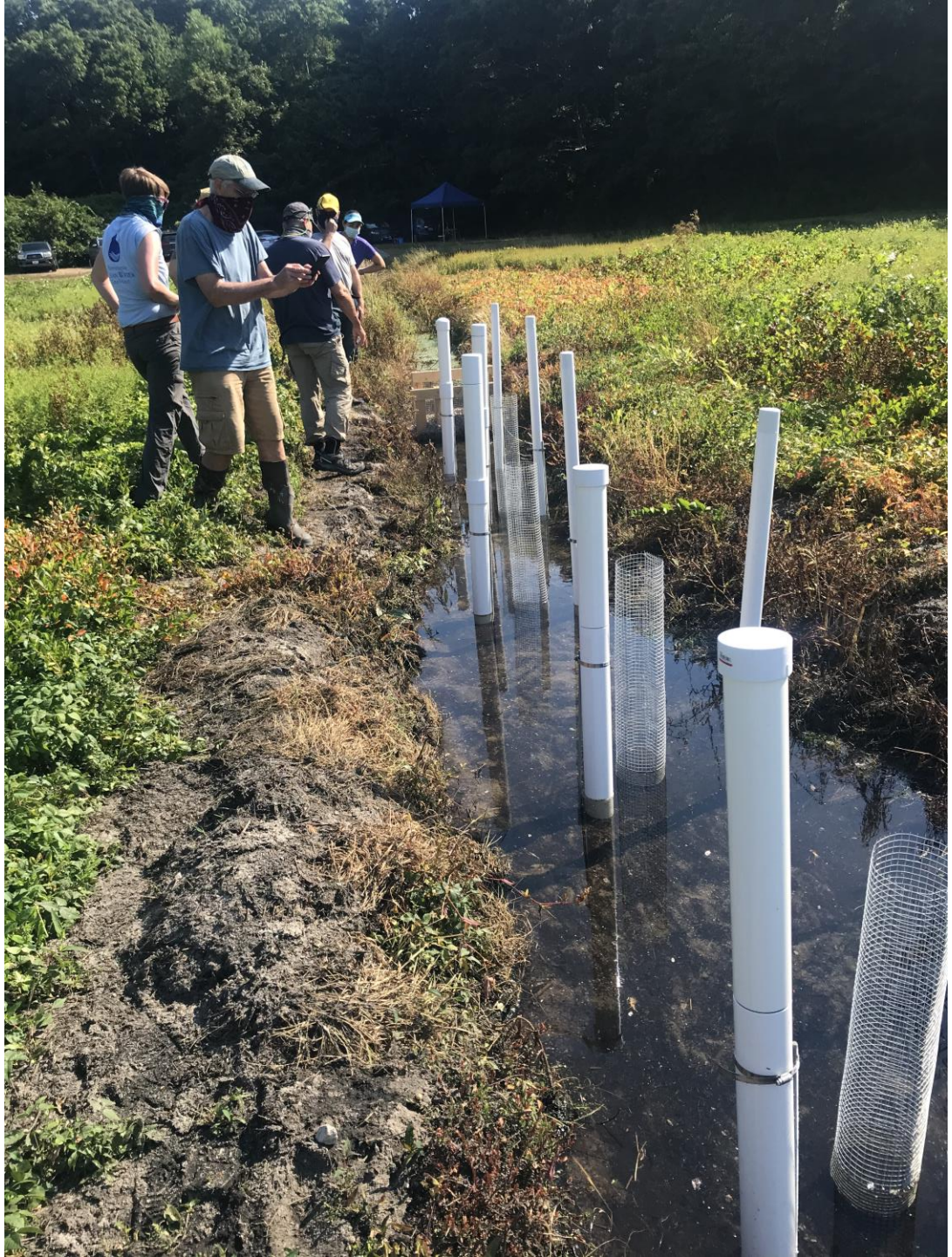
