

WATERSHED BUILD-OUT ANALYSIS

Watershed Build-Out Analysis

A build-out analysis is a useful technique to determine the potential number of new residential dwelling units and maximum commercial/industrial square footage that can be built in a given area, such as a municipality or watershed. By using a parcel map, property owner information, an existing land use/land cover map, and a municipal zoning map and ordinances, the amount of developable land can generally be determined. However, the accuracy of this analysis is based to a great extent on the accuracy of the data that is available.

The build out analysis for Berry's Brook Watershed included portions of three municipalities--Greenland, Portsmouth and Rye. The following maps were used from the Watershed Map Inventory: the Parcel Map, the Zoning Map and the Hydric Soil coverage from the Soil Map. The only other information that was required was land use/land cover. Since there was no recent mapping of this information, the Portsmouth Planning Department conducted a windshield survey that was verified by Watershed Council members. Therefore, while most of the Map Inventory information in this analysis is reasonably accurate, the land cover information should be considered in light of the manner in which it was prepared.

By combining the above maps into a composite map, the gross areas of available land was determined. This determination was based upon the following methodology:

1. All areas of very poorly drained soils and known critical resource areas, such as Atlantic white cedar stands, were eliminated from consideration.
2. Areas that were relatively small and/or not accessible to roadways were generally discarded on the assumption that they would be unlikely to be developed. For example, there is a small portion of the Trefethen property in Rye on the Portsmouth boundary that was not considered developable, because it is cut off from access by a significant amount of very poorly drained soils.
3. All publicly owned parcels were eliminated from consideration.

For the remaining potentially developable areas the following procedure was used to determine the amount of available acreage.

1. The area of each potentially developable area was calculated.
2. For each area, approximately 15% of the total acreage was deducted to account for any critical on-site resources, such as wetlands, and interior subdivision roadways.

3. Using the Watershed zoning map, the remaining acreage of each undeveloped area was categorized as residential or commercial/industrial and density calculations were prepared for each. This resulted in either potential new residential units or potential commercial/industrial square footage for each area. These individual areas were then aggregated for each community and totalled for the Watershed as shown in **Table 4**.

Table 4 - Potential Watershed Build Out

	<u>Residential Units</u>	<u>Acres</u>	<u>Commercial/Industrial Space(sf)</u>	<u>Acres</u>
Greenland	100	150±	NA	NA
Portsmouth	290*	175	220,000	265
Rye	<u>350</u>	<u>410</u>	<u>1,300,000</u>	<u>95</u>
Total	740	735	1,520,000	360

* Includes 100 mobile home units.

In spite of the fact that much of the Watershed is developed and that much of the watershed is classified as very poorly drained soils, there is still a significant potential for additional residential and commercial/industrial growth. These numbers only serve to indicate the relative potential for future growth since the analysis relies upon existing generalized land use data. In addition, these numbers may be modified downward, since poorly drained soils in Rye, included in its Wetland Overlay District, were not totally eliminated from consideration.

ACTION PLAN

Watershed Goal and Policies

Goal

Protect the unique natural inland and coastal resources of the Berry's Brook - Bellyhack Bog drainage basin and the Berry's Brook - Little Harbor estuary within an inter-municipal management framework that allows for appropriate development and recreational use.

Policies

1. Protect and enhance the quality of surface and ground water resources within the Berry's Brook Watershed through sound land use policies, regulatory enforcement, public education, and proper infrastructure maintenance and improvements.
2. Protect open spaces that have significant scenic, recreational, wetland, water, wildlife, fishery, and/or rare and endangered species value through acquisition, easement, or some other means.
3. Promote appropriate public access and recreational opportunities within designated portions of the Berry's Brook Watershed.
4. Preserve and protect critical fish and shellfish resources, wildlife habitat and migration corridors, and rare and endangered species through proper management and regulation.
5. Identify and protect environmentally sensitive natural resource areas including rivers and streams, shorelands, the estuary, coastal and inland wetlands, floodplains, and aquifer recharge areas.
6. Direct new development away from environmentally sensitive areas through proper land use regulation.
7. Minimize the negative impacts of existing and proposed development on surrounding natural, scenic, open space, and passive recreational resources.

Watershed Management Strategies

While much of the Berry's Brook Watershed is developed, significant land remains available for development. In addition, there is a potential for redevelopment of some existing uses, especially the commercial uses along Lafayette Road. The watershed management strategies presented below address impacts from existing and future development activities, as well as provide opportunities for public use of the Watershed's natural resources.

