The Last Thing That Planners Talk About Should Be the First

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Whenever I have dinner with my planner friends, I enjoy discussing the latest issues of the day. Top on the list, especially recently, have been adaptation planning for climate change, reconciling sustainable development with historic preservation, and developing infill strategies for suburbs to meet changing demographics and reposition the existing housing stock which is physically, economically, and functionally obsolescent. The debate goes on over whether the SmartCode™[1] is all that smart and whether its proponents are cultish. First Amendment issues are another hot topic sometimes causing religious land use and adult entertainment to become curiously and awkwardly melded.

Inevitably, and I mean always, by the time the dinner plates are cleared, coffee is poured, snifters of brandy set out, and desserts have made their way to the table, our conversation turns to sewerage. Yes, sewerage. Planners always talk about sewerage at the end of their dinner conversation. To save you from making the common nomenclature mistake, please be advised that "sewerage" is the equipment that collects, transports, treats, and ultimately disposes of the waste, "sewage," that goes down the drain. I think with that bit of information I have accomplished about half of what I set out to do in this discussion.

I would also like to say by way of introduction how pleased I was to be invited to participate in Julian Juergensmeyer's Festschrift. I have known him for most of my professional career in land use law—more

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1. Duany Plater-Zyberk & Co., SmartCode, *available at* http://www.dpz.com/pdf/3000_Smartcode.pdf.

than three decades, have followed his writings, and have especially appreciated the objectivity he brings to his work when too many land use lawyers and academics in the field allow themselves to be drawn into polemics. Professor Juergensmeyer did not assign me the subject of this article—he is way too proper to even bring up the subject.[2] The blame is mine alone for including it, with sixty-two color slides at the Festschrift and now memorializing that potty language talk in this scholarly collection of articles to the certain embarrassment of my fellow authors and the editors. I chose to address the issue because I believe, as most of my fellow land use planners do, that one of the key determinants of development density and patterns of land use is how we collect, transport, treat and dispose of wastewater. It is an entirely indelicate subject that makes most of us look down or wiggle a bit in our seats when we read or talk about it or make scatological jokes to overcome our own embarrassment.

I. Carrying Capacity[3]

The objective of my talk at the Festschrift and this accounting of those remarks is to explain more about the available treatment alternatives to big public systems and small backyard operations, how these alternatives affect patterns of land development, and what the issues are in implementing these alternative approaches.

Planners use the concept of "carrying capacity" when determining the density of development that can be accommodated by natural systems and the built infrastructure. Most planners assume that carrying capacity is fixed and finite. The origins of the concept date back to ship loading regulations in Crete around 2500 BCE, during the Roman Empire, and in the Middle Ages in the Venetian Republic.[4] The mod-

2. It could have been worse. I thought about the title "Thomas Crapper Was Only the Beginning" for this article, playing off the reputed inventor of the flush toilet. Then I fact checked and lo and behold the Thomas Crapper story is a myth, as revealed by Snopes.com. *See* Snopes.com, Thomas Crapper, http://www.snopes.com/business/names/crapper.asp (last visited Oct. 14, 2010). Yes, he took out nine plumbing patents between 1881 and 1896 but none were for the flush toilet. Joseph Adams in 1853 patented a flush mechanism eight years before Thomas Crapper started his plumbing business. The myth arose out of a fictional work in 1969 by Wallace Reyburn, *Flushed with Pride: The Story of Thomas Crapper*.

3. *See* Jonathan Douglas Witten, *Carrying Capacity And The Comprehensive Plan: Establishing And Defending Limits To Growth*, 28 B.C. ENVTL. AFF. L. REV. 583,583-608 (2001) (providing an overview on the subject).

4. International Maritime Organization, Historical Background Leading to The Adoption of The Load Lines Convention, http://www.imo.org/conventions/mainframe.asp?topic_id=1034 (last visited Oct. 14, 2010).

ern shipping concept, relevant to our purposes here, arose out of loading recommendations made by Lloyd's Register of British and Foreign Shipping in 1825.