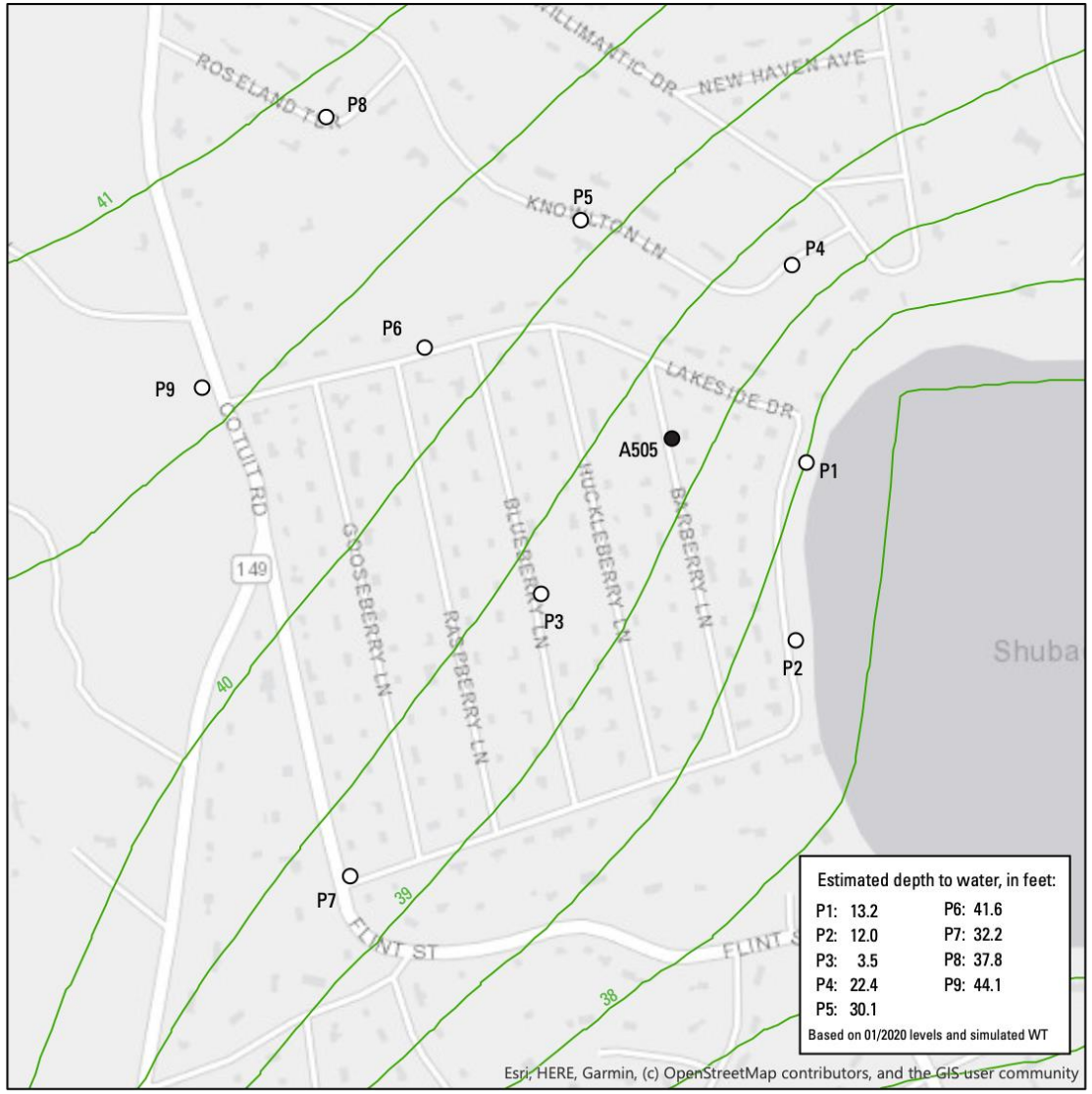

