AMSTON LAKE
WASTEWATER MANAGEMENT STUDY
for the
TOWN OF LEBANON, CONNECTICUT

November 2007

Wright-Pierce
Civil and Environmental Engineering Services

September 3, 2008
W-P Project No. 10840A

Mr. George Hicks, Sanitary Engineer
Department of Environmental Protection
Bureau of Water Management
Planning and Standards Division
79 Elm Street
Hartford, CT 06106-5127

Subject: Amston Lake Wastewater Management Study
Amendment to Final Report

Dear George:

We are writing to you on behalf of the Town of Lebanon. At the Board of Selectmen's meeting on November 13, 2007, the Selectmen indicated that they had officially approved the *Amston Lake Wastewater Management Study for the Town of Lebanon - Final Draft, June 2007*, with the condition that "Table 4-3, Preliminary Implementation Schedule" be revised to reflect what they believe is a more realistic schedule.

As directed by the Board of Selectmen, the *Amston Lake Wastewater Management Study for the Town of Lebanon - Final Draft, June 2007* has been amended, and a copy of the Final Report is enclosed. On behalf of the Town we are requesting that DEP review and approve of this report.

Please let the Town know if this report is approved by DEP. As you may be aware, the Town has been in the process of forming a Water Pollution Control Authority in order to proceed with this important wastewater management project.

Feel free to contact the First Selectwomen (Joyce Okanuk at 860-642-6100) or me with any questions or comments.

Very truly yours,
WRIGHT-PIERCE

John W. Braccio

John W. Braccio, P.E.
Vice President

cc: Joyce Okanuk, First Selectwomen

AMSTON LAKE
WASTEWATER MANAGEMENT STUDY
FOR THE
TOWN OF LEBANON, CONNECTICUT

Prepared By:

Wright-Pierce
169 Main Street
700 Plaza Middlesex
Middletown, CT 06457

AMSTON LAKE WASTEWATER MANAGEMENT STUDY

TABLE OF CONTENTS

TABLE OF CONTENTS (CONT.)

TABLE OF CONTENTS (CONT.)

LIST OF TABLES

LIST OF FIGURES

Section 1

Wright-Pierce
Engineering a Better Environment™

SECTION 1

EXECUTIVE SUMMARY AND CONCLUSIONS

1.1 EXECUTIVE SUMMARY

Amston Lake is a 182 acre freshwater lake located on the border between the Towns of Lebanon and Hebron. The lake itself is privately owned by the Amston Lake District, a tax district formed in 2002 by the Connecticut Legislature's merging of the Amston Lake Hebron Tax District and the Amston Lake Lebanon Tax District. The portion of the District in the Town of Lebanon is a mostly seasonal community, including a significant number of small cottages built on small parcels of land. Approximately 70% of the residences on the Lebanon side of the District are zoned for seasonal occupancy only.

Due to concerns over the potential impact on Amston Lake water quality by the existing septic systems in the local community, the Connecticut Department of Environmental Protection (DEP) issued an Abatement Order in 1986 to both Hebron and Lebanon, requiring the preparation of an engineering study to evaluate the current and future wastewater needs of the Amston Lake area. A copy of the Abatement Order addressed to the Town of Lebanon is provided in Appendix A. In Hebron, the evaluation was performed and a wastewater collection system was installed with treatment at the Colchester-East Hampton Joint Facilities Water Pollution Control Facility in East Hampton. In the years since the Abatement Order was initially issued, discussions regarding improved wastewater treatment have occurred in Lebanon, but no action has been taken. Recently, due to increasing concerns about deteriorating lake water quality, the DEP has renewed their attention on Amston Lake, and the Town of Lebanon hired Wright-Pierce to conduct the required wastewater management study.

Four different options were considered as potential acceptable means for wastewater management in the Amston Lake District, in the Town of Lebanon. These options include: replacement and upgrade of existing on-site subsurface wastewater treatment and disposal systems to meet current state health code requirements; installation of innovative/alternative treatment technologies, capable of achieving increased nutrient removal, on individual properties; construction of a community wastewater treatment facility serving only the Amston Lake area; and connection to the existing wastewater collection system in Hebron.

Each of the alternatives is technically feasible to provide improved wastewater treatment and reduce the impact from the existing septic systems on Amston Lake water quality. However, each option has a variety of differing advantages, disadvantages, costs, and other issues to consider. This report describes the evaluation of the different wastewater management options.

Based on the effectiveness in mitigating wastewater impacts on Amston Lake, acceptability to the Town and to the DEP, and both the capital and operating costs, it appears that a connection to the existing sewer would result in the most favorable long-term solution for Amston Lake's wastewater treatment and disposal needs.

1.2 CONCLUSIONS

A significant number of the existing properties appear to have limitations that affect the properties' ability to support a code compliant and/or effective conventional on-site, subsurface septic disposal system. These limitations include small lots with limited acceptable soil conditions, shallow depth to ledge and/or groundwater, and inadequate septic tank and/or leach field design. Due to both the above limitations and the close proximity of the existing subsurface systems to Amston Lake, it is likely that the many of properties, particularly those along Deepwood Drive, are contributing to the nutrient pollution of Amston Lake.

Stormwater runoff is also a contributing factor to lake pollution, but an extensive evaluation of stormwater management alternatives was not included in the scope of this study.

The overall conclusions for each the wastewater management options are:

- *Upgrade of existing on-site systems* - Upgrades would result in the existing systems being closer to achieving current State Health Code requirements for conventional on-site septic systems. Conventional systems, however, would not provide a high level of nutrient removal, and nutrient pollution to the Lake would still occur. Furthermore, due to the limitations of many lots in the District, is likely that upgrades would still fall short of meeting the current health code.

- *Innovative/Alternative on-site systems* - Such systems could result in improved nutrient removal and reduce nutrient pollution to the Lake, if properly operated, maintained, and monitored. However, such systems are costly to install and require regular maintenance. Additionally, the seasonal nature of many properties could make it more difficult to maintain reliable performance of these systems.
- *Community Wastewater Treatment System* - This type of system could achieve improved nutrient removal and reduce pollution to the Lake. However, it would be the most expensive alternative to construct, and it may be difficult to find a property of sufficient size with sufficient soils in reasonably close proximity to the lake community. Furthermore, the seasonal nature of the community would impact and possibly limit the reliable performance of this type of system.
- *Connection to Existing Sewer* - This option would achieve improved nutrient removal and reduce pollution to the Lake. However, without sufficient zoning restrictions, a sewer could result in increased development of currently unbuildable lots, more intensive redevelopment of existing homes, and more year-round use of existing seasonal properties, all of which could result in increased stormwater runoff and resulting pollution impacts to the Lake. A low pressure sewer system with individual property pump systems would be less costly than a gravity-type sewer system. A low pressure system could also be designed to limit the capacity for additional sewered growth.

Each of the above systems would have a variety of organizational, legal, and funding issues that would need to be addressed as part of an actual implementation program. A summary of the estimated feasibility level costs for the implementation of each alternative at 195 properties, identified in this evaluation as properties with the potential to negatively affect the water quality of Amston Lake (or "properties of concern") are shown in Table 1-1.

TABLE 1-1
SUMMARY OF FEASIBILITY LEVEL COST ESTIMATES

	Capital Cost	Annual Operating Cost	Total Annual Cost[1]
Conventional Upgrades	$4,390,000	-	$268,000
Individual I/A Systems	$4,140,000	$228,000	$503,000
Community Wastewater Treatment Plant	$8,615,000	$115,000	$642,000
Connection to Existing Sewer[2]	$4,125,000	$98,000	$350,000

1. Including capital costs annualized at 2% interest over 20 years, without grant.
2. Assumes installation of low pressure sewer.

The above costs are representative of the average cost of multiple options, for example, different treatment technologies, within each of the four provided wastewater management alternatives. It should be noted that all costs used in this report are preliminary in nature. These costs are intended for use only in the screening and comparison of potential alternatives. Further investigation would be required to refine the provided costs to the point that they may be used as construction or operation cost estimates, or for accurate budgetary purposes. It should be noted that all costs included both in Table 1-1 above as well as the overall study are based on 2007 costs, and are subject to fluctuation.

Section 2

Wright-Pierce
Engineering a Better Environment

SECTION 2

BACKGROUND

2.1 BACKGROUND

Amston Lake is a significant natural asset for the Town of Lebanon (Town) and helps define the character of this community. The lake straddles the Lebanon/Hebron town line and, except for the northern shore line, is densely developed with both seasonal and year-round homes on small lots; see Figure 2-1. The average house in the Amston Lake area, within the Town of Lebanon, was built in 1964. Generally, the older homes in the area are closer to the lake, along Deepwood Drive and Sunset Drive.

Amston Lake has historically been considered as one of the "cleanest" lakes in Connecticut and for many years had no significant water quality concerns. However, in 1986, the Connecticut Department of Environmental Protection (DEP) issued an Abatement Order requiring Lebanon to prepare an engineering study to evaluate the current and future wastewater needs for the lake community. Discussions ensued in the following years but no action was taken; the Town of Hebron received a similar Order from the DEP and proceeded with the installation of a wastewater collection system within their town boundaries on the west side of the lake.

Results of regular water sampling of Amston Lake from 1993 to 2001 indicated that the lake water quality was satisfactory. However around 2001/2002, sampling indicated deterioration in lake water quality, with subsequent data indicating this trend may be continuing. There is concern that failed or improperly sited subsurface disposal systems may be contributing to eutrophication of the lake, primarily due to the discharge of phosphorus, which is the limiting nutrient for freshwater algae growth. There also are concerns regarding nitrogen nutrient pollution and bacterial contamination of the lake and drinking water supplies from failed subsurface disposal systems.

APPROXIMATE BORDER OF AMSTON LAKE DISTRICT (LEBANON)

TOWN OF LEBANON
AMSTON LAKE DISTRICT

SITE MAP

PROJ NO:	10840A	Wright–Pierce	FIGURE: 2–1
DATE:	MAR 2007		
SCALE:	NTS		

The DEP has requested that the Town prepare an engineering study as required by the 1985 Abatement Order. In order to comply with the Abatement Order the Town of Lebanon selected Wright-Pierce to perform a Wastewater Management Study to evaluate wastewater disposal problems and alternative treatment/disposal methods.

2.2 SUMMARY OF EXISTING INFORMATION

A significant amount of information has been compiled with regards to Amston Lake and the surrounding community over the twenty year period that has passed since the DEP first issued the Abatement Order. As part of the evaluation, Wright-Pierce collected and reviewed existing information from the Town of Lebanon's Sanitarian and Planning Department as well as from the DEP. Additional data was gathered during site visits. This information is as follows:

- *Enforcement History-Amston Lake Area* - Including prior mapping, inspections, memos and correspondence, as provided by the DEP.
- *Responses to 1987 Resident Survey* - As conducted by the Town and provided by the DEP.
- *Available Information on Existing Amston Lake Septic Systems* - Provided by the Town Sanitarian's office. These are somewhat limited and consist of records for only 18 properties over approximately the past five years.
- *Amston Lake Water Quality Report (2005)*- George Knoecklein's most recent annual water quality report, documenting the observed degradation of the water quality of Amston Lake.
- *Tax Map and Assessor's Sheets* - Provided by the Town Assessor's office. This data was used to make a determination of seasonal versus year-round residential status, as well as establish projected wastewater flows. Analysis shows that of the 310 developed properties in the District, 98 are zoned for year-round occupancy (approximately 32%), and 212 are zoned for season use only (68%).
- *Site visits* - Several site walks were conducted by Wright-Pierce staff to review site layouts and topography as well as to note those existing septic systems that may be insufficient or failing, have a potential for future failure, or that may be having a negative impact on lake water quality. Note that no testing was conducted during these walks, and

all conclusions of septic system viability are based on visual observations, including lot size and grading, apparent ground water depth, ledge outcroppings, proximity to lake, detection of objectionable odors, or other possible limiting factors.

Since information on the existing septic systems is limited, a homeowner survey, similar to the one conducted in 1987, was performed in order to obtain additional information from homeowners, as well as to solicit any questions or concerns. Results of this survey are discussed in Section 2.3.2 of this report.

2.3 EXISTING CONDITIONS

2.3.1 Amston Lake District

The Amston Lake District is a tax district formed in 2002 by the Connecticut Legislature's merging of the Amston Lake Hebron Tax District and the Amston Lake Lebanon Tax District. The responsibilities of the Amston Lake District include the management and supervision of lake facilities and operations, including all roads in the Lebanon part of the District. Conducting studies and projects, and monitoring activities regarding the environmental protection of the lake are also the responsibility of the District. To this end the District collects taxes from all property owners within the boundaries of the District, in addition to the taxes which property owners pay to their respective town. The Amston Lake District owns all lands publicly accessible to the residents, including beaches, right of ways, roads in the Town of Lebanon, and the lake itself.

The Amston Lake District does not keep track of seasonal versus year-round residents, but estimates that approximately 70% of the homes on the Hebron side of the lake are year-round, as opposed to 30% of the homes on the Lebanon side. According to 2006 data from the Lebanon Assessor's Office, the Lebanon section of the District includes within its boundaries 310 developed, residential properties; 212 (68%) of the recorded, developed properties are seasonal homes and 98 (32%) are year-round residences. The Town of Lebanon charges different tax rates to seasonal and year-round residents; additional restrictions, such as a ban on continuous year-round occupancy, are placed by the Town on seasonal residences. It should be noted that while some year-round zoned homes may be occupied only on a seasonal basis, or vice-versa, this report assumes the occupancy status of the homes in the Amston Lake District is as indicated on Town records.

The Amston Lake District currently contains within its borders 180 undeveloped lots, within the Town of Lebanon. Based on zoning information obtained from the Lebanon Town Planner's office, 175 of these lots, by nature of having an area less than two acres, are zoned for seasonal use only. Five of the currently undeveloped lots are greater than 2 acres, and therefore could be permitted for year-round residences. It is reported by the office of the Lebanon Town Planner that a full build-out analysis by the Town has not been conducted. Note that there is considerable uncertainty about the ability to build on many of the vacant properties. For example, the prevalence of ledge outcroppings which dominate some of the undeveloped lots may prevent the ability to construct a code compliant septic system; those lots might only be developed at great expense. Therefore, while all 180 undeveloped properties could theoretically be developed, this report focuses only on providing wastewater upgrades to the existing homes. Figure 2-2 summarizes which homes are seasonal, which are year-round, and those lots that are undeveloped.

All existing developed properties within the Lebanon side of the District were evaluated to determine if they have suspected failing systems, unknown or obsolete systems, are adjacent to the lake or if there were observed ledge outcroppings on the property. Additionally, lot sizes that might be inadequately sized were noted. Lot sizes were considered inadequate if, through visual observation, it appeared unable to support a conventional septic system with the necessary setbacks. Note that this evaluation was "desk-top" in nature; no test borings or sampling was completed. The results are based on visual observations and the information summarized in Section 2.2 of this report. The results of this evaluation are shown on Figures 2-3 through 2-7 with Figure 2-8 being a compilation of all these categories.

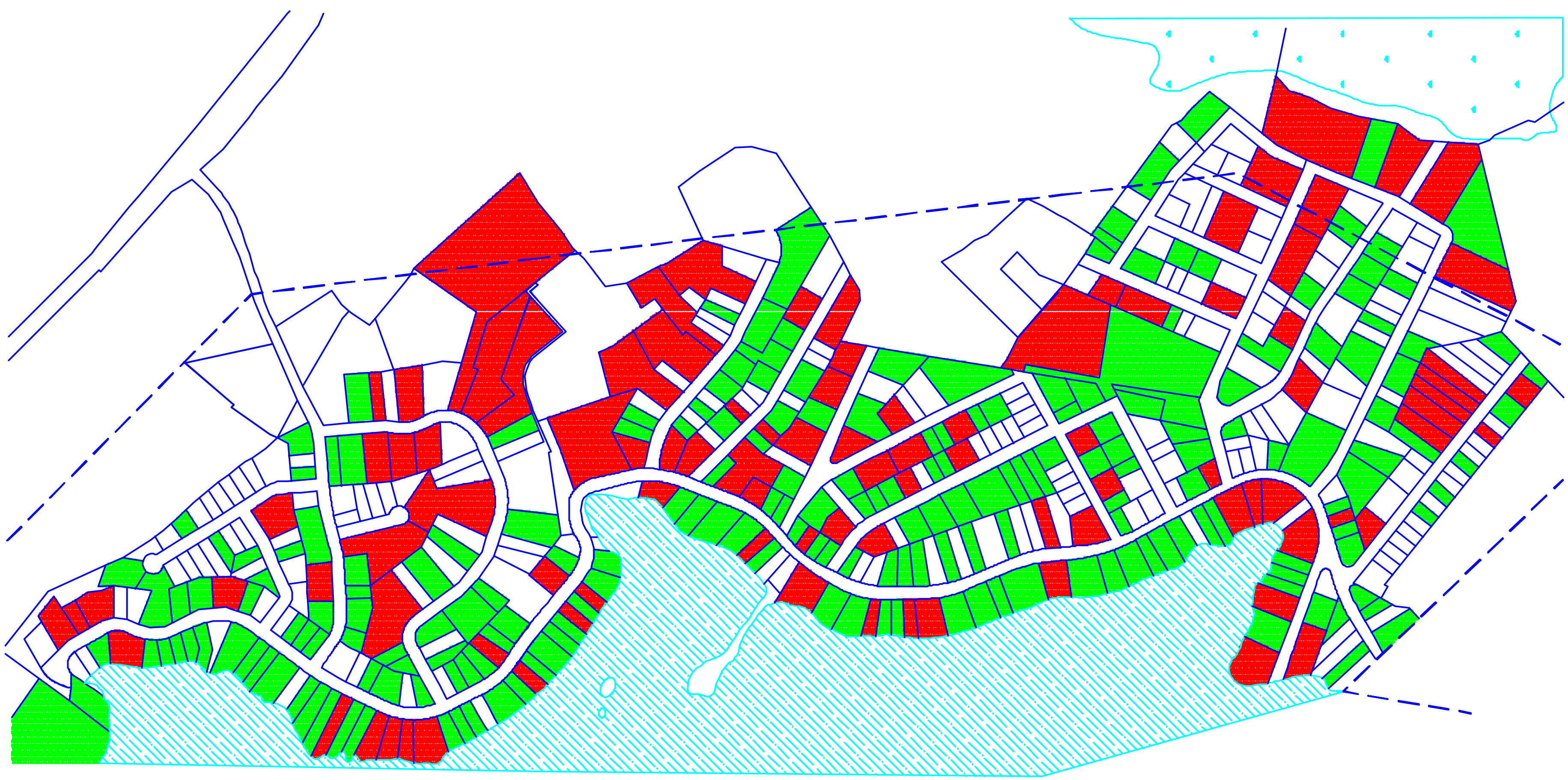
For the purpose of this report, three distinct wastewater management scenarios were considered: (1) assume all homes (seasonal and year round) within District are included in any wastewater upgrade; (2) assume that only those properties identified as being "properties of concern" are included in any wastewater upgrade; and (3) assume that only the homes on Deepwood Drive are included in any wastewater upgrade.

2.3.2 Existing Wastewater Treatment

Currently, little information is available on the type, condition or performance of the existing on-site wastewater treatment systems for homes in the Lebanon portion of the District. As previously noted, houses in the Hebron side of the District are served by sanitary sewers. Records from the Town of Lebanon Sanitarian date back only approximately five years and only include records of eighteen recently installed, repaired, or suspected failing systems. Additionally, the Town of Lebanon Sanitarian reports that there may be houses along the lake side of Deepwood Drive that may unknowingly be served by a line into Amston Lake.

In February 1987 a homeowner survey, in the form of a voluntary mailed questionnaire, was performed in an attempt to identify the nature and condition of the existing systems. However, this survey was limited to homes along Deepwood Drive. The received homeowner replies to the survey indicated that many homeowners were unsure of the nature and condition of their sub-surface wastewater disposal systems.

In order to supplement the information obtained in the 1987 resident survey, Wright-Pierce conducted a similar survey in the fall of 2006. Unlike the 1987 survey, the 2006 questionnaire was sent to all owners of developed properties in the Amston Lake District in Lebanon. Of the 310 surveys sent out, only 96 (31%) were returned completed. A return rate of 31% could be considered a poor response rate for this type of focused survey. However, considering the seasonal nature of the majority of the properties, this may actually be a reasonable return. Additionally, based on some responses, some homeowners may have been reluctant to report on the actual known condition of their systems. Information from the survey confirms that many of the systems are likely as old as the residences themselves, and have only received repairs or inspections when prompted by system failure. Many residents reported that they were unaware of the age, condition or design of their sub-surface treatment and disposal systems. While newer homes have systems likely designed to meet or approximate the Public Health Code (PHC; as evidenced by their record with the Town Sanitarian Office) these systems are typically located

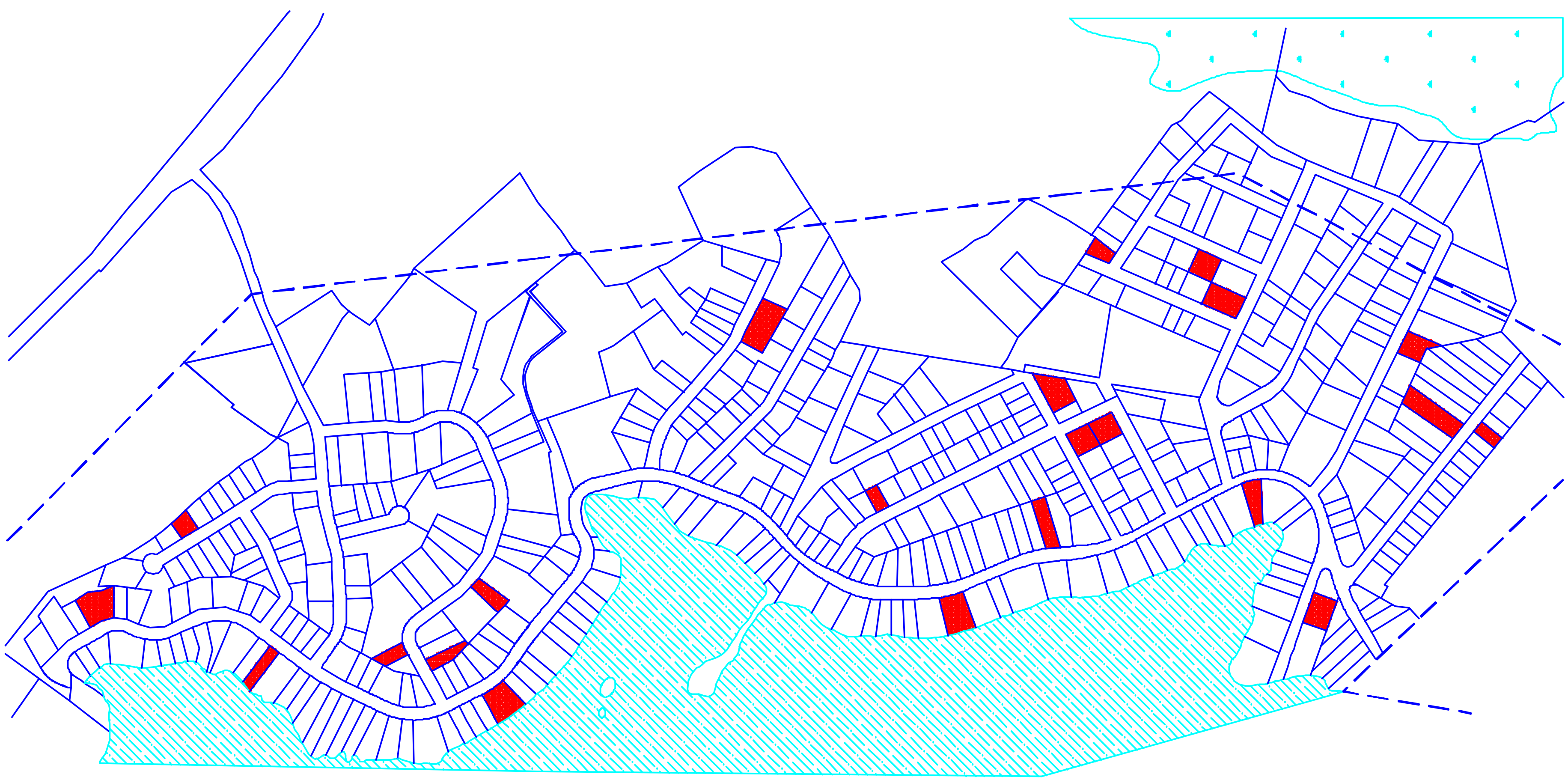


SEASONAL OCCUPANCY (212 HOMES)

YEAR–ROUND OCCUPANCY (98 HOMES)

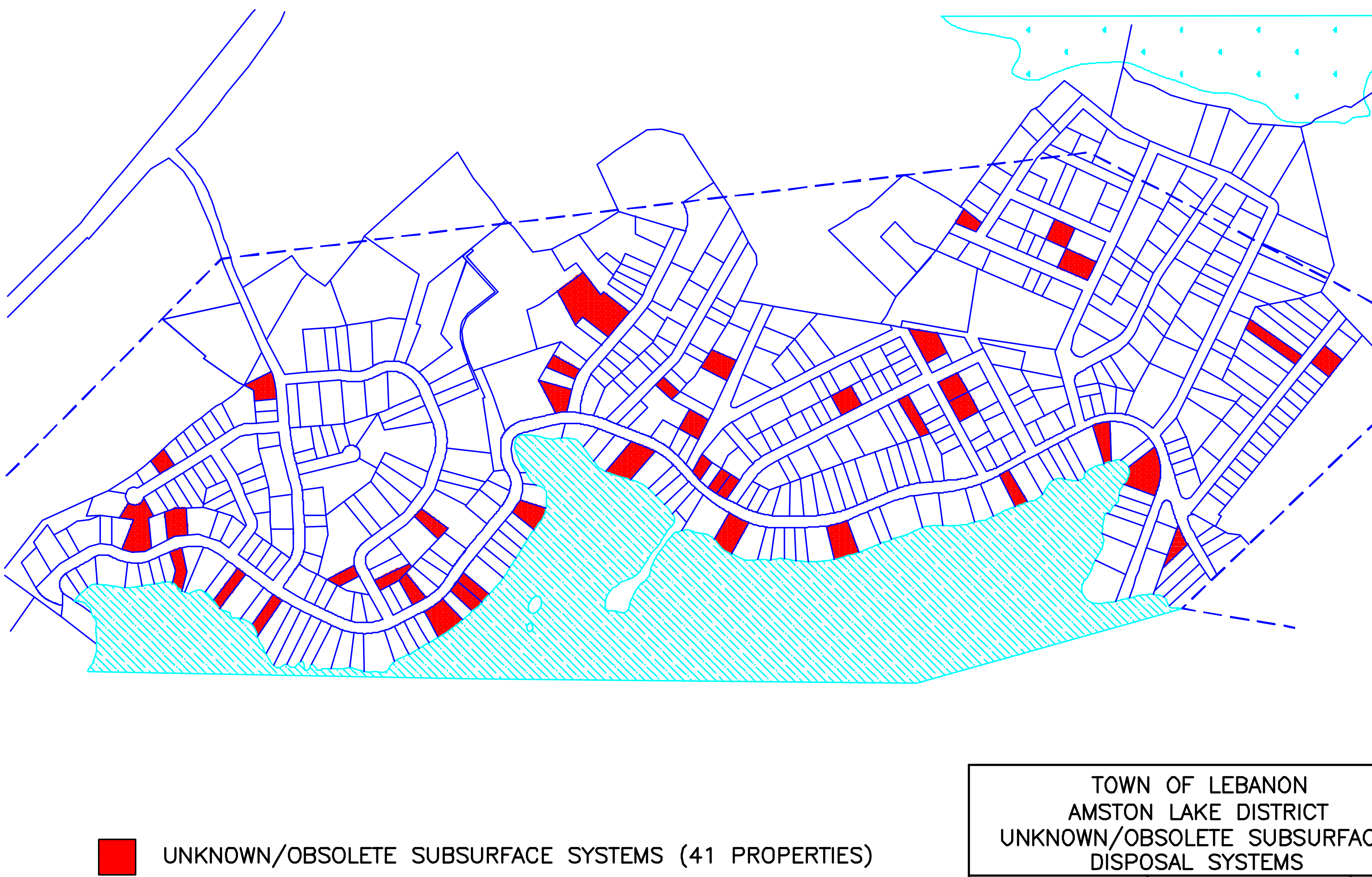
UNDEVELOPED LOTS (175 LOTS)

TOWN OF LEBANON AMSTON LAKE DISTRICT PROPERTIES BY ZONING	
PROJ NO: 10840A	Wright–Pierce
DATE: MAR 2007	FIGURE: 2–2
SCALE: NTS	



SUSPECTED FAILING SUBSURFACE SYSTEMS (22 PROPERTIES)

TOWN OF LEBANON AMSTON LAKE DISTRICT SUSPECTED FAILING SUBSURFACE DISPOSAL SYSTEMS	
PROJ NO: 10840A	FIGURE: 2-3
DATE: MAR 2007	Wright-Pierce
SCALE: NTS	

