Board of Selectmen
59 Town Hall Square
Falmouth, MA 02540

July 21, 1995

Re: Update on Buzzards Bay Project assistance on West Falmouth Harbor Nitrogen Management needs

Dear Honorable Selectmen,

As you may recall, the Buzzards Bay Project[1] has been providing technical and financial assistance to the Town of Falmouth to identify nitrogen management needs for the West Falmouth Harbor drainage basin. Among our efforts:

1) Last year the Buzzards Bay Project awarded a $10,000 grant to the town to conduct a flushing study for West Falmouth Harbor. This award was supplemented by $10,000 raised by the town at town meeting, and a $7,000 grant for the Cape Cod Commission. With this funding, the town awarded a contract to Aubrey Consulting Inc. (ACI), which completed its study earlier this year, and which is now under review by the town, the Cape Cod Commission, and the Buzzards Bay Project.

2) Last year, with the approval of the Board of Selectmen, the Buzzards Bay Project tested water samples from groundwater monitoring wells in conjunction with ongoing monitoring being conducted by the town and overseen by Falmouth's

[1] *The **Buzzards Bay Project National Estuary Program** is a planning and technical assistance unit of Massachusetts Coastal Zone Management, and which is jointly funded by the Commonwealth and the US EPA. We are sometimes confused with two other Buzzards Bay organizations with which we closely work. One of these organizations is the **Coalition for Buzzards Bay**, which is a not-for-profit education group noted for its annual report card and Citizen's Water Quality Monitoring Program which is funded by the Project and jointly implemented by both the Project and Coalition. The other organization is the **Buzzards Bay Action Committee** which is a not-for-profit lobbying group which advises the Buzzards Bay Project on funding and technical assistance needs of Buzzards Bay municipalities.*

Utility Manager Raymond Jack.

3) The Buzzards Bay Project has been working with the Falmouth Planning Board to develop a parcel level buildout analysis and nitrogen loading analysis for the West Falmouth Harbor drainage basin.

The Buzzards Bay Project has prepared the enclosed progress report to summarize the findings of these evaluations and to assist the town of Falmouth in its efforts to develop a nitrogen management strategy for West Falmouth Harbor. Some of the points made in the progress report include:

● Overall, West Falmouth Harbor now has good water quality and ranks in the top 1/3 of Buzzards Bay embayments. The upper most regions of the estuary however have elevated nitrogen concentrations and the embayment will likely be sensitive to additional inputs.

○ In an earlier report (also enclosed), the Buzzards Bay Project identified the town's sewage treatment facility as the principal source of nitrogen in the watershed. A new delineation prepared by the Cape Cod Commission now means that the Falmouth Solid Waste Disposal Facility site is also within the harbor's watershed. The plume from the landfill, particularly from the area of the now abandoned septage lagoons, are a very significant source of nitrogen to the bay. The plume from the abandoned lagoons, which were in use from 1975 to 1987, is now in transit to West Falmouth Harbor, but it is unknown if it has yet reached the estuary. This spring, wells monitored by the town near the landfill showed ammonia concentrations in excess of 120 ppm still leaching from these buried abandoned lagoons. Since most of this ammonia is likely converted to nitrate downstream in the plume, a plume with a concentration perhaps as high as 240 ppm plume of nitrate (or nitrate plus ammonia) from operation of the septage lagoons is now travelling through the watershed. These concentrations well exceed state and county drinking water standards of 10 and 5 ppm nitrate respectively.

○ Existing monitoring well locations downstream of the Town's sewage treatment facility and landfill are inadequate to document the movement and nitrogen loadings associated with these plumes.

○ It appears that the leading edge of the sewage treatment facility plume is now reaching West Falmouth Harbor. We expect that water quality will continue to decline in West Falmouth Harbor as the full extent of the plumes from the landfill and treatment facility reach the harbor.

○ Nitrogen management options for the West Falmouth Harbor watershed include fast tracking the capping of the portion of the landfill over the abandoned septage lagoons, further enhancing the nitrogen removal capabilities of Falmouth's sewage treatment facility, limiting inputs from new development (e.g. changing minimum lot size on unsubdivided land), or requiring the use of alternative nitrogen removal septic systems on new and existing substandard systems.

The Buzzards Bay Project would like to continue to assist the Town of Falmouth in its efforts to manage nitrogen inputs to West Falmouth Harbor. If you have any questions, please do not hesitate to call me. I would be happy to also meet with you or any town board to further discuss these issues.

Sincerely,

Joseph E. Costa
Executive Director

cc. Brian Currie, Falmouth Planning Department
Rhett Lamb, Falmouth BBAC representative
Raymond Jack, Falmouth Utilities Manager
Bill Owen, Falmouth DPW
Bob White, Falmouth WWTP
Falmouth Board of Health
Tom Cambareri, Cape Cod Commission
George Crombie, DEP-SERO
Ron Lyberger, DEP-BMF
John Higgins, DEP-DWPC
Eileen Gunn, Coalition for Buzzards Bay
John Ramses, ACI
Brian Howes, WHOI

wfalup

Progress Report

Nitrogen Management Issues for West Falmouth Harbor

prepared for the
Town of Falmouth

by

J.E. Costa and D.S. Janik

Buzzards Bay Project
National Estuary Program

July 21, 1995

Background

In the Buzzards Bay Comprehensive Conservation and Management Plan[2], nitrogen inputs from development and agriculture were identified as a potential threat to many portions of Buzzards Bay, particularly in the many shallow, poorly flushed embayments that fringe the Bay. In the Management Plan, West Falmouth Harbor was identified as a site of potential nitrogen management action.