These strategies can be broken down into two general categories--regulatory and non-regulatory. Regulatory strategies that are suitable for the Watershed include:

- o zoning;
- o subdivision regulations;
- o site plan review regulations;
- o wetlands and groundwater protection;
- o erosion and sediment control;
- o stormwater management;
- o wastewater management; and
- o hazardous materials management.

The first four strategies listed above deal primarily with controlling future land uses within the Watershed, while the remaining four deal with controlling potential sources of pollution from both existing and future land uses.

Non-regulatory strategies for the Watershed include:

- o land acquisition,
- o conservation easements,
- o current use taxation,
- o transfer of development rights, and
- o public education and information.

The implementation of a mix of these management strategies is critical to the long-term protection of the Watershed's water and wetland resources. To the extent possible, these strategies should be addressed and implemented as a fully integrated package in order to provide the highest level of protection and management of the Watershed's resources.

A number of these strategies are consistent with the goals of existing and updated master plans. For example, Portsmouth has recommended the adoption of a wetland ordinance in furtherance of its Master Plan goal to "continue to protect the function of natural resources through innovative zoning techniques." In addition, Rye and Portsmouth have protected open space and critical natural resource areas through acquisition, e.g. the Adams property along Berry's Brook, and conservation easements, e.g. the areas surrounding the Woodlands Development. Thus, the strategies presented here are meant to reinforce, and expand upon, some of the activities that the Watershed communities have already begun.

As a part of the Action Plan for the Watershed, a **Watershed Management Plan Map** was prepared that identified various management areas including, Protected Resource Areas, such as high salt marsh and publicly owned lands; Resource Management Areas, such as poorly drained soils and parcels with high resource value; Public Access Areas; and Developable Lands. Many of the recommended management strategies that follow are included graphically on this map.

Regulatory Strategies

Zoning

Issue: Regulatory protection for the Watershed's resources is fragmented among three communities--Greenland, Portsmouth, and Rye. While there is state jurisdiction through a permit process over certain activities in wetlands (NH RSA 482-A) and significant alteration of terrain (NH RSA 485A:17), the primary control for development is at the local level. Each community has varying degrees of control over activities that might impact the Watershed's natural resources and quality of the water in Berry's Brook. Rye is the only community to have a natural resource protection zone -- a Wetlands Ordinance and a Conservation District that includes the salt marshes adjacent to the lower end of Seavey Creek adjacent to the Watershed. Portsmouth has several Conservation Districts in the watershed and several Rural Districts that require large lot zoning (5-acre lots). Portsmouth is also currently considering the adoption of a wetlands district. Greenland relies only on large lot zoning--60,000sf--as a means to protect watershed resources.

Discussion: Zoning regulates the use and density of land development by establishing minimum building lot sizes, maximum lot coverages, and setback distances from property boundaries, streets, and sensitive resource areas (i.e., estuaries, wetlands, streams, or other water bodies). Controlling future land use is clearly an important element of protecting the Watershed's sensitive natural resources and the quality of Berry's Brook. Although there is no established minimum lot size which assures the protection of water quality, it is generally accepted that lot sizes based upon the potential impact to critical natural resources, when coupled with appropriate site development guidelines, provide better water quality protection.

While there has been a reliance on large lots, i.e., greater than one acre, as a means to protect natural resources, a more suitable approach is to ensure that the overall density within a given area be compatible with the ability of the environment to sustain given types of development. This approach can usually be accomplished through a more flexible zoning technique, such as cluster or open space zoning. In essence, this option allows higher density on land within a large parcel that can accommodate such an increase, while providing areas of open space where the land is more sensitive. The overall density of the parcel remains the same as the underlying zone. In addition, any such changes to the zoning density should be accompanied by appropriate coverage and setback requirements to ensure protection of any adjacent sensitive resource areas. When zoning regulations are designed in a manner which considers the land's capacity to attenuate nutrients and other pollutants, flexible zoning can be one of the most effective tools available to a community to preserve critical natural resources.

In addition, there are a number of options for protection of specific natural resources through the use of overlay districts that in effect overlay the existing underlying zone while affording additional protection to a particular resource. Commonly adopted overlay zones include: watersheds, wetlands, slopes, and shorelands. Rye has already adopted a Wetland Ordinance. The New Hampshire Office of State Planning has prepared a *Model Shoreland Protection Ordinance* (1993) for use by local communities.

Recommendations:

1. Base any future zoning changes upon the capacity of the Watershed's land and water resources to accommodate development.