Like the loading limits under the Plimsoll Mark system,[5] carrying capacity today as it applies to land development is not fixed and finite. Carrying capacity is elastic, tied to sustainability, incapable of rigid quantification, and essentially subjective. Planners need to step back from the view that we are locked into limits for development and understand that with the use of alternative treatment systems it is possible to have sustainable development at higher densities in areas where infill will lead to smarter growth. Alternative treatment systems for wastewater disposal will enable "smart sprawl"—the intensification of underdeveloped suburban land that will enable transitioning those communities to greater sustainability.

II. The Basics

Every land use lawyer should know the basics of wastewater treatment.[6] First, on the continuum from the largest to the smallest, there are at least

5. Many ships were still lost in storms because there was no system for determining the capacity of a vessel sailing during different times of the year in various parts of the world. Samuel Plimsoll (1825-1898), a British politician and social reformer successfully pushed legislation mandating a system by which the load level of ships would be marked to identify the level to which ships could safely be loaded depending upon whether they would be sailing in more buoyant, salty, ocean waters, or fresh water, and where in the world they would be sailing during what time of year. The marks which you see on the side of ships include: TF–Tropical Fresh Water, F–Fresh Water, T–Tropical Seawater, S–Summer Temperate Seawater, W–Winter Temperate Seawater, and WNA–Winter North Atlantic. For example, the load line for ships in the North Atlantic in the winter would be lower than the load line for ships in the tropics during the summer. United Kingdom Merchant Shipping Act (1876).

6. As you will see momentarily, this discussion should help you avoid the problem of the bagpiper because he did not know the basics of backyard septic system technology. One of the endearing qualities of Professor Juergensmeyer is the sense of humor he readily shares among his closest circle of friends. When you see Professor Juergensmeyer, you are likely to see Professor Arthur Christian "Chris" Nelson and Professor James Nicholas ("I'm an economist," he says, "and an economist is an accountant without a personality."). These conjoined triplets can quickly bring anyone to tears of laughter. Chris Nelson shared the bagpiper story with Professors Juergensmeyer and Nicholas and me in the exchange of messages after the Festschrift celebration when I sought their help in focusing the issues for this written discussion:

Chris Nelson: This is a beautiful story of a bagpiper who was late for a funeral. I know you will be touched like I was, pass it on to those you know who will be appreciative . . .

As a bagpiper, I was asked by a funeral director to play at a graveside service for a homeless man who had no family or friends. The funeral was to be held at a cemetery in the remote Irish countryside and this man would be the first to be laid to rest there. As I was not familiar with the area, I became lost and being a typical man, did not stop for directions. I finally arrived an hour late. I saw the backhoe and the crew who were eating

16,000 big public treatment works. The *New York Times* quotes a figure of 25,000 such systems, 9,400 of which have discharged untreated or partially treated sewage in the last three years.[7] These are the large systems that you see closest to the literal end of the pipe where the discharge is into some body of water. Most of the collection and transport in these systems is by gravity; as a result, the publicly-owned treatment works tend to be located at the lowest elevations and closest to the point of discharge.

At the other end of the size continuum are the individual, house-by-house systems. There are some 23 million septic systems of this type. The modern version of the onsite system consists of a large concrete tank of about 1250 gallons capacity in which the wastewater is first deposited to allow the solids to settle out with the liquids leaving the tank through an elevated drain pipe to a leaching field. The leaching field is a series of trenches called galleys in which perforated pipes or domed half pipes are placed above the groundwater level and back filled with sand and gravel. The combined length of the galleys is dependent on how much flow the system must serve, typically determined by the number of bedrooms in the home and the ability of the soil to accept the effluent (usually determined by a percolation test). Many jurisdictions require that a reserve area be identified for a new leaching field if the original field fails. The wastewater is renovated or cleansed, usually in a microbial layer or slime layer that builds up at the interface between the gravel and the native soil, as well as during the process of seeping in and around the particles of sand and gravel adjacent to the pipes in the leaching field. The large total surface area of all those small soil particles captures the contaminants leaving the effluent to filter on down through the subsoil until it reaches the water table.