To help better document management needs, in 1992 the Buzzards Bay Project implemented jointly with the Coalition for Buzzards Bay a citizens' water quality monitoring program to document existing water quality conditions in Buzzards Bay embayments, including West Falmouth Harbor[3]. Water quality data for 1992 and 1993 (see attached newsletter) showed that West Falmouth Harbor had very good water quality in the outer half of the embayment, but the innermost portions of the embayment were more eutrophic, giving an overall water quality in the mid-range of embayments examined in Buzzards Bay.

Between 1993 and 1994, the Buzzards Bay Project conducted a subwatershed evaluation for Buzzards Bay embayments (Buzzards Bay Project, 1994). In this report (attached and sent to all Boards of Selectmen), West Falmouth Harbor ranked very high in its value of natural resources and high in the likely effectiveness of potential management action taken in its subwatershed (see attachment), making West Falmouth Harbor the second highest ranked embayment in Buzzards Bay for priority of management action. In this report, and in another prepared for the town by Howes et al. (1992), the Falmouth Wastewater Treatment Facility was identified as the largest source of nitrogen to the watershed.

Because of these findings, last year the Buzzards Bay Project awarded a $10,000 grant to the Town to conduct a flushing study for West Falmouth Harbor. This award was supplemented by $10,000 raised by the town at town meeting, and a $7,000 grant for the Cape Cod Commission. With this funding, the town awarded a contract to Aubrey Consulting Inc. (ACI), which completed its study earlier this year, and which is now under review by the town, the Cape Cod Commission, and the Buzzards Bay Project.

In addition, last year, with the approval of the Board of Selectmen, the Buzzards Bay Project tested water samples from groundwater monitoring wells in conjunction with ongoing monitoring being conducted by the town and overseen by Falmouth's Utility Manager Raymond Jack. The Project has also been working with the Falmouth Planning Board to develop a parcel level buildout analysis and nitrogen loading analysis for the West Falmouth harbor drainage basin.
The findings of these efforts are summarized in this report.

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[2] This management plan for Buzzards Bay, which was approved by Governor Weld in 1991, was drafted by the Buzzards Bay Project National Estuary Program.

[3] West Falmouth Harbor has also been monitored by Dr. Brian Howes of the Woods Hole Oceanographic Institution as part of Falmouth Pond Watchers program.

Figure 1. New and old watersheds of West Falmouth Harbor.

What are the sources of nitrogen to West Falmouth Harbor?

In analyzing N sources in the West Falmouth Harbor subbasin, Howes et al. (1992), the Buzzards Bay Project (1994), and ACI (1995) concur that the largest existing source of nitrogen in the West Falmouth Harbor watershed is the Falmouth Sewage Treatment Facility. In our 1994 study, the Buzzards Bay Project estimated that the facility accounted for about 65% of the watershed loading with residential property, at 23%, being the second largest source (principally from septic systems and to a lesser extent lawns).

The loading estimates for the Howes et al. and Project studies were based on a watershed subbasin delineated by the Buzzards Bay Project in cooperation with USGS in 1991. This watershed was based on 10 ft groundwater contours. In this watershed delineation, Falmouth's Solid Waste Disposal Facility ("landfill") was just outside of the watershed boundaries, but because of uncertainties in the delineation, the landfill had been conservatively included in some loading estimates for the harbor.

Earlier this year, the Cape Cod Commission developed a new groundwater map for the Sagamore Groundwater Lens using new well data and 5 foot groundwater contours. The revised watershed for West Falmouth Harbor (Fig. 1) is considerably different, and most importantly now unquestionably includes the landfill. The landfill is important as a nitrogen source not only from the household and commercial debris buried at the site, but also because the towns septage lagoons were in use at the site between 1975 and 1987.

The plumes from these sources are still in transit to West Falmouth Harbor, and they must now be included as part of any nitrogen management strategy for the Harbor. The three studies described above included the landfill in the loadings to the embayment, but in each study it was only a minor source because the assumed loads were underestimated. As described below, new well monitoring conducted by the Town of Falmouth indicate that the landfill and abandoned septage lagoons is a considerable larger source of nitrogen than previously recognized.

How important is the landfill as a source of nitrogen?

Howes et al. (1992) and Buzzards Bay Project (1994) assumed the landfill contributed about 500 kg/y. ACI (1995a) assumed a lower estimated loading of 112 kg/y, based on an assumed 63 ppm recharge concentration under the lagoons reaching groundwater. ACI did not take into account the existing plume and discharge volumes in transit from the lagoons when they were in actual use. In light of the town's recent groundwater monitoring data, none of these studies accurately estimated the load from the landfill and abandoned septage lagoons.

Shown in Fig 2. is the annual volume of septage accepted at the lagoons during the 1980's as reported in Town of Falmouth Annual Reports. It is unknown what volumes were received prior to 1981 when a gate was installed at the lagoons and the town began keeping records. It is likely that the 1970's volumes were at least as great as in later years because, even though Falmouth had a smaller population, the Town annual reports note a severe problem with after hour unreported dumping at the unsecured site (likely from septage haulers from outside Falmouth).

Septage is very high in nitrogen, typical averaging 588 ppm (US EPA, 1984). It is unclear how much of the septage nitrogen from the abandoned septage lagoons actually reached groundwater when the facility was in operation, but in March 1995, 7 years after the lagoons were abandoned, monitoring conducted by the town of Falmouth showed ammonia concentrations in the groundwater 300 yards downstream of the abandoned lagoons were a remarkable 124 ppm (well 558 and 6S, Fig. 3). This ammonia will eventually be converted to nitrate. Thus a plume exceeding 120 ppm nitrogen is originating from the buried lagoons today, merely through rainfall recharge. In the absence of any documentation of concentrations in the leading edge of the plume (from the period when the facility