- a. Cluster/Open Space Development

Each of the communities in the Watershed should adopt a cluster or open space development option where the overall residential lot densities are equal to, or greater than, 40,000 square feet. If adopted, the original residential zone setback dimensions, etc. could remain the same.

- b. Increased Lot Size

Portsmouth should consider rezoning the SR II zone that is within Berry's Brook Watershed to SR I, thus making the minimum lot size 40,000 square feet. Where site conditions dictate and/or where sewer is available, density may be increased through the cluster option.

2. Adopt and implement a Watershed Protection District for the protection of the Berry's Brook/Little Harbor Watershed. This district would establish specific land use controls for residential and nonresidential areas within the watershed. The overlay district would be established as a Watershed Protection District provision within local zoning ordinances, under the authority of NH RSA 674:21.

An ordinance of this kind may:

- o Define the boundaries of the District to include all land draining to Berry's Brook to the greatest extent possible. For regulatory purposes, the district boundaries should be easily identifiable, or legally defined, landmarks, such as roads or town boundaries.
- o Permit, only by special exception, any non-residential land use which involves the usage or storage of hazardous materials, herbicides, pesticides, or fertilizers.
- o Consider the development and implementation of a resource-based land use allocation model for the Watershed that is based on the assimilative capacity of Berry's Brook. For example, see *Phosphorous Control in Lake Watersheds: A Technical Guide to Evaluating New Development*, Maine DEP, 1989 or *Model Subdivision Regulations for Soil-Base Lot Size*, NHDES and Rockingham County Conservation District, June 1991.
- o Include provisions for shoreland protection that use the *Model Shoreland Protection Ordinance* prepared by the NH Office of State Planning, January, 1993 as a source document. Within a defined shoreland area consider the prohibition of certain commercial uses--such as gas stations that are currently permitted in Rye's commercial district--which may cause significant impact to the Brook. The **Watershed Management Plan Map** includes a 250-foot buffer zone around the Berry's Brook and its tributaries to identify those areas where such provisions may be appropriate.

Subdivision/Site Plan Review Regulations

Issue: Portsmouth's subdivision and site plan review regulations generally lack specific standards for protection of the Watershed's sensitive natural resources. Greenland's subdivision regulations have strict standards for septic systems, but lack specific standards for protection of the Watershed's resources. Greenland's site plan review regulations provide minimal standards for development. Rye's subdivision and site plan review regulations are generally appropriate for managing development in the Watershed, but the guidance document cited for managing erosion and sedimentation from new development is outdated. Furthermore, in some instances planning boards have approved plans with conditions for open space and conservation areas, but these conditions have not been legally recorded as part of the deed in the county registry of deeds.

Discussion: Subdivision regulations constitute an important means of local control over the quality of proposed multiple lot/commercial-industrial developments in each of the Watershed communities. These regulations establish:

- o provisions for the local review of preliminary and final subdivision plans; and;
- o design standards for subdivisions.

Within these regulations, standards for erosion and sediment control, stormwater management and open space set asides may be established to protect sensitive Watershed resources. Further discussion of some of these standards follow this section.

Recommendations:

1. Revise each community's subdivision/site plan review regulations to incorporate the following provisions:
 - o specify that an Environmental Impact Review (EIR) may be required, and
 - o require a claim of "no adverse phosphorous, nitrogen, or coliform impacts to Berry's Brook". To substantiate this claim, the regulating board may conduct a technical review by a consultant of its choice.

These provisions should apply to any proposed subdivisions greater than five acres or site plans for a commercial/industrial use greater than 50,000 square feet of gross floor area (Portsmouth' Site Review Regulations already generally conform to these threshold criteria)

2. Revise each community's subdivision and site plan regulations to incorporate standards for erosion and sediment control and stormwater management, as outlined in subsequent sections.

3. Consider the adoption of a regulation that requires a cutting plan for any cutting/ logging activity within the Watershed that directly impacts 40,000 square feet or more, whether for purposes of timber sale or new development.
4. Each community's subdivision and site plan review regulations should provide for the option of conducting a technical review at the expense of the applicant for any proposed activity that might have an adverse impact on the sensitive resources, such as critical wetlands, of the Watershed. Such a review should be conducted by a recognized authority, such as a certified civil engineer, certified soil scientist, certified wetland scientist or expert natural scientist.
5. Ensure that any conditions of subdivision or site plan approval, that set aside property for open space or conservation, be legally recorded as part of the deed at the Rockingham County Registry of Deeds.

