MEPA EENF Meeting
Effluent Discharge Reprioritization

CAMELOT DRIVE WASTEWATER TREATMENT PLANT

PLYMOUTH, MA

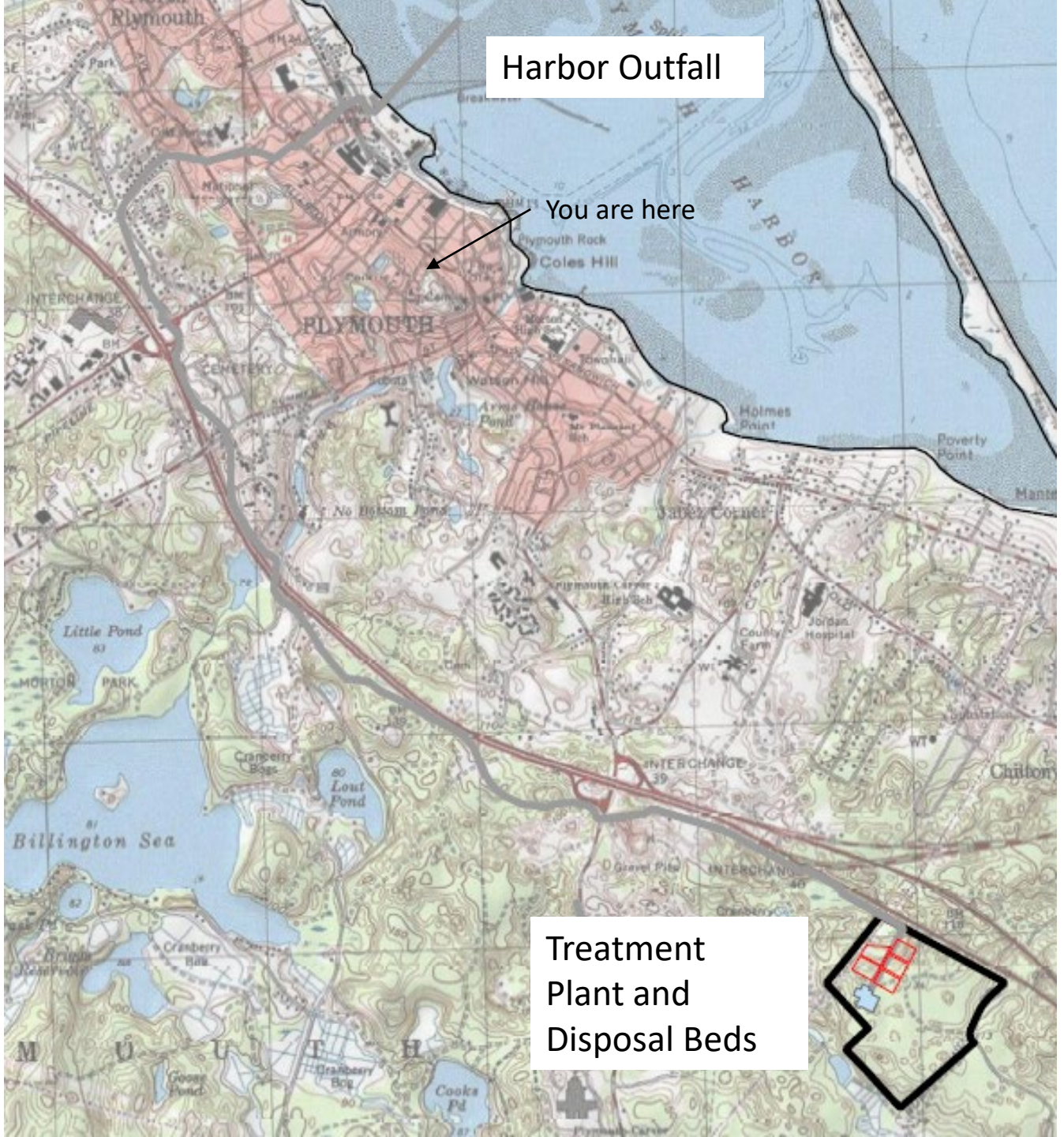
OCTOBER 4, 2023

Agenda

- PROJECT OVERVIEW
- PROJECT BENEFITS
- POTENTIAL IMPACTS
- ALTERNATIVES ANALYSIS
- MITIGATION MEASURES
- MEPA PROCESS

Project Overview:

Locus



Project Overview:

Reprioritization

	Existing Conditions	Proposed Conditions
Harbor Outfall	**Primary discharge location** Permitted up to 1.75 MGD discharge	Emergency/backup discharge location NPDES permit retained for emergency use
Groundwater Discharge Beds (Camelot Drive)	Secondary discharge location Permitted up to 0.75 MGD after initial 1.75 MGD discharged to Harbor	**Primary discharge location** Permitted 3.0 MGD discharge
Total Discharge	2.5 MGD total discharge permitted	3.0 MGD total discharge permitted

Site Description

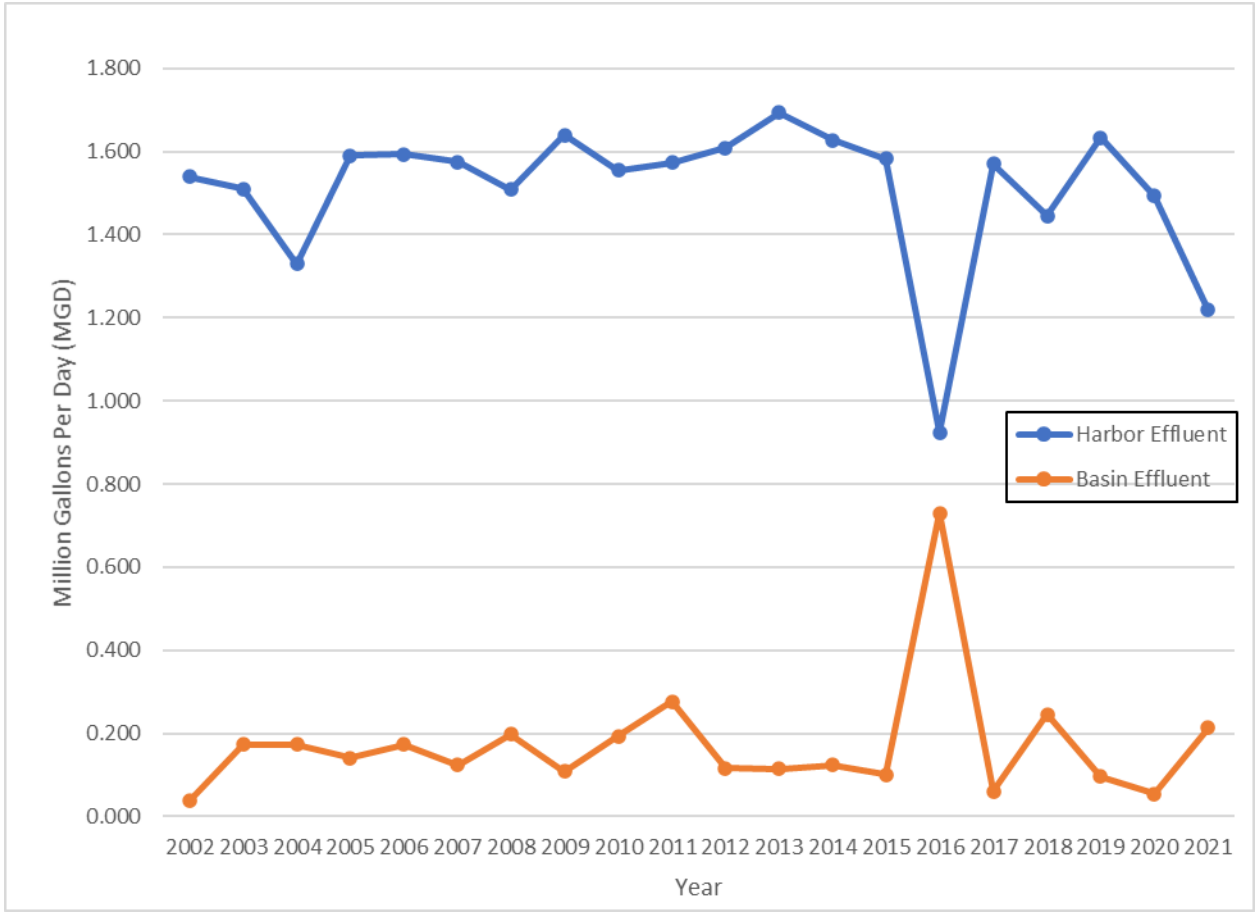
- In operation since 2002 with the capacity to treat 5.2 MGD
- Site area = ~ 96 acres
- 5 open-sand, disposal beds for groundwater discharge, each approximately 81,000 SF in area and 10 feet deep.
- 30-inch discharge pipeline into Plymouth Harbor

Flow Data

Disposal beds and harbor outfall

Average flow to outfall:
1.5 MGD

Average flow to disposal beds:
0.2 MGD



Due to sewer main repairs, all effluent was discharged to disposal beds between June 2016 and January 2017.

Flows were diverted again during the 2018 hydraulic loading test.