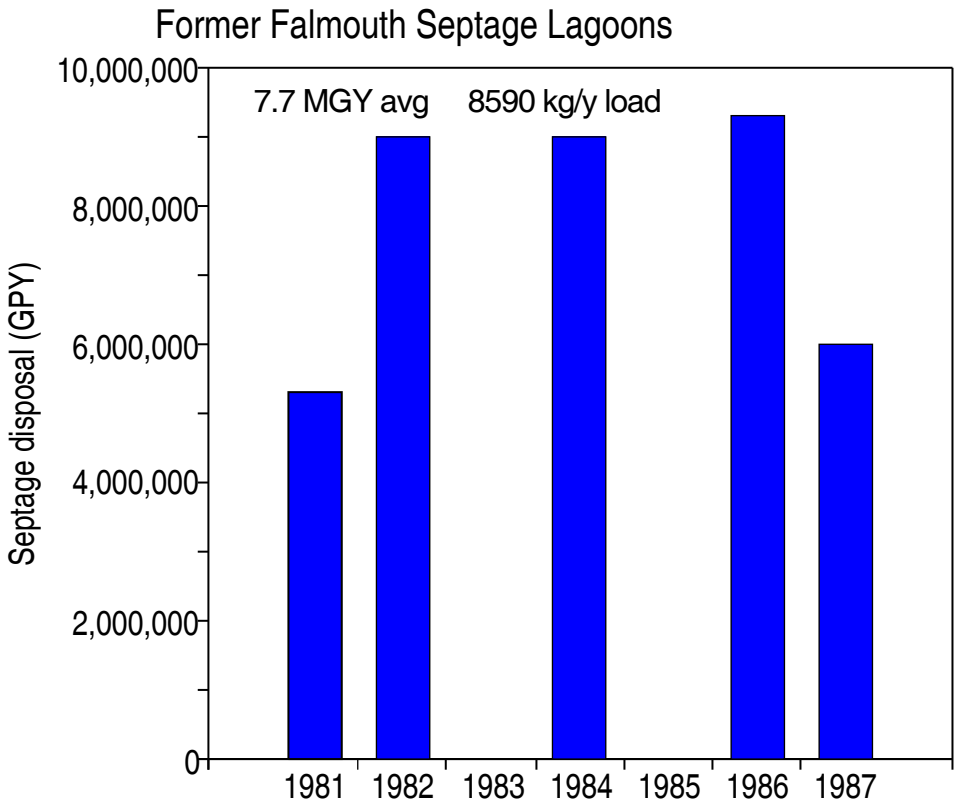

Figure 2. Annual septage volume received at the landfill septage lagoons as reported in town annual reports

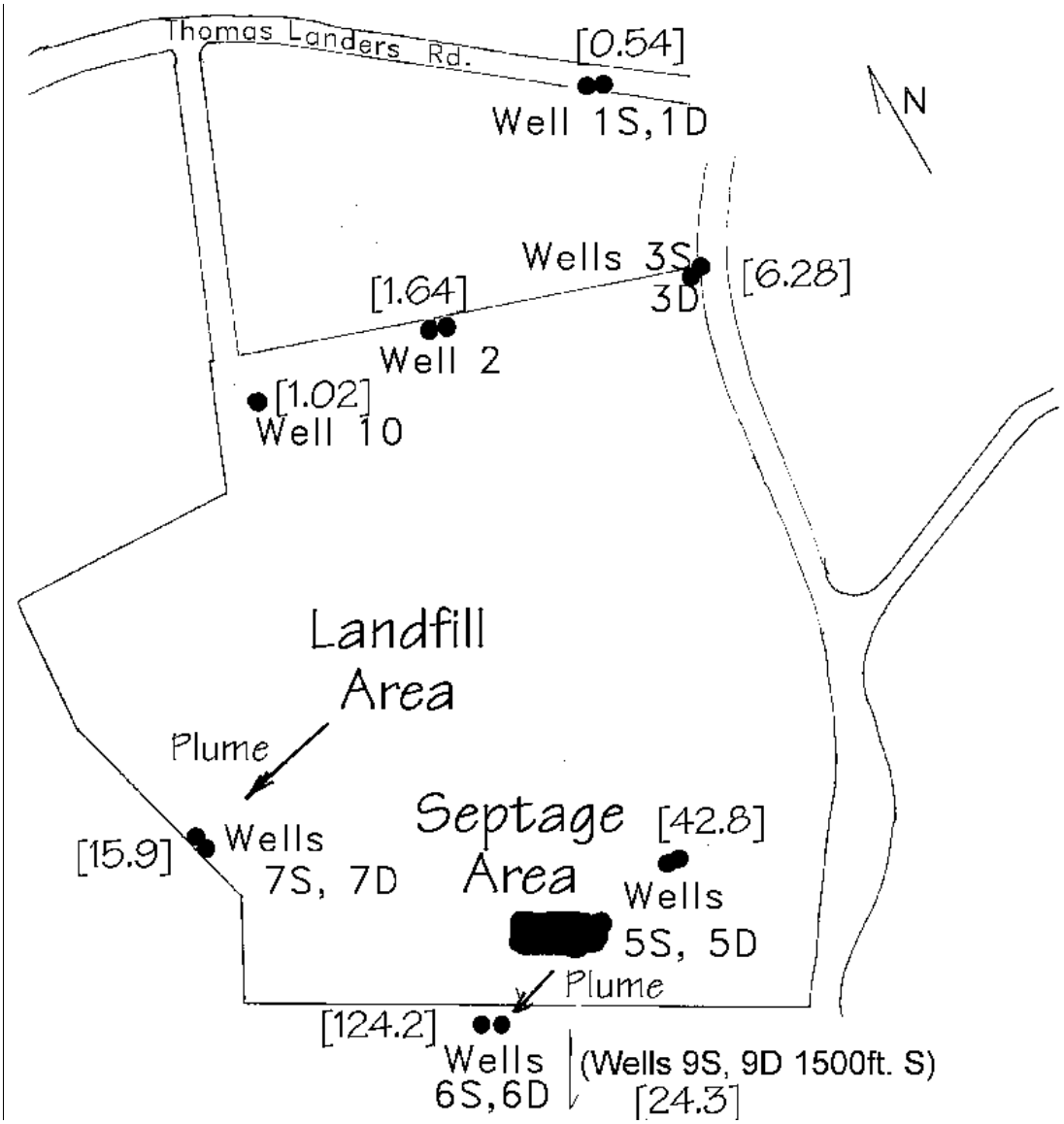

Figure 3. Monitoring wells around the Falmouth landfill. Arrows indicate probable plume directions, numbers in brackets show DIN concentrations from 3/95 sampling.

was active), we assumed for our calculations that 40% of the septage nitrogen reached groundwater (i.e. a nitrate+ammonia plume of about 240 ppm).