bog
B
downstream ditch station
upstream ditch station
A′
ditch
river
monitoring wells
stone particle llter
B′
woodchip bioreactor 20′x4′x3′
proposed bioreactor pilot1
proposed bioreactor pilot2



Enhanced I&A Septic System Study
Shubael's Pond, Barnstable, MA



Proposed USGS/EPA water-table well network in an area west and northwest of Shubael Pond, Barnstable, MA

NitROE™ Tank Concept

CES Clean Water®

Title 5 Amendment – Nitrogen Sensitive Areas (310 CMR 15.00)

15.214: Nitrogen Loading Limitations
(1) No system serving new construction in Nitrogen Sensitive Areas designated in 310 CMR 15.215 shall be designed to receive or shall receive more than 440 gallons of design flow per day per acre except as set forth at 310 CMR 15.216 (aggregate flows) or 15.217 (enhanced nitrogen removal).

(3) It shall be the duty of the owner of the system or proposed system to ascertain whether or not the facility to be constructed will be in a nitrogen sensitive area. The Department will prepare and make available at locations generally accessible to the public maps portraying designated nitrogen sensitive areas within the Commonwealth.

15.215: Designation of Nitrogen Sensitive Areas
The following areas have been determined by the Department to be particularly sensitive to the discharge of pollutants from on-site sewage disposal systems and are therefore designated nitrogen sensitive.

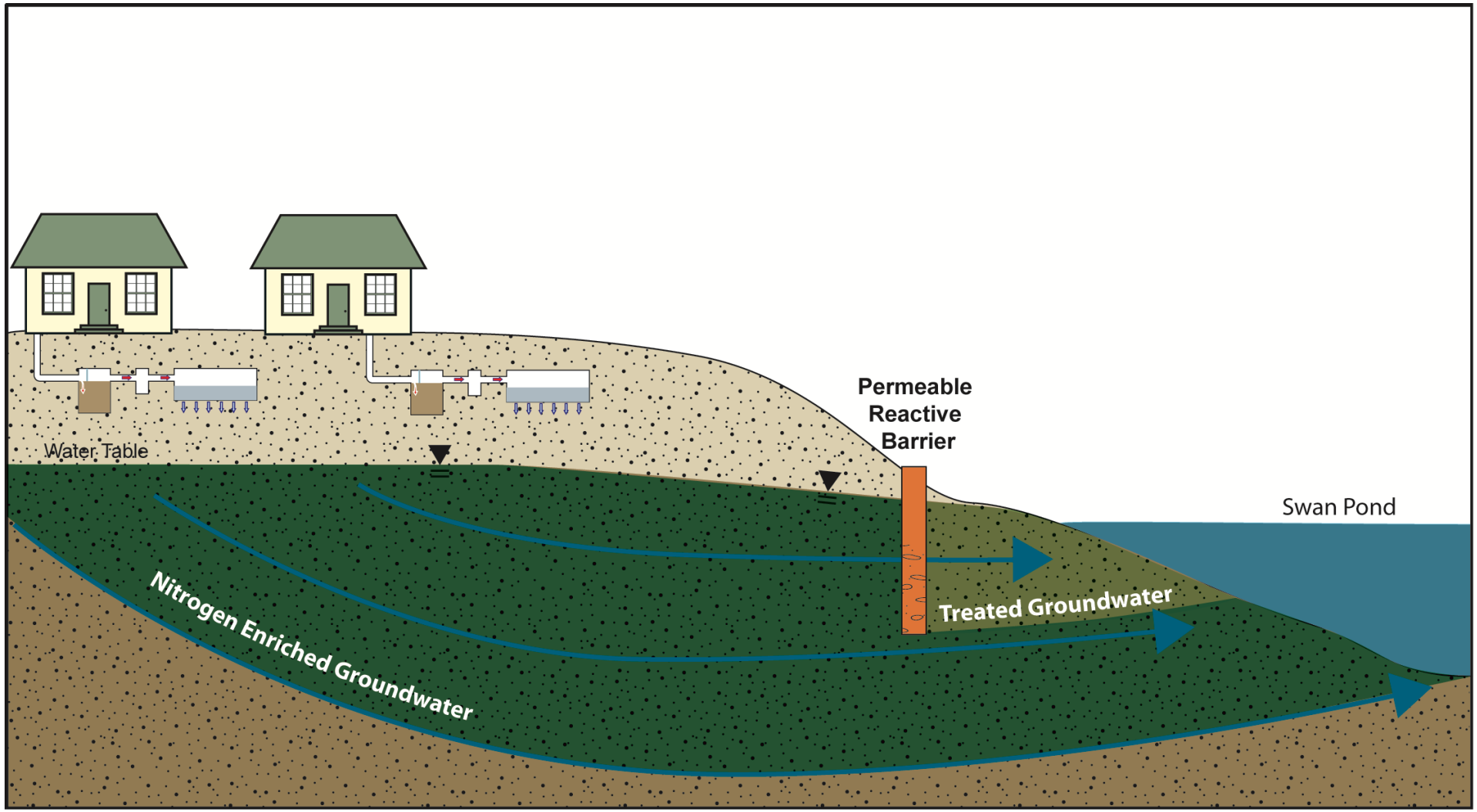
(1) Interim Wellhead Protection Areas and Department approved Zone IIs of public water supplies; (2) Nitrogen sensitive embayments or other areas which are designated as nitrogen sensitive for purposes of 310 CMR 15.000 shall be mapped based on scientific evaluations of the affected water body and adopted through parallel public processes pursuant to both 310 CMR 15.000 and 314 CMR 4.00: Massachusetts Surface Water Quality Standards.