Project Benefits

- IMPROVED WATER QUALITY IN PLYMOUTH HARBOR AND PLYMOUTH/KINGSTON/DUXBURY (PKD) BAY
- INCREASED GROUNDWATER RECHARGE TO OFFSET DRINKING WATER WITHDRAWALS
- INCREASED GROUNDWATER RECHARGE TO SUPPORT BASEFLOWS OF THE EEL RIVER
- REDUCED ENERGY USAGE

Treatment Facility Energy Usage

- Change in primary discharge location will reduce energy costs by eliminating the need to pump the treated effluent to the Plymouth Harbor outfall.
- Estimated annual savings:
  - Eliminate 1.5 MGD from outfall: $36,000
  - Eliminate 1.75 MGD from outfall: $42,000

	Average Monthly Effluent (MG)	Average Monthly Planet Power (kWh)	kWh per MG	Cost per MG
Basin Only Months*	48.2	200,286	4,155	$581.74
Ocean Only Months*	48.2	222,858	4,624	$647.31
Difference	0	22,572	468	$65.56

*Basin Only Months include July-October 2016. Ocean Only Months include December 2016, February 2017, March 2017, and July 2018. Based on utility cost of 14 cents per kWh for fall 2021.

Potential Impacts

- GROUNDWATER MOUNDING IMPACTS TO INFRASTRUCTURE (SEPTIC SYSTEMS AND BASEMENTS)
- INFRASTRUCTURE (DAMS, BRIDGES) IMPACTS CAUSED BY INCREASED FLOWS IN THE EEL RIVER
- NUTRIENT MIGRATION TO THE EEL RIVER

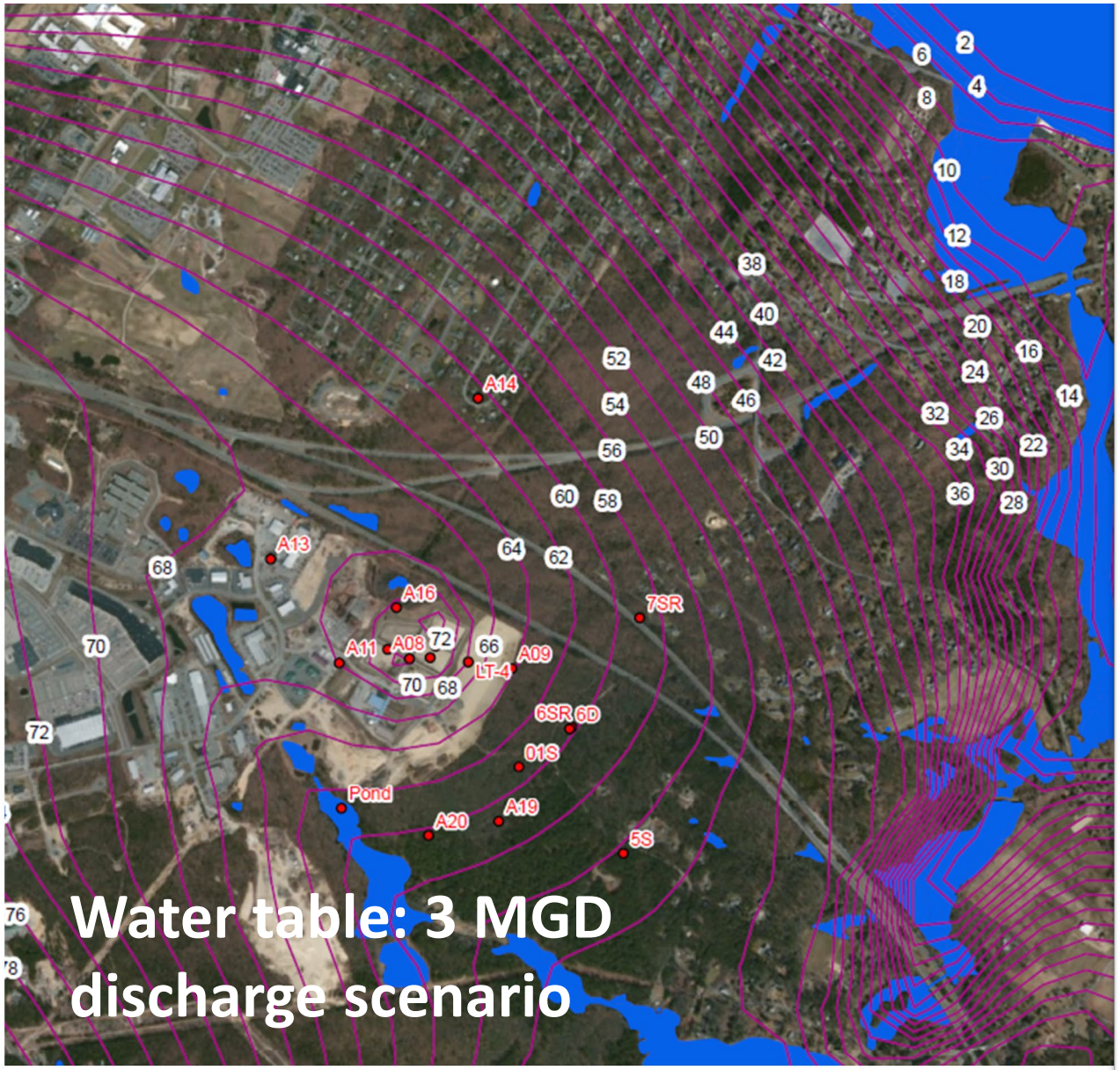
2018 Loading Test

- Discharge of 1.5 MGD to bed #4 for 38 days
- Groundwater level monitoring in 18 wells
- Monitoring from August 4th through November 7th
- Results used to refine and validate the USGS Plymouth-Kingston-Carver-Duxbury regional groundwater model

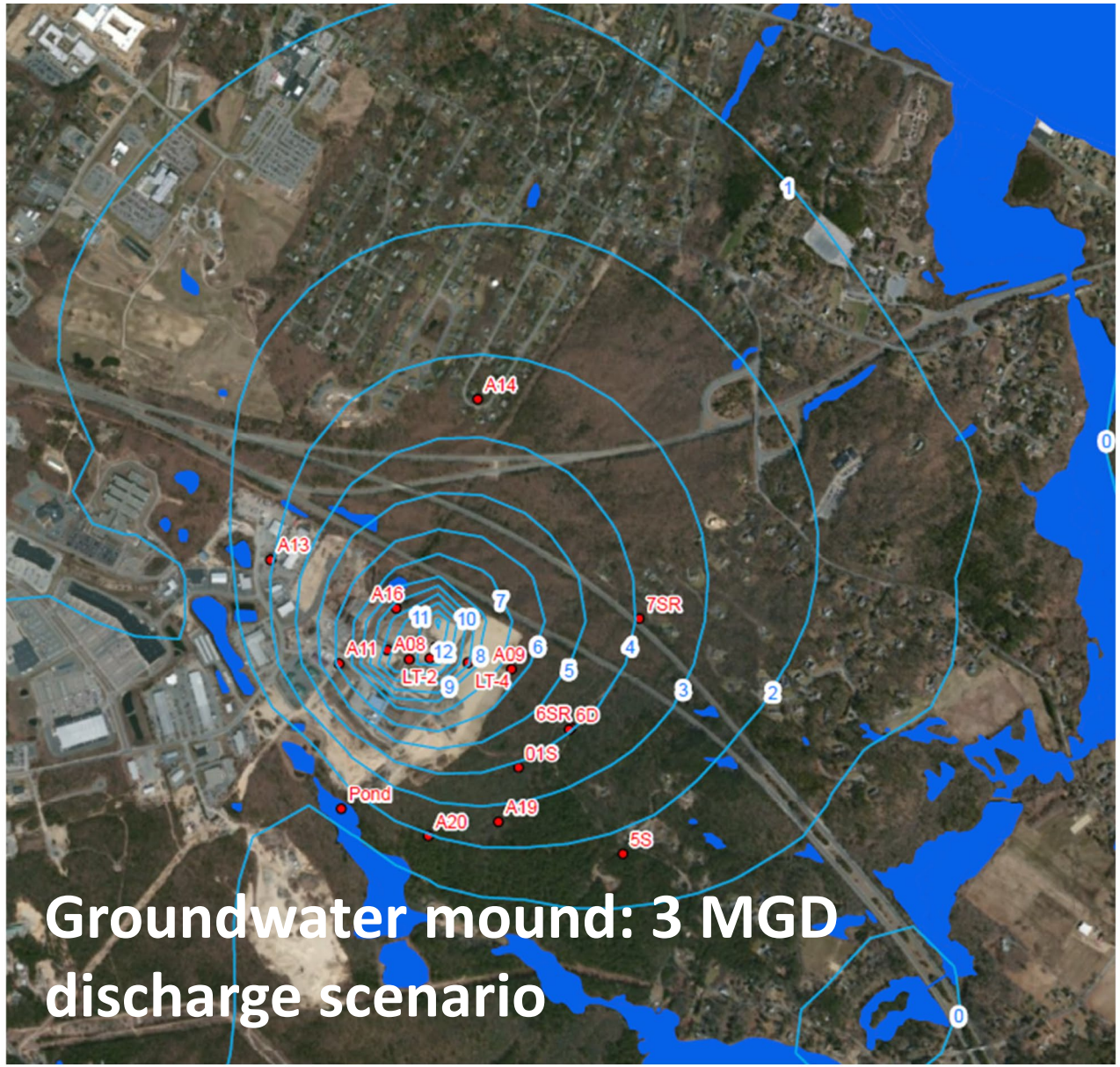
Loading Test

Peak water table based on field observations (9/27/2018) with a groundwater discharge of 1.5 MGD