The rest of the landfill is a less important nitrogen source to the Harbor, but groundwater concentrations at well 7S were 15.8 ppm, but still more than an order of magnitude higher that what ACI used (1.5 ppm) in their loading assessment. The landfill plume is also high in certain benzene compounds. These compounds are less of a marine pollution issue than a drinking water concern, and are not being addressed in this study, but should be reviewed by the Falmouth Board of Health.

What do the towns monitoring wells tell us about plume migration?

It has been noted in the press that most of the town's groundwater monitoring wells in West Falmouth do not show appreciable groundwater contamination. As noted by the Buzzards Bay Project at a Board of Selectmen's meeting last fall, this is true with respect to the town's wastewater primarily because most of the down gradient monitoring wells are not sited along the principal path of the sewage treatment facility plume (Fig. 4). That is, the wells were primarily sited on either side of the so-called "Class III area" (principal path of the plume) in order to determine if groundwater outside of the Class III became contaminated. Except for the wells adjoining or under the spray irrigation area or infiltration ponds (2, 15, 16, 17), only wells 6 and 11 were placed down gradient in the plume. We believe however that well 11 was placed at too great a depth and that the sampling

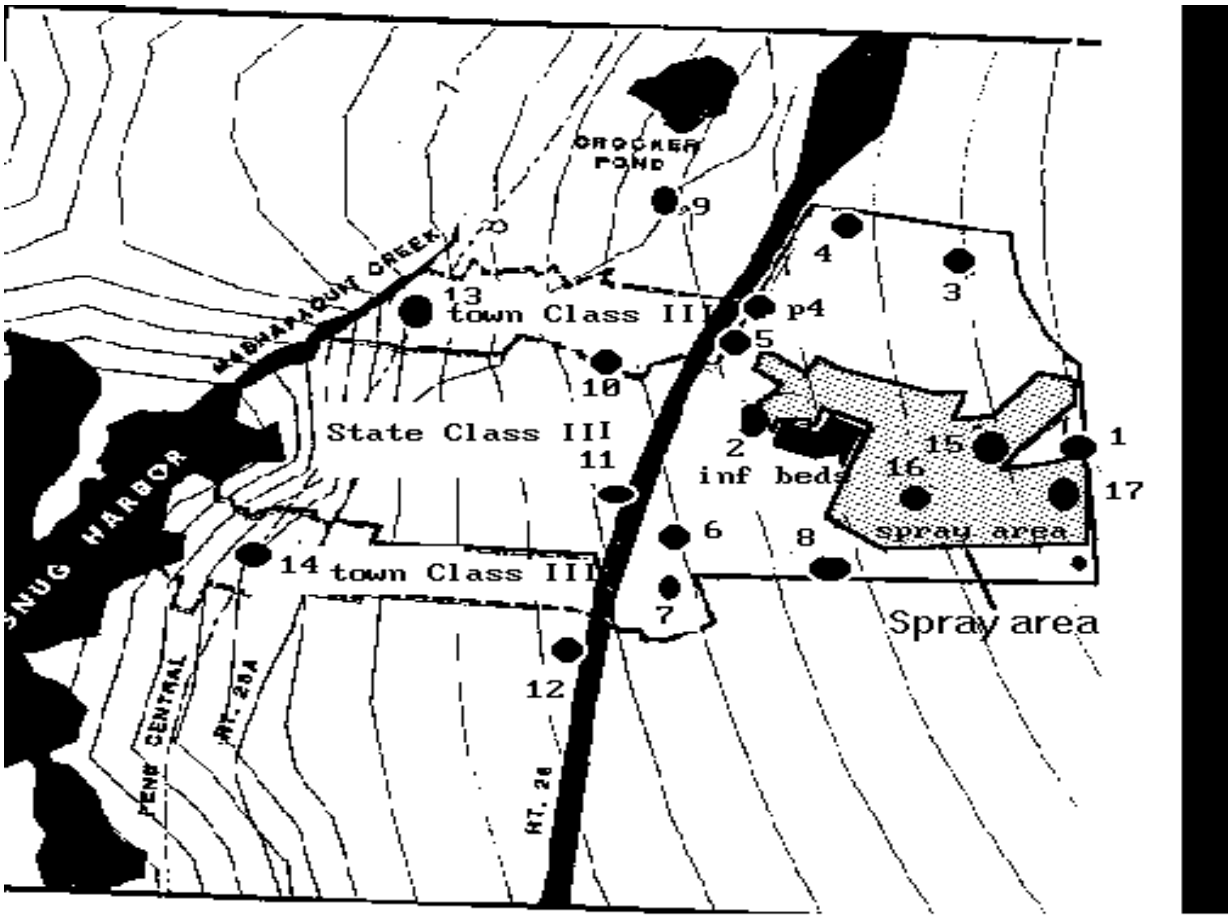

Figure 4. Location of monitoring wells near the wastewater facility. The expected plume path, particularly for the infiltration basins is along the center of the area marked State Class III.