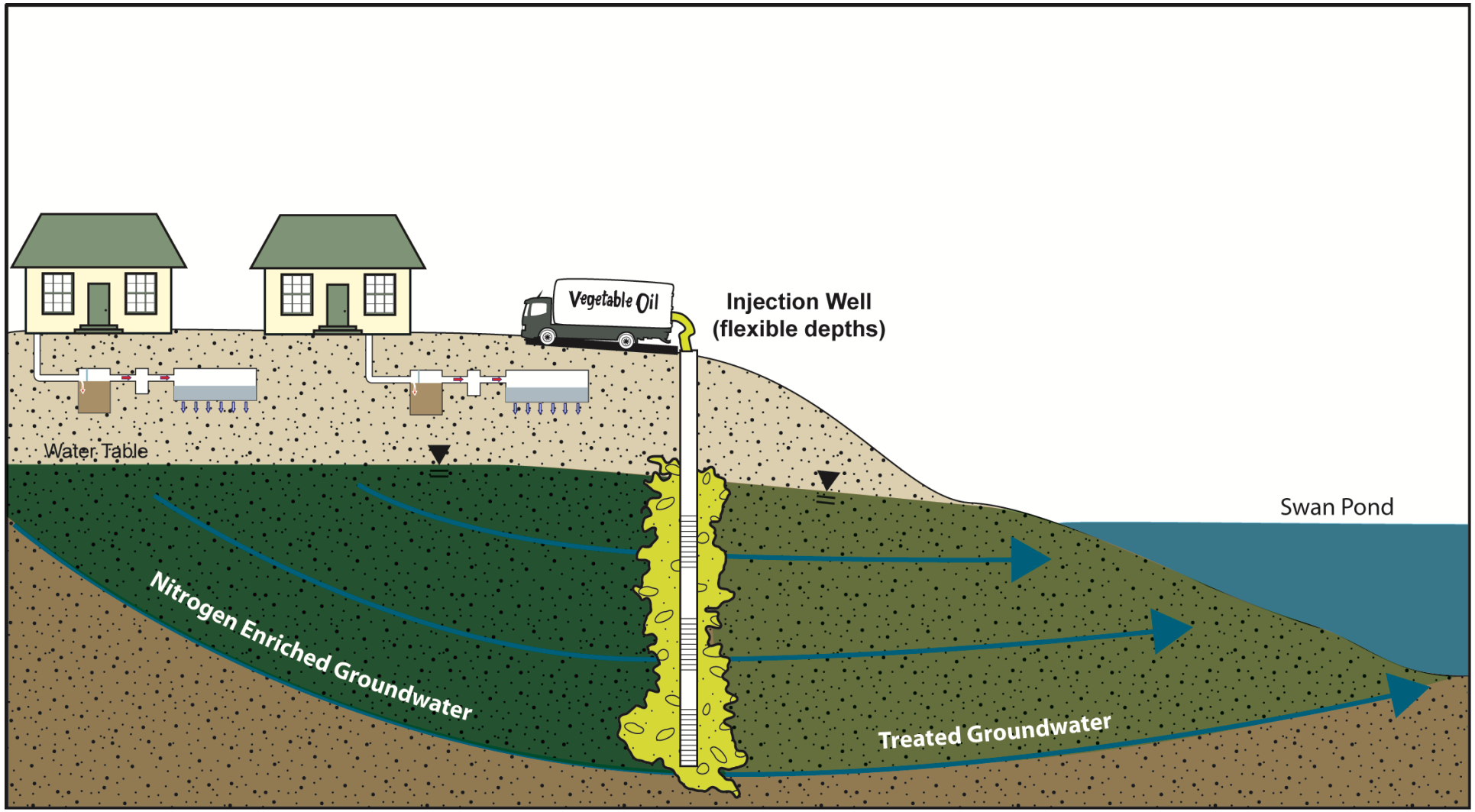
15.217: Systems with Enhanced Nitrogen Removal
(1) The nitrogen loading limitations established in 310 CMR 15.214 shall not apply to discharge of an effluent meeting the federal Safe Drinking Water Act nitrate standard of 10 ppm through either an approved alternative system or a treatment works with a groundwater discharge permit issued pursuant to 314 CMR 5.00: Ground Water Discharge Permit Program. (2) An increase in calculated allowable nutrient loading per acre may be allowed with the use of a technology approved for enhanced nutrient removal pursuant to either the piloting, provisional or general use certification provisions in 310 CMR 15.281 through 15.288 15.100 through 15.255.