Modeling Results



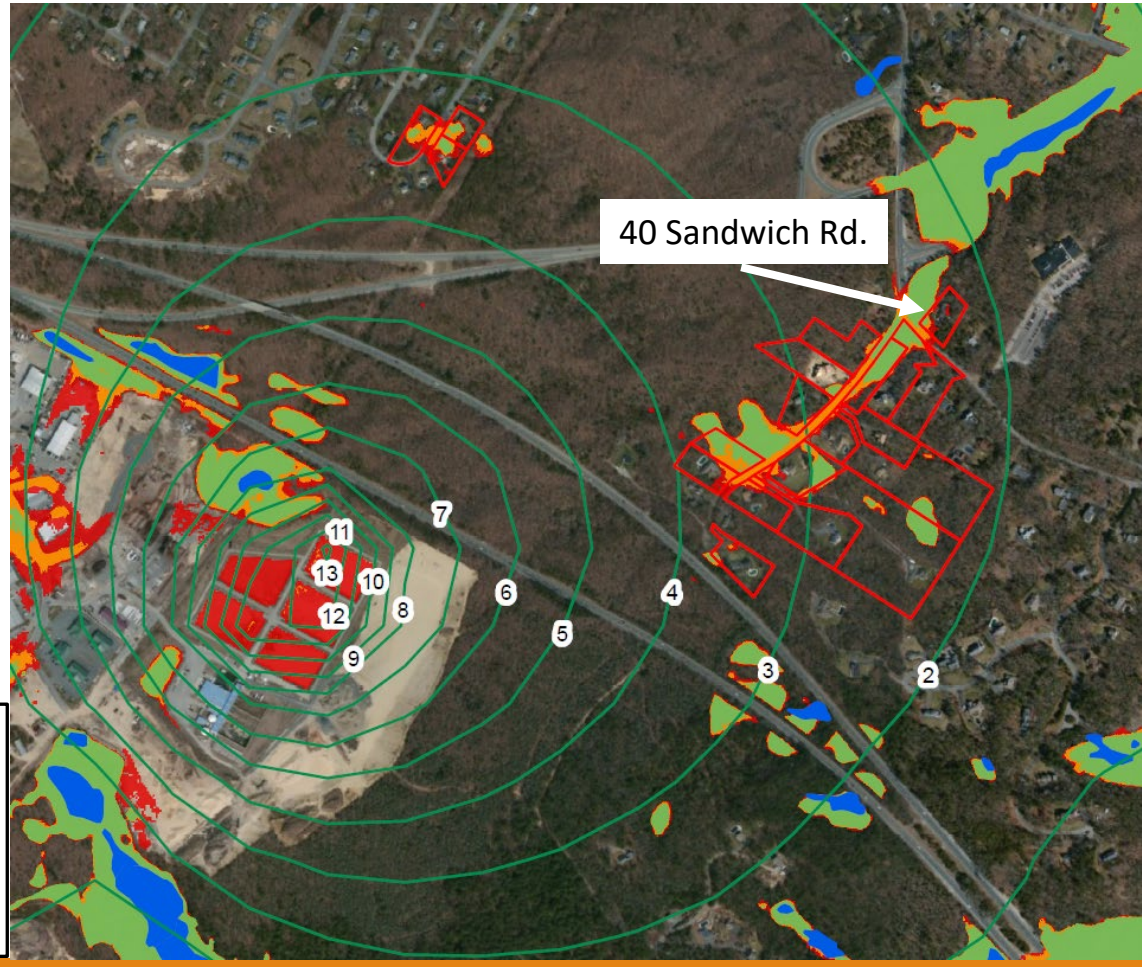
Water table: 3 MGD discharge scenario



Groundwater mound: 3 MGD discharge scenario

Depth to Groundwater for Surrounding Parcels

- The Town undertook a review of BOH records and on-the-ground elevations surveys to determine the elevation of septage.
- All but one parcel will have more than 5 feet
- One parcel (40 Sandwich Road) has a 12-foot-deep seepage pit which would need to be replaced.



Colors indicate <15' DTGW
Existing conditions
1.5 MGD loading simulation
3.0 MGD loading simulation

Table 5: Low elevation parcels survey results and model comparison.

Address	Parcel ID	Surveyed Top of Foundation	Estimated Basement Floor (8' below TOF)	Ground Elevation	Septic system depth (from BOH records)	Estimated Elevation of Sewer System (lowest elevation)	Mounded Groundwater Elevation (NAVD88)	Difference between Mounded GW & Basement	Difference between Mounded GW & Septic System
12 E RUSSELL MILLS RD	082-000-007A-000	64.31	56.31	62.07	4.3	57.77	49.53	6.78	8.24
32 E RUSSELL MILLS RD	082-000-009-005	74.25	66.25	71.35	5.5	65.85	52.53	13.72	13.32
38 E RUSSELL MILLS RD	082-000-004A-004	70.4	62.4	76.9	9.23	67.67	53.53	8.87	14.14
				72.56	4.23	68.33	53.53		14.8
40 SANDWICH RD	047-000-007B-001	65.04	57.04	63.28	12	51.28	46.53	10.51	4.75
43 E RUSSELL MILLS RD	082-000-004-001	71	63	68.98	7	61.98	55.53	7.47	6.45
49 E RUSSELL MILLS RD	082-000-004-002	75.72	67.72	73.18	5.5	67.68	56.53	11.19	11.15
50 E RUSSELL MILLS RD	082-000-004A-003	72.8	64.8	73.61	11	62.61	55.53	9.27	7.08
58 E RUSSELL MILLS RD	082-000-003A-003	80.12	72.12	75.33	5.81	69.52	56.53	15.59	12.99
72 CURTIS DR	026-000-009-074	69.8	61.8	71.25	5	66.25	57.03	4.77	9.22
78 CURTIS DR	026-000-009-075	75.98	67.98	75.45	8.5	66.95	57.28	10.7	9.67
79 CURTIS DR	026-000-009-103	71.97	63.97	73.24	4.3	68.94	58.28	5.69	10.66
9 E RUSSELL MILLS RD	082-000-007-002	72.9	64.9	72.06	6.1	65.96	50.03	14.87	15.93
				70.45	4.33	66.12	50.03		16.09

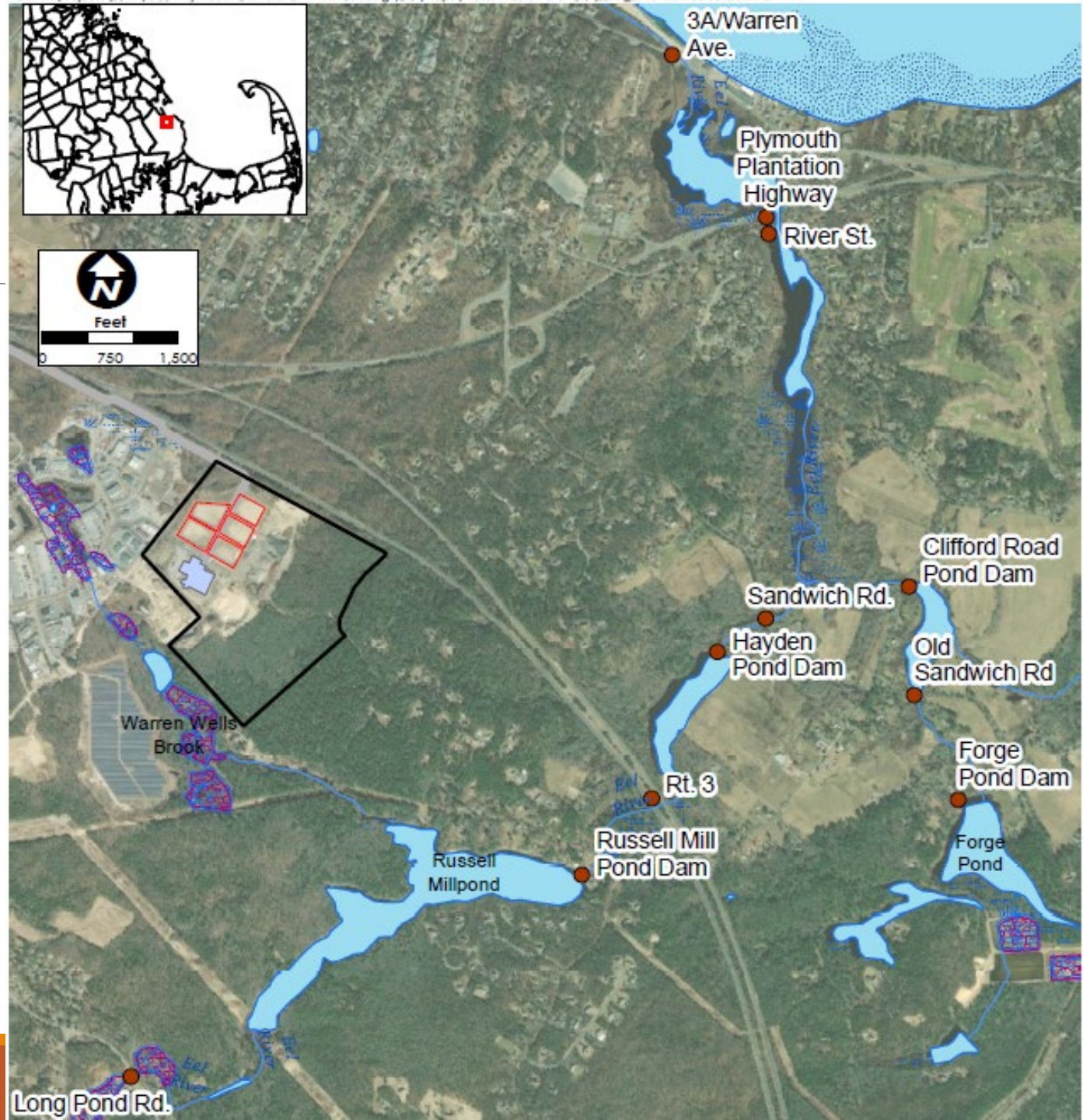
Elevations in feet, NAVD88

Eel River Infrastructure Impacts

Infrastructure assessed

	Bridge/Dam/Culvert	Width (feet)
Western Branch	Long Pond Road Culvert	10
	Russell Mill Pond Dam	12
	Route 3 Bridge	54
	Hayden Pond Dam	13
	Sandwich Rd. Bridge	12
Eastern Branch	Forge Pond Dam	*
	Old Sandwich Rd.	16
	Clifford Rd	10
Lower	River St/ Plymouth Plantation Hwy	32/87
	MA Rt. 3A	31