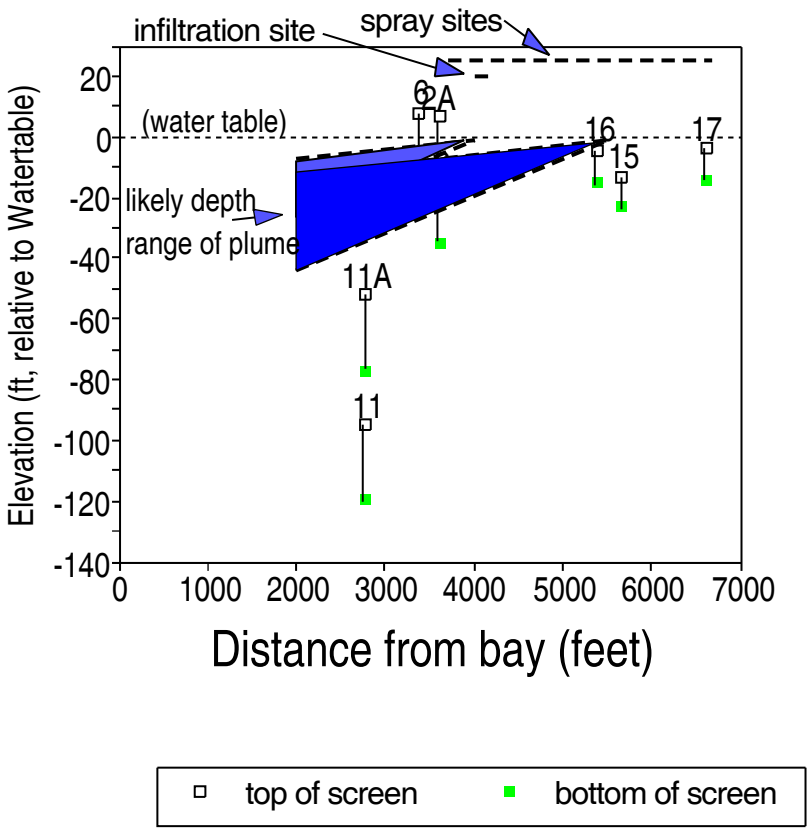

Figure 5. Depth of monitoring wells in path of plume in relation to water table. Note that well 11 is probably too deep.

screens are in fact under the plume (see Fig. 5), and cannot be used to track the plumes progress or nitrogen concentrations.[4]

Under the spray irrigation areas, groundwater nitrate concentrations sometimes exceed 12 ppm[5]. Until the last sampling date, well 6, probably near the periphery of the spray irrigation area plume (but not infiltration basins, has been consistently above 5 ppm since fall 1992. The drop at well 6 could be due to the reduction in the use of the spray area since 1994.

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[4] In Figure 5, the likely vertical migration range for deep migration was based on a slower horizontal groundwater movement (1 ft/day) and high recharge (16-18" yr), and for shallow migration was based on fast horizontal groundwater movement (3 ft/day) and little recharge (9-10"/y).

[5] Well monitoring data discussed in this report from DeFeo, Wait and Pare, Inc. 1994. Report on groundwater monitoring for Falmouth Wastewater Treatment Plant, Sampling Program Sample Series #17, March 1994, and town of Falmouth DPW report to DEP dated December 1, 1994.

Based on groundwater flow rates and water quality data, particularly nitrogen levels in Snug Harbor, ACI, the BBP, and Brian Howes believe that the leading edge of the plume is just now reaching the harbor during the past few years. Without additional monitoring wells it will be difficult to develop a good estimate of how much nitrogen is now entering the bay from the plume at this time, and how much the loading rates will increase in the next few years.

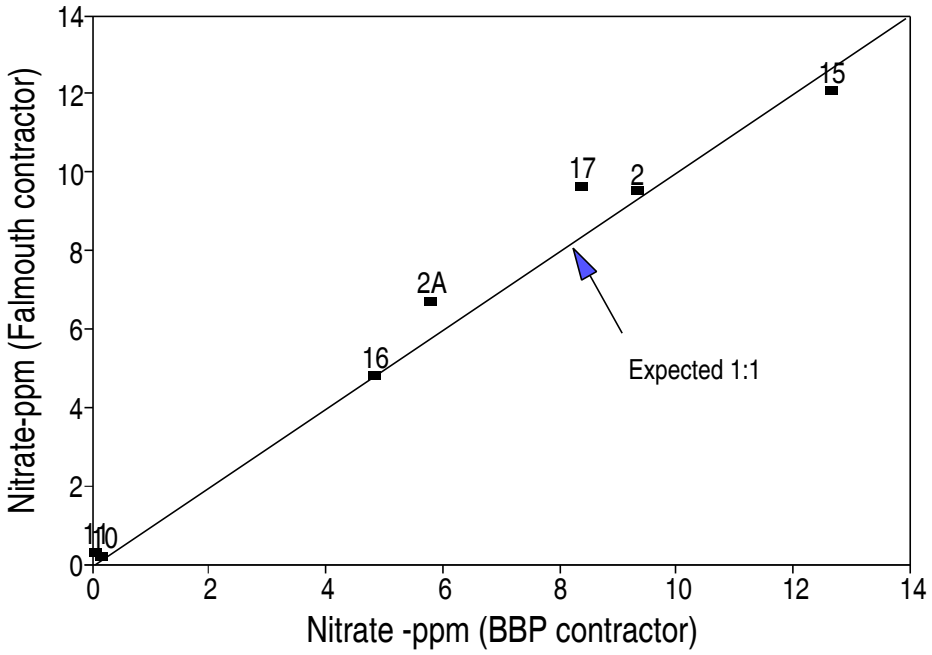

Figure 6. Comparison of laboratory results between Town and BBP contracted laboratories.

Last September, the Town of Falmouth changed laboratories measuring nutrients in the groundwater. The Buzzards Bay Project found good agreement between the new Town contractor (Envirotech Laboratories and the Buzzards Bay Project's contractor (Howes Laboratory, WHOI) on the September 1994 sampling (see Fig. 6).