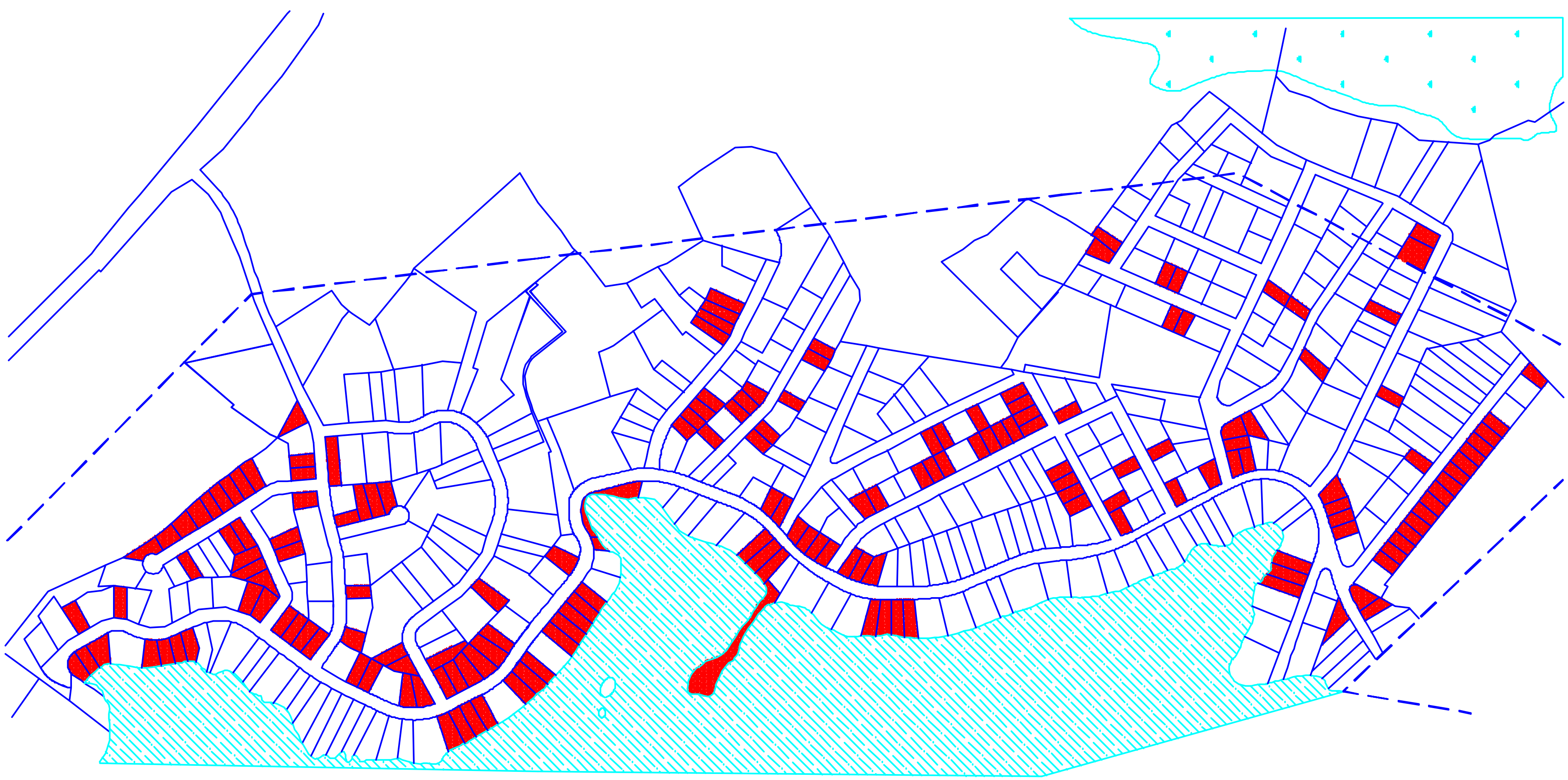


TOWN OF LEBANON
AMSTON LAKE DISTRICT
UNKNOWN/OBSOLETE SUBSURFACE
DISPOSAL SYSTEMS

PROJ NO:	10840A
DATE:	MAR 2007
SCALE:	NTS

Wright-Pierce

FIGURE: 2-4



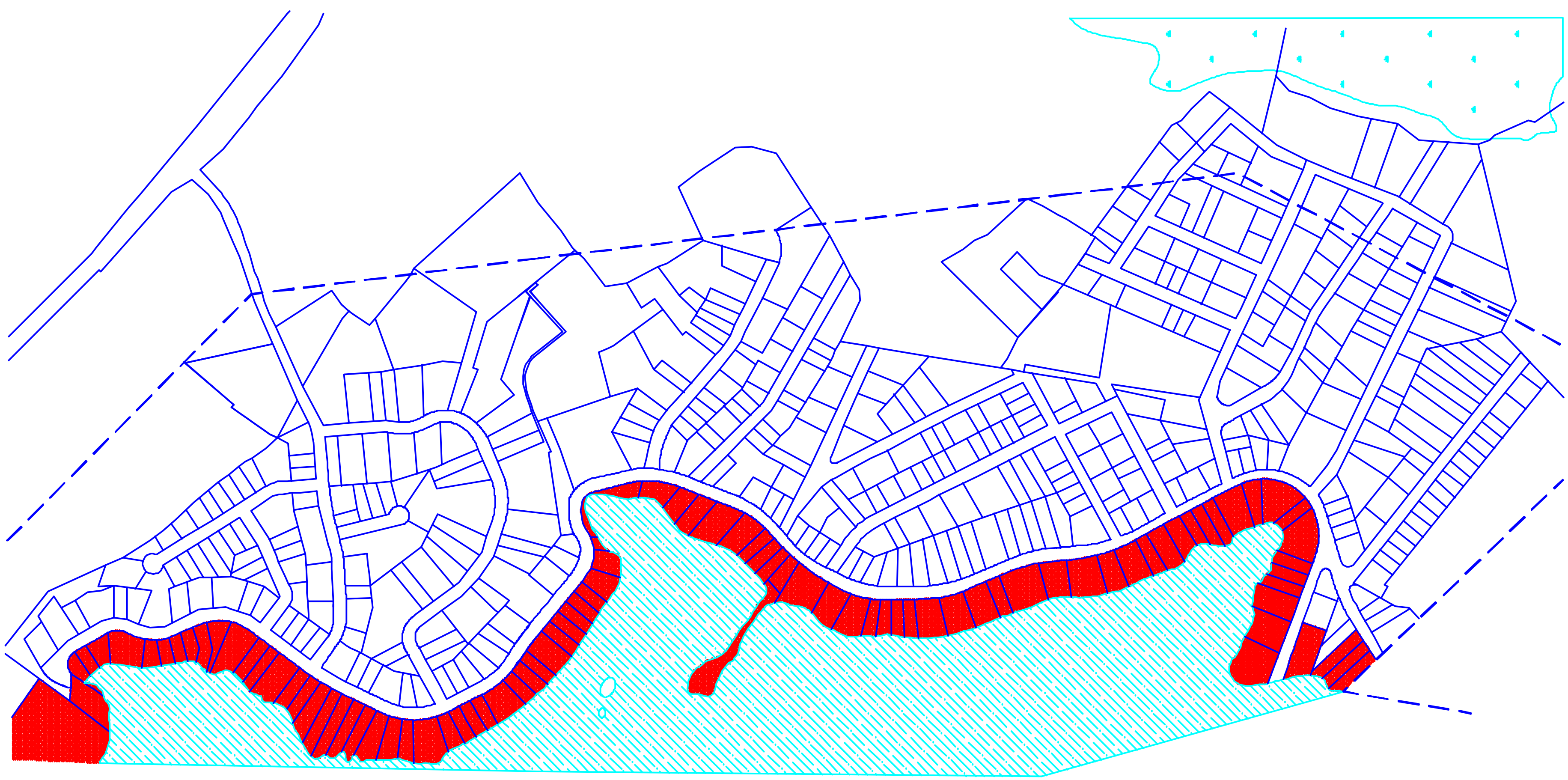
INSUFFICIENT LOT SIZE (180 PROPERTIES)

TOWN OF LEBANON
AMSTON LAKE DISTRICT
INSUFFICIENT LOT SIZE

PROJ NO:	10840A
DATE:	MAR 2007
SCALE:	NTS

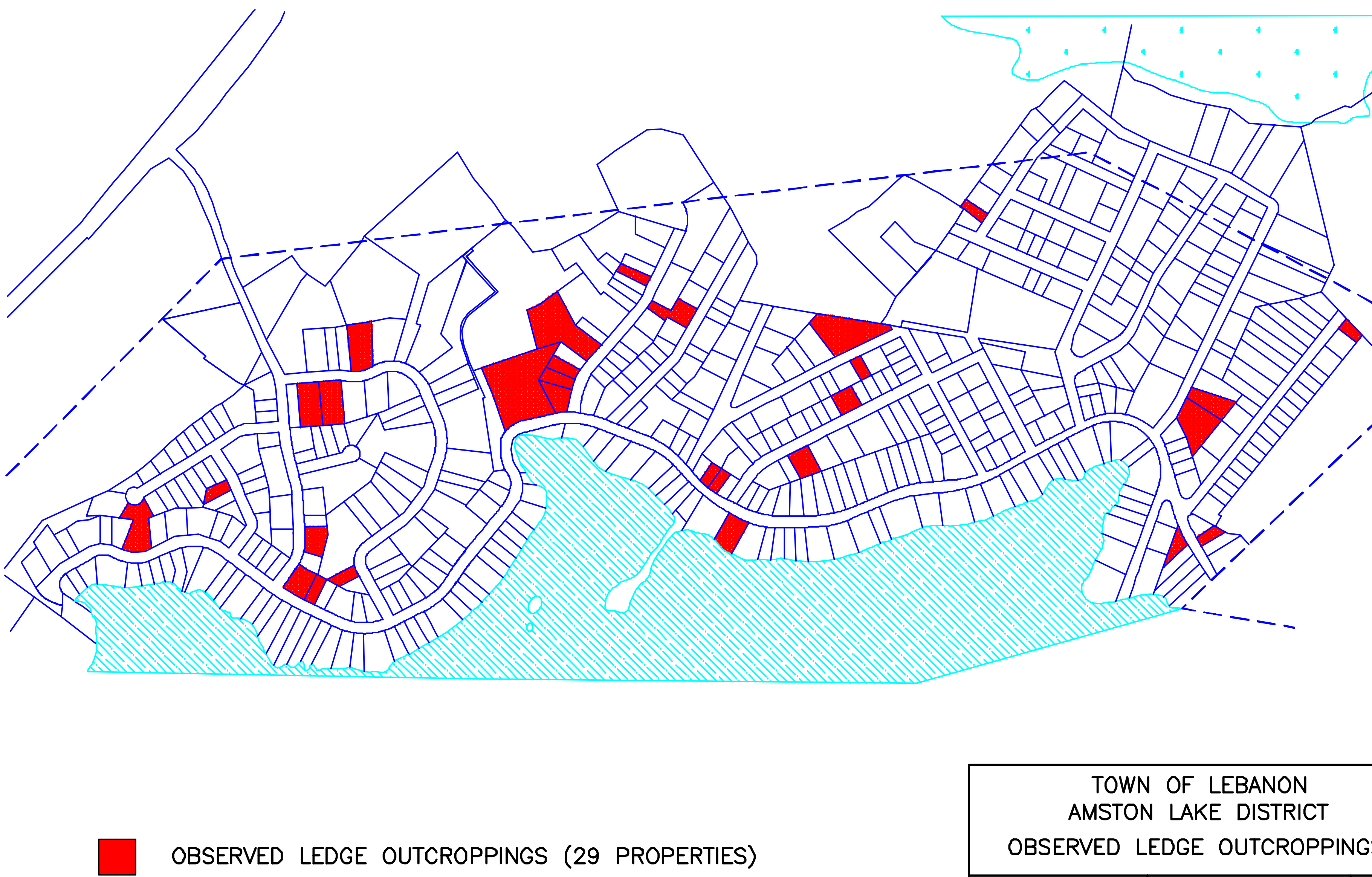
Wright-Pierce

FIGURE: 2-5

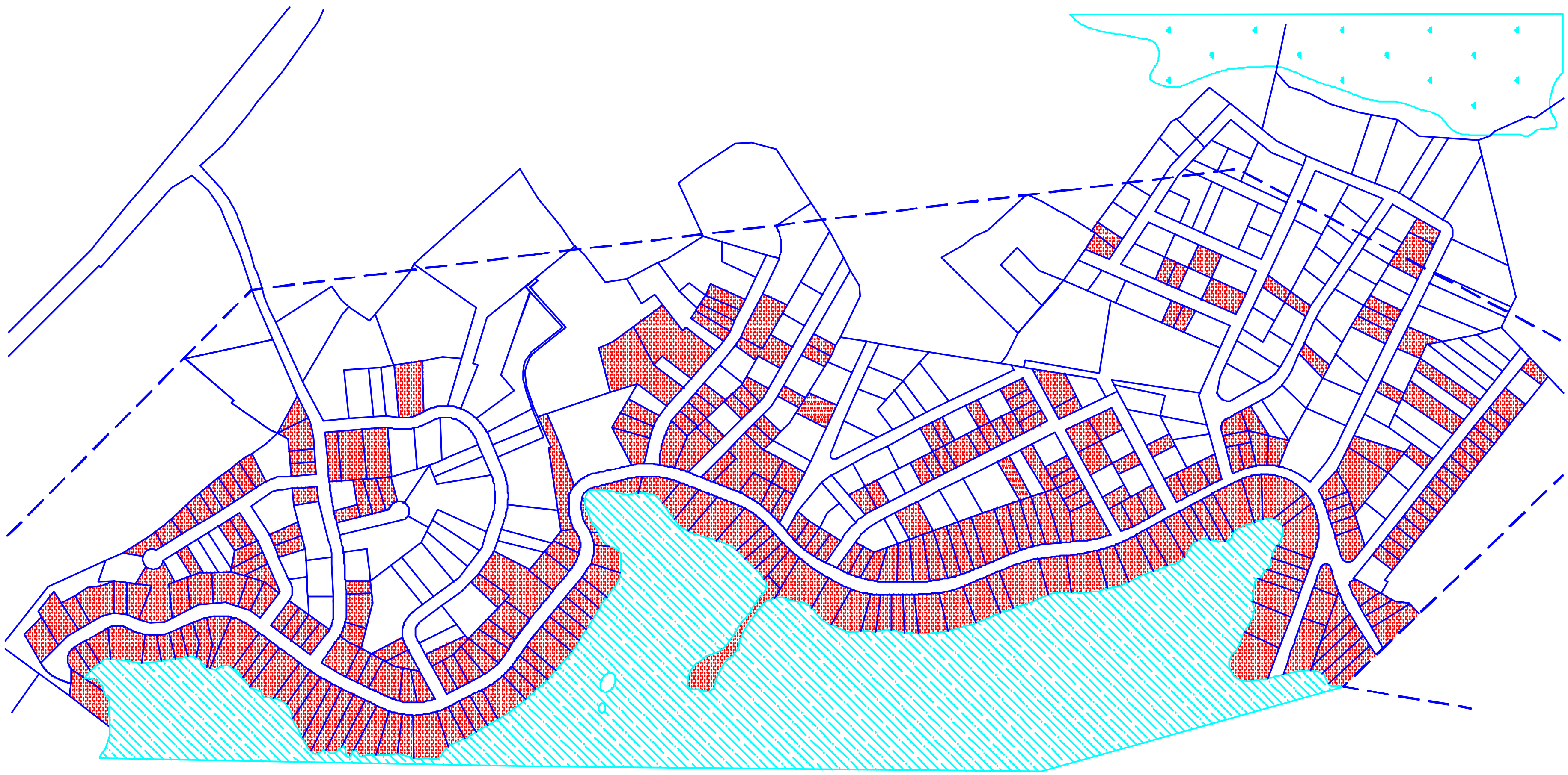


PROXIMITY TO LAKE (92 PROPERTIES)

TOWN OF LEBANON AMSTON LAKE DISTRICT PROXIMITY TO LAKE	
PROJ NO: 10840A	FIGURE: 2–6
DATE: MAR 2007	Wright–Pierce
SCALE: NTS	



TOWN OF LEBANON AMSTON LAKE DISTRICT OBSERVED LEDGE OUTCROPPINGS	
PROJ NO: 10840A	Wright-Pierce
DATE: MAR 2007	FIGURE: 2-7
SCALE: NTS	



OVERALL PROPERTIES OF CONCERN (195 PROPERTIES)

TOWN OF LEBANON AMSTON LAKE DISTRICT OVERALL PROPERTIES OF CONCERN	
PROJ NO: 10840A	FIGURE: 2-8
DATE: MAR 2007	Wright-Pierce
SCALE: NTS	

further from the lake, matching the development trend of the District with older homes near the lake and newer ones further away. Based on the survey it appears that many of the older systems include drywells (cesspools) or aging steel tanks, neither of which meet the current PHC requirements. Additionally, we suspect that many of the older homes have no leach fields and that the older homes with leach fields do not meet the current PHC requirements. To summarize, though it should not be taken as indicative of the condition or effectiveness of any one particular system, the survey results indicate that the current overall condition of subsurface wastewater treatment and disposal systems in the District is mostly poor, does not meet current Public Health Code requirements and has the potential to negatively impact the water quality of Amston Lake. Copies of these responses are provided in Appendix B.

It should be noted that even well designed septic systems are not the most efficient methods of wastewater treatment and disposal, particularly in densely populated areas in close proximity to open watercourses, such as Amston Lake. Conventional septic systems are designed primarily to protect public health hazards by means of infiltration of effluent to the ground and preventing the presence of wastewater at the ground surface. The level of nutrient removal provided by a septic tank and leach field is relatively limited. For example, even in a properly sized septic tank the removal rate of phosphorus, a nutrient commonly contributing to the degradation of lake water quality, is only approximately 8%. Nitrogen removal rates are similarly low, at about 15%. Furthermore, while additional treatment is provided during the infiltration of effluent to groundwater, soils have a finite potential for the uptake of nutrients, such as phosphorus, which is reduced over time. It is therefore possible that a well designed septic system as far as 300 feet from an open watercourse could still contribute nutrients to that body of water over an extended period of time. It can generally be concluded that the higher number of systems located in a given area, the sooner the nutrient uptake ability of the soils will be exhausted, and the greater the flow of nutrients to the lake.

2.3.3 Stormwater Considerations

Members of the Amston Lake community have expressed concern that stormwater runoff, including non-point source pollution from properties immediately adjacent to the lake, as well as the limited stormwater management practices throughout the District, may be negatively impacting the water quality of Amston Lake. Additionally, typical stormwater sewer systems, such as those present in the District, can provide a conduit for pollutants from throughout the area to be discharged to the lake. Northeast Aquatic Research's *Amston Lake Annual Monitoring Report, 2005* states: "The storm water runoff samples collected in 2005 continue to show that inflow water is of very poor quality … sediments are closely related to phosphorus and … significant quantities of each are retained both within the conveyance system and in the lake near the discharge points." A copy of this report is included in Appendix C. Typical pollutants found in stormwater include bacteria, fertilizers, suspended solids, nutrients, pesticides, oil and grease, metals, and other floatable materials. In fact, the EPA has stated that stormwater runoff is the most common cause of surface water pollution. Substances of highest concern for a lake front community such as the Amston Lake District include fertilizers, pet waste and other phosphorus containing materials, which may be linked to seasonal algal blooms as well as the prevalence of nuisance aquatic plants, and bacteria contamination related to pet waste. It should be noted that since the volume of stormwater flowing into Amston Lake has not been measured, it is difficult to determine the actual level of pollutants that enters the lake.

Best Management Practices (BMP's) are methods used to prevent or reduce the level of pollutants that enter into a waterway, and may be either structural (such as detention basins or vegetative swales) and/or societal (such as public education and outreach). A cursory investigation of properties abutting the lake indicated that few structural BMP's are in place. No stormwater detention basins, or other means to encourage stormwater infiltration to the ground or to prevent sedimentation, were observed. The majority of collected stormwater is conveyed via paved swales, storm sewers, and culverts directly to the lake itself, possibly depositing an array of pollutants into the lake every time it rains.

Although there does not appear to be any structural BMP's in place, public awareness of the potential effects of stormwater runoff is reportedly prevalent in the District, and is typically a topic of discussion at District meetings as well as in the seasonal District newsletter, *The Amston Laker*. A volunteer organization, the Organization to Preserve and Protect Amston Lake (OPPAL) was established in 2006 to address concerns such as stormwater management, local zoning, and environmental awareness and education. While addressing failing septic systems within the District is a good long term investment for limiting pollutants and nutrients to the lake, it is recommended that an analysis of stormwater management and recommendations for Best Management Practices also be conducted in order to identify solutions to the non-point source portion of the problem, though such an investigation is beyond the current scope of this project.

2.3.4 Additional Information

The Eastern Division of Birmingham Utilities, Inc., owns and operates a water distribution system within the District, serving homes in both Hebron and Lebanon. A water tank and one of the system's three wells is located in Lebanon, on Island Beach Road. While all homes served by the utility in Hebron are year-round, 132 of the 161 Birmingham water services in Lebanon are seasonal, owing to the seasonal nature of the area. It is assumed that those homes not served by the public water system each have their own private well. According to Birmingham Utilities staff, a positive coliform test from the Island Beach Road well in late 2003 was likely caused by a nearby septic system failure. The septic system in question was repaired immediately and Birmingham Utilities reports that no positive coliform tests have been recorded since. Reportedly, routine well testing has never indicated that the well is under the surface water influence of Amston Lake.

In 1985, the Eastern Connecticut Environmental Review Team (ERT) prepared a report on the site characteristics surrounding Amston Lake on behalf of the Eastern Connecticut Resource Conservation and Development Area Executive Committee. This report was prepared for the Town of Hebron as part of a determination of the condition of the Amston Lake Dam. Included in the report was a review of the existing geologic and biological conditions surrounding Amston Lake as well as possible local health concerns, as determined by the ERT. Based on their observations of ground water levels, lot sizes, ledge outcroppings, and existing soils mapping for the developed areas around the lake, the ERT expressed concern that "these lots would be only marginally suited for on-site sewage disposal systems…Unless these systems were properly designed, installed and maintained, it seems likely that these existing systems could malfunction and ultimately discharge septage effluent into the lake, particularly during periods of heavy precipitation and/or during summer months when cottages get heavy usage by residents". The

ERT concluded that "the potential for septic discharges in these areas may ultimately threaten the water quality of the lake as well as create a public health nuisance condition."

Current water quality monitoring of Amston Lake is contracted by OPPAL to Northeast Aquatic Research of Mansfield Center, Connecticut. Data indicates that over the past several years, lake water quality has deteriorated significantly in several categories. Information from Northeast's 2005 Annual Monitoring Report can be found in Appendix C. While the data does not directly point to a cause of the decline, it is believed that it is the result of both failing and poorly designed septic systems, as well as inadequate management of stormwater runoff. Staff from Northeast Aquatic Research indicated that a combination of lake water sampling for organic nitrogen as well as conducting a nutrient balance for Amston Lake could assist in determining the nature of the quality degradation, though these analyses have never been performed due to financial constraints on the part of OPPAL.

Preliminary investigation of Natural Diversity Database mapping obtained by the Connecticut DEP indicates that the northern end of Amston Lake may contain habitats for listed threatened or endangered species. Further investigation and cooperation with the DEP on this matter would be required as part of any preliminary design for all of the wastewater management alternatives discussed in this report.

Section 3

SECTION 3

WASTEWATER MANAGEMENT ALTERNATIVES

3.1 CONVENTIONAL UPGRADES

It is assumed that all residences in the Lebanon side of the Amston Lake District are currently served by subsurface treatment disposal systems (e.g. septic tanks and leaching fields, drywells, etc.). These systems are "conventional" in that they are what are typically found on properties not serviced by sanitary sewers. Therefore, for the purpose of this report a "conventional upgrade" is one that would repair an existing subsurface treatment system, or replace it with a septic tank-type/leach field type system adhering to the current Public Health Code.

3.1.1 Existing Systems

A functioning septic system will help protect the environment and public health by reducing the level of contamination to groundwater and surface water. It will accomplish this by providing sufficient capacity to store wastewater effluent during periods of heavy use or rainfall, providing sufficient subsurface soil application area to adequately treat the septic tank's effluent, and by being installed in soils that are capable of treating, dissipating, and dispersing its discharge without becoming oversaturated. Septic systems that are not functioning properly can introduce nitrogen, phosphorus, bacterial and viral pathogens and organic matter into the surrounding groundwater and surface water.

The Town of Lebanon's records for the existing subsurface disposal systems are limited and date back only five years. The existing records are supplemented by the voluntary responses to the residential surveys conducted in 1987 and 2006. Based on the lack of subsurface disposal permit records, it is assumed that the majority of the subsurface systems are original to the residences served, particularly in the case of seasonal residences. Many of these systems may be in some state of failure. However, in order to determine which existing systems are failing, a clear definition of "failure" is needed.

Failure of a subsurface disposal system can be defined as a system which does not provide the proper treatment level to the wastewater it receives. Common symptoms of a failed system include visible breakout of wastewater at the ground surface, chronically wet areas of the lawn in the area of the leach field, a noticeable "sewage" odor, and/or backups in interior drain plumbing. However, it should be noted that simply because these symptoms are not observed does not mean that a septic system is not failing. For example, a leach field discharging directly to the water table is considered to be in failure, even though there may be no readily apparent indication of a problem. Failure of a subsurface disposal system can occur for many reasons, including system overloading, high groundwater conditions, improper design and materials, improper maintenance, and damage due to trees, vehicles and onsite construction activities. A failed septic system will not adequately treat the nitrogen, phosphorus, pathogens and organic matter typically found in septic effluent, which may then leach into the surrounding ground and surface waters. The presence of excess phosphorus (and to some extent, nitrogen) in surface waters such as Amston Lake can lead to algae and other plant blooms that tend to degrade the water quality. The presence of nitrogen, pathogens and organic matter will also have a detrimental affect on the lake and surrounding groundwater and may provide a public health risk.

3.1.2 Conventional Upgrades on Existing Lots

Based on the presumed age of the existing subsurface disposal systems in the Amston Lake District, it is anticipated that the vast majority utilize leaching trenches as means of disposal. Furthermore, it is believed that many of the developed lots in the Amston Lake District (particularly those that border Amston Lake itself, contain a private drinking well, and/or are only one-tenth of an acre in size), are currently utilizing subsurface disposal systems which fail to meet the current State of Connecticut Public Health Code (PHC). Anecdotal evidence indicates that some systems may consist of nothing more than a steel 55-gallon drum with holes drilled into it. Therefore, it is not unreasonable to assume that many of the existing systems, particularly those close to the water, are having a negative impact on the water quality of Amston Lake.

In order to comply with the PHC, a leaching system for a three bedroom house with well-percolating soil would require a leaching system covering, at the very minimum, 1,155 square feet. Site conditions and individual leach field configuration would most likely require more area for a suitable system. While exceptions to the PHC are available on emergency basis for upgrades and repairs to existing systems, and any such upgrades would likely help to minimize the impact on lake water quality, even a properly functioning subsurface disposal system has the potential to have a negative impact on the water quality of Amston Lake, due to its proximity to the lake. Finally, based on PHC requirements, there are very few existing undeveloped lots in the Amston Lake District on which a new subsurface disposal system could be installed.

3.1.3 Regulatory Requirements

The two regulatory requirements that must be considered with any proposed upgrades to existing subsurface treatment disposal systems are the local Inland Wetland Regulations and the Connecticut Public Health Code. While construction of a new, or upgrades to an existing, septic system do not fall per-se under the jurisdiction of the Inland Wetlands Commission (IWC), any earth disturbance within, or within 100 feet of, a wetland or watercourse (such as Amston Lake) is subject to Lebanon's Inland Wetland and Watercourses regulations and as such would need to be presented to the IWC for a permit review. Therefore, at a minimum, all properties along Amston Lake would need to go before the IWC prior to system repair or upgrade.

The Connecticut Department of Public Health (DPH) requires that all repairs and upgrades to, and replacements of, conventional subsurface wastewater treatment and disposal systems meet the current Public Health Code. It is the responsibility of the Town Sanitarian's Office, as well as any applicable community health district (such as the Uncas Health District) to enforce this requirement. In the case of new construction, a Certificate of Occupancy is withheld unless the system meets all state and local requirements. The PHC stipulates where a subsurface disposal system may be located by means of specifying minimum separation distances from other site features. Some of these offsets are summarized in Table 3-1.