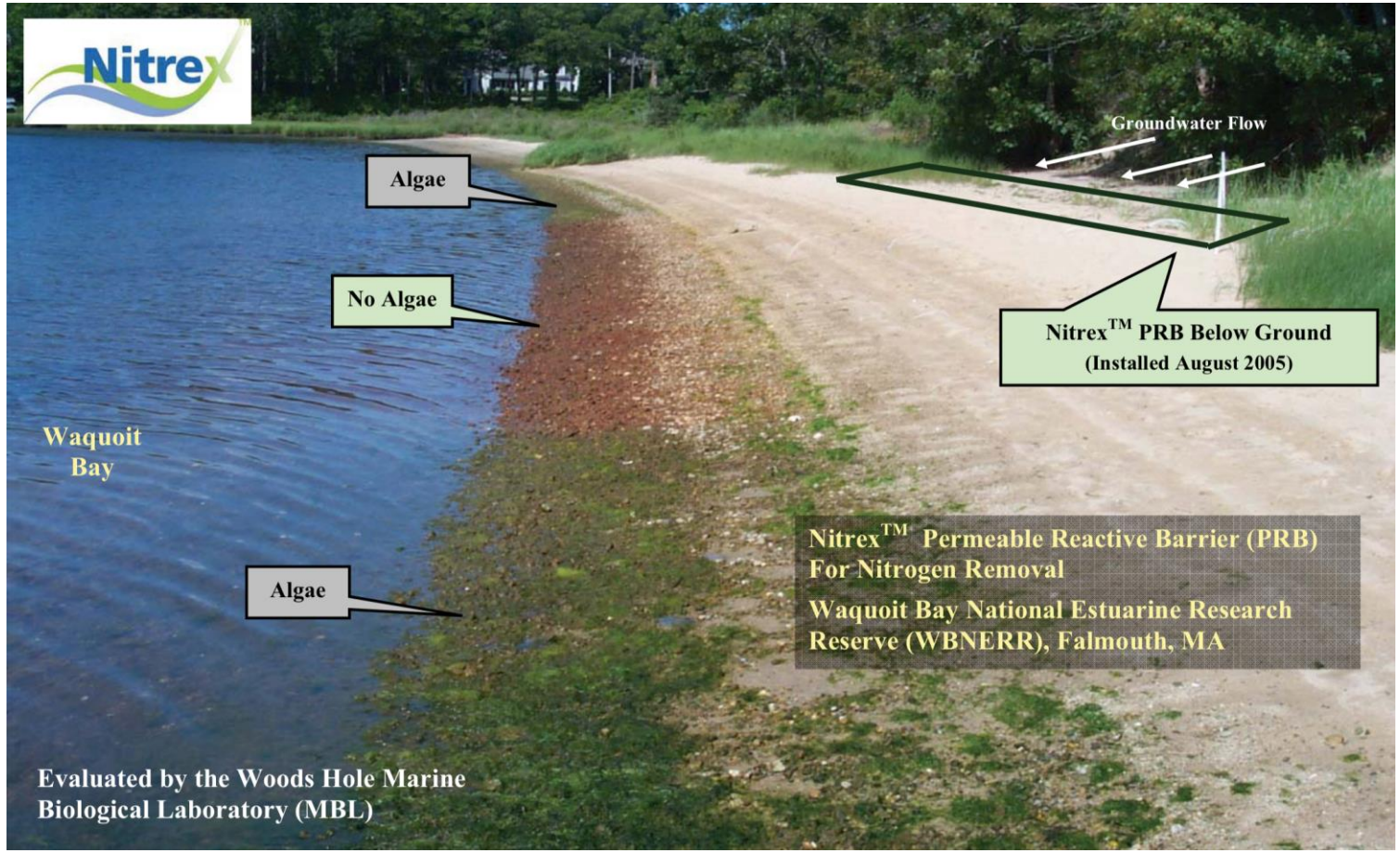
Net Change Duck Creek

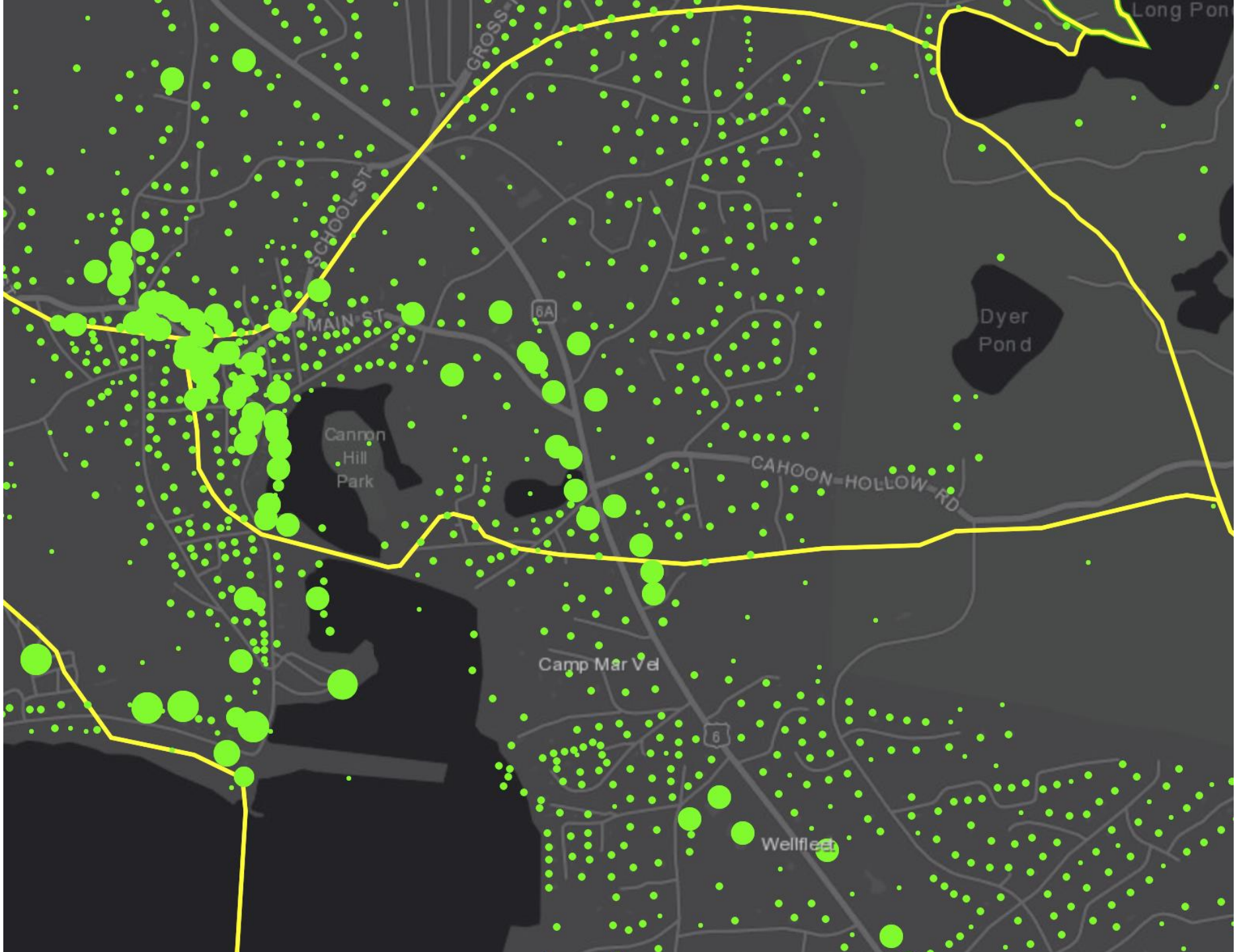
95 Lawrence Housing Project – Nitrogen Loading Wastewater Options