Like the monitoring wells at the Sewage Treatment Facility, the monitoring wells around the landfill are ill suited to document the travel path or loadings to West Falmouth Harbor, and most are not along the path of the plume (Fig. 3). Only well 7 is useful for estimating loading from recharge from solid waste disposal area and wells 6 and 558 (not shown on map) are in the plume path of the septage disposal area. In Fig. 3, dissolved inorganic nitrogen concentrations (ammonia+nitrate)

from a March 1995 sampling are shown in brackets[6]. Generally, wells with DIN concentrations over 5 ppm usually had most of their DIN as ammonia. Where two wells are located together (two depths, D=deep, S=shallow), only the higher DIN value for the site is shown. Not shown on the map is a new well 558, which is several hundred feet down gradient along the plume path from wells 6S, 6D. Well 558d had a DIN concentration 113.9 ppm in the 3/95 sampling, consistent with the 124.2 ppm DIN in well 6S. Both wells 6s and 558d had DIN concentrations over 100 ppm in a 10/94 sampling as well. Presumably most of the ammonia in the groundwater will be eventually converted to nitrate down gradient of these sites. For comparison, in the 3/95 sampling, upgradient well 1D had a DIN concentration of less than 0.1 ppm (below 0.1 ppm nitrate, the detection limit+ 0.04 ppm ammonia). These values probably represent the background DIN concentrations of groundwater in West Falmouth before contamination from the landfill.

It is unknown if the septage lagoon plume has yet reached West Falmouth Harbor. Considering that the abandoned lagoons are approximately 11,000 feet from the shore of the bay, and a 1.5 foot per day average groundwater travel time is typical for many parts of Cape Cod, 20 years may be a conceivable lag time between inputs at the landfill and inputs to the receiving waters. Actual transit time is most likely to be between 15 and 30 years. Thus inputs from 1975 at the septage lagoons site could be arriving or could soon arrive at the Harbor

Table 1. Preliminary findings of buildout study:

Old watershed area:	2652	acres
New watershed area:	2319	acres

New Watershed Delineation findings

- Existing units: 689
- Subdividable parcels: 169
- Area of developable land: 1089 acres (includes single grandfathered lots)
- Potential new units at buildout: 1006
- Potential total units at buildout: 1695 (=145% percent increase)

What is the status of the buildout study and future loading analysis?

The Buzzards Bay Project has developed a spreadsheet application for conducting buildout and loading assessments. The Falmouth Planning Department has provided the Buzzards Bay Project with the relevant parcel data for the new Cape Cod Commission watershed delineation completed this spring, and these data which are shown in Appendix A. The preliminary findings of this

[6] Data from a Barnstable County Health and Environmental Department Laboratory Analytical Report dated April 21, 1995.

evaluation are shown in the Table 1. These findings are being reviewed by the Planning Department and are subject to future revision. In particular the actual property frontage on unsubdivided parcels is a crude estimate based on parcel area, and actual frontages will need to be calculated by the planning department. Despite these limitations, it is clear there there is considerable growth potential in this watershed.

Table 2. West Falmouth Subbasin: Existing and Future Potential N Sources

EXISTING

Potential Sources of N	Loading (kg/y)	% of total	Comments
Sewage Treatment Facility	11,796	42.0%	0.446 avg. MGD flow, project N recharge estimates, see text
Residential Land	3,734	13.3%	New watershed
Abandoned Septage Lagoons	8,590	30.6%	7.7 MGY (town reports:1981-87), assumed concentration reaching groundwater= 240 ppm of plume in transit. Total recharge from lagoons estimated at 378 kg/y by ACI.
Landfill Recharge	1,120	4.0%	16 ppm N reaching groundwater, 10x estimate by ACI (1995)
Other NPS	2,020	7.2%	From land use of former subbasin, will be revised
Precipitation to Embayment	583	2.1%	From land use of former subbasin, will be revised
Road Runoff	249	0.9%	From land use of former subbasin, will be revised
Total	28,092		

FUTURE- before landfill capping

Potential Sources of N	Loading (kg/y)	% of total	Assumptions
Sewage Treatment Facility	21,159	46.4%	0.880 MGD (design) flow, project N recharge estimates
Residential Land	11,882	26.1%	New watershed
Abandoned Septage Lagoons	8,590	18.8%	As above
Landfill recharge	1,120	2.5%	As above
Other NPS	2,020	4.4%	From land use of former subbasin, will be revised
Precipitation to Embayment	583	1.3%	From land use of former subbasin, will be revised
Road Runoff	249	0.5%	From land use of former subbasin, will be revised
Total	45,603		

FUTURE- after landfill capping

Potential Sources of N	Loading (kg/y)	% of total	Assumptions
Sewage Treatment Facility	21,159	46.4%	0.880 MGD (design) flow, project N recharge estimates
Residential Land	11,882	26.1%	New watershed
Abandoned Septage Lagoons	859	1.9%	Assumed 10 % of existing plume after capping
Landfill recharge	112	0.2%	Assumed 10 % of existing plume after capping
Other NPS	2,020	4.4%	From land use of former subbasin, will be revised
Precipitation to Embayment	583	1.3%	From land use of former subbasin, will be revised
Road Runoff	249	0.5%	From land use of former subbasin, will be revised
Total	36,864		

Revised loading estimates for the West Falmouth Harbor watershed

In Table 2 are shown revised potential loadings from the various existing sources discussed above. One of the most significant findings in the current analysis is that plumes from the landfill, especially from the abandoned septage lagoons appear to be the second largest source of nitrogen in the watershed.

Why was the flushing study conducted?

The Town of Falmouth requested and received funding from the Buzzards Bay Project to conduct a flushing study so that the town could apply the tiered nitrogen loading limit strategy identified in the Buzzards Bay Comprehensive Conservation and Management Plan. This mass-loading nitrogen management strategy was developed by the Buzzards Bay Project and has been adopted by the Cape Cod Commission.