* Dimensions were not available



Eel River Flow Increase

- The majority of effluent discharged to groundwater reaches the Eel River at either Warren Wells Brook or Russell Mill Pond.
- Flow increases at each infrastructure location were evaluated under the 3.0 MGD scenario
- Greatest flow increases expected at Russell Mill Pond.

	Bridge/Dam/Culvert	Baseline Flow* (CFS)	3 MGD Flow* (CFS)	Change in flow (CFS)	Change in flow** (%)
Western Branch	Long Pond Road	2.12	2.33	0.21	9.99%
	Russell Mill Pond/Russell Mill Rd	10.77	14.16	3.38	31.40%
	Route 3	12.62	15.87	3.26	25.83%
	Hayden Pond	14.20	17.47	3.27	23.01%
	Sandwich Rd	14.73	18.00	3.27	22.23%
Eastern Branch	Forge Pond	4.36	4.26	-0.09	-2.12%
	Old Sandwich Rd.	5.20	5.10	-0.10	-1.93%
	Clifford Rd	5.85	5.76	-0.10	-1.66%
Lower Eel River	River St/ Plymouth Plantation Hwy	22.85	26.08	3.23	14.12%
	MA Rt. 3A	24.44	27.73	3.29	13.44%
	*Modeled net contributions to streamflow from groundwater upstream of the identified feature. **Change in flow based on modeled net groundwater contribution to streamflow.				

Hydraulic Impacts

- Infrastructure with the greatest impact :
  - Russell Mill Pond Dam
    - Expected flow increase of 3.38 cfs
    - Dam width of 12 feet
  - Hayden Pond Dam
    - Expected flow increase of 3.27 cfs
    - Dam width of 13 feet

Table 8: Russell Millpond Dam Hydraulic Calculation Results

Scenario	Flow (CFS)	Height above spillway top (ft)	Change in height (ft) and (%)	Velocity (ft/s)	Change (ft/s) and (%)
50% Exceedance (Baseline)	16	0.55		2.42	
50% Exceedance (3 MGD discharge)	19.4	0.62	0.07 (12.7%)	2.62	0.20 (8.3%)
10% Exceedance (Baseline)	20	0.63		2.63	
10% Exceedance (3 MGD discharge)	23.4	0.70	0.07 (11.1%)	2.77	0.14 (5.3%)

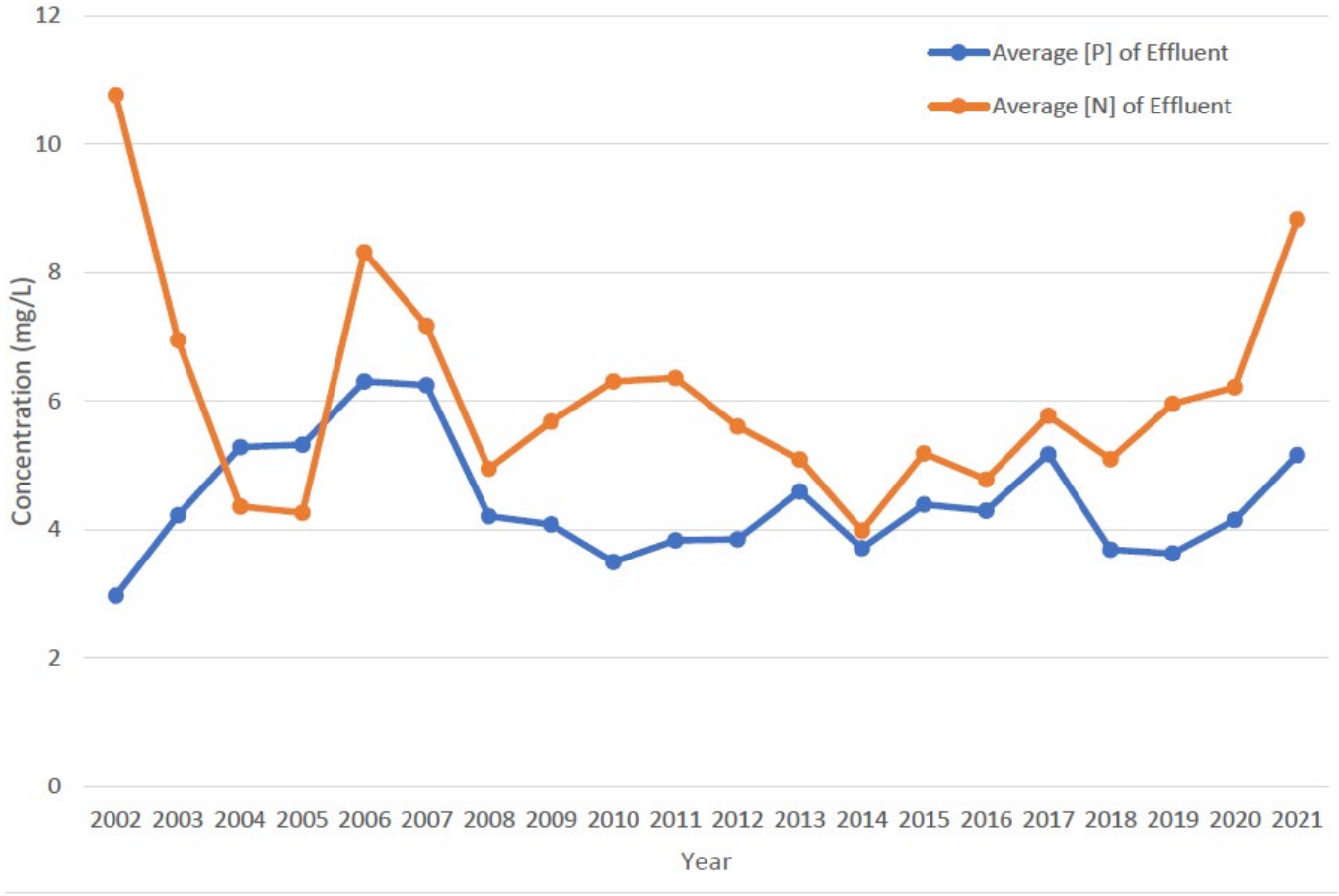
Table 9: Hayden Pond Dam Hydraulic Calculation Results.

Scenario	Flow (CFS)	Height above spillway top (ft)	Change in height (ft) and (%)	Velocity (ft/s)	Change (ft/s) and (%)
50% Exceedance (Baseline)	21.1	1.36		3.87	
50% Exceedance (3 mgd discharge)	24.4	1.51	0.15 (11%)	4.04	0.17 (4.4%)
10% Exceedance (Baseline)	25.1	1.53		4.10	
10% Exceedance (3 mgd discharge)	28.4	1.67	0.14 (9.1%)	4.25	0.15 (3.7%)