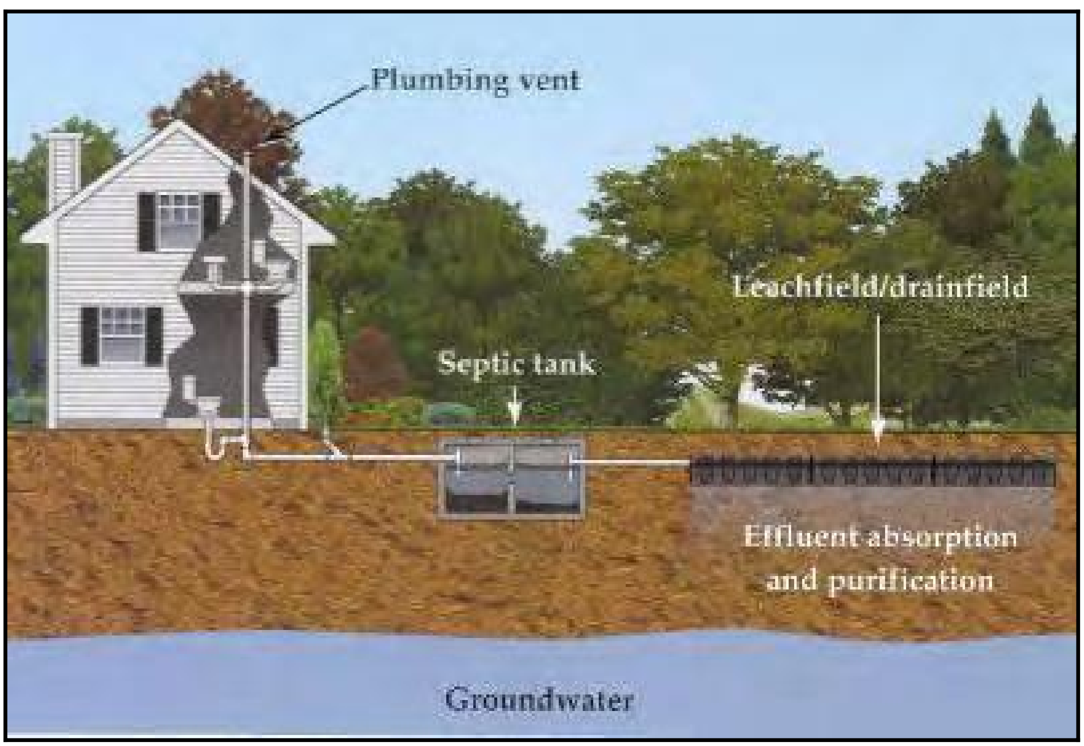
TABLE 3-1
SUBSURFACE SEWAGE DISPOSAL SYSTEM OFFSETS[1]

Item	Min. Separation
Potable Well (<10 gpm)	75 feet
Public Well	200 feet
Watercourse	50 feet
Building served	25 feet[2]
Property Line	10 feet
Ledge Rock Outcrops	50 feet (down slope)

1. Source: CT PHC Subsurface Sewage Disposal, January 1, 2004
2. With footing drain. Structures without footing drains are permitted 15 feet minimum separation.

A typical septic system schematic is shown in Figure 3-1.

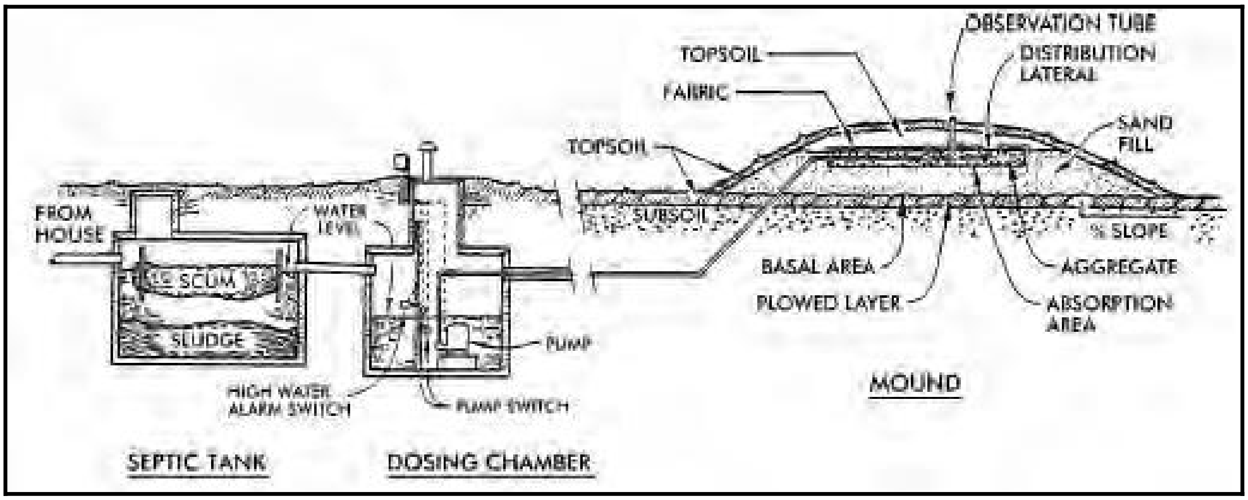
FIGURE 3-1
TYPICAL SEPTIC SYSTEM SCHEMATIC



Courtesy of CT DEP

Additionally, the PHC requires that the bottom of any leaching system be at least four feet above any ledge rock and eighteen inches above the seasonal high groundwater level. If these requirements can not be met with existing site conditions, a more expensive, mounded system such as that shown in Figure 3-2 may be needed. Leaching systems must be installed perpendicular to the slope of the site and leaching areas may not be located under a driveway, parking area, or otherwise impervious surface.

FIGURE 3-2
TYPICAL MOUNDED SEPTIC SYSTEM SCHEMATIC



Courtesy of US EPA

The required size of a subsurface disposal system is determined by both the flow requirements and hydrogeological characteristics of the site. For residential buildings, the required capacity of a subsurface disposal system is determined by the amount of bedrooms in the residence. The PHC requires that all subsurface disposal systems be designed to accommodate a daily flow of 150 gallons per day per bedroom, for up to three bedrooms. This includes not only rooms currently being utilized as bedrooms, but also rooms such as studies and finished basements which have the potential to be used at bedrooms without major building improvement. The hydrogeological characteristic of a site is determined by digging test pits (to determine soil characteristics, the presence of ledge rock or hardpan, and to determine the depth to groundwater) and by performing a percolation test (to determine the ability of the soil to disperse septic tank effluent). In general, the faster the percolation rate, the smaller the required size of a leach field. Note that if the percolation rate is too fast (generally faster than one minute per inch), the separation distances shown in Table 3-1 are increased.

The design criterion for subsurface disposal systems is a percolation rate between 5 and 60 minutes per inch. Experience from the Town of Lebanon Sanitarian indicates that typical percolation rates in the Amston Lake area are between 5 and 20 minutes per inch, with the faster draining soils typically located near the lake. Faster draining soils generally provide less treatment than slowly draining soils, though they are less prone to plumbing backups and surface breakthrough of wastewater generally seen as indicative of a system failure. Based on both USDA Soil Conservation Survey maps as well as visual observations, it appears that the majority of the soils in the area have a high sand content, and are typically rocky, with large boulders prevalent throughout the area. Ledge outcroppings are also fairly common, and it can be assumed that the depth to ledge in much of the district is fairly shallow. For a hypothetical, best case scenario site with a percolation rate below 10 minutes per inch, the required septic tank and effective leach field sizes are shown in Table 3-2.

TABLE 3-2
MINIMUM REQUIRED SUBSURFACE DISPOSAL SYSTEM SIZES[1]

Bedrooms	Daily Flow (gpd)	Required Tank Size (gal)	Required Effective Leaching Area (ft^2)	Smallest Possible Area of Leach Field (sq. ft)[2]
1	150	1000	190	190
2	300	1000	375	750
3	450	1000	495	1155
4	600	1250	660	1540

1. Assumes a percolation rate below 10 minutes per inch.
2. Based on 3-foot wide leaching trench; does not include the required reserve area.

Note that while Table 3-2 provides sizing for a hypothetical percolation rate, the total area required by the leaching area depends on several factors, combined which may result in a higher overall square footage needed for the system. Leaching systems may consist of individual leaching trenches, leaching galleries, or proprietary leaching systems. The PHC assigns each particular method an effective leaching credit, given as ft^2/ft, based on its evaluated ability to disperse septic tank effluent. Typical effective leaching credits range from 2.1 ft^2/ft for conventional leaching trenches to as much as 20.4 ft^2/ft for some proprietary leaching systems. For example, a leaching trench 18 inches wide and 18 inches deep has an effective leaching credit of 2.1 ft^2/ft. This means that a two bedroom house requiring an effective leaching area of 375 ft would need approximately 179 linear feet (375 divided by 2.1) of this particular leaching method in order to meet the PHC. Individual sections of a leaching system are limited in length to 75 feet, with a mandatory spacing of at least 9 feet on center between sections. Spacing requirements are as high as 27 feet for some proprietary systems.

In addition to the aforementioned sizing requirements, new subsurface disposal systems must have an area equal to the size of the constructed leach field, set aside as a reserve, both to allow for potential future renovation and expansion of the residence, as well as to provide a measure of redundancy, should the original system fail. Note that reserve areas are not required for repairs or alterations to existing systems.

As an alternative, a water-tight holding tank could be installed to collect all wastewater flows from a residence. Instead of discharging through a leaching system, this tank would be pumped out on a routine basis. The advantage of such a tank is that there is no disposal of tank effluent or wastewater to the water table. The disadvantages are that pumping is performed much more frequently than a septic tank (greatly increasing costs), and that routine monitoring of the level of wastewater in the tank is required. As such, this type of wastewater disposal is typically only used where no other option is available.

3.1.4 Management Issues

Conventional repairs and upgrades to subsurface disposal systems should not introduce significant additional management issues for the Town of Lebanon. While the construction of new subsurface disposal systems with flows less than 5,000 gallons per day, along with any repairs to such a system, is under the jurisdiction of the Town Sanitarian, it is assumed that no new staff would need to be hired to administer the corrective action. The responsibility and costs associated with planning, permitting, constructing and maintaining a conventional system or upgrade all typically fall on the property owner.

Although some towns maintain databases ensuring that all septic systems are inspected and pumped on a regular basis (typically every three to five years), all costs associated with this maintenance are borne by the homeowner. The Town of Lebanon does not currently have a regular, enforced septic tank pumping and inspection program, or minimum required pumping requirements, as have been implemented in some waterfront communities. Generally, the Town's role in the management of these systems is minimal unless a system is known to have failed, in which case the Sanitarian will work with the homeowner to coordinate the necessary replacement or repairs. A mandatory inspection and pumping program would be critical if Lebanon were to implement any conventional upgrades to address the water quality issues in Amston Lake. Note that due to their proximity to Amston Lake, it is unlikely the DEP would approve conventional upgrades to the systems along Deepwood Drive as an effective response to the Abatement Order.

3.1.5 Feasibility Level Cost Estimate

Costs associated with a conventional upgrade to an existing subsurface disposal system are very site specific. Upgrades to a system that is readily accessible, has suitable soil, low groundwater and no boulders or ledge rock would be considerably less costly than upgrades to a system that is difficult to access and located in poor soils with high groundwater and/or ledge. Therefore, the feasibility level cost estimate provided in Table 3-3 shows a range of cost estimates. These costs estimates were obtained from several excavators from the Lebanon area who are familiar with the Amston Lake area.

Both cost estimates assume that an entirely new subsurface disposal system, including a septic tank and leach field, would be necessary. The "straightforward" cost assumes that the septic system can be installed on property that has low groundwater, well draining soil, no ledge and that machinery can readily access the site. The "complex" cost assumes that the property where the system is to be installed is difficult to access, has high groundwater, poorly draining soil, and shallow depth to ledge. Such a system could potentially require an engineered, mounded system, for example. Other factors that can affect the costs are the level of landscaping repairs needed and economy of scale. Obviously, there are numerous permutations between these two extremes, but the costs shown provide an approximate range.

TABLE 3-3
CONVENTIONAL UPGRADE TO EXISTING SUBSURFACE DISPOSAL SYSTEM
FEASIBILITY LEVEL COST ESTIMATE[1]

Type Construction[2]	Range of Cost Per Home	Total Range of Cost (millions)		
		All Residences[3]	Properties of Concern[4]	Deepwood Drive[5]
"Straightforward"	$10,000 - 25,000	$3.1 - $7.8	$2.0 - $4.9	$1.3 - $3.1
"Complex"	$20,000 - 35,000	$6.2 - $10.9	$3.9 - $6.8	$2.5 - $4.4

1. Estimates provided by local excavation contractors.
2. Assumes installation of new septic tank and leaching field. "Straightforward" assumes readily accessible land, low groundwater, well draining soil and no ledge; "Complex" assumes difficult-to-access land, high groundwater, poorly draining soil and ledge.
3. Assumes all 310 existing developed properties.
4. Assumes 195 currently developed properties, as identified on Figure 2-8.
5. Assumes 125 currently developed properties.

As noted previously, with septic system repairs it is typically the homeowner's responsibility to coordinate and fully pay for the repairs needed. The excavators contacted for estimates did however indicate that there may be a cost reduction associated with "economy of scale"; that is, discounts could apply where there are multiple properties where upgrades or replacements are conducted in a similar time period.

3.2 INNOVATIVE/ALTERNATIVE TECHNOLOGY

As stated previously, for the purpose of this report a "conventional upgrade" is one that would replace an existing subsurface treatment system with a septic tank/leaching field type system. An Innovative/Alternative (I/A) treatment system would provide a superior level of wastewater treatment compared to a conventional septic system, could better address site area and soil limitations, and typically would require less land area. Installing an I/A system on an individual lot would essentially be replacing a conventional septic tank with a miniature advanced wastewater treatment plant.

3.2.1 Innovative/Alternative Upgrades

I/A systems are manufactured by a variety of vendors and include of a variety of mechanized biological treatment systems such as aerobic/anaerobic treatment units, trickling filters, sand filters and other proprietary systems. Because these systems can produce a higher quality effluent than a conventional septic tank, less area is required for the subsurface disposal system and there is generally longer field operational life. Treatment systems such as these are optimum for use in areas with little room available for leaching systems, or for areas that are located near environmentally sensitive features, such as Amston Lake. Particularly, I/A systems can provide a level of nitrogen removal far superior to standard septic systems; as much as 70% removal versus 15% removal, respectively. Given favorable site conditions, they can also be a viable alternative to connection to a traditional wastewater collection system. With proper operation and maintenance these systems can have a life expectancy of twenty or more years.

As part of this evaluation, three distinct I/A systems were considered: the *Amphidrome* system which consists of a fixed film, sequencing batch biofilter; the *MicroFAST*, a fixed, activated sludge bioreactor and the *Bioclere*, a modified trickling filter and clarifier. Additional information for each system can be found in Appendix D. Figures 3-3 through 3-5 show a typical schematic for each of these systems, respectively.

FIGURE 3-3
TYPICAL AMPHIDROME INSTALLATION

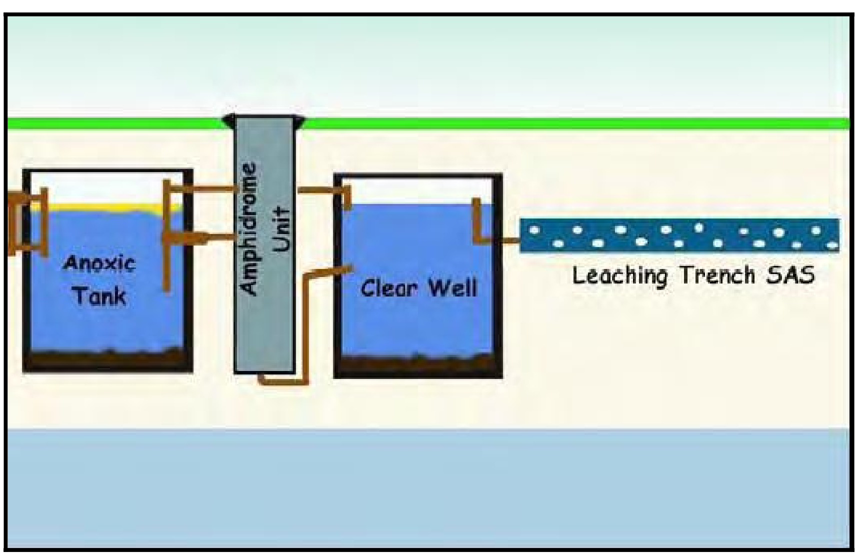


FIGURE 3-4
TYPICAL MICROFAST INSTALLATION

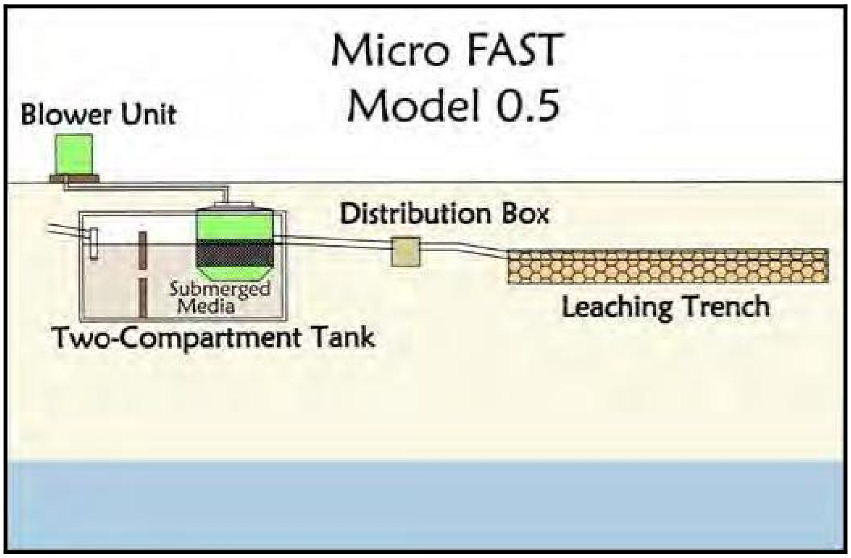
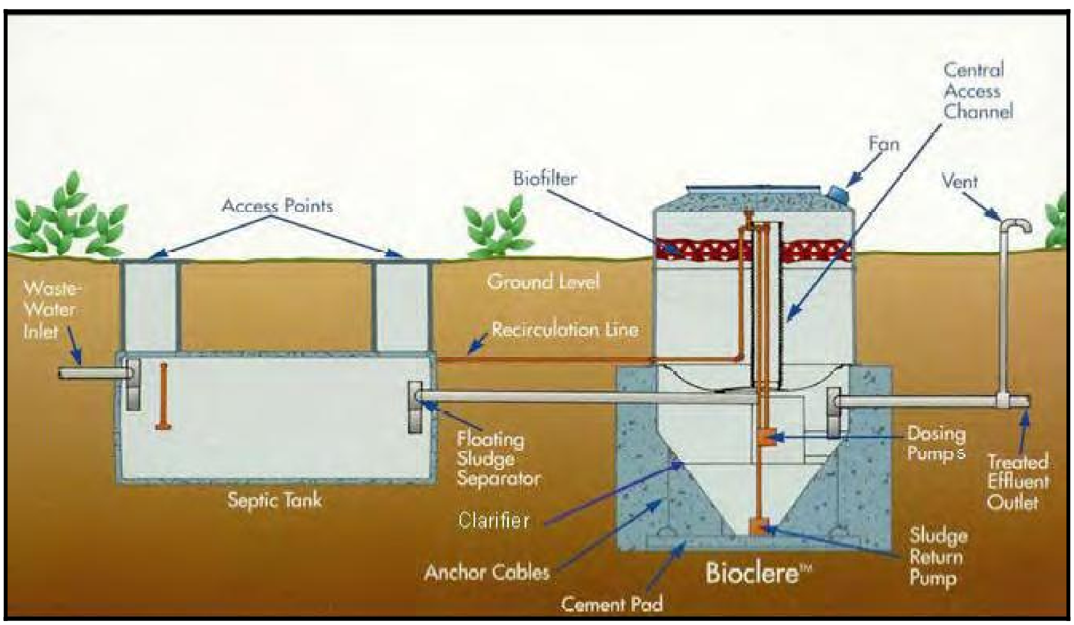


FIGURE 3-5
TYPICAL SINGLE BIOCLERE INSTALLATION



Due to the level of treatment provided by an I/A system compared to a typical septic system, standard leach fields are often not the best option for subsurface disposal. Since a great deal of the treatment typically provided by micro-organisms in a leach field is provided by the I/A process, a greater emphasis is placed on effluent disposal and infiltration, rather than treatment. As such, effluent dispersal systems are typically smaller and may be designed to better meet the needs of a particular site. Alternative sub-surface dispersal systems such as drip distribution systems, shallow narrow drainfields, and bottomless sand filters are common means of effluent disposal installed for I/A treatment systems. Due to their shallower installation depths, shallow narrow drainfields and drip distribution systems can also provide supplemental nitrogen removal, due to uptake by nearby plants and grasses.

When leach fields are used for subsurface disposal following an I/A treatment process, they may be eligible, as is the case in Massachusetts and other New England states, for a leach field area reduction of as much as 50%. Currently, as the use of individual, residential sized, I/A systems in Connecticut is still in its infancy, the Connecticut DEP does not grant credits for reduction of leach field sizes.

Although I/A systems can be an attractive option for many communities struggling with wastewater management issues, there are some matters of concern regarding the management of these systems. In particular in the case of Amston Lake, where 70% of the Lebanon homes are "seasonal", maintaining the treatment biomass or "health" of the system during periods of inactivity becomes an issue. Most of the treatment in I/A systems is provided by microorganisms living inside the unit itself. In order to maintain high treatment efficiencies, these microorganisms require a relatively stable flow of wastewater. When flows (and thus food sources) cease, these microorganisms begin to die back, and depending on the length of the "no-flow" period, may die out completely. Once the unit is restarted, it can take anywhere from three to ten weeks for the microbial action to be such that the system is at its designed level of treatment. This means that for up to two months, the system would be overloading a leach field or effluent dispersal system with an inadequately treated effluent.

While most manufacturers of these systems are confident that their processes are robust enough to survive periods of inactivity, all stress that these systems are designed to produce superior quality effluent based on continuous use. A dormant period of two or three weeks would likely not provide a problem for these systems, however given the seasonal nature of the community, it is possible that some systems would not experience an inflow of wastewater for as much as eight consecutive months. In order for these systems to survive these periods of inactivity and still provide the level of treatment they were designed for, these I/A systems may need to be "fed" using materials such as sugar or pet food. This would further increase the operations costs of the system and would necessitate access to the system and property as part of any operation and maintenance contract.

3.2.2 Regulatory Requirements

The use of individual onsite I/A treatment systems is an emerging method of wastewater treatment in Connecticut. There are currently no state defined standards for the performance, operation, or management of I/A systems, though standards may currently be set by local health districts which have operating I/A systems within their jurisdiction. Similarly, there is no current permitting process or state-approved technology for individual I/A systems in Connecticut. Permitting and system approval, as well as enforcement of proper system operation and maintenance, is the currently the responsibility of the Town and/or the local Water Pollution Control Authority (WPCA) and the local health district.

The Town of Old Saybrook, Connecticut is currently working with the DEP, in conjunction with the DPH, to create a model for the implementation of I/A systems on a wide spread basis. Under an Abatement Order from the DEP (due to nitrogen contamination in the Connecticut River and Long Island Sound linked to failing and underperforming conventional septic systems, and with little land available for the construction of community wastewater treatment plants), Old Saybrook chose to begin the permitting of onsite I/A systems as an alternative to creating a regional sewer district with centralized treatment. This case will likely set the precedent for use of onsite I/A systems in Connecticut. It is anticipated that treatment standards, a permitting process, and a list of approved technologies will ultimately be developed by either the state DEP or DPH. Until that time, the DEP has set up a series of steps that must be undertaken prior to the implementation of any I/A system. These steps are summarized in Section 3.2.3. The creation of a WPCA for the Town of Lebanon would be required to implement and enforce these measures.

3.2.3 Management Issues

There are numerous items that must be considered and addressed prior to the implementation of I/A systems within Lebanon. The first step to installing I/A systems would be the designation of a "Decentralized Wastewater Management District" (DWMD). Creation of such a District would be achieved through adoption of a municipal ordinance and as required by the Connecticut General Statutes; approval of the DEP and DPH Commissioners is also needed. Such approval typically would be granted after consultation with the local Health Director. Note that while a DWMD would not be necessary if only a few homes were slated to have an I/A system installed, the permitting effort involved with installing these systems without a DWMD in place are considerable. Other items that would need to be addressed by ordinance are the physical boundaries, and therefore properties, covered by such a District, a process for evaluating individual properties, the establishment of minimum remediation standards and a process by which to implement upgrades. Additionally, a local WPCA would need to be established to oversee the construction, operation and maintenance of within the District. It is important to note that many of these regulations and requirements are still evolving; a copy of the DEP's most recent presentation on these issues is attached as Appendix E.

Under the district-wide approach, DPH-approved local health agents would review each property under consideration to determine its status with regards to the remediation standards that would be adopted by the ordinance. Depending on the result of this investigation, each property would then be either issued a permit to discharge (if it is found to be meet all standards, including monitoring and maintenance), an order to upgrade (if it is determined that an upgrade will enable the property to meet the standards) or an order to abandon (if it is found that no level of upgrade will bring the property into compliance with the standards). Those sites that receive an order to abandon will then have to connect to an off-site system or install an I/A system. Because the DEP currently has the sole authority to review and approve alternative technologies, they would evaluate and provide comments on any such system. Coordination with the DEP for discharge permits would be necessary as well; permits would be issued after inspection of the upgrade or installation.

I/A wastewater treatment systems are not passive treatment units. Unlike a septic tank, which generally only needs pumping every few years, I/A systems require inspection and effluent quality sampling, typically on a quarterly basis, to ensure proper operation of the system. Critical components such as pumps, blowers, piping, filters and any disinfection units installed must be regularly inspected, cleaned, repaired and replaced as necessary. These operation and maintenance tasks are beyond the ability of the homeowner; therefore the DEP has determined that they would need to be performed by a licensed system operator, either hired individually by the homeowner, or contracted on a community-wide basis. As mentioned in the previous section, any operation contract involving homes not occupied on a continuous basis (i.e., seasonal) may require provisions for system "feeding" on an as needed basis to ensure proper treatment efficiency. Oversight of the proper operation and maintenance of these systems, and any subsequent enforcement necessary, would be the responsibility of the Town, typically through the WPCA. How this maintenance would be done (licensed Town personnel or contract operator) and who would bear the costs of such maintenance (the Town or the homeowner) are questions that must be considered prior to the installation of any I/A systems. Additionally, easement agreements would need to be drawn up allowing the maintenance workers and WPCA staff access to the installed systems.

The Connecticut DEP has expressed strong concerns over whether local health departments and/or districts can handle the extra work load associated with I/A systems. Much of this additional work load would be performed by Town staff, in effect, managing and being responsible for the maintenance of a significant number of discharge permits. Although the exact permitting process has not yet been established, discussions with DEP staff indicate it will be thorough but straightforward. The general consensus among DPH and DEP staff is that some additional staff, increased time and attention from existing staff, would be required. The exact number of staff would be based on the availability and capabilities of existing Town staff and/or whether the Town would provide oversight only or oversight and maintenance. It is estimated that at least two people would be needed on a part-time basis to oversee and manage these types of systems. This assumption is based on having a minimum of one part-time person (Town staff or contract operator) to perform the actual I/A systems operation and maintenance and a minimum of one additional part-time Town staff member to oversee and manage compliance with the permit(s).

3.2.4 Feasibility Level Cost Estimate

Typically, as with a conventional septic system upgrade, the individual homeowner would be responsible for paying for any upgrades associated with the installation of an individual I/A system. However, if such upgrades become mandated and since a WPCA would need to be created, the Town could possibly assist the homeowners by initial funding of the upgrades with debt payment through the implementation of user fees and/or through property assessments. Additionally, small community state grants of 25% of the project cost and loans may be available to assist in the funding of such a program. Fees and funding are discussed in further detail in Section 4.2.2. Table 3-4 summarizes the estimated costs per home for the three typical I/A systems considered for the district. Additional information on each of these technologies can be found in Appendix D.

TABLE 3-4
INDIVIDUAL INNOVATIVE/ALTERNATIVE UPGRADES
TO EXISTING SUBSURFACE DISPOSAL SYSTEM
FEASIBILITY LEVEL COST ESTIMATE PER HOME

	Amphidrome	**MicroFAST**	**Bioclere**
Capital Cost			
Treatment System[1]	\$21,500	\$11,300	\$16,000
Effluent Disposal System	\$8,000	\$8,000	\$8,000
Yearly Operating Costs			
Operation & Maintenance[2]	\$600	\$200	\$600
Average Electrical Cost[3]	\$200	\$300	\$200
System "Feeding"[4]	\$200	\$200	\$200
Total Yearly Costs	\$1,000	\$700	\$1,000

1. Average for a typical installation, including equipment, tankage and property restoration.
2. O&M costs include system inspection, sampling, and maintenance plan.
3. Per unit, assuming \$.12/kWh and that unit is operating year-round with typical flows (100 gpcd).
4. Assumes feeding of seasonal homes one time per month.

Table 3-5 extrapolates the "Per Home" costs to a District wide level. The costs shown for all homes assumes that all 195 homes previously identified as "Properties of Concern", and shown in Figure 2-8, would be equipped with an I/A system. Costs for homes along Deepwood Drive are as described. Annualized capital costs, as well as annual operating and maintenance costs and Town management costs have been included to demonstrate the total annual costs of implementing a District-wide I/A program.

TABLE 3-5
INDIVIDUAL INNOVATIVE/ALTERNATIVE UPGRADES
TO EXISTING SUBSURFACE DISPOSAL SYSTEM
DISTRICT WIDE FEASIBILITY LEVEL COST ESTIMATES

	Amphidrome	**MicroFAST**	**Bioclere**
Capital Costs			
Treatment Systems	$4,195,000	$2,205,000	$3,120,000
Engineering Service (15%)	$630,000	$330,000	$470,000
Contingency (25%)	$1,050,000	$550,000	$780,000
Legal & Administration (2%)	$84,000	$44,000	$62,000
Total Capital Cost	$5,955,000	$3,130,000	$4,430,000
Annualized Capital Cost[1]	$365,000	$190,000	$270,000
Annual Operating Costs			
Operation & Maintenance[2]	$117,000	$39,000	$117,000
Electrical Cost	$39,000	$59,000	$39,000
System "Feeding"	$39,000	$39,000	$39,000
Additional Town Personnel	$52,000	$52,000	$52,000
Total Operating Cost	$247,000	$189,000	$247,000
Total Annual Cost	$612,000	$379,000	$517,000
Annual Cost/System Installed[3]	$3,100	$1,900	$2,700

1. Annualized at 2% interest over 20 years, assuming no grant.
2. As part of a contract O&M plan.
3. Based on 195 "Properties of Concern".

