1.0 INTRODUCTION

1.1 Overview

Ayer, Harvard, Lancaster and Shirley, are linked by two unique characteristics, one of which is natural and the other built: the Nashua River and Devens (Figure 1.1-1). After decades of pollution, the Nashua River is returning to life, but much remains to be done. After seventy years of military activity and governance, Devens is now the towns' and one of the Commonwealth's greatest redevelopment opportunities. The Nashua River represents an incredible resource for the four towns, from an extensive ground water system, to wildlife habitat, and recreational opportunities. Devens stands to be the economic force that will stimulate development in this region. The towns share the common interests of protecting and enhancing the Nashua River and its watershed, and mitigating the local impacts that will occur as Devens is successfully redeveloped. Absent a collaborative planning process, growth will neither be sustainable nor in keeping with the four towns' individual characters.

To address this issue, the four towns applied together, through the Joint Boards of Selectmen (JBOS) to the Massachusetts Executive Office of Environmental Affairs (EOEA). The JBOS was awarded a grant under the Communities Connected by Water program. Through this initiative, the JBOS is partnered with the Nashua River Watershed Association (NRWA) and the Montachusetts Regional Planning Commission, to develop a growth management plan for this subregion of the Nashua River watershed. The Devens Commerce Center and the Devens Enterprise Commission are also providing substantive input to this program.

1.2 Statement of Problems

The problems addressed through this program include:

- Assuring a safe ground water supply for future generations.
- Preserving water quality through safe and dependable wastewater treatment and septic disposal.
- Assessing population growth and its demands for municipal services and limited natural resources.
- Evaluating projected housing demand, the rate at which it's introduced to the market, the demands it will place on the towns' natural, municipal and fiscal resources, including the potential loss of open space.
- Preventing traffic congestion and its negative impact on the communities character and quality of life.

Figure 1.1-1 Study Area

How these problems are addressed, and the questions to be answered, are detailed below.

Water

Assuring a safe water supply for future generations is absolutely critical to the health of these four towns. This region is served by a substantial high yield aquifer. Presently, Ayer, Lancaster and Shirley have public water supplies drawing from this resource, as does Devens. Harvard relies primarily on private wells, expect for a small system serving the town center. Despite several extensive studies, no know future public water supply has been identified for Harvard other than the aquifer beneath Devens. The aquifer needs to be more fully delineated and understood so that proper precautions can be taken to protect it from contamination.

What is the capacity and location of the aquifer? What population (both numbers of people and numbers and types of businesses and industries) can it safely support? What are the recharge areas? Are they adequately protected from contamination?

Wastewater and Septic Disposal

Key to preservation of ground water resources is safe and dependable wastewater treatment and disposal. The Ayer wastewater facility needs upgrading. Lancaster is sewered, in part, through Clinton and is looking for expanded sewering for its Center. Harvard has no municipal sewer system, and is completely reliant on individual sewage disposal systems. Portions of Shirley, in particular Shirley Village will be connecting to the Devens wastewater treatment facility, as will Shirley MCI. Private septic systems need to dispose of sewage. Expanding sewer lines and districts is expensive. Alternatives need to be identified to safely serve town municipal centers, commercial districts, and clustered residential areas.

How could/will a regional wastewater treatment facility alleviate wastewater treatment needs for Ayer and Shirley? What alternatives are available to provide for safe septic disposal in denser, unsewered areas in the towns? What will the effects be on sprawl should these alternatives be allowed or if/when sewer lines are extended into the towns?

Population Growth

With the change of Devens from a fenced military reservation to an open development area actively seeking new businesses, the dynamics of population growth has been dramatically altered. As Devens redevelops, it will accelerate and reinforce the present steady regional growth rate. Increased populations will bring increased pressures and demands for municipal services and on limited natural resources such as water. How our resources should be managed to support this population growth, without being damaged or depleted, is a challenge facing the four towns.

How are town centers and villages (i.e. Ayer's Main Street, Harvard's town center and Still River village, Lancaster's town center and North village, and Shirley's town center and village) enhanced to support traditional development patterns? Can village patterns be replicated in emerging commercial areas such as Route 110/111 in Harvard and Route 2A in Shirley?

Housing and Open Space

As the regional population grows, so does the demand for housing - and all types of housing. Increasingly woods and fields - open lands - are converted from rural landscapes to subdivisions. Because the Devens Reuse Plan lacks a substantial housing component, businesses locating on Devens will look first to the four towns for housing, adding to the existing development pressure. As with population growth, future residential growth will place sever demands on the towns' natural, municipal, and fiscal resources. On the other hand, there is concern about the rate at which the housing that does exist on Devens is introduced and the impact that will have on the local housing market.

What are the tools (e.g. zoning, infrastructure improvements) available to the towns to assure sustainable housing development that provides for all segments of the population? What is the regional housing inventory? How do we encourage diversity of housing and subdivision patterns (e.g. cluster) that do not destroy the rural landscape of these towns? How can we link greenways and open space corridors within the region in keeping with the towns' open space plans and Nashua River Watershed Association's 2020 Vision Plan?

Traffic

The major east-west routes of 117, 2, Main Street in Ayer and Shirley, and 2A and north-south routes of I-495, 110/111, and 70 carry significant through-region, as well as local traffic. Seeking relief from congested major routes, more through traffic is detouring over local roads. At issue: keeping through traffic from becoming a negative impact on the region's resources or the communities' character and quality of life (e.g. clogged local roads and business districts), and encouraging alternative transportation (e.g. regional buses, commuter trains, bike trails).

Which roads are most suited for regional through-traffic? What traffic patterns are emerging? What are the safe levels of flow? What and how are alternative modes of transportation encouraged?

1.3 Study Process

As shown in Figure 1.3-1, the study was conducted in phases, coinciding with a series of public workshops. Phase 1 is the investigation of existing conditions; Phase 2 the analysis of trends; Phase 3 the development of planning and technological alternatives to manage growth; and Phase 4,

Figure 1.3-1 Study Process

recommendations and an action plan for implementing policies and programs to preserve quality of life in the region and foster and institute regional cooperative roles.

For each of the phases, ENSR, the consultant-coordinator, conducted the technical analyses. These analyses were directed by a Steering Committee comprised of two representatives of each of the four towns (Ayer, Harvard, Lancaster and Shirley), the Nashua River Watershed Association (NRWA), the Montachusett Regional Planning Commission (MRPC), the Devens Commerce Center (DCC), and the Devens Enterprise Commission (DEC). Also participating were the EOEA Nashua River Watershed Team Leader and a representative of the Massachusetts Audubon Society. Each of these representatives provided a network of involvement through other boards, agencies and public groups as the process proceeded. During preparation of the analyses, public input invited to frame the analyses, as well as to comment on the prepared analyses through a series of workshops.

1.4 Report Outline

To address the issues described in Section 1.2, this report has been organized as follows:

- Section 1 provides the statement of problems addressed by this study and the process used to implement the study.
- Section 2 provides a description of the existing environment in this four-town subregion of the Nashua River basin for the following resource topics: water supply, wastewater and septic disposal, population, housing, traffic and open space (Phase 1).
- Section 3 provides an analysis of the future trends associated with these five topics assuming no changes occur in resource management within the four towns (Phase 2).
- Section 4 provides a description of planning tools and technological alternatives available to preserve the quality of life of the four towns (Phase 3).
- Section 5 includes recommendations and an action plan, based on the selection of preferred alternatives presented during the previous phase (Phase 4).

The results of these phases serve as a foundation and establishment of institutional roles for future growth management in this subregion of the Nashua River watershed.

Included in this report are recommendations for implementing a Geographic Information System (GIS) for managing growth over the long-term. A GIS database has been provided to the members of the Steering Committee for use in continuing the planning process.

2.0 EXISTING CONDITIONS

2.1 Introduction

The following section provides a characterization of the existing environment within the four-town Joint Boards of Selectmen of Ayer, Harvard, Lancaster and Shirley (JBOS) region. The conditions described are current as of September 1999, and are based on a review and compilation of existing secondary data sources. Subsections address water supply, wastewater and septic disposal, population, housing, traffic and open space.

2.2 Water Supply

2.2.1 Approach/Sources of Data

This section provides a summary of the existing water resources and water supplies in the JBOS region. General descriptions of regional surface water and groundwater resources are presented. The water supply systems of each of the towns is reviewed, including present supply, possible future supply, present and future demand, delineation of protection areas and potential contamination sources. This information will serve to define the baseline conditions for water supply in the Devens/four towns region.

To gather information of the existing conditions of water supply, all of the towns, and staff of the DCC were contacted to determine the date and content of studies conducted concerning water supply in the area. Copies of all relevant reports were requested. Additional information was obtained from the NRWA, the Massachusetts Department of Environmental Protection (MADEP), and MassGIS. MassGIS data, which is general in nature, was compared with more local and/or specific information provided in the town studies. The studies were used to update/append the information provided by MassGIS.

The following water-related reports were obtained by ENSR and served as the basis for the information provided herein.

- Water Supply and Distribution Study, Town of Ayer, 1999
- Conceptual Zone II Delineation for the Spectacle Pond Wells, Ayer, 1999
- Water Supplies in the Nashua River Watershed: Towards a Sustainable Future, 1995.
- Squannacook River Protection Plan, 1997.
- Shirley Groundwater Protection Study, 1986.

- Devens Water Resources Protection Report, 1994

The following coverages are available on MassGIS:

- High and medium yield aquifers
- Watershed basin boundaries (including subbasins)
- Public water supplies
- DEP-approved Zone II Protection Areas
- Interim Wellhead Protection Areas
- Surface Water Supply Protection Areas

2.2.2 Surface Water Issues

Most of the JBOS region lies within the 538 square mile Nashua River watershed basin. The Nashua River forms the town boundaries between Ayer and Shirley and Harvard and Shirley. A small portion of eastern Ayer lies in the Merrimack River watershed basin (Figure 2.2-1). Some of the larger tributaries draining into the Nashua River in the region include the Squannacook River, which flows through Shirley, and the North Nashua River, which flows through Lancaster. Average and extreme flows for these rivers are presented in Table 2.2-1**.** Subbasin boundaries within the region are presented in Figure 2.2-1. Downstream of Lancaster, the Nashua River flows into the Wachusetts Reservoir, part of the Massachusetts Water Resources Authority (MWRA) system that supplies drinking water to the greater Boston area.

Table 2.2-1 Summary Flow Statistics for the Nashua and Merrimack Rivers

Flow (ft^3/s)	**Nashua River (E. Pepperell gaging station)**	**N. Nashua River (Fitchburg gaging station)**	**Squannacook River (W. Groton gaging station)**
Annual Mean	584	123	113
Highest Annual Mean	969	169	174
Lowest Annual Mean	214	59.5	35.9
Highest Daily Mean	19400	2830	3420
Lowest Daily Mean	1.1	2.7	2.0
Source: Socolow et al., 1998			

In the first half of the 1900's, as mills flourished in this region, the Nashua River received large quantities of industrial waste. In 1965, it was so polluted that it was designated unfit to receive sewage. Since then, a great deal of effort has gone into cleaning up the river and the watershed. The EPA Index Watershed Indicator (IWI) for the Nashua River watershed is now a 1, the highest score, indicating better health and low vulnerability. The primary issues or health concerns in the watershed

Figure 2.2-1 Surface Water Resources

are the loss of wetlands and limited fish consumption due to presence of contamination. Watershed pollution pressures come primarily from increasing population and hydrologic modifications (dams and impoundments) to the watershed.

The Nashua River and its tributaries are classified as Class B waterways by the MADEP. The primary uses of Class B waterways are habitat for fish, other aquatic life and wildlife, primary and secondary contact recreation, irrigation and industrial cooling and aesthetic value. The Nashua River, the North Nashua River and the Squannacook River at the confluence with the North Nashua have dissolved oxygen and temperature restrictions to insure the waterways maintain suitable habitat for warm water fisheries.

Lakes and ponds in the region include Grove Pond (Devens and Ayer), Long Pond, Spectacle Pond and Sandy Pond (Ayer), Bare Hill Pond (Harvard), Lake Shirley (Shirley), Mirror Lake, Little Mirror Lake, Robbins Pond, Plow Shop Pond, Fort Pond, and Cranberry Pond (Devens) and White Pond (Lancaster). There is concern about metals in Grove Pond, which overlies an aquifer pumped by both Devens and Ayer. Long Pond has been considered as a potential future source by the town of Ayer, but was eliminated because it is upgradient of the Town's Grove Pond wells, and changes to the surface water supply could potentially affect the groundwater supply (Tata & Howard, 1999a).

Although many municipalities within the watershed rely on surface water withdrawals as part or all of their water supply, none of the four towns or Devens use surface water as any part of the public supply. However, some indirectly draw surface water through induced infiltration into valley aquifer wells.

2.2.3 Groundwater Resources

The four towns lie within the Upland Subprovince of the New England physiographic province, characterized by gently rolling terrain intersected by river and stream basins (VHB et al, 1994). The Nashua River basin is underlain by folded and faulted metamorphic and granitic bedrock, ranging in depth from approximately 100 to 600 feet deep. Along the river valleys, sand and gravel deposits overlay the bedrock. These glacial deposits comprise the high-yielding aquifers that underlie Devens and portions of Shirley and Ayer, with pumps yielding more than 300 gpm (Figure 2.2-2). Sand and gravel deposits within fine-grained silts and sands surround the high-yield regions. These deposits are approximately 75 feet thick, and wells within these regions may yield 100 to 300 gpm. In the smaller valleys are low-yielding aquifers consisting of fine silt, sand and clay deposits that may be more than 100 feet thick. Wells within these areas can be expected to yield less than 100 gpm (Brackley and Hansen, 1977).

All of the public water supply in the four towns region is obtained from groundwater resources. Figure 2.2-3 presents the public wells located in the region, which are summarized in Table 2.2-2. Many of

Figure 2.2-2 High and Medium Yield Aquifers

Figure 2.2-3 Water Supply Wells and Protection Areas

the larger wells have delineated protection areas, Figure 2.2-3. In areas where public water is not supplied, residents rely on small, private wells.

Table 2.2-2 Public Drinking Wells

Well	Town	Max. Approval (gpm)
Spectacle #1	Ayer	791
Spectacle #2	Ayer	730
Grove #1	Ayer	694
Grove #2	Ayer	780
Catacunemaug	Shirley	104
Patterson	Shirley	450
Walker	Shirley	0
McPherson	Devens	833
Grove Pond	Devens	764
Patton	Devens	972
Sheboken	Devens	972
MCI	Shirley	500
Source: ENSR, 1999		

Ayer

The town of Ayer supplies 95% of the required water needs (6527 people). Water usage is divided between residential (34%), commercial (23%), industrial (28%) and municipal (9%) uses (NWRA, 1995). The primary water sources are two sets of wells, Spectacle Pond wells #1 and #2 and Grove Pond wells #1 and #2. The maximum safe yields are 791 gpm (1.14 mgd) and 730 gpm (1.05 mgd) for the Spectacle Pond wells (Tata and Howard, 1999a) and 694 gpm (1.0 mgd) and 780 gpm (1.12 mgd) for the Grove Pond wells (B. Bouck, pers. comm.) , for a total yield of 4.3 mgd. The town has a 1.5 million gallon storage tank. Additional water supply (primarily for emergency situations) is available via interconnections with the town of Littleton (1.2 mgd) and Devens (0.54 mgd) .

A Zone II delineation was developed for the Grove Pond wells in 1993 and for the Spectacle Pond wells in 1999. The town of Ayer owns all of the Zone I delineated aquifer protection areas, and much of the Zone II areas. Thirty percent of the Spectacle Pond Zone II area lies in the town of Littleton within a designated aquifer protection area. Potential contamination sources within the Spectacle Pond Zone II regions include heavy industry, residential septic systems, underground storage tanks and the Littleton inactive municipal landfill.

The Grove Pond wells share the aquifer with the Grove Pond wellfield on the Devens property. Potential contamination of these wells comes from VOCs detected in Grove Pond, the Shepley and Cold Spring Brook landfills in Devens, the Massachusetts National Guard motor pool area and the

B&M Railroad tracks and yard. At present, the town has no Aquifer Protection District By-Law in place, but is under development.