Nutrient Migration to Eel River

WWTF Effluent Nutrient Data

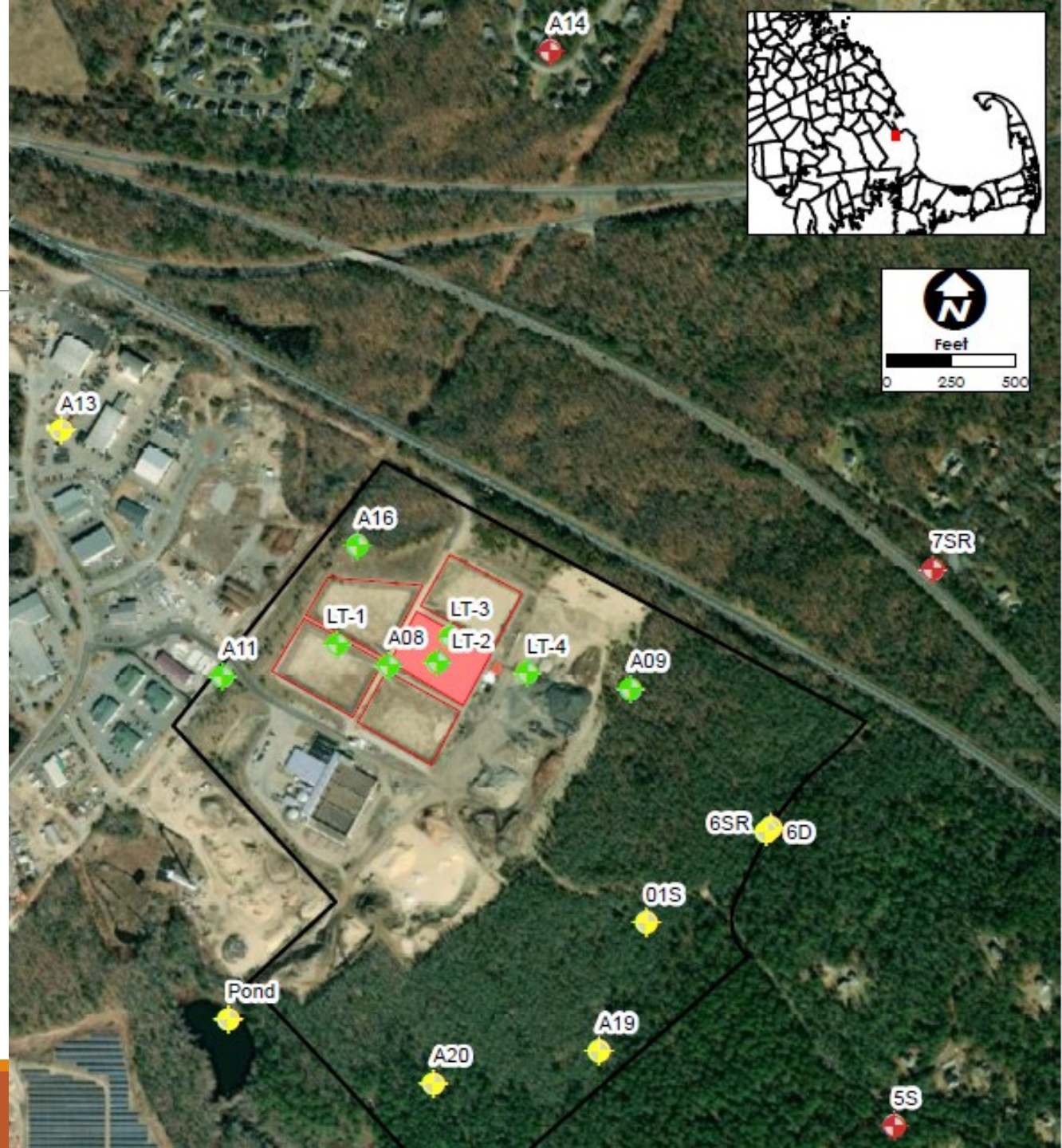
- Maximum allowable nitrogen concentration = 10mg/L
- No guidance on maximum phosphorus concentration
- Average [P] of Effluent = 4.4 mg/L



Groundwater Sampling Well Locations

- Nutrient monitoring at 18 Well Locations
- Consistent data from 2006-2020
- LT 1-4 wells only sampled in 2021

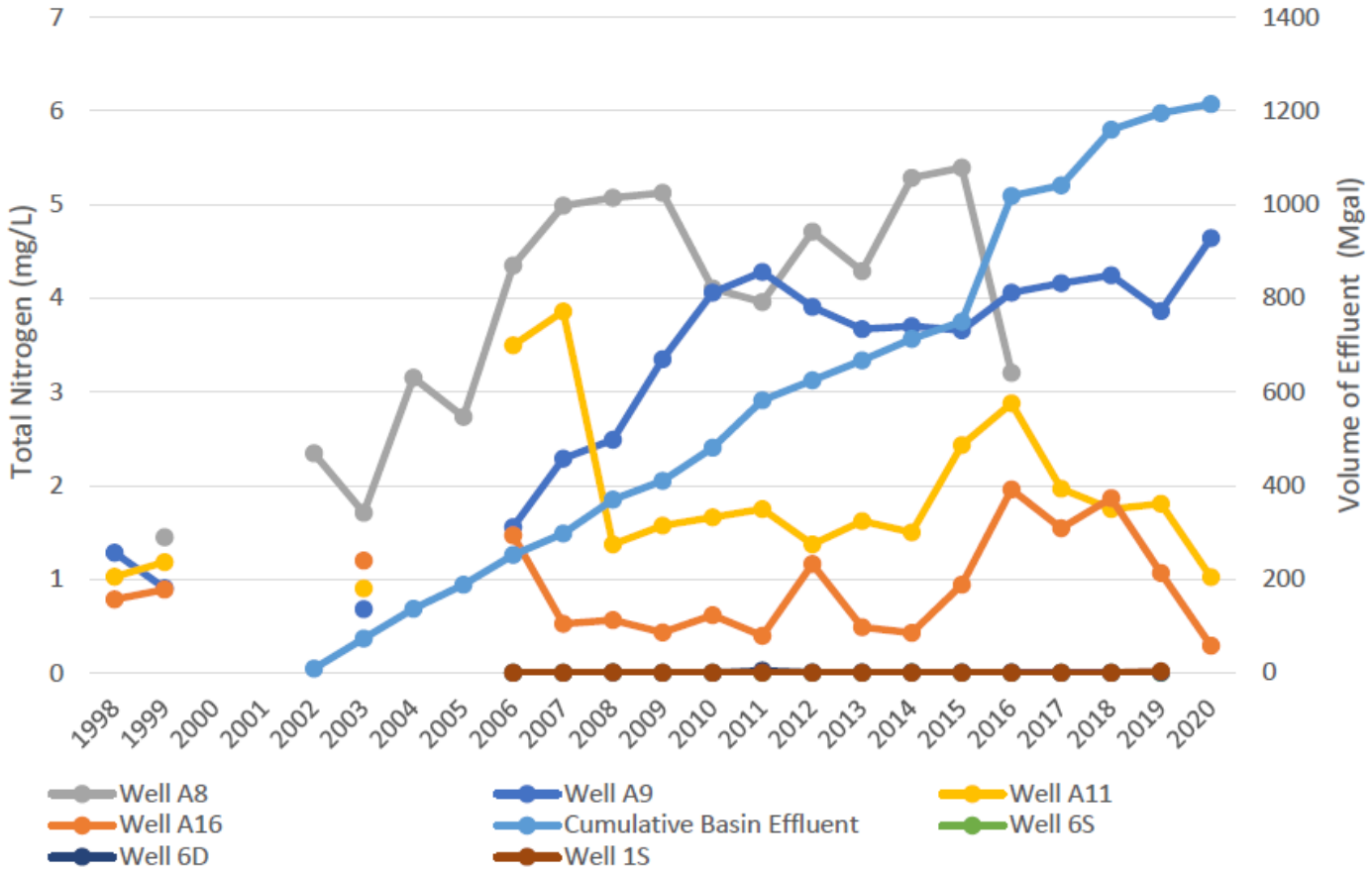
Well	*Distance from Center of sand beds (ft)*
LT-1	215ft (Directly under sand beds)
LT-2	185ft (Directly under sand beds)
LT-3	265ft (Directly under sand beds)
LT-4	545ft
A8	0ft (Directly under sand beds)
A16	428ft
A9	946ft
A11	651ft
6SR	1626ft
6D	1627ft
1S	1775ft



Groundwater Sampling Nitrogen Data Analysis

Nitrogen concentrations

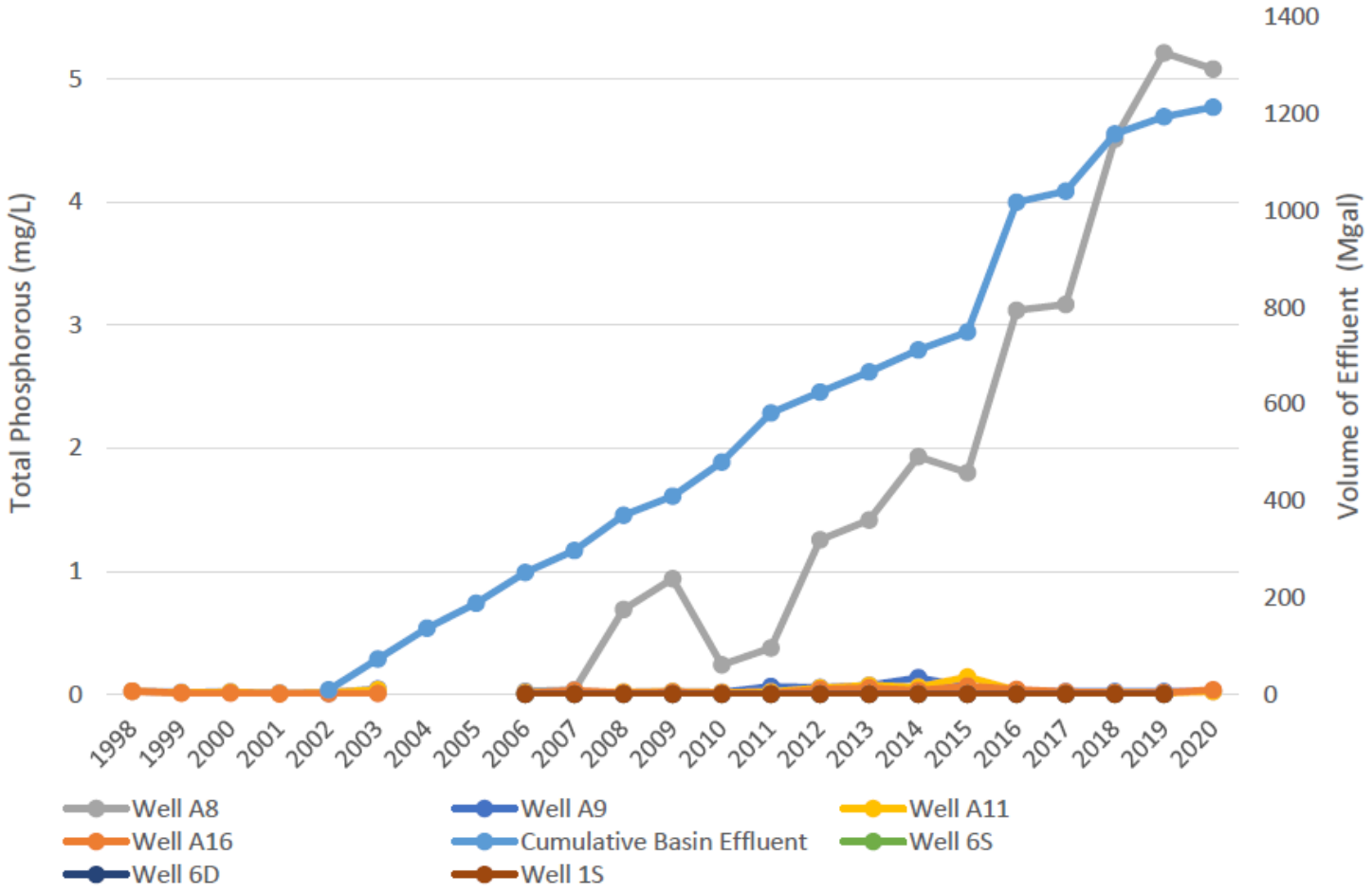
- Elevated nitrogen concentrations at groundwater wells close to the sand beds (Well A8, Well A9, Well 11, Well 16).
- Minimal correlation between nitrogen concentrations observed in the groundwater wells and the cumulative volume of effluent infiltrated on site.