Due to the superior level of wastewater treatment provided, as well as the ability to deal with conditions such as small site areas and poor soil conditions, replacement of the existing subsurface systems with an I/A system on a home by home basis could be considered a favorable means of wastewater management for Amston Lake. However, District-wide replacement of the existing systems with I/A systems does not appear to be economically viable. Typically, installation of individual I/A systems is most prevalent in areas where centralized wastewater collection is not feasible, or on properties where conventional upgrades to repair an existing system failure are not possible, but surrounding systems have acceptable treatment systems. Economies-of-scale dictate that one large treatment system to serve the entire community should be more economical, both with regards to initial capital costs as well as operation and maintenance costs, compared to multiple smaller treatment systems. In lieu of individually installed I/A systems, the installation of a community treatment system, using similar technology, should be considered.

3.3 COMMUNITY WASTEWATER TREATMENT SYSTEM

Installation of a community wastewater treatment facility is an alternative method of wastewater management that can be often used in areas where a higher level of treatment, compared to conventional sub-surface treatment techniques, is required due to proximity to environmentally sensitive features, such as public drinking water wells or lakes and wetlands. Additionally, community systems may be installed as an alternative to connecting to a centralized wastewater collection and treatment system, or in locations where such a centralized system either does not presently exist, or is not feasible.

3.3.1 Community Treatment Technologies

Community systems, such as those that might be applicable for the Amston Lake area, are often pre-fabricated, delivered to the site, and assembled by either the manufacturer, or a contractor hired by the Town. Due to their modular design and relative ease of construction, they are often referred to as "package plants". Many of these systems operate on the same principle as, and are essentially scaled up versions of, the I/A systems previously discussed. Given the wide range in wastewater flows in the District between seasons, and considering economies of scale, the option of a community package wastewater treatment and disposal system could compare favorably to individual I/A treatment systems. Depending on the site and effluent requirements, various compartments can be added for wastewater treatment, nutrient reduction, and elimination of pathogenic organisms. Following treatment, effluent may be discharged to a permitted body of water, or through a subsurface disposal system.

Compared to centralized wastewater treatment facilities, community treatment systems can be relatively unobtrusive. Most equipment, and the entire treatment process, can be contained in underground tanks and vaults or located within a small building. For most technologies, the only noticeable structures at such an installation would be hatches and tank lids at surface grade, vent pipes, and small equipment enclosures or auxiliary buildings. To the average observer, it should not readily appear to be a wastewater treatment system. However, construction associated with the installation of such a system is not limited to the site itself. Significant offsite work, including the installation of sewers and house laterals, is necessary to connect the individual houses to the system. Additionally, other utilities such as electric, water and/or telephone must be extended to the site. These offsite construction requirements and their associated costs can be quite significant and are discussed further in Section 3.3.5 and 3.3.6.

Compared to the individual Innovative/Alternative treatment system discussed in the preceding section, community wastewater treatment systems would typically be better suited to handle variations in incoming wastewater flow. As these systems are typically modular, identical system components may be arranged in parallel treatment trains. In addition to providing required redundancy, parallel operation allows the facility to adjust to seasonal variations in flow. During the summer, when wastewater flow is at its highest, an equalization tank may be used to smooth out periods of high influent flow; during the winter, when flows drop, individual components may be shut off while still producing effluent of a consistent quality. Furthermore, by combining wastewater flows from both seasonal and year-round properties, the variations in flow would be less drastic than those seen in a treatment system serving strictly a seasonal residence. In addition to the three treatment systems examined for I/A systems, we have also investigated the installation of a package Rotating Biological Contactor (RBC) system. RBC systems are characteristic for tolerating wider ranges in flow than many other technologies.

3.3.2 Wastewater Flows

The size of any community wastewater treatment system is ultimately dependent on how many properties will be connected to the system. As stated previously, it is reported that no "build-out" analysis of the Amston Lake District has been conducted by the Town of Lebanon.

Therefore, the following information was used to estimate the number of seasonal and year round properties that might be treated in a community system:

- The Lebanon section of the District has 310 developed residential properties within its borders; of these, 212 are seasonal homes and 98 are year round residences.
- There are 180 undeveloped lots within the Lebanon side of the District; of these 175 are zoned for seasonal use only and 5 are zoned for year round residences.

Typical engineering figures, taking into account differences between seasonal and year-round residences, were used to estimate total flows that would be treated. As stated previously, three estimates were calculated: (1) assume all homes (seasonal and year round) within District are connected to the system; (2) assume only those properties identified as "properties of concern" are connected; and (3) assume that only the homes on Deepwood Drive are connected. Based on these three scenarios, the design basis total average wastewater flow would range from an average of 27,800 gallons per day (gpd) to 69,700 gpd (Deepwood Drive alone and the entire District, respectively). These flow ranges assume that the current seasonal and year round usage would remain as they currently are. A more conservative approach would be to assume that all existing properties could eventually be converted to year round use if an upgraded wastewater treatment system was provided. The total average wastewater flows for each of these scenarios is summarized in Table 3-6. A residency rate of 2.83 residents per home, as established in the draft Colchester-East Hampton Joint Facilities Wastewater Facilities Plan, prepared in June 2005 by Earth Tech, was used for these calculations. Not that the average design flows are fairly conservative and are used for the purpose of comparison of alternatives. Actually per capita flows will likely be somewhat lower.

TABLE 3-6
WASTEWATER FLOW ESTIMATES
AMSTON LAKE DISTRICT
(GALLONS PER DAY)

	All Residences Connected	All "Properties of Concern" Connected	All Properties on Deepwood Dr. Connected
Seasonal Homes	212	146	89
Year-Round Homes	98	49	36
Total Homes	310	195	125
Seasonal Flow[1]	42,000	28,900	17,600
Year-Round Flow[2]	27,700	13,900	10,200
Total Flow	69,700	42,800	27,800
Total Potential Flow[3]	87,700	55,200	35,400

1. Assumes 70 gpcd, and 2.83 residents per household.
2. Assumes 100 gpcd, and 2.83 residents per household.
3. Total flow if all homes are year round.

While all the remaining undeveloped lots in the District could potentially be developed, recent building trends suggest that the area is approaching what could be considered a functional build-out population. This is due to small existing lot sizes and geologic characteristics (wetlands, ledge, etc.) on many of the sites, resulting in considerable uncertainty about the ability to build on many of the vacant properties. As such, the design basis flow estimates used for this evaluation were calculated based on existing developed properties. The Town will need to decide whether or not currently unbuildable lots should be allowed to be developed if sewer service was provided, and modify the current zoning ordinances accordingly. If a decision to allow development of some or all currently undeveloped lots was made prior to implementing a District-wide wastewater management plan, the new system would be designed to accommodate the additional flow. Due to economy of scale, it is assumed that a larger capacity community wastewater treatment system would not result in any higher costs for an individual homeowner.

In order to evaluate potential treatment options, it is necessary to establish a design flow basis. As seen in Table 3-6 above, there are a variety of flow scenarios that could be considered. One relatively conservative approach would be to use the flow from all the "systems of concern" and assume that with adequate wastewater treatment all of these properties could eventually become year round residences. This approach would likely provide an overly conservative flow for all the known properties of concern. The conservative flow could likely accommodate other developed or undeveloped lots, especially since not all the seasonal properties would likely convert to year-round use. Therefore, at this time the evaluation of alternative wastewater treatment technologies is based on a design flow basis of 55,000 gallons per day.

3.3.3 Treatment System Siting

Wright-Pierce conducted a preliminary assessment of overall land requirements needed to provide wastewater effluent disposal for a community-sized system. We considered loading rates of 1.0 gpd/sf (for soils with 10 to 20 min/in perc rates) and 3.0 gpd/sf (for soils with less than 5 min/in), for standard subsurface leaching beds. For a design flow of 55,000 gpd, the minimum parcel size ranges from 0.6 acres to 1.8 acres, assuming that a 25% reserve area is provided. If a 50% reserve area is provided, the minimum parcel size is 0.7 to 2.2 acres. The land needs for a 55,000-gpd modular treatment plant would be another 0.5 to 1.0 acres. Therefore, for this study, we assumed a parcel of land approximately 3-acres in size would be adequate. The preliminary costs provided in Section 3.3.7 assume that such a parcel of land with adequate soils can be found and purchased within approximately one mile of the District.

3.3.4 Required Infrastructure

The installation of a community wastewater treatment system would require installing sewers in the area of the homes to be served by the community system. At a minimum, it is recommended that all homes on both sides of Deepwood Drive and Sunset Road be sewered, due to their proximity to Amston Lake. In addition, sewering areas where small lots with prevalent outcroppings of ledge rock (such as Ledge Road) and other "properties of concern" would likely further protect the water quality of both Amston Lake as well as local drinking water wells.

Due to the difference in elevations between Deepwood Drive and many houses directly adjacent to the lake, the installation of a low pressure sewer system may be the most feasible option. Within a low pressure sewer system, each residence has a small grinder pump station buried on its property, typically in close proximity to either the house or the existing septic tank. Note that although these grinder pumps would require maintenance, the level needed is much less than that required for an individual I/A system. Wastewater from each home would flow from the building into the grinder station, where it is periodically pumped into a low pressure sewer main, typically 2 to 4 inches in diameter. Since the entire sewer main is under pressure (as supplied by the pumps) the main may be constructed to match the existing roadway topography and only needs to be as deep as the seasonal frost line. This contrasts with conventional gravity sewers which may need to be buried up to twenty feet deep in order to maintain a constant pitch through the varying roadway elevation profile. As such, the installation of a low pressure sewer main in an application such as this would typically be considerably less costly than a gravity sewer. It should be noted that given the seasonal nature of the District, flow variations within the sewer itself could be an issue, particularly on "dead-end" lines. Solid deposition and odor build-up could result in these locations. Therefore, if low pressure sewer mains were installed, it would be prudent to include access points for flushing the line.

As an alternative, conventional gravity sewers could be installed, with grinder pumps required only at locations were the elevation prohibits the installation of a conventional gravity sewer connection (such as those homes located below the elevation of Deepwood Drive). Due to changes in elevation along Deepwood Drive, intermediary pump stations would likely be required. Additionally, a larger main pump station would be required at the main collection point to convey the wastewater to the community treatment plant. While gravity sewers have lower maintenance issues for a homeowner to deal with, the intermediary pump stations would add significant cost, including initial capital costs and annual operation and maintenance costs.

In addition to the actual treatment system, numerous appurtenances would be needed for the installation of a community wastewater treatment system. These appurtenances include an adequately sized building, access road, security measures, electricity, emergency power, telephone and water. Discussions with Connecticut Light and Power indicate that the District is currently serviced by single phase electricity. Single phase electrical service should be adequate for the treatment technologies considered for the given flow rates. However, should connection of all existing homes be desired, or if expansion of a treatment system was required due to increased development in the Amston Lake District, an infrastructure upgrade to provide three phase power to the site could be necessary.

Process and wash water would also be necessary at a community treatment facility. Although Birmingham Utilities could theoretically provide water to the system, potential sites for a community treatment system are beyond the current extent of the water mains, and installation of a new, year-round, main would be required. As a result, an on-site well would most likely be a less costly option for providing water at the site.

As with larger, centralized wastewater treatment facilities, the effluent from a community system can be directed to an open Class B watercourse such as a stream or river, in accordance with a discharge permit issued by the Connecticut DEP. Much of the Amston Lake District in Lebanon however, is within the drainage basin of Amston Lake. A direct discharge of treated effluent into Amston Lake would not be permitted by the DEP. A more feasible solution would be the use of a subsurface dispersal and infiltration system, similar to methods used with individual I/A systems, albeit greater in size. Due to the prevalence of ledge rock in the area, there are concerns as to where such a system could potentially be located. Therefore, a thorough hydrogeological survey of potential sites would need to be performed as part of the site selection process.

3.3.5 Regulatory Requirements

As with individual onsite I/A treatment systems, there are currently no state defined standards for the performance of community I/A systems. While design guidelines are available, treatment system approval is currently conducted on a site by site basis. Similarly, there is no current permitting process or state-approved technology in Connecticut. Other decentralized package plants in Connecticut have been issued discharge permits with fairly typical discharge limits, which are not based on actual receiving water quality limitations. As discussed in Section 3.2.2, it is anticipated that more defined treatment standards, a permitting process, and a list of approved technologies will ultimately be developed by either the state DEP or DPH. Until that time, the DEP has set up a series of steps that must be undertaken prior to the implementation of any I/A system. These are the same steps are summarized in Section 3.2.3, and in Section 3.3.6.

3.3.6 Management Issues

Management issues associated with the installation of a community I/A system are very similar to those needed for individual I/A systems. One noted difference is that the Town, through the formation of a Water Pollution Control Authority (WPCA), would be responsible for all operations and maintenance associated with a community I/A system. A contract operator could still be utilized to physically run and maintain the plant (instead of Lebanon Town staff), but the individual homeowners would not be involved in, or have responsibility for, any maintenance as they might be with individual systems. The WPCA would also be in charge of determining user fees; fees and funding are discussed in further detail in Section 4.2.2.

How this maintenance would be performed (be it licensed town personnel or contract operators) must be considered prior to the installation of such a system. Though these community-type treatment systems are typically highly automated, and do not require full-time operator presence, the level of operations and maintenance work associated with a community wastewater treatment system are comparable to that needed for a conventional, larger-scale, municipal wastewater treatment plant. Frequent, perhaps daily, inspections and water quality sampling would be required to ensure general compliance with a discharge permit. Critical system components such as pumps, blowers, piping, filters and disinfection units must be regularly inspected, cleaned, and repaired or replaced as necessary. Though less of a concern than with individual I/A systems, the treatment system may still need to be "fed" to ensure adequate treatment levels are maintained during periods of reduced flows.

The exact number of staff required for a community treatment system would be dependent on whether the Town is providing oversight only or oversight and maintenance. We have estimated that the budgetary equivalent of approximately two to four people, would be needed on a part-time basis to oversee and manage these types of systems. This assumption is based on having a minimum of one additional person (Town or contract operator staff) perform the actual treatment system operation and maintenance, and a minimum of one additional part-time Town staff member to oversee and manager compliance with the permit(s).

3.3.7 Feasibility Level Cost Estimate

Costs for community I/A systems, including both capital and operation and maintenance costs, vary considerably. Preliminary costs for four different systems are summarized in Table 3-7 below. It is important to note that the costs shown in this table assume that adequate land for a community treatment system can be found within one mile of the Amston Lake District. Additionally, the capital and installation costs of the individual grinder stations associated with a low pressure sanitary sewer could be paid for either by the Town of Lebanon, or by the individual homeowners. Fees and funding are discussed in further detail in Section 4.2.2.

TABLE 3-7
COMMUNITY WASTEWATER TREATMENT SYSTEM
FEASIBILITY LEVEL COST ESTIMATE

	Modular FAST	Amphidrome	Lotus ActiveCell	Envirex-RBC
Treatment Facility				
Treatment System	$565,000	$540,000	$706,000	$750,000
Effluent Disposal	$2,200,000	$2,200,000	$2,200,000	$2,200,000
Land Purchase (3 acres)	$150,000	$150,000	$150,000	$150,000
Site Work	$170,000	$170,000	$170,000	$170,000
Wastewater Collection System				
Gravity Sewer	$8,145,000	$8,145,000	$8,145,000	$8,145,000
Low Pressure Sewer	$2,905,000	$2,905,000	$2,905,000	$2,905,000
Engineering Services (15%)	$900,000	$895,000	$920,000	$925,000
Contingency (25%)	$1,500,000	$1,495,000	$1,535,000	$1,545,000
Legal & Administration (2%)	$120,000	$120,000	$125,000	$125,000
Total Capital Cost[1]	$8,505,000	$8,470,000	$8,705,000	$8,770,000
Annualized Capital Cost[2]	$520,000	$520,000	$530,000	$540,000
Annual Operating Costs				
Operation & Maintenance [3]	$78,000	$45,000	$52,000	$21,000
Electrical Costs	$12,000	$12,000	$12,000	$20,000
Additional Town Personnel	$52,000	$52,000	$52,000	$52,000
Total Operating Costs	$142,000	$109,000	$116,000	$93,000
Total Annual Costs	$662,000	$627,000	$648,000	$629,000
Annual Cost Per Property[4]	$3,390	$3,210	$3,320	$3,230

1. Includes installation costs of low pressure sewer.
2. Capital cost annualized at 2% interest over 20 years. Assumes no grant awarded.
3. Based on typical contract operations cost of approx. $100/hour.
4. Based on 195 properties of concern.

As discussed in Section 3.3.2 above, the treatment plant cost estimates are representative for a treatment system required to treat an average of approximately 55,000 gpd of wastewater, which is the average flow produced during the summer season from all the 195 properties containing "systems of concern". These technologies may be installed in such a manner as to provide both redundancy in the event of equipment failure, as well permit the treatment system to handle the wide ranges of flow to be expected in a largely seasonal community. The significant cost associated with effluent disposal should be noted. This is due to the fact that since there appear to be no watercourses capable of accepting discharged effluent from the treatment system, a subsurface dispersal and infiltration system would need to be installed. The cost of such an infiltration system appears to result in an overall capital cost which would not compare favorably to other wastewater management alternatives.

3.4 CONNECTION TO EXISTING SEWER

3.4.1 Wastewater Flows

According to the July 2005 Draft Wastewater Facilities Plan for the Colchester-East Hampton Joint Facilities, prepared by Earth Tech of Glastonbury, Connecticut, the Colchester-East Hampton Joint Facilities collection system and wastewater treatment plant currently serves the towns of East Hampton, Colchester, and Hebron, and has also been sized to include flows from the Amston Lake area of Lebanon, as well as portions of East Haddam, Marlborough, and Portland. The treatment plant currently receives an average flow of 1.39 million gallons per day (mgd), considerably below the NPDES permitted design capacity of 3.9 mgd. According to the facilities plan, and confirmed by Colchester-East Hampton Joint Facilities staff, the collection system and treatment facility has been sized to accommodate the installation of sewers for 125 homes along both sides of Deepwood Drive. A future flow of 24,800 gallons per day (gpd) has been determined based on an average of 2.83 people per household (2000 Census data) and a water usage of 70 gallons per capita per day. However, discussions with the DEP indicate that if installing sewers was found to be the most appropriate solution for a larger portion of the Amston Lake area, the Colchester-East Hampton facility could accommodate more flow from the Lebanon side of Amston Lake than indicated.

Based on the three scenarios developed in Section 3.3.1, the average wastewater flow originating from the Lebanon side of the District would range from 27,800 gpd to 69,700 gpd. Note that as stated previously, the Town of Lebanon and Amston Lake District would need to decide on whether to allow currently "unbuildable" vacant lots to be developed if a new wastewater system was provided. Therefore, while these additional flows are theoretically possible, this report is based only upon costs associated with providing wastewater upgrades to the existing homes. It is assumed that due to economies of scale, that the costs to accommodate additional development would result in a slightly lower capital cost contribution per additional homeowner.

If homes in the Amston Lake District were connected to the Colchester-East Hampton Joint Facilities collection system, the recommended connection point would be at an 8-inch diameter gravity sewer located on Deepwood Drive at the Lebanon/Hebron town line. This section of sewer was installed when Hebron sewered their side of Amston Lake and was left in anticipation of the eventual sewering of the Amston Lake area in Lebanon. A pump station - the Amston Lake Pump Station - was installed as part of this project and was designed with the anticipation of eventually receiving wastewater flows from Lebanon, having a design peak pumping rate of 130 gpm. Hebron Town personnel report that the pump station currently pumps a daily average flow of approximately 46,000 gpd. Therefore, there may be sufficient capacity to handle all of the flow from the currently developed properties on the Lebanon side of the Lake. However, this system may not have sufficient capacity to handle flows from all the developed properties on the Lebanon side of the lake without installation of larger capacity pumps and/or a larger wetwell. This issue would need to be further investigated as part of a preliminary design process. Wastewater flows from the Lebanon side would be via intermediate pump stations, and by gravity, to the Amston Lake Pump Station, located on Deepwood Drive in Hebron. From this pump station, all wastewater flow would be pumped into the Hebron and Colchester wastewater collection systems, and ultimately to the treatment plant in East Hampton.

3.4.2 Required Infrastructure

The infrastructure required for connecting to the existing sanitary sewer system in Hebron would be very similar to that required for the installation of a community wastewater system. As with the community system, at a minimum, it is recommended that all homes on both sides of

Deepwood Drive and Sunset Road be sewered due to their proximity to Amston Lake. In addition, providing sewers in those areas where small lots with prevalent outcroppings of ledge rock (such as Ledge Road) or other "properties of concern" would likely further protect the water quality of both Amston Lake as well as local drinking water wells.

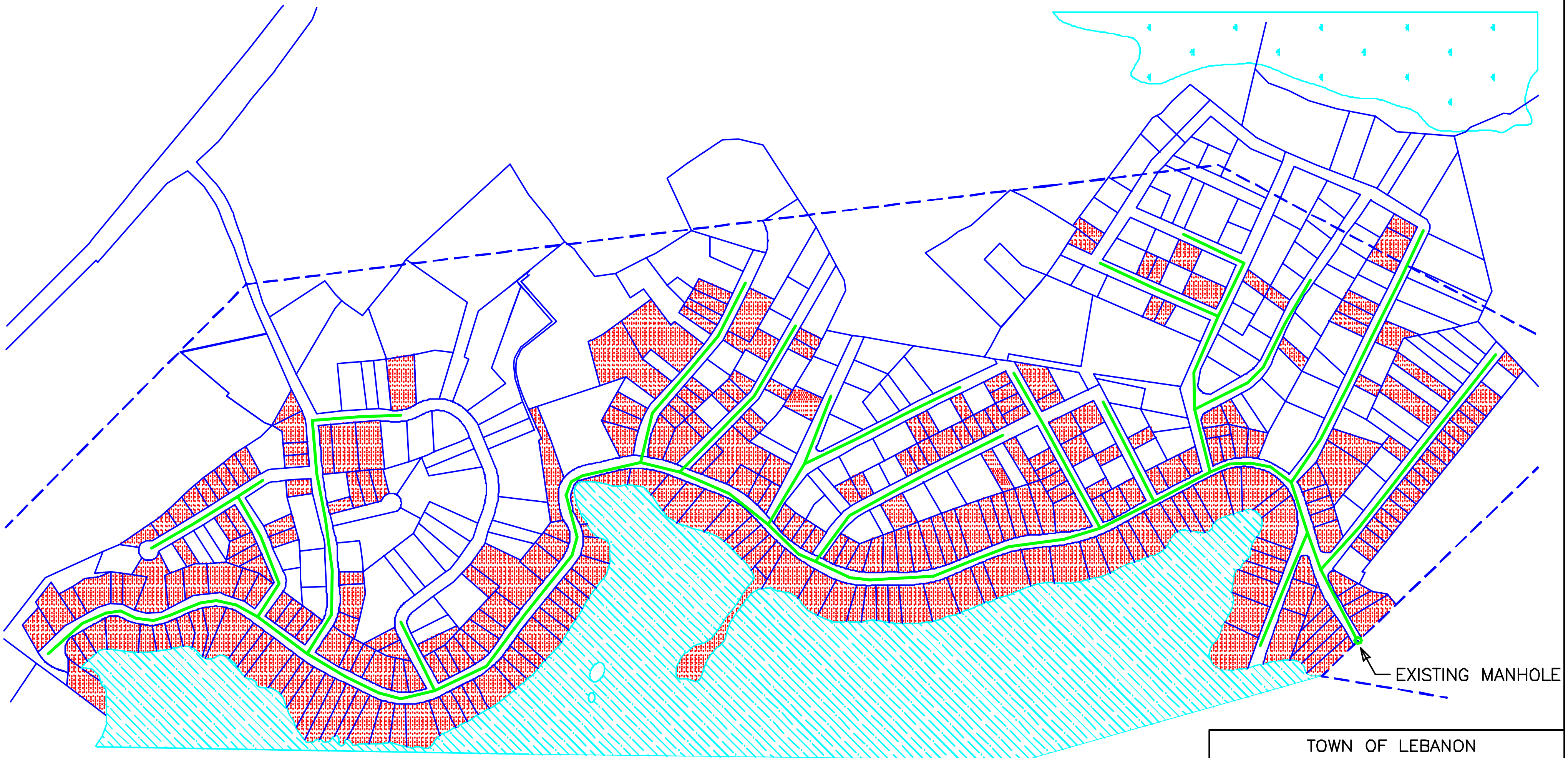
As with the community system, either a low pressure system or conventional gravity system can be used to connect houses to the existing sanitary sewer system. Additionally, the pros and cons associated with the installation of either system are similar. Potential layouts for a low pressure or gravity system are shown on Figure 3-6. Regardless of which type of sewer system is installed, it would ultimately discharge to the existing sanitary manhole near the Hebron town line, on Deepwood Drive.

One potential additional capital cost associated with connecting to the existing sanitary sewer system involves needed upgrades to the existing pump station. While this pump station is fairly new, discussions with Hebron personnel were not conclusive as to the actual capacity of the existing pumps. Therefore, the existing pumps may need to be replaced with larger capacity pumps to accommodate flows from Lebanon.

3.4.3 Regulatory Requirements

Since some of the roads that would be sewered, and many of the necessary individual grinder stations, would be within 100 feet of Amston Lake, a local Inland Wetland permit would be needed for any sewer installation (gravity or low pressure). Other local permits that would likely be necessary are street opening permits and building permits. Since there would be excavation within public roads in Colchester and Hebron, both of those towns would also need to be contacted for any Inland Wetland or street opening permits, or any other applicable permitting. Additionally, the installation of any sewers will require that the Town coordinate with the State of Connecticut's Office of Policy and Management (OPM).

The OPM, in coordination with local planning and zoning departments, determine a Town's Conservation and Development Policies Plan. This Plan designates portions of the community in a variety of ways, from a "Regional Center" or "Growth Area" to a "Conservation Area".



TOWN OF LEBANON
AMSTON LAKE DISTRICT
PRELIMINARY SEWER LAYOUT

PROJ NO: 10840A	Wright–Pierce		FIGURE: 3–6
DATE: JUN 2007			
SCALE: NTS			

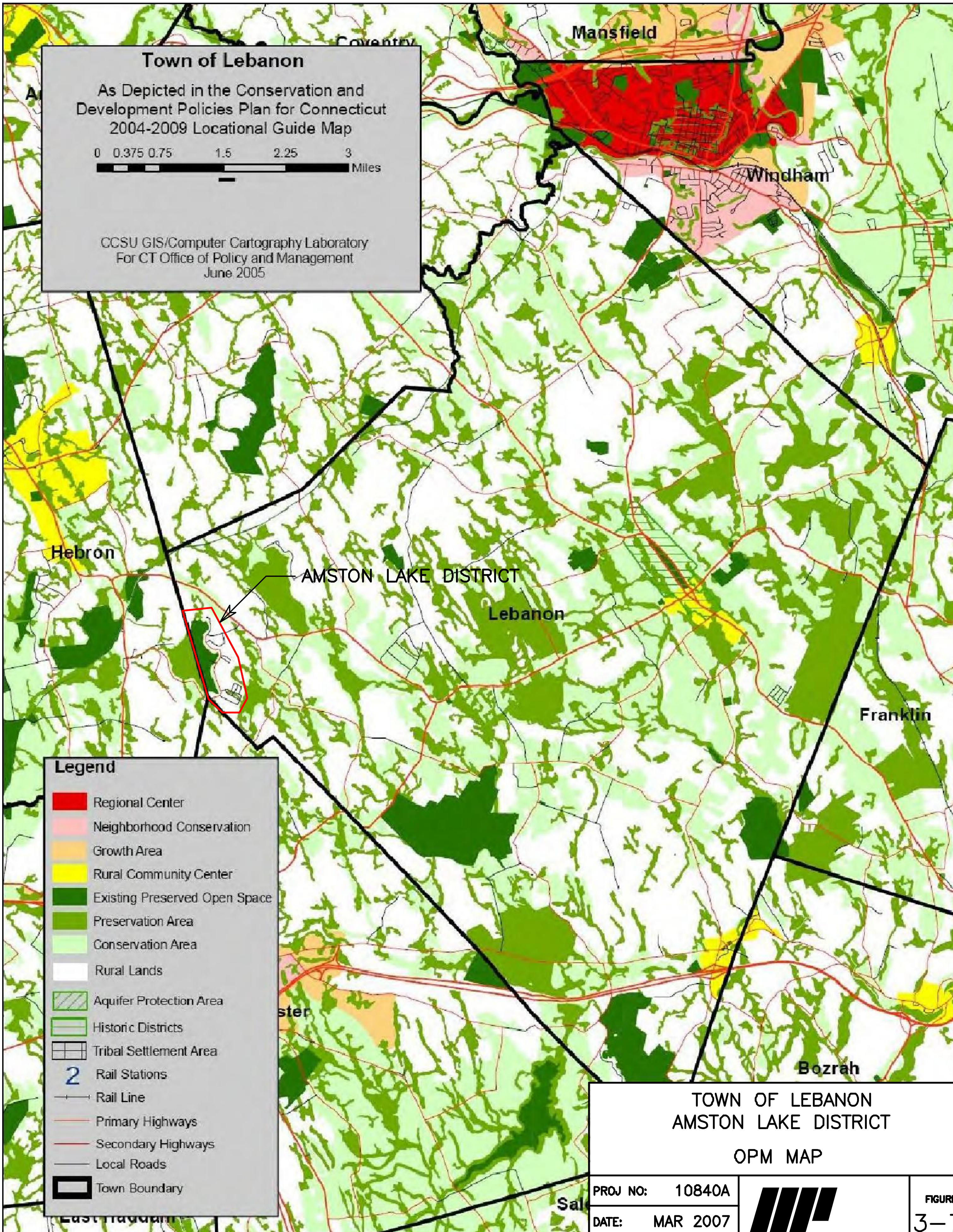
Typically, if a municipality chooses to install sewers outside the Regional Center or Growth Area, no Clean Water Fund monies will be made available to that municipality. Figure 3-7 shows the Conservation and Development Policies Plan Locational Guide Map for Lebanon.