Wetlands Protection

Issue: Wetlands, both tidal and fresh water, are resources that provide many valuable functions, including the removal of sediments, nutrients, and other potential pollutants from stormwater runoff and other overland flows to Berry's Brook. In addition, the wetlands of the Watershed provide: 1) flood control, 2) habitat for fin fish, shellfish, and a variety of wildlife, 3) communities of rare, endangered and threatened species and 4) potential recharge areas for ground water supplies. Past development in certain areas of the Watershed, particularly along Lafayette Road, have had a negative impact on the Watershed's wetland resources. For example, the Woodlands residential development has encroached directly into a potential Prime Wetland area, BB-7. The protection of wetlands within the Berry's Brook Watershed is critical to protecting the Brook and other sensitive resources within the watershed.

Discussion: Wetlands are currently regulated at both the federal level (Section 404 of the Clean Water Act) and the state level through RSA 482-A. The New Hampshire statute was designed to preserve the critical natural functions of wetlands as outlined above.

At the federal level, the Army Corps of Engineer (ACOE) manages the wetlands program for permitting any dredging or filling of wetlands. Through an agreement with the ACOE, the state Wetlands Board administers both the federal and state programs to permit any dredging or filling of wetlands up to three (3) acres in size. Any state approved project is subject to a 21-day waiting period for an ACOE review, comment or intervention, if appropriate. The Conservation Commissions in Greenland, Rye and Portsmouth are empowered through state statute to comment on, and set conditions on, development proposals which may significantly impair critical wetlands functions.

As part of the New Hampshire wetlands law there is also a local option that provides for the identification of Prime Wetlands (RSA 482-A:15). The aim of this provision is to establish criteria for municipalities to select wetlands of significant value that are worthy of extra protection because of their uniqueness, quality, fragility and/or unspoiled character. The law also provides guidance as to the special consideration that needs to be taken by the local Conservation Commission and the state Wetlands Board.

At the local level, only Rye has implemented a wetland ordinance that specifies permitted and non-permitted uses and the exclusion of any wetlands as part of lot size calculations for minimum lot size. In addition, minimum lot size may be further adjusted based upon the provision in Rye's Subdivision Regulations that requires High Intensity Soil Mapping.

Although Greenland has no wetlands overlay district, there is large lot zoning in the watershed and strict regulation for septic system installation. In addition, although wetlands may be included in minimum lot size calculation, more than one (1) acre must be non-wetland soil.

Portsmouth does not have a wetland overlay district, although a draft ordinance is currently being developed. In addition, Portsmouth's subdivision and site plan review regulations have only minimal language to encourage protection of this resource.

Recommendations:

1. The City of Portsmouth should adopt a wetlands ordinance, as well as additional provisions in its subdivision and site plan review regulations to protect wetland resources.
2. The Town of Greenland should adopt a Wetlands Ordinance based upon hydric soils maps from the SCS. In addition, consideration should be given to allowances for smaller lot sizes in the residential zone as long as there is no negative impact on the watershed's wetland resources. This can be accomplished through a density bonus provision, cluster ordinance and/or provisions for an Environmental Impact Review in the subdivision regulations, as recommended previously in this report.
3. Portsmouth and Rye should consider adopting as Prime Wetlands those wetlands already identified in the Wetland Inventory Section of this plan and previous mapping studies, pursuant to NH RSA 482-A:15. In Portsmouth these would include wetlands BB-3, BB-7, PB-3. In Rye these would include wetlands BE012 and BE014 through BE018.

Erosion and Sediment Control

Issue: Sedimentation associated with the off-site transport of sediment during construction activities, as well as from existing uses with large impervious surfaces, may be one of many principal threats to water quality in Berry's Brook.

Discussion: The implementation of soil erosion and sediment controls is site-specific, and numerous factors contribute to determining the level of complexity necessary for a given control plan. The topography, size of disturbed area, volume and direction of runoff, soil characteristics, vegetative cover, and length and steepness of slope are all important factors in the site's susceptibility to soil erosion. In turn, these factors determine the type of control measures which should be implemented. In general, the goals of erosion and sediment controls during construction and development are to:

- o keep disturbed areas small;
- o stabilize and protect disturbed areas as soon as possible;
- o keep stormwater runoff velocities low;
- o protect disturbed areas from stormwater runoff; and
- o retain sediments within the corridor or site area.

While the subdivision regulations in each of the watershed communities require sediment and erosion control, only Rye specifically identifies guidelines (*Erosion and Sediment Control Design Handbook for Developing Areas in New Hampshire*, SCS, 1981) to be followed by the site developer. By naming a specific document or methodology, a community may lose some of the desired flexibility to keep current with the required practices and compliance standards as new technologies or information become available. For example, the handbook cited above was updated in 1992. One alternative to resolve this issue is to add language which allows for the use of other documented and accepted erosion and sediment control practices or guidelines. On the other hand, the community should keep abreast of commonly accepted, updated guidance documents that are suitable for reference in its land use regulations.

Compliance standards may either take the form of engineering or design standards or performance standards. Engineering standards consist of specific control mechanisms that must be included in the proposed development plans (e.g., hay bales, silt fences, sediment basins, sod waterways, etc.) for a given site. Environmental performance standards, on the other hand, are an alternative to engineering standards. Performance standards are designed to take into account the natural characteristics of the land for both erosion potential as well as runoff retention capabilities.

For further discussion of erosion and sediment control standards, see **Appendix E**.

Recommendations:

1. Each Watershed community should reinforce, and or update, existing local sediment and erosion control provisions of the subdivision regulations to include specific recommendations for minimum sediment and erosion control measures for all sites disturbed during construction. Specify a guidance document that developers should follow, or document specific requirements within the regulations. Appropriate guidance documents include the *Stormwater Management and Erosion and Sediment Control Handbook for Urban and Developing Areas in New Hampshire*, August, 1992² or Schueler's *Practical Manual for the Design of Best Management Practices*. The requirements set forth in the regulations, including those in any referenced guidance document, should be at least as restrictive as those outlined in the NPDES general permits for construction activities.
2. Adopt specific provisions requiring routine inspection and maintenance of erosion and sediment control practices. Inspection and maintenance within the jurisdiction of the community may require further training for existing staff or hiring additional staff. Maintenance of erosion control facilities located on private property should be required through site plan approval as a responsibility of the landowner. The community may want to inspect these devices on a periodic basis.
3. Portsmouth and Greenland should revise their subdivision and site plan regulations to reference a preferred guidance document (see Recommendation #1 above) or set of guidelines which must be adhered to, or to specifically outline sediment and erosion control compliance standards for new development. Rye should update their regulation to reference the revised 1992 SCS document.

Stormwater Management

Issue: Stormwater discharges to Berry's Brook contribute suspended sediments, nutrients, bacteria, heavy metals, petroleum hydrocarbons, and other pollutants which may degrade water quality, and impair wildlife, fisheries, and human uses. There are a number of drains in the watershed identified in the Existing and Potential Threats section of the inventory that may be contributing contaminated discharge to the Brook.

² This document contains a model erosion and sediment control regulation that is currently under review. The model regulation is scheduled to be re-issued in 1993.

Discussion: The management or control of stormwater runoff may include source control (reducing the generation and transport of pollutants) as well as treatment (the removal of pollutants prior to discharge to the receiving resource). Traditionally, stormwater control measures and any regulation of stormwater runoff associated with development activities has focused on flood control (e.g., controlling peak runoff rates, etc.). However, more recently, attention has broadened to include water quality considerations.

Stormwater Management for New Development

Control of runoff from new development is most commonly accomplished through subdivision regulations. Stormwater regulations may dictate that new development must follow accepted engineering design practices, performance standards, or both.

Performance requirements or standards set an expected level of performance for the stormwater treatment system, while allowing for flexibility in the actual types and sequences of treatment devices. An example of a performance standard is the use of a treatment criteria. Recent guidance issued by the US EPA and the National Oceanic and Atmospheric Administration (NOAA) for the control of nonpoint source pollutants within the coastal zone include the following treatment criteria: "require new development projects to reduce the average annual loadings of total suspended solids (TSS) from the site by 80% or demonstrate no greater than pre-development loads." (See *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters*, USEPA, 1993). Similar approaches for establishing treatment criteria have been recommended in some states (e.g., Rhode Island which recommends 85% reduction in TSS for sensitive resources or watersheds).

The premise for TSS treatment criteria is that a large proportion of pollutants found in urban runoff are associated with particulate material. Therefore, if one removes a substantial portion of the suspended solids, other pollutants will also be removed. The developer must demonstrate that the proposed stormwater treatment design will achieve the desired removal efficiency. This is most commonly done through the use of standard design criteria or predictive hydrologic-based water quality models. There are several models or guidance documents (e.g., *P8 Urban Catchment Model*, Schueler's *Practical Manual for the Design of Best Management Practices*, and *A Current Assessment of Urban Best Management Practices: Techniques for Reducing Nonpoint Source Pollution in the Coastal Zone*, 1992) which could be used by the reviewing agencies to determine if the proposed design would be expected to provide the desired results.

Stormwater Management for Existing Sources

While regulation of development may minimize impacts of runoff from new development, such regulations do not provide a means for controlling pollutant discharges from currently developed areas, including roadways. Mechanisms to control existing discharges may be of particular importance in watershed areas which are almost entirely developed. Control of existing sources must be implemented by the communities rather than specific land owners, and may include:

- o enhanced maintenance activities, e.g., street sweeping and catch basin cleaning;
- o reduced salting and sanding, leaf pick-up and composting;
- o retrofitting of catch basins with more effective structures for pollutant attenuation, e.g., catch basins with sumps and oil/grease separators, triple chambered basins, leaching catch basins;
- o modifying discharge points, e.g., flow dissipaters (rip rap), vegetated swales, check dams; and
- o public education regarding fertilizer/pesticide use, hazardous materials disposal, etc.

Recommendations:

1. Institute a street sweeping policy for public impervious surfaces, including roads and parking lots, on a bi-annual basis in the Watershed to reduce sediment and nutrient loads to Berry's Brook and its tributaries. These sweepings should occur during the autumn after leaf-fall and in the spring immediately after snow melt.
2. Institute a similar policy for cleaning catch basins on the same schedule as street sweeping.
3. Include provisions in the Rye and Portsmouth site plan regulations that require Best Management Practices for new development based upon accepted manuals as noted in the above discussion. For example, as a condition of site plan approval, require parking lot sweeping on a regular basis, such as monthly or more frequently as dictated by individual site conditions.
4. Conduct an inventory of existing stormwater management designs, devices and practices within the watershed. Determine how effective these practices are in maintaining water quality in the Watershed.

5. As part of this inventory, conduct stormwater sampling and dry weather observations of the storm drains in the watershed, especially the high density residential (Beechstone, Spring Brook, and Woodlands) and commercial uses along Lafayette Road. Any dry weather discharge may indicate a cross connection or illegal discharge and should be further investigated.
6. Where the above inventory of stormwater practices indicates that there is a resultant adverse impact on the sensitive resources of the Watershed, (for example, the erosion of the banks of the detention pond at Springbrook Condominium) consider a policy to retrofit or modify the discharges from storm drains or impervious surfaces that discharge directly into Berry's Brook or its tributaries or contiguous wetlands.
7. Modify subdivision and site plan regulations for proposed residential subdivision of 5 acres or greater and proposed commercial and industrial uses of greater than 50,000 square feet to incorporate total suspended solids (TSS) treatment criteria of either 85% reduction after construction is completed or no greater than pre-development loadings.

Wastewater Management

Issue: Septic systems which are functioning improperly or are poorly maintained can be sources of nitrates, phosphorus, pathogenic bacteria, and a variety of inorganic hazardous materials. Although there is currently no evidence that failed systems are contributing pollutants to the water resources of the watershed, the Watershed Protection Council should consider ways to determine if this is a problem.

Discussion: While septic systems can be effective in removing organic matter and bacteria, they function correctly only if the system is properly sited, used and maintained. Lots adjacent to waterways and water bodies are often inappropriate for individual septic systems, with septic system failure frequently associated with water quality problems. The overloading of solids to the system can cause clogging. When this occurs, the system requires rehabilitation, which is commonly done with the use of strong acids or organic solvents. Such treatment can seriously degrade the water quality of adjacent water resources. In addition, hydraulic overload caused by large volume use is a common cause of leach field failure (EPA, 1993).

Soil types and topography play a significant role in the function of septic systems. Tightly bound soils such as clay provide poor infiltration. On the other hand, gravel is a poor filter because wastewater drains too rapidly for treatment to occur. Likewise, on steep slopes inadequate filtering occurs due to rapid flow, or surface break out may occur due to a lack of soil penetration. Additional causes of ineffective sewage treatment include:

- o improper maintenance of septic systems, such as failure to pump out frequently enough;
- o the use of detergents containing phosphates which increase phosphorus loading in the water supply; and
- o the flushing of household hazardous materials down drains or toilets which can introduce toxins into ground and surface water bodies.

Aging septic systems require scheduled monitoring to detect signs of system failure and scheduled cleaning to avoid seepage levels which compromise the system's effectiveness at removing contaminants from wastewater. NH RSA 147 and 485-A of the Water Supply and Pollution Control Code require owners of properties which have septic systems or other on-site wastewater disposal systems to keep such systems in proper operational condition at all times. The purpose of NH RSA 147 and 485-A is to provide minimum standards for the protection of human health and the environment in circumstances where septic systems or other individual subsurface wastewater disposal systems are used. These standards may not be sufficient to protect human health and the environment in environmentally sensitive areas.

Recommendations:

In general, these recommendations apply to areas within the watershed that are unsewered, i.e. portions of Rye and Greenland.

1. Adopt and implement as part of a health ordinance a provision to regulate subsurface disposal systems using the *Model Health Ordinance to Regulate Subsurface Disposal Systems and Establish Local Enforcement Procedures* prepared by the NH Office of State Planning, December, 1992 as a source document.

2. As a part of the health ordinance, establish a mandatory septic system inspection and maintenance program through supplementary health regulations that require both cleaning and inspection of all septic systems within 250 feet of Berry's Brook or its permanent tributaries. See 250 foot buffer on **Watershed Management Plan Map**. For example, septic systems within the watershed could be required to be pumped out every two years with a receipt for such pump out provided to the building inspector or included in the property tax bill. This policy may be waived if a homeowner can prove that the septic system does not require such action by providing written notification to the building inspector from a certified septic waste hauler. Inspections/pump outs could also be triggered when there is an application for a building permit that includes the addition of a bedroom to a residential unit.
3. Educate the public regarding the importance of proper use and maintenance of septic systems (Refer to the subsequent section on public education strategies).
4. Encourage/require connection to Portsmouth municipal sewer system, where possible, especially the commercial properties in Rye along Lafayette Road.
5. Consider additional requirements that would be incorporated into the supplemental regulations for properties in unsewered portions of the Watershed, such as:
 - o requiring a 100-foot setback distance from Berry's Brook, its tributaries or adjacent wetlands for any portion of a septic system or leaching chamber;
 - o prohibiting the use of chemical septic tank cleaners and/or chemical additives;
 - o requiring septic system design that is sufficient to accommodate discharge from washing machines, dishwashers and garbage disposals (for example, a requirement for a separate leaching system);
 - o amending the building code to require use of low-flow plumbing fixtures to prevent hydraulic overload of leaching systems; and
 - o requiring ground water monitoring annually for the life of the system for any new system designed for greater than 2,000 gallons per day flow or for new clusters of systems designed for greater than 2,000 gallons per day cumulative flow. Such monitoring should test for nutrients (i.e. phosphorous and nitrogen) and bacteria.

Non-Regulatory Management Strategies

Issue: The city of Portsmouth and the town of Rye have a number of parcels within the watershed that are under public ownership (e.g. the Adams property in Rye). In addition, the planning boards in each community have required specific conditions that set aside areas for conservation as part of subdivision or site plan approval (e.g. the rear portion of the Beechstone Apartments subdivision). These conditions typically establish restrictions to limit development adjacent to Berry's Brook. Furthermore, a number of parcels in the watershed are under the state's Current Use program. Although each of these strategies for maintaining open space has value for protecting the watershed's resources, there are additional actions that might be considered.

Discussion: Non-regulatory management strategies usually entail the acquisition and public ownership of, or the placement of restrictions on selected parcels of land within the watershed by the respective communities. Although land acquisition is the most effective and certain means of protecting Berry's Brook and other environmentally sensitive areas in the watershed from adverse impacts of development, it is also the most costly. Additional information regarding alternative mechanisms for securing or restricting development rights are provided in **Appendix G**. Open space protection techniques include land acquisition, purchase of development rights, conservation easements, transfer of development rights, land set asides as part of subdivision development, and preferential tax policies such as the current use assessment program.

Recommendations:

1. Identify sites and properties to be targeted for purchase or alternative development restriction mechanisms, including conservation easements or current use taxation. Approach appropriate property owners to determine their willingness to sell, place restrictions/easements on portions of their property or enter the current use program. Priority should be given to selecting properties in the Watershed which:
 - o include or border Berry's Brook or its permanent tributaries;
 - o include or border wetlands contiguous to the Brook or its permanent tributaries;
 - o exhibit erosion-prone conditions (e.g.: erodible soils, steep slopes, and clear-cut areas);
 - o contain significant natural features (e.g. rare/threatened species habitat, unique wetland or upland habitat, etc.);
 - o are reasonably accessible from town or state roads; and/or
 - o when purchased, will discourage direct public access to Berry's Brook unless it is a designated site for public access.

2. Obtain conservation easements as part of the development approval process for parcels and large lots located within critical areas of the Watershed. Ensure that such restrictions or easements are not only a condition of subdivision or site plan approval, but are also recorded with the property deed as a deed restriction. For example while there are legal site review agreements for setting aside conservation areas in the Ceders and Beechstone apartment development, it is not clear that these agreements were recorded with the county Registry of Deeds at the time of plan recording.
3. Consider the implementation of a TDR system for protecting critical resource areas within the Watershed. The implementation of a TDR system is potentially a very effective watershed protection strategy, but can become a complicated and lengthy process, and should therefore be pursued as a second priority to the current use incentive, easement restriction, and land acquisition alternatives.
4. Establish a Community Land Trust for the purpose of obtaining key parcels within the Watershed.

The **Watershed Management Plan Map** identifies parcels by number within the Watershed that have high resource value that may be suitable for protection through one of the non-regulatory recommendations above. There are three (3) such properties in Greenland, one (1) in Portsmouth and four (4) in Rye.

Public Education and Participation

Issue: Land use regulations or public health strategies may be effective at controlling sources of water pollution on a large scale throughout the watershed, but do little to influence the habits of each resident or business owner within the watershed. Informing residents and business owners of the role they can play in protecting Berry's Brook and critical watershed resources will complement regulatory strategies by addressing watershed protection on a lot by lot basis.

Discussion: Public education and participation may take many forms, including:

- o public meetings, Awareness Days or workshops,
- o newsletters or fliers;
- o posting of the watershed boundaries and stream crossings;
- o forming neighborhood groups;
- o developing and/or encouraging educational programs and curricula in public schools that relate to natural resources protection and watershed management;
- o developing community educational programs for adults; and
- o providing information through the media.

The most effective form of public education depends upon the target group and the objectives of the public education program. The target group for such a program is all of the Watershed's residents and businesses as well as state and local land use regulatory boards. The objectives should be:

- o to notify the public and governmental decision-makers of the need for protection of the Watershed;
- o to identify and explain the issues that threaten the Watershed;
- o to explain ways in which the target group can participate in watershed protection on an individual basis;
- o to instill a sense of responsibility for, and interest in, protecting the Watershed; and;
- o to establish institutions which will sustain and build on the initial efforts to protect the Watershed.

Recommendations:

1. Expand the role of the Watershed Council to hold regular informational neighborhood meetings, and encourage residents and business owners to practice environmentally sound habits through a broad-based public education program.
2. Participate in the public review, comment and decision-making process for proposed projects within or affecting the watershed.
3. Develop and implement a broad-based public education program that might include:
 - o periodic newsletters to watershed residents and business that discuss watershed issues and problems;
 - o fact sheets, such as those provided by the UNH Cooperative Extension Service on specific watershed issues, such as proper installation, cleaning and maintenance of septic systems (See **Appendix F** for a sample);
 - o encouraging the use of low flow plumbing fixtures to reduce hydraulic flow to septic systems;
 - o informative news releases that deal with specific timely issues or a project that might be undertaken by the Watershed Council;
 - o the development and implementation of a science curriculum within the public school system that includes a section on watershed management;
 - o self-guided, low maintenance, outside laboratory(ies) or field study area(s) for students and the public; and
 - o the implementation of Berry's Brook Watershed Day with programs and events that focus on the opportunities for public enjoyment of the Watershed and the ecological values of the Watershed's sensitive natural resources.

4. Implement a "Watershed Watch" group to conduct periodic water quality sampling, perhaps in association with the Great Bay Watch or through the River Watch program based in Vermont that works with groups like the Watershed Council. Such a program could be conducted at minimal expense initially by sampling for such parameters as temperature, dissolved oxygen, pH, conductivity, salinity, and turbidity. Sampling should occur in the following six locations along Berry's Brook which are identified on the **Watershed Management Plan Map**:
 - o Lafayette Road crossing in Rye;
 - o Lang Road crossing in Portsmouth;
 - o Rye Elementary School property;
 - o Sagamore Road crossing in Rye;
 - o Brackett Road in Rye; and
 - o Pioneer Road in Rye.
5. Develop links with such institutions as the University of New Hampshire (School of Natural Resources or Department of Civil Engineering) or the Jackson Lab to encourage further research and monitoring of the Watershed's natural resources;
6. Identify and implement opportunities for controlled public access to the Watershed. Immediate opportunities include:
 - o rehabilitating the Rye Elementary School Nature Trail in conjunction with the development of an appropriate curriculum as recommended above;
 - o acquiring and developing an access point where Berry's Brook crosses Brackett Road;
 - o providing a trail link between the town right-of-way on Berry's Brook Lane and the Seavey Acres Trail that begins at Pioneer Road; and
 - o working with the NHDOT to improve the safety of, and provide a bike lane along, Pioneer Road between Foye's Corner and Odiorne State Park. This project would provide a link to the existing bike trail at the Park and along Route 1A.

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