Scenario 1	I&A alone	Standard Title 5	9900	gal/day	35	mg/liter	479	kg/year
		Enhanced I&A	9900	gal/day	5	mg/liter	68	kg/year
		Net Change Duck Creek					68	kg/year
Scenario 2	neighborhood treatment	Treatment Plant	20000	gal/day	5	mg/liter	138	kg/year
		Reduction	10100	gal/day	35	mg/liter	488	kg/year
		Net Change Duck Creek					-350	kg/year
Scenario 3	neighborhood treatment	Treatment Plant	30000	gal/day	5	mg/liter	207	kg/year
	(expanded)	Reduction	20100	gal/day	35	mg/liter	972	kg/year
		Net Change Duck Creek					-765	kg/year


Water Table
Permeable
Reactive
Barrier
Swan Pond
Treated Groundwater
Nitrogen Enriched Groundwater

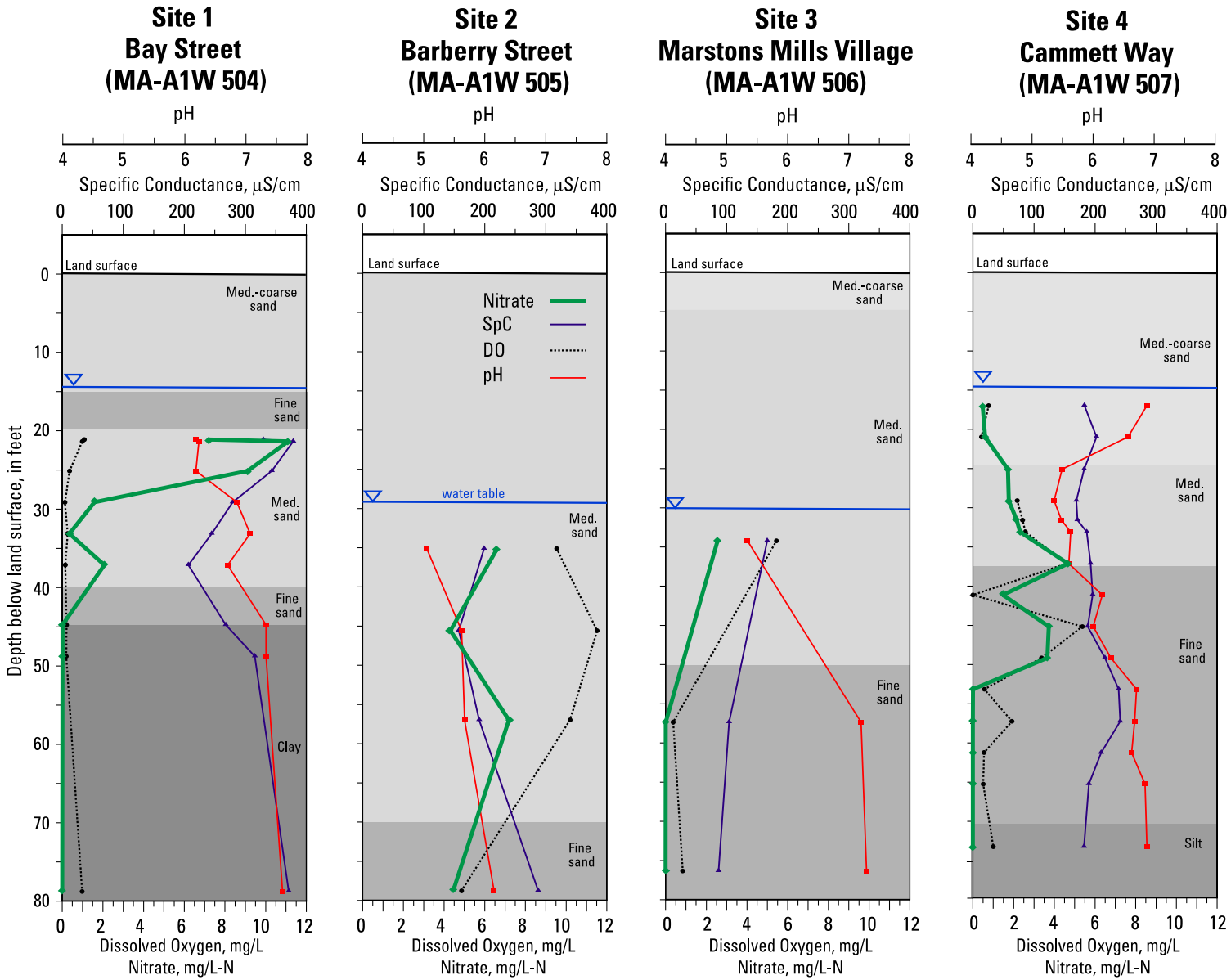

Vegetable Oil
Injection Well
(flexible depths)
Water Table
Swan Pond
Nitrogen Enriched Groundwater
Treated Groundwater


Nitrex
Groundwater Flow
Algae
No Algae
Nitrex™ PRB Below Ground
(Installed August 2005)
Waquoit
Bay
Algae
Nitrex™ Permeable Reactive Barrier (PRB)
For Nitrogen Removal
Waquoit Bay National Estuarine Research
Reserve (WBNERR), Falmouth, MA
Evaluated by the Woods Hole Marine
Biological Laboratory (MBL)


Long Pond
SCHOOL ST
GROSS
MAIN ST
6A
Dyer
Pond
Cannon
Hill
Park
CAHOON HOLLOW RD
Camp Mar Vel
6
Wellfleet


MAIN ST
Cannon
Hill Park


E. COMMERCIAL ST
COMMERCIAL ST
TOWN PIER



Attachment 2. Results from USGS/EPA drilling and sampling at four locations in Barnstable, MA, November-December 2019.

Wellfleet Targeted Watershed Plan - Nitrogen Load Calculator

Goals		Reduction	Reference	Herring River	Duck Creek	The Cove	Drummer/ Blackfish	Hatches	Wellfleet Harbor	Loagy Bay		Total