The Town of Falmouth hired ACI to conduct this study. ACI found that the estuary as a whole had a hydraulic residence time of 0.52 days, but that uppermost reaches of the estuary such as Snug Harbor, Harbor Head, and Oyster Pond have residence times of 4.5, 14.8, and 106.8 days respectively . Application of the Buzzards Bay Project's methodology requires an average flushing time for the upper 1/3 of the estuary which was not estimated by ACI, but an estimate of this calculation is shown in Table 3. If for example the upper 1/3 of the estuary has an average residence time of 2.4 days[7] , then the nitrogen loading limit for this estuary if it had an ORW classification (most stringent level of protection) should be 17,300 kg/y. If the estuary were classified as SA (a mid or typical level of protection), the loading limit would be 34,600 kg/y.

[7] The upper 1/3 of the estuary includes some very well flushed areas and the above referenced poorly flushed coves. This value, from Table 3 excludes Oyster Pond.

Table 3. Various estimates of turnover time and acceptable loading rates for West Falmouth Harbor.

Embayment name	turn-over time(d)	area acres	mean depth (m) mid-tide	volume (cu. m)	REVISED ORW limit	METHODOLOGY SA limit	METHODOLOGY SB limit
Calculations from Aubrey (1995a), combined methodologies							
West Falm. Harbor-entire (cells 1-	0.57	248	1.1	1056000	70290	140590	246030
NOTE 1: Cell 1 and 2 volumes shown below calculated by BBP.							
NOTE 2: Incorrect cell numbers cited in ACI Table IV-6. Cell numbers consistent with ACI Fig IV-1.							
Embayment Subareas (cells):							
Outer Harbor (1)	not cal	91	1.3	476700			
South Central (2)	not cal	84	1.1	385633			
Snug Harbor (3)	4.52	48	0.9	181252			
Harbor Head only (4)	0.57	17	0.8	53809			
Total "Main" Harbor (1,2,3)	1.05	148	1.6	951572			
Harbor Head/Oyster Pond (4,5,6)	14.78	25	1.0	104509			
Oyster Pond only (5-6)	106.80	8	1.6	50700			
Total volume cross check (Cells 1-6)				1148094			
Calculations from Aubrey (1995b), Spatial Model:							
W. Falm. Harb.- upper 1/3 min	0.92	198	1.2	932000	38970	77940	136400
W. Falm. Harb.- upper 1/3 max	1.79	198	1.2	932000	20320	40630	71110
BBP interpolation of upper 1/3 of Aubrey (1995a)							
W. Falm. Harb.- upper 1/3	6.10	248	1.1	1056000	7130	15050	30110
(equals weighted average of "Main Harbor" cells (1,2,3), Harbor Head (4) and Oyster Pond (5-6)							
flushing values. This turnover time gives too much weight to Oyster Pond for managing whole estuary.)							
W. Falm. Harb.- upper 1/3	2.41	248	1.1	1056000	17300	34600	60560
(equals weighted average of "Main Harbor" cells (1,2,3) and Harbor Head/Oyster Pond (4,5,6).							

When discussing possible nitrogen loading limits, and when considering well nitrogen monitoring data as described in the preceding section of this report, there is the tendency to focus on acceptable groundwater concentrations of nitrogen on Cape Cod. However, when it comes to protecting coastal embayments, it is the mass load of nitrogen (that is volume times concentration) that must be evaluated, and this loading rate will translate into an embayment-specific ground water concentration. For example, if the West Falmouth Harbor watershed were to have a nitrogen loading target of 34,600 kg/y, this would translate to an average watershed groundwater concentration target of 6.3 ppm. If the watershed had a 17,300 kg/y limit, then the groundwater target would be 3.2 ppm.

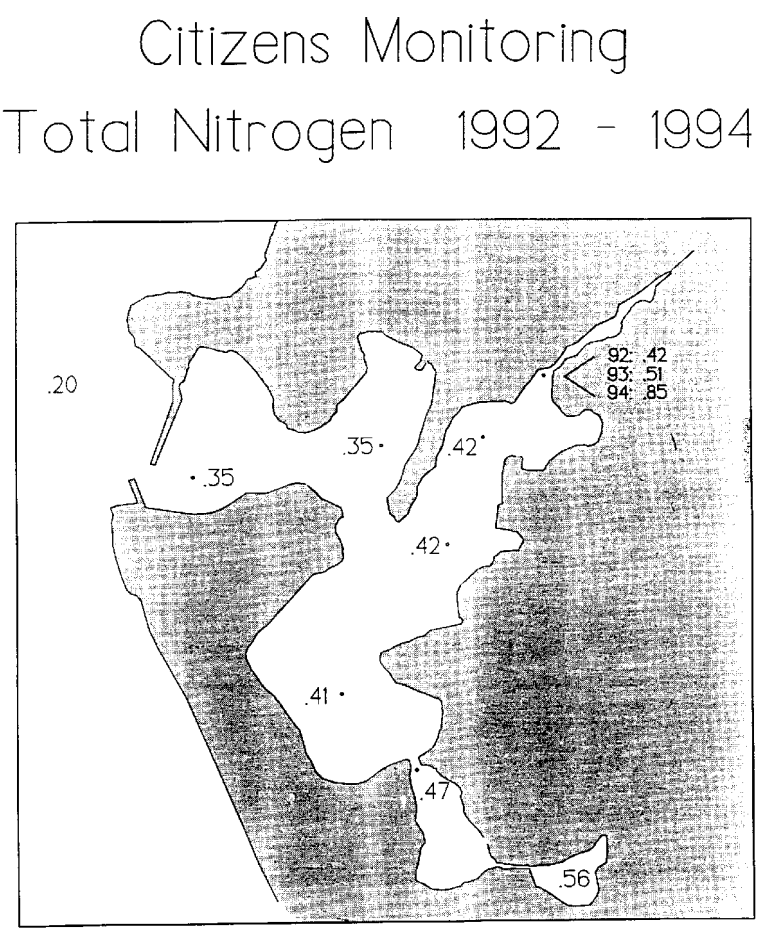

Figure 7. Total nitrogen concentrations in West Falmouth Harbor. Figure from ACI 1995a. Data from Coalition-Buzzards Bay Project Citizen's Water Quality Monitoring Program and Falmouth Pondwatchers Program.