Groundwater Sampling Phosphorus Data Analysis

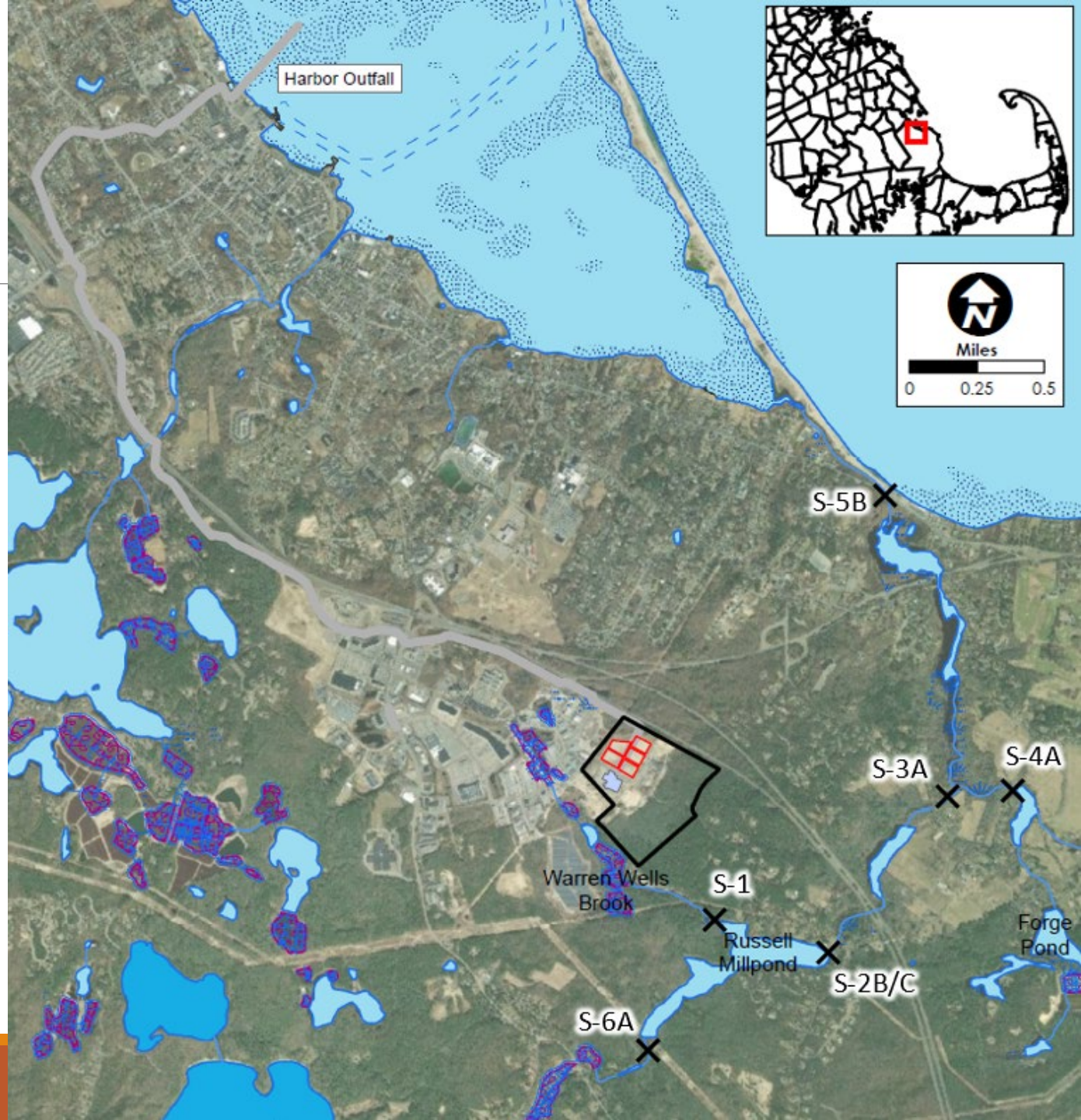
Phosphorus concentrations

- Correlation between phosphorus concentrations at Well A8 (directly below beds) and the cumulative volume of effluent infiltrated on site.
- Groundwater at Well A8 appeared to increase significantly roughly around 2011, when approximately 600 million gallons had been released into sand beds since operation began in 2002.

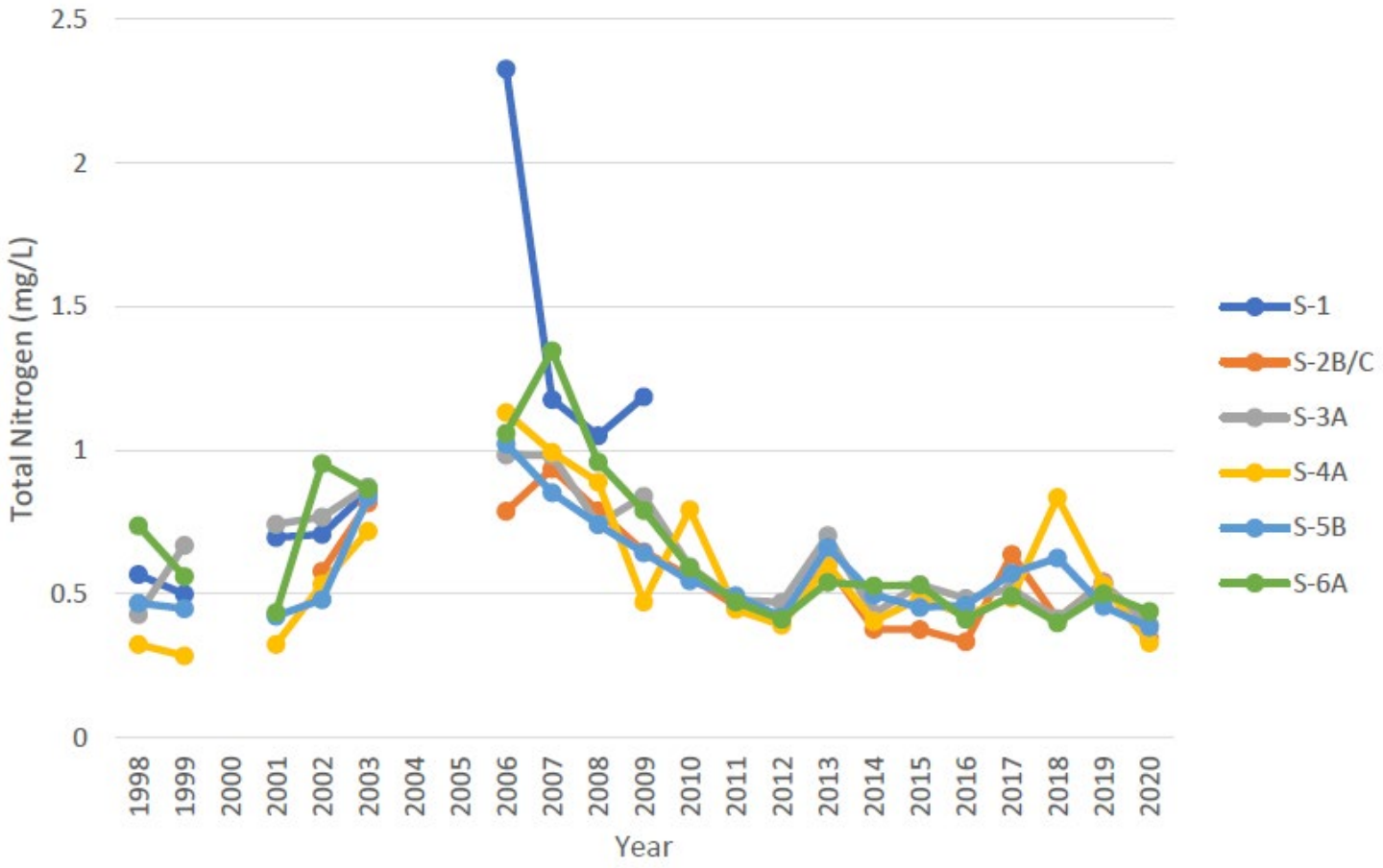


Surface Water Sampling Locations

- Nutrient monitoring data included at six locations
- Consistent data from 2006-2020