Older backyard septic systems, many of which remain, have cesspools which are tanks without leaching fields that are typically loosely

lunch but the hearse was nowhere in sight. I apologized to the workers for my tardiness and stepped to the side of the open grave where I saw the vault lid already in place. I assured the workers I would not hold them up for long but this was the proper thing to do. The workers gathered around, still eating their lunch. I played out my heart and soul.

As I played the workers began to weep. I played and I played like I'd never played before, from Going Home and The Lord is My Shepherd to Flowers of the Forest and Danny Boy. I closed the lengthy session with Amazing Grace and walked to my automobile. As I was opening the door and taking off my jacket, I overheard one of the workers say to another, "Sweet Jeezuz, Mary 'n Joseph, I have never seen nothin' like that afore and I've been putting in septic tanks for twenty years."

7. Charles Duhigg, *As Sewers Fill, Waste Poisons Waterways*, N.Y. TIMES, Nov. 22, 2009, *available at* http://www.nytimes.com/2009/11/23/us/23sewer.html.

constructed of concrete blocks which allow the solids to settle to the bottom of the tank while the liquids pass through the cracks between the blocks and go on through the subsurface soils to be renovated as the effluent passes on to the groundwater. These systems ultimately fail over time and in most circumstances have to be dug up and rebuilt in place or replaced at another location on the site. Sometimes cesspool systems are do-it-yourself operations with the "tanks" consisting of a refrigerator or even an automobile.[8]

The septic system must be separated by some distance from the potable water supply well on a lot not served by public water. This separating distance creates a de facto lower limit on the size of lots that can be developed with onsite septic systems. The minimum lot size also varies depending upon the character of the soil and the presence of other hydrologic features such as watercourses and wetlands. It is not unusual to have minimum lot sizes of two acres or more where there is an onsite potable water well and a septic system. The separation of the subsurface sewage disposal from other activities, or the "isolation distance," varies. Minnesota law, for example, requires that a septic or holding tank and the leaching field be at least 50 feet from a potable well.[9] A privy has to be at least 50 feet away from the well and a cesspool, seepage pit, leaching pit or dry well has to be a minimum of 75 feet from a water well.[10]

Lot sizes in terms of dwelling units per acre or bedrooms per acre are limited by the underlying soils even in areas served by public water. The liquid effluent dispersed in the leaching field seeps to the underlying soils at rates that vary depending upon the nature of the soils. Lots with soils with very low percolation rates, such as those with clayey soils or with hardpan, are going to require larger leaching areas with low rates of discharge. Lots with soils that have high percolation rates also create problems because the effluent will move too quickly through the soil to the groundwater without sufficient renovation and those lots

8. *See, e.g.*, Amanda Goodman, *Seeping Waste Troubles Mobile Home Park* (CBS affiliate KRQE News 13 broadcast Feb. 26, 2010), *available at* http://www.krqe.com/dpp/news/environment/seeping-waste-troubles-mobile-home-park (website also contains a written report); Karen Dillon & Judy L. Thomas, *Cleaning Up Lake of the Ozarks a Vast Challenge*, Kan. City Star, Dec. 20, 2009, at A-1 (homemade, leaking septic tanks included buried automobile).

9. WELL MGMT. SECTION, MINN. DEP'T OF HEALTH, PROTECTING YOUR WELL: SELECTED WELL ISOLATION DISTANCE REQUIREMENTS (2010), *available at* http://www.health.state.mn.us/divs/eh/wells/construction/protect.pdf.

10. *Id.*

may need to be larger than normal to provide for lower rates of dosing in the leaching fields.

Onsite septic systems also are limited where they have to be constructed in or close to environmentally sensitive areas, such as water bodies, streams, and wetlands. There are water quality issues from onsite septic systems when the unrenovated leachate reaches groundwater or during periods of unusually high groundwater when leachate is unable to be absorbed and is forced to the surface. Furthermore, onsite septic systems are limited in many areas with impaired water quality by Total Maximum Daily Load (TMDL) requirements—"the maximum amount of a pollutant that a waterbody can receive and still safely meet water quality standards."[11] It is interesting to note that health code or local regulations aside, the saturated soils near and in wetlands can actually renovate nitrogen, a wastewater contaminant that is otherwise only treated by dilution. Therefore, there may be sound water quality protection reasons to locate leaching fields near (but not in) wetlands, assuming that the hydraulic acceptance rate of the soils and the depth to seasonal high groundwater are adequate.