Note that there are no Regional Centers or Growth Areas with Lebanon. However, if sewers are being proposed as a remedy to a community pollution problem, then it should be possible to qualify for CWF funding, even if the construction is inconsistent with the OPM map. This situation would be considered a "community pollution" problem, and as such the OPM map would not need to be changed, provided that sewer service is not offered to properties outside the immediate Amston Lake area.

3.4.4 Management Issues

While management issues associated with the oversight of sanitary sewers is less complex than the installation of I/A systems, there are still several items that must be considered and addressed prior to the construction of a sanitary sewer within Lebanon. A local WPCA would need to be created to oversee the implementation of any sewer plan. This WPCA would also be tasked with operating the sewer, either through oversight of Town personnel, one of the other town's WPCA's, or by contract operators. Determination of user fees would also fall under the jurisdiction of the WPCA. Fees and funding are discussed in further detail in Section 4.2.2.

If Lebanon were to connect to the existing sanitary sewer manhole on Deepwood Drive in Hebron, the sewage would eventually discharge to the East Hampton - Colchester Joint Facility, located in East Hampton. The Town of Lebanon would need to enter into inter-municipal agreements with the Town of Hebron to accept these wastewater flows, and with the East Hampton-Colchester Joint Facilities to provide treatment of the wastewater. This agreement would establish discharge parameters as well as the basis for user fees and connection fees. Additionally, a small portion of the collection system would pass through the Town of Colchester along Deepwood drive prior to discharging into the Hebron collection system. It would therefore also be necessary for the Town of Lebanon to obtain from the Town of Colchester an easement to maintain and operate this section of sewer. It is currently uncertain



TOWN OF LEBANON
AMSTON LAKE DISTRICT

OPM MAP

PROJ NO:	10840A	Wright–Pierce	FIGURE: 3–7
DATE:	MAR 2007		
SCALE:	NTS		

whether a formal inter-municipal agreement would be needed for Lebanon's flow to pass through the Colchester collection system.

3.4.5 Feasibility Level Cost Estimate

Table 3-8 summarizes preliminary costs associated with the construction of a sanitary sewer system in the District. Costs are provided for a gravity type sewer and a low pressure sewer.

TABLE 3-8
CONNECTION TO EXISTING SANITARY SEWER
FEASIBILITY LEVEL COST ESTIMATE[1]

	Gravity Sewer	Low Pressure Sewer
Capital Costs		
Sanitary Sewer	$3,960,000	$1,190,000
Pump Station	$3,000,000	-
Grinder Pumps	-	$685,000
Service Laterals	$300,000	$150,000
Landscaping	$15,000	$15,000
Roadway Reconstruction	$870,000	$870,000
Engineering Services (15%)	$1,210,000	$435,000
Contingency (25%)	$2,035,000	$725,000
Legal & Admin. (2%)	$160,000	$60,000
Total Capital Cost	$11,565,000	$4,125,000
Annualized Capital Cost[1]	$705,000	$250,000
Annualized Cost w/ 25% Grant[1]	$530,000	$189,000
Annual Operating Costs		
User Fee[2]	$46,000	$46,000
Additional Town Personnel[3]	$52,000	$52,000
Total Operating Cost	$98,000	$98,000
Total Annual Cost	$805,000	$350,000
Annual Cost w/ 20% Grant	$628,000	$287,000

1. Annualized at 2% interest over 20 years
2. Based on $2.30/1,000 gallons at an average flow of 55,000 gpd; subject to change.
3. Assumes hiring additional Town personnel, or an allowance for contract operation.

It should be noted that the capital and installation costs of the individual grinder stations associated with a low pressure sanitary sewer may be paid for either by the Town of Lebanon, or by the individual homeowners. The capital cost of the individual grinder stations may be included in a Clean Water fund grant, provided that the responsibility for their maintenance is taken up by the Town.

Annual operations costs include a user fee which would need to be paid to the Town of Hebron as the municipality accepting the wastewater flows from Amston Lake. This user fee is based upon the $2.30 per 1,000 gallons of wastewater paid by Hebron to the Town of East Hampton, which ultimately accepts and treats the sewage. This charge would be based upon the total flow sent to the Hebron collection system and is subject to change on a yearly basis.

The existing wastewater collection system on the Hebron side of Amston Lake was constructed with the expectation that the Lebanon side of the Amston Lake District would eventually be sewered, and as such sewers and pump stations were sized to accept this estimated flow. Upon connection to the Hebron sewer system, the Town of Lebanon would be required to pay a connection fee to reimburse the Town of Hebron for providing this infrastructure. The terms and amount of this connection fee would be determined during the negotiation of the above mentioned inter-municipal agreement between the two towns and is not included in the cost estimate at this time.

Section 4

SECTION 4

RECOMMENDED WASTEWATER MANAGEMENT PLAN

4.1 SUMMARY OF WASTEWATER MANAGEMENT ALTERNATIVES

There are several approaches that Lebanon can take to address the DEP's Abatement Order. While none of the alternatives discussed herein is an obvious "best choice", based on environmental benefits, costs and the level of management necessary for each of the options, Wright-Pierce recommends that a phased sewer installation program be implemented. The conclusions regarding the evaluation of each wastewater management alternative are summarized below.

4.1.1 Conventional Upgrades

Compared to the other wastewater management options considered, a district-wide conventional upgrade for each individual subsurface wastewater treatment and disposal system has only a minimal operations cost, entirely comprised of town permitting and oversight. As such, an upgrade program can be seen as the most cost-effective option. However, it is also unlikely that the DEP would approve of conventional upgrades to all the existing systems along Deepwood Drive, due to their proximity to Amston Lake, and because a conventional upgrade would do little to eliminate the nutrient inflow to Amston Lake. Small lot sizes prevalent in the District also limit the feasibility of constructing conventional treatment systems to the standards established in the public health code. Additionally, even with the best site conditions, conventional upgrades can still have a limited life and over time these systems may need replacing. Furthermore, while any option implemented will require financial input from the property owners, the entire cost of conventional subsurface system upgrades is typically borne by the homeowner. Although the Town could provide some funding assistance for such upgrades, it is possible that such a move would not be viewed favorably from the rest of Lebanon. Therefore based on the uncertain long term environmental benefits and costs, a District wide upgrade to the existing systems is not recommended.

4.1.2 Individual I/A Systems

The installation of individual I/A systems is another approach that Lebanon could implement to address the degrading water quality of Amston Lake. The DEP's acceptance of this approach in Old Saybrook would seem to indicate that a similar approach in Lebanon may also be acceptable. However, the Town would need to consider the level of management that would be necessary if such an approach is undertaken, particularly since 70% of the homes in the Lebanon side of the District are seasonal. The DEP has made it clear that the Town, not the individual homeowner, will ultimately be responsible for ensuring these systems are functioning and maintained correctly. The Town, either through its own staff or by contract with certified operators, would be responsible for managing and maintenance of a significant number of individual systems. While this is not an insurmountable task, it is one that will most likely require additional town resources to properly implement. From an annual cost-based perspective, the implementation of a District-wide individual I/A treatment program does not compare favorably to other options. If wastewater treatment within the District is desired, economy of scale dictates that the construction of a community wastewater treatment facility would be a more economically feasible option.

4.1.3 Community Treatment System

From a technical standpoint, the installation of a community treatment system to serve the Amston Lake District is more feasible than the installation of individual I/A systems. In fact, due to economy of scale most equipment vendors recommend that if a community-wide wastewater treatment program was to be implemented, a community system would easily be the preferable choice over individual treatment units. However, when including the cost for the necessary sewer system, as well as a subsurface effluent disposal system, the community treatment system is in fact more costly. From a financial perspective, it is the most costly option considered. Additionally, this option would require many of the management issues that the installation of individual I/A systems would incur, albeit at a larger scale.

4.1.4 Low-Pressure Sewer

Installation of a low pressure sanitary sewer with a connection to the existing Hebron wastewater collection system appears to be the least expensive approach that would allow Lebanon to properly implement a successful wastewater management program in the Amston Lake area, as well as comply with the DEP's Abatement Order. While there are a variety of land use issues surrounding the installation of sanitary sewers, most notably the concern that uncontrolled growth could result following installation, there are methods by which this concern can be addressed. A discussion of these methods can be found in Section 4.2.1.

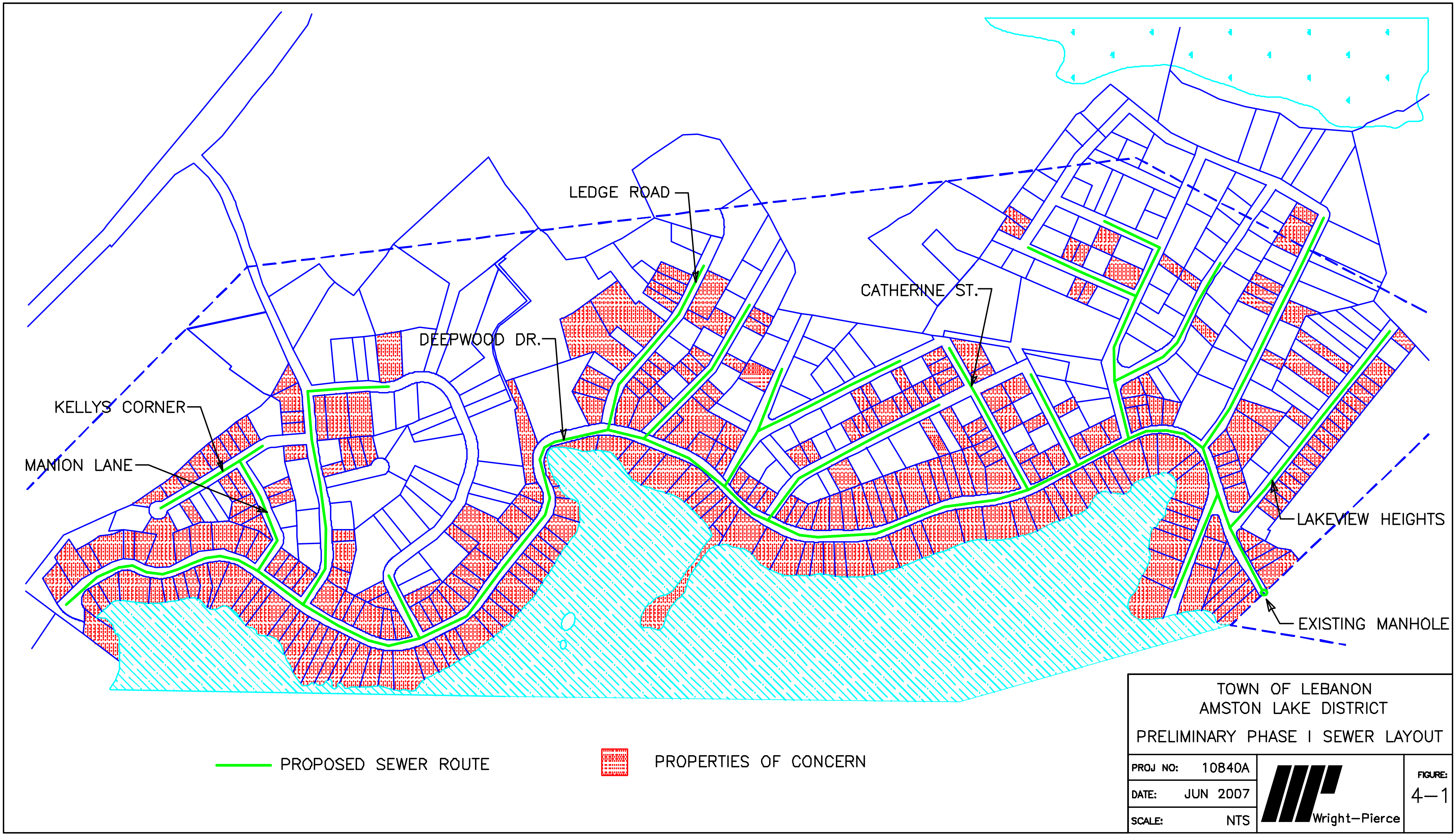
Another concern often sited when sanitary sewers are proposed is the environmental effects of taking water out of its watershed of origin. While this would occur, the wastewater flows represent a relatively small percentage of the water flows within the Amston Lake drainage basin. Furthermore, as Amston Lake is a dam-controlled impoundment, the concerns of inter-basin transfer are not as significant as in the case of a natural water body. The environmental benefits to Amston Lake gained by reduced nutrient inflow should offset any detrimental effect. Additionally, if the installation of sanitary sewers were tightly limited in area and phased in, both of these concerns can be addressed.

Initially, a low pressure sewer could be installed along Deepwood Drive, Lakeview Heights, Catherine Street, Ledge Road, Kelly's Corner and Manion Lane; see Figure 4-1. Installation of sewers on these roads would address many of the homes that have been identified as "Properties of Concern" while reducing the initial capital cost. Additional sewers could be extended to the remaining "Properties of Concern" as needed. Alternatively, the remaining "Properties of Concern" (and any undeveloped lots) could be required to manage their wastewater through conventional upgrades or individual I/A systems.

4.2 OTHER CONSIDERATIONS

4.2.1 Smart Growth

Quite often when wastewater upgrades are suggested within an unsewered community, concerns regarding uncontrolled growth, or "sprawl", are cited as a reason to not install sewers or other


LEDGE ROAD
CATHERINE ST.
DEEPWOOD DR.
KELLYS CORNER
MANION LANE
LAKEVIEW HEIGHTS
EXISTING MANHOLE
PROPOSED SEWER ROUTE
PROPERTIES OF CONCERN
TOWN OF LEBANON
AMSTON LAKE DISTRICT
PRELIMINARY PHASE I SEWER LAYOUT
PROJ NO: 10840A
DATE: JUN 2007
SCALE: NTS
Wright-Pierce
FIGURE: 4-1

wastewater management infrastructure. While there are numerous cases where such growth did occur, uncontrolled growth is not necessarily a byproduct of wastewater management. Within Connecticut, as well as throughout New England, communities have addressed this potential problem in successful ways. According to the DEP, there are several examples where communities have been able to address similar environmental problems while curbing unwanted growth through strengthening of local land use controls.

Local land use regulations can be strengthened through several avenues. The Town may opt to limit sewer access to only those homes that are currently developed and to maintain the current occupancy restrictions on seasonal residences. The Town currently permits the construction of seasonal-only residences on lots which fail to meet the 2-acre area zoning requirement for year-round residences. In conjunction with this approach, the Town could create a wastewater district with strict boundaries, limiting which lots may connect to a sewer. Another option that could be done in lieu of, or in connection with, this approach would be to revise the local Zoning Regulations, restricting the size and height of homes that are constructed within the District, or limit the number of properties which may be developed in the area. Additional restrictions can also be included in the yet to be created WPCA regulations. The critical item common to each of these approaches is the consultation of an attorney with successful experience in these matters. Implementation of zoning restrictions or other land use controls prior to the start of any actual construction is critical. Keeping these two important issues in mind, uncontrolled residential growth can be greatly reduced.

4.2.2 Funding

Typically the cost of a conventional septic system upgrade is the responsibility of the individual homeowner. Costs associated with an individual I/A system would also typically fall to the homeowner. However, in the case of Amston Lake, individual I/A systems may be eligible for Clean Water Funding if the are seen as an approved, cost effective, wastewater management solution by the DEP. Since a WPCA would need to be created to support the required municipal oversight for any I/A system installations, an assessment/user fee program could also theoretically be established to assist homeowners with the costs. Although a community I/A system or sanitary sewer connection would typically be paid for by the Town (up to each property line), the homeowners who benefit from such construction would be charged an assessment and/or user fee. It should be noted that any assessment charged to the homeowner can not exceed the actual benefit received from the sewer; a dollar figure associated with this benefit is often determined by the Town Assessor.

There are a variety of funding sources that the Town of Lebanon could consider and pursue for the design and construction of the chosen alternative, including:

- Clean Water Fund
- U.S. Department of Agriculture Rural Development
- Department of Economic Community Development
- State and Tribal Assistance Grants
- Small Town Economic Assistance Program

A brief discussion of each of these programs is provided below. Note that there may also be other funding programs available for this type of project that we are not aware of at this time.

4.2.2.1 Clean Water Fund

The State of Connecticut has an environmental infrastructure assistance program, known as the Clean Water Fund (CWF). The CWF provides monies in the form of grants and loans to municipalities for wastewater collection and treatment projects. Generally, qualifying projects can receive grants for a portion of the total project costs, including design, and loans are granted for the remainder of the project costs. Within the CWF is a requirement that the construction of at least one small community wastewater project be financed every year; projects are evaluated for funding as they complete planning. Approved small community projects can theoretically receive a grant for as much as 25% of the project cost, with the reminder financed through a 20-year, 2% interest loan. However, small community sewer extension projects will more typically be listed on the loan-only priority list. Therefore, if a community is low on the primary priority list, they can choose to fund the project more quickly through loans only, eliminating potentially costly inflationary increases. In recent years, the level of funding available through the CWF has been minimal, due to under-funding by the State Legislature. Discussions with DEP personnel indicate that the level of funding for fiscal year 2008 - 2009 may increase such that Lebanon could be eligible to receive loan and grant monies for this project. Wright-Pierce has submitted to the DEP a preliminary CWF Application for this project in order to gain acceptance to the priority list as soon as possible.

4.2.2.2 USDA Rural Development

Another potential source of funding is the US Department of Agriculture's Rural Development program. Regional Rural Development offices nationwide determine the eligibility of communities for funding; projects such as this one are considered for funding through the Rural Utilities Service (RUS). Funding is typically provided in the form of a low interest loan, though the RUS will evaluate each project for the possible inclusion of grants. Grant eligibility is based on a community's mean income, as compared to the mean income of the entire state. For 2006, the State of Connecticut non-metropolitan median household income has been set at $60,751; Lebanon's median household income, at $61,173, just exceeds that level. However, if justified, it may be possible to perform a site specific income survey to determine if the actual median household income in the Amston Lake area is actually lower than the average Town income. This approach has been used successfully in other communities where it is believed that the actual income in the proposed sewer service area is lower than the State median income level. A similar effort might be successful for Amston Lake if it is believed that the median household income is less than $61,173. Additionally, if grant monies are not available due to excess income levels, Lebanon would still be eligible for a 4.5% loan that can be carried out for up to 40 years.

4.2.2.3 Department of Economic Community Development

The Department of Economic Community Development (DECD) provides Community Development Block Grants to municipalities, typically up to $500,000, on an annual basis. It is at times possible to qualify for several successive block grants over several years.

4.2.2.4 State and Tribal Assistance Grants

The State and Tribal Assistance Grant (STAG) is a direct appropriation of funds to a particular project by a U.S. Congressional Representative. Representative Joe Courtney would need to be contacted to determine the eligibility of this type of project.

4.2.2.5 Small Town Economic Assistance Program

The Small Town Economic Assistance Program (STEAP) can provide up to $500,000 per year in grant money for infrastructure projects to support "economic development, community conservations, and quality of life projects."

4.2.3 Stormwater Evaluation

As noted in Section 2.2.3, stormwater is likely an important component of the degrading water quality within Amston Lake. Although beyond the scope of this project, the Town or District should conduct a study of the Amston Lake watershed to confirm/identify those areas that are potentially contributing the most pollutants to the lake. Such a study should be also include identification of recommended Best Management Practices, such as detention basins, vegetative swales, natural buffer strips, and individual property landscaping plans, in order to mitigate the pollution impact of storm water runoff.

4.3 SELECTION OF WASTEWATER MANAGEMENT ALTERNATIVES

Table 4-1 summarizes the feasibility level costs and management issues associated with each of the wastewater management solutions discussed in this report. Note that the individual tables for different alternatives included in Section 3 show a range of costs. For ease of comparison, Table 4-1 shows approximate costs for providing wastewater management to the 195 "Properties of Concern", based upon the average cost for each option considered. The only exception is for connection to the existing sewer in Hebron. Due to the large difference in capital costs between gravity and low pressure collection systems, only low pressure sewers were further considered as a feasible wastewater management solution.

TABLE 4-1
SUMMARY OF FEASIBILITY LEVEL COST ESTIMATES[1]

	Conventional Upgrades	Individual I/A Systems	Community Wastewater Treatment Facility	Connection to Existing Sewer[2]
Capital Cost	$4,390,000	$4,140,000	$8,615,000	$4,125,000
Equivalent Cost Per Property	$22,500	$21,200	$44,200	$21,200
Annual Operating Cost	-	$228,000	$115,000	$98,000
Total Annual Cost[3]	$268,000	$503,000	$642,000	$350,000
Annual Cost per Property	$1,400	$2,600	$3,300	$1,800

1. Based on 195 "Properties of Concern".
2. Assuming installation of low pressure sewer.
3. Assumes capital costs annualized at 2% interest over 20 years.

Based on the above cost estimates, it can be seen that connection to the existing sewer in Hebron has the lowest capital costs. The capital cost of a community wastewater treatment system is the highest of the options considered. The reason for this is that a community treatment system would require almost exactly the same wastewater collection system as would be required to connect to the existing sewer, plus the cost of a wastewater treatment facility. Convention upgrades and replacement of septic systems has the lowest total annualized costs (due to the lack of any operations costs). However, due to reasons discussed in Section 3.1, conventional upgrades should not be considered as a District-wide solution to the existing wastewater management issues. Connection to the Hebron sewer has the next lowest total annual costs, and overall as appears to be the most technically and economically feasible option.

As such, it is recommended that the installation of a low-pressure wastewater collection system, with connection to the existing collection system at the Lebanon-Hebron border be implemented as a means of wastewater management for the Amston Lake District in Lebanon. This solution is less costly than the individual I/A or community systems considered, and would likely prove to be the option most acceptable to the Connecticut DEP, the Town of Lebanon, and the residents of the Amston Lake District in Lebanon. Note that once the DEP approves the implementation of this recommendation, it may become the required basis for final design.

Along with capital and operational cost considerations, the costs associated with creating an additional layer of Town management must be considered prior to the implementation of any wastewater management solution. Table 4-2 summarizes the different phases of wastewater management, along with the party responsible for each phase.

TABLE 4-2
SUMMARY OF MANAGEMENT ISSUES

Function	Conventional Upgrade	Individual I/A System	Community I/A System	Connection to Centralized System
Planning	Property Owner	Town / WPCA & State	Town / WPCA & State	Town / WPCA & State
Land Acquisition	Property Owner	Property Owner	Town / WPCA	Town / WPCA
Permitting	Property Owner	Town/WPCA & State	Town / WPCA & State	Town / WPCA
Design	Property Owner	Property Owner	Town / WPCA	Town / WPCA
Construction	Property Owner	Property Owner	Town / WPCA	Town / WPCA
Operation	Property Owner	Property Owner &/or Town / WPCA	Town / WPCA	Town / WPCA
Monitoring	Property Owner & Town / WPCA	Property Owner &/or Town / WPCA	Town / WPCA	Town / WPCA
Enforcement	Town & State	Town / WPCA & State	Town / WPCA & State	State
Funding	Property Owner	Property Owner &/or Town / WPCA	Town / WPCA	Town / WPCA
Typical Flows, gpd	< 1,000	250 to 5,000	1,000 to 30,000	varies

4.4 RECOMMENDED WASTEWATER MANAGEMENT PLAN

Based on the evaluations provided in this report, the recommended wastewater management plan for the Amston Lake community in Lebanon is as follows:

- **Provide a low-pressure wastewater collection system for Amston Lake** - This evaluation concludes that the existing subsurface wastewater treatment and disposal systems contain a significant potential to detrimentally affect the water quality of Amston Lake. The sewer system recommended in this report would serve the Amston Lake District in Lebanon, and discharge to the Hebron wastewater collection system, for ultimate treatment at the Colchester-East Hampton Joint Facilities wastewater treatment facility in the Town of East Hampton. The estimated capital cost of this sewer system, designed to accept wastewater flows from properties determined to contain the potential to negatively impact the water quality of Amston Lake is $4,125,000. The equivalent cost per property connected to the collection system (assuming connection of all 195 "Properties of Concern") would be approximately $21,200. The total annual cost of such a system, including annualized capital costs and an estimated total annual operations cost of $98,000, is estimated to be $350,000. Grants and low-interest loans from sources such as the Clean Water Fund (CWF), Rural Development and other sources may be available to assist in the funding of this project.

- **Conduct a stormwater management study for the Amston Lake Community** - While it is the conclusion of this report that the existing subsurface wastewater treatment and disposal systems at Amston Lake are, or contain the potential to, negatively affect the water quality of Amston Lake, it is likely that stormwater runoff from the same area is also contributing to the problem. A stormwater management study would determine stormwater flows to the lake, analyze the nutrient contribution to the lake from stormwater runoff, evaluate the condition and effectiveness of existing stormwater management practices, and develop recommended stormwater Best Management Practices (BMPs).

- **Evaluate existing zoning regulations** - Proper zoning and land-use regulations are critical to maintain environmentally sensitive features, such as Amston Lake. Preparation and enforcement of such regulations can be effective methods to protect Amston Lake, as well as manage growth. Since development and undesired growth is an important issue in the Amston Lake District, it is critical that an evaluation of any zoning changes be made prior to the implementation of any wastewater management plan. Situations to be evaluated should include seasonal versus year-round occupancy of both existing and future residences, minimal lot sizes for future development, redevelopment restrictions, and criteria for connection to the recommended wastewater collection system. While in some cases the installation of sewers can lead to uncontrolled growth, proper zoning can be used to prevent this problem.

- **Create a Water Pollution Control Authority** - A WPCA should be created to create sewer use laws and regulations and provide for their enforcement, negotiate inter-municipal agreements, and obtain funding to assist in the construction of the proposed collection system as well as other related capital improvement projects. Many of the decisions to be made in the implementation of a district-wide wastewater program, such as which properties may connect to the collection system, which properties must connect to the collection system, and the time table for doing so, will need to be determined by the WPCA.

4.4.1 Implementation Plan and Schedule

The detailed scheduling of any project such as this is critical to ensure its success. While deadlines can be adjusted as circumstances dictate, it is important at this point in the planning process to begin to formulate an implementation plan and schedule. A more detailed, schedule should be developed following review and approval of this study and identification of funding options. Table 4-3 below contains a preliminary implementation schedule outlining some critical project benchmarks as well as proposed completion dates. The intent of this preliminary schedule is to illustrate that it can take several years to design and construct a system after initial approvals to proceed.

TABLE 4-3

REVISED PRELIMINARY IMPLEMENTATION SCHEDULE

Action	Proposed Deadline
Town Approval of Wastewater Management Plan	November 2007
DEP Approval of Management Plan	September 2008
Creation of Water Pollution Control Authority	August 2008
Identify Viable Funding Options	December 2008
Begin Preliminary Low-Pressure Sewer Design	March 2009
P&Z Review and revise Zoning Regulation (to limit Uncontrolled growth)	June 2009
Begin Final Low-Pressure Sewer Design	May 2009
Complete Bid Package for Low-Pressure Sewer	Winter 2009
Begin Construction	Spring 2010
Substantial Completion	Spring 2011

As discussed throughout this report, there are a variety of issues that will need to be addressed in order to implement a wastewater management plan for Amston Lake. So as to proceed with a "focused" effort, it is recommended that Lebanon consider forming an official committee that would report to the Board of Selectmen and other appropriate Town boards, such as the Finance Board. A listing of items that such a committee would need to consider includes:

- Review and approval of this draft wastewater management study prior to submittal to the DEP for approval;
- Formation of a Water Pollution Control Authority (WPCA) and development of associated sewer use regulations;
- Consideration of possible project funding scenarios (capital and operational);
- Formal application to the DEP Clean Water Fund (CWF) or other funding sources;
- Consideration of changes to current zoning requirements;
- Consideration of possible project connection scenarios, such as:
    - Town construction of low pressure sewer with laterals terminating at the property line; subsequent sewer hook-ups and individual grinder pump installations would be the responsibility of the homeowners; or

    - Town installation or sewer, pumps and complete laterals with sewer assessment adjusted as necessary.
- Consideration of schedule requirements for individual property connection to sewer;
- Negotiations with the Hebron and the Colchester-East Hampton Joint Facilities to establish inter-municipal agreements;
- Coordination of design, permitting, and construction process; and
- Consideration of system operation and maintenance alternatives.

APPENDIX A
1986 Connecticut DEP Abatement Order

STATE OF CONNECTICUT
VS
TOWN OF LEBANON

IN THE MATTER OF AN ORDER TO THE TOWN OF LEBANON TO ABATE POLLUTION

ORDER

Having found that the Town of Lebanon is a municipality in which a community pollution problem can reasonably be anticipated to occur in the future,under the provisions of Chapter 446k of the Connecticut General statutes as amended, the Commissioner of Environmental Protection acting under Sections 22a-6, 22a-424, and 22a-428 , hereby Orders the Town of Lebanon to take such action as is necessary to:

(1) Prepare an engineering study of the Amston Lake area to evaluate the existing and future wastewater disposal needs of the area.