- The spike in 2006 is thought to be caused by the wetland clearing violation that occurred along Warren Wells Brook in 2006.
- Nitrogen concentrations have remained somewhat constant, around 0.5mg/L from 2012-2020



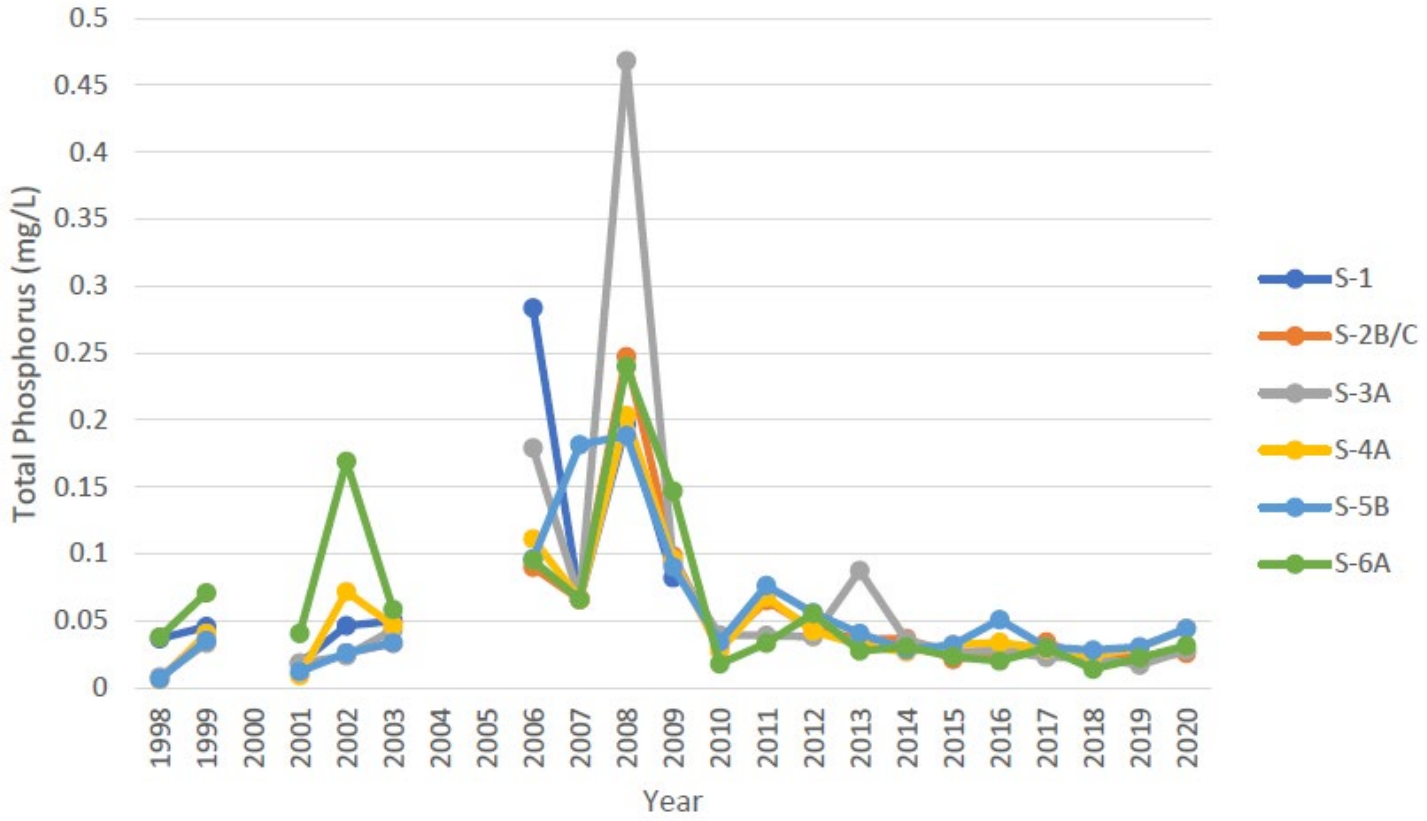
Surface Water Sampling Nitrogen Data Analysis

Nitrogen concentrations

Surface Water Sampling Phosphorus Data Analysis

Phosphorus concentrations

- The spike in 2006 is thought to be caused by the wetland clearing violation that occurred along Warren Wells Brook in 2006.
- The spike in 2008 is thought to be caused by algal blooms that were present when testing.
- Since 2010 phosphorus concentrations have remained around 0.04-0.06mg/L.

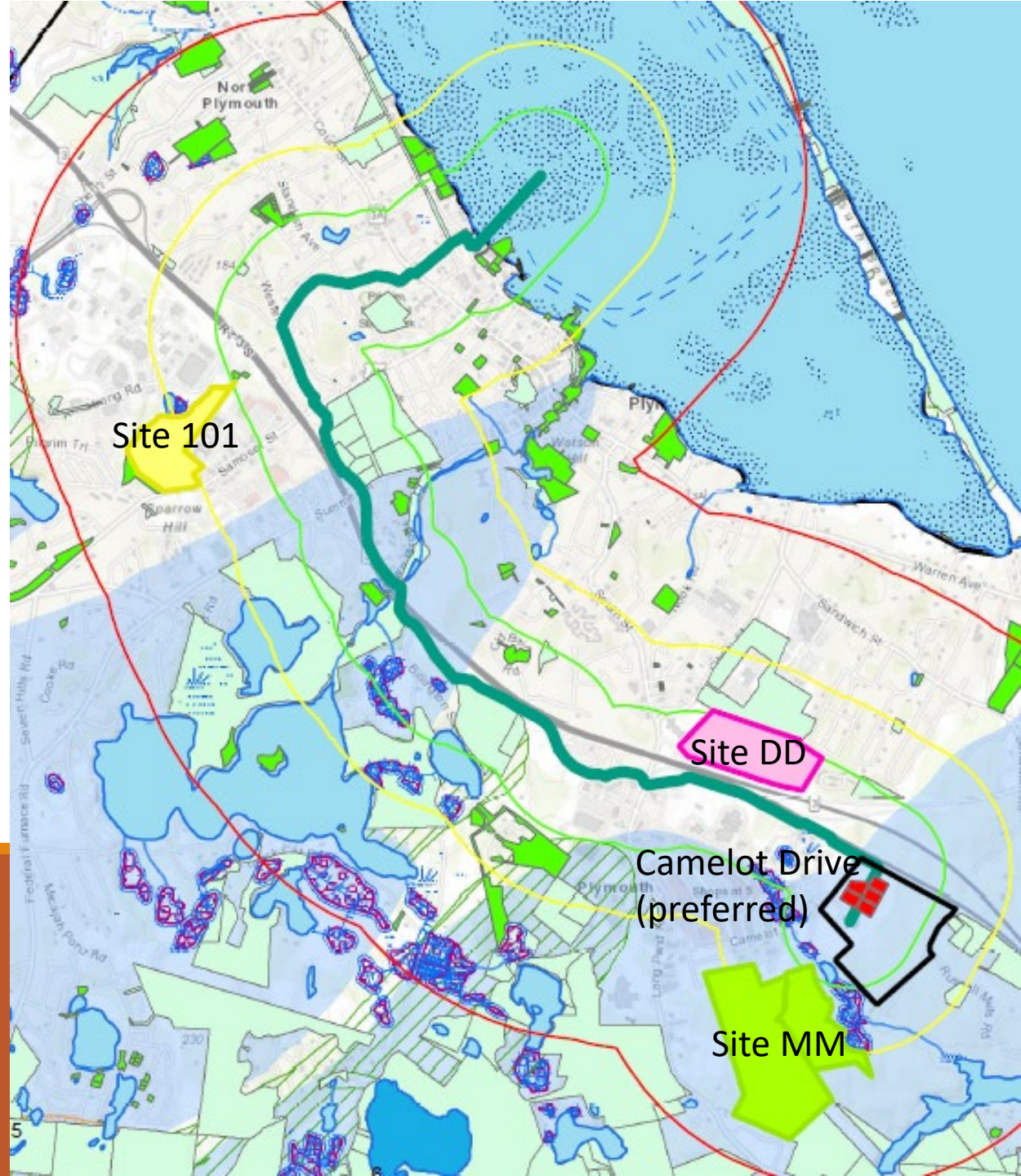


Alternative discharge locations were considered based on:

- Sufficient size (>10.5 acres)
- Location (<1 mile from existing sewerage)
- Hydrogeology and separation from groundwater
- Proximity to developed residential and commercial areas
- Proximity to sensitive receptors (drinking water wells, surface waterbodies, etc.)