Buildout Loads				13184	2683	5406	3989	5409	8439	1529		40639
Existing Loads				10117	1971	3584	2686	3452	6398	894		29102
Threshold				9902	657	1110	1675	3453	3154	434		20385
Reduction Required (From Buildout)				3282	2026	4296	2314	1956	5285	1095		20254
				25%	76%	79%	58%	36%	63%	72%		50%
Nitrogen Reductions												
Health Regulation Future Septics Enhanced I&A		75%	Heufelder, 2019	2300	534	1367	977	1468	1531	476		8653
Enhanced I&A Upgrades	total # existing septics (calc from MEP Table VIII-2)			906	328	615	447	563	1055	189		4103
	upgrades to enhanced I&A			92	222	574	344	94	656	164		2146
	percentage			10%	68%	**93%**	77%	17%	62%	87%		52%
	N reduction	75%	MASSTC	326	788	2036	1220	333	2327	582		7613
Stormwater Mitigation 25%		25%	CCC 208 Plan	228	44	81	60	78	144	20		655
Fertilizer Reductions 25%		25%	CCC 208 Plan	228	44	81	60	78	144	20		655
Aquaculture/Shellfish/Harvest		0.13 g/oyster-yr	CC Tech Matrix			416			1040			1456
Mayo Creek Restoration		40%	CCS/WHG			317						317
Permeable Reactive Barrier		72.5%	CC Tech Matrix		316							316
Fertigation Well (Golf Course)		80%		200					100			300
95 Lawrence Road Cluster/Neighborhood Wastewat		85%			300							300
Remaining Load				0	0	-1	-4	-1	-1	-3	0	-10

Next Steps?

- PRB pilot project – conceptual design/preliminary hydrogeo
- Mayo Creek restoration – evaluate bioreactors as possible enhancement
- 95 Lawrence – coordinate with town's consultants
- Enhanced I&A septics – local regulations/Title 5 amendments (NSA)/town subsidies
- Others?