(2) Implement the approved recommendations of the study prepared in (1), above.

The Town of Lebanon is further Ordered to accomplish the above described program, except as may be revised by the recommendations of detailed engineering study and agreed to by the Commissioner of Environmental Protection in accordance with the following schedule:

A. On or before January 31, 1987 verify to the Commissioner of Environmental Protection that a professional engineer licensed to practice in Connecticut has been retained to perform the requirements of directive No. 1.

B. On or before March 31, 1987 submit for the review and approval of the Commissioner of Environmental Protection an outline of the tasks that will be completed to meet the requirements of directive No. 1.

C. On or before July 31, 1987 submit for the review and approval of the Commissioner of Environmental Protection an engineering report to meet the requirements of directive 1. Such report shall include a current detailed cost estimate of any required construction work, and a schedule for implementation.

APPENDIX D
Treatment Technologies Cut Sheets

U.S. Environmental Protection Agency

EPA New England's Center for Environmental Industry and Technology (CEIT)

Serving Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont & Tribal Nations

Recent Additions | Contact Us | Print Version Search: GO

EPA Home > EPA New England > Water > Wastewater > CEIT Show: Wastewater > Bioclere

EPA NE Home
A-Z Index

CEIT Home
CEIT Virtual Show Home
Wastewater
Introduction
History
Virtual Wastewater Trade Show
Regulations / Permitting in New England
Background Info
Links to Other Sources of Info
Technologies
Important Information

Storm Water Virtual Trade Show

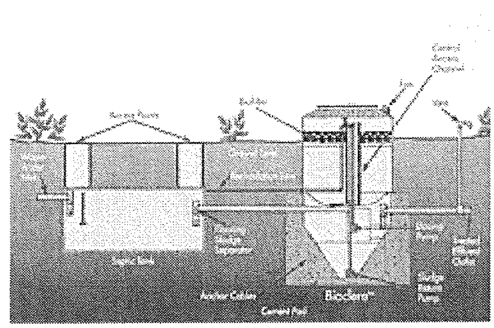
Innovative Technology Inventory

Wastewater Virtual Trade Show Bioclere

--- Select a Company/Technology ---

Narrative Description

The **Bioclere** is a modified trickling filter over a clarifier designed to provide secondary treatment and nitrification for waste streams with intermittent flows and varying strengths of waste in climates with seasonal temperature variations. The combination of its natural fixed film process and its capacity for internal and external recirculation makes the **Bioclere** a resilient, versatile and competitive treatment system. The ability of the biological film to self-regulate variations in hydraulic and organic loading as well as environmental variations such as temperature, pH, and process inhibitors is widely acknowledged.



The Bioclere is modular, and may be installed in parallel to accommodate larger flows, or in series to achieve higher levels of treatment. Typical installations range from 300 to 100,000 gallons per day.

The **Bioclere** has been --

- National Sanitation Foundation (NSF) Certified under Standard 40,
- Formally reviewed under an Advisory Letter from the New England Interstate Water Pollution Control Commission (NEIWPCC),
- Permitted under the Ten State Standards for trickling filters,
- Accepted under a Memorandum of Understanding for technology transfers agreed to by California, Illinois, Massachusetts, New Jersey, New York and Pennsylvania.

The **Bioclere** has been installed or approved in twenty US states and in Canada. Many states allow variances in design requirements for soil disposal fields based on a level of treatment equivalent to recirculating sand filters.

Importa

Criteria
The criter
environm
site are d
instructio

Verificat
The techr
containec
but not li
technoloc
performa
and costs
directly b
attempt v
screen or
technoloc
Therefore
the accur
any disclc
performa
provided
used by E

Complia
EPA has r
statemen
pertaining
federal, s
standards
requirem

Endorse
The inclu
their proc
does not
endorsem
by the EP

Keeping
Vendors a
keeping t
date.

General Description: The trickling filter is a well-known treatment process in which microorganisms attach themselves to a highly permeable media, creating a biological filter or slime layer. Loading rates for the **Bioclere** for both BOD removal and nitrification conform to well-known standards for trickling filters.

In the **Bioclere** the biofilter is enclosed and insulated. Hydraulic dosing and sludge return pumps are set at pre-determined rates, minimizing maintenance and enhancing treatment. Oxygen is introduced to the system through a fan in the **Bioclere** housing and is exhausted through a vent that is usually located in the discharge line.

The **Bioclere** is a passive gravity flow treatment system installed in line between the primary tank and distribution box. The **Bioclere** neither intrudes on nor adversely affects the flow of a conventional on-site system. Electrical outages do not inhibit flow, and dilution factors within the system minimize the impact of a short-term power failure on effluent quality.

The **Bioclere**'s fixed film process and hydraulic capacity minimize the impact of organic and hydraulic fluctuations on the treatment process and effluent quality. Generally, **Bioclere** installations do not require flow equalization prior to treatment.

Process Flow: Wastewater flows from the primary settling tank (septic tank), into a baffled chamber in the clarifier of the **Bioclere**. Dosing pumps located in this baffled chamber distribute the wastewater over the filter media. In the trickling filter, the organic material in the wastewater is reduced by a population of microorganisms, which attach to the filter media and form a biological slime layer. In the outer portion of the slime layer, treatment is accomplished by aerobic microorganisms. As the microorganisms multiply, the biological film thickens and diffused oxygen and organic substrate are consumed before penetrating the full depth of the slime layer. Consequently, the biological film develops aerobic, anoxic, and anaerobic zones.

Periodically, the microorganisms in the anaerobic zone near the media surface lose their ability to cling to the media due to the lack of sufficient oxygen and food. The wastewater flowing over the media washes the slime layer from the media bed and a new slime layer begins to form. This process of losing the slime layer is called "sloughing" and is primarily a function of the organic and hydraulic loading on the filter. This natural process allows the media bed to be self-purging and maintenance-free.

The sloughed biomass settles to the bottom of the sump as sludge. These secondary sludges are periodically pumped back to the primary tank for storage, and eventually removed.

Nitrification: Consistent nitrification is accomplished by cultivating a healthy microorganism population and an environment where pH, temperature, organic loading, and supply of oxygen are stable. In a **Bioclere** system, the pH is buffered by the carbonate system associated with the wastewater; the temperature remains constant because of the insulated environment and the exothermic biological activity.

Denitrification: Denitrification utilizing septic tank carbon is widely considered to be the most economical and efficient method for nitrogen removal. Utilizing prescribed recirculation rates, nitrified wastewater from the **Bioclere** is returned to the anoxic zone of the primary tank where influent wastewater provides a suitable carbon source for the denitrification reaction. In this process, bacteria convert the nitrate to nitrogen gas, which is then released to the atmosphere. This method has achieved reductions of nitrogen between 65% and 75%.

Site Constraints/Limitations

The single-family **Bioclere** will accommodate up to 1000 gallons per day. The **Bioclere** has a five-foot diameter footprint; it poses no additional problems in terms of site constraints. Other model sizes and configurations are available to accommodate larger flows as well as commercial, light industrial and shared residential systems.

Performance

The **Bioclere** has been certified by the National Sanitation Foundation (NSF) for the secondary treatment of wastewater. NSF test results indicate:

91-97% removal of CBOD
86-93% removal of TSS
75% reduction in fecal coliform.

Inspection/Maintenance

Semi-annual maintenance is required; however, many states require quarterly service as part of their codes.

Costs

Single Family Residential **Bioclere** units are not sold except to qualified management districts. In our judgement the cost of properly managing, maintaining and monitoring residential systems is significant regardless of the technology.

Cluster/Multiple Residence Potential

Bioclere systems for clustered residential applications may be cost as little as $800.00 per home.

Potential Problems & Solutions

Problems tend to relate to the biology of the wastewater and the habits of the homeowner. The **Bioclere** is vented through the septic tank to the home roof vent. Typical systems do not experience odor problems.

Delivery Time

Delivery time is approximately 4 to 6 weeks.

Manufacturer

Company:	AWT / Aquapoint
Address:	241 Duchaine Boulevard, PO Box 50120 New Bedford, MA 02745
Telephone:	(508) 998-7577
Fax:	(508) 998-7177
eMail:	awt@aquapoint.com
Website:	www.aquapoint.com EXIT Disclaimer
Contact:	Sales office, New Bedford, MA 508 998-7577 ext.18

Serving Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, & Tribal Nations

EPA Home | Privacy and Security Notice | Contact Us

Last updated on Monday, November 20th, 2006
URL: http://www.epa.gov/ne/assistance/ceitts/wastewater/techs/bioclere.html

AquaPoint™

Performance Based Wastewater Treatment Solutions

BIOCLERE™

Self contained Wastewater treatment systems

THE BIOCLERE ADVANTAGE:
Bioclere is a modified trickling filter over a clarifier. It is designed to treat wastewater with varying organic and nutrient concentrations as well as intermittent flows. Bioclere's natural fixed film treatment process is stable, simple to maintain and inexpensive to operate.

Bioclere reduces biochemical oxygen demand (BOD_5) and total suspended solids (TSS) to levels that meet or exceed NSF and EPA standards. As water trickles through the biofilter, organic material is consumed by a population of microorganisms that form on the surface of the media. Sloughed solids from the biofilter filter are returned to the primary tank as secondary sludge and treated water is displaced to the next treatment component or the disposal area.

Bioclere is a modular technology. Units can be installed in parallel to accommodate large flows or in series to achieve high levels of treatment. The systems are sealed and insulated to minimize the impact of seasonal temperature variations on the treatment process.

NITROGEN REDUCTION:
Bioclere systems can be designed to consistently convert and reduce nitrogen. Total nitrogen is reduced substantially and cost effectively by recirculation nitrified water from the Bioclere back to the primary settling tank. Large Bioclere systems may incorporate a second stage nitrifying Bioclere and a tertiary anoxic reactor to achieve < 10 mg/l total nitrogen.

Applications include: residential, commercial, institutional, light industrial and municipal wastewater treatment

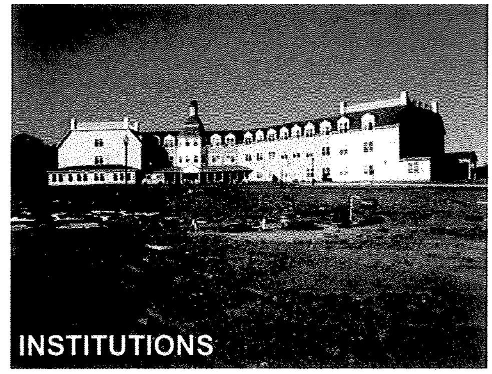
FEATURES & BENEFITS

- Treats flows from 200 to 100,000 gpd
- Cost effective treatment with efficient installation and operation
- Treats high strength wastewater
- Internal flow stabilization treats intermittent flows
- Fully automated pump system
- Self adjusting process control
- Small footprint / compact design
- Gravity flow system
- Quiet operation
- Sealed and insulated for seasonal conditions
- Durable UV resistant fiberglass construction
- Minimal energy usage
- Remote monitoring capabilities

www.aquapoint.com

SINGLE FAMILY HOMES

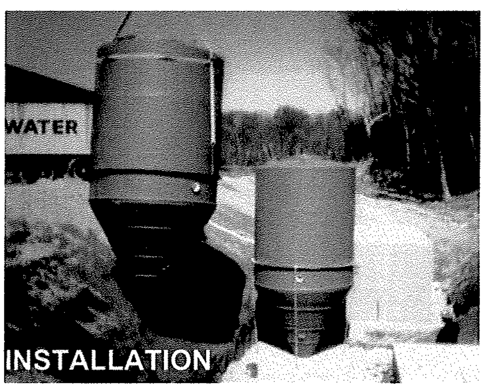
COMMUNITIES & SUDIVISIONS



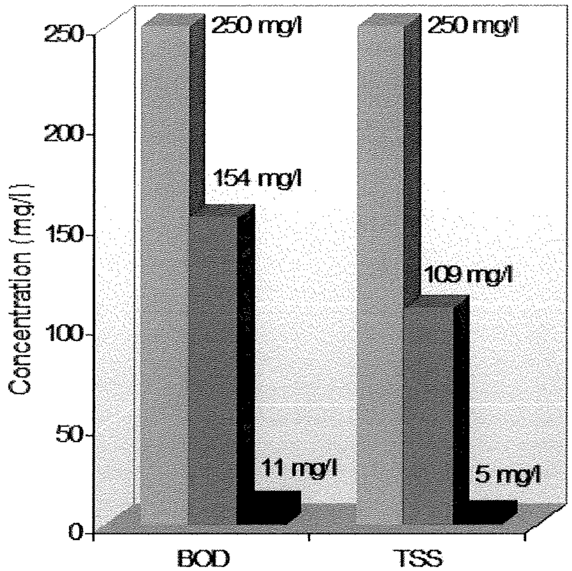
INSTITUTIONS

SHOPPING CENTERS

COMMERCIAL CLUSTERS



INSTALLATION



Typical Septic Tank Influent

Septic Tank Effluent

Bioclere Effluent

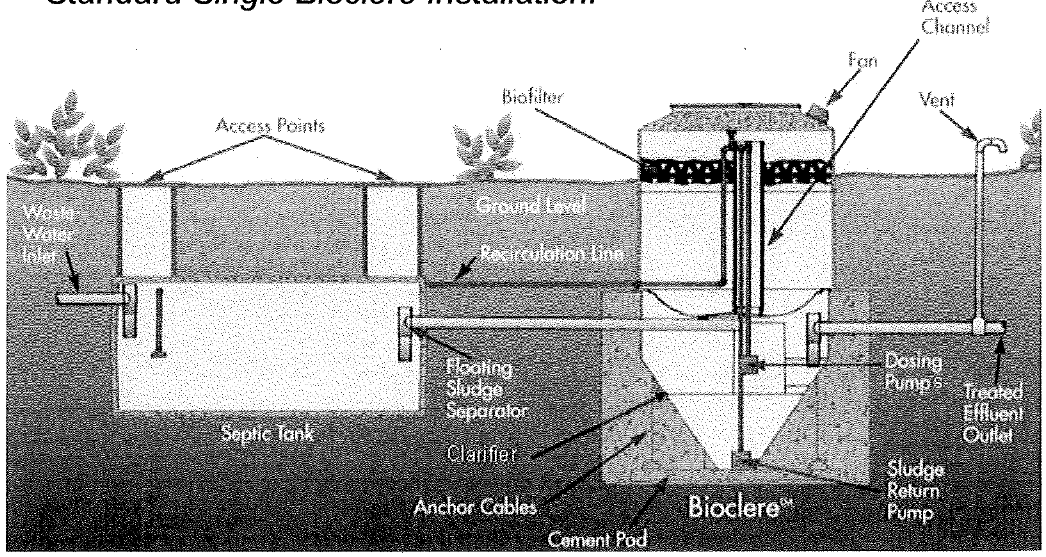
* Septic tank effluent is diluted by the Bioclere's recirculation system.

Bioclere 16/12-350 is ANSI/NSF Standard 40 certified by the National Sanitation Foundation (NSF). The above performance results are based on a six month accumulative average from NSF's certification testing program.

NSF International

U.S. Environmental Protection Agency's (EPA) technology verification program. Results can be viewed at www.epa.gov/etv

Standard Single Bioclere Installation:



Technical Representation throughout the United States

Represented by:

AquaPoint™
Performance Based Wastewater Treatment Solutions

241 Duchaine Blvd. • New Bedford, MA 02745
Tel: 508-998-7577 • Fax: 508-998-7177
sales@aquapoint.com • www.aquapoint.com

BIOCLERE TREATMENT PROCESS

Wastewater flows from the septic or primary settling tank into a baffled chamber inside the Bioclere's clarifier. The baffled chamber prevents short circuiting of wastewater through the system. Alternating dosing pumps are automatically activated by timers and periodically dose the media filter with wastewater from the clarifier. Above the media filter a dosing array ensures uniform distribution of the wastewater over the media surface. Oxygen is distributed throughout the filter by a fan that draws external air into the Bioclere.

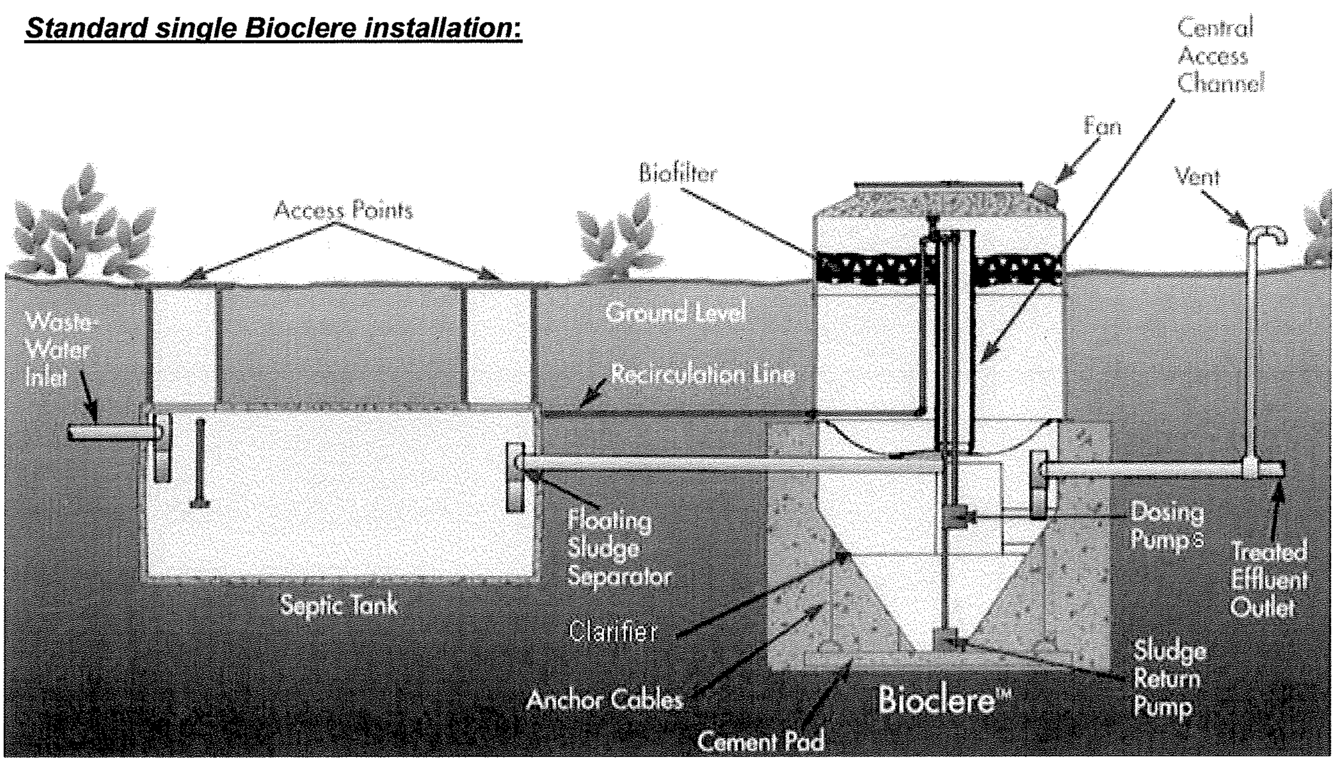
In the trickling filter the organic material in the wastewater is reduced by a population of microorganisms that attach themselves to the media and form a biological slime layer known as biomass. Treatment is accomplished in the outer layer of the biomass by aerobic microorganisms. As the microorganisms multiply and the biological film thickens, diffused oxygen and organic substrate are consumed before the wastewater penetrates the full depth of the film. Consequently, the biomass develops aerobic, anoxic and anaerobic zones.

As the microorganisms that are in contact with the plastic media become starved for oxygen and organic carbon that is consumed by the surface layer, they lose their ability to cling to the media. The trickling wastewater washes the biomass off of the media and a new biological film begins to form. This process of losing the biomass is called "sloughing". The rate of sloughing is primarily a function of organic and hydraulic loading on the filter. This natural process does not compromise treatment and allows the media bed to be self-purging, self-regulating and maintenance free.

The sloughing biomass is washed through the trickling filter and settles to the bottom of the clarifier as secondary sludge. Bioclere's re-circulation system periodically pumps the secondary sludge back to the septic tank where it is stored and eventually removed. Treated effluent flows out of the Bioclere by gravity to the next stage of treatment or disposal.

This physical process is essentially the same for the reduction of BOD_5 and nitrification (conversion of ammonia nitrogen to nitrate nitrogen).

Standard single Bioclere installation:



NITROGEN REDUCTION (NITRIFICATION/DENITRIFICATION)

Removing ammonia from wastewater is a well-established and quantifiable biological process. Nitrogen exists in the influent waste stream primarily in the form of organic nitrogen and ammonia nitrogen (Total Kejldahl Nitrogen or TKN). The principle part of the organic nitrogen is mineralized to ammonia nitrogen by bacterial activity in the septic tank. Therefore, ammonia nitrogen is commonly regarded as the starting point in the nitrogen reduction process.

Nitrification is the conversion of ammonia (NH_3) nitrogen to nitrate (NO_3) nitrogen. This biological process is accomplished by Aerobic Autotrophs, Nitrosomonas and Nitrobacter bacteria in the presence of dissolved oxygen. Bioclere effluent ammonia concentrations of 1 mg/l to 3 mg/l are reliably achieved.

Successful nitrification is accomplished with a healthy microorganism population and an environment where pH, alkalinity, temperature, organic loading and oxygen supply are relatively stable. In a Bioclere system; the pH is buffered by the carbonate system associated with wastewater; the temperature remains relatively constant because Bioclere provides an enclosed and insulated environment and the biomass generates heat; the organic loading is relatively consistent because treated wastewater is recycled through the septic tank and the Bioclere; and the fan provides an adequate supply of oxygen.

Denitrification is the conversion of nitrate (NO_3) nitrogen, to nitrite (NO_2) nitrogen and then to nitrogen gas which is released into the atmosphere. This is a biological process performed by Facultative Heterotrophic bacteria in the presence of a soluble carbon source and anoxic conditions (dissolved oxygen = < 0.3 mg/l).

Denitrification occurs by several different means and through process control adjustments. In the Bioclere trickling filter, diffused oxygen is used up by the aerobic outer portion of the biomass and anoxic conditions are created within the biological film. This allows for significant nitrogen removal in the Bioclere via simultaneous nitrification and denitrification. Denitrification is also achieved by re-circulating nitrified wastewater from the Bioclere back to the septic tank where there is an anoxic zone and sufficient carbon in the influent waste stream to denitrify. This process has achieved total nitrogen reductions up to 80 percent.

TERTIARY DENITRIFICATION

Nitrogen removal can be enhanced further with an Aquapoint ANOX Biological Reactor or a denitrifying sand filter following Bioclere treatment. Aquapoint employs tertiary denitrification when effluent total nitrogen concentrations of <10 mg/l are required for sites with elevated influent TKN concentrations. These denitrification methods have proven effective and are recognized as viable processes by the EPA.

PHOSPHORUS REDUCTION

Bioclere treatment systems achieve phosphorus reduction by dosing the waste stream with coagulants such as metal salts, typically aluminum or iron. This type of phosphorus removal is simple and is the most commonly used method in the United States. It consists of adding metal salts that react with phosphates in the wastewater to form insoluble precipitates. The precipitates settle to the bottom of the treatment chamber reducing the phosphorus concentrations in the wastewater. Coagulant dosing rates are based on the stoichiometric metal salt to phosphorous ratio dictated by the concentration of phosphorus in the daily wastewater flow. The efficiency of phosphorus removal is simply related to the coagulant dose provided that alkalinity is present in sufficient quantities. The precipitated sludge can be processed in the same manner as typical settled sludge. This type of phosphorus reduction can effectively achieve 80-95 percent total phosphorus removal and effluent concentrations of <1 mg/l. Greater reduction in total phosphorus can be achieved by incorporating a physical barrier filter such as a sand filter, disc filter or a membrane.

LOTUS – ActiveCell TREATMENT PROCESS

Primary settled or screened wastewater can flow directly to the Lotus-ActiveCell reactor(s) by gravity or can be pumped in from an equalization basin. Once the wastewater enters the plant, it flows by gravity through each treatment compartment contacting the submerged, free-moving *ActiveCell450 Biofilm Carriers.* Stainless steel media retention screens are installed to ensure that the media is held within each basin.

As flow enters each aerobic treatment compartment, dissolved oxygen is transferred into the wastewater by an air compressor and stainless steel coarse bubble aeration grids. The aeration grids are designed to provide complete coverage of the bottom of the basin and distribute air downward against the bottom of the treatment basin to prevent settling of solids. The diffused air provides the oxygen needed for aerobic treatment and prevents short-circuiting by completely mixing the media and the wastewater.

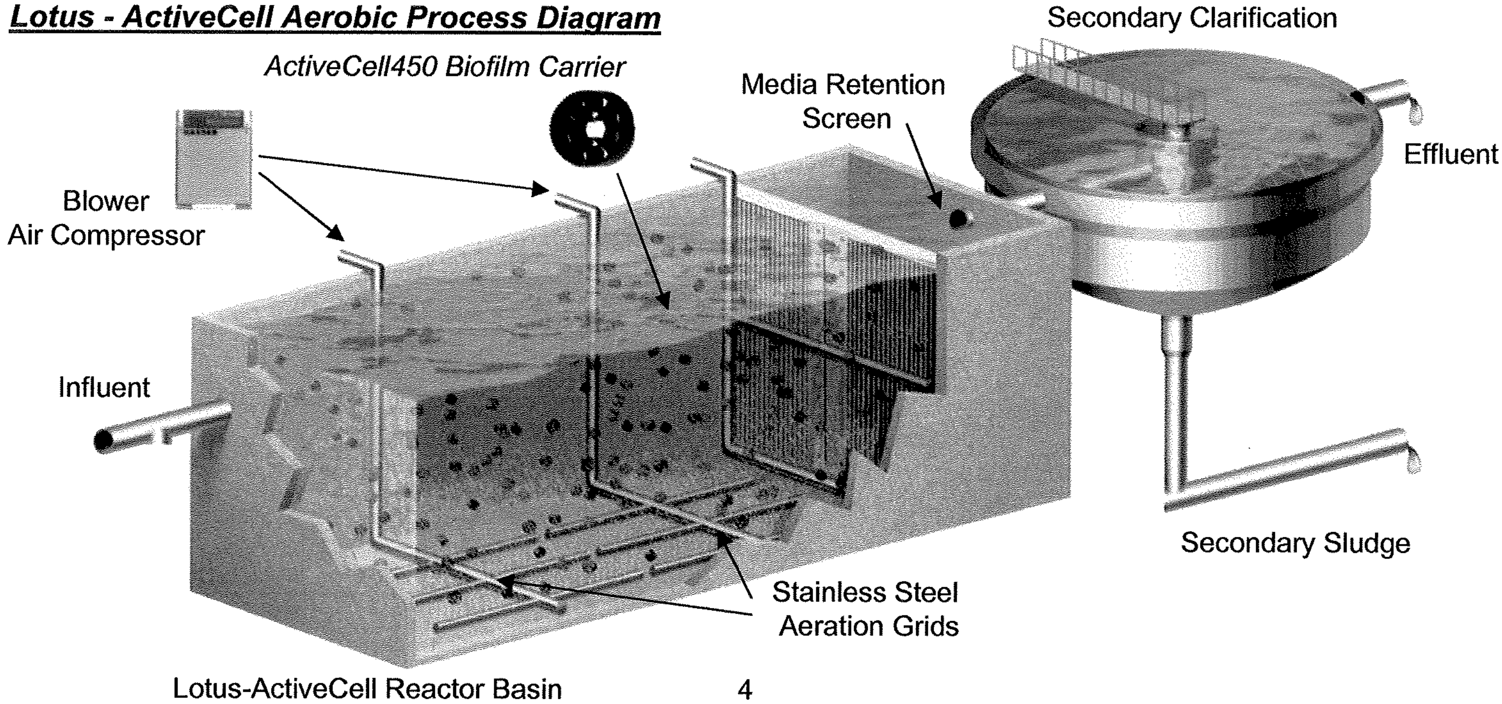
In the aerobic chambers of the Lotus-ActiveCell, treatment is accomplished by a population of aerobic microorganisms that attach themselves to the media and consume the organic material in the wastewater. These microorganisms form a biological film known as biomass. As the microorganisms multiply and the biomass thickens, diffused oxygen is consumed before it can penetrate the full depth of the film. Consequently the biomass develops aerobic, anoxic and anaerobic layers.

As the microorganisms near the media surface become starved for oxygen and organic carbon that is consumed by the surface layer, they lose their ability to cling to the media. The mixing of the wastewater washes the biomass off the media and a new biological film begins to form. This process of losing the biomass is called "sloughing" and is primarily a function of organic and hydraulic loading on the system. Sloughing does not compromise treatment and allows the media beds to be self-purging, self-regulating and maintenance free. These characteristics eliminate the need to manage mixed liquor suspended solids (MLSS), food to mass ratios (F/M) and return activated sludge (RAS).

Sloughed biomass flows with treated wastewater to secondary clarification where it settles as secondary sludge. The sludge is periodically pumped back to a primary tank, sludge holding basin or digester for eventual removal and treated effluent flows out of the clarifier by gravity to the next stage of treatment or disposal.

This physical process is essentially the same for the reduction of BOD_5 and nitrification (conversion of ammonia nitrogen to nitrate nitrogen).