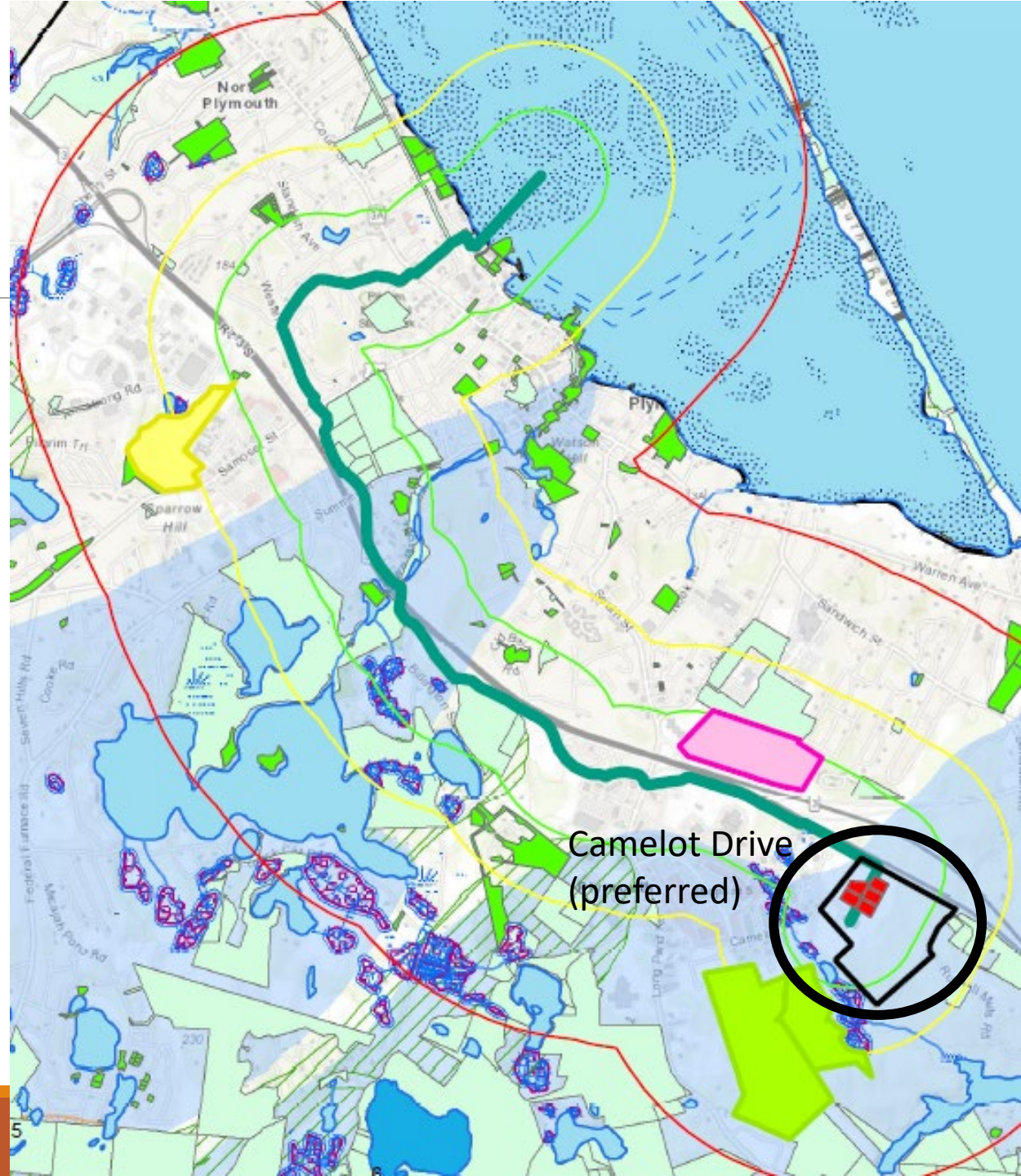
A no-build scenario was also considered.

Alternatives Analysis



Preferred Alternative

- Changing the prioritization of treated effluent discharge locations from the harbor outfall to on-site infiltration.
- Benefits:
  - No existing infrastructure to be impacted.
  - No significant impact to access to water supply.
  - No significant risk to existing dams/bridges along Eel River.
  - No significant impact to Eel River water quality.
  - No pumping or new infrastructure required.



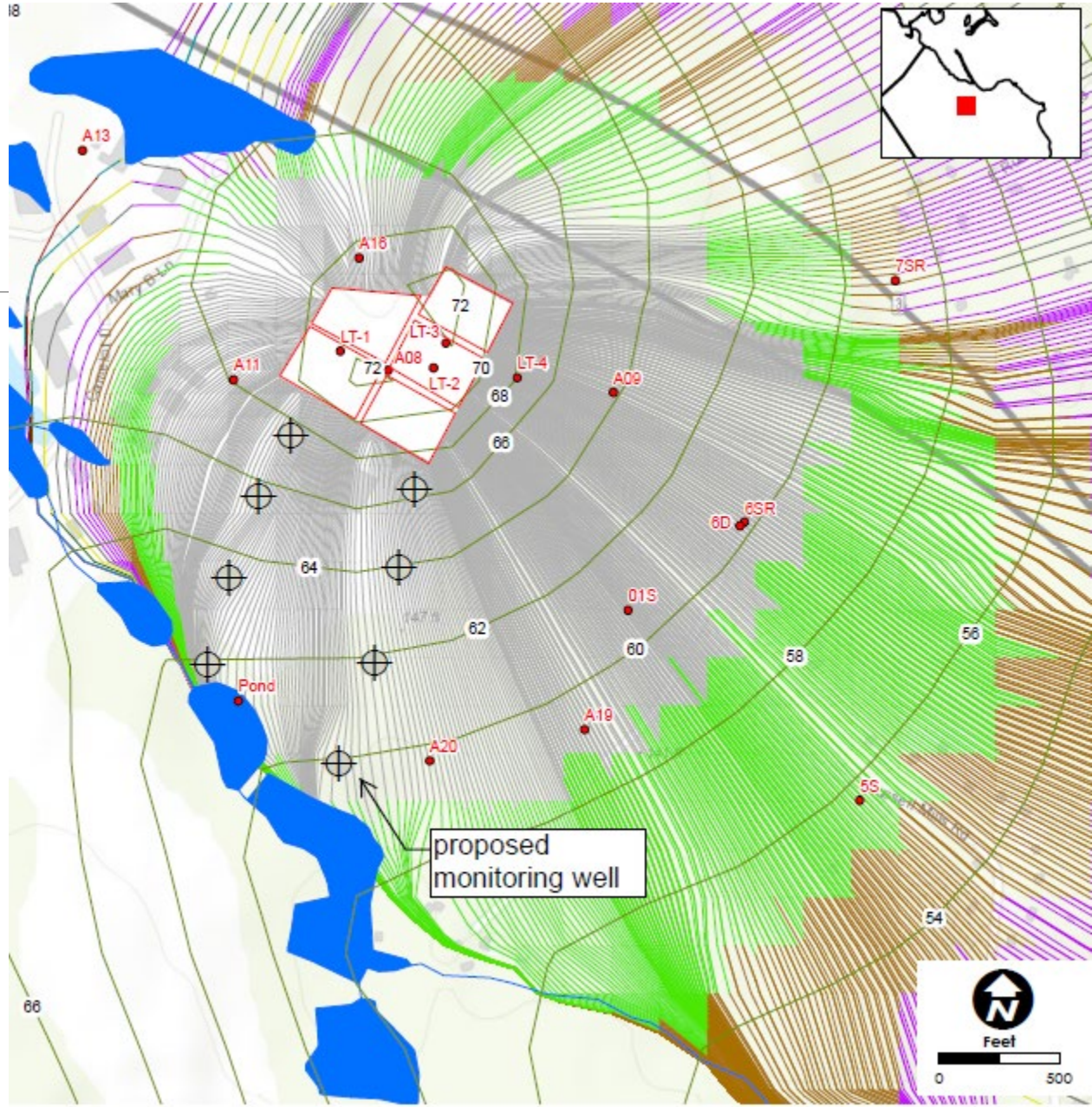
Mitigation Measures

CURRENT (TO REMAIN IN PLACE)

- Nutrient Management Plan and Eel River Watershed Monitoring Program
  - Consistent monitoring of groundwater, surface waters, and biological indicators.
  - Annual report summarizing data.

PROPOSED

- Eight additional monitoring well to better assess the potential for phosphorus migration to Warren Wells Brook.
- Replacement or relocation of private septic as necessary.



Ongoing Analyses for EIR

Update Data for analyses to current time period.

Estimate N loading offsets available from extending sewer service and treatment upgrades.

Further evaluation of P control, monitoring, and mitigation options.

MEPA Process

6. Meetings – to accommodate the new EJ regulations, we propose a day of meetings and hearings so that the public can attend at times convenient to them. We propose one day with the following meetings (all virtual except two onsite options, including the hearing with MEPA staff):
   - 8am – 9am – public on-site
   - 9am – 10am – public on-site hearing with MEPA staff
   - 1pm – 2pm - virtual
   - 5pm-6pm - virtual
   - 7pm-8pm – virtual
7. Submittal of Single EIR responding to MEPA requests for additional information if Rollover request is not granted.