The large publicly-owned treatment works are of limited use because they require a substantial number of users at moderate to high densities to justify the cost of constructing the expensive collection and transport systems to bring the effluent to the treatment works. Those piping systems are not economically justified in lower density areas including many suburban locations, especially where gravity flows will not work and expensive pumping stations would be required. Backyard septic systems are not well managed by many homeowners, can and do fail, sometimes pollute groundwater, and limit the density of development, particularly where onsite potable water wells are necessary and the soils are less than ideal for septic systems. The key to overcoming the limitations of the systems at both ends of the size continuum is to find alternative treatment systems that will enable higher density development at scattered sites.

III. Alternative Treatment Systems

A. *Where Alternative Treatment Systems Are Used*

Alternative treatment systems can be used with just about any wastewater-generating use. These are some examples:

11. EPA, Impaired Waters and Total Maximum Daily Loads, http://www.epa.gov/owow/tmdl (last visited Oct. 14, 2010).

- Residential communities[12]
- Schools[13]
- Restaurants[14]
- Shopping plazas/malls[15]
- Office buildings[16]
- Marinas[17]
- Grocery stores[18]
- Hospitals[19]
- Convalescent homes[20]
- Assisted living[21]
- Hotels[22]
- Recreational facilities[23]

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12. *See* J.L. Anderson & D.M. Gustafson, *Alternative Wastewater Treatment Systems, in* RESIDENTIAL CLUSTER DEVELOPMENT: ALTERNATIVE WASTEWATER TREATMENT SYSTEMS (1998), *available at* http://www.extension.umn.edu/distribution/naturalresources/components/7059-02.html.

13. *See* Stone Envtl. Inc. et al., Warren Elementary School Innovative/Alternative Wastewater Treatment and Dispersal System, *available at* http://www.stone-env.com/docs/posters/StoneWW-WarrenInnoAltOnsite_poster.pdf.

14. *See* UNIV. OF R.I. COOP. EXTENSION ONSITE WASTEWATER TRAINING CTR., NATURAL RES. SCI. DEP'T, QUALITY ASSURANCE PROJECT PLAN FOR FIELD SAMPLING OF ALTERNATIVE AND INNOVATIVE ONSITE WASTEWATER TREATMENT SYSTEMS (2003), *available at* http://www.dem.ri.gov/pubs/qapp/innovowt.pdf.

15. *See* David Interdonato & Eileen McCarthy, *Trends: Technology and Management of Municipal Wastewater*, 31 CLEARWATERS (2001), *available at* http://www.nywea.org/clearwaters/pre02fall/314010.html.

16. *See* ENVTL. PROT. AGENCY, ESTABLISHING TREATMENT SYSTEM PERFORMANCE REQUIREMENTS § 3.53 (2008), *available at* http://www.epa.gov/nrmrl/pubs/625r00008/html/625R00008chap3.htm.

17. *See* TUNICH-NAH CONSULTANTS & ENG'G, ENVIRONMENTAL IMPACT ASSESSMENT FOR PELICAN POINT MARINA & YACHT CLUB (2008), *available at* http://www.doe.gov.bz/documents/EIA/Pelican%20Point/Chapter%206.pdf.

18. *See* Della Batts, *Alternative Septic Systems Bringing Big Changes in Hollister*, ROANOKE DAILY HERALD, May 29, 2010, *available at* http://www.rrdailyherald.com/articles/2010/05/29/news/doc4c01ae73e947b932235106.txt.

19. *See* Mass. Dep't of Envtl. Prot., Nonresidential Septic System Users, http://www.mass.gov/dep/water/wastewater/nonresid.htm (last visited Oct. 14, 2010).

20. NAYADIC, CONSOL. TREATMENT SYS., OWNER'S MANUAL: WASTEWATER TREATMENT SYSTEMS (n.d.), *available at* http://www.consolidatedtreatment.com/index.php?option=com_wrapper&view=wrapper&Itemid=97.

