STATE OF CONNECTICUT
DEPARTMENT OF ENVIRONMENTAL PROTECTION

REPORT FOR THE BLUE RIBBON COMMISSION ON HOUSING, ON THE LAND REQUIRED TO SUPPORT RESIDENTIAL DEVELOPMENT IN CONNECTICUT.

PREPARED BY THE DEPARTMENT OF ENVIRONMENTAL PROTECTION, WATER COMPLIANCE UNIT
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Abstract

The Department has been involved in the process of development of residential property for 16 years and has available unique tools and experience in determining levels of development that will minimize degradation. In addition, the Department has played a critical role in the development of an infrastructure that can meet our housing needs. The following is a summary of our conclusions.

* While critics have assailed current zoning densities in unsewered areas as overly restrictive, the Department disagrees. In the main we believe that the current restrictions in some of these areas is not as stringent as it should be.

* The maximum density that we can support in unsewered areas is one dwelling unit for each 0.6 acres, under ideal conditions. However the majority of base natural resource conditions mitigate towards a density of less than one dwelling per acre.

* Many host conditions and potentials for new environmental damage require a density that is less than one house per two acres of "buildable," (non-wetlands) soils.

* The foregoing is based on our analysis of pollutant impacts, septic system reliability, availability of potable water, storm water runoff, short and long term construction impacts, and the availability of regulatory resources to ensure that environmental and health standards are met.

* Connecticut has utility capacity to meet a large housing need. Sewerage capacity is available in many of our towns and in all geographical areas. It is available in urban, suburban and even rather undeveloped areas.

Preface

The Department of Environmental Protection is pleased to respond to the request of the former Speaker of the House, The Honorable Irving J. Stolberg, for information on the availability of land to meet the State's housing needs. the Speaker's request, contained in a letter dated May 10, 1988, was as follows;

"...conduct an analysis of soil types and characteristics, soil depth and drainage characteristics, groundwater patterns and terrain and aquifer protection standards in order to determine the amount of land necessary to satisfy minimum health and sanitation requirements for residential uses..."

After a careful review of the literature on this subject, and utilization of the analytical techniques developed by the Department, the following densities or lot sizes are recommended for various natural resource conditions.

	Without public water	With public water
Minimum lot area	1 unit/acre (exclusive of wetlands)	1 unit/0.6 acre (exclusive of wetlands)
In public water supply watershed	1 unit/2 acres (exclusive of wetlands)	1 unit/ 2 acres (exclusive of wetlands)
In high yield aquifers	As above for public water supply watersheds	
In inland and coastal waterfront areas	1 unit/ 1.5 acres (exclusive of wetlands)	1 unit/ 1.5 acres (exclusive of wetlands)

The values that the Department has obtained are supported by a study that has been funded by the Department and administered by the Litchfield Hills Council of Elected Officials. This report has been delayed to allow the incorporation of the study results which are published as, Carrying Capacity of Public Water Supply Watersheds: A Literature Review of Impacts on Water Quality From Residential Development, March 10, 1989.

Introduction

The Department has long recognized the need for housing in our State and has acted in concert with its charge to ensure that such development takes place in harmony with the environment. DEP has played a critical role in the provision of our sewerage infrastructure, and the allocation of water resources in a manner which meets the needs of our expanding population.

The Department has also recognized a need for programs that could allow more creative development in areas without sewerage infrastructure. In the legislatively mandated Sewer Avoidance Report, published in 1978, the Department identified a need for certain types of housing in non-sewered areas, which could best be served by what are termed Community Sewerage Systems. Further information on this program is available from an examination of Community Sewerage Systems, a Primer For Developers and Local Officials, available from the Department.

Existing Regulatory Programs Which Protect Specific Resources and Which Limit Land Availability

The legislature has enacted several programs which remove certain land areas from the category of building land, or which heavily regulate such uses.

A great deal of this land is of marginal value for building and would not normally be utilized unless development pressure and land values are extraordinarily high.

While these programs are primarily intended to protect a portion of our natural resources, they are also a reaction to building in unsuitable areas, with resultant negative impacts for residents. Constructing in flood prone areas, areas subject to storm damage, or areas with poor soils has resulted in houses that settle, have serious water problems, or are damaged or destroyed by flooding.

Wetlands

The legislature has provided programs which regulate the utilization of tidal and inland wetlands. The former are regulated directly by the Commissioner and are in the limited coastal areas of the state. The Department estimates that there are 17,000 acres of tidal wetlands in the State. Tidal wetlands are essentially lowlands covered by tidal waters capable of growing certain types of vegetation. While such lands may be of extraordinary economic value for the construction of housing with an ocean view, it is not land that would meet any significant portion of our housing need.

It should also be understood that the Federal government, acting through the U.S. Army Corps of Engineers is exercising an increasing role in the regulation of wetlands, either tidal or inland.

Inland wetlands regulations do play a significant role in the availability of land for building. Wetlands regulation is primarily conducted by local commissions, subject to the variability of our 169 municipalities. While questions have been raised about undue or excessive enforcement, the major public concern has been that wetlands regulations have not been enforced with sufficient thoroughness. This is reflected in action by the 1987 General Assembly which reinforced the existing laws.

Wetlands in Connecticut are defined as certain soil types, classified as poorly drained, very poorly drained, alluvial, and flood plain by the Cooperative Soils Survey. These soil groups are not suitable for most construction activities, and the predominant regulatory issues have been the proximity of activities to wetlands, and crossings of wetlands. The relationship of septic systems to wetlands has also been a major regulatory issue that affects both the size of lots and issue of allowing the land to be built on.

The relationship of Inland Wetlands regulation to the septic system regulations contained in the public health code is a difficult and complex one. All too often there is a substantial philosophical disagreement between the respective agencies that enforce these rules. The rules of the public health code have primarily been a construction standard, not a judgemental, resource based, regulation. The Public Health Code has carefully avoided being a document that regulated development.

As a result of this, wetlands agencies regard large areas, set back from wetlands as falling under their purview, a practice which is sometimes viewed as second guessing the local health departments decisions regarding adequacy of septic system proposals..

Since wetlands comprise approximately 15% or 435,148 acres of the land area of our State, there is little question that the adoption of large setback distances has lessened the amount of land that is available for development. It is not, however, likely that this practice has significantly reduced the amount of land that is suitable for development. Apart from the legislatively recognized value of wetlands and the difficulty of proper construction in such soils, the relationship of wetlands to surrounding soils often renders the latter marginal.

In most cases, particularly in the uplands soils, a wetlands demarcation line is not a line between "good" and "bad" soils. Too often people conceive of such lines as a clear delineation when they are not. Very often the transition is from a clearly unsuitable wetlands soil to a poorly drained glacial till, characterized by low soil permeability and high groundwater tables. such soils, while outside the wetlands boundary, still pose great difficulty for proper, sound construction.

Other Water Resources Issues: Stream Channel Encroachment, Water Company Lands, and Aquifer Protection

Several programs embodied in the General Statutes either remove certain portions of our land from development or heavily regulate it. These include Stream Channel Encroachment Lines, Water Company Lands Regulation, and potentially Aquifer or "Wellhead" Protection.

It seems evident that stream encroachment lines and flood hazard zones are reasonable regulations that relate to protecting people from building or occupying flood prone structures. The Department does not recommend any changes in this program to enhance the availability of buildable land.

The Statutes regarding Water Company land also do not appear overly restrictive in terms of the availability of land for housing. It is manifest that some of our surface water supply reservoirs have had inadequate protective land use regulation in the past. This has led to the highly desirable program to maintain protective buffers. Despite the need for care, the Statutes do provide for the sale of land that is determined to be in excess of the amount needed for adequate protection.

A legislatively mandated study is currently under way to determine the measures that should be undertaken to provide protection for certain unique land areas which overlay stratified drift aquifer areas. Some of these areas of the State have large and pristine groundwater resources that will be essential to meet future water supply needs, and the State has determined that protection of these resources is of great importance.

It should be understood that protection of these water supply resources is not a limit on the development of housing, but rather an absolute need if we are to meet the water supply needs for an expanding population with the highest quality of water available. The States goal is to protect these water supplies for use as drinking water without treatment. This may place limits on the density and type of human activity that can be tolerated in these areas. The department developed an initial hierarchy of proposed land uses over such areas, a copy of which is attached. The hiearchy is not a regulation but is advisory in nature. It will be noted that the hierarchy discourages any higher density development in such sensitive areas.

Permit Programs which Directly Regulate the Density of Development: The Public Health Code, The Clean Water Act

The primary State programs that relate to the land area needed to support a residence are those programs that regulate the design and installation of on-site sewage disposal systems, most commonly subsurface sewage disposal systems (SSDS), which normally consist of a septic tank and leachfield system.

These are the provisions of the Public Health Code (section 19-13-B103 et. seq) that govern SSDS that discharge a total (through one or more systems) of less than 5000 gallons per day of domestic sewage to one property. They are complimented by the provisions of section 22a-430 CGS (the Clean Water Act) and sections 22a-430-1-4 RCSA, which DEP utilizes for permitting all other discharges to the waters of the State, including projects where the SSDS total discharges will exceed 5000 gpd or will constitute a community sewerage system.

In practical terms this means that single family homes, subdivisions and small commercial SSDS are governed by the Health Code while multifamily, and large commercial developments utilizing SSDS are regulated directly by DEP. The Health Code is administered by the State Department of Health Services which delegates a substantial portion of its authority to local and regional health authorities. The Health Code has standards for the construction of private water supply wells as well as septic systems.

Both regulatory programs grew from different viewpoints but are reasonably well integrated at this time. The Public Health Code sewage disposal requirements were developed empirically with a primary goal of preventing human exposure to raw sewage with its attendant pathogenic and nuisance consequences. Rudimentary separating distances to streams and wells were provided. While the code served fairly well with its limited goals, its administrative mechanisms were quite weak, allowing SSDS's to be built in many areas that were manifestly unsuitable, resulting in failures and overloading ground and surface water resources. A huge investment of public funds for the extension of sewer lines and the construction of treatment plants has been utilized to correct large historic errors in the allowable siting and density of SSDS. In 1982 the Department of Health Services conducted a significant upgrading of the code requirements for SSDS. This revision has put in place an excellent regulatory tool.

The DEP regulatory program grew from a clear statutory mandate for the protection of water resources and was greatly assisted by a spate of research programs which investigated this topic. Not the least of these was very active research at the University of Connecticut. The DEP program remains unique in the United States and is frequently consulted by other States interested in its groundwater flow and pollutant renovation modeling components. The Departments regulatory program has few rigid requirements, demanding instead that the applicant perform complex site specific analysis, modeling and monitoring to ensure that the proposal will not cause pollution.

Since the passage of the 1982 Public Health Code revisions the principles of the DEP regulatory program have been integrated into the health regulations. Since that time DEP analytical techniques, and clear bottom lines for unbuildable sites have been incorporated into the code. Both of these programs will be referenced in the discussion of the land area needed to support residential development.

Septic Systems

This paper will concentrate on analysis of development that utilizes on-site water supply, normally a drilled well, without treatment, and a septic tank leachfield system for sewage disposal. The use of this latter technology raises some difficult issues that the Blue Ribbon Commission may wish to consider.

Septic systems are an old technology that was not well understood until very recently. While most people probably envision it as a crude or, "second best" technology it is actually, in scientific terms quite elegant, meaning it poses a simple and excellent solution to a problem. A septic system consists of a septic tank, which is a primary treatment system where physical operations predominate. Raw sewage enters the tank where its velocity is slowed to the degree that scum and grease will float and solids will settle to the bottom where they will slowly be digested, reducing accumulation and allowing a considerable interval before solids removal is required. The effluent from the tank is directed to a leaching system or structure. At the interface between the leaching system and the surrounding soil a biologically active crust growth occurs which provides excellent treatment for a variety of parameters. Finally, if the system has been properly sited, effluent will travel through soil providing final treatment. The following are the important advantages of SSDS's;

1) The system is essentially passive, requiring little maintenance, withstanding both abuse and shock-loading with few problems.

2) There is no reason why a properly sited designed and maintained system should fail or wear out.

These systems must be properly sited to minimize impacts and prevent failure and do not lend themselves to the addition of special treatment mechanisms to provide for additional treatment of specific pollutants

Other Systems

There are available certain alternate on-site sewage treatment systems that may be quite costly but which would provide better treatment of one or more pollutants, such as nitrogen removal, than a conventional SSDS. The Department has approved several such systems to meet specific needs and several such systems merit mention. All of these systems have the serious drawbacks of higher capital cost, higher potential or established operation and maintenance costs as well as some serious environmental disruptions.

Package sewage treatment systems are prefabricated secondary (aeration) treatment systems, generally operating in the extended aeration mode. While the provision of secondary treatment prior to land disposal is redundant, these plants could be combined with other technologies to remove problem pollutants in specific circumstances. The Department has utilized this type of technology in some repair systems but cautions that such plants alone rarely offer any appreciable advantage over conventional systems.

An alternative treatment system refered to as the RUCK system provides sand filtration and partial passive denitrification. The Department has allowed use of this system to meet site constraints in several cases with good results. The Department has required that these systems have reasonable reserve capacity.

The extreme of alternate technology is represented by the Cyclelet(tm) system which is a recycling system primarily utilized in commercial and office applications. One is in service in Connecticut, while another has been approved. The system takes all wastewater and directs it to a treatment system in the basement. it is subject to screening, primary and secondary treatment, ultrafiltration, disinfection and deodorization with the process effluent directed back to toilet flushing. The excess is directed to a very small SSDS since it is a clean water discharge. The units are redundant, computer controlled, entirely self contained, and maintained by the corporation, as well as being provided with remote sensing for problems.

A domestic application utilization of this technology would virtually eliminate land requirements for a SSDS, albeit the cost of the technology would probably offset that benefit.

From the standpoint of environmental impact, cost, benefit, system stability and reliability the conventional septic tank leachfield system or some modification of it such as the addition of intermediate sand filters will continue to be the mainstay of onsite sewage disposal.

Determination of minimum required land areas and soil types.

Septic System Components and Current Separating Distances Required by the Public Health Code

PLEASE NOTE THAT YOU HAVE A COPY THAT HAS BEEN REPRODUCED FROM OUR COMPUTER, WHICH DOES NOT HAVE A GRAPHIC CAPABILITY. THE DRAWING IN THIS SPACE IS NOT CRITICAL IN UNDERSTANDING THE CONCLUSIONS OF THIS REPORT.

Note: The Public Health Code requires that the bottom of any leaching system be located a minimum of 18" above the seasonal high water table and 4' above ledge rock.

Pollutant Renovation

Nitrogen

What can be quantified is the probable concentration of pollutants that will be produced in various configurations of development. The most common of these to enter into discussion is nitrate nitrogen. This compound has been studied in fair detail, has an established drinking water limit and is most closely related to the issue of lot size. While actual movement of nitrogen compounds in soil are fairly complex, subject to three dimensional dispersion, slug flows, and the processes of nitrification and denitrification, some simple models can be utilized to estimate the impact of various levels of development.

The most common of these is the model that May and Healy developed in 1978, which was published in "Seepage and Pollutant Renovation Analysis for Land Treatment Sewage Disposal Systems" in 1982. This model has been monitored by comparing its projected levels with a great many DEP permitted projects monitoring well results, and by comparison with one study at UConn. It has also been the basis of similar regulatory efforts in about five other states. When this model is properly applied it is used for a specific project, with a reasonable estimate of sewage quantity and quality, a known topography, and a site specific hydrogeologic model. In our experience, utilizing it in this manner gives good results. When it is utilized for broader planning purposes careful judgement must be utilized to determine proper inputs.. Factors which must be considered and evaluated are the values to use for; wastewater strength and quantity, topography and potential infiltration.

Essentially, the model utilizes a normal and well established total nitrogen concentration in a conservative theoretical wastewater flow. The assumption is that this flow is discharged to the soil on site and is diluted by the infiltrating rain.

Literature in the field of pollutant concentration shows nitrogen concentrations ranging from 25 to 125 mg/l in domestic sewage. The typical median values are in the area of 35 to 40 mg/l.

This model is generally utilized with an average wastewater nitrogen concentration of 35 mg/l, reduced by treatment processes to an actual soil discharge of 24 mg/l, the amount subject to dilution by infiltrated rainwater. The dilution is required to meet the minimum goal of compliance with the drinking water standard of 10 mg/l at the downgradient property line. This average wastewater strength is reasonable to use on large residential projects, since they involve a considerable number of families on one property, a condition that tends towards the average. This is not necessarily a good planning number to utilize if the principle of the State's Water Quality Standards, that each property renovate its own sewage is to be continued. A number that will be used as a determinant of density must be conservative and should be based on a medium to high strength waste with a total nitrogen concentration of 70 mg/l.

Typical Calculation

1 acre = 43560 ft^2 43560 X 0.6 (minimum lot size) = 26,136 ft^2

26,136 X 0.003' (this is 1/3 of the average daily rainfall which falls on one square foot of Connecticut) = 78 ft^3 of dilution rainfall

78 X 7.48 (conversion) = 583 gallons per day X 3.8 (conversion) = 2215 litres of dilution.

Design sewage flow = 350 gallons per day X 3.8 (conversion) = 1330 litres sewage flow

Design sewage nitrogen concentration = 24 mg/l X 1330 l = 31,920mg of Nitrogen/day.

$$\text{Final Concentration} = \frac{\text{Total Nitrogen}}{\text{Rainfall Dilution + Effluent Dilution}}$$

$$\text{Therefore: Final Concentration} = \frac{\text{31,920 mg nitrogen}}{\text{2,215 litres + 1330 litres}}$$

Final Concentration = 9.0 mg/l

9.0 mg/l < 10.0 mg/l (drinking water standard), therefore dilution is available on 0.6 acres to dilute sewage nitrogen just below the standard for drinking water.

Calculations of Nitrogen loading factors under ideal, non-conservative conditions indicates that at least 0.6 acres is needed to dilute nitrogen. If the higher waste strength (70 mg/l) is utilized the lot size requirement jumps to 1.5 acres, just to dilute nitrogen. This still assumes that 1/3 of all rainfall infiltrates and the lot topography is regular, allowing dilution. The topography issue is another example where the assumptions in the DEP model are more clearly applicable to large systems, which must be spread out over extensive contour lines. The microtopography of subdivided land may be quite different from this, prompting caution in the infiltration analysis. Finally, if the recent measured infiltration rate developed in Connecticut by the United States Geologic Service (USGS) is combined with a high strength wastewater, lot size for nitrogen dilution will rise to 2.5 acres.

The reasonable range of adequate lot sizes range therefore from 0.6 to 2.5 acres, for the purpose of diluting nitrogen. The figure of 0.6 acres applies only to lots that are provided with public water and provides little margin for error. In non public water supply areas, the range of minimum allowable lot sizes runs somewhere in the range of 1.0 to 2.5 acres depending on the sensitivity of the receiving resource and several other factors. The actual size chosen for planning purposes will depend on the weight assigned to other factors that are more difficult to quantify.

Bacteria

There are other pollutants of concern, however several of them are more closely associated with design than with lot size. Several items do, however have a substantial relation to lot size and support a cautious approach. These are bacterial time of travel, and trace organic chemicals. The separating distance of 50' between leaching systems and streams, contained in the Connecticut Public Health Code is the result of many sets of calculations of the needed area for time of travel for bacterial die-off in soil. Unfortunately the code only requires 10 feet from a system to a downgradient property line which is not in agreement with the principal that the lot renovate its own sewage. Therefore, bacterial die-off factors support lot configurations and sizes that allow considerable distances to downgradient property lines.

Virus

The Department is also concerned that in one area the existing public health code may not necessarily provide the desirable level of protection from pollution. This is the factor of the attenuation of virus. Research work utilizing the poliovirus has demonstrated that the primary deactivation mechanisms are associated with the poor survival of virus in an unsaturated soil column approximately 2 feet in length. For this reason the DEP standard, which relates very directly to the type (depth) of soil, but not to lot sizes, requires that an applicant measure the seasonal high groundwater and by mathematical modeling project the height of the groundwater mound that will be created by the discharge. The mound height is then superimposed on the seasonal high groundwater and the system bottom must be held 2 feet above that elevation.

By contrast the Public Health Code requires that seasonal high groundwater be identified, but mound height is not. The system can be placed a minimum of 18" over the seasonal groundwater elevation. While this is not ideal practice the Department has not aggressively sought a change in the current standard since, in a State characterized by high groundwater, such a change could have tremendous consequences on the availability of building land. Further, while considerable work has been done on this issue, the nature of our soils provide some substantial protections not available in other areas of the country.

Trace Organic Chemicals

With regards to trace organic chemical pollutants, the evidence is mixed and difficult to quantify. Several studies, including one in Connecticut indicate that the typical discharge and ground water concentrations of such chemicals are well within drinking water parameters. A recent analysis of groundwater monitoring data taken from wells downgradient from several large SSDS's located in Connecticut has been examined for aquatic and human toxicity. The initial conclusion was that the levels of aquatic toxicity were not exceeded. While, once again no existing Federal drinking water standard was violated there would be potential effects on humans consuming the groundwater at those sampling points. This should not be considered to be a likely scenario, however it does point out the potential problems of dense on-site development utilizing SSDS.

There is substantial concern that as detection levels, and knowledge increase, the drinking water standards will become increasingly stringent, while the available treatment is somewhat fixed. The standards are, in fact being tightened at this time. The Department believes that this is an area where higher technology may have to be applied to on-site systems to meet the challenge of ground water protection. This will have to be coupled with careful and stringent land use controls. The other aspect of this particular issue that is disturbing is the lack of data on residual impacts in soils, sediments and drinking water supplies. While there is no current reason to act on such concerns, such impacts are inevitable and will increase with density.

Phosphorus

The Department is also concerned with a more accurate assessment of the impacts of phosphorus on impounded water bodies. Phosphorus is the principal trigger of eutrophication of ponds and lakes, a serious impairment of utilization. Present models utilized by the Department have been criticized as non conservative, and may need refinement.

In summary of this portion of the issue, it is evident that various lot sizes may meet the need for nitrogen dilution, however the predominant factors for design of individual systems, in our most sensitive areas indicate that densities should not exceed one dwelling per 1.5 acres. This position is supported by an examination of the other pollutant renovation issues which mitigate towards lower densities. Other factors also support this conclusion, and bear discussion.

Soils Types

In general, the conclusions about lot sizing requirements can be applied across the range of soils types present in the State. Individual lots will, of course vary and careful site specific analysis is a more accurate tool than assumed conditions. Despite this disclaimer, the numbers utilized in this report are valid. Soils types which will host septic systems vary from permeable sands to compact glacial tills and there will be some differences in the ability of the site to provide renovation. There are however factors which tend to balance the pollutant renovation equation and allow reasonable judgement.

Nitrogen dilution will vary somewhat based on soil type and slope and that is reflected in the figures supplied in this report. Bacterial time of travel will vary with soil permeability and gradient. There is however a balance that takes place. More permeable sands result in a lower gradient in the zone of saturation, therefore times of travel move closer to a norm. In a similar manner glacial till soils have greater ability to deactivate virus, however the groundwater mound formed by the discharge will be higher, requiring more conservative system placement.

Given these factors, the conclusions of this report reflect reasonably conservative calculations and a considerable number of years of water quality monitoring to check the validity of our models. We have not attempted, therefore to break out sample calculations for individual soil types. We believe that such calculations would be somewhat redundant and could lead to the conclusion that the calculations were suitable for actual project design in specific soil types.

Stormwater Issues

Overall storm water runoff, management and pollutant loading issues are by no means settled or well understood. There is a brief regulation concerning termination of storm drainage in the Public Health Code that is often overlooked. There is considerable debate about the type, location and capacity of storm drainage treatment systems in relation to water quality. What we are certain of is that storm water runoff, and particularly the first flush of such runoff can carry a significant amount of pollutants. The only practicable treatment for such runoff is some combination of stilling and land treatment in a location that will not contaminate wells. Considering the difficulties in both quantification and treatment and the value of the receiving waters, particularly public water supply resources, this becomes another factor which supports conservative lot sizing. Simply put the less land that can be disturbed, and prepared in a manner that reduces infiltration, the less stormwater that we must deal with.

One concept that must be introduced at this time is the relationship of buildable land to the total lot size. This report has already discussed several types of land that the Legislature has either excluded from development or severely restricted the development thereof. The size and shape of the portion of the lot that falls outside those restricted categories is often termed "buildable land." This may not actually be the case as has been pointed out in the discussion of the relation of wetlands to the surrounding soils. The test for what is buildable may need more stringent definition. Despite this caveat, the concept that a certain portion of a property must meet a reasonable standard has considerable validity.

The Department recently delivered an opinion to the Town of Goshen supporting the concept that in our most sensitive resource areas, public water supply watersheds, it was reasonable to require lot sizes of two acres exclusive of wetlands. This is essentially a buildable land concept. Some discussion of that position is warranted.

The issue of two acres, exclusive of wetlands ties to the foregoing issues of pollutant renovation, to the non quantified environmental impacts, and to the actual methods of development and construction. In examining this issue we must remember the relationship of the wetlands to the surrounding soil types. In most cases the wetlands are the worst possible soils for construction activity. Even if we had no reason to protect them, we would avoid trying to build in them. The transition from wetlands to the surrounding soils is only occasionally an abrupt one. More often it is a transition from a totally unsuitable soil to one that is difficult and costly to develop such as Woodbridge, (a soil group in the Soil Conservation Services classification series) characterized by high water tables of long duration. The reality is that the exclusion of wetlands is not, in most cases of upland till sites, as conservative as it sounds. In most cases a significant amount of the buildable land adjacent to the wetlands will be of marginal quality.

Construction Issues

The Department has had substantial experience in the regulatory process as well as many staff members with former engineering and construction related experience in the private sector. Based on that experience it is instructive to examine the actual course of construction and the problems that are associated with it. The builder generally has a tract of raw land that has been tested and found suitable in some location and configuration. What the lot will generally provide is an envelope of land that is the best for construction. This will be the highest and dryest area to minimize wet basements and to provide the best septic area. Several factors will very often push construction outside this suitable area.

The new home customer or speculative builder will come to the land with a specific plan and a location on the site that may or may not fit in the optimum area.

Unless stringent regulations are in place and effectively enforced, this will result in a foundation being placed without particular regard to the optimum location. Even if specific site plans are required, with offset stakes, and as-built requirements, considerable error may result. The builder generally will have to clear the land, resulting in tons of brush and stumps, qualifying as bulky waste. Theoretically this will be disposed of at a town bulky waste landfill. The reality is that some area of the site will be a stump dump. Generally this additional source of pollution will be located downgradient at the edge of the cleared area. On many sites the stumps will, of necessity be buried in the groundwater table, under reducing conditions which will release pollutants. While this is not condoned, provision of such an area in our buildable land area is entirely reasonable.

If code compliance and minimal environmental standards can be met on the best of sites can be obtained by clearing and building on about 0.6 acres, factors such as the movement of the house location and the stump disposal area greatly increase the needed area. Normal well drilling practice will increase it even more. Wells are seldom located in the area designated on any plan of record, nor is there substantive regulatory control of this factor. The simplest test seems to be to locate the well where the drill rig can be conveniently set up in proximity to the house. Once again the available area to construct must be sufficient to allow movement related to this factor. Finally the septic system itself must be installed, in code compliance, and at the tail end of a variety of decisions that may have substantially altered its intended location. The point here is that precise engineering drawings of an intended, or even required lot layout may bear little resemblance to the actual development.

One of the other water quality related factors associated with the lot size and construction technique is short term sedimentation and erosion controls. Once again the norm is to make some field adjustment, even in carefully planned layouts. This may well be needed because of the accuracy of the topographic information available at the time of planning, as well as the aforementioned plan alterations. The establishment and maintenance of adequate sedimentation and control measures requires more land, particularly if the controls are set up outside the wetlands proper.

The techniques and reality of construction, the succession of soils from wetlands, to poor soils to suitable soils, and the impacts of stormwater runoff on water quality are all factors that weigh in judging the minimum lot size.

In the Departments opinion they are serious enough to move the desired lot size upwards in the range determined by the calculation of the dilution values for nitrogen.

All of these factors are exacerbated by the fact that each lot must stand on its own as a separate design, engineering and construction problem. Once again considering cluster, creative development can add scale factors that allow the location of houses, roads and utilities in the best environmental location rather than placing them on an arbitrarily decided minimum lot.

Matrix of Lot Sizes or Densities

Based on the numerical factors of nitrogen dilution, and the impacts of non quantified pollutant factors that have been discussed and the conventional engineering realities of the design and construction process, the Department recommends that the following lot sizes or densities are required for the protection of public health and the environment.

Note: The phrase, "exclusive of wetlands" means that the density/lot size is calculated without including wetlands soils groups as part of the required land area.

	Without public water	With public water
Minimum lot area	1 unit/acre (exclusive of wetlands)	1 unit/0.6 acre (exclusive of wetlands)
in public water supply watershed	1 unit/2 acres (exclusive of wetlands)	1 unit/ 2 acres (exclusive of wetlands)
in high yield aquifers	As above for public water supply watersheds	
In inland and coastal waterfront areas	1 unit/ 1.5 acres (exclusive of wetlands)	1 unit/ 1.5 acres (exclusive of wetlands)

Comments Regarding the Suitability of Soils and the Setback Distance Requirements

Connecticut is a State generally blessed with an abundance of rainfall. It is also a State that was subjected to the enormous forces of glacial action. Accordingly much of its soil mantle is thin and soil permeability is low. As a result much of our land has very shallow depths to bedrock and to the groundwater table. An examination of soils ratings for onsite sewage disposal prepared by the National Cooperative Soil Survey shows that most of our soils have substantial limitations for septic systems. The common phrase is that "all the good soils have been used up." While this is a considerable exaggeration, there are very serious limitations on our soils.

Many of our soils have very high seasonal groundwater tables, subject to great fluctuations over the course of a year. It is not uncommon for these water tables to be 18" or less below grade during the spring. When the reader considers that a minimum vertical separating distance of 24" of unsaturated flow is desirable for nitrification and viral removal is needed, the severity of this common limitation is evident.

At the other extreme are the soils that were traditionally considered "excellent" for on-site systems, the highly permeable sands and gravels, present in glacial outwash areas. While certain aspects of the renovative capacities of these soils are often misunderstood, they do not provide treatment that is as effective as the tighter soils. In most cases the cooperative soils survey stresses the potential for groundwater contamination in such areas.

An examination of the separating distances in the public health code for septic systems, compared to the engineering models utilized by DEP indicates that these distances are not conservative, but are in the reasonable range. Further, the authors have compared the relevant requirements in Connecticut's code with those in adjacent states, and selected additional jurisdictions. This analysis indicates that the numbers utilized in Connecticut are less conservative than those in most jurisdictions. As an example the vertical distance to seasonal high water, a critical element in both groundwater protection and total cost, is less in Connecticut than in any other New England state. The horizontal distance to a waterbody is also equivalent to the smallest requirement in New England.

One mathematical model for phosphorus attenuation developed in the Windham region shows that under certain conditions horizontal separating distances of more than 500 feet should be utilized. An alternate, bedrock withdrawal nitrogen dilution model developed by Rutgers indicates that in some till associations lot sizes of up to seven acres should be utilized. Standards developed as part of the Cape Cod Aquifer Management Project essentially agree with the data developed by CTDEP.

While no single number, or set of numbers can be correct in meeting the significant variety of environmental conditions, the foregoing is provided to indicate that existing, relevant regulatory constraints are not excessive either from a technical standpoint or in comparison with the requirements of other States. The Department cannot recommend the relaxation of this type of setback requirements in the light of substantive evidence that they should be increased.