Lotus - ActiveCell Aerobic Process Diagram



NITROGEN REDUCTION (NITRIFICATION/DENITRIFICATION)

Removing ammonia from wastewater is a well-established and quantifiable biological process. Nitrogen exists in the influent waste stream primarily in the form of organic nitrogen and ammonia nitrogen (Total Kejldahl Nitrogen or TKN). The principle part of the organic nitrogen is mineralized to ammonia nitrogen by bacterial activity. Therefore, ammonia nitrogen is commonly regarded as the starting point in the nitrogen reduction process.

Nitrification is the conversion of ammonia (NH_3) nitrogen to nitrate (NO_3) nitrogen. This biological process is accomplished aerobically by Autotrophs, Nitrosomonas and Nitrobacter bacteria in the presence of dissolved oxygen. Lotus-ActiveCell can reliably achieve effluent ammonia concentrations to less than 1mg/l.

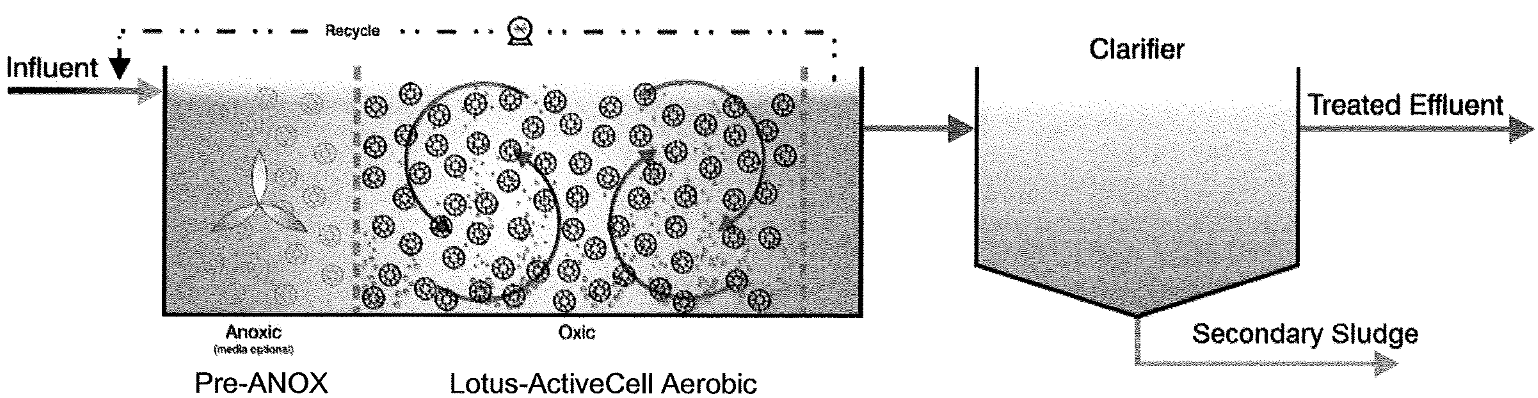
Successful nitrification is accomplished with a healthy microorganism population and an environment where pH, alkalinity, temperature, organic loading and oxygen supply are stable. In a Lotus-ActiveCell system; the pH is buffered by the carbonate system associated with wastewater; the temperature remains relatively constant because the biological activity in the plant produces heat; the organic loading is consistent because the wastewater is treated in the compartments prior to nitrification processes; and the air compressors provide an adequate supply of oxygen.

Denitrification is the conversion of nitrate (NO_3) nitrogen to nitrite (NO_2) nitrogen and then to nitrogen gas which is released into the atmosphere. This is a biological process performed by Facultative Heterotrophic bacteria in the presence of a soluble carbon source and anoxic conditions (dissolved oxygen = < 0.3mg/l).

Denitrification occurs by several different means and through process control adjustments. In the Lotus-ActiveCell submerged media beds, diffused oxygen is consumed by the aerobic outer portion of the biomass and anoxic conditions are created within the biological film. This allows for significant nitrogen removal via simultaneous nitrification and denitrification. Further denitrification can be achieved by re-circulating nitrified wastewater from the final aerobic chamber back to the anoxic zone of a primary settling tank or by incorporating an attached growth Aquapoint Pre-ANOX Denitrification Reactor in the Lotus-ActiveCell design.

In the Pre-ANOX Reactor, a mechanical mixer is used to mix the organic carbon in the influent wastewater, the re-circulated nitrified water and the media. This mixing sustains anoxic conditions and ensures contact of denitrifying bacteria, nitrified water and carbon needed to denitrify. Efficient denitrification in the Pre-ANOX Reactor is contingent on the presence of sufficient quantities of organic carbon. Therefore, an external carbon feed system may be implemented depending on the level of nitrogen removal that is required and the quantity of organic carbon in the influent waste stream.

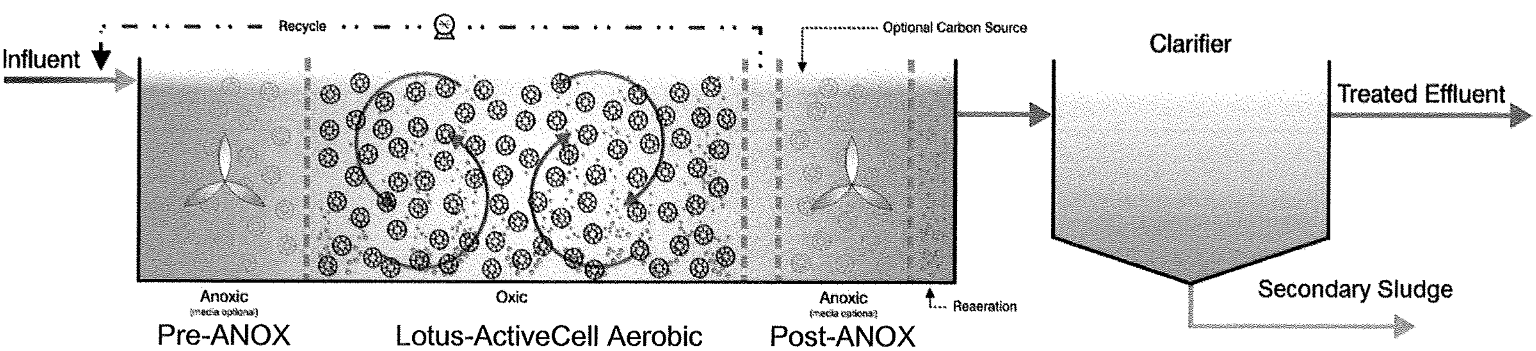
Lotus - ActiveCell Process Diagram Utilizing a Pre-ANOX Denitrification Reactor:



TERTIARY DENITRIFICATION

To achieve low levels of total nitrogen, the system requires Pre and Post-ANOX Denitrification Reactors. The Pre-ANOX Reactor uses nitrified water re-circulated from the final aerobic chamber and the organic carbon present in the influent waste stream to achieve denitrification. The Post-ANOX chamber also uses nitrified water from the final aerobic chamber but incorporates an external chemical feed system to dose organic carbon. The Post-ANOX Reactor needs the external carbon feed system because the organic carbon available in raw wastewater no longer exists in sufficient quantities after the water has undergone aerobic treatment. This proven denitrification method is a process recognized by the EPA.

Lotus - ActiveCell Process Diagram Utilizing Pre and Post-ANOX Denitrification Reactors:



PHOSPHORUS REDUCTION

Lotus-ActiveCell treatment systems achieve phosphorus reduction by incorporating chemical precipitation in the clarification stage. In this process coagulant, typically aluminum or iron salts, are automatically dosed to the clarifier using a chemical feed pump. The metal salts react with phosphates in the wastewater to form insoluble precipitates. The coagulant dosing rates are based on the stoichiometric metal salt to phosphorous ratio dictated by the concentration of phosphorus in the daily wastewater flow. This means that the efficiency of phosphorus removal is simply related to the coagulant dose provided that alkalinity is present in sufficient quantities. The precipitates settle out in the clarifier and are pumped to a sludge holding tank or to a sludge dewatering unit. Lotus-ActiveCell systems are capable of producing effluent total phosphorus concentrations of <1 mg/l without that addition of filtration equipment. Greater reduction in total phosphorus can be achieved by incorporating a physical barrier filter such as a sand filter, disc filter or a membrane.

Wastewater Virtual Trade Show

Amphidrome® ETV✓

--- Select a Company/Technology ---

Narrative Description

ETV Verification Report/Statement (EPA HQ)
(www.epa.gov/etv/verifications/vcenter9-3.html)

The **Amphidrome®** process is an advanced biological wastewater treatment system that utilizes a fixed film, sequencing batch biofilter. The system consists of a deep bed filter that alternates between aerobic and anoxic treatment. The unique design allows for the nitrification and denitrification of the waste stream to be carried out in a single reactor. The cyclical action of the system is created by allowing a batch of wastewater to pass from the anoxic/equalization tank through the granular biological filter into the clear well, and then reversing the flow through the use of a pump. The reverse flow passes from the clear well up through the filter, where it overflows into a trough that carries it back to the anoxic/ equalization tank. These cycles are repeated multiple times, while the treatment is allowed to progress from aerobic to anoxic conditions within the filter. Once sufficient cycles have been repeated to insure the degree of treatment required, a batch of effluent is discharged.

In the aerobic portion of the cycle, air is supplied to the reactor by process air blowers. The air is distributed at the bottom of the media by the underdrain. As it flows up through the media the air bubbles are sheared by the sand, thus producing a fine even pattern throughout the bed. During the aerobic phase of operation carbonaceous BOD, ammonia, and organic nitrogen-based compounds are oxidized. As the batch of wastewater is cycled back and forth the mode of operation progresses from aerobic to anoxic. While operating in the anoxic mode the nitrates are reduced to nitrogen gas, thus completing the removal of nitrogen from the waste stream.

Periodically, the deep bed filter in the reactor has to be backwashed. This is accomplished by simultaneously pumping water, back from the clearwell, and blowing air, at a high volume, into the **Amphidrome®** Reactor.

Application rates (i.e., loading rates) to the soil absorption are as follows, for the given percolation rates:

	Application Rates (gpd/ft^2)		
Perc Rate (min/inch)	<5	5-10	10-20

Importa

Criteria f
The criter
environm
site are d
instructio

Verificat
The techr
containec
but not lii
technoloç
performa
and costs
directly b
attempt v
screen or
technoloç
Therefore
the accur
any disclc
performa
provided
used by E

Complia
EPA has r
statemen
pertaining
federal, s
standards
requirem

Endorse
The inclu:
their proc
does not
endorsem
by the EP

Keeping
Vendors a
confirmin
accuracy
Decembe
such info
removed.

Leaching Pits	3.0	2.5	1.5
Leaching Chambers	3.0	2.5	1.5
Leaching Trenches	2.5	1.5	1.0

The major benefits of this system are that it allows a sewage treatment installation in nitrogen sensitive areas, where a conventional system may not be allowed. It also allows for a significant reduction in leaching area, which may significantly lower the cost for a system that may require mounding.

The following is an equipment list for a typical three-bedroom home at 440 gallons per day:

2 ft diameter stainless steel underdrain
4.7 ft^3 of various size gravel.
15.7 ft^3 of filter media
Process air blower
Backwash
Return flow/backwash pump
Effluent discharge pump
4 Float switches
2 Float brackets
Amphidrome® Control panel
Sample collector

The **Amphidrome®** reactor consists of the following four items: underdrain, support gravel, and the filter media. The underdrain, constructed of stainless steel, is located at the bottom of the **Amphidrome®** reactor and provides support for the media and distribution liquid into the reactor. It is also designed as a manifold to distribute air evenly over the entire filter bottom during the aerobic portion of the cycle. Air is fed from a common pipe at the center of the underdrain. The air is pumped down into the reactor from above and enters the underdrain via a lateral distribution header. The air flows from the header into channels that distribute the air evenly throughout the bottom of the **Amphidrome®** reactor. On top of the underdrain is approximately 18" of gravel. Several layers of different size gravel are used. Above the gravel is a deep bed of coarse, round silica sand. The deep bed filter design, employed in this manner is multi-functional. First, it functions as filter, significantly reducing suspended solids. Secondly, it serves as a fixed film reactor.

Septic tank, clear well tank, **Amphidrome®** Reactor tanks, and interconnecting and internal piping are by others. Installation and piping of reactor is by contractor. The **Amphidrome®** system is typically installed underground. The control panel and blowers maybe installed in a garage, shed, basement, or a small separate building. The entire operation of the system is controlled by PLC. Typically the programmed cycle is design for 12, or 24 hours. In the event of a problem (i.e., either excess flow, or insufficient flow), float switches will override the programmed mode of operation for the pumps.

Inspection/Maintenance

In Massachusetts, the system must be operated by a Massachusetts Class 2 operator. The operator must maintain the system monthly for the first year, quarterly thereafter, and any time there is an alarm condition.

Costs

The equipment cost for a single-family home **Amphidrome®** System, (330 to 440 gallons per day) is $7,500.00. The total installed cost is between $12,000.00 and $14,000.00. The average electrical cost for operation of the system is 70 cents per day.

Cluster/Multiple Residence Potential

This system could be used for multiple residences. Currently, there are fourteen large systems operating with design flows ranging from 5,000 to 36,000 gallons per day. The systems are located in Massachusetts and Connecticut.

Delivery Time

Single family systems are in stock. The delivery time for large systems is approximately eight to ten weeks.

Manufacturer

Company:	Tetra Technologies
Address:	503 Martindale Avenue Pittsburgh, PA 15212
Telephone:	(412) 321-7400

Local Designers/Engineers

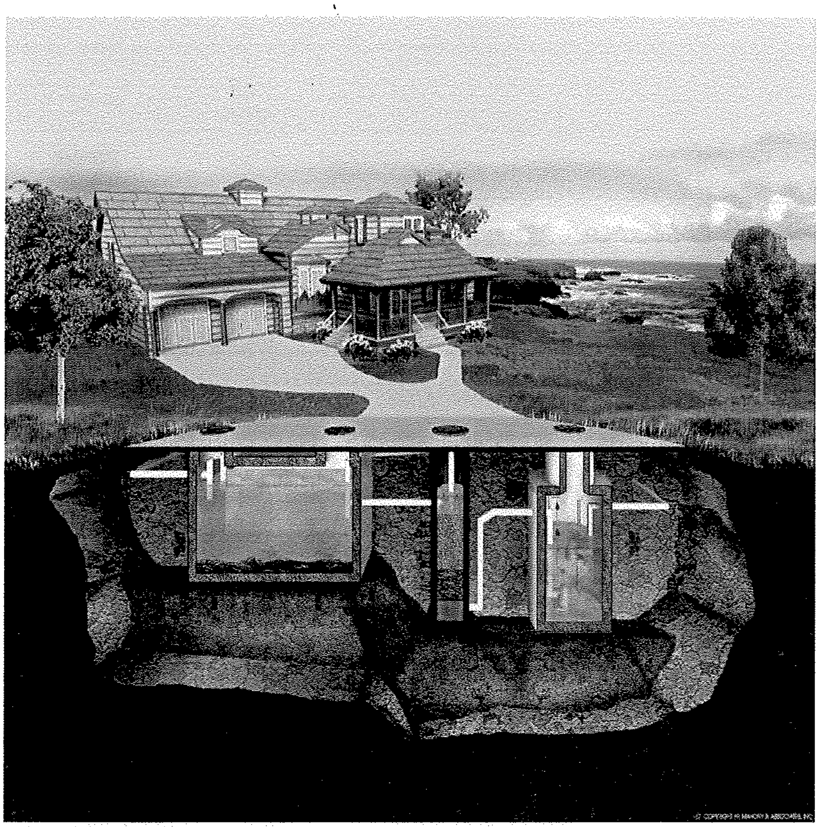
Company:	FR Mahony & Associates
Address:	273 Weymouth Street Rockland, MA 02370
Telephone:	(781) 982-9300
Fax:	(781) 982-1056
eMail:	FRMA@CompuServ.com
Contact:	Keith Dobie

Serving Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, & Tribal Nations

The

AMPHIDROME®

Wastewater Treatment System



Amphidrome® and Amphidrome Plus®

f.r. mahony & associates inc.

frma

273 Weymouth Street • Rockland, MA 02370

tel. 781.982.9300
fax. 781.982.1056
www.frmahony.com

EQUIPMENT/PROCESS APPLICATION ENGINEERS ■ WATER SUPPLY AND POLLUTION CONTROL

Introduction

The removal of soluble organic matter (SOM) from wastewater was traditionally the primary objective of biological wastewater treatment. The removal of SOM occurs as microorganisms use it as a food source, converting a portion of the carbon in the waste stream, to new biomass and the remainder to carbon dioxide (CO_2) and water (H_2O). The CO_2 is released to the atmosphere as a gas and the biomass is removed by sedimentation, yielding a waste stream free of the organic matter.

Cultures of aerobic microorganisms are especially effective for waste streams, which have a biodegradable chemical oxygen demand (bCOD) ranging between 50-4,000 mg/l. To accomplish this task, treatment units were designed and operated to maintain a culture of heterotrophic bacteria, under suitable environmental conditions so that the bacteria utilized the organic carbon from the incoming waste stream. The biochemical unit operations were coupled with additional solid-liquid separations processes to remove the suspended and colloidal solids in the waste stream. The result was an effective method for the removal of both soluble and particulate organic matter from the waste stream.

However, since the discovery of the effects of eutrophication, the removal of inorganic nutrients from wastewater has become an important consideration, and has imposed additional challenges on the design of wastewater treatment plants. The two primary causes of eutrophication are nitrogen and phosphorus and a number of biological nutrient removal (BNR) processes have been developed to remove them. In sea water and in tidal estuaries, nitrogen is typically the limiting nutrient. Therefore, nitrogen discharge limits, in coastal areas, have been made especially stringent in recent years.

In domestic waste water, nitrogen is present as ammonia (NH_3) and as organic nitrogen (NH_2^-) in the form of amino groups. The organic nitrogen is released as ammonia, in the process of ammonification, as the organic matter containing it, undergoes biodegradation. Two groups of bacteria are responsible for converting ammonia to the innocuous form, nitrogen gas (N_2). The completion of this process occurs in two steps, by completely different bacteria, and in very different environments. In the first step, bacteria oxidize ammonia to nitrate (NO_3^-) in a process called nitrification. The bacteria responsible for nitrification are chemolithotrophic, autotrophs that are also obligate aerobes; therefore, requiring an aerobic environment. Chemolithotrophic bacteria obtain energy from the oxidation of inorganic compounds, which in the nitrogen cycle, are ammonia (NH_3) and nitrate (NO_3^-). Autotrophic bacteria obtain their carbon source from inorganic carbon, such as carbon dioxide. In the second step, denitrification, facultative, heterotrophic bacteria convert nitrate to nitrogen gas, which is released to the atmosphere. This is accomplished only in an anoxic environment in which the bacteria use NO_3^- as the final electron acceptor. The ultimate electron acceptor being nitrogen, as it undergoes a stepwise conversion from an oxidation state of +5 in NO_3^- to 0 in N_2. This process may be carried on by some of the same facultative, heterotrophic bacteria that oxidize the soluble organic matter under aerobic conditions. However, the presence of any dissolved oxygen inhibits denitrification, since the preferential path, for electron transfer, is to oxygen not to nitrate.

Since biological removal of nitrogen is both possible and economically viable, many of today's waste water treatment plants require the removal of both soluble organic matter and nitrogen. To achieve this requires: a heterotrophic population of bacteria, operating in an aerobic environment to remove the SOM; a chemolithotrophic autotrophic population of bacteria, also operating in an aerobic environment, to convert the ammonia to nitrate; and finally a facultative heterotrophic population of bacteria, to convert nitrate to nitrogen gas, but in an anoxic environment. Therefore, typical treatment plant designs approach the removal of organics and nutrients, in one of three ways. The first, method is to combine the aerobic steps, (i.e. SOM removal and nitrification), into one operation and design the anoxic denitrification process as a separate unit operation. The second method is to design three separate unit operations for each step. The third method to is to design a sequencing batch reactor (SBR), which has both aerobic zones and anoxic zones. The type of technology utilized greatly influences the number of unit operations to reach the desired effluent treatment level.

Biochemical operations have been classified according to the bioreactor type because the completeness of the biochemical transformation is influenced by the physical configuration of the reactor. Bioreactors fall into two categories, depending on how the biological culture is maintained within, suspended growth, or attached growth, (also called fixed film). In a suspended growth reactor the biomass is suspended in the liquid being treated. Examples of suspended growth reactors include activated sludge and lagoon. In a fixed film reactor the biomass attaches itself to a fixed media in the reactor and the wastewater flows over it. Examples of attached growth reactors include rotating biological contactor, (RBC), trickling filter, and submerged attached growth bioreactor, (SAGB).

During the last twenty years different configurations of SAGBs have been conceived and advances in the understanding of the systems have been made. The advantages of SAGBs are that they may operate without a solids separation unit process after biological treatment, and with high concentrations of viable biomass. Removal of sludge is usually achieved by backwashing the filter. In such bioreactors the hydraulic retention time (HRT) is less than the minimum solids retention time (SRT) required for microbial growth on the substrates provided. This means that the growth of suspended microorganisms is minimized and the growth of attached microorganisms is maximized. The low hydraulic retention time results in a significantly smaller required volume, to treat a given waste stream, than would be achieved with either a different fixed film reactor, or a suspended growth reactor, for the same waste stream.

The Amphidrome®Process

The Amphidrome® system is a BNR process utilizing a submerged attached growth bioreactor operating in a batch mode. The deep, bed sand filter is designed for the simultaneous removal of soluble organic matter, nitrogen and suspended solids, within a single reactor.

To achieve simultaneous: oxidation of soluble material, nitrification, and denitrification in a single reactor, the process must provide aerobic and anoxic environments for the two different populations of microorganisms. The Amphidrome® system utilizes two tanks and one submerged attached growth bioreactor, subsequently called Amphidrome® reactor. The first tank, the anoxic/equalization tank, is where the raw wastewater enters the system. The tank has an equalization section, a settling zone, and a sludge storage section. It serves as a primary clarifier before the Amphidrome® reactor.

This Amphidrome® reactor consists of the following three items: underdrain, support gravel, and filter media. The underdrain, constructed of stainless steel, is located at the bottom of the reactor. It provides support for the media and even distribution of air and water into the reactor. The underdrain has a manifold and laterals to distribute the air evenly over the entire filter bottom. The design allows for both the air and water to be delivered simultaneously, or separately, via individual pathways, to the bottom of the reactor. As the air flows up through the media the bubbles are sheared by the sand; producing finer bubbles as they rise through the filter. On top of the underdrain is 18", (five layers), of four different sizes of gravel. Above the gravel is a deep bed of coarse, round, silica sand media. The media functions as a filter; significantly reducing suspended solids, and provides the surface area for which an attached growth biomass can be maintained.

To achieve the two different environments required for the simultaneous removal of soluble organics and nitrogen, aeration of the reactor is intermittent, rather than continuous. Depending on the strength and the volume of the wastewater, a typical aeration scheme may be three to five minutes of air and ten to fifteen minutes without air. Concurrently, return cycles are scheduled every hour, regardless of the aeration sequence. During a return, water from the clear well is pumped back up through the filter and overflows into the return flow/backwash pipe. A check valve in the influent line prevents the flow from returning to the anoxic/equalization tank, via that route. The return flow/backwash is set at a fixed height above both the media and the influent line; and the flow is by gravity back to the front of the anoxic/equalization tank.

The cyclical forward and reverse flow of the waste stream, and the intermittent aeration of the filter, achieve the required hydraulic retention time and create the necessary aerobic and anoxic conditions to maintain the required level of treatment.

Biochemical Reactions

The removal of SOM is achieved by the oxidation of carbonaceous matter, which is accomplished by the aerobic growth of heterotrophic bacteria. The biochemical transformation is described by the following normalized mass based stoichiometric equation in which the carbonaceous matter is a carbohydrate (CH_2O) and the nitrogen source for the bacteria is ammonium (NH^+_4).

$$CH_2O + 0.309\ O_2 + 0.085\ NH^+_4 + 0.289\ HCO_3^- \rightarrow 0.535\ C_5H_7O_2N + 0.633\ CO_2 + 0.515\ H_2O$$

The oxidation of ammonia to nitrate is accomplished by the aerobic growth of chemolithotrophic, autotrophic bacteria and is described by the following normalized mass based stoichiometric equation. The overall equation describes the two-step process in which ammonia is converted to nitrite by *Nitrosifyers*, and nitrite is converted to nitrate by *Nitrifyers*.

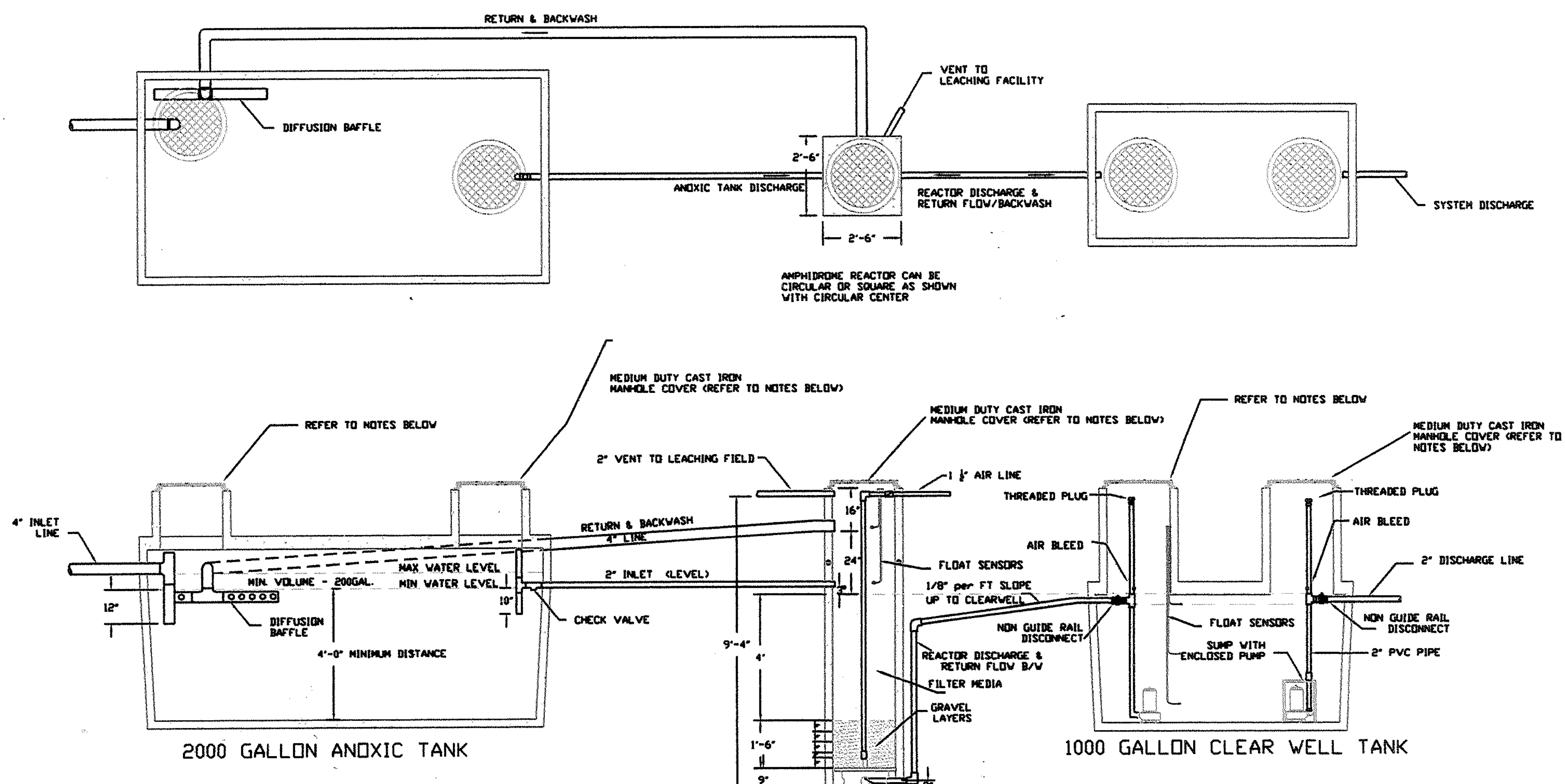
$NH^{+}_{4} + 3.30\ O_2 + 6.708\ HCO_3^- \rightarrow 0.129\ C_5H_7O_2N + 3.373\ NO^-_3 + 1.041\ H_2O + 6.463\ H_2CO_3$

The final step in the removal of nitrogen from the waste stream occurs when carbonaceous matter is oxidized by the growth of heterotrophic bacteria utilizing nitrate as the terminal electron accepter. The equation describing the biochemical transformation depends on the organic carbon source utilized. The following is the normalized mass based stoichiometric equation with the influent waste stream as the organic carbon source.

$NO^-_3 + 0.324\ C_{10}H_{19}O_3N \rightarrow 0.226\ N_2 + 0.710\ CO_2 + 0.087\ H_2O + 0.027\ NH_3 + 0.274\ OH^-$

Biological removal of nitrogen has been the focus of much attention and many of today's wastewater treatment plants incorporate it. However, the difficultly in promoting these biochemical transformations in one reactor is the different environmental conditions required for each transformation.

This Amphidrome® process is designed to achieve the above reactions simultaneously within one reactor. The aerobic environment within the filter promotes the first two reactions. The return flow, to the anoxic/equalization tank, mixes the nitrates with organic carbon in the raw influent, and with organic carbon that has been released from the stored sludge. The anoxic environment within the filter promotes denitrification, the third reaction.



AMPHIDROME® REACTOR

NOTES:
1. TANKS ARE NOT PROVIDED BY FR MAHONY.
2. ALL TANK PENETRATIONS BELOW AND INCLUDING THE RETURN/BACKWASH PIPE SHOULD INCORPORATE A WATER TIGHT BOOT SEALED WITH HYDRAULIC CEMENT.
3. THE TOP ELEVATION OF THE AMPHIDROME REACTOR COVER WILL GOVERN FINAL GRADE. AND ALL OTHER MANHOLE RISERS SHOULD BE ADJUSTED ACCORDINGLY.

AMPHIDROME® SINGLE FAMILY LAYOUT		
Scale: NTS Date: 6/22/05	Drawn By: ADW App'd By: PBP	Plan No. Drawing 1 Rev. No. 3

FR MAHONY & associates, inc.
Water Supply & Pollution Control Equipment
273 Weymouth Street, Rockland, Massachusetts 02370

U.S. Environmental Protection Agency

EPA New England's Center for Environmental Industry and Technology (CEIT)

Serving Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont & Tribal Nations

Recent Additions | Contact Us | Search: GO

EPA Home > EPA New England > Water > Wastewater > CEIT Show: Wastewater > FAST® Wastewater Treatment Systems

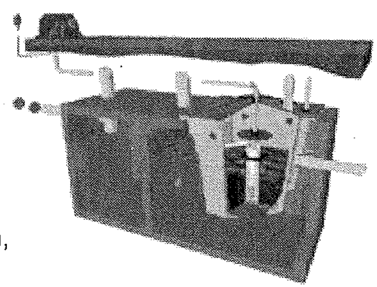
Wastewater Virtual Trade Show FAST® Wastewater Treatment Systems

ETV✓

--- Select a Company/Technology --- GO

Narrative Description

ETV Verification Report/Statement (EPA HQ) (www.epa.gov/etv/verifications/vcenter9-3.html)



The **FAST®** wastewater treatment system is a pre-engineered modular wastewater treatment system/device designed to treat wastewater from residential, commercial, high strength and small community applications. The **FAST**, or Fixed Activated Sludge Treatment, system is a fixed film, aerated system utilizing a combination of attached and suspended growth, capable of performing nitrification/denitrification in a single tank. This innovative combination of the stability of fixed film media and the effectiveness of proven activated sludge treatment is reliable and environmentally sound.

The **FAST** system cultivates large volumes of microorganisms in the inner aerated media chamber to digest the wastewater coming from a residence and turn it into a clear, odorless, high-quality effluent. The attached growth system assures that more microorganisms remain inside the system rather than being flushed out, even during times of peak hydraulic flows. During times of low usage, the large volumes of thriving microorganisms prevent a dying-off of the system, making **FAST** equally suited for intermittent use applications.

FAST technology is well suited for high strength waste, residential development, renovation of failing systems, and light commercial applications on marginal or severely limited sites. Multiple units may be used, in parallel or in series, to meet larger flow and waste strength needs.

Installation of the **FAST** system is straightforward, consisting simply of mounting the unit into a locally obtained septic tank. The first compartment of the two- compartment septic tank will act as the primary settling and anaerobic zone. Inside the **FAST** treatment insert is the aerobic zone. The area of the second compartment immediately surrounding the **FAST** insert is anoxic.

Once installed, the **FAST** system is virtually maintenance free. The clean, odorless **FAST** wastewater treatment system is located below ground level and the system's only moving part, the quiet-running aerating blower, is placed above ground in an unobtrusive blower housing that can be located up to 100 feet away. The **FAST** system needs no other filters or pumps.

FAST has been tested and certified by the National Sanitation Foundation (NSF) International. In addition to ANSI/NSF Standard 40, Class 1, **FAST** has obtained certification from Canadian Great Lakes (the most stringent marine standard in the world). **FAST** also carries certification from the US Coast Guard and the International Maritime Organization (IMO) rules by the UK Department of Trade. **FAST** is listed with the Commonwealth of Massachusetts Department of Environmental Protection as an approved Title V system Certified for General Use, Provisional Use and Remedial Use. **FAST** is listed as an approved system with the State of Rhode Island and can be found on the Rhode Island Department of Environmental Management's Innovative or Alternative Technology List.

Specifications

FAST wastewater treatment systems are ideally suited for use in single family dwellings, clustered subdivisions, restaurants and other commercial applications as well as renovation of biologically failed septic systems.

MicroFAST is used in primarily domestic wastewater applications and is pre-engineered to be sized based on population equivalents and/or flow. **MicroFAST** is currently available in module sizes of 250, 500, 900, 1500, 3000, 4500, and 9000 US gallons per day.

High-StrengthFAST is utilized in commercial applications or anywhere the strength of the waste introduces special challenges. **High-StrengthFAST** is currently available with hydraulic capacities of 1000, 1500, 3000, 4500, and 9000 US gallons per day. (Biological treatment capacities will vary with waste strength - consult factory for assistance in design of these unique, non-domestic applications.)

Multiple modules may be used in parallel and/or in series to meet larger flow or waste strength needs. Each treatment vessel or tank containing **FAST** treatment systems is capable of housing a single system or multiple systems, depending on size and design, giving engineers and project managers maximum flexibility.

In addition to the traditional tank-housed system, specially designed buoyant modules allow any of the **FAST** treatment systems to become floating treatment systems. These cleverly designed systems, called **LagoonFAST**, are ideally suited to retrofit and upgrade the treatment levels in underperforming lagoons, as well as to provide treatment in ponds, fish farms, etc.

Every **FAST** system has similar functionality and operation, keeping O & M simple and straightforward. Dependable, regenerative blowers are utilized, introducing high volumes of oxygen into the robust system. Blowers range from 0.25 to 7.5 HP with output levels of 15 to 325 cfm. Blowers and control panels are available in 110/115V, 208/220/230V, or 460V (single phase and three phase). Each **FAST** system is equipped with an inlet filter assembly and near-permanent, washable filter element (replacement value approximately

$20.00 for the most common sizes).

FAST systems come equipped with a simple and effective control panel. Common malfunctions (including blower interruption/failure and high water conditions) would trigger both visual and audible alarms. Expanded panels are available with additional features for a variety of applications. Control panels are equipped with built-in timers to allow sequencing of the systems blower to assist in optimizing operation. Remote monitoring is also possible should the application call for such assurances. Disinfection devices such as ultraviolet, ozone or chlorination can offer very reliable treatment when site conditions and disposal options dictate their use.

All system specifications and schematics are available for download as AutoCAD files on Bio-Microbics' website, www.biomicrobics.com EXIT Disclaimer, listed under technical specs.

Performance

Sufficient conditions are present to allow nitrification and denitrification to occur in the same tank without any system modifications. Special patented technology allows FAST to consistently reduce nitrogen levels, including nitrates and all other nitrogen species, by over 70%. A properly designed FAST system can be expected to reliably produce an effluent of:

BOD	$\leq$ 10 mg/L
TSS	$\leq$ 10 mg/L
Total Nitrogen	$\leq$ 10 mg/L
Nitrate	$\leq$ 5 mg/L

Inspection/Maintenance

Annual maintenance involves a system check of the aboveground components, easily cleanable, to assure continuous problem-free operation. The air filter element located at the remote blower should be checked for washing or possible replacement (a replacement cost of approximately $20.00). The septic tank should be inspected annually to determine if pumpout is necessary.

Costs

The cost for **FAST** wastewater treatment systems starts at $2,000.00.

Cluster/Multiple Residence Potential

FAST systems are ideally suited to cluster applications of several homes.

Delivery

FAST wastewater treatment systems are pre-engineered and factory assembled, and field installation involves very simple connections. **FAST** systems are lightweight; each system is shipped complete via regular ground transportation

Manufacturer

Company: Bio-Microbics, Inc.
Address: 8450 Cole Parkway
Shawnee, KS 66227

Telephone: (800) 753-**FAST** (3278) or (913) 422-0707
Fax: (913) 422-0808
eMail: sales@biomicrobics.com
Website: www.biomicrobics.com EXIT Disclaimer

Contacts: Raymond Peat, Vice President, Marketing
Brody Dorland, Sales and Marketing Coordinator

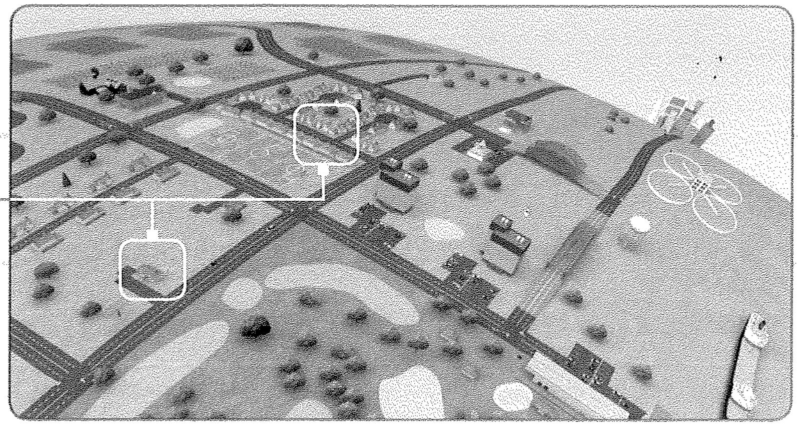
Local Supplier

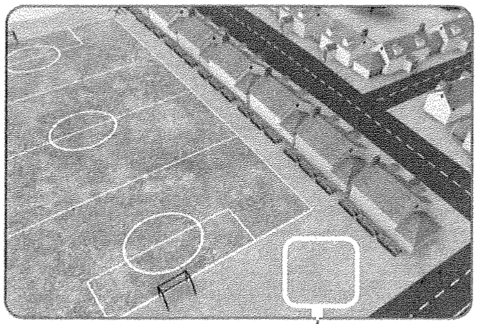
Company: J & R Sales and Service, Inc.
Address: 44 Commercial Street
Raynham, MA 02767

Telephone: (508) 823-9566

Contacts: Jim Dunlap
John Rowland

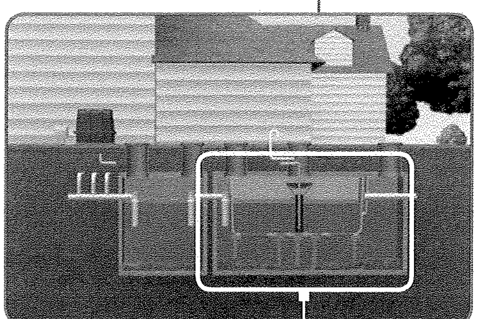
MicroFAST® wastewater treatment systems





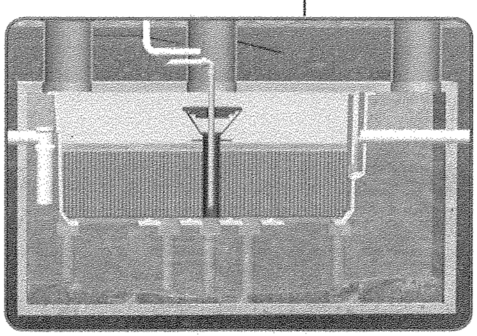
Dependable, Affordable...FAST®

MicroFAST® wastewater treatment systems are ideally suited for use in single family dwellings, clustered residential developments and small communities. MicroFAST modules can also be used to upgrade struggling municipal package plants, providing small communities with innovative, affordable options versus centralized wastewater systems. Proven, Safe, Reliable.



The real beauty of this remarkable system is how well it works.

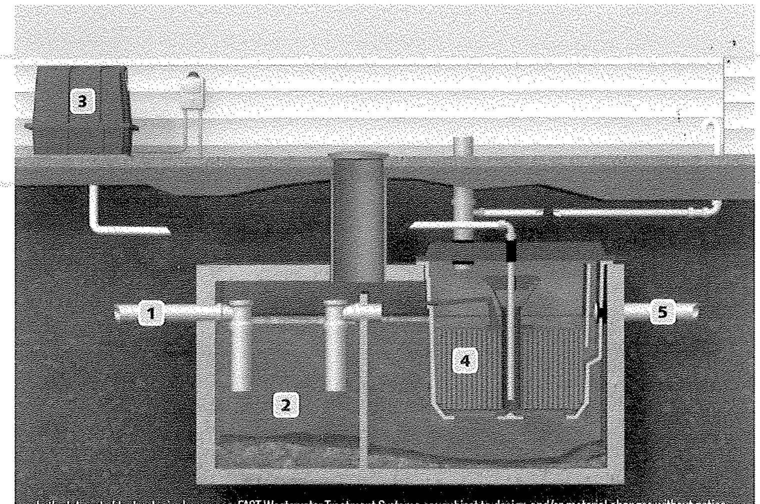
FAST® is simply great technology, based on environmentally sound and simple scientific principles. The FAST (Fixed Activated Sludge Treatment) process employs a unique hybrid combination of attached and suspended growth in an aerobic, packed bed bioreactor. This proven IFAS (Integrated Fixed-Film Activated Sludge) combination includes the stability of fully-submerged, fixed-film media and the effectiveness of activated sludge treatment, making the innovative, patented FAST system technologically advanced and extraordinarily reliable.



Nitrogen Reduction

Nitrification and denitrification projects are much easier with FAST technology. Multiple biological, bio-chemical, chemical and physical processes occur simultaneously within the FAST wastewater treatment system. MicroFAST wastewater treatment systems have proven themselves to consistently reduce nitrogen levels – including nitrates and all other nitrogen species - at exceptionally high percentage rates.

MicroFAST® wastewater treatment systems



In the Interest of technological progress, FAST Wastewater Treatment Systems are subject to design and/or material changes without notice.

How Does It Work?

1. MicroFAST® wastewater treatment systems process all the wastewater from single family homes, clusters of homes, small communities or a portion of wastewater to aid struggling municipal package plants.

2. Natural separation and settling processes occur prior to entering the MicroFAST treatment module.

3. A remote-mounted, above-ground blower, the system's only moving part, introduces air (oxygen) into the treatment module to facilitate a robust circulation of wastewater through the media's channeled flow path.

4. FAST's fixed film media provides a high surface-to-volume ratio to maintain exceptional microbial growth during low, average and peak usage. Bacteria become "fixed" or attached to the stationary media where the abundant, diverse and self-regulating population of microbes is consistently maintained in the aeration zone to metabolize the incoming waste.

5. Clear, odorless, treated water is ready for standard or innovative dispersal.

Technical Specifications

Materials of construction: Made with 100% corrosion resistant materials and contains post-consumer recycled materials.

FAST® Installation: FAST systems are mounted inside tanks in above ground or below ground applications. Tanks can be made from concrete, fiberglass, steel or plastic materials. Please consult product specifications for specific tank recommendations. Always check local regulations before installing or altering a wastewater system. Contact Bio-Microbics or a dealer near you for more information on the availability of proper tankage in your area.

Capacity: FAST systems are available in several convenient, affordable sizes and configurations. Multiple FAST modules, in parallel or in series, can be used to achieve higher flows or treatment capacities. Please contact Bio-Microbics or a dealer near you for more information on the FAST system that's right for your application.

Dispersal Options: Check your local regulations. The extraordinarily high treatment levels may allow reductions in drain field areas, use of treated water for irrigation or other innovative discharge methods.

Power Required: Electrical components are available to meet all worldwide electrical specifications (volt/phase/frequency).

Maintenance Requirements: Once installed, FAST systems are virtually maintenance free. The only moving part in the system is an above ground blower placed up to 100 feet (33 m) away. Periodic review of electronic components and residual levels recommended. Residuals will need to be removed when appropriate.

MicroFAST® wastewater treatment systems Specifications

MicroFAST Application Modules	Maximum Treatment Capacity*		Blower Capacity	Module Dimensions***	Weight*** [Metric]
	Volume/Module**	Persons /Module**			
MicroFAST 0.5	500 GPD (1893LPD)	1 to 8 persons	1/3 HP 11-25 cfm	59" L (149.9 cm) x 30" W (76.2 cm) x 56" H (142.2 cm)	74.8 kg
MicroFAST 0.75	750GPD (2839LPD)	1 to 11 persons	1/3 HP 17-25 cfm	59" L (149.9 cm) x 48" W (121.9 cm) x 57" H (144.8 cm)	103 kg
MicroFAST 0.9	900 GPD (3407LPD)	1 to 14 persons	1/3 HP 17-25 cfm	59" L (149.9 cm) x 48" W (121.9 cm) x 57" H (144.8 cm)	103 kg
MicroFAST 1.5	1500 GPD (5678LPD)	6 to 21 persons	1/2-3/4 HP 20-45 cfm	82" L (208.3 cm) x 55" W (139.7 cm) x 58" H (147.3 cm)	163.3 kg
MicroFAST 3.0	3000 GPD (11356LPD)	10 to 42 persons	1-2 HP 44-85 cfm	71" L (180.3 cm) x 59" W (149.9 cm) x 81" H (205.7 cm)	200.9 kg
MicroFAST 4.5	4500 GPD (17034LPD)	18 to 63 persons	2-2.5 HP 90-140 cfm	145" L (368.3 cm) x 73" W (185.4 cm) x 51" H (129.5 cm)	725.8 kg
MicroFAST 9.0	9000 GPD (34068LPD)	30 to 126 persons	4-5 HP 155-200 cfm	145" L (368.3 cm) x 73" W (185.4 cm) x 76" H (193 cm)	1043.4 kg
Larger Applications >9000 GPD	Multiple FAST® treatment modules can be used in parallel and/or series for additional flow or desired treatment levels.				

***Treatment capacity:** Individual FAST module capacities are rated based on biological (BOD), hydraulic and other project-specific considerations. All rated capacities are given as guidelines for suggested use. Actual capacity may vary with local conditions and performance goals.
****Volume/Persons per module:** Please note that only residential applications or those applications requiring treatment for only sanitary wastewater, may be designed from the volume and number of persons per module. Actual capacity may vary with local conditions and performance goals.
*****Module dimensions/weight** provided only for shipping specifications. Please see design specifications for recommended exterior tankage sizing. Treatment modules shall be installed inside tanks that are locally approved and manufactured using watertight materials.
Electrical Options: Electrical components are available to meet all worldwide electrical specifications (volt/phase/frequency).

FAST Certifications Include:

U.S. Coast Guard • Canadian Great Lakes • UK Department of Trade • NSF Standard 40, Class I • International Maritime Organization (IMO) • Royal Australian Navy • SASSO-Saudi Arabian Standards Organization • USEPA-Environmental Technology Verification (ETV) • C.S.A.-Canadian Standards Association • Underwriters Laboratories (UL) • C.E.-European Electrical Systems

BIO-MICROBICS INCORPORATED

Better Water. Better World.

8450 Cole Parkway, Shawnee, KS 66227 • 1.800.753.FAST (3278) • Ph: 913.422.0707 • Fax: 913.422.0808 • Email: sales@biomicrobics.com • URL: www.biomicrobics.com

APPENDIX E
DEP Presentation
Decentralized Wastewater Management Districts

Decentralized Wastewater Management Districts
A New Alternative for Addressing Community Pollution Problems in Connecticut

How do we handle wastewater ?

- The Public Health Code defines the minimum criteria for a subsurface sewage disposal system (septic system) which will protect public health and the environment
- Many older systems (especially around lakes or on the shoreline) don't meet the requirements of the current health code.
- If the systems are not code compliant, then public health and the environment may be at risk.

What does the health code require?

- A properly sized septic tank (minimum 1,000 gallons, larger for special criteria) with two compartments and proper baffling.
- Adequate leaching area to treat the wastewater, and return the treated effluent to the ground.
- Adequate depth from bottom of leaching system to groundwater or impermeable surface to allow for reduction of pathogens.
- Adequate separating distances from water supply wells, watercourses, structures, property lines, etc.

What is often encountered…

- Cesspools
- Septic tanks of varying sizes (as small as 250 gallons, often with a substantial percentage less than 1,000 gallons).
- Leaching systems that are too small.
- Leaching systems installed too close to the groundwater or other impermeable layer.
- Leaching systems with inadequate separating distances from sensitive resources

What about lot size ?

- Small lots (less than ¼ acre) pose significant challenges in siting septic systems.
- When significant number of small lots are in a neighborhood, even the health code may be insufficient to protect health and the environment (DPH Circular Letter 2000-01)
- Nitrogen analysis recommended by DPH for density of greater than 3 bedrooms per ½ acre.

Why is it a problem ?

- Each of the preceding deficiencies diminishes the ability of the septic system to perform its function; that is, to renovate wastewater to a quality that can be safely discharged back into the environment
- When a number of properties with similar deficiencies exists in a neighborhood, "…a community pollution problem exists, or… can reasonably be anticipated in the future…" (CGS 22a-428)

Is there scientific evidence to prove a problem exists?

- Not always. Substantial science went into developing the public health code, which tells us what the minimum standards for wastewater treatment need to be to protect health and the environment.
- Wastewater planning studies include a limited amount of groundwater and surface water sampling.
- The sampling data is not, by itself, used to validate or repudiate an evaluation of a study area. It is one of several components which, when taken as a whole, are used to reach conclusions about the status of an area

What is a "community solution"?

- A community solution is one where the municipality takes responsibility for the implementation of the solution, either through contract or through management:
  - Community sewerage system: Conveying the wastewater from multiple lots to a common point for treatment and discharge
  - Decentralized management district: Requiring the upgrade of individual systems to a pre-determined standards, through a combination of conventional septic systems and alternative technology, with continuing management.

A New Approach to Wastewater

- Decentralized wastewater management districts
  - Provide new tools for improved management of new and existing onsite sewage systems
  - Allow use of alternative technologies for remediation of existing onsite problems
  - Require DEP and DPH approvals, and concurrence of local Director of Health

Terminology Check: Decentralized

- Decentralized has different meanings, based on who is doing the talking
- EPA Publications use the term to describe any non-centralized system, including cluster systems and small community systems
- More info on EPA's program is available at: http://cfpub.epa.gov/owm/septic/guidelines.cfm#handbook

"Decentralized wastewater management district"

(per Section 7-245 of the Connecticut General Statutes) :

- areas of a municipality designated by the municipality through a **municipal ordinance**
- when an **engineering report** has determined that the existing subsurface sewage disposal systems may be detrimental to public health or the environment and that
- **decentralized systems are required** and
- such **report** is **approved** by the Commissioner of **Environmental Protection** with concurring approval by the Commissioner of **Public Health**, after consultation with the local director of health.

The NEW Approach

- When a municipality establishes a decentralized wastewater management district, the 2003 legislation allows local officials
  - To establish remediation standards for type and level of treatment, with DEP and DPH approval, and
  - To require upgrades of existing systems to meet the remediation standards, or
  - To require abandonment of existing system and installation of alternative technology if upgrades will not meet the established standards
- Locally, the process is a joint effort of local health department and WPCA

Looking at the details…

- There are a number of criteria that must be met when considering a decentralized solution:
  - It must be the most cost-effective solution, as determined by an engineering report,
  - It must be approved by both CT DEP and CT DPH, with local health department consultation,
  - It must be adopted by local ordinance,
  - It must include a long-term commitment to maintenance and monitoring by both the municipality and the citizens.

Step 1: The Engineering Report

- A consultant prepares an engineering report (also called a Facilities Plan) that
  - Evaluates the severity and extent of the existing or potential pollution problems
  - Evaluates alternatives to determine their suitability and cost-effectiveness
  - Recommends an alternative or combination of alternatives
  - Recommends a schedule for implementing solution

Establishing the standards

- When decentralized management is to be considered as an alternative.
  - Report must evaluate a decentralized alternative in comparison to other options (the cost-effectiveness)
  - The remediation standards are reviewed jointly by DEP, DPH, local health, and the WPCA.
  - Includes a review of existing local health department resources and programs

Cost-Effectiveness

- Does NOT simply mean the cheapest alternative
- The **Cost** evaluation calculates the "present worth", and considers both the immediate, or capital costs and the long-term operation and maintenance costs
- The **Effectiveness** evaluation considers whether the alternative adequately addresses the environmental problems and includes consideration of the ability to implement the alternative

Regulatory Review

- The **CT DEP** is usually the primary agency in the review process, because the study is generally carried out by a WPCA under a pollution abatement order from DEP and possibly with funding from DEP.
- The **CT DPH** has a significant role in the review process, and will work with the **Local Health Department** to insure they have adequate programs and resources for implementation

Step 2: The Local Ordinance

- The statute provides that a decentralized management district must be implemented through the adoption of a local ordinance.
- The ordinance needs to:
  - Identify the affected areas of town,
  - Establish a process for evaluating individual properties,
  - Establish remediation standards for the upgrade or replacement of individual systems
  - Provide a process for implementing upgrades or replacement of existing systems

Step 3: Detailed Site Investigation

- The Director of Health oversees the detailed site investigation of each property in the district, to determine existing conditions and status with regard to the remediation standards adopted through the ordinance.
- The investigations must be conducted by DPH approved local health agents.

Step 4: Upgrade or Abandon?

- Based on the results of the site investigations of step 3, the Director of Health will either
  - Issue a **permit to discharge** if the existing onsite sewage disposal system fulfills all the criteria of the standards, with mandatory monitoring and maintenance requirements.
  - Issue an **order to upgrade** the system if the investigation determines that an upgrade to the system will enable the property to meet the standards
  - Issue an **order to abandon** the system if it is determined that, even with an upgrade, the system will not meet the standards. In this case, the order to abandon is accompanied by an order from the WPCA to install alternative technology or connect to an off-site system.

Step 5: Implementation

- System improvements (upgrades to the system or installation of alternative technology) must be designed and installed.
- Permits to discharge will be issued upon proper completion of the required work and inspection of the upgrade or installation.
- Proper operation and maintenance of all systems must be ensured by the municipality, either by:
  - Municipal employees performing operation, maintenance and monitoring functions, or
  - A contract operator, under contract to the municipality or the property owner (and reporting to the municipality)

Delegation of Authority

- The authority to review and approve alternative technologies (those systems not covered under the current Public Health Code) is with DEP.
- To allow the use of alternative technologies, DEP is currently evaluating the delegation of their review and approval authority to individual municipalities as part of a comprehensive wastewater management district.

Conclusions…at the state level

- Connecticut DEP and DPH may approve decentralized alternatives if they are shown to be a cost-effective method of addressing a community pollution problem.

Conclusions…at the town level

- Local government needs to realize that
  - Decentralized alternatives require a substantial local maintenance and management component in order to be properly implemented.
  - The implementation of such a district requires a coordinated effort between local health department and WPCA
  - Installation and operation of a decentralized wastewater management district can be as costly as a sewer system.

Conclusions…at the individual level

- Citizens need to understand, and base their decisions on, how each method of addressing long-term wastewater issues addresses
  - Environmental concerns
  - Economic constraints
  - Community character

…from Theory to Reality…

- In 1989, Old Saybrook citizens disapproved a plan to build a wastewater treatment plant and sewers.
- In 1990, DEP sued the town for failure to address a community pollution problem
- In 1996, the judge issued a final determination requiring Old Saybrook to address their wastewater problems, but allowed them time to develop an alternative that addressed local issues without regionalization.
- From 1996-2003, Old Saybrook and their consultant prepared over a dozen reports and evaluations looking at potential options.
- During that time period, DEP committed to the project an unprecedented 3 staff members to facilitate a solution.
- In 2003, the state legislature enacted changes to the statutes empowering the creation of decentralized wastewater management districts. With this empowerment, DEP and the town began moving toward a new solution…

CASE STUDY:Old Saybrook

From Tri-Town Sewers to Onsite Upgrades

Centralized Sewer System

- From 2003 Fuss & O'Neill Report
- Cost Estimate (updated to 2006 $)
- Wastewater Treatment Facility (550,000 gpd) = $10,670,000
- Central Sewerage System = $41,080,000
- Total = $51,750,000
- Est'd EDUs = 2,550
- Cost per EDU = $20,294

What are the problems we are trying to solve?

- High Density Development
  - 4 to 8 homes per acre
- Older systems (50+ years old) built prior to current Public Health Code (PHC)
- Marginal land developed because of proximity to shore
- High Groundwater table
  - Unsuitable Soils for Septic Systems

Mediation

- Issue identification and mediation plan – spring of 2004
- Mediator selected fall of 2004
  - Cindy Cook of Adamant Accord
- Mediation commenced January 2005
- Conceptual Agreement reached September 2005

Upgrade Standards Within the WWMD

- Cesspools removed and replaced
- Tanks upgraded to PHC
- Leaching structure upgraded to extent possible – between 2/3 and 100% PHC
- Alternative Technology Required for:
  - All waterfront lots
  - When leaching field can not be upgraded to 2/3 PHC

What Does That Mean on the Ground? What are the Major Steps?

- Agreement on Upgrade Standards – done
- Public Participation - underway
- Capital and O&M cost allocation - underway
- DEP / DPH approval of plan – summer 2007
- Adoption of WWMD Ordinance – summer 2007
- Local Funding Referendum – summer 2007
- Delegation of Authority – 2007
- Upgrade of systems – beginning in 2008, with completion estimated 2015

Total Number of Residential Lots	1898
Alternative Technology (waterfront)	217 (11%)
Alternative Technology (inland)	256 (14%)
Cesspool and Drywell upgrades	421 (22%)
Septic Tanks Upgrades	546 (28%)
# of Leachfields upgrades	Unknown
Cost per lot	Wide range

Celebrating 60 Years of Engineering Excellence

Wright-Pierce

Civil and Environmental Engineering Services