21. *See* Cape Cod Water Prot. Collaborative, Existing Wastewater Treatment Facilities, http://www.ccwpc.org/index.php/municipal-wastewater-management/existing-wastewater-treatment-facilities (last visited Oct. 14, 2010).

22. *See* INT'L ENVTL. TECH. CTR., SOURCE BOOK OF ALTERNATIVE TECHNOLOGIES FOR FRESHWATER AUGMENTATION IN LATIN AMERICA AND THE CARIBBEAN § 3.1 (1997), *available at* http://www.oas.org/DSD/publications/Unit/oea59e/ch25.htm.

23. *See* Anderson & Gustafson, *supra* note 12.

B. *Types of Alternative Treatment Systems*

There are many types of alternative treatment systems, but they might be subcategorized into shared or community systems and advanced technology alternative treatment systems. The terminology is by no means settled. Delaware, for example, refers to them as "innovative and alternative (IA) onsite wastewater treatment and disposal systems."[24] Connecticut considers two or more residences on a system to be a "community sewerage system"[25] while an "alternative sewage treatment system" is one or more buildings connected to a system using a method other than a subsurface sewage disposal system that involves discharge to the groundwaters of the state.[26]

1. SHARED OR COMMUNITY SYSTEMS

Shared systems are basically backyard septic systems on steroids. Take a twenty-lot subdivision of single-family detached homes on quarter-acre lots, pipe the wastewater from the houses to a single, large septic tank where the solids can settle out, and discharge the liquid effluent through a pump chamber or distribution box to a large leaching area. The technology is simple and the operation and maintenance are straightforward. There may be some advantages to shared systems in terms of managing pollutants. They work essentially the same in handling solids and organics. Both of them can have grease traps and use a septic tank or other primary settling tank. Both use a conventional leaching system, but the shared system may incorporate some additional technology to enhance the biological processes.

With a conventional septic system, there is some nitrogen removal by natural processes in the septic tank and the leaching field and some treatment in the soil with dilution from rainfall. In the shared system with additional treatment it may be possible to remove up to eighty percent of the nitrogen if the systems are properly designed, operated, and maintained—an issue of major importance discussed in more detail below.

There is some phosphorous removal in the conventional septic system through natural processes in the septic tank and the leaching field

24. DIV. OF WATER RES., DEP'T OF NATURAL RES. & ENVTL. CONTROL, REGULATIONS GOVERNING THE POLLUTION CONTROL STRATEGY FOR THE INDIAN RIVER, INDIAN RIVER BAY, REHOBOTH BAY AND LITTLE ASSAWOMAN BAY WATERSHEDS 7 (2008), *available at* http://www.wr.dnrec.delaware.gov/Documents/IBPCS_Effective_111108.pdf.
25. CONN. GEN. STAT. § 7-245(3) (2010).
26. *Id.* § 7-245(2).

and as the liquid effluent passes through the soil. Again, with the addition of a technology and active treatment, the shared system may allow removal of up to ninety percent of the phosphorous.

Finally, a conventional septic system removes bacteria and viruses by natural processes in the leaching fields, through attachment to soil particles, and by the retention time in the soil and in the groundwater. The shared system may make it possible to enhance those processes through the addition of active disinfection.

2. ADVANCED TECHNOLOGY ALTERNATIVE TREATMENT SYSTEMS

There are many types—too many to describe in any detail—of alternative treatment systems and technologies. "Alternative treatment system" may be a generic term including anything beyond a single residence with a backyard septic system, such as the shared system just described. Here is a partial list; all are essentially mini or package sewage treatment plants:

- Zenon membrane bioreactor[27]
- Bioclere trickling filter[28]
- FAST submerged media activated sludge[29]
- Recirculating sand filter[30]
- Rotating biological contactor[31]
- Activated sludge[32]
- Extended aeration[33]
- Sequencing batch reactor (Amphidrome or other)[34]

27. GE Power and Water, ZENON Environmental, http://www.gewater.com/zenon.jsp (last visited Oct. 14, 2010).

28. *See* AquaPoint, Bioclere, www.aquapoint.com/bioclere.html (last visited Oct. 14, 2010).

29. SMITH & LOVELESS, INC., FIXED ACTIVATED SLUDGE TREATMENT (FAST®) PROCESS TECHNOLOGY OVERVIEW (2002), *available at* http://www.eco-oczyszczalnie.pl/downloads/FAST-Process-(9538-1).pdf.

30. NAHB Research Center, Re-circulating Sand Filters: Improved On-site Wastewater Treatment and Disposal Technology, http://www.toolbase.org/Technology-Inventory/Sitework/recirculating-sand-filters (last visited Oct. 14, 2010).

31. Water/Wastewater Distance Learning Website, Lesson 16: Rotating Biological Contactors, http://water.me.vccs.edu/courses/env110/lesson16.htm (last visited Oct. 14, 2010).

32. UCLA College of Letters and Science, Microorganisms and Their Role in the Activated-Sludge Process, http://www.college.ucla.edu/webproject/micro7/studentprojects7/Rader/asludge2.htm (last visited Oct. 14, 2010).

33. Water/Wastewater Distance Learning Website, Extended Aeration and Packaged Plants, http://water.me.vccs.edu/concepts/packplants.htm (last visited Oct. 14, 2010).

34. OFFICE OF WATER, ENVTL. PROT. AGENCY, WASTEWATER TECHNOLOGY FACT SHEET: SEQUENCING BATCH REACTORS (1999), *available at* http://www.epa.gov/OWOWM.html/mtb/sbr_new.pdf.

- White Knight aeration and biological enhancement[35]
- Kubota membrane filtration[36]
- Fluidyne ISAM[37]
- Cromaglass[38]

C. *Wastewater Management Costs*

More treatment costs more money. Construction, operation, and maintenance costs vary depending upon the type of system and where it is located. A rough approximation of the difference in costs is possible. The standard backyard septic system costs $5,000-$10,000 to build, though so-called "engineered" systems with mounded leaching fields required to overcome problems of high groundwater levels can cost two or three times that amount. The operation and maintenance costs for a conventional septic system are a couple hundred dollars a year, principally for pumping out the septic tank to remove the solids every two or three years.

Alternative treatment systems with active treatment cost $13,000-$18,000 per unit to construct and have annual operation and maintenance costs of $500-$1,000 for an individual system and $150-$200 per dwelling unit where the system is shared among many units.

Private sewage treatment plants, essentially the same as the large publicly-owned treatment plants working on a much smaller scale, suffer from the lack of economies of scale and can be quite expensive. Construction can cost $30,000-$60,000 per dwelling unit and operation and yearly maintenance is upwards of $700-$1,000 per unit.

D. *Design Issues*

Alternative treatment systems present design issues requiring attention of state, regional, and local authorities. Site hydraulics are critical as suggested in the earlier discussion about percolation rates. Site hydraulics determine the ability of the site to accept the design flow even

35. Div. of Water Res., Dep't of Natural Res. & Envtl. Control, Innovative and Alternative System Approval (Sept. 6, 2007) *available at* http://www.wr.dnrec.delaware.gov/Information/GWDInfo/Documents/060706whiteknightapproval.pdf (The Delaware Department of Natural Resources and Environmental Control's approval of the Knight Treatment Systems microbial inoculator generator).

36. Japan Society of Industrial Machinery, Ceramic Membrane Filtration System Kubota FILCERA®, http://www.gec.jp/JSIM_DATA/WATER/WATER_1/html/Doc_172.html (last visited Oct. 14, 2010).

37. Fluidyne Corporation, http://www.fluidynecorp.com/ (last visited Oct. 14, 2010).

38. Cromaglass Corporation, http://www.cromaglass.com/ (last visited Oct. 14, 2010).

during times of high groundwater, such as in the spring in those regions where the soil is saturated and there is the greatest rainfall. The ability of the site to accept the flow without "breaking out" or seeping to the surface is essential in achieving renovation of the wastewater before it is discharged into the groundwater or surface water. Renovation is measured by regulatory standards in terms of the concentration of identified contaminants. Variables that must be considered include the soil permeability (often approximated by the percolation rate), the depth to groundwater and gradient, and geotechnical characteristics of the site such as surface water and bedrock.

The physical size of the system—principally an issue with subsurface disposal and leaching fields—is also an important consideration. Determining the size requires knowing the percolation rates, physical properties of the receiving soils, whether the effluent is going to be dispersed by gravity or under pressure, and sometimes the concentrations of contaminants in the wastewater.

Renovation is important in comparing backyard septic systems with shared systems and alternative treatment systems. To properly renovate for bacteria, for example, it may be necessary to provide for three weeks or more of travel time for the effluent to move from its point of discharge to an area of environmental or regulatory concern so that the bacteria in the wastewater can die off. Viruses require a certain distance of unsaturated flow from the bottom of the leaching structure to the highest point of groundwater. Two feet or more of distance may be mandated.

Phosphorus has become the battleground in much of the debate over alternative treatment systems with some governments taking the position that no phosphorus should ever reach a property line, watercourse, water supply well, or other sensitive receptor. Finally, nitrogen, assuming that ammonia nitrifies, needs to be diluted by rainfall infiltration and be reduced to a certain level of concentration before it reaches some sensitive receptor. The debate continues over the amount of concentration but the human health standard is 10 milligrams per liter[39] a figure that may be 5 to 10 times higher than the standard necessary to protect amphibian larvae.

39. Delaware has some useful forms online. Delaware Department of Natural Resources and Environmental Control, Division of Water Resources, http://www.wr.dnrec.delaware.gov/Information/GWDInfo/Pages/GroundWaterDischargesForms.aspx (last visited Oct. 14, 2010); *see also* Susan Peterson, *Nitrogen Removal in Small Flows Wastewater Facilities in Massachusetts*, 7 SMALL FLOWS Q. 29, 29 (2006), *available at* http://www.nesc.wvu.edu/nsfc/Articles/SFQ/SFQ_su06/Juried.pdf.

E. *Performance and Reliability*

The most recent evidence suggests that alternative treatment systems can provide high levels of treatment if—isn't there always an "if" when it comes to technology?—they are properly designed, installed, operated, and maintained. It may be desirable to have these systems use soil absorption systems to get additional treatment for nutrients and pathogens, although sometimes it is more practical and desirable to discharge to surface water.[40]

F. *Planning Considerations*

Alternative treatment systems can be advantageous in land planning. They can enable development of unsewered areas, relieving development pressure on more environmentally sensitive lands. Alternative treatment systems increase the carrying capacity of the land. By allowing certain land to be brought into production, density can be transferred, and other lands preserved. Finally, alternative treatment systems reduce conflicts between the development and use of potable water supplies and wastewater treatment. Alternative systems are sometimes viewed as usable for environmentally sensitive lands or rural land that may not otherwise support such development due to lack of either infrastructure or capacity to support conventional systems.

IV. What Planners Must Do

This is an area where planning activism is essential. First, comprehensive plans should identify environmentally sensitive areas that are the highest priority for preservation and those that will support only the most limited development. Recognizing the need to meet development demands, other lands, particularly those that are unsewered but have little or no environmental sensitivity, should be identified as areas where alternative treatment systems might be developed. Planners should undertake a thorough analysis of the following alternative treatment systems: federal and state regulatory requirements as to their installation, operation, and maintenance; state regulation of such systems; and local laws, including the failure at all three levels of government to address

40. Consideration of the technology can be complicated. *See* Leyland Alliance LLC, App. No. 20040181 (Conn. Dep't of Envtl. Prot. Sept. 23, 2008), *available at* http://www.ct.gov/dep/lib/dep/adjudications/decisions_pdf/092308madisonlandingfinaldecision.pdf.

alternative treatment systems.[41] More often than not, there is incomplete and inadequate state, substate-regional, and local regulation of alternative treatment systems.[42]

For the most part, land economics and markets are the principal controlling force in how land is ultimately used. The important limiting factor is infrastructure and, although those who spoke at the Festschrift and have written on other elements of infrastructure including transportation, electricity, and water may argue the point, I respectfully submit that the most critical limiting determinant of density is ultimately wastewater treatment and disposal. Land use planning and conventional regulation, such as subdivision controls and zoning, are probably in third place after the market and infrastructure even though planning and public regulation are absolutely essential to protecting the interests of constituents who have little or no voice in land use decision making and the interests of the generations not yet born. Land use planning and traditional local regulation serves us all most effectively when it intercedes at times of market failure, for example when the government regulates to preserve a sole-source aquifer or to stop a developer from building another white Georgian colonial McMansion on a ridge top.

Planners need to refocus on capital improvement programs and infrastructure planning which was our first focus of master planning, because public and private investments and the increasing carrying capacity that comes from infrastructure improvements have a significant impact on land use decision making, often far beyond mere land use planning and traditional land use regulation.

Wastewater treatment and disposal through alternative treatment systems requires that planners coordinate at the state and regional level for growth management and incorporate those multitier plans into the process of designating areas permitted for alternative treatment system development. This process is characteristically interactive and iterative. Planning starts at the local level, moves up to the state, and may push on to the federal level through total maximum daily loads. But, it also comes from the top down, and each part of the process builds on

41. For a comprehensive state system, *see* OFFICE OF WATER RES., R.I. & PROVIDENCE PLANTATIONS DEP'T OF ENVTL. MGMT, RULES ESTABLISHING MINIMUM STANDARDS RELATING TO LOCATION, DESIGN, CONSTRUCTION AND MAINTENANCE OF ONSITE WASTEWATER TREATMENT SYSTEMS (2009), *available at* http://www.dem.ri.gov/pubs/regs/regs/water/owts09.pdf.

42. One example of a detailed local ordinance is WESTPORT, CONN., CODE OF ORDINANCES part II, ch. 30, art. VI, div. 3, § 30-227 (2006), *available at* http://library.municode.com/index.aspx?clientId=14484&stateId=7&stateName=Connecticut.

the prior one such that as areas are identified for increased density and more intensive development through the implementation of alternative treatment systems, preservation areas can be expanded.

Planners, regulators, developers, alternative treatment system designers and manufacturers, installers, operators, engineers, and consumers are all still learning about the benefits and shortcomings of alternative treatment systems. Critical to optimizing the safe, effective, and efficient use of alternative treatment systems is careful design, proper installation, operation, and maintenance, and careful monitoring of performance.[43] Due consideration of how these systems are to be operated and maintained, and an audit system by which periodic inspections and performance evaluations will be conducted throughout the lifecycle of the system, must be built into the regulatory process.[44] There must be adequate capital reserves for the replacement of the system at the end of its lifecycle and some contingency for catastrophic failure.

V. Conclusion

Alternative treatment systems can fill the great middle gap between large publicly owned treatment works and the backyard cesspool. They can enable densification through infill in suburban areas. They can allow us to create walkable, urban-scale villages in suburban, exurban, and rural areas. They can provide relief from development pressure thereby enabling the preservation of critical environmental resources. Still, alternative treatment systems cannot be embraced uncritically. There must be targeted areas identified in substate-regional and local plans. The systems must be certified, permitted, properly installed, operated, maintained, inspected, and analyzed for performance if they are to be more panacea than problem.

43. *See* THE NATURE CONSERVANCY, ALTERNATIVE ON-SITE SEWAGE TREATMENT SYSTEMS: WATERSHED IMPLICATIONS (2007), *available at* http://www.nature.org/wherewework/northamerica/states/connecticut/files/ats_white_paper.pdf.

44. On tracking, see Penelope Grenoble O'Malley, *When Tracking Is Critical*, ONSITE WATER TREATMENT (2006), *available at* http://www.forester.net/ow_0611_when.html. For a performance report, see BUREAU OF MATERIAL MGMT. & COMPLIANCE ASSURANCE WATER PERMITTING & ENFORCEMENT DIV., CONN. DEP'T OF ENVTL. PROT., ZENON PERFORMANCE APPRAISAL (2008), *available at* http://www.ct.gov/dep/lib/dep/water_regulating_and_discharges/subsurface/080312_zenon_performance_appraisal.pdf.