The Average Daily Demand (ADD) in 1992 for the town of Ayer was 1.79 mgd, and the Maximum Daily Demand (MDD) in 1996 was 2.1 mgd (Tata & Howard, 1999b). The present town water system is capable of meeting the current maximum demand. Increases in water demand in the near future include expansion of the present distribution system to include the remaining 5% of population and to water supply to provide increased fire fighting capacity. The Massachusetts Department of Environmental Management (MADEM) has projected the ADD for Ayer to be 3.0 mgd in 2010. In a recent study, Tata and Howard (1999b) projected the ADD to be 4.14 mgd in 2020. In either case, the present water supply appears to be adequate to meet the future projected demand.

Several studies over the past several years have been conducted to identify potential future water supply sources for the town. The results of drilling and pump tests have found all of the proposed gravel-pack well locations to be inadequate due to low yield, potential upgradient contamination or distance from existing distribution systems. The possibility exists to develop high-yielding bedrock wells. Preliminary investigations pointed to a fault intersection that might produce adequate yield, but was located near the Ayer Wastewater Treatment Plant (Tata & Howard, 1999b). Future studies would include a fracture trace analysis to determine map fault locations if this option were to be pursued. SEA Consultants (1990) identified Long Pond as a potential surface water. However, Long Pond is located upgradient from the Grove Pond wells, and withdrawal at this location could induce a negative impact on the pumping capacity at Grove Pond.

<u>Harvard</u>

The town of Harvard has the smallest public water supply of the four towns, serving approximately 200 people, the schools and some businesses in the center of town. The average daily demand (ADD) on this system is 0.02 million gallons per day (mgd). Two bedrock wells, located on Pond Road, currently meet this demand. The primary well has a maximum pumping rate of 22 gallons per minute (gpm). The second well, located 100 feet west of the first Pond St. well, has a maximum pumping rate of 17 gpm. A backup well with a maximum pumping rate of 20 gpm, is located on Bolton Road, used only for emergencies due to the high iron content. A 340,000 gallon storage tank aids in water distribution.

Neither of the town wells have Zone II Aquifer Protection Plans. The Pond Road Zone I Aquifer Protection Area is owned by the town. Potential sources of contamination include a combined town/state drainage system that discharges into this area, and residential septic systems located within the Zone I delineated area.

MADEM has projected a future ADD of 0.38 mgd for Harvard in the year 2015 (NWRA, 1995). Many exploratory test wells have been developed to identify feasible locations for additional wells. In the mid-70's an exploratory drilling study located a viable shallow aquifer located near the Boxborough town line (Ted Morine, pers. comm.). Pump tests indicated that wells in this aquifer could yield approximately 175 gpm. However, the infrastructure required to move this water from its source, over two ridges and into the center of town to tie in with the current distribution system make this an unfeasible source at the present time. Other preliminary studies have turned up no new, feasible locations in which to install additional wells. Additional future water supplies might be secured from a regionalized water supply system, with sources in Littleton or Devens.

Lancaster

The town of Lancaster supplies water for 95% (~6000 people) of the town population. The ADD is 0.53 mgd, and the maximum daily demand (MDD) was 1.4 mgd in 1993. The town operates two wells, located on the south side of town, and a 2 million gallon storage tank (NWRA, 1995).

No Zone IIs have been delineated, however the town owns 30 acres around the wells, and any use of this area is forbidden. The wells are located under 75 feet of clay, which is believed to act as a protective barrier to potential contamination.

The MADEM projected the ADD for the town of Lancaster to be 0.61 mgd in 2014 (NWRA, 1995).

Shirley

The Shirley Water District supplies 50% (3059 people) of the town's population, through the operation of two wells. Patterson Well, with a safe yield of 450 gpm, provides 83% of the water, and Catacunemaug well has a safe yield of 250 gpm, for a total supply of 1.0 mgd. The ADD is 0.31 mgd, and the MDD was 0.6 mgd in 1994. Residential use accounts for 65% of the total usage, commercial/industrial 7%, and 27% miscellaneous (NWRA, 1995).

In 1986, the town of Shirley passed a Water Supply Protection By-Law, delineating aquifer protection areas and specifying land use within the protection zones. The Water District owns 75% of the W1 (Zone I) areas. Pollution sources threatening the Catacunemaug well include the Shirley Landfill and point and nonpoint source discharges from nearby gravel mining operations. Existing and proposed industrial development poses a potential pollution source for the Patterson Road well (ENSR, 1999). The Patterson Road well shares the aquifer with the McPherson Well, one of the Devens water supply wells.

MADEM predicted the ADD for the town of Shirley to be 0.32 mgd in 2015 (NWRA, 1995). In order to meet future demand that might arise from an expansion of the water district, a third well has been proposed off Walker Road, near the Patterson Road well, to supplement existing supply. The development of this well is in the preliminary stage, a pump test will be performed sometime in the future to determine expected yield. Present supply is more than adequate to meet future demand.

Devens

The water supply system at Devens, designed to serve a population of 30,000 people, includes 145 miles of distribution mains and two million gallon storage tanks (ENSR, 1995). Three wells and one tubular well field are in operation at Devens: Grove Pond wellfield (1.1 mgd safe yield), Patton Well (1.4 mgd safe yield), MacPherson well (1.2 mgd safe yield) and Sheboken well (1.4 mgd safe yield). Under the state Water Management Act, Devens is registered to withdraw 1.35 mgd, however, a prior study indicated a safe yield in excess of 5 mgd (ENSR, 1995). The Water Management Act (WMA) permit issued in April 1999 allows a maximum of 5.33 mgd in total from the four Devens wells in addition to the previously registered 1.35 mgd (personal communication; A. Aglington ,MADEP, 2001). The MacPherson well withdrawal amount was conditionally approved pending relocation of abandoned military landfill AOC9 and completion of new source approval by the Shirley Water District for its proposed Walker well. Excavation of AOC9 is currently underway as part of landfill consolidation at Devens.

Average water consumption in 1995 was less than 500,000 gallons/day, the majority of which was used for residential purposes (EarthTech, 1995). Water use is expected to increase as industry grows at Devens. A new golf course is anticipated to use approximately 175,000-225,000 gpd at peak times and an application is being submitted for an amendment to the Devens WMA permit to accommodate the golf course irrigation well. This amendment would not change total withdrawal amounts allowed under the WMA but would provide for a fifth withdrawal location and possibly a reallocation of total permitted amounts among the Devens wells (Personal Communication, A. Eglington, MADEP, 2001). The use of potable water for irrigation purposes is a concern of the Steering Committee, while use of process water (grey water or treated effluent) may be appropriate and preserve future potable water for potential future domestic needs.

There are many existing sources of contamination within the boundaries of the former Fort Devens, which is a federal Superfund site and a Massachusetts Contingency Plan (MCP) site. Fifty-nine separate source areas have been identified, including an eight-acre maintenance yard, a fifty-acre sanitary landfill, former gas stations, and the firefighter training area. Concentrations of VOCs, petroleum products, heavy metals, asbestos and explosive residue have been measured in soil, surface water and groundwater. Groundwater quality monitoring data has shown minimal contamination to the aquifers in the vicinity of the water supply wells. Low concentrations of volatile organic carbons, including trichloroethylene, have been detected at Grove Pond and MacPherson wells at concentrations below drinking water standards.

There are several sources or potential sources of contamination to the high-yield aquifer underlying Devens. Storm water runoff from Route 2 and other major roadways, which is likely to contain dissolved and suspended solids, heavy metals, and VOCs, in addition to oil and hazardous materials resulting from spills. The Hill Yard, a rail yard operated by the B&M/Springfield Terminal Railway Company, could release chloride, metals, nitrates, pesticides, herbicides, VOCs and other contaminants to the groundwater. Runoff from the former Moore Airfield could contain metals, pesticides, herbicides, VOCs and surfactants, all contaminants common to runoff from airports.

Seven state-listed disposal sites are located within one-half mile of the Devens boundary: two in Ayer, likely upgradient of Grove Pond; two in Harvard; and three in Shirley. Contamination consists predominantly of groundwater and soil impacted by gasoline and petroleum products leaking from underground storage tanks.

2.3 Wastewater and Septic Disposal

2.3.1 Approach/Sources of Data

Wastewater generated by the communities of Ayer, Harvard, Lancaster, and Shirley is managed (treated and disposed) using either centralized community sewage systems and associated wastewater treatment facilities or by means of individual on-site subsurface sewage disposal systems. The evaluation of "existing" conditions in each of these communities was developed as a result of conversations with community officials and by reviewing pertinent town and regional wastewater facility plans, master sewer plans, sewer construction plans and specifications, and subsurface sewage disposal studies. Specific information reviewed for the communities of interest included:

Ayer

- Tata & Howard, Inc.; Town of Ayer - Draft Wastewater Treatment Facility (WWTF) Alternatives Analysis; prepared for Town of Ayer Department of Public Works, June 28, 1999.
- Personal communication with Mr. Gary Girouard; Superintendent of Ayer Department of Public Works.

Harvard

- Town of Harvard Town Center Task Force; Report to the Harvard Planning Board; August 1, 1998.
- Woodard & Curran, Inc.; Town of Harvard, Massachusetts - Wastewater Planning Letter Report; Prepared for the Town Center Task Force; May 30, 1997.

Lancaster

- Earth Tech, Inc., Draft Drawing Showing Lancaster Sewer District Center District Sewer Expansion, Lancaster Massachusetts; March, 1999.

- SEA Consultants, Inc.; Master Sewer Plan Update - Town of Lancaster, Massachusetts; March, 1986.
- Personal communication with Jonathan Gulliver, District Administrator, Lancaster Sewer District.
- Personal communication with John Riggio, Facility Manager of MWRA-Clinton WWTF.

Shirley

- Larry Koff & Associates - Thomas Planning Services, Inc.; Town of Shirley Wastewater Impact Study; November 5, 1997.
- Woodard & Curran, Inc.; Town of Shirley, Massachusetts - Wastewater Facilities Plan Update; March, 1999.
- Woodard & Curran, Inc.; Town of Shirley, Massachusetts - Plans and Specifications - Contract 1A - Shirley Village Wastewater Collection System - DEP Project No. CWSRF 124; Prepared for Town of Shirley Board of Selectmen; March, 1999.
- Woodard & Curran, Inc.; Town of Shirley, Massachusetts - Plans and Specifications - Contract 1B - Shirley Village Wastewater Collection System - DEP Project No. CWSRF 124; Prepared for Town of Shirley Board of Selectmen; March, 1999.

Regional Information

- Massachusetts Development Finance Agency - Massachusetts Government Land Bank; Devens Commerce Center - Request for Statements of Qualifications and Expressions of Interest for Purchase or Lease, Management, Operation and Maintenance of the Devens Wastewater Treatment Facilities and Sewerage System; October 25, 1996.
- Personal communication with Mr. Michael Domenica, Consultant to Devens Commerce Center, MassDevelopment.

2.3.2 Wastewater Overview

A majority of the town of Ayer's wastewater is treated at the Ayer Wastewater Treatment Facility (WWTF), with the treated effluent discharged to the Nashua River. Wastewater treatment and disposal in the towns of Harvard, Lancaster and Shirley historically has been accomplished by individual subsurface sewage disposal systems. The town of Harvard is exclusively serviced by individual septic systems. Although soil, depth to bedrock, and groundwater elevation conditions are not ideally suited for such systems in all parts of town, the town currently has no plans to construct or connect to any type of centralized wastewater treatment facility.

The southern and central areas of Lancaster have experienced numerous failures of septic systems due to a combination of aged systems, adverse soil conditions, and shallow depth to groundwater. Municipal sewer lines and associated pump stations have been constructed in the southern part of town and the sewerage collected is routed to the Massachusetts Water Resources Authority's (MWRA) Clinton WWTF, located just over the town line in Clinton. Construction plans and specifications are currently being prepared for an extension of this municipal system to include the Center District area. Additional future connections to the municipal system beyond the planned Center District expansion could be limited due to a moratorium on new connections imposed by the Clinton WWTF.

Up until two or three years ago, the Town of Shirley was exclusively served by subsurface sewage disposal systems, with the one exception being the Massachusetts Correctional Institution (MCI-Shirley), which had its own wastewater treatment facility, which discharged to the Nashua River. Widespread failures of septic systems (due to aged systems, adverse soil conditions, and high groundwater) and the expansion of the prison facility prompted the town to consider centralized wastewater treatment alternatives. With the cessation of military operations at Fort Devens, the Devens WWTF has excess capacity and agreements were developed to allow the town to connect to the Devens system. In 1998, the existing Hospital Road interceptor pipeline was upgraded to provide capacity for the Town of Shirley's flows, the MCI-Shirley WWTF was closed, and the flows from MCI-Shirley were routed to the Devens WWTF. Construction plans and specifications have been and are being developed for provision of municipal sewer lines for much of the southern and central areas of town including Shirley Village and Shirley Center. Construction on the first phase of the Shirley Village extension is slated to begin in Fall of 1999. While it is anticipated that the remaining non-sewered areas of town will continue to use individual septic systems, the planned sewer construction project has been designed with excess capacity to allow for additional connections in the future.

Flows to the Town of Ayer's WWTF are approaching the design capacity of the facility. The town is currently evaluating three options for expansion of their treatment capacity. These are: 1) expansion of the existing Ayer WWTF, 2) closing of the Ayer WWTF and routing of flows to the Devens WWTF, and 3) a hybrid plan that includes minor upgrades to the Ayer WWTF and construction of a pipeline that will allow routing of excess flows to the Devens WWTF. Town meetings to be held in the Fall of 1999 are expected to resolve this issue.

2.3.3 Municipal Wastewater Treatment Facilities

There are three municipal wastewater treatment facilities that serve the four communities connected by water (Figure 2.3-1). These are:

- the Town of Ayer WWTF (serves the town of Ayer)
- the Devens WWTF (will serve much of the town of Shirley, could serve the town of Ayer in the future)

Figure 2.3-1 Municipal Wastewater Systems and Septic Disposal Constraints

- the Clinton WWTF (serves select areas of the Town of Lancaster)

The municipal sewer systems serving the towns and the role that the above-listed wastewater treatment facilities play in these systems is discussed below. A fourth smaller (6,000 gallons per day) private wastewater treatment plant serves the River Terrace Nursing Home, located on Route 117 in Lancaster, and discharges to the North Nashua River. This evaluation assumes that the River Terrace facility will continue to operate independent of any municipal system.

<u>Ayer</u>

Wastewater treatment and disposal in the Town of Ayer is primarily accomplished by the Town's municipal sewer system and associated wastewater treatment facility. An estimated 85% to 90% of Ayer's residential population discharges wastewater to the municipal sewer system. The municipal sewer system also serves five large industrial dischargers and numerous smaller commercial and municipal facilities (Tata and Howard, 1999).

The Ayer WWTF is an activated sludge based treatment system consisting of aerated grit tanks, primary clarifiers, aeration basins, secondary clarifiers, and chlorine contact tanks. The facility also has a septage receiving station. The existing facility was designed to accommodate a year 2000 average daily wastewater flow of 1.79 million gallons per day (mgd) and sufficient space was provided to allow for potential expansion to accommodate a year 2025 average daily wastewater flow of 2.79 mgd. The existing average daily flow is reported as 1.54 or approximately 86% of the design flow mgd (Tata and Howard, 1999).

A wastewater treatment alternatives report (Tata and Howard, 1999) projects that the average daily flows to the Ayer WWTF could approach 1.89 mgd by the year 2005 and 2.37 mgd by the year 2020.

As the existing facility is approaching its design capacity and in anticipation of future growth, the Town is evaluating three alternatives for handling increased wastewater flows. The first alternative is an upgrade and expansion of the existing facility to handle the projected increased flows. Tata and Howard indicated that this would include construction of an additional primary clarifier, secondary clarifier, aeration tank, and sludge storage tank and upgrades to pumping facilities, all to accommodate increased flows. Improvement would also likely involve an upgrade to the existing disinfection system, and addition of phosphorus and ammonia-nitrogen removal systems, all to ensure compliance with anticipated more stringent future wastewater discharge permit requirements. This system would be designed to accommodate year 2020 projected average daily, maximum daily, and peak hour flows of 2.37, 7.11, and 8.77 mgd, respectively.

The second alternative being considered is the abandonment of the existing Ayer WWTF and the diversion of all flows to the Devens WWTF, which is located on the opposite side of the Nashua River. This would require upgrades to the Ayer facility's existing pump station and the construction of approximately 2,500 linear feet of 18-inch force main from the Ayer facility to the Devens WWTF. To understand implications of this alternative on the Devens WWTF, a discussion of this existing facility is warranted and provided below in the section "Devens".

Harvard

Wastewater in the Town of Harvard is treated and disposed of exclusively by means of individual on-site subsurface sewage disposal systems (primarily septic tanks with leaching fields). The Town has funded a screening level evaluation of wastewater treatment alternatives for the town center and for the town as a whole (Woodard and Curran, 1997), including possible construction of a new wastewater treatment facility or connection to the Devens WWTF, but found such alternatives to be cost prohibitive and counter to the town's objective of maintaining its historic rural character.

Lancaster

Historically, most of the wastewater of the Town of Lancaster has been treated and disposed of using individual on-site subsurface sewage disposal systems. A municipal sewer collection system is currently available to only the southernmost area of town, serving approximately 30% of the Town's population (SEA, 1986) and running along Main Street from the Clinton town line, north to Atlantic Union College and running along High Street from the Clinton town line, north to Five Corners (Route 110). The MCI-Lancaster facility has also recently been connected to this system, via a pipeline running down Old Common Road to a newly constructed pump station at Five Corners. Sewerage collected in this "Lancaster Sewer District" system is routed to the MWRA's Clinton WWTF, located in Clinton, just over the town line, on High Street. Treated effluent from the Clinton WWTF is discharged to the Nashua River.

A 1986 master sewer plan (SEA, 1986) indicated that adverse soil conditions that exist along Main Street and the general Center District area have resulted in septic systems problems and failures in these areas. To address these problem areas, a Center District sewer expansion project is currently in the design phase and plans and specifications are expected to be released for bidding in the Fall of 1999. This project will extend the municipal sewer system from the existing Five Corners pump station to the north, along Center Bridge Road to Main Street, and will continue to the north, along Main Street, to Route 117. The system will continue to the east along Route 117 to Harvard Road and will extend to the south, serving Harvard Road, Neck Road, Packard Street, and other smaller roads in the Center District area (Earth Tech, 1999). This sewerage will also be routed to the Clinton WWTF.

The Clinton WWTF has a design average daily flow capacity of 6.0 mgd but is currently permitted to discharge a maximum average daily flow of 3.01 mgd. The current average daily discharge from the Clinton WWTF is approximately 2.7 mgd (personal communication with John Riggio). The 1986 Lancaster facilities plan (SEA, 1986) indicated that up to 0.37 mgd of the Clinton WWTF's capacity is allocated to the Lancaster Sewer District and, at that time, the district had an estimated average daily flow of 0.127 mgd. With the increased development and population since 1986, the recent addition of the MCI-Lancaster flows, the current average daily flow for the Lancaster Sewer District is approximately 0.155 mgd. With the proposed connection of the Center District, it is assumed that the average daily flow in Lancaster Sewer District will approach approximately 0.28 mgd or around 75% of the regulatory allocation.

In 1986, the MADEP imposed a moratorium on additional future outside connections to the Lancaster sewer collection system. Only Lancaster Board of Health (BOH) certified failed septic systems located within the sewer district are eligible for connection to the municipal system. While the Center District expansion qualifies for connection under this moratorium, new developments (an example being the proposed 115-unit Eagle Brook senior housing development) are required to identify and eliminate infiltration and inflow (I/I) in the existing system in a 2 to 1 ratio to their proposed discharge in order to be eligible for connection. This means a development seeking to discharge 10,000 gallons per day (gpd) of wastewater to municipal system would be required to locate and eliminated 20,000 gpd of I/I flows in order to be eligible for connection. Since such development would represent an expansion of the sewer district, legislative action (approving an expansion of the district) would be required prior to the issuance of any approved connection permit (personal communication with Jonathan Gulliver).

It is assumed that, following the construction of the Center District Sewer Extension, the remaining non-sewered parts of town outside of the Lancaster Sewer District will remain non-sewered and will continue to be served by individual on-site subsurface sewage disposal systems. Potential connection of some northern portions of town to the Devens WWTF, while being the subject of discussion in the past, is not considered likely but will be evaluated.

Shirley

Except for the MCI-Shirley, which has had its own wastewater treatment facility, wastewater treatment and disposal in Shirley has historically been performed using individual on-site subsurface sewage disposal systems. Expansion of the MCI-Shirley facility and failure of numerous septic systems (especially in the Shirley Village and Shirley center areas) have prompted the town to consider alternate treatment options. In 1998, a pipeline was constructed to route wastewater from the MCI-Shirley facility to the Devens WWTF and the prison's WWTF was abandoned. The average daily flow of wastewater from the expanded MCI-Shirley to the Devens WWTF is approximately 0.6 MGD. The pipeline between MCI-Shirley and the Devens WWTF, however, was sized to accommodate future flows from Shirley Village and Shirley Center areas and excess capacity was provided for additional future connections (Woodard & Curran Facilities Plan, 1999).

Engineering design and construction plans and specifications have recently been completed for a Shirley Village wastewater collection system. This system, for which construction will begin in the fall of 1999, will serve the village including Main Street, Lancaster Road, Center Road, Ayer Road, Front Street, and southern sections of Clark Road and Walker Road. Flow will be routed to the MCI-Shirley Interceptor at Hospital Road. Engineering design, plans, and specifications are currently in progress for a Shirley Center wastewater collection system which will serve the center including sections of Center Road, Hazen Road, Benjamin Road, Brown Road, Horse Pond Road, Parker Road, Little Turnpike Road, and Route 2A. This system will connect to the Shirley Village system both at Center Road and Benjamin Road.

The constructed Shirley Village and Shirley Center sewer systems are expected to provide municipal sewer service to approximately half of the town's population. The anticipated average daily flow from the Shirley Village and Shirley Center systems is approximately 0.3 mgd. The remaining areas of town are currently served by septic systems and it is anticipated that this will continue to be the case. The planned Shirley Village and Center systems, however, have been designed with excess capacity future connection of other certain areas of town may be feasible.

Devens

The Devens WWTF was originally constructed in 1942 to serve Fort Devens and consists of Imhoff tanks, which provide limited anaerobic biological treatment, and discharge to rapid infiltration sand filter beds. The systems has a design average daily flow capacity of 3.0 mgd. Over the past few years, the facility has had difficulty complying with applicable groundwater discharge standards and, consequently, a new treatment plant has been designed and construction has recently been initiated. The new plant that is currently under construction will also be a 3.0 mgd facility, but will provide space for potential future expansion. The new facility will provide preliminary settling followed by anaerobic treatment in sequencing batch reactors (SBR's), disinfection, and discharge to the existing rapid infiltration beds (personal communication with Mike Domenica).

The existing Devens WWTF currently receives an average daily flow of approximately 0.4 mgd from Devens based facilities and (as discussed later) as much as 0.6 mgd from MCI-Shirley. When the Shirley Village and Shirley Center sewer expansions are completed, an additional flow of up 0.3 mgd will be treated at the Devens WWTF. By 2001, not accounting for growth at Devens, approximately 1.3 mgd of the 3.0 mgd capacity of the Devens WWTF will be in use. Addition of the current Ayer average daily wastewater flow of 1.54 mgd would essentially use up the remaining plant capacity and future growth in Ayer would certainly result in flows that would exceed the capacity of the Devens WWTF. Consequently, consideration of the second alternative (routing all Ayer flows to Devens) would necessarily involve expansion of the Devens WWTF.

The third alternative being considered, the "hybrid solution", is to use the Ayer WWTF to treat a portion of the town's wastewater (say 1.5 mgd), with the remaining excess flows being routed to the Devens WWTF. While the existing Ayer WWTF would require some degree of upgrading under this alternative (e.g., disinfection improvements and possible implementation of nitrogen removal and phosphorus removal), improvements would be significantly less than those required under the first alternative. Since the diversion flow to the Devens WWTF would be much less than that under alternative 2, expansion of the Devens WWTF to accommodate the Ayer flows would likely not be required. This third alternative was the alternative recommended by Tata and Howard.

The expansion of the Devens WWTF to accommodate Ayer may necessitate a surface water discharge to the Nashua (currently Devens is permitted for groundwater discharge only from the WWTF).

2.3.4 Subsurface Sewage Disposal Systems

Description of Subsurface Discharge Systems

Areas of town not served by municipal wastewater collection systems and associated municipal wastewater treatment facilities rely on individual on-site subsurface sewage disposal systems. Wastewater management in the town of Harvard is provided exclusively by such individual septic systems. Major portions of the town's of Shirley and Lancaster also rely on such systems, but such reliance will be diminished somewhat in the next few years with the expansion of the respective communities municipal sewer systems. Even with the expanded municipal sewer, as much as 30% to 50% of Lancaster and Shirley's population likely will continue to be served by individual subsurface sewage systems. Since municipal sewers are provided for much of the town of Ayer, there is less reliance on subsurface systems, however between 10 to 15% of the town's population still utilizes septic systems.

The typical residential subsurface sewage disposal system consists of a septic tank, distribution box, and leaching field. The septic tank is typically a large concrete tank (usually with a capacity of 1,000 to 1,500 gallons; although older smaller tanks do exist) that first receives the wastewater discharge from the home. Heavier solids settle to the bottom of the tank forming a "sludge" layer. Lighter solids (fat, oil, grease, etc.) float on the top of the tank forming a "scum" layer. Between the scum layer and the sludge layer is the partially clarified water that is ultimately discharged from the tank. Tanks are designed to provide retention time to allow for the settling of the solids which contain a majority of the wastewater's organic loading. Anaerobic biodegradation occurs within the sludge layer, eliminating much of the potential biological contaminants. Septic tank solids are typically removed every two years to prevent excess sludge build-up.

The partially clarified effluent discharges from the septic tank typically enters a distribution box. Where one pipe brings flow into the distribution box, two, three, four or more pipes "distribute" flow out from the box into an adjacent leaching field. The function of a distribution is to evenly distribute flows to the various pipes that make up the leaching field so that wastewater is evenly discharged to the leaching bed materials. The leaching field consists of a series of perforated pipes placed usually upon a layer of highly permeable materials (crushed stone or sand) placed upon the naturally occurring soils. The leaching field serves two functions. As the effluent settles into the permeable materials a zone of aerobic digestion, referred to as a "biomat", typically forms which further degrades organic wastes present in the effluent. The leaching field also allows this "treated" effluent to percolate down to the groundwater table, where it is "discharged" to the groundwater system.

The system described above is a "typical" system, however, many variations exist. Many older systems may include simple cesspools, may have leaching "tanks" rather than leaching fields, or may not include distribution boxes. Many of these older systems (and some newer systems) have failed over the past decade or expected to fail in the near future. System failures can be usually be attributed to failed leaching fields or clogging of leaching field associated components. If septic tanks are not pumped regularly, sludge can buildup within the tank to the point where solids are discharged along with the effluent, clogging the distribution box or downstream perforated piping. Excessive waste loadings can often result in the development of an impervious biomat which diminishes the absorptive capacity of the leaching field and underlying natural soils. Limited permeability of the naturally occurring underlying soils (for example clayey soils) can also diminish absorptive capacity and result in failure. Shallow bedrock and/or a shallow depth to the groundwater table can adversely affect both the absorptive capacity and "treatment" efficiency of the leaching field.

The age and construction of many of the existing systems in the communities of interest combined with the adverse soil, bedrock, and groundwater conditions that exist in many areas of these communities, have resulted in failure of numerous systems. As will be discussed later, more stringent State requirements associated with the upgrading of existing septic systems and construction of new systems and the siting of such systems with respect to sensitive environmental areas, has placed additional constraints on the suitability of certain areas for construction of "traditional" septic systems and has prompted consideration of alternative designs and configurations. Since the continued use and/or future development of properties in non-sewered areas of these communities will rely on such systems, a discussion of the potential regulatory and hydrogeological constraints is appropriate.

Regulatory Overview

The design, construction, and operation of subsurface sewage disposal systems are regulated by Massachusetts regulation 310 CMR 15.000, also referred to as Title 5. Title 5 regulations were initially promulgated in 1978 and were substantially revised in 1995. The 1995 revisions have impacted requirements for existing systems, upgrades of existing systems, and construction of new systems. The most significant component of the regulation as it relates to existing systems is the requirement that systems be inspected as a requirement for property transfer, and, unless granted a variance by the local BOH, be brought into compliance with the revised 1995 requirements. As a result of such inspections, many systems that have been operational from a disposal perspective have been declared failed from an environmental protection perspective. Unless variances are granted, these failed systems must be replaced, often requiring implementation of costly and sometimes aesthetically unpleasing (e.g. mounded systems) alternative systems. Inspections and associated required improvements can also be required when additional bedrooms are proposed for an existing residence.

For currently undeveloped properties, provided that a disposal system construction permit has been submitted before January 1, 2000, the septic system must comply "to the maximum extent feasible" with the 1995 Title 5 code. This "transition rule" has provided limited "grandfathering" for property owners, potentially easing some of the more stringent requirements of the 1995 code, providing compliance with the 1978 code is demonstrated. Permit applications received after January 1, 2000 must comply fully with the 1995 code.

The Title 5 regulation addresses a myriad of issues related to subsurface sewage system design including the size and location of septic tanks, the location, size, and construction of leaching fields, required absorptive capacities of naturally occurring soils beneath leaching fields, required depths to bedrock and to high groundwater elevation, required distances from private water wells, public surface water supplies, and public water supply interim wellhead protection areas, and required distances from wetlands, vernal pools, and surface waters. Specific, more stringent, requirements are presented for areas designated as "nitrogen sensitive areas". In the communities of interest, nitrogen sensitive areas are limited to the Interim Wellhead Protection Areas and the designated Zone II contribution areas of public water supply wells.

The design flow for a residential home is based the number of bedrooms in a home, assuming two persons per bedroom and a resultant flow of 110 gallons per bedroom. The minimum system typically allowed is for a 3 bedroom home or a minimum design capacity of 330 gallons per day. The minimum size for a new septic tank is 1,500 gallons, providing approximately four and one-half days of retention for the minimum design flow.

When proposing a leaching field location, the absorptive capacity, depth to bedrock, and depth to high groundwater must be established. Sites for new leaching systems must demonstrate a percolation rate of 30 minutes per inch (min/in) or faster. Sites for upgraded leaching systems must "perc" at a rate of 60 min/in or faster. At least four feet of naturally occurring pervious (60 min/in or faster) must be provided beneath the bottom of the leaching trench. If the percolation rate is very quick (2 min/inch or faster), five feet of soil is required. This means that the separation between the trench bottom and bedrock must be 4 to 5 feet.

The trench bottom must be a minimum of 4 feet above the high groundwater elevation in soils with a percolation rates of slower than 2 min/in and 5 feet above high groundwater in soils with a percolation rate of 2 min/in or faster. In areas with high groundwater, this requirement has often resulted in the construction of mounded systems in order to achieve the required separation.

In Nitrogen Sensitive Areas (NSA's), new on-site sewage disposal systems have a nitrogen loading limitation based maximum design flow of 440 gallons per day per acre of land. This requirement, which is to be strictly enforced for developments seeking construction permits after January 1, 2000, means that in NSA's, a four bedroom home will require a one acre minimum lot size and a 3 bedroom home will require a 3/4 acre lot.

The Title 5 regulations also provide minimum setback distances for septic tanks and soil absorption systems (leaching fields) from property lines, buildings and sensitive resources. A list of these setback distances is provided in Table 2.3-1. Figure 2.3-1 shows these setbacks in the four-town region.

Table 2.3-1 Title 5 – Minimum Setback Distances in Feet

Minimum Setback from	Septic Tank	Soil Absorption System
Property Line	10	10
Cellar Wall or Swimming Pool (inground)	10	20
Slab Foundation	10	10
Water Supply Line (pressure)	10	10
Surface Waters (except wetlands)	25	50
Bordering Vegetated Wetlands(BVW), Salt Marshes, Inland and Coastal Banks	25	50
Surface Water Supply – Reservoirs and Impoundments	400	400
Tributaries to Surface Water Supplies	200	200
Wetlands Bordering Surface Water Supply or Tributary thereto	100	100
Certified Vernal Pools	50	100
Private Wager Supply Well or Suction Line	50	100
Public Water Supply Well	Not in Zone I	Not in Zone I
Irrigation Well	10	25
Open, Surface or Subsurface Drains which discharge to Surface Water Supplies or tributaries thereto	50	100
Other Open, Surface or Subsurface Drains (excluding foundation drains) which intercept seasonal high groundwater table	25	50
Other Open, Subsurface Drains (excluding foundation drains)	5	10
Leaching Catch Basins & Dry Wells	10	25
Downhill Slope	NA	15

In situations where space constraints, adverse soil or bedrock conditions, high groundwater elevations, or proximity of water supplies or sensitive environmental resources limit the use of "traditional" subsurface sewage disposal system, Title 5 presents alternative systems that can be utilized to develop a property that might not be developable using traditional systems. The most frequently implemented "alternative" system has been the construction of mounded leaching fields. By constructing placing the bottom of the leaching trench at higher elevation, often near or at the pre-construction ground surface, sufficient separation from high groundwater and/or bedrock can be achieved. While such a system is attractive from an operational standpoint (it functions as a traditional passive system with minimum maintenance), it can often be unpleasing aesthetically, converting a previously flat lawn into a large mound.

Other Title 5 "alternative" systems typically involve installation of supplemental treatment systems prior to discharge to the soil absorption system. These include provision of filtration between the septic tank and leaching field (e.g., an intermittent sand filter or synthetic filter medium), use of recirculating sand filters (requires pumping equipment), use of composting toilets, and use of alternative leaching field designs or leaching structures. These alternative systems typically involve increased maintenance requirements, can include mechanical and electrical equipment, and typically cost more to construct and maintain than traditional systems.

Evaluation of the suitability of land for subsurface sewage disposal systems will require consideration of all of the regulatory constraints discussed above.

2.3.5 Constraints on Use of Subsurface Sewage Disposal Systems

The principal limitation in developing an individual septic system is finding an appropriate site for the soil absorption system – commonly referred to as a leach field. As noted previously, leach field locations are constrained by the following:

- Permeability of Soils
- Depth to Bedrock/Groundwater
- Proximity to Wetlands/ Water Resources

The following is discussion of these constraints for the communities of interest.

<u>Soils/Bedrock</u>

<u>Ayer</u>

For a variety of reasons, including shallow depth to bedrock, shallow depth to groundwater, excessively drained soils (limiting filtering capacity), and poorly drained soils (limiting percolation rates), most of the Town of Ayer is unsuitable for subsurface sewage disposal systems. The central developed area of town is dominated by Merrimac and Canton-Charlton soils. These are very sandy soils with excessive drainage characteristics which limit the filtering capacity of soil absorption systems. Lesser developed areas to the north and east of Flannagan Pond and Sandy Pond are dominated by Charlton-Hollis soils. While these soils are somewhat excessively drained, the steep slopes on which they occur and the shallow depth to bedrock typical of such a unit is the limiting factor for the implementation of subsurface sewage disposal systems. Other soil units present in Ayer are the Carver and Windsor units (both are excessively drained sandy units), the Freetown and Woodbridge units (poorly drained units that are subject to ponding), and Woodbridge and Montauk units (poorly drained units that percolate water very slowly).

Due to problems with operation of subsurface sewage disposal systems, most of the town (an estimated 85% to 90% of Ayer's residential population and most larger commercial and industrial dischargers) are connected to the town's municipal sewer system. It can be assumed that significant future developments will likely also request permission to connect to this sewer system. If such connection is not possible, either due to sewer system capacity limitations or physical constraints (e.g., excavation problems due to ledge or bedrock outcrops), use of mounded systems or other more innovative systems will likely be required for subsurface systems. Suitability of individual properties for subsurface sewage disposal systems must be conducted on a site by site basis, however, and there could be individual lots or properties which would be suitable for traditional septic systems.

Harvard

Although the Town of Harvard has no municipal sewer system and its population is served almost entirely by individual subsurface sewage disposal systems, soil conditions, depth to bedrock, and depth to groundwater in the town are all generally unfavorable for subsurface sewage disposal systems. Harvard soils are predominantly characterized as Paxton and Chatfield-Hollis, with smaller localized areas of Merrimac, Pinkly, Woodbridge, and Ridgebury. In Harvard, the Paxton soil units typically percolate slowly and the Chatfield-Hollis units are typically associated with the presence of shallow bedrock, severely limiting operation of soil absorption systems. The Merrimac and Hinckley units are excessively drained, sandy soils that provide minimal filtering and the Woodbridge and Ridgebury units percolate slowly. These soil conditions, along with the shallow depth to bedrock and high groundwater levels, have adversely impacted the operation of existing and siting of future subsurface sewage disposal systems.

Since Harvard has no plans to develop a municipal sewer system or connect into a regional system, implementation of mounded sewer systems or innovative alternative systems will be critical for assuring compliance with Title 5 groundwater discharge requirements and for supporting future growth. Suitability of individual properties for subsurface sewage disposal systems must be conducted on a site by site basis, however, and there could be individual lots or properties which would be suitable for traditional septic systems.

Lancaster

Lancaster soils vary somewhat from north to south. The northern portion of town is dominated by Quonset soils with smaller areas of Paxton and Chatfield-Hollis units. These soils are not well suited for subsurface sewage disposal systems. The Quonset soils are very sandy and excessively drained, providing minimal filtering, the Paxton units percolate slowly, and the Chatfield-Hollis units are associated with shallow depth to bedrock. The north-central area of town has less of the Quonset soils and has a general mix of Paxton, Chatfield-Hollis, Hinckley, Windsor, and Merrimac series. The Hinckley, Merrimac and Windsor series all tend to be excessively drained sandy soils, which limits their filtering capacity. The south central area of town, which encompasses most of the Central District, is characterized as having soils with slow percolation rates including Paxton, Chatfield-Hollis, Woodbridge, Winooski, and Limerick soil series. These limited permeability soils have contributed to many of the septic system failures in the Central District area. The southern area of town has mixture of poorly drained Paxton and Merrimac soils and excessively drained Windsor soils.

Failure of septic systems in the Central District area has resulted in an extension of the town's municipal sewer district to include areas south of Route 117 along Main Street, Harvard Street, Neck Road, and Centerbridge Road and also the MCI Lancaster facility. Construction of the expanded district is expected to be completed within the next one or two years. Most failed septic systems have occurred in areas of town with poorly drained soils (primarily the central area of town, between Bolton Road and Route 117). Where soils are excessively drained (portions of the southern, north-central, and northern areas of town) system failures are less frequent, due to the rapid drainage. In light of Title 5 regulations regarding soil absorption system filtering requirements, however, many of these existing systems could be out of compliance with the regulations due to the rapid drainage. Soil conditions, depth to bedrock, and depth to groundwater could require implementation of mounded systems or other innovative technologies as septic systems are replaced or as additional properties are developed. Suitability of individual properties for subsurface sewage disposal systems must be conducted on a site by site basis, however, and there could be individual lots or properties which would be suitable for traditional septic systems.

Shirley

Soils in the Town of Shirley vary from east to west. Soils in the eastern part of the town, generally within 1/2 mile of the Nashua River, are excessively drained sandy soils and include the Carver, Quonset, Windsor, and Hinckley units. These units drain quickly and offer limited filtering capacity for soil adsorption systems. Soils in the central and western areas of town, including those in the vicinity of Shirley Village and Shirley Center, are generally a mixture of moderately well drained soils with slow percolation rates. These include the Scituate, Montauk, Ridgebury, and Woodbridge units and poorly drained soils which are subject to ponding and have very slow percolation rates, such as the Saco, Scarboro, Freetown, Whitman, and Rippowan units.

The slow percolation rates of the soils in the vicinity of Shirley Center and Shirley Village have resulted in numerous failed septic systems. For this reason, the town has expanded the municipal sewer district to include these most densely populated sections of town and is initiating sewer main construction in these areas. The current sewer design has provided for excess capacity should additional areas of town require sewer hookup in the future. The soil conditions indicate that either due to slow drainage characteristics or excessively quick drainage characteristics, there are very few areas of town ideally suited for traditional septic systems and leaching fields. It can be assumed that future development will typically either involve connection to the municipal sewer systems or installation of mounded systems or other innovative designs. Suitability of individual properties for subsurface sewage disposal systems must be conducted on a site by site basis, however, and there could be individual lots or properties which would be suitable for traditional septic systems.

Wetlands/Water Resources

As discussed previously, the Title 5 regulations require specific setback distances for septic tanks and soil absorption systems from wetlands, water resources, and other potential locations for human contact. Table 2.3-1 summarized these setback distances. Clearly multiple instances of each of these constraints occur within the region. Figure XX depicts areas within the region that fall within these Title 5 setbacks. Approximately 15 to 20 percent of the acreage of each of the four towns are within a setback area.

Groundwater Elevations

Groundwater elevations are another constraint to development of soil adsorption systems. Title 5 Regulations require a separation of four or five feet (depending on percolation rates) between the bottom of the soil adsorption system and the seasonal high groundwater table. The regulations do allow placement of fill to create the required separation (i.e., mounded system). Based on the distribution of soils throughout the region approximately 5 to 10 percent of the area suitable for leach field construction will require mounding for proper groundwater separation or consideration of other alternative designs.

2.4 Population, Housing and Open Space

2.4.1 Technical Approach/Sources of Data

The towns of Ayer, Harvard, Lancaster and Shirley are linked by two distinct characteristics: the Nashua River and Devens. Since the closure of Fort Devens in 1995, these towns have had to contend with an array of local and regional changes. These changes include a dramatic shift in the local and regional labor force, increased traffic volumes and changes in commuting patterns, additional single-family housing construction, skyrocketing real estate values, and increases in the local and regional population as people move to the region for the employment opportunities at Devens. While the jobs created at Devens have more than replaced those lost as a result of the base closure, the economic growth comes at a cost to many towns within the I-495, Route 2/2A, and Route 110/111 area.

In order to understand the potential for growth in the towns of Ayer, Harvard, Lancaster and Shirley, an examination of recent population figures and building permits issued was undertaken using information from each towns annual reports, and information collected from the Montachusett Regional Planning Commission (MRPC).

2.4.2 Population

The population figures provided in Table 2.4-1 do not reflect military personnel from Fort Devens and are an estimate of each town’s population minus those military personnel. As shown below, the populations of both Ayer and Lancaster have nearly doubled between 1950 and 1998. In the same time frame, Harvard's population has tripled and Shirley's has more than doubled.

Table 2.4-1 Total Population, 1950 to 1998 for Selected Towns in Region

Town	1950	1960	1970	1980	1990	1998	% Change 1950-1998
Ayer	3,723	3,649	7,393	6,993	6,229	7,378	+98%
Harvard	1,331	1,978	2,962	3,744	4,662	5,263	+295%
Lancaster	3,601	3,958	6,095	6,334	6,661	6,542	+82%
Shirley	2,645	3,006	4,909	5,124	5,390	5,800	+119%
*** These figures do not reflect Fort Devens military personnel. Source: Montachusetts RPC, US Census and MISER Population Figures.**							

As shown in Table 2.4-2, each town grew between 3 and 15 percent from 1995 to 1998. As stated previously, these population figures do not include the military population of Fort Devens and provide a good base for an analysis of future population growth, now that Fort Devens has closed. Unlike those figures presented in Table 2.4-1, the figures shown below are actual town records of each town's population and are thus more suitable to providing baseline data points for the regression analysis to be used to estimate future population.

Table 2.4-2 Population per Town, 1995-1998

Town	1995	1996	1997	1998	1999	% Change
Ayer	6,089	6,621	6,676	6,500	7,004	15 percent
Harvard	5,104	5,157	5,211	5,263	5,337	5 percent
Lancaster	6,410	6,462	6,500	6,542	6,600	3 percent
Shirley	5,545	5,600	5,665	5,800	5,860	6 percent
Source: Towns of Ayer, Harvard, Lancaster and Shirley, 1999						

2.4.3 Housing Units and Building Permits

To better determine the future growth of a town, it is important to examine the rate of development that has occurred in the recent past. Table 2.4-3 provides the numerical changes per category of housing for each town between 1995 and 1998. Of the three categories of housing, single family residential accounts for the overwhelming majority of new housing in each town and will likely constitute the majority of new residential construction in the future.

Table 2.4-3 Total Housing Units by Type, 1995-1998

Town	Type of Housing	1995 Total Units	1996 Total Units	1997 Total Units	1998 Total Units
Ayer	Single-family	1,556	1,590	1,620	1,679
	Multi-family	1,465	1,470	1,475	1,475
	Manufactured Housing	101	101	101	101
	Total	**3,122**	**3,161**	**3,196**	**3255**
Harvard	Single-family	1511	1527	1546	1559
	Multi-family	386	386	386	386
	Manufactured Housing	17	17	17	17
	Total	**1914**	**1930**	**1949**	**1962**
Lancaster	Single-family	1,676	1,718	1,740	1,779
	Multi-family	398	398	398	398
	Manufactured Housing	21	21	21	21
	Total	**2,095**	**2,137**	**2,159**	**2,198**
Shirley	Single-family	1,393	1,405	1,440	1,490
	Multi-family	625	625	628	631
	Manufactured Housing	279	279	279	279
	Total	**2,297**	**2,309**	**2,347**	**2,400**
Source: Towns of Ayer, Harvard, Lancaster, and Shirley, 1999					

As shown in Table 2.4-4, the four towns collectively issued 933 building permits for new residential construction between 1990 and 1998 (these permits are inclusive of single family, condominiums and multi-family dwelling units). This represents a nine-percent cumulative increase in residential housing in the four towns between 1990 and 1998.

Table 2.4-4 Residential Building Permits Issued, 1990-1998

Town	Year	# of New Housing Permits Issued
Ayer	1990-1998	364
Harvard	1990-1998	163
Lancaster	1990-1998	191
Shirley	1990-1998	215
TOTAL:		**933**
Source: Town Annual Reports, 1990-1998.		

2.4.4 Open Space

Approach/Sources of Data

The protection of open space plays an integral role in the planning and development activities of any community. Open space is used for a variety of purposes including but not limited to, water supply protection, recreation, wildlife habitats, aesthetics, buffers to development, historic preservation and natural resource management.

The Executive Office of Environmental Affairs, Division of Conservation Services requires all communities in the Commonwealth to develop Open Space and Recreation Plans, if they plan to pursue grants and loans for land acquisition and development activities. The state offers a variety of grant programs including the Self-Help, Urban Self-Help and the Land and Water Conservation Fund, that will allocate funds to Cities and Towns for the express purpose of preserving open space.

To obtain an accurate depiction of the status of open space protection and uses, a review of the most recent Open Space and Recreation Plan for each of the four communities and for the Devens Commerce Center was undertaken. The following will describe, in general terms, the key ingredients of each community plan and identify common goals and areas of protection that have been established as well as what is planned over the ensuing years.

Ayer

The Town of Ayer completed its Open Space and Recreation Plan in January 1998. This OSRP was prepared as part of the Ayer Comprehensive Plan. The prior OSRP was completed in the 1970's. Many of the recommendations made in the earlier plan have been implemented including the purchase of the Erskine Property, development of interpretative trails, restoration of the Nashua River waters, establishment of an Historic Commission and Main Street Historic District and the purchase of land on Long Pond for resource protection reasons (OSRP, 1998).

The Open Space and Recreation Plan for the Town of Ayer examined both protected and unprotected conservation and recreation lands as part of its inventory. A total of 675 acres of land is presently classified as open space with 575.15 acres or 85% considered protected (refer to Appendix B. The protected parcels are sites owned by the Town of Ayer and the Commonwealth of Massachusetts. The Ayer Sportsmen's Club, located off Snake Hill Road and Wright Road was the only unprotected parcel noted.

A total of 180 acres of conservation land in Ayer is controlled by the Conservation Commission. These areas consist primarily of pond areas, including Erkine Pond, Bennett's Brook, and Fletchers's Pond (refer to Figure 2.4-1). All other Town-owned lands are managed by various Town Departments including Pubic Works, Water, Schools and Recreation, totaling 209 acres. (Ayer OSRP, 1999)

Figure 2.4-1 Ayer Open Space

The OSRP identifies all Chapter 61 Lands (310 acres in Ayer) as unprotected from potential development. This designation is given to properties that are held as either forest land (61), farmland (61A), or private recreation (61B) for tax purposes under M.G.L. Chapter 61. These lands can be developed if the Town does not exercise its "first right of refusal" to purchase the property, as required under state law.

The major goals for open space and recreation outlined by the 1999 OSRP include the following:

- Preservation of Ayer's important water resources;
- Preservation of Ayer's important land resources;
- Provide recreational opportunities and programs for all residents;
- Identify and prioritize management and maintenance needs of existing open space and recreation areas;
- Enhance Ayer's natural environment by taking advantage of local and regional linkage of open space;
- Promote public awareness and advocate education about open space, recreation and natural resources; and,
- Maintain an inventory of protected and semi-protected open space and recreation land in Ayer.

The Town of Ayer developed a detailed Action Plan based on specific plan objectives adopted by a subcommittee for Open Space working on the Comprehensive Plan. The action plan specified which Town Department was responsible for implementing the action recommendations, such as the Planning Board, Conservation Commission, Board of Health, Selectmen, and the Water Department.

The objectives associated with the action plan include the following:

- Preserve and maintain all surface water resources;
- Protect existing drinking water resources and provide new sources;
- Preserve land for conservation and natural purposes;
- Preserve land for active and passive recreational purposes;
- Expand recreational and educational program offerings;
- Develop facilities to support programming and serve present and future residents;
- Explore special opportunities for recreational facilities;

- Investigate staffing needs from a management and maintenance perspective;
- Implement strategies that will facilitate the care of recreation and conservation efforts;
- Work to link open space and recreation areas to each other;
- Work with neighboring Towns to line adjacent open and recreation areas;
- Educate the public about available recreational cultural and natural resources;
- Instruct the public as to non-polluting land and water practices;
- Develop and maintain a listing of Town and State parcels, easements and right of ways; and,
- Develop and maintain a listing of private Chapter 61 Lands, conservation and deed restrictions.

Harvard

The Town of Harvard adopted its Open Space and Recreation Plan in August 1995. Since the completion of the last OSRP, a total of forty parcels or lands or 545 acres has been protected as open space. The Town has a long-range goal of attempting to protect 15% (2,073 acres) of its total land area estimated to be 13,820 acres.

The most significant change that has occurred in the Town in the last ten years has been the closure of Devens and its rebirth into a major mixed-use industrial commerce center. A total of 2,682 acres or 20% of the total land area of Harvard is located within the boundaries of the former army base.

In 1995, the residents of Harvard voted to support the U.S. Fish and Wildlife's proposal to extend the boundaries of the Oxbow National Wildlife Refuge into the entire South Post of Devens. The Oxbow National Wildlife Refuge, managed by the U.S. Fish and Wildlife Service, is located south of Devens. The transfer of the South Post to the USFWS is planned to protect the sensitive resources and wildlife located along the Nashua River and its environs. Federal legislation has been enacted that will expedite this action, pending the approval of the U.S. Army, to declare this 4,880 acre site as surplus property. Over 700 acres of the South Post is located in Harvard.

A total of 2,860 acres of land are protected as open space for conservation, recreation and general open space purposes in the Town of Harvard as noted on Figure 2.4-2. A total of 104 separate parcels of land have been acquired through gift to the Town, purchase, tax title or conveyed as easements as noted on the inventory list in Appendix B. These properties are managed by the Conservation Commission (1,689 acres), through Conservation restrictions (141 acres) and under Federal and State law (1030 acres).

Figure 2.4-2 Harvard Open Space

A portion of the Delaney Wildlife Management Area (580 acres in total) is located in the Town of Harvard that is used primarily as a flood control area for the Assabet Brook which has extensive wildlife and recreational resources.

Harvard also has a significant amount of unprotected lands which include Chapter 61 lands, institutional property and lands held in private trusts. A total of 318 acres of land are considered unprotected open space which could be developed at a later time.

The OSRP established a series of Open Space and Recreation Goals for developing a framework for a long-term action program. The following are a series of selected goals that are pertinent to fostering long-term protection of the environment within the study area.

- Maintenance of the rural character of the Town;
- Preservation of agricultural lands (i.e. orchards and farms);
- Protection of environmentally sensitive areas threatened by development pressure;
- Initiate the construction of linkage trails for the greenway belt; and,
- Identify lands of geological, historical, ecological or of viewshed importance to protect.

The plan indicated that the major priority remains the preservation of the Town's rural character and that a proactive approach needs to be taken to acquire additional conservation lands.

The five-year action plan highlighted the following goals:

- Permanently protect 500 acres of open space;
- Develop a plan for identifying specific parcels of land;
- Set up a conservation fund as a percentage of the Town's budget;
- Improved public awareness of the need to acquire and protect open space lands; and,
- Set up and implement a management and maintenance plan for Harvard's conservation lands.

<u>Lancaster</u>

The Lancaster Open Space and Recreation Plan was completed by the Montachusett Regional Planning Commission in 1999. The Massachusetts Division of Conservation Services granted the Town a conditional approval for the plan pending modifications to the Section 504 Handicapped Accessibility program.

A significant portion of the Central Nashua River Valley Resource Area ACEC is located in the Town of Lancaster. A total of 13,700 acres of the area's rivers, floodplains, brushy swamps, oxbows, sedge marshes and grasslands are located in the Lancaster portion of the ACEC. The Lancaster State Forest is located within the ACEC area.

The protection of open space in Lancaster is centered around the Nashua River Greenway. The confluence of the north and south branches of the Nashua River forms in the Town of Lancaster and flows for over 15 miles within the boundaries of the community.

The Town of Lancaster has 1,148 acres of protected open space (see Figure 2.4-3). This land is under the jurisdiction of the Conservation Commission, Water Department, local land trusts, state agencies, and/or contains deed restrictions.

Additional open space (unprotected) would include areas owned by the School Department, Department of Defense, and the Dept. of Corrections. These areas include the Fort Devens South Post (legislated to become an expansion of the Oxbow National Wildlife Refuge, if the DoD declares it excess), Atlantic Union College, MCI-Lancaster, The Perkins School and other municipally owned property. A list of conservation and recreational lands are noted under Appendix B.

The MRPC, through a resident survey and workshops developed the following series of goals and objectives for the plan.

- Preserve significant natural areas, particularly the Nashua River corridor, the Fort Devens South Post, aquifer recharge areas, forests and parks;
- Foster a sense of community by maintaining a balanced recreation program that cultivates respect for the Town's natural resources, its neighborhoods and its residents;
- Broaden awareness of the important role agriculture plays in Lancaster's history, economy and special character; and,
- Work with educational institutions to protect key natural and cultural resources that sustain Lancaster's quality of life.

The Town of Lancaster established a five-year Action Plan, taking into account those actions not implemented from previous plans and setting forth action items that are realistic and attainable within this time frame. A summary of the action plan recommendations are as follows:

- Establish a Recreation and Open Space Commission;
- Establish legal conservation restrictions for town-owned land;

Figure 2.4-3 Lancaster Open Space

- Maintain open communication between the Town and the Devens Enterprise Commission on environmental matters;
- Assist the NRWA in pursuing land acquisitions along the North Nashua River under the Federal Forest Legacy Program, to show Lancaster students; and,
- Coordinate with adjacent towns/organizations to develop links between trail systems.

Shirley

The Open Space Plan for Shirley (1996-2001) was prepared by the Shirley Conservation Commission in conjunction with the land inventory subcommittee and local volunteers. The plan was adopted by the Town of Shirley and approved by the Massachusetts Division of Conservation Services in 1996. Shirley is eligible for funding under the Self-Help Program, which would provide grants for land acquisition for open space, conservation, water supply, and passive and active recreation purposes.

The Town of Shirley has approximately 1900 acres of protected open space including conservation and recreational lands, as noted within its open space inventory (see Appendix B). This represents approximately 19% of the total land area of the Town. Approximately one-third is controlled by local departments, including the Conservation Commission, one-third by the Commonwealth of Massachusetts (DFW/MCI) and the remaining one-third by private interests through conservation restrictions.

The major state land holdings include the Squannacook Wildlife Management Area, Mulpus Brook Wildlife Management Area and other associated areas near the Nashua River managed by the Massachusetts Division of Fish and Wildlife (see Figure 2.4-4). The state owns 593 acres of land in Shirley. Other land set aside includes dedicated open space from cluster developments (116 acres).

The Shirley plan identified the following goals for protecting open space within their community:

- Preserve the Town's rural character;
- Protect the Town's water supply to include all wells and aquifer recharge areas;
- Expand protected parcels to create linkages for protecting habitat areas;
- Increase awareness of the Town's open space and recreational resources; and,
- Develop and maintain a broad recreational base for all age groups.

The major recommendations of the five-year action plan are as follows:

- Preserve the Town's rural character;

Figure 2.4-4 Shirley Open Space

- Protect the Town's public water supply by developing plans for protected parcels in aquifer recharge areas;
- Expand protected parcels to create linkages between existing protected habitats;
- Increase the citizen's understanding and awareness of the Town's open space and recreation resources; and,
- Develop and maintain a broad recreational base, for all ages, for all types of recreation.

<u>Devens</u>

The Massachusetts Government Land Bank (now MassDevelopment) prepared an Open Space and Recreation Plan as part of the overall Fort Devens Reuse Plan in 1996. The plan addressed areas designated as "Open Space and Recreation" under the land use zoning plan adopted by the local communities and the state legislature. This plan does not address open space areas to be dedicated for management by the U.S. Fish and Wildlife Service. These areas include the Nashua River Corridor and the extension of the Oxbow National Wildlife Refuge.

The Open Space and Recreation Plan utilized the Land Stewardship Zoning Classification System, adopted by Massachusetts Department of Environmental Management for forest and park planning purposes. Land areas are classified into four categories including Preservation, Conservation, Intensive Use, or Linkage based on a number of environmental and recreational values (see Figure 2.4-5).

The identification of open space areas for conservation and recreational purposes was based on an intensive environmental inventory of resources including wetlands, wildlife habitats, visual and landscape character and historic and cultural interests undertaken as part of the overall Devens Reuse Plan. These areas in turn became part of the land use zoning plan which includes sensitive resources areas, recreational uses and buffers along major roadway corridors within Devens proper. A listing of existing recreational facilities at Devens are located in Appendix B. Approximately 1,000 acres is devoted to the Devens Open Space and Recreation Zone which consist primarily of an interwoven environment of wetlands, water resources, vegetative communities and wildlife habitat areas.

A majority of the land located within the open space and recreation zone is dedicated to conservation. Areas that have been designated for conservation include open space buffer corridors along the perimeter of the site, areas of steep slopes, western edge of Mirror Lake, wetlands along Cold Spring Brook and along a system of glacial ridges or eskers near Queenstown Road.

The mission statement, goals and objectives for the OSRP were developed through a series of public workshops and from secondary sources including the Devens Reuse plan, the Fort Devens Regional Recreation Master Plan and the Water Resources Plan. All of which was overseen by the Devens Open Space and Recreation Task Force.

Figure 2.4-5 Classification Plan: Overall & Linkages

The goals and objectives were aggregated based on ecological, recreational and buffers/linkage factors. Emphasis was placed on enhancing the natural resource base and promoting the reuse of existing recreational uses and promoting organized activities near main roads and neighboring town borders.

The Devens Open Space Action plan identified the following major action plan recommendations.

- Responsibilities for Implementation of the Open Space and Recreation Plan;
- Conservation Restrictions for protecting Mirror Lake, ASP Bog, Cold Spring Brook and Wetland Area C which include eskers and vernal pools;
- Implementation of site and management recommendations outlined within the OSRP;
- Coordination with other entities;
- Monitoring and updates;
- Boundaries of Open Space and Recreation Zone; and,
- Five-year Action Plan.

The following table summaries the amount of open space that has been identified within each of the communities and Devens obtained from the most recent Open Space and Recreation plans.

Table 2.4.3 Open Space within the Study Area

Town	Total Land Area[1]	Total Protected Open Space	Percent of Total	Developable Land[2]
Harvard	14,577 acres	2,860 acres	19.6%	7,402 acres
Lancaster	18,046 acres	1,148 acres	6.4%	7,158 acres
Ayer	3,117 acres	675 acres	22%	1,924 acres
Shirley	9,358 acres	1,887 acres	20%	3,706 acres
Devens[3]	4,400 acres	1364 acres	31%	500 acres
Totals	49,498	7,934	16%	20,690

Notes:
[1] The total acreage figures for each of the communities do not include Devens.
[2] These figures are taken from the build-out analysis completed by Montachusett Regional Planning Commission and from the Fort Devens Reuse Plan
[3] This includes the North and Main Posts only.

2.5 Traffic

2.5.1 Sources of Data

There are three sources of data on historic traffic counts used for this analysis: MRPC, MHD, and the Devens Traffic Monitoring Program. MRPC publishes an annual count book listing seasonally adjusted count information collected by MRPC, MHD, and private consultants dating back to the 1980's. MHD counts through 1997 are available on their web site. The Devens Traffic Monitoring Report contains 1996 and 1998 count data for locations near Devens, but no seasonal adjustments have been applied to the Devens counts.

2.5.2 Regional Transportation System Overview

Devens and the surrounding communities are well-connected to other parts of New England and the United States via both the national highway and rail systems. A number of expressways provide highway access between the Devens region and other parts of New England and the United States, and the junction of a number of rail lines at Ayer was a principal reason for the Army locating Fort Devens there.

<u>Expressways</u>

As shown in Figure 1.1-1, Route 2 is a four-lane east-west highway that crosses the four communities and connects to the Devens Commerce Center (Devens) directly via the Jackson Road interchange and indirectly via the Route 110/111 interchange. To the east Route 2 provides access to I-495, Route 128, and the Boston metropolitan core. To the west Route 2 provides direct access to I-190 and the cities of Fitchburg and Leominster and connects to highways serving Vermont and southwestern New Hampshire. Route 2 is a limited-access highway between I-495 and I-190, although the acceleration and deceleration lanes at the interchanges are very short and do not meet design standards for freeways.

Interstate 495 is a six-lane freeway which serves as the outer beltway for Boston and provides indirect connections to the Devens region via Routes 2 and 2A. To the north I-495 provides access to the cities of Lowell and Lawrence and connects to interstates serving Maine and most of New Hampshire. To the south I-495 provides access to Worcester (via I-290) and Marlborough and the two major interstates serving western New England and the rest of the United States, I-90 and I-95.

Interstate 190 is a four-lane freeway that provides an indirect connection to the four towns and DCC via Route 2. I-190 terminates at Route 2 in Leominster and provides access to both Worcester and I-90.

Other State Highways

In addition to the expressway system a number of state highways provide access and distribution within the region. The most heavily traveled of these routes are those serving the town of Ayer, Routes 2A, 111, and 110.

Route 2A is an east-west route that passes through the Ayer business district and also passes through the town of Shirley. Within Ayer and Shirley it is a two-lane roadway which provides direct access to Devens via Barnum Road at the Carlton Rotary. Route 2A served as the principal highway connection between Fitchburg and Boston before Route 2 was constructed and is the principal access route to Ayer and Barnum Road from Littleton and I-495 north and remains a significant access route to Ayer from Fitchburg and Lunenberg to the west. From the east Route 2A, combined with Route 110, serves as the principal access route to Ayer and Barnum Road from Littleton and I-495 north. West of the Carlton Rotary Route 2A combines with Route 111 to pass through the Ayer business district as East Main Street and Park Street. West of the Ayer business district Route 2A separates from Route 111 and continues west through Shirley and Lunenberg to Fitchburg.

Route 111 is a north-south route that passes through the Ayer business district and also passes through the town of Harvard. Within Ayer and Harvard it is a two-lane roadway which provides direct access to Devens via Barnum Road at the Carlton Rotary. The combined Routes 110 and 111 serve as the principal access route to Ayer and Barnum Road from Route 2 and Route 111 serves as the principal access route to Ayer and Devens from Groton and other towns north of Ayer. In the south, Route 111 connects to I-495 in Boxborough before proceeding northwestward to Harvard center, where it combines with Route 110 and is referred to as Route 110/111. Route 110/111 continues northward, crossing Route 2 where there is a full interchange, and continues to the Carlton Rotary in Ayer. West of the Carlton Rotary Route 111 combines with Route 110 to pass through the Ayer business district as East Main Street and Park Street. North of the Ayer business district Route 111 separates from Route 2A and continues north to Groton where it intersects Routes 119 and 225.

Route 110 is a north-south route that passes through the towns of Ayer and Harvard. Within Ayer and Harvard it is a two-lane roadway which provides direct access to Devens via Barnum Road at the Carlton Rotary. The combined Routes 110 and 111 serve as the principal access route to Ayer and Barnum Road from Route 2, while the combined Routes 2A and 110 serve as the principal access route to Ayer and Barnum Road from Littleton and I-495 north. From the south, Route 110 enters Harvard from Bolton and proceeds northward to Harvard center, where it combines with Route 111 and is referred to as Route 110/111. Route 110/111 continues northward, crossing Route 2 where there is a full interchange, and continues to the Carlton Rotary in Ayer. East of the Carlton Rotary Route 110 combines with Route 2A and connects to I-495 in Littleton.

Routes 70, 117, and 225 are routes that have little or no direct impact on Devens. Route 70 is a two-lane north-south roadway which provides access to Route 2 for many Lancaster residents, but would not be expected to provide access from other towns due to the presence of I-190 to the west and

Route 110 to the east. Route 117 is a two-lane east-west roadway which passes through Lancaster connecting I-190 and Leominster in the west with I-495 and the Hudson/Marlborough area in the east. Routes 225 is a two-lane east-west route which passes through the northern part of Shirley, connecting Route 2A in Lunenberg with Route 111 in Groton.

Devens Roadways

There are four entrances to Devens. The main entrance to Devens is Verbeck Gate, which is located on the north side of Devens at the intersection of West Main Street and MacPherson Road in Ayer. The southern entrance to Devens is Jackson Gate, located on Jackson Road just north of the Jackson Road interchange on Route 2. The northeast entrance to Devens is Barnum Gate, located on Barnum Road near the Carlton Rotary. The fourth entrance, Shirley Gate, is on the northwest side of Devens and provides access to the town of Shirley.

Devens includes an extensive network of paved roadways for access between most locations on the property. These roadways were not constructed with civilian traffic in mind and often have sharp turns or poor sightlines at intersections, with most roadways having a posted speed limit of 30 miles per hour or less. In addition, no roadways provide a direct through route between any two of Devens' gates.

The Devens roadway network has undergone a few minor improvements since the Main Post of Fort Devens was turned over to MassDevelopment in 1995. The most significant improvement is in the Devens Rail-Industrial Park area, where the roadways which provided access directly to the rail spurs have been replaced by a new roadway, Independence Way, and a realigned Saratoga Boulevard to provide better circulation through the area. Elsewhere at Devens, a number of minor roadways not essential for circulation have been closed off.

2.5.3 Historical Trends and Existing Conditions

Regional Traffic

Traffic volumes on the region's roadways have been growing during the economic recovery of the 1990's. MRPC estimates that traffic volumes within the MRPC region have been growing at an average rate of 2.08% per year for rural roadways and 1.67% per year for urban roadways since 1993. As shown in Table 2.5-1**,** the observed growth rates at permanent count stations on Route 2 and I-190 during this period are close to these averages. However, the volumes on I-495 in the vicinity of the Route 2 interchange have increased at average annual rates of 3% or more.

Table 2.5-1 Traffic Growth on Expressways Near Devens, 1993-1997

Town	Location	Average Daily Traffic		Growth	Annual %
		1993	1997	1993-97	Growth
Lancaster	Route 2 West of Route 70	38,158	41,221	3,063	1.95%
Fitchburg	Route 2 East of Oak Hill Road	34,000	36,500	2,500	1.79%
Leominster	I-190 North of Route 117	29,000	32,420	3,420	2.83%
Littleton	I-495 North of Route 119	82,000	92,300	10,300	3.00%
Boxborough	I-495 South of Route 111	66,000	74,800	8,800	3.18%

Roadways Near Devens

The AWDT volumes reported in the Devens Traffic Monitoring Report are summarized in Table 2.5-2. Traffic volume changes on the individual roadways surrounding Devens are mixed in the Devens report, with some roadways having growth which exceeds the regional average while other roadways report lower volumes in 1998 than in 1996. The data indicate that traffic volumes to the east and south of Ayer are increasing faster than the regional average while volumes to the north and west are actually decreasing.

Table 2.5-2 AWDT Volumes Near Devens

Town	Location	AWDT Volume			Annual Pct.
		1996	1998	Change	Change
Ayer	Route 110/111 South of Carlton Rotary	13,837	14,533	696	2.48%
Ayer	Route 2A/110 East of Carlton Rotary	14,472	15,229	757	2.58%
Ayer	Route 2A/111 West of Carlton Rotary	20,306	21,044	738	1.80%
Ayer	Sandy Pond Rd North of Carlton Rotary	4,701	6,505	1,804	17.63%
Ayer	Barnum Road West of Carlton Rotary	3,186	2,694	(492)	-8.04%
Ayer	Route 2A/110 at Ayer/Littleton Line	9,598	11,958	2,360	11.62%
Ayer	Route 2A at Ayer/Shirley Line	9,316	8,643	(673)	-3.68%
Ayer	Route 111 at Ayer/Groton Line	6,482	5,497	(985)	-7.91%
Harvard	Route 110/111 North of Route 2	13,185	12,813	(372)	-1.42%
Harvard	Route 110/111 South of Route 2	7,440	8,140	700	4.60%
Harvard	Poor Farm Rd East of Route 110/111	1,351	1,442	91	3.31%
Shirley	Front Street West of Ayer Street	5,651	5,790	139	1.22%
Lancaster	Route 2 West of Route 70	43,940	45,581	1,641	1.85%
Littleton	Route 2 West of I-495	44,720	49,076	4,356	4.76%
Littleton	Route 2 East of I-495	40,233	43,328	3,095	3.78%
Leominster	Route 2 West of I-190	55,588	60,966	5,378	4.73%
Ayer	Verbeck Gate	2,354	3,363	1,009	19.53%
Ayer	Jackson Gate	3,578	4,854	1,276	16.47%
Ayer	Barnum Gate	2,172	2,766	594	12.85%
Source: Devens Traffic Monitoring Plan					

All four of the non-Devens approaches to Carlton Rotary report volume increases from 1996 to 1998 which exceed the regional average for urbanized areas, although only a portion of the volume increases can be attributed to Devens development. The Barnum Road approach is reported as having a volume decrease from 1996 to 1998, which seems inconsistent with the buildup of new businesses in the Devens Industrial Park located near the Barnum Road entrance. The count location further west on Barnum Road at Barnum Gate, which reports a volume increase of more than 12 percent annually, may be more indicative of traffic trends on Barnum Road. Even if the Barnum Road volume is assumed to have increased at a rate similar to Barnum Gate the increase would account for less than a third of the increases on the other approaches.

Both Route 2A and Route 111 report traffic volume decreases west and north of Ayer, respectively, between 1996 and 1998. The count data does not indicate why these volumes are dropping, but it may result from more travelers north and west of Ayer increasingly choosing routes which bypass Ayer.

Devens Roadways

The largest percentage increases in traffic volumes occur at the three main Devens entrances, which is not surprising given that new businesses have been moving into Devens. Although the total volumes at Verbeck Gate, Jackson Gate, and Barnum Gate remain well below pre-closure volumes, the percentage growth at each gate exceeds 12% per year.

2.5.4 Peak Hour Conditions

Roadway Volumes

Table 2.5-3 presents the peak hour directional volumes for roadways analyzed as part of the Devens Traffic Monitoring Program. Two roadways, Route 2 between I-190 and I-495 and Route 2A/111 (Main Street) in Ayer, have peak hour directional volumes which exceed 50% of their theoretical capacities. Route 2 eastbound experiences congestion in the morning at interchanges due to the inadequate lengths of acceleration and deceleration lanes, but the mainline volume itself is approaching the threshold where peak period speeds will be noticeably reduced between exits as well. Main Street in Ayer is very congested during the peak period, but also experiences congestion during the midday period.

Table 2.5-3 Peak Hour Traffic Volumes on Roadways

Town	Location	Direction	Volume	Direction	Volume
I. Expressways					
Lancaster	Route 2 East of I-190	EB	3,377	WB	2,437
Littleton	Route 2 West of I-495	EB	3,136	WB	2,969
Littleton	Route 2 East of I-495	EB	2,703	WB	2,613
II. Peak Direction Volumes					
Ayer	Route 2A/111 West of Carlton Rotary	EB	1,122	WB	1,222
Ayer	Route 2A/110 East of Carlton Rotary	EB	639	WB	817
Ayer	Route 110/111 South of Carlton Rotary	SB	661	NB	789
Ayer	Sandy Pond Road North of Carlton Rotary	SB	141	NB	249
Ayer	Barnum Road West of Carlton Rotary	WB	107	EB	110
Harvard	Route 110/111 N. of Route 2	SB	588	NB	516
Harvard	Route 110/111 S. of Route 2	SB	388	NB	371
Ayer	Route 2A/110 at Littleton Line	EB	662	WB	567
Ayer	Route 2A at Shirley Line	EB	590	WB	568
Ayer	Route 111 at Groton Line	SB	436	NB	402
Harvard	Poor Farm Road East of Route 110/111	SB	133	NB	109
III. Significant Offpeak Direction Volumes					
Ayer	Route 110/111 South of Carlton Rotary	NB	455	SB	499
Harvard	Route 110/111 N. of Route 2	NB	425	SB	553
Harvard	Route 110/111 S. of Route 2	NB	290	SB	394
IV. Devens Entrances					
Ayer	Jackson Gate	NB	340	SB	199
Ayer	Verbeck Gate	SB	202	NB	184
Source: Devens Traffic Monitoring Program					

The peak period peak directional movements on most roadways in the region are heavily oriented towards jobs located along I-495 or within the Boston metropolitan core, and are generally more than twice as high as the reverse movements. There are a few roadways in the vicinity of Devens that are exceptions, however. Peak directional flows at each of Devens' gates are oriented toward jobs located at Devens, reflecting Devens' redevelopment as a business community. The majority of AM peak hour traffic on Route 110/111 is southbound, but more than 40% of the total AM peak hour traffic is northbound.

Intersection Volumes

Table 2.5-4 presents the peak hour volumes and levels of service (LOS) for the intersections analyzed as part of the Devens Traffic Monitoring Program. Only one of these intersections, the Route 2A/Route 119/Route 110 intersection at Littleton Common, is currently signalized, so the level of service calculation reflects delays encountered by vehicles on minor roadways and to a lesser extent by leftturning vehicles on the main roadway. Peak hour traffic volumes increased at most intersections between 1996 and 1998, but the levels of service at the various intersections have not changed significantly. All of the intersections with LOS F were at LOS F prior to the closure of Fort Devens.

Table 2.5-4 Peak Hour Intersection Volumes

		AM Peak Hour Volume			PM Peak Hour Volume		
Town	Location	1996	1998	LOS	1996	1998	LOS
Ayer	Carlton Rotary	2152	2131	#N/A	2487	2494	#N/A
Ayer	Park Street/Main Street/West Main Street	1492	1556	F	1721	1547	F
Ayer	Park Street/Fitchburg Road/Groton School Road	1210	1241	F	1353	1523	F
Ayer	Groton-Harvard Road/Central Avenue	864	941	F	841	956	C
Ayer	Verbeck Gate/West Main Street/MacPherson Road	774	710	A	726	669	A
Shirley	Front Street/Lancaster Street/Leominster Road/Center Road	802	861	B	953	779	A
Harvard	Route 110-111/Route 110/Route 111	818	952	B	869	1135	A
Lancaster	Route 70/Route 117 (Seven Bridge Road)	1452	1582	F	1614	1685	F
Lancaster	Route 70/Route 117 (Lunenberg Road)	1471	1581	F	1578	1800	F
Littleton	Route 2A-110/I-495 NB Ramps	1555	1703	B	1675	1711	D
Littleton	Route 2A-110/I-495 SB Ramps	1539	1714	F	1844	1705	F
Littleton	Route 110/Route 119/Route 2A	2085	2196	F	2809	2880	F
Littleton	Route 2A-110/Goldsmith Street	1469	1667	F	1758	1724	F

3.0 TRENDS ANALYSIS

3.1 Introduction

The following section provides an analysis of trends in the areas covered by the CCbW program - water supply, wastewater/septic disposal, population, housing, open space and traffic. The trends have been identified at a planning level of detail and are based on growth projections through the year 2010 as supplemented by "absolute" buildout projections provided by the MRPC.

Specifically, trends projections for the four-towns outside the fenceline were estimated on the basis of the regression analysis provided in this document for the year 2010; and on the basis of the buildout conducted by the MRPC, which were adjusted based on the closure of Devens in 1995.

The trends analysis for Devens, however, was conducted using different assumptions than those presented for the four towns. Projections for the year 2010 were based on the Reuse Plan; projections for buildout were based on a doubling of the levels of development of the Reuse Plan. This doubling is based on a rough estimation of the existing undeveloped areas which remain on the property (assuming that the existing developed areas are nearly to the levels identified in the Reuse Plan) that could be developed on the basis of Devens zoning if it were not for the ceilings established in the Reuse Plan.

As with the buildout analyses for the four towns, the buildout analyses for Devens are gross estimates for planning purposes and would likely have no bearing on the actual buildouts that could occur once site-specific variables and limitations are considered. As legislated in Chapter 498 of the Massachusetts General Laws, MassDevelopment is not authorized to exceed the levels of development established in the Reuse Plan unless either the legislation is amended or the towns of Ayer, Harvard and Shirley vote in favor of an increase or different mix of development through favorable votes at concurrently-held Town Meetings using the same approval process agreed to for the original vote.

3.2 Water Supply

This section provides an analysis of projected water use for each of the four communities in 2010, 10 years into the future. A projection of water demand will allow the communities to seek additional supply in a timely fashion, or to consider alternative options, such as promoting conservation or limiting development (See Section 4.2). Ten-year water demands are compared with the projected demands developed in the buildout analysis performed by MRPC.

Maps are presented overlaying potentially developable area with aquifers and aquifer protection areas. These maps provide an indication of areas that may require additional protection in order to assure a continued supply of clean water. The implications of these maps is further discussed in Section 4.2.

3.2.1 Approach

Water demand projections were based on existing water use, breakdown of users (residential and commercial/industrial), existing (1998) residential population values and population projections (year 2010) presented in Table 3.4-1. To calculate residential water demand, it was assumed (based on existing water demands and wastewater loads), that each person uses 75 gallons per day. For each town, the percentage of the population on the public water system was assumed to remain constant. The 2010 projected residential water demand was calculated by multiplying the projected number of users by 75 gallons. To compare this with the results of the buildout analysis, the projected additional population at buildout was added to the existing population, and the percentage of users (again, assumed to remain constant) was calculated. This figure was multiplied by 75 gallons per person to arrive at total buildout water demand.

Because ENSR has not prepared any specific estimates of non-residential (commercial and industrial) growth, estimation of the projected non-residential water demand was somewhat less straightforward. First, total current demand was estimated. The population-based calculated residential demand was divided by the percentage of residential water demand presented in the MRPC buildout analysis to provide one estimate of total demand. This value was compared to values for Average Daily Demand (ADD) presented in Section 2.2. Because most of the Section 2.2 values for ADD are several years old, the higher of these two estimates was chosen for the projection analysis. The total demand was assumed to grow at the same rate as the population, and 2010 total demand was calculated by multiplying the existing total demand by the rate of population growth.

The estimated total non-residential water use at buildout was calculated by adding the incremental increase (between 1998 and buildout) in non-residential water use presented in the MRPC buildout analysis to the estimated present non-residential water use (estimated as described in the previous paragraph). This estimated non-residential "buildout" demand was then added to the population-based estimated "buildout" residential demand, yielding a total estimated "buildout" demand. Note that this calculated total buildout water demand value was used in place of the total buildout water demand reported in the MRPC buildout report because baseline existing population values presented in the MRPC report include 1990 Fort Devens population and are, therefore, inconsistent with the data used in our evaluation.

Several assumptions were made in the estimation of the water demand projections. In general, conservative, or worst case, assumptions were chosen, such that the projections presented here are likely to somewhat overstate the 2010 water demand. Additionally, all of the projections are based on the population projections. Any change in these trends will affect the validity of these projections.

3.2.2 Projected Demand

Ayer

The population and associated residential water demand in Ayer is projected to increase by 28% in the next 10 years. The projected 2010 residential water demand on the public water supply system is 0.67 mgd, up from the estimated current demand of 0.53 mgd (See Table 3.2-1). The projected residential demand on public water systems at buildout, using ENSR's existing population estimates, is 0.87 mgd, which represents a 64% increase over the current demand. Cumulative water withdrawals from private wells are estimated to increase at a similar percentage rate as the projected residential growth. Since private wells supply but 5% of the town's water, increases in private well withdrawals are insignificant as compared to the increased demand on the public water supply system.

Non-residential usage, which comprises 71% of the total water demand and is assumed derived 100% from public water supply systems, is projected to increase from 1.27 mgd to 1.62 mgd in 2010 (See Table 3.2-2). The total projected public water system water demand in 2010 is 2.29 mgd. This projection, which is based on population regressions analyses alone, is lower than the Massachusetts DEM projection of 3.0 mgd. The total public system water use at buildout, based on the estimate of existing non-residential use plus the incremental increase in non-residential use presented in the MRPC buildout, is 2.79 mgd. The combined yield of the Spectacle Pond wells and the Grove Pond wells is estimated to be 4.3 mgd, indicating that the existing water supply should be adequate to meet the rising demand in the next 10 years and beyond. The amount of water withdrawn using private wells is negligible as compared to the magnitude of public water withdrawals.

Table 3-2.1 Projected Residential Water Demand for Ayer

	Population	% Using Public Water	Number of Residential Public Water Users	Residential Public Water System Demand (mgd)	Increased Residential Demand on Public Water System (compared to existing)	Total Residential Private Well Withdrawals (mgd)	Increased Residential Private Well Withdrawals (compared to existing)
Existing	7378[a]	95%	7009	0.53	--	0.028	--
2010	9417[b]	95%	8946	0.67	28%	0.035	28%
Buildout	12184[c]	95%	11575	0.87	64%	0.046	64%

[a]Population based on 1998 population values presented in Table 2.4-1
[b]Population projections based on ENSR regression analysis
[c]Population projection based on existing population (presented in first row) plus the incremental increase in population presented in MRPC buildout analysis.

Table 3.2-2 Total Projected Water Demand for Ayer

	% Non-residential Usage	Residential Public Water System Demand (mgd)	Non-residential Public Water System Demand (mgd)	Total Public Water System Demand (mgd)	Total Residential Private Well Withdrawals (mgd)	Total Water Demand (Private + Public) (mgd)
Existing	71%	0.53	1.27[a]	1.80	0.028	1.828
2010	71%	0.67	1.62[b]	2.29	0.035	2.325
Buildout	69%	0.87	1.92[c]	2.79	0.046	2.836

[a]Non-residential use based on estimated total use minus the calculated estimated residential use.
[b]Projected non-residential use estimated based on the assumption that non-residential use increases at the same percentage rate as residential use.
[c]Projected buildout non-residential use estimated by adding the incremental increase in non-residential use presented in the MRPC buildout analysis to the estimated "existing" non-residential use presented in the first row.

Harvard

The projected residential water use for the town of Harvard is presented in Table 3.2-3. Assuming that the percentage of population served by the public water supply remains constant, residential water demand on public water systems is projected to increase 13%, to 0.018 mgd by 2010. For comparison, the projected buildout demand on public water systems is provided, using existing population and the buildout projection of future residents. Projected residential water use at buildout is 0.052 mgd, 225% more than the current demand.

Water withdrawals from private water supply wells are expected to increase at similar rates (by 13% in 2010 and by 225% at buildout). Since private wells constitute 96% of the water supply withdrawals in Harvard, the magnitude of the increase of private well withdrawals is greater than increases of public system withdrawals. By 2010 it is projected that cumulative withdrawals from private wells will increase by 50,000 gallons per day, from an existing rate of 0.38 mgd to a 2010 rate of 0.43 mgd. Private well withdrawals at buildout are estimated at 1.26 mgd.

The total projected water demand for the town of Harvard is presented in Table 3.2-4. The total public water system demand is project to increase to 0.0224 mgd in 2010. The two wells serving the town of Harvard have a combined yield of 0.06 mgd, indicating that there is enough municipal water to meet the projected demand, assuming no expansion in the service area. The buildout analysis indicates a potential residential demand of 0.052 mgd, which is just within the combined yield of the town's wells. The buildout also indicated a potential non-residential demand of 0.8942 mgd, which is assumed associated with construction of one or more large commercial or industrial establishments in the town. If such facilities were to be served by public water systems, significant additional public water supplies would be required. It is more likely that such facilities were they to be developed, would need to seek their own water supply, independent of the town system.

Table 3.2-3 Projected Residential Water Demand for Harvard

	Population	% Using Public Water	Number of Residential Public Water Users	Residential Public Water System Demand (mgd)	Increased Residential Demand on Public Water System (compared to existing)	Total Residential Private Well Withdrawals (mgd)	Increased Residential Private Well Withdrawals (compared to existing)
Existing	5263[a]	4%	210	0.016	--	0.38	--
2010	5935[b]	4%	237	0.018	13%	0.43	13%
Buildout	17435[c]	4%	663	0.052	225%	1.26	225%

[a]Population based on 1998 population values presented in Table 2.4-1
[b]Population projections based on ENSR regression analysis
[c]Population projection based on existing population (presented in first row) plus the incremental increase in population presented in MRPC buildout analysis.

Table 3.2-4 Total Projected Water Demand for Harvard

	% Non-residential Usage	Residential Public Water System Demand (mgd)	Non-residential Public Water System Demand (mgd)	Total Public Water System Demand (mgd)	Total Residential Private Well Withdrawals (mgd)	Total Water Demand (Private + Public) (mgd)
Existing	21%	0.016	0.0042[a]	0.0202	0.38	0.400
2010	21%	0.018	0.0047[b]	0.0224	0.43	0.452
Buildout	94%	0.052	0.8942[c]	0.9465	1.26	2.206

[a]Non-residential use based on estimated total use minus the calculated estimated residential use.
[b]Projected non-residential use estimated based on the assumption that non-residential use increases at the same percentage rate as residential use.
[c]Projected buildout non-residential use estimated by adding the incremental increase in non-residential use presented in the MRPC buildout analysis to the estimated "existing" non-residential use presented in the first row.

<u>Lancaster</u>

The projected residential water use for the town of Lancaster is presented in Table 3.2-5. Assuming that the percentage of population served by the public water supply remains constant, residential water demand on the public water supply system is projected to increase 19%, to 0.56 mgd. For comparison, the projected buildout demand is provided, using existing population and the buildout projection of future residents. Projected residential water demand on the public water supply system at buildout is 0.99 mgd, 111% more than the current demand. Since private wells supply but 5% of the town's water, increases in private well withdrawals are insignificant as compared to the increased demand on the public water supply system.

The total projected water demand for the town of Lancaster is presented in Table 3.2-6. The total demand on public water supply systems, assuming non-residential demand is supplied by the public water supply system, is projected to increase to 0.64 mgd in 2010. Lancaster DPW is permitted for a 1.44 mgd withdrawal, which will be adequate to meet the projected demand. The buildout analysis indicates that increases in residential demand combined with significant increases in non-residential demand could result in a total water demand of as much as 2.79 mgd. Such demand could not be met by existing municipal water systems. Additional sources would be required to meet major non-residential water demands, should they develop. The amount of water withdrawn using private wells is negligible as compared to the magnitude of public water withdrawals.

Table 3.2-5 Projected Residential Water Demand for Lancaster

	Population	% Using Public Water	Number of Residential Public Water Users	Residential Public Water System Demand (mgd)	Increased Residential Demand on Public Water System (compared to existing)	Total Residential Private Well Withdrawals (mgd)	Increased Residential Private Well Withdrawals (compared to existing)
Existing	6542[a]	95%	6215	0.47	--	0.025	--
2010	7873[b]	95%	7480	0.56	19%	0.030	19%
Buildout	13894[c]	95%	13199	0.99	111%	0.052	111%

[a]Population based on 1998 population values presented in Table 2.4-1
[b]Population projections based on ENSR regression analysis
[c]Population projection based on existing population (presented in first row) plus the incremental increase in population presented in MRPC buildout analysis.

Table 3.2-6 Total Projected Water Demand for Lancaster

	% Non-residential Usage	Residential Public Water System Demand (mgd)	Non-residential Public Water System Demand (mgd)	Total Public Water System Demand (mgd)	Total Residential Private Well Withdrawals (mgd)	Total Water Demand (Private + Public) (mgd)
Existing	12%	0.47	0.064[a]	0.53	0.025	0.555
2010	12%	0.56	0.077[b]	0.64	0.030	0.670
Buildout	65%	0.99	1.80[c]	2.79	0.052	2.842

[a]Non-residential use based on estimated total use minus the calculated estimated residential use.
[b]Projected non-residential use estimated based on the assumption that non-residential use increases at the same percentage rate as residential use.
[c]Projected buildout non-residential use estimated by adding the incremental increase in non-residential use presented in the MRPC buildout analysis to the estimated "existing" non-residential use presented in the first row.

Shirley

The projected residential water use for the town of Shirley is presented in Table 3.2-7. Assuming that the percentage of population served by the public water supply remains constant, residential water demand on the public water supply system is projected to increase 27%, to 0.28 mgd. For comparison, the projected buildout demand is provided, using existing population and the buildout projection of future residents. Projected residential water demand on the public water supply system at buildout is 0.63 mgd, 186% more than the current demand.

Water withdrawals from private water supply wells are expected to increase at similar rates (by 27% in 2010 and by 186% at buildout). Since private wells constitute 50% of the water supply withdrawals in Shirley, the magnitude of the increase of private well residential withdrawals is the same as the public system withdrawals. By 2010 it is projected that cumulative withdrawals from private wells will increase by 60,000 gallons per day, from an existing rate of 0.22 mgd to a 2010 rate of 0.28 mgd. Private well withdrawals at buildout are estimated at 0.63 mgd.

The total projected water demand for the town of Shirley is presented in Table 3.2-8. The total public water supply system demand is projected to increase to 0.40 mgd in 2010. Shirley has a total safe yield of 1.0 mgd, which is adequate to meet the projected demand. The buildout analysis indicates that increases in residential and non-residential demand (assuming 100% of non-residential demand is met by public water systems) could result in a total public water supply system water demand of as much as 0.97 mgd, which is approximately equal to the total safe yield of the existing Shirley municipal water supply system.

Table 3.2-7 Projected Residential Water Demand for Shirley

	Population	% Using Public Water	Number of Residential Public Water Users	Residential Public Water System Demand (mgd)	Increased Residential Demand on Public Water System (compared to existing)	Total Residential Private Well Withdrawals (mgd)	Increased Residential Private Well Withdrawals (compared to existing)
Existing	5800[a]	50%	2900	0.22	--	0.22	--
2010	7493[b]	50%	3747	0.28	27%	0.28	27%
Buildout	16780[c]	50%	8390	0.63	186%	0.63	186%

[a]Population based on 1998 population values presented in Table 2.4-1
[b]Population projections based on ENSR regression analysis
[c]Population projection based on existing population (presented in first row) plus the incremental increase in population presented in MRPC buildout analysis.

Table 3.2-8 Total Projected Water Demand for Shirley

	% Non-residential Usage	Residential Public Water System Demand (mgd)	Non-residential Public Water System Demand (mgd)	Total Public Water System Demand (mgd)	Total Residential + MCI Shirley Private Well Withdrawals[d] (mgd)	Total Water Demand (Private + Public) (mgd)
Existing	29%	0.22	0.09[a]	0.31	0.97	1.28
2010	29%	0.28	0.12[b]	0.40	1.03	1.43
Buildout	35%	0.63	0.34[c]	0.97	1.39	2.36

[a]Non-residential use based on estimated total use minus the calculated estimated residential use.

[b]Projected non-residential use estimated based on the assumption that non-residential use increases at the same percentage rate as residential use.

[c]Projected buildout non-residential use estimated by adding the incremental increase in non-residential use presented in the MRPC buildout analysis to the estimated "existing" non-residential use presented in the first row [d]Includes a 0.75 mgd withdrawal from MCI-Shirley private wells.

Devens

Based on the levels of development established in the Reuse Plan, water demand is projected to increase by the year 2010 from 500,000 gpd in 1995 (EarthTech, 1995) to 1.8 MGD average (ENSR, 1995). This represents an increase of 1.3 MGD. Under buildout, potable water demand is estimated at double that level, or 3.6 MGD average. This demand is 1.5 MGD less than the estimated safe yield of the property's four wells, which total 5.1 MGD. It represents an increased demand of 1.8 MGD.

3.2.3 Water Budget

A preliminary, regional water budget was estimated for the four-town area by examining streamflow measurements in the Nashua River. Long term measurements at two gauges were used in the analysis: North Nashua River in Leominster, upstream of the four towns, and Nashua River at East Pepperell, downstream of the four towns. Between these two gauges, streamflow increases due to releases from the Wachusett Reservoir, groundwater discharges and tributaries. As a first approximation, it was assumed that the aquifer is directly recharged from the river, and that the volumetric increase in flow between these two stations is available for extraction in the four-town region.

Low flow statistics were conducted on the historical streamflow data at each station. The 90% exceedence flow, or the flow that is exceeded 90% of the time, is approximately 31 mgd at North Nashua and 62 mgd at East Pepperell, indicating a 31 mgd net gain in streamflow during low flow conditions. The increase in streamflow at the 50% exceedence level is 150 mgd. The total 2010 projected demand for the four towns plus Devens is approximately 6.7 mgd (3.4 mgd from municipal supplies + 1.5 mgd from private wells + 1.8 mgd for Devens), and the projected demand at buildout is approximately 13.5 mgd. This analysis suggests that, volumetrically, there is enough water in the Nashua River Basin to meet the future needs of the four towns.

Although the water budget analysis indicates that there is an adequate volume of water within the four towns to meet all future demand, there are other criteria that must be evaluated when considering available water, including local availability (i.e. not all of the water can be extracted, and extractable water may not be in the areas where it is needed), environmental concerns and downstream users. As ecosystem understanding advances, minimum streamflow requirements are likely to become more stringent, resulting in lower withdrawal permits. Finally, as water demand rises in the four towns, it is also rising downstream, where users are also relying on available surface water and groundwater for drinking supply. Beginning to plan now for future changes in supply and demand will allow the four towns to avoid any water shortages that could arise in the future.

3.3 Wastewater Disposal

Anticipated population and industrial growth in the four communities of interest will result in an associated increase in residential, commercial, industrial, and municipal wastewater generation. The need to dispose of this wastewater will lead to an increased demand on local and regional municipal wastewater treatment facilities (where such facilities are or will be available) and to increased discharges to groundwater, in communities where subsurface sewage disposal systems are the predominant means of disposal. This section provides an analysis of projected residential and non-residential wastewater flows in the four communities in the year 2010 (10 years in the future). Increased residential and non-residential flows are estimated based on projected increases in population. The estimated 2010 flows are compared to the projected "buildout" flows. This comparison of 2010 flows to buildout flows is presented to provide confirmation that the project 2010 development can be accomplished within the land use, zoning, and environmental constraints accounted for in the buildout analysis.

3.3.1 Approach

The evaluation of future wastewater flows included two separate evaluations: 1) an analysis of projected wastewater flows to existing municipal wastewater treatment facilities, and 2) an estimation of wastewater flows to subsurface sewage disposal systems. Each of these evaluations used existing (1998) residential population values and population projections (year 2010) presented in Table 3.4-1. To calculate residential wastewater generation rates, a wastewater generation rate of 60 gallons per capita day per day (gpcd) was used. Consistent with the water demand analysis, the 60 gpcd value assumes that 80% of the 75 gpcd water used is returned as wastewater. For Ayer and Harvard, the percentage of the population served by municipal sewer systems was assumed to remain constant. For Lancaster and Shirley, where expansion of municipal sewer districts is on-going, it is assumed that an increased percentage of the residential population will be served by the expanded sewer districts. To compare projected 2010 results with those of the buildout analysis, the projected additional population at buildout was added to the existing population, and the percentage of users was calculated. This figure was multiplied by 60 gallons per person to arrive at total buildout wastewater discharge to municipal systems.

Existing non-residential wastewater generation values were developed by subtracting the estimated residential wastewater generation values from recent reported total flows of wastewater from the communities to the various municipal wastewater treatment facilities. In Harvard, where no municipal wastewater treatment systems exist, non-residential flows were estimated as being equal to 80% of the existing non-residential water demand. In Harvard, as with residential flows, non-residential wastewater flows were assumed to be disposed by means of individual subsurface sewage disposal systems. The year 2010 non-residential wastewater generation rate was calculated by multiplying the existing non-residential rate by the rate of population growth.

The estimated total non-residential wastewater use at buildout was calculated by adding the incremental increase (between 1998 and buildout) in non-residential water use presented in the MRPC buildout analysis to the estimated present non-residential water use (estimated as described in the previous paragraph). This estimated non-residential "buildout" wastewater generation was then added to the population-based estimated "buildout" residential wastewater generation, yielding a total estimated "buildout" generation. Note that this calculated total buildout wastewater generation value was used in place of the total buildout wastewater reported in the MRPC buildout report because baseline existing population values presented in the MRPC report include Fort Devens population and are, therefore, inconsistent with the evaluation performed herein.

3.3.2 Projected Wastewater Generation

Ayer

The population and associated residential wastewater generation for municipal disposal in Ayer is projected to increase by 28% in the next 10 years. Assuming that 90% of the residential population continues to be served by the municipal sewer system, the projected 2010 residential wastewater discharge to the municipal sewer is 0.51 mgd, up from the estimated current discharge of 0.40 mgd (See Table 3.3-1). The projected residential discharge rate to the municipal sewer at buildout, using ENSR's existing population estimates, is 0.66 mgd, which represents a 65% increase over current discharge.

Table 3.3-1 Projected Residential Wastewater Discharges to Municipal Sewer System for Ayer

	Population	% Connected to Ayer Municipal Sewer	Number of Users	Wastewater Discharge to Sewers (mgd)	Additional Discharge to Sewers
Existing	7378[a]	90%	6640	0.40	--
2010	9417[b]	90%	8475	0.51	28%
Buildout	12184[c]	90%	10966	0.66	65%

[a]Population based on 1998 population values presented in Table 2.4-1

[b]Population projections based on ENSR regression analysis

[c]Population projection based on existing population (presented in first row) plus the incremental increase in population presented in MRPC buildout analysis.

Non-residential discharges, which comprise 74% of the total discharge to the municipal sewer system, are projected to increase from 1.14 mgd to 1.46 mgd in 2010 (See Table 3.3-2). The total projected wastewater discharge to the Ayer municipal sewer system in 2010 is 1.97 mgd. The estimated total wastewater discharge to municipal sewers at buildout, based on the estimate of existing non-residential wastewater discharges plus the incremental increase in non-residential discharges presented in the MRPC buildout, is 2.32 mgd. Since the projected 2010 flows are less than the projected buildout flows, it appears that the town can support the projected 2010 growth from a land use and zoning standpoint. Both the 2010 flows and the buildout exceed the 1.79 mgd average daily flow capacity of the existing Ayer wastewater treatment facility. It appears that additional treatment capacity will be required, either by expanding the existing Ayer wastewater treatment facility or by sending either a portion or the entire town of Ayer's flows to an expanded Devens wastewater treatment facility.

Table 3.3-2 Total Projected Wastewater Discharges to Municipal Sewer System for Ayer

	% Non-residential Discharge	Residential Discharge (mgd)	Non-residential Discharge (mgd)	Total Usage (mgd)
Existing	74%	0.40	1.14[a]	1.54
2010	74%	0.51	1.46[b]	1.97
Buildout	72%	0.66	1.66[c]	2.32

[a]Non-residential discharge based on estimated total discharge minus the calculated estimated residential discharge.

[b]Projected non-residential discharge estimated based on the assumption that non-residential discharge increases at the same percentage rate as residential discharge.

[c]Projected buildout non-residential discharge estimated by adding 80% of the incremental increase in non-residential water demand presented in the MRPC buildout analysis to the estimated "existing" non-residential discharge presented in the first row.

Approximately 10% of the town's residential population is currently not connected to the town sewer system and is served by individual on-site subsurface sewage disposal systems (SSDS's). As shown in Table 3.3-3, assuming an average of 2.3 people per residential lot (based on 1998 population and household information presented by the MRPC buildout for Ayer) and based on an existing population of 7378, there are currently an estimated 321 residential properties with SSDS's. If the number of residential properties with SSDS's increases at the same rate as the projected population growth, there will be 410 such residences in 2010 (an increase of 89 from existing) and 530 residential properties at buildout (an increase of 209 from existing).

Table 3.3-3 Projected Residential Wastewater Discharges to On-site Subsurface Sewage Disposal Systems (SSDS's) in Ayer

	Population	% with SSDS's	Number of Users	Number of Residential Properties with SSDS's[d]	Additional Lots with SSDS's	Wastewater Discharge to SSDS's (mgd)
Existing	7378[a]	10%	738	321	--	0.044
2010	9417[b]	10%	942	410	89	0.057
Buildout	12184[c]	10%	1218	530	209	0.073

[a]Population based on 1998 population values presented in Table 2.4-1
[b]Population projections based on ENSR regression analysis
[c]Population projection based on existing population (presented in first row) plus the incremental increase in population presented in MRPC buildout analysis.
[d]Number of households with SSDS's estimated based on 2.3 users per household (as per MRPC buildout).

Built-in to the above assumptions is that 10% of the developable residential land would be suitable for installation of SSDS's. While soil, groundwater level, and depth to bedrock properties in Ayer are not ideally suited for SSDS's, it would be reasonable to assume that 10% of the residentially developable land could support SSDS's. Areas with the most adverse conditions would likely be given priority for connection to the municipal sewer system. Certain remote parcels might require mounded septic systems or other innovative systems in order to be developed. Sufficient developable land is likely available to support the development of 89 additional residential properties in 2010.

<u>Harvard</u>

The town of Harvard currently has no municipal sewer system and is served entirely by subsurface sewage disposal systems. Although various studies have evaluated the potential for centralized wastewater treatment systems, none currently exist. The evaluation that follows assumes that no municipal sewer service will be available in 2010 or at buildout.

The population and number of households presented in the MRPC buildout was skewed due to inclusion of Devens population. Therefore, data for the town of Lancaster (the community most similar to Harvard) was used to evaluate the number of existing and future residential properties in Harvard. As shown in Table 3.3-4, assuming (based on MRPC buildout for Lancaster) an average of 3.1 people per residential lot and based on an existing population of 5,263, there are currently an estimated 1,698 residential properties with subsurface sewage disposal systems (SSDS's). If the number of residential properties with SSDS's increase at the same rate as the projected population growth (13% and 331% for by 2010 and buildout, respectively), there would be 1915 such residences in 2010 (an increase of 217) and 5,624 residential properties at buildout (an increase of 3,926 from existing).

Table 3.3-4 Projected Residential Wastewater Discharges to Subsurface Sewage Disposal Systems (SSDS's) in Harvard

	Population	% with SSDS's	Number of Users	Number of Residential Properties with SSDS's[d]	Additional Lots with SSDS's	Wastewater Discharge to SSDS's (mgd)
Existing	5263[a]	100%	5263	1698	--	0.316
2010	5935[b]	100%	5935	1915	257	0.356
Buildout	17435[c]	100%	17435	5624	3926	1.046

[a]Population based on 1998 population values presented in Table 2.4-1
[b]Population projections based on ENSR regression analysis
[c]Population projection based on existing population (presented in first row) plus the incremental increase in population presented in MRPC buildout analysis.
[d]Number of households with SSDS's estimated based on 3.1 users per household

An additional 257 properties fit well within the buildout estimate of 3,926 additional properties, indicating that from a land use and zoning perspective, such development by 2010 would be possible. Soil, groundwater level, and depth to bedrock properties in Harvard are poorly suited for construction of SSDS's. While there are most probably many more than 257 developable lots (from a SSDS perspective) in Harvard, such properties are likely dispersed throughout the town and siting and construction of large housing developments (e.g., in excess of 20 units) could pose a problem. Use of mounded systems, other innovative systems, and/or a neighborhood-based SSDS or package wastewater treatment facilities serving multiple residences will likely merit consideration. There is little doubt that accommodation of residential development projected by the buildout would require implementation of neighborhood or community-based wastewater treatment systems and possibly connection to some type of regional wastewater treatment system.

Existing non-residential wastewater discharges, as estimated in Table 3.3-5, are minimal (around 3400 gallon per day) and, since no sewer is available, are discharged to subsurface sewage disposal systems. If it is assumed that non-residential discharges would increase at the same rate as population growth (13% increase by 2010), the projected 2010 discharge rate of 3,800 would be similarly insignificant.

Table 3.3-5 Projected Non-Residential Wastewater Discharges to Subsurface Sewage Disposal Systems (SSDS's) in Harvard

	Non-residential Discharge to SSDS (gpd)	Additional Discharge to SSDS
Existing[a]	3400	--
2010[b]	3800	13%
Buildout[c]	715400	20941%

[a]Non-residential discharge estimated based on 80% of non-residential water demand being returned as wastewater.
[b]Projected non-residential discharge estimated based on the assumption that non-residential discharge increases at the same percentage rate as residential discharge.
[c]Projected buildout non-residential discharge estimated by adding 80% of the incremental increase in non-residential water demand presented in the MRPC buildout analysis to the estimated "existing" non-residential discharge presented in the first row.

The projected buildout wastewater generation rate of 715,400 gallons per day is several orders of magnitude greater than existing or projected 2010 rates and is based on the development of approximately 278 acres of commercially zoned land. Constraints on water supply and the community's interest in remaining rural in character would likely significantly limit such extensive commercial development. Should several hundred thousand gallons of water become available for non-residential commercial development, such commercial facilities will in all likelihood require some form of wastewater treatment facility or will need to discharge to a municipal or regional wastewater treatment facility located outside of the district.

<u>Lancaster</u>

The population of the town of Lancaster is projected to increase by 20% by 2010. Currently, approximately 30% of the town's population is served by the Lancaster Sewer District municipal sewer system. With the on-going expansion of the sewer district, by 2010 it is projected that approximately 50% of the town's population will discharge wastewater to the municipal system. Based on this increase in population and increased in service area, the projected 2010 residential wastewater discharge to the municipal sewer is 0.24 mgd, a 200% increase from the estimated current discharge of 0.12 mgd (See Table 3.3-6). The projected residential discharge rate to municipal sewers at buildout, using ENSR's existing population estimates and assuming 50% discharge to sewers, is 0.42 mgd, which represents a 350% increase over current discharges.

Table 3.3-6 Projected Residential Wastewater Discharges to Municipal Sewer System for Lancaster

	Population	% Connected to Lancaster Municipal Sewer	Number of Users	Wastewater Discharge to Sewers (mgd)	Additional Discharge to Sewers
Existing	6542[a]	30%	1963	0.12	--
2010	7873[b]	50%	3936	0.24	200%
Buildout	13894[c]	50%	6947	0.42	350%

[a]**Population based on 1998 population values presented in Table 2.4-1**

[b]**Population projections based on ENSR regression analysis**

[c]**Population projection based on existing population (presented in first row) plus the incremental increase in population presented in MRPC buildout analysis.**

Non-residential discharges, which currently comprise 25% of the total discharge to the municipal sewer system, are projected to increase from 0.04 mgd to 0.08 mgd in 2010 (See Table 3.3-7). The total projected wastewater discharge to the Lancaster municipal sewer system in 2010 is 0.32 mgd. The estimated total wastewater discharge to municipal sewers at buildout, based on the estimate of existing non-residential wastewater discharges plus the incremental increase in non-residential discharges presented in the MRPC buildout, is 1.85 mgd. Since the projected 2010 flows are less than the projected buildout flows, it appears that the town can support the projected 2010 growth from a land use and zoning standpoint. The projected 2010 flow of 0.32 mgd is less than the 0.37 mgd currently allocated to the sewer district by the Massachusetts Water Resources Authority (the operator of the Clinton WWTF that receives flow from the district). Therefore, barring significant non-residential development within the district, the sewer systems being constructed to serve the expanded district are projected to be sufficient to meet 2010 discharge flow requirements. Both the projected buildout residential flow of 0.42 mgd and the projected buildout total wastewater flow of 1.85 mgd exceed the district's 0.37 mgd allocation. It appears that additional treatment capacity will be required, either by securing an increase in the allocation to discharge to the Clinton WWTF or by developing alternate wastewater treatment options. Discharge to some type of regional wastewater treatment facility (e.g., the Devens WWTF) may merit consideration.

Table 3.3-7 Total Projected Wastewater Discharges to Municipal Sewer System for Lancaster

	% Non-residential Discharge	Residential Discharge (mgd)	Non-residential Discharge (mgd)	Total Usage (mgd)
Existing	25%	0.12	0.04[a]	0.16
2010	25%	0.24	0.08[b]	0.32
Buildout	77%	0.42	1.43[c]	1.85

[a]**Non-residential discharge based on estimated total discharge minus the calculated estimated residential discharge.**

[b]**Projected non-residential discharge estimated based on the assumption that non-residential discharge increases at the same percentage rate as residential discharge.**

[c]**Projected buildout non-residential discharge estimated by adding 80% of the incremental increase in non-residential water demand presented in the MRPC buildout analysis to the estimated "existing" non-residential discharge presented in the first row.**

Approximately 70% of the town's residential population is currently not connected to the town sewer system and is served by individual on-site subsurface sewage disposal systems (SSDS's). By the year 2010, with the expansion of the sewer district, the proportion of the town's population not served by town sewers will be reduced to 50%. As shown in Table 3.3-8, assuming an average of 3.1 people per residential lot (based on 1998 population and household information presented MRPC buildout for Lancaster) and based on an existing population of 4580 users, there are currently an estimated 1477 residential properties with SSDS's.

Table 3.3-8 Projected Residential Wastewater Discharges to On-site Subsurface Sewage Disposal Systems (SSDS's) in Lancaster

	Population	% with SSDS's	Number of Users	Number of Residential Properties with SSDS's[d]	Additional Lots with SSDS's	Wastewater Discharge to SSDS's (mgd)
Existing	6542[a]	70%	4580	1477	--	0.28
2010	7873[b]	50%	3936	1270	(-207)	0.24
Buildout	13894[c]	50%	6947	2240	763	0.42

[a]Population based on 1998 population values presented in Table 2.4-1
[b]Population projections based on ENSR regression analysis
[c]Population projection based on existing population (presented in first row) plus the incremental increase in population presented in MRPC buildout analysis.
[d]Number of households with SSDS's estimated based on 3.1 users per household (as per MRPC buildout)

Assuming that the sewer district is expanded to service 50% of the residential population and considering an overall population growth rate of 20%, the number of residential properties with SSDS's in 2010 is projected to be 1270 (an decrease of 207 from existing). This drop in the number of SSDS's is misleading, however, since it is primarily due to the decommissioning of SSDS's at existing developed residential properties. The number of properties with SSDS's in 2010 is projected to decrease because the 20% increase in population is offset by a 67% increase in properties served by municipal sewers. Were it not for the expansion of the sewer district, the projected number of properties of SSDS's in 2010 would be 1772 or 295 more properties than existing. Assuming 50% of these new properties would be served by SSDS's, it is projected that 148 new properties with SSDS's will be required in 2010. The projected number of residences with SSDS's at buildout is 2240, an increase of 763 from existing.

Soil, groundwater level, and depth to bedrock properties in Lancaster tend not to be ideally suited for SSDS's. There are likely one to two hundred potentially developable lots with adