TOWN OF WINCHESTER

LOW IMPACT DEVELOPMENT AND STORMWATER MANAGEMENT MANUAL

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1.0 INTRODUCTION

1.1 Purpose

The Town of Winchester has undertaken land use regulation and municipal ordinance revisions to promote the use of Low Impact Development (LID) principles for planning and stormwater management throughout the community. This work is being done through a grant from the Connecticut Department of Environmental Protection as part of an initiative to eliminate barriers to LID for towns in the Farmington River Watershed. More specifically, the goal of the grant is to review local land use regulations and ordinances and draft recommended revisions to eliminate impediments to the use of LID in land development projects.

This is being accomplished through establishment of a study committee that is coordinating with the local land use boards and interested project partners to take a comprehensive look at how LID can best be integrated into the land use process. As the project develops, a public meeting will be held to discuss the draft findings and allow for public interaction to incorporate input from all residents and business partners in the community.

This manual is provided as a guide to designers for use in the conceptual planning for a land use project. The intent is to provide the designer with a tool kit for implementation of LID strategies with the goal of tailoring each development project to fit the natural character of a site and protect the natural resources of the area. The townwide natural resource information is for planning purposes only and is no substitute for site-specific studies that are necessary to understand individual site constraints that must be considered as part of the design.

1.2 Impacts of Uncontrolled Development

Prior to implementing land use regulations, development occurred in an uncontrolled fashion as our nation grew rapidly through the industrial age. During that period and in previous years, many industrial uses were located close to streams, rivers, and large water bodies where water could be harnessed for use for power generation or as needed in the internal processing. For many of these uses, dams were created and major infrastructure was developed to serve these industries. As the industries grew and attracted more and more workers, housing was developed in adjacent areas and infrastructure was further expanded to support the workforce. During this period of growth, there was not much thought of the impacts of development. Over time, we realized that the decrease in floodplain adjacent to rivers, combined with the increased runoff from impervious areas, led to major flooding problems, decreases in water quality, and negative impacts on wildlife. The initial solution was to increase the capacity of rivers and streams by widening, deepening, and providing armored linings. In addition, flood control dams and large-scale water quality treatment facilities were implemented to lessen the impacts. This eventually led to the thinking that stormwater management controls were necessary for all new developments. The designs were based on collect-and-convey type of controls. Roads were curbed and pipe systems were designed to collect stormater and convey it to a central detention basin where the peak flows were metered back to control flooding. While this helped to solve flooding issues, it did little to improve water quality. The practice of site development and stormwater management design has now evolved to be more environmentally sensitive where more attention is paid to maintaining natural conditions and protecting natural resources. This is where LID plays a major role in land use today.

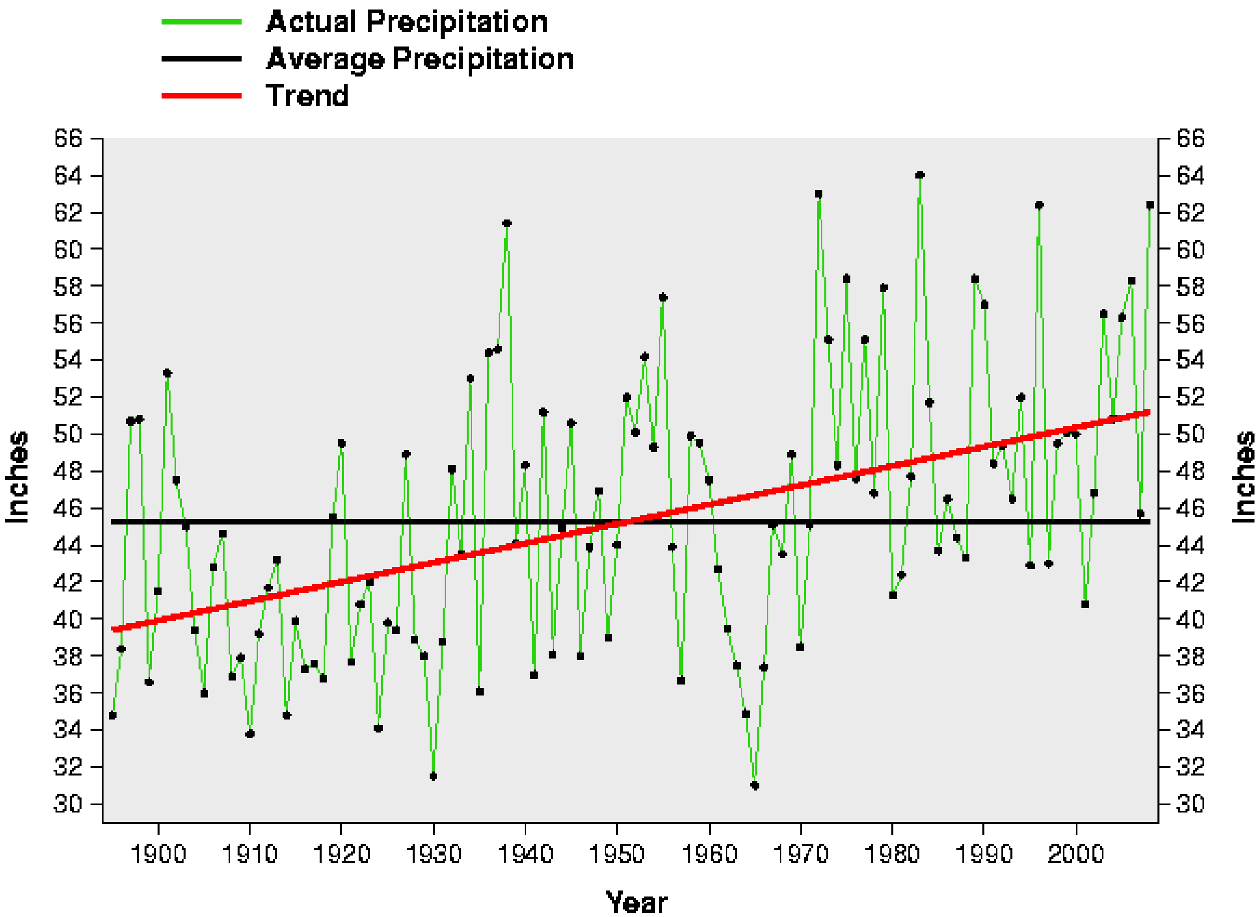
1.3 Connecticut Rainfall and Stream Flow Patterns

This section provides a broader look at climate changes that are affecting Connecticut. While this may not have a direct effect on planning and design considerations for individual land use applications, it is something that the town should consider on a long-term basis in evaluating major infrastructure improvements in town.

It is well documented that changes associated with land development and other activities can alter hydrologic conditions by modifying the way water moves over, through, and from the land. Watershed deforestation for lumber, firewood, charcoal, and farming was the first impact of colonial settlers. Subsequent drainage of wetlands, channelization, and gravel mining resulted in modification of watershed runoff through the 19th century. During the 20th century, watershed modifications included increased impervious cover (often the result of construction of residential subdivisions, roads, retail stores, and the like) and storm drains with direct discharges to surface water bodies.

In broad classification, typical impacts to wetlands and water resources due to the alteration of hydrologic conditions associated with land development and other activities include: (1) degraded water quality; (2) unnatural stream channel geomorphic changes; and (3) increased frequency and severity of flooding.

In New England, the effects of urbanization are exacerbated by changes in rainfall patterns that have been observed. Connecticut's annual mean precipitation has consistently increased through the last century, with the increase generally measuring 0.96 inches per decade. This trend is depicted graphically in Figure 1-1



Source: NOAA, National Climatalogical Data Center

FIGURE 1-1 Precipitation Trends in Connecticut 1895-2008

Despite the controversy surrounding the causes of climate change, scientists generally agree that the earth is undergoing a warming trend. Scientific models suggest that the rate of evaporation will increase as the climate warms, which will increase global precipitation. Precipitation is projected to show little change in spring, increase by 10% in summer and fall and increase by 30% in winter. The amount of precipitation on extremely wet or snowy days in winter is likely to also increase. Since the precipitation increases are not projected to be linear over the course of the year, it is expected that when storm events occur larger rainfall amounts will be recorded and at higher intensities than in the past.

This combination of increased rainfall intensity and increased runoff rates will invariably result in increases in stream flows. This trend is already evident when evaluating stream flow data in Connecticut. The United States Geological Survey (USGS) has operated a gauge (#01205500) on the Housatonic River for nearly 70 years. Figure 2-10 depicts the mean annual flow in cubic feet per second for water years 1929 to 2006. While the drainage area at this gauge is substantially larger than any of the rivers in Winchester (1,544 mi^2 vs 11.0 mi^2), the data from this gauge indicates that annual stream flow has increased on this river by approximately 6.7 cfs/year. It is important to understand that the increases in annual stream flows equate to higher water elevations in the channel at the start of a storm and, hence, less storage area available for flood flows.

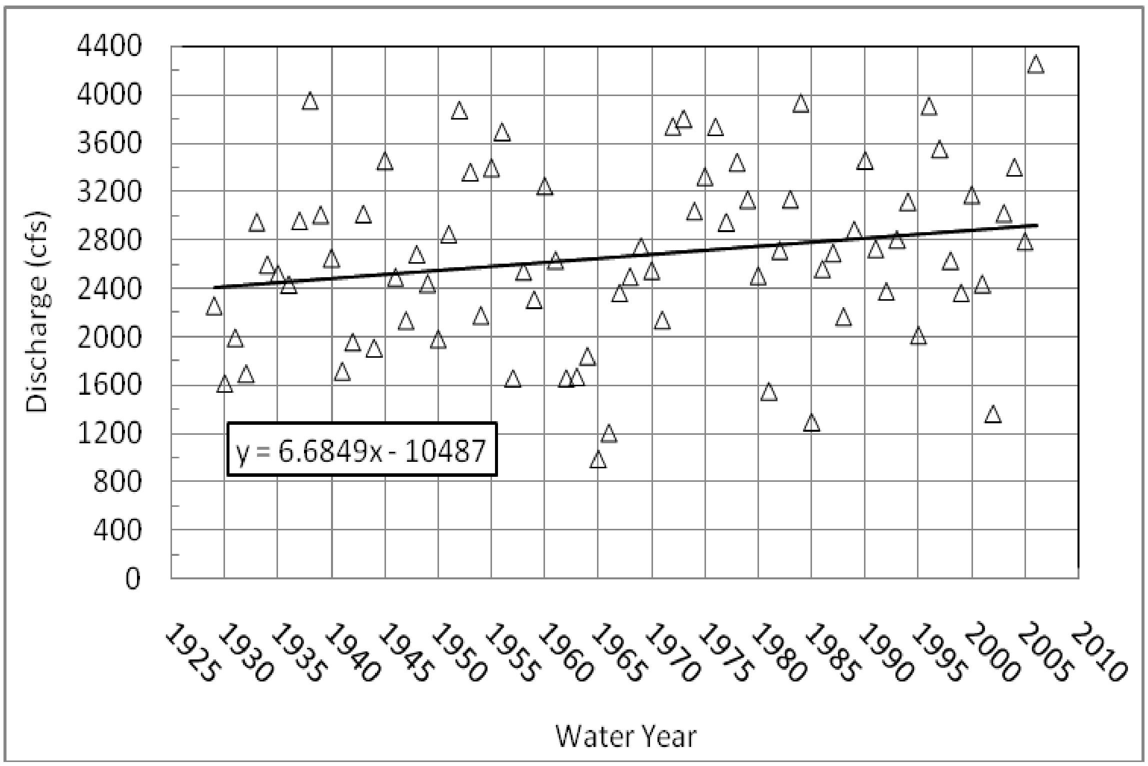


FIGURE 2-10 Annual Mean Stream Flow - Housatonic River at Stevenson, Connecticut

While the precipitation and flow data cannot prove that runoff on any particular river is increasing, these data are suggestive of a trend toward increased rainfall and runoff in Connecticut.

2.0 OVERVIEW OF LOW IMPACT DEVELOPMENT

2.1 Introduction

There are three generic ways of looking at stormwater management to protect water quality. The first of these is land use controls, which involves regulatory processes that govern land development and other activities. A second is source controls, which are intended to reduce potential pollutants at their source by identifying and either prohibiting or conditioning land uses or activities that are known to have a high risk to generate pollutants. The third is treatment controls. These are both nonstructural and structural practices that are designed to mitigate the impacts of hydrologic condition changes that have occurred or will occur as a result of land development or other activities.

In LID, land development design practices for stormwater management make use of creative site planning and design tools that are intended to preserve or reduce the changes to a site's hydrology, rather than simply providing "end of pipe" treatment or highly engineered management systems. Instead of a traditional stormwater management approach that conveys stormwater in pipe and catch basin systems to a centralized detention area, LID techniques allow stormwater management to occur in discrete small locations across the site.

Fundamentally, LID is a strategy for managing land and water resources based on an understanding of the inherent function of critical natural resource systems. It can be characterized as the application of sound environmental planning principles or, as Ian McHarg coined the phrase 40 years ago, it is "design with nature." The principal goal of LID is to maximize protection of the ecological integrity of the receiving stream by maintaining watershed hydrology. LID techniques and practices are intended to preserve natural systems and protect resources and their buffer areas through design of drainage systems that mimic natural systems. The following goals are common to LID:

- protect existing vegetation
- minimize changes in surface water drainage patterns
- avoid excessive site grading
- minimize disturbance area and compaction of soils during construction
- reduce the area of impervious and managed surface coverage
- encourage the disconnection of impervious surfaces
- promote temporary storage of stormwater runoff
- promote infiltration of stormwater runoff
- reduce or mitigate increases in the volume of stormwater runoff as well as changes in magnitude, frequency, and duration of stormwater discharges to receiving waters

The use of these planning and design tools can often reduce or even eliminate the requirement for more costly and sometimes obtrusive storage, infiltration, or end-of-pipe structural practices for the management of stormwater runoff. They can also result in development proposals that better fit the existing characteristics of a site, are aesthetically pleasing, and protect the environment.

The goal of LID site planning is to maintain hydrologic functions while allowing full development of the property. The traditional approach to stormwater management is to drain water from the site as quickly and efficiently as possible. LID site planning begins by understanding the essential hydrologic functions of the site, including the streams, wetlands, buffer areas, floodplains, steep slopes, high permeability soils, and conservation zones. The remaining site area is the "development zone," the area where development activities will have the least impact on hydrologic function.

There are many factors that must be considered in properly implementing LID design. The first step is proper evaluation of the existing natural conditions at the site and the constraints that limit development potential. This evaluation must also consider issues beyond the site such as downstream stormwater receptors, potential impacts to adjacent properties, and critical natural resources that could potentially be impacted beyond the limits of the subject property. The designer must carefully consider soil conditions, wetland functions and values, and any drainage problems that may currently exist. Once all this information is gathered, the designer must evaluate the existing site constraints and define a limit of development that will provide proper protection of the critical natural resources of the area. Once those limits are established, then an outline of the stormwater management should be prepared considering the potential for LID to be integrated as part of the design.

2.2 Application of LID in Winchester

While discussions of LID and its benefits abound, putting these principles into practice can be challenging. This is due in part to the confines generated by some local land use regulations and in part due to lack of understanding by design professionals and land use commissions alike. Implementing the principles of LID may not appropriate for every site and determining which methods are appropriate requires an intimate understanding of the resources of the site. LID elements that work well on one site might be inappropriate for another. One simple example of this relates to infiltration. Infiltration is generally a desirable method of stormwater management because it maintains the existing hydrology of the site and can remove pollutants through natural filtration; it may not be an appropriate technology for an industrial use that is located within the watershed of a water supply reservoir. The decision to provide infiltration would depend on the land use, soil types, and the proximity of the site to the resource requiring protection. This manual provides a broad overview of the natural resources in Winchester and provides other necessary planning tools that can be used in conceptual land use planning, which should provide the designer enough knowledge to avoid such pitfalls early on in the site design process. The manual also seeks to encourage designers to consider applying LID in the design of any project.

3.0 NATURAL RESOURCES INVENTORY

As one of the key features of LID design, protection of natural resources plays an important role on any scale. This section seeks to document some of the major natural resources that are important from a large scale perspective. While the impacts of development on an individual parcel may seem small to a lake the size of Highland Lake, cumulative impacts in the watershed on a long-term basis can lead to impairment of water quality. The narrative below provides some basic information with regard to these resources, but there are several documents that provide more detailed information that may require review as part of an individual land use application. The intent is to make applicants aware that these resources exist, but this certainly serves as no substitute for site-specific evaluations, which are critical to understanding natural features and resources on a project or parcel scale. Without a thorough understanding of the natural resources on site and those that may be affected by stormwater runoff from the site, it is impossible to know how best to protect those resources. Each project should be carefully evaluated on an individual basis with the evaluation looking, at a minimum, at the site-specific natural resources and how they may relate to the larger scale resources categorized in this section.

3.1 Geology

3.1.1 Surficial Geology

Soil mapping from the NRCS as available to the public in GIS format from the DEP was used to evaluate the surficial geology of the town. The soil mapping for the town is generally glacial till. The Still River valley is underlain with alluvium, sand and gravel deposits laid by glacial melt-water. Minor areas of alluvium, sand, and gravel deposits also exist along portions of the Mad River and the headwaters of the East Branch of the Naugatuck River. There are also minor areas of swamps in the western part of town in the higher elevations. Three different analyses of the soils data are provided as three separate maps in this section. They include environmentally sensitive soils and soils classified by hydrologic soil group.

3.1.1.1 Environmentally Sensitive Soils

This map is provided as Figure 1 in Appendix A and identifies environmentally sensitive soils, which are soils that should be considered for protection. The soil categories here include inland wetlands, steep slopes, and prime farmland soils. Within this group are also soils that are susceptible to erosion. No notable erosion sites have been identified by the DEP in Winchester, but a large portion of town contains soils that are susceptible to erosion with the most highly erodible soils being within the Mad River and Still River valleys. For any development project, the existing soil characteristics should be reviewed not only as part of the conceptual planning process but should also be used in later design efforts for preparation of an erosion and sediment control plan designed to be consistent with the DEP Connecticut Guidelines for Soil Erosion and Sediment Control.

3.1.1.2 Soil Hydrologic Group

Figure 2 in Appendix A shows the soils distribution in town by hydrologic soil group. This map will be particularly useful when planning stormwater management for the development site. Soils in the A and B categories have permeability rates that are favorable for infiltration design. Soils in hydrologic soil group C are most likely not appropriate for large-scale infiltration basins but still could accommodate some small-scale practices if appropriately sited and designed. Infiltration should be avoided for soils in the group D category. Several factors must be considered in stormwater infiltration design such as separation from ground water or ledge, structures, wells, leaching fields, etc. The designer should carefully consider the guidance for infiltration design as presented in the DEP Connecticut Stormwater Manual or other relevant design publications when incorporating infiltration into the stormwater management system for a proposed development.

3.1.2 Bedrock Geology

The bedrock geology of the town consists of five varieties of schist and gneiss. Average depth to bedrock is not known. Bedrock types include the Hoosac Schist, Hornblende gneiss and amphibolite, pink granitic gneiss, rusty mica schist and gneiss, and layered gneiss. These bedrock types trend north to south through the town. A high angle fault primarily from the Jurassic period runs south to north beneath the Still River valley, and several folded thrust faults surround the Hoosac Schist in the northern section of Winchester. None of these faults are active.

For the Lower Housatonic River Basin, which includes western Winchester, median well yield is 5-6 gpm, at least 75 percent yield 3 gpm, and 10 percent yield 20 gpm or more. These values are likely similar for Winchester, indicating that the bedrock aquifer has an adequate ability to support wells. The granitic bedrock generally has higher yields than gneiss. No data is available for the eastern side of Winchester.

3.2 Water Resources

The town of Winchester is fortunate to have several significant water resources within its borders. The Still River finds its origins in Torrington but flows generally south to north along the eastern side of the town. The Mad River enters Winchester from Norfolk and flows in an easterly direction through the center of Winsted where it meets the Still River. The East Branch of the Naugatuck River has its origins in the southern part of Winchester.

While rivers and their tributaries are a significant water resource in town, Winchester also has many large lakes and reservoirs that add to the wide diversity of wildlife habitat and recreational activities. Several smaller named streams are tributaries to the rivers and lakes identified in this section, but the summary here only includes the larger rivers and water bodies. A map showing the major water resources in Winchester is located in Appendix A as Figure 3. A brief summary of each of the major water resources is discussed below.

3.2.1 Highland Lake

The largest of these water bodies is Highland Lake, which has a surface area of about 444 acres and is a natural lake whose water surface was elevated in the 1800s by construction of a dam on the northern end. The lake is owned by the Connecticut Department of Environmental Protection (DEP), and they manage yearly drawdown of the lake that seeks to protect docks from the winter ice and provide other water quality benefits. It is designated as a trout management lake by the DEP.

The lake is encircled by East Wakefield Boulevard, which provides access to a myriad of homes located around the perimeter shoreline. The homes originally were seasonal cottages, but over the years many of them were winterized and turned into permanent residences. Even though the DEP categorizes the water quality as level A, the lake has a history of water quality problems mainly stemming from past development around the lake. A major contributor to the degradation of water quality was improperly sized septic leaching fields, many of which were located very close to the edge of the lake. Sanitary sewers were extended to serve the homes around the lake in 1992 to eliminate the ongoing leaching field pollution. While this had an immediate impact on improving water quality, the lake is still impacted by nutrient loading with signs of impairment still remaining. Recognizing that the lake is already impaired, any new land use improvements in the lake watershed should provide methods to maintain predevelopment conditions for nutrient loading, particularly phosphorus, and other potential stormwater runoff contaminants.

3.2.2 Lake Winchester

Lake Winchester, located in the south end of town, is a man-made lake with a surface area of about 229 acres. This lake is much different than Highland Lake in that its shoreline is primarily undeveloped mainly because the DEP owns the waterfront and maintains it as a natural riparian corridor. The DEP classifies the water quality as level A and has designated the lake for northern pike management. With the watershed to the lake mainly undeveloped, there is little or no impairment to water quality currently. The relatively pristine nature of this lake should be considered when contemplating any land use changes in the watershed.

3.2.3 Mad River

The Mad River enters Winchester's western boundary with Norfolk and flows in an easterly direction through the Algonquin State Forest, eventually making its way through the center of Winsted where it empties into the Still River just east of downtown.

The upper portion of the Mad River watershed is part of the water supply system due to an engineered diversion that leads to Rugg Brook reservoir. Further downstream is the Mad River Dam, which is located in the Algonquin State Forest and forms the Mad River Reservoir. This dam was constructed in the 1960s to help protect the center of Winsted from devastating floods like the one that occurred in 1955.

3.2.4 Still River

As noted above, the origin of the Still River is in Torrington, and it runs in a south to north direction along the eastern side of town. It parallels the Route 8 corridor and flows through a mainly industrially zoned area. Due to past industrial pollution along the river, the water quality is degraded, and some areas are designated as being impaired. In particular, the run from the Torrington town line to the confluence with the Mad River is classified as a water quality of B/A. This means that this section is currently impaired with a Class B rating, but the DEP has a goal of achieving a future Class A rating. Any new developments or redevelopment in this area should seek to improve water quality in the watershed. Areas of existing industrial development should be encouraged to retrofit stormwater quality controls to help improve the overall water quality of the river. Most of the northern section of the river beyond the Mad River confluence is designated as Class A with only the portion adjacent to the sewage treatment plan designated as Class B.

3.2.5 East Branch of the Naugatuck River

This river originates in the southern part of Winchester where tributaries from Lake Winchester, Park Pond, and Hurlbut Pond join together. The river then flows southerly into Torrington. It has no FEMA-mapped floodplain in Winchester, but it has a Class A water quality designation. It is also designated as both a "Wild and Scenic" river and a "Wild Trout Management Area." Due to these designations, it is important to maintain a high level of water quality in this watershed.

3.2.6 Public Water Supply Watersheds

A large portion of the land west of the Highland Lake is designated for public water supply. Rugg Brook and the Mad River are the main sources of drinking water with a smaller watershed surrounding Crystal Lake that also contributes to the system. The entire Rugg Brook watershed above the reservoir outlet to the Mad River is designated for public water supply and has a DEP surface water classification of AA. Rugg Brook Reservoir also receives water from the Mad River diversion. A dam upstream of the Algonquin Sate Forest diverts water from the Mad River into a canal, which conveys the flow to Rugg Brook Reservoir. While the natural overflow from the reservoir is to the Mad River, outflow used for water supply from this reservoir flows to Crystal Lake via the Gilbert Tunnel aqueduct. The town of Winchester operates a water treatment plant at Crystal Lake to provide potable water supply to the residents and businesses in Winchester. Figure 3 in Appendix A shows the reservoirs and watershed associated with Winchester's water supply system.

3.2.7 FEMA Floodplain

FEMA has defined regulatory floodplains for a number of selected channels for the purposes of identifying properties that are prone to flooding. The floodplain limits are published in Flood Insurance Studies (FIS) that are published by a town or county, depending on the location. The limit of flooding can be determined for any rainfall event or storm, but the "regulatory limit" (sometimes referred to as the "base flood") is considered to have a one percent chance of occurring in any given year (the so-called 100-year storm). Floodplains are defined by an elevation.

FEMA also designates a floodway along some channels. After a floodplain is delineated, the floodway is defined by encroaching on the floodplain until the predicted water surface elevation increases by one foot. Construction activities (e.g., building construction, bridge replacements, and channel realignment) in the floodway must not increase the water surface elevation by more than 0.1 foot.

In its FIS of Winchester effective July 17, 1978, FEMA defines Zone A (100-year) floodplain designations along the Still River, Grant Swamp, Mad River, Highland Lake, Crystal Lake, and Lake Winchester. There are also Zone B floodplains designated for Winchester Club Pond, Park Pond, and Rugg Brook Reservoir. Areas designated as Zone B generally are areas that are subject to flooding for storm event between the 100-year and 500-year storms or areas that receive less than one foot of flooding for the 100-year storm. No floodways are defined for any of the mapped floodplain areas.

3.3 Significant Habitat Areas

The Connecticut Department of Environmental Protection (DEP) maintains a Natural Diversity Database (NDDB) of locations where state and federally endangered, threatened, and/or special concern species have been identified. The presence of such species can impact the ability to obtain state and federal permits for projects that require work in that area.

According to the December 2009 NDDB mapping, there are several areas of concern located throughout the town of Winchester. Additional correspondence with state and/or federal agencies may be required for these areas. Natural diversity areas in the town are shown in Figure 4 in Appendix A.

4.0 LID DESIGN AND PLANNING

4.1 Site Planning

4.1.1 Introduction

The initial phases of planning a project are the most important in identifying the viability of a project and the direction the design will take in shaping the development. Designers are often asked to prepare conceptual layouts for a landowner or developer to understand the highest and best use for a property. Often past designs only considered the zoning regulations and/or subdivision regulations in determining a preliminary density of development for a property. Little or no consideration of the natural systems of the property was considered. While small-scale developments may not have any discernable impact independently, the cumulative impact can have detrimental effects. Larger developments certainly require more careful planning because their impact increases with scale. No matter how you view development, sound planning is a benefit to all involved. The goal in planning a project is to determine the appropriate level of development for a site based on the site constraints. Full utilization of the site has to be carefully balanced with minimizing impact to the environment both on and around the site.

4.1.2 Planning and Design Process

As with any development project, there is a critical design path to be followed. Along this path, there will be a few stopping points where the landowner, developer, regulators, and others should have the opportunity to review the progress of the design and provide guidance based on their unique roles in the process. The extent of preliminary involvement of local, state, and federal regulators varies for each project and is directly related to the governing regulations for the site location. The designer must have a clear understanding of the regulatory process for the location of the site in order to effectively implement a design that is consistent with the regulations and will stand up to scrutiny through the permitting process. Often the scale of the project plays a significant role in the level of regulatory review required. While a more complex project may have several additional intermediate steps, the basic design process is outlined below.

- *Define Project Objective and Goals* – Here the owner/developer defines their vision of the project. The use of the site is defined, number of lots for a subdivision, size of a building, access, and parking requirements. Typically, a preliminary review of the zoning regulations is done to confirm development goals are consistent with the requirements of the zone. Figure 7 in Appendix A shows the zoning designations for the town for use in determining the zone established for a given property.

- *Data Collection* – The data collection phase is arguably the most important part of the design process. All relevant information for the site must be carefully gathered so that a full understanding of the property and the environment surrounding the property is developed. If a key piece of information is overlooked at this point, significant rework of the design may be needed as the project progresses. This manual includes a broad overview of the major natural resources known to Winchester, which provides a starting point for detailed study of the site. Each individual site requires additional detailed field investigation to gain an understanding of the smaller scale resources that may exist on a parcel level. A typical list of data collection items is listed below.

- Detailed Review of Regulatory Requirements
- Research of Town Hall Records for the Property
- Field Survey of Property
- Soil Scientist Field Investigation to Identify Presence or Absence of Inland Wetlands or Watercourses
- Review DEP Natural Diversity Database (NDDB) for Occurrences of Endangered, Threatened, or Special Concern species
- Review of Property for Unique Wildlife Habitat or Natural Resources that may or may not be listed in the NDDB
- FEMA Flood Study Mapping
- DEP Impaired Waters List
- Geology and Soils Conditions
- Overall Hydrology and History of Past Drainage Problems
- Historic Uses of Property / Environmental Assessment
- Availability of Utilities

- *Define Site Constraints* – The information gathered in the data collection phase should identify any development limitations for the property. The severity of the limitations should also be evaluated to understand how great or small their impact may be to development of the site. These constraints may provide an understanding that the original objectives and goals for development are no longer achievable as the plan is currently conceived. At this point, the designer must consider alternatives that may address these site constraints in an effort to evaluate the continued viability of the project.

- Evaluate Site Development to Address Site Constraints and Conserve Natural Resources – Once those limitations are known, the plan for development of the property should be redesigned as needed to address those limitations. The alternatives investigated should include preservation of any newly identified natural resources. As part of this phase of work, the permitting requirements should be reevaluated to determine if any new permits are triggered.

- Review Desired Concept Plan with Town Staff and/or Local Regulatory Commissions – Preliminary review meetings are often a useful tool in confirming that the data collection phase has not omitted a critical piece of information and to confirm the local permitting required. Since most regulations require some level of interpretation, this is a good opportunity to confirm that the plan is consistent with the regulations and get relevant feedback from town staff and officials as to how the development project will be received.

At this point most of the planning work for the project is done, and the next step involves the detailed design of the project and submission to local land use commissions for permitting. The design is usually broken down into preliminary design and final design for the permitting phase and then will ultimately move on to preparation of construction documents once all necessary local, state, and federal permits are achieved.

4.1.3 Impervious Cover

Impervious surfaces come in many forms, but the most common that we see every day are asphalt and concrete. One of the key elements to LID is the minimization of impervious surfaces and where they are necessary, the disconnection of those surfaces. Disconnection is achieved by separating the impervious surface from the collection system through the use of an infiltration practice or a pervious surface. This allows for infiltration and treatment of the surface runoff before entering the collection system. Figure 5 in Appendix A shows an analysis of the existing impervious cover conditions in Winchester. This map can be a useful tool in understanding appropriate limits of impervious cover for layout of a new development and planning of the stormwater management design. The most commonly recognized thresholds are at 10% and 25% impervious cover as recognized by Schueler in an article titled "The Importance of Imperviousness." In this article it defines stream quality based on levels of impervious cover. It notes that high quality or sensitive streams normally have watersheds with impervious levels of 0 to 10%. Streams with watersheds with 11 to 25% impervious are impacted and ones over 25% are generally nonsupporting. The article also notes that proper stormwater management practices can be argued to mitigate for higher levels of impervious, but more monitoring should be done to confirm. What this provides are some guidelines for managing stormwater for a particular site relative to the watershed that it lies in. It also shows the importance of minimizing and disconnecting impervious cover. In site development, the most common uses of impervious surfaces are for construction of buildings, roadways, and parking lots. Their typical applications and methods of reducing their use are discussed below.

Buildings – Buildings inherently need to be waterproof so roofs have been typically designed to shed water. There is a movement toward green roofs, but generally these only apply to large-scale flat roof buildings where the special roof treatments involved and the additional reinforcement of the structure can be accommodated in the cost of the project. For most projects, green roofs don't easily apply, but there are some basic considerations in building layout and design that can serve to reduce the impact of the building. One solution is to accommodate the needed space in the building on multiple floors to minimize the footprint. Zoning regulations normally have height restrictions, so there will likely be a vertical limit to be considered. Once the minimum footprint is established, stormwater runoff from the roof can be directed to stabilized grass areas or infiltration structures to help mitigate the impact of the impervious roof area. The location of the building can also play a role in reducing impervious area. If the building and associated parking are located close to the street, this will shorten the access drive to reduce pavement area. For subdivision purposes, clustering of lots to shorten roadways and allowing for smaller setbacks will allow for shorter driveways.

Roadways – The greatest impact to reducing impervious area for roadways is to minimize the width. Often a standard roadway width is written into regulations and applied everywhere. In LID planning for roadways, we seek to only provide the minimum width of roadway to properly accommodate the anticipated amount of traffic using the road. Sometimes other factors such as emergency service access require wider roadway width than what is recommended based on the average daily traffic volume. The local police and fire department should be contacted for coordination on this issue early in the design process.

Open space or conservation-type subdivisions allow for clustering of lots that will serve to reduce the length of roadway constructed. This type of design generally lends itself to sewered area but can sometimes be accommodated with septic systems as well. Figure 6 in Appendix A shows the sewer service areas in Winchester and can be used as a preliminary planning tool for projects that may require municipal sewers.

Cul-de-sacs at the end of roadways are often designed as vast expanses of pavement. In LID designs, the pavement area can be reduced by allowing flexibility in the shape and size that fit it to the anticipated level of traffic and type of vehicles expected to use it.

Other techniques involve incorporating a vegetated island in the middle. The island can be excavated to provide stormwater runoff storage, filtering, and infiltration. The pavement width around the island can be further reduced if signage is provided for one-way circulation. If the edge of the island is not curbed, then the paved area can be sloped toward the island to allow sheet flow off the pavement and minimize the need for storm drainage infrastructure. The vegetated island can serve as the stormwater management area for runoff from the cul-de-sac.

Another technique to mitigating runoff from roadways is to allow an open roadway section where curbs are eliminated and surface runoff can sheet flow from the pavement to grass swales located along the side of the road. To limit erosion potential, this type of roadway design is normally considered for roadways with a gradient of 6% or less. Steeper sections will require curbing or special treatments to avoid erosion. Roadway widths will generally vary based on the classification of use and need to accommodate parking along the roadway. Most roads in Winchester that aren't classified as state roads are rural in nature and don't require on street parking. Some exceptions to this are the local roads surrounding Main Street in the downtown Winsted area. Roadway widths should be set based on the expected volume of traffic and the applicable local regulations and state guidelines. Safety of motorists, pedestrians, and others using the road should also be considered. The goal is to provide a minimum appropriate width of road to provide safe access for the volume and type of users anticipated.

4.1.4 Protection of Natural Resources

The first step in protection of natural resources is identifying the specific resources present on the subject property and those in the nearby area that may be affected by any proposed improvements. There are several maps located in Appendix A that represent some of the major natural resources in Winchester. These maps along with the narrative in Section 3 serve as a basis for further site specific investigations. The level of study on site will likely be dictated by the nature of the existing natural features of the site and the level of permitting required for the project.

Once the natural features of the site and surrounding area are properly evaluated, appropriate protective buffer areas should be established. The CT DEP has several documents that can provide guidance for the various natural features that may warrant preservation on a given property.

4.1.5 Minimizing Grading and Site Disturbance

For any new development, the design should fit into the landscape. The more a development is forced to fit into a particular location, the more difficult it is to mitigate for the changes. Significant cuts and fills will tend to vary watershed divides and have influences on groundwater conditions. The proposed grading of the site should seek to match the existing landscape as much as practicable and balance the earthwork. Site constraints will limit a designers ability to achieve these goals.

After the natural resources are known for the area, appropriate buffers should be established for protecting important natural features. Once these buffers are set, the remaining area can be further evaluated to define the most appropriate buildable area and limits of disturbance.

4.1.6 Site Layout

Once the limits of disturbance are established, the site layout of the building, access drives, parking, utilities, and other infrastructure are accommodated in accordance with the project goals. The layout must meet the requirements of the applicable Town of Winchester Zoning and/or Subdivision regulations. If the project needs cannot be achieved within the established building envelope, some compromises of the buffer areas may be appropriate if proper mitigation is provided. The designer should properly categorize the impacts and have an understanding of what permits are required for the project. If the project disturbs more than five acres, then a DEP Stormwater General Permit will likely be needed and the requirements of the appropriate permit should be evaluated as part of the site design.

4.2 Stormwater Management

Stormwater management plays an important role in the design of any site development project. The development of a site will always cause some change in the runoff characteristics that requires evaluation. Development of vacant lands will generally require some form of peak flow attenuation along with water quality management. Redevelopment of existing infrastructure should consider improvements to any existing stormwater management and possible inclusion of stormwater retro fits to improve water quality. The process should always start with a careful evaluation of existing conditions.

4.2.1 Existing Drainage Problems

As part of the planning and data collection phase of a project, it is important to gather information regarding existing drainage problems in the area of the proposed development. The planning staff and the Public Works Director are usually the best sources of this information. The Zoning Enforcement Officer is normally the person responsible for tracking and following up on complaints. However, the Public Works Director is usually the most knowledgeable about the drainage system itself because the public works staff is responsible for maintaining and repairing the majority of the stormwater piping network in town. If appropriate, contacting neighboring property owners can also be effective in identifying existing drainage problems that may be occurring on adjacent property.

If there are known drainage problems, these should be taken into consideration in the design of the project. While the developer is not responsible to fix off-site problems, the development of the site should not further contribute to the problem. Careful documentation and analysis of existing conditions is necessary to understand why a problem may be occurring.

4.2.2 Maintain Drainage Patterns

The best way to minimize drainage infrastructure costs is to maintain existing runoff patterns to avoid shifting flow from one watershed to another. Watershed shifts often cause an increased need for detention in one area and lead to concerns of increased volume and velocities that may affect downstream properties. Additional concerns for stability of natural channels and the capacity of downstream drainage structures can also be encountered.

Efforts to maintain exist drainage patterns should include the following:

- Maintain existing watershed divides to the extent practicable
- Avoid concentrating flows
- Avoid diversion of flows
- Focus development on soils that have highest runoff potential
- Preserve any natural depressions that collect and store surface runoff
- Minimize land disturbance and conserve natural vegetation

If these principles are implemented, there will be less of a need to collect, convey, and control surface runoff. Obviously, any development will change the natural runoff patterns, but the extent of the stormwater management system can be minimized through careful planning.

4.2.3 Small-Scale Distributed Controls

The premise of collecting and conveying stormwater through expansive collection systems has led to the need for large-scale stormwater controls at the outlets to lessen downstream impact. LID design looks at stormwater management from the opposite perspective. By providing small-scale controls at the source and distributing these controls throughout the landscape, you lessen the need for a pipe conveyance system. This method also serves to better match existing drainage patterns where surface runoff sheet flows over vegetated surfaces where infiltration, transpiration, and other methods of uptake decrease runoff. By disconnecting impervious, we allow opportunities for surface runoff to flow through vegetated areas and allow the same natural uptake to occur. Some examples of small-scale controls are listed below:

- Rain Barrels
- Cisterns
- Rain Gardens
- Filter Strips
- Depressed islands
- Biofilter Swales
- Bioretention

4.2.4 Infiltration

Natural conditions on any site allow for some level of infiltration. For properties with low permeability soils, a designer should seek to meet the DEP Groundwater Recharge Volume. On sites with higher permeability soils, the designer may want to take advantage of this and promote infiltration as a major component of the stormwater management design. Infiltration provides a two-fold benefit in that it can serve to reduce peak flows and also reduce runoff volumes. Types of infiltration practices include:

- o Infiltration Basins
- o Bioretention
- o Infiltration Trenches
- o Infiltration Structures

Advantages

- Attenuate peak rates of runoff
- Reduce volume of runoff
- Ground water recharge and support of stream base flows
- Filtering of runoff through soil

Limitations

- Soil subject to clogging over time
- Frequent inspection and maintenance is often required
- Can be an increased risk for contamination and should be avoided under certain conditions
- Mainly suitable for small drainage areas

If properly sited, designed, and maintained, the concerns relative to the limitations noted above can be minimized. For any land use development site with high sediment loads or pollutant loads, infiltration practices should either be avoided or carefully designed pretreatment measures must be provided. Industrial properties are of particular concern and virtually any property that lies in an aquifer protection area.

4.2.5 Peak Runoff and Volume Attenuation

The Town of Winchester has specific requirements in the subdivision regulations for peak runoff attenuation on all sites. These regulations apply to all properties by reference in the Zoning Regulations. The Connecticut Water Quality Manual in Section 7.6

outlines additional considerations for peak runoff attenuation that should be considered in all designs. For LID, traditional methods of runoff analysis are sometimes difficult to apply when using small-scale controls. While there are several ways to consider the benefits of small-scale controls in an overall model, the most common are by either volume analysis or appropriate modification of CN values to better consider disconnection of impervious.

For a volume analysis, the TR-55 Manual in Chapter 6 provides a good way to determine the overall storage requirements. By calculating the runoff volume under existing conditions and then subtracting that from the proposed conditions volume, you get the total storage required. The small-scale distributed controls such as rain gardens and bioretention areas can be summed to determine compliance with the storage requirements. If the smaller scale controls do not provide enough volume, the overflows should be directed by grass swales or other methods to a more centralized flood storage area. Flows should be routed through this basin using TR-20 modeling or some other suitable routing method for proper sizing of the basin and outlet flow controls. This flood storage basin will serve to control peak rates and volumes for the less frequent, larger scale storms while the other LID elements will serve the majority of rainfall events.

If modification of the CN values is desired, methods for this type of analysis can be found in the "Low Impact Development Hydrologic Analysis" as prepared by Prince Georges County Maryland Department of Natural Resources. Since traditional stormwater runoff models consider that all impervious area is directly connected, these methods can overestimate runoff for a well planned LID design. The modified CN method provides a basis for accounting for disconnection of impervious, which will reduce post development runoff rates. The additional opportunity to slow the flow and allow for natural infiltration in vegetated areas is accommodated with these adjustments.

The designer should keep in mind that all models provide estimates and some fit better than others. Each model's individual limitations should be considered when analyzing any site. These models are most effective when they can be calibrated to actual flow data, but actual data is often limited and generally tied to large watersheds. The designer should carefully document the reasons for selecting the method of analysis chosen and the specific limitations associated with the analysis conducted.

4.2.6 Water Quality Management

The concepts considered in LID design not only serve to reduce runoff but promote natural filtering of runoff through vegetated areas. This is primarily achieved through disconnecting impervious surfaces. In the standard collection and conveyance design, pollutants generated from impervious surfaces flow through an enclosed pipe system to the outfall with little or no opportunity for filtration. When runoff from impervious surfaces is allowed to flow through vegetated areas, there is an opportunity for vegetative uptake of nutrients, infiltration, temperature reduction, and filtering of sediment and other potential pollutants. Measuring the effectiveness of these practices is often difficult. There have been several studies done, but published data is still lacking. One of the best sources for estimating the effectiveness of certain stormwater management practices for filtering pollutants can be found in the National Pollutant Removal Performance Database as prepared by the Center for Watershed Protection. The data provided in this publication can be used with the Simple Method calculation to estimate pollutant removal rates for specific stormwater management designs. While this may not be relevant for all development projects, sites that discharge to impaired waters or sensitive areas may warrant a pollutant removal analysis to better understand the effectiveness of the design. There is no requirement for this type of analysis in the current regulations in town but, in certain situations, this information could be a useful tool in evaluating a proposed development.

The Connecticut Water Quality Manual in Chapter 7 sets standards for water quality management. This chapter outlines the methodology for calculating three important water quality parameters that are relevant to all properties in Winchester. The three parameters are Water Quality Volume (WQV), Water Quality Flow (WQF), and Groundwater Recharge Volume (GRV).

Water Quality Volume (WQV) is the volume of runoff generated by one inch of rainfall on the developed site. This number is used for design of stormwater management basins.

Water Quality Flow (WQF) is the peak flow associated with the WQV, which is calculated using the NRCS Graphical Peak Discharge Method. This flow is commonly used for sizing grass drainage channels and sediment chambers.

Groundwater Recharge Volume (GRV) is a volume of stormwater that is intended to be infiltrated under post development conditions to maintain predevelopment ground water recharge.

The WQV and GRV apply to all sites and should be considered in any stormwater management design. The WQF has limited use and will only need to be calculated when it applies to the selected design. There may be situations where the GRV cannot be fully implemented or, if ground water contamination is an issue, there may be good reason not to implement it. This would be the case for existing brownfield sites or industrial sites that have the potential for higher concentrations of polluted runoff.

4.3 Retrofits

Many urban areas were developed with vast expanses of impervious cover before we understood the effects of impervious on the increase in peak rates of runoff or the detrimental effects it has on water quality. Since a majority of the sites have little or no natural landscape left, there is limited opportunity to implement many of the natural LID stormwater management practices. However, there are always opportunities to reduce and disconnect impervious surfaces. Below are several options that can be considered in urban redevelopment areas or as retrofits in existing urban areas.

Pervious Pavements

- Pavers – There are many types of pervious pavers that can be used to take the place of traditional asphalt or concrete surfaces. They provide a more decorative hardscape but are often more costly than paving. While they can be utilized for entire entrance drives and parking areas, they are most cost effective when used in strips to break up large expanses of impervious. They are commonly used for parking spaces while travel aisles may remain paved. They can also be used along the gutter line of driveways and roads to provide for a wider access with less impervious surface. Replacing paved or concrete walkways with pavers can provide an attractive decorative accent along streets and around buildings. The base for setting permeable pavers is critical to the long-term durability of the surface. Normally, a specially graded stone base is used to allow for drainage while providing structural stability. Manufacturer's specification should be followed for each product.

- Pervious Asphalt – Pervious asphalt has not been used widely in New England in the past but has gained acceptance more recently with research that has been done by the University of New Hampshire (UNH). UNH has developed a specification for permeable asphalt that has been designed to stand up to the freeze and thaw action of winter and early spring. The base course and the asphalt mix must be properly specified to provide open pore space for drainage through the media. One of the first uses of this pavement in Connecticut was at the University of Connecticut. To date, it is not widely produced by asphalt plants in Connecticut but may be more prevalent in the future.

- Pervious Concrete – The design of pervious concrete is similar to pervious asphalt in that the composition of the mix is varied to provide for pore space in the cured surface.

Green Roofs – Green roofs are a way of turning a building's roof into a pervious planting media. In this application, a graded porous media is applied to an impervious roof and underdrains are provided to collect excess water that infiltrates through the surface. A planting mix is placed over the drainage media, which is normally separated by a filter fabric. Plants are selected based on the climate and anticipated rooftop conditions. Sometimes patios and gathering spaces are incorporated into the design while others simply serve to create a naturally vegetated surface. The plants and media store and utilize the stormwater, while natural evaporation and transpiration also serve to relieve the roof of the stored rainwater. These designs are typically used on flat urban roofs in large buildings that are able to incorporate the additional structural and rooftop treatment cost into the cost of developing the site.

Rain Barrels and Cisterns – These serve as storage devices for rainwater with the rain barrel being simply a smaller version of a cistern. Whether a rain barrel collecting a single downspout or a large underground cistern collecting stormwater from an entire roof, these containment systems are designed to capture runoff and store it for later use. Surface storage usually allows for gravity irrigation to planting beds or lawn areas while larger buried cisterns often have pumps for distribution to irrigated areas. No matter how it's done, rainwater storage and reuse utilizes stormwater as a resource, which reduces potable water usage and serves to reduce stormwater runoff during rain events. These storage options are relatively easy to implement and, in most cases, are cost effective.

Tree Box Filters – Tree box filters are used in an urban landscape to redirect surface runoff usually from a paved street or sidewalk into an underground structure. This structure is filled with a planting media and is usually planted with a street tree suitable for the local environment. Surface runoff is directed into the structure through a curbside opening or surface grate. An overflow or bypass is provided so that the tree does not become completely inundated with water. These structures serve to filter runoff, allow for uptake of the stormwater by the tree, and evaporation will take place through the grate thus reducing runoff.

Bioretention – Bioretention can be incorporated in urban areas by converting curbed or paved islands into vegetated storage areas. Typically, the soils in these areas would need to be amended to allow for infiltration and to provide a suitable planting media. Often an underdrain is necessary to ensure that the planting media does not remain saturated for long periods. Since urban sites often have contamination issues, a liner may be necessary. An investigation of on-site soil conditions should be conducted early in the design process to determine design parameters. The bioretention area can be an attractive landscaped area that may be suitable for planting shade trees, which will serve to shade the paved areas and reduce the temperature of surface runoff.

5.0 NEXT STEPS

5.1 Conservation Subdivision

Conservation subdivision regulations are a rethinking of the cluster subdivision standards and a movement away from large lot zoning in rural areas. They are more focused on water quality, wildlife habitat, and preserving rural character. The design is similar to cluster subdivisions in that the units are clustered together to increase open space. The difference is that the open space is usually 50% of the land or more, and the design focuses initially on understanding of the natural resources of the property and surrounding land to first establish the conservations areas that warrant protection. This part of the design takes into consideration views, vegetation, wetlands, wildlife habitat, passive recreation, connection to greenways, proximity to protected forests or parks, and other planning issues specifically relevant to the area or the town. In the next step, a yield plan would be prepared to establish a lot count based on the underlying zone of the property. Once a lot count is established, the designer is allowed flexibility in the design to cluster homes together in a traditional village fashion, which reduces the amount of road and driveway constructed. The minimum roadway width to serve the number of units is established and overall impervious surface is kept to a minimum. The goal is to create a development with a neighborhood feel that creates larger tracts of meaningful open space that preserves natural resources and creates additional value. Typical postconstruction coverage goals would achieve 65% retention of vegetated areas and 10% or less of impervious surface with no reduction in the conventional subdivision lot yield.

5.2 Impervious Cover Standards

It is important to understand that impervious surfaces are one of the leading contributors to stormwater pollution. Therefore, reduction or minimization of impervious cover will lead to improved water quality. This is most meaningful on a watershed basis but could be applied to zoning standards as well. One application would be a rural zoning district in a public water supply watershed. The public water supply watersheds in Winchester are typically zoned as RU-1 and RU-3, which are one- to two-acre minimum lot requirements. Here a typical goal is to maintain impervious surface coverage below 10%. These watersheds under existing conditions already meet that standard, so the idea would be for new developments to maintain that level. While the regulations currently set maximum impervious percentages by zone, incentives could also be provided for developments to further reduce impervious cover. These rural zones would also be a good location for conservation subdivisions discussed previously.

Another example of these standards applies to a more densely developed area like Winsted center. Here, past development was built without consideration of impervious cover or stormwater management. A large part of the Winsted area has impervious percentages above 25%, which is a level that leads to water quality degradation. For this type of area, incentives could be written into the regulations to reward redevelopment of these areas that decreases or disconnects impervious area and sets new goals for overall impervious. It is not realistic to think that impervious surface could be reduced below 10% like that of rural areas, but there are several measures that can be implemented to reduce the impact of impervious surface such as discussed in the retrofit section above. Additional incentives could be provided for the retrofit of urban stormwater quality measures to improve water quality from the existing impervious areas.

5.3 Storm Drainage Design Standards

The town at some point may choose to further establish specific stormwater design requirements. Generally, strict requirements for stormwater management require coordination with a full-time staff person such as the Town Engineer or Public Works Director. The standards are normally tailored to be consistent with the reviewer's preference for design and are intended to provide consistency in the review process. They are sometimes implemented to address unique drainage issues or stormwater management goals. There are many factors to consider in establishing these standards and, if established, will require periodic updating to be consistent with the ever-changing methods of stormwater management.

6.0 REFERENCES

ESRI, 2006. ArcGIS. Redlands, CA, Environmental Systems Research Institute, Inc.

Federal Emergency Management Agency, 1978. Flood Insurance Study, Town of Winchester, Connecticut, Litchfield County. Community Number – 090132. July 17, 1978.

Miller, David R., G.S. Warner, and A.T. DeGaetano, 1997. Final Report to Connecticut Department of Environmental Protection, Bureau of Water Management, Planning and Standards Division. Update and Publish Climate Statistics for the State of Connecticut. Rainfall in Connecticut. Department of Natural Resources Management and Engineering, University of Connecticut. 65 pp.

2004 Connecticut Stormwater Quality Manual by the Connecticut Department of Environmental Protection

Low-Impact Development Manual, Department of Environmental Resources, Prince George's County, Maryland, November 1997.

Low-Impact Development Design Strategies An Integrated Design Approach, Prince George's County Maryland, Department of Environmental Resources, June 1999, EPA Document # EPA 841-B-00-003

Low-Impact Development Hydrologic Analysis, Prince George's County Maryland, Department of Environmental Resources, July 1999, EPA Document # EPA 841-B-00-002

Local Documents Specific to the Town of Winchester:

Town of Winchester 2009 Draft Plan of Conservation and Development

Natural Resource Inventory Narrative – Water Resources, supplement to 2009 Town of Winchester Draft Plan of Conservation and Development as written by James Roberts and rewritten by Clare Stevens.

7.0 OTHER RESOURCES AND LINKS

Low Impact Development (LID) A Literature Review, October 2000, EPA Document # EPA-841-B-00-005.

Rain Gardens in Connecticut, A Design Guide for Homeowners, UCONN Cooperative Extension System.

Websites

Low Impact Development Center - http://www.lowimpactdevelopment.org/index.html

The Center for Watershed Protection - http://www.cwp.org/

Prince Georges County DER - http://www.princegeorgescountymd.gov/Government/AgencyIndex/DER/index.asp

Connecticut NEMO Program - http://nemo.uconn.edu/

National Pollutant Removal Performance Database - http://www.stormwaterok.net/CWP%20Documents/CWP-07%20Natl%20Pollutant%20Removal%20Perform%20Database.pdf

EPA Low Impact Development Website - http://www.epa.gov/owow/NPS/lid/

Low Impact Development Urban Design Tools - http://www.lid-stormwater.net/

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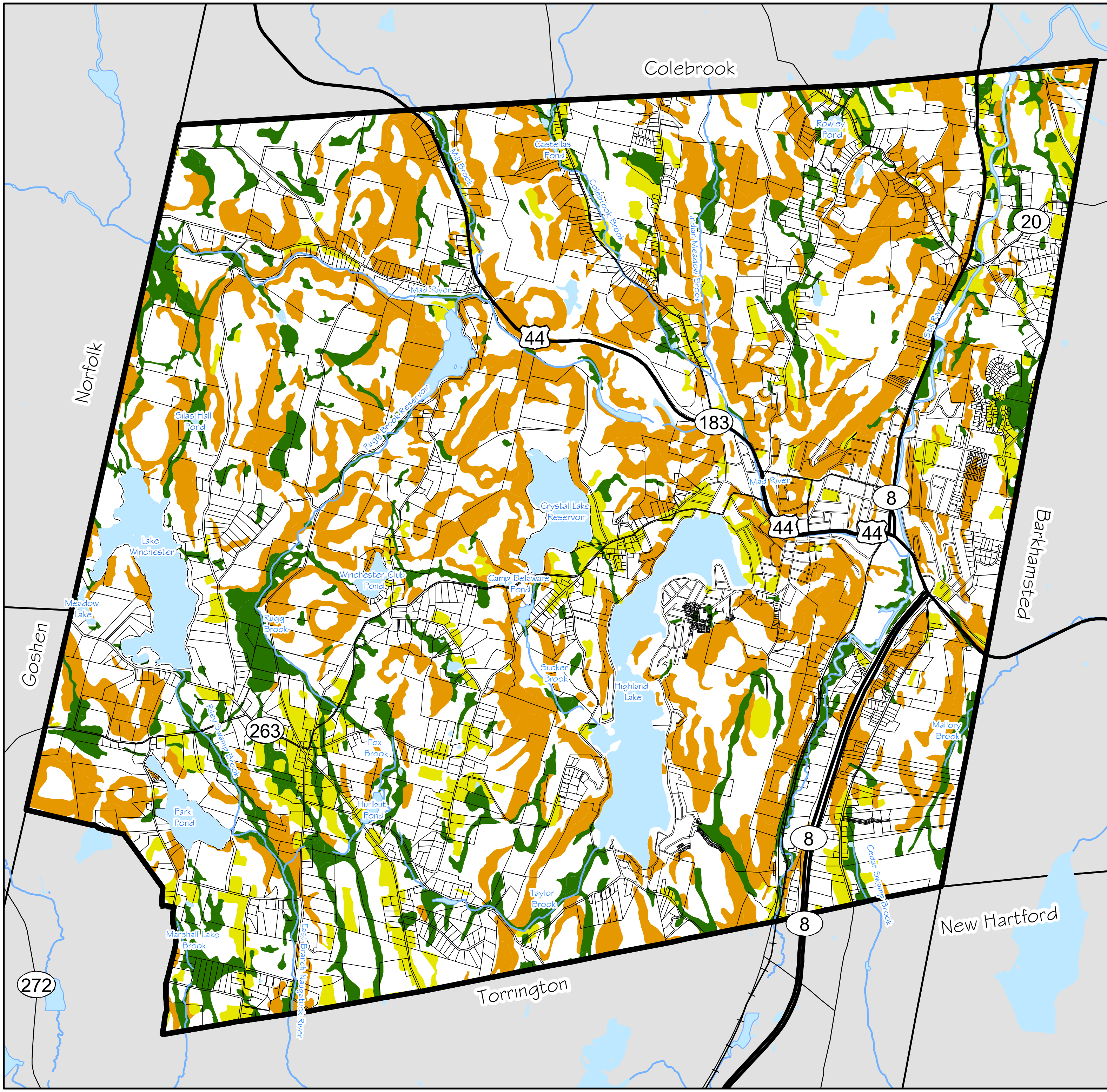
APPENDIX A



Town of Winchester

Low Impact Development Guidelines & Regulations

Environmentally Sensitive Soils

Legend

- Wetland Soils (Hydric)
- Steep Slope Soils*
- Prime Farmland Soils

Source:
GIS Parcel Basemap:
Town of Winchester
CT Department of Environmental Protection
Map & Geographic Information Center.
USDA, Natural Resource Conservation Service (NRCS) and the Connecticut Department of Environmental Protection.
Streetmap USA (2009).

*Only soil types with a minimum slope of 15% have been depicted on this map. Other soil types with a minimum slope of less than 15% and a maximum slope of greater than 15% may exist.

Please note that the Parcel Basemap does not reflect the lots around Highland Lake.

This map was developed for use as a planning document. Delineations may not be exact.

MILONE & MACBROOM®

0 0.5 1 2 Miles

N

Town of Winchester

Low Impact Development Guidelines & Regulations

Soil Hydrologic Group

Legend

- Soil Hydrologic Group A
- Soil Hydrologic Group B
- Soil Hydrologic Group C
- Soil Hydrologic Group D

Source:
GIS Parcel Basemap:
Town of Winchester
CT Department of Environmental Protection
Map & Geographic Information Center.
USDA, Natural Resource Conservation Service (NRCS) and the Connecticut Department of Environmental Protection.
Streetmap USA (2009).

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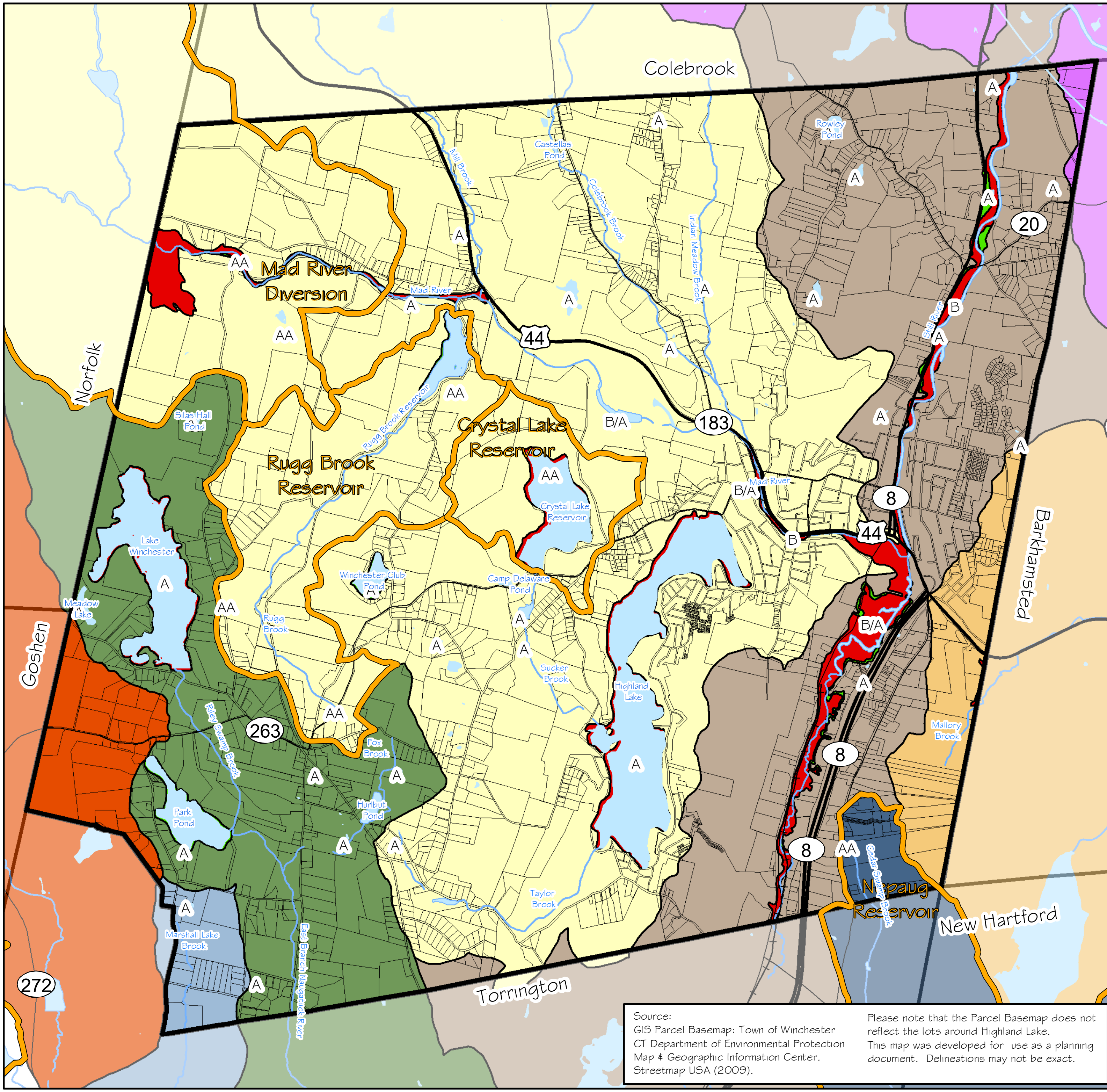
Town of Winchester

Low Impact Development Guidelines & Regulations

Water Resources



Source:
GIS Parcel Basemap: Town of Winchester
CT Department of Environmental Protection
Map & Geographic Information Center.
Streetmap USA (2009).

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Legend

Subregional Watersheds

- East Branch Naugatuck River
- Hall Meadow Brook
- Mad River
- Morgan Brook
- Nepaug River
- Sandy Brook
- Still River
- West Branch Naugatuck River
- Reservoir Systems
- 100 Year Flood Zone
- 500 Year Flood Zone

Surface Water Classifications

Classification	Definition
CLASS AA	Existing or potential public drinking water supply, fish and wildlife habitat, recreational use, agricultural and industrial supply and other purposes.Recreational uses may be restricted.
CLASS A	Potential drinking water supply, fish and wildlife habitat, recreational use, agricultural and industrial supply and other legitimate uses including navigation.
CLASS B	Recreational use, fish and wildlife habitat, agricultural and industrial supply and other legitimate uses including navigation.
CLASS C	Certain fish and wildlife habitat, certain recreational activities, agricultural and industrial supply and other legitimate uses including navigation. Swimming may be precluded. One or more quality criteria or designated uses impaired.
CLASS D	Present conditions severely inhibit or preclude one or more designated uses for extended time periods or totally preclude attainment of one or more designated uses. May be suitable for bathing or other recreational purposes, certain fish and wildlife hab
CLASS SA	Designated uses: marine fish, shellfish and wildlife habitat, shell fish harvesting for direct human consumption, recreation and all other legitimate uses including navigation.
CLASS SB	Designated uses: marine fish, shellfish and wildlife habitat, shellfish harvesting for transfer to approved areas for purification prior to human consumption, recreation, industrial and other legitimate uses including navigation.
CLASS SC/SD	Indicates unacceptable quality, the goal is Class SB or Class SA Designated uses: same as for Classes C or D surface waters.

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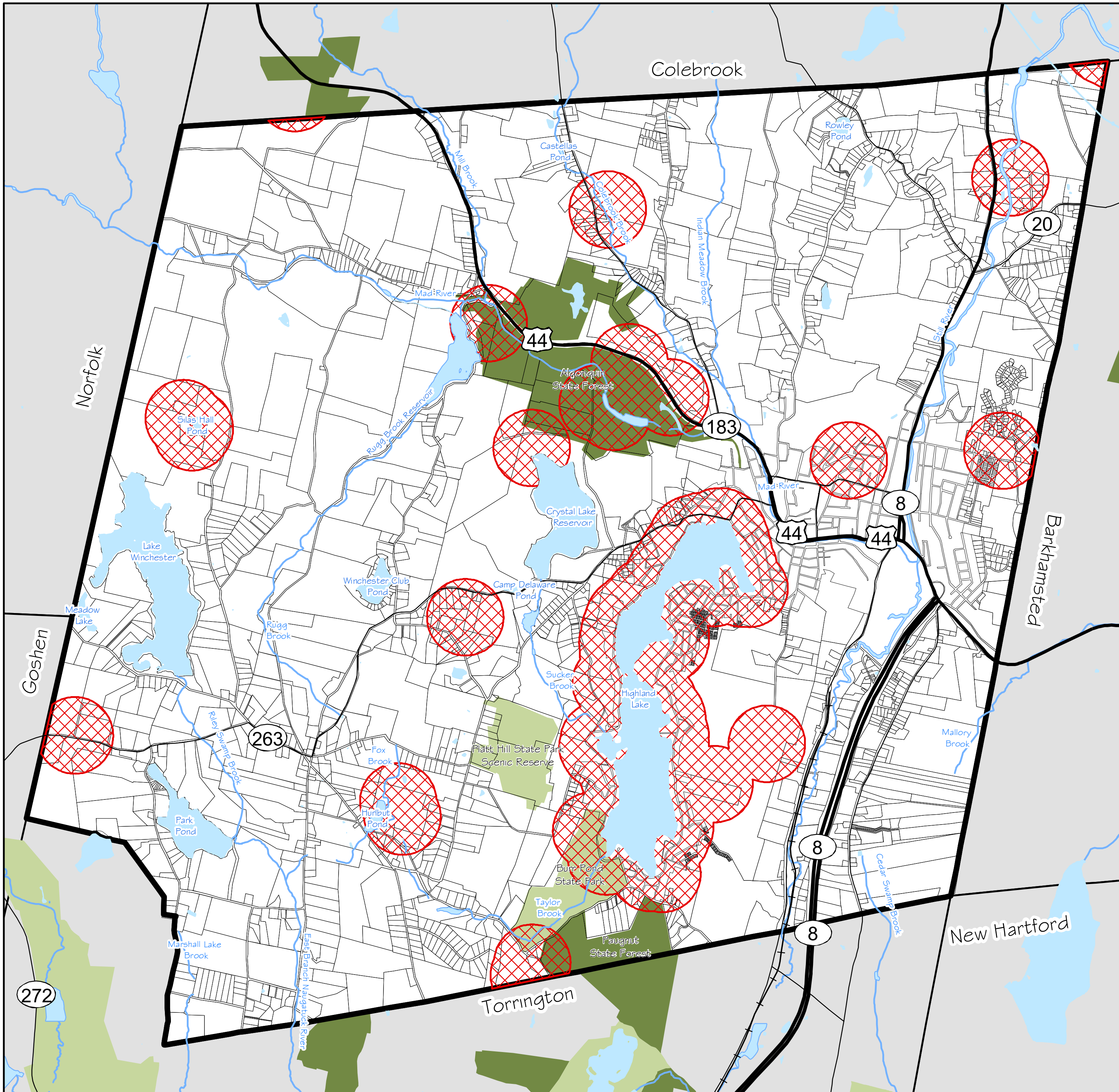
Town of Winchester

Low Impact Development Guidelines & Regulations

Significant Habitat & State Listed Species



Legend

- Natural Diversity Database Listed Species (NDDB)
- State Park
- State Forest

Source:
GIS Parcel Basemap:
Town of Winchester
CT Department of Environmental Protection
Map & Geographic Information Center.
Streetmap USA (2009).

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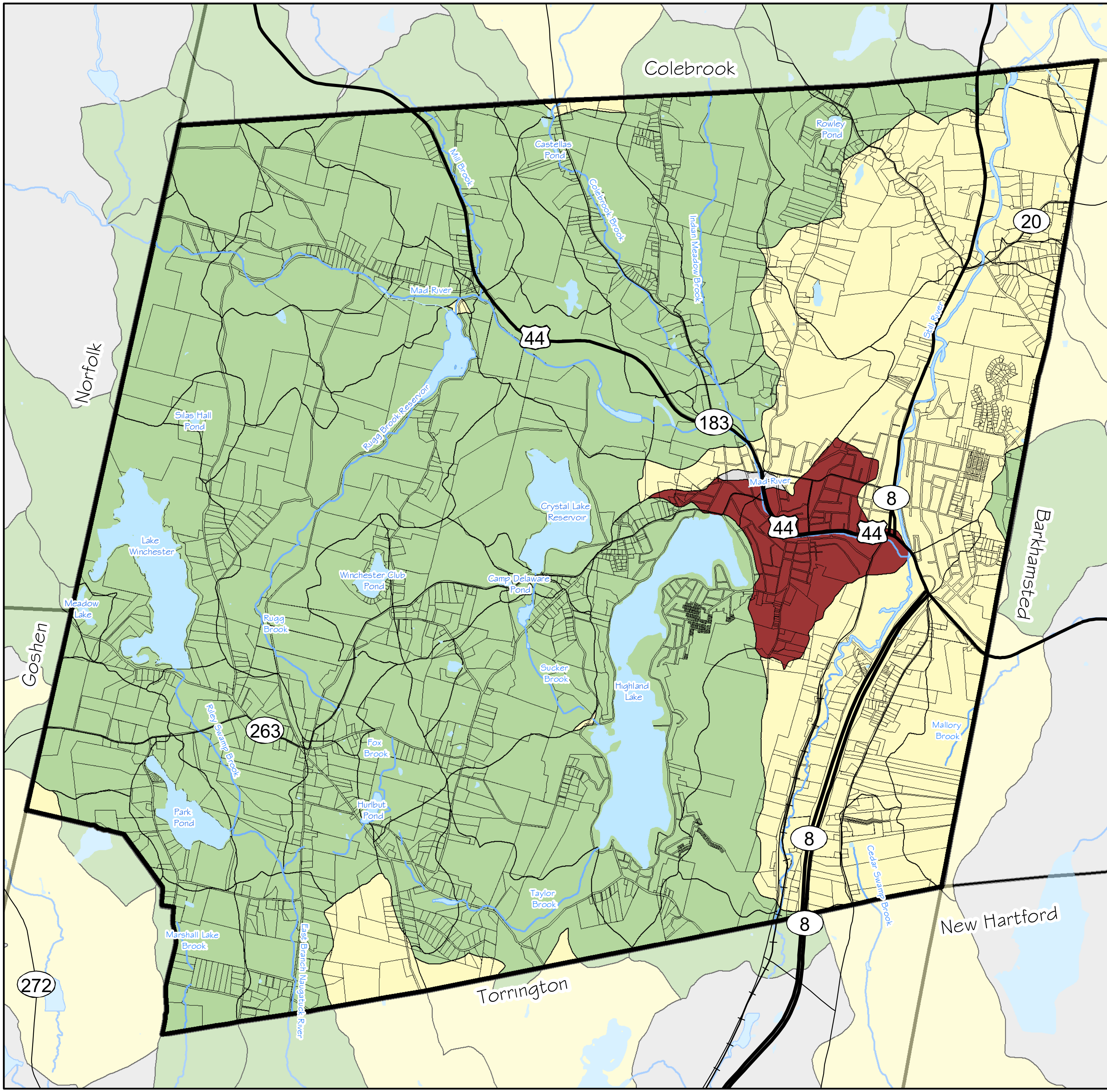

Town of Winchester

Low Impact Development Guidelines & Regulations

Percent Impervious Surface Analysis for Drainage Basins

Legend

- < 10% Impervious Sensitive Water Quality
- 10% - 25% Impervious Impacted Water Quality
- >25% Impervious Non-Supporting Water Quality

Source:
GIS Parcel Basemap:
Town of Winchester
CT Department of Environmental Protection
Map & Geographic Information Center.
Streetmap USA (2009).

Percent impervious surface was calculated using the Estimation Tool for Impervious Surface (ETIS) developed by the University of Connecticut's Center for Land Use Education & Research (CLEAR). Data sources for the analysis include: 2006 Land Cover, Population at the Block Level from the US Census Bureau (2000) & Watershed Basins from the U.S. Department of Agriculture, Natural Resources Conservation Service.

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This map was developed for use as a planning document. Delineations may not be exact.

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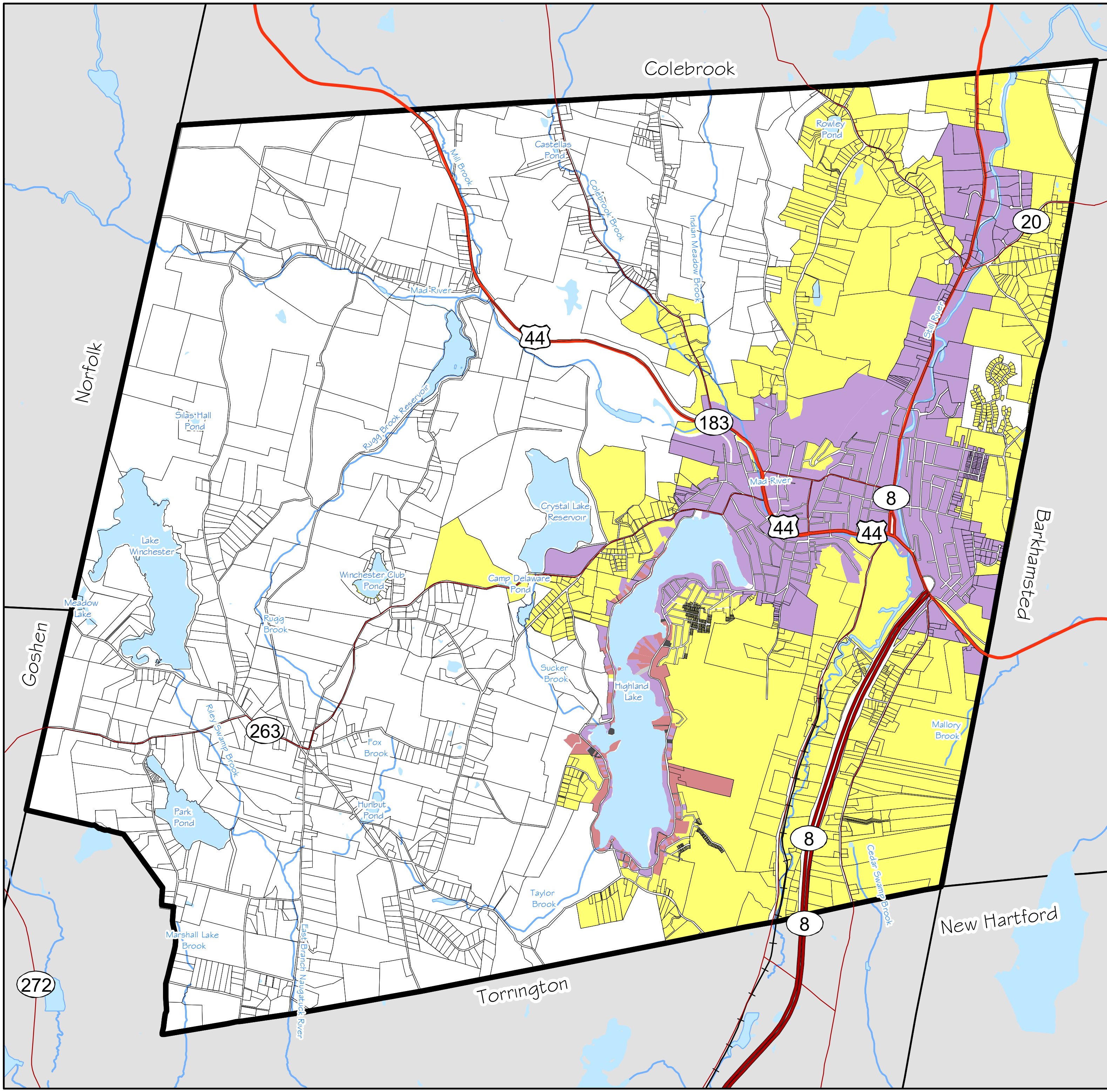

Town of Winchester

Low Impact Development Guidelines & Regulations

Sewer Service Area Plan

Legend

- Sanitary Connected
- Sanitary Future Connections
- Sanitary Likely Connected
- Sanitary No Plumbing
- Sanitary Not Connected

Source:
Town of Winchester &
Northwest Conservation District.
CT Department of Environmental Protection
Map & Geographic Information Center.
CT Department of Heath (2008).
Streetmap USA (2009).
Please note that the Parcel Basemap does not reflect the lots around Highland Lake.

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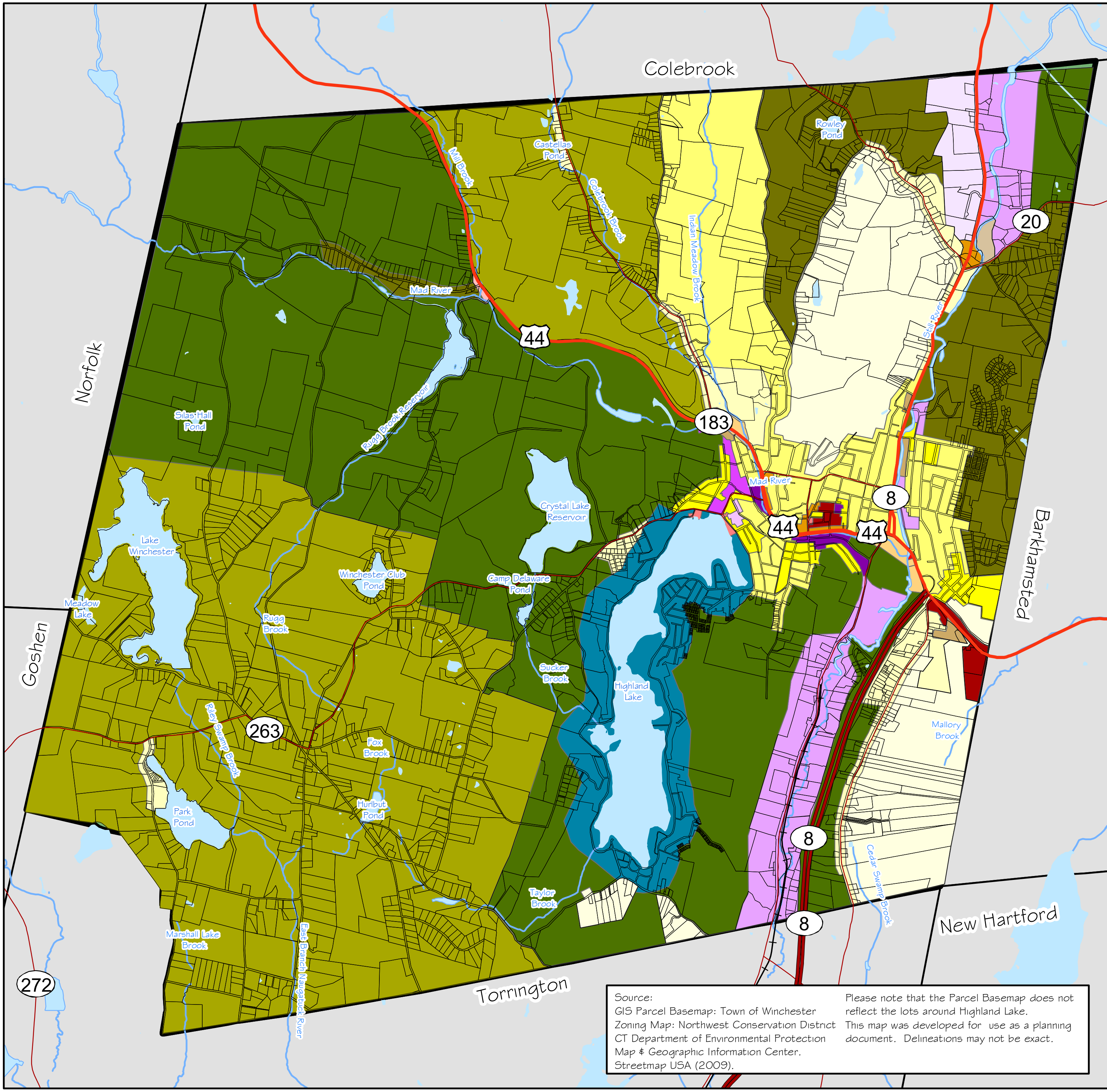
Town of Winchester

Low Impact Development Guidelines & Regulations

Zoning



Source:
GIS Parcel Basemap: Town of Winchester
Zoning Map: Northwest Conservation District
CT Department of Environmental Protection
Map & Geographic Information Center.
Streetmap USA (2009).

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Legend

- R-1 (40,000 sqft)
- R-2 (20,000 sqft)
- R-3 (11,250 sqft)
- R-4 (7,500 sqft)
- PD (1 acre)
- RU-1 (40,000 sqft)
- RU-2 (30,000 sqft)
- RU-3 (85,000 sqft)
- HLD (40,000 sqft)
- CA-1 (40,000 sqft)
- CA-2 (15,000 sqft)
- CA-3 (6,000 sqft)
- CB-2 (15,000 sqft)
- CB-3 (10,000 sqft)
- CX (40,000 sqft)
- IA-1 (80,000 sqft)
- IA-2 (40,000 sqft)
- IB-1 (80,000 sqft)
- IB-2 (40,000 sqft)
- IB-3 (20,000 sqft)

MILONE & MACBROOM®

0 0.5 1 2 Miles

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