It is worth noting that the Town of Falmouth already has a nitrogen loading bylaw in place, and ACI made an attempt to evaluate West Falmouth Harbor conditions, now and in the future. The ACI report notes that water quality monitoring conducted by the Project-Coalition Citizens' Water Quality Monitoring Program, and Falmouth's Pond Watcher Program, show that total nitrogen concentrations in most of West Falmouth Harbor already exceed the town's most stringent total nitrogen limit of 0.32 ppm, and many portions of the Harbor exceed the middle level of protection of 0.5 ppm (see Fig. 7). ACI attempted to predict how total nitrogen concentrations in the Harbor would be elevated both as the town's sewage treatment facility plume reached the Harbor, and under buildout conditions. The Buzzards Bay Project will shortly complete its review of this portion of the draft report. ACI will need to revise their report because they did not consider the septage plume

in transit from the period of when the septage lagoons were in use, because their assumed nitrogen loadings from recharge of the septage lagoons are too low, and because the watershed boundaries and therefore watershed buildout potential have changed.

Considering the fact that this watershed has two major point sources of pollution, the Falmouth wastewater treatment plant and the Falmouth landfill, and that water column total nitrogen concentrations already exceed the most stringent limits in Falmouth's nitrogen loading bylaw, it may be unrealistic to pursue a ORW designation for West Falmouth Harbor. Rather, a SA limit is far more achievable. Adoption of the SA limit however will not likely be adequately protective of the most poorly flushed areas like Oyster Pond and Snug Harbor. Alternatively, the Town of Falmouth could pursue some intermediate level of acceptable loading for this estuary.

How will the upgrades to the Falmouth Sewage Treatment facility affect nitrogen loading to West Falmouth Harbor?

The installation of an aerator, and other improvements could partly decrease nitrogen loading to the facility through increased denitrification. Because these improvements were not really intended to reduce nitrogen from the plant, the degree of nitrogen removal will need to be documented in wells immediately down gradient of the infiltration ponds. We expect that even with these potential nitrogen loading reductions, the sewage treatment facility would remain the largest source of nitrogen in the watershed.

What are the next steps?

It appears that existing nitrogen loading to West Falmouth Harbor will exceed the most stringent water quality standards under Falmouth's Nutrient Bylaw and the Buzzards Bay Project's tiered loading strategy and will approach or exceed the mid level limit for nitrogen loadings under both management strategies under buildout conditions. In the future, plume migration, increased development, or increased discharge from the treatment plant could cause degradation of the waters and living resources in West Falmouth Harbor. If a nitrogen management strategy is adopted for the harbor, such a strategy could include a range of options such fast tracking the capping of the town landfill in the vicinity of the abandoned septage lagoons, improving nitrogen removal at the sewage treatment facility, limiting buildout in the watershed through zoning changes or procurement of open space, or upgrading failed septic systems with nitrogen removing alternative septic systems.

Clearly many assumptions were made in developing the loading rates and limits included in this report, and some of these will need to be revised. It will be particularly important to estimate the amount of nitrogen in the landfill plume now migrating to the harbor. The Buzzards Bay Project will meet shortly with the Falmouth Planning Department and the Cape Cod Commission to discuss the available information, identify information gaps, and explore what steps required to define an appropriate nitrogen management strategy for West Falmouth Harbor.

Report Highlights

- Overall, West Falmouth Harbor now has good water quality and ranks in the top 1/3 of Buzzards Bay embayments. The upper most regions of the estuary however have elevated nitrogen concentrations and the embayment will likely be sensitive to additional inputs.
- In earlier nitrogen loading evaluations, the town's sewage treatment facility as the principal source of nitrogen in the watershed. A new delineation prepared by the Cape Cod Commission now means that the Falmouth Solid Waste Disposal Facility site is also within the harbor's watershed. The plume from the landfill, particularly from the area of the now abandoned septage lagoons, are a very significant source of nitrogen to the bay. The plume from the abandoned lagoons, which were in use from 1975 to 1987, is now in transit to West Falmouth Harbor, but it is unknown if it has yet reached the estuary. This spring, wells monitored by the town near the landfill showed ammonia concentrations in excess of 120 ppm still leaching from these buried abandoned lagoons. Since most of this ammonia is likely converted to nitrate downstream in the plume, a plume with a concentration perhaps as high as 240 ppm plume of nitrate (or nitrate plus ammonia) from operation of the septage lagoons is now travelling through the watershed. These concentrations well exceed state and county drinking water standards of 10 and 5 ppm nitrate respectively.
- Existing monitoring well locations downstream of the Town's sewage treatment facility and landfill are inadequate to document the movement and nitrogen loadings associated with these plumes.
- It appears that the leading edge of the sewage treatment facility plume is now reaching West Falmouth Harbor. We expect that water quality will continue to decline in West Falmouth Harbor as the full extent of the plumes from the landfill and treatment facility reach the harbor.
- Nitrogen management options for the West Falmouth Harbor watershed include fast tracking the capping of the portion of the landfill over the abandoned septage lagoons, further enhancing the nitrogen removal capabilities of Falmouth's sewage treatment facility, limiting inputs from new development (e.g. changing minimum lot size on unsubdivided land), or requiring the use of alternative nitrogen removal septic systems on new and existing substandard systems.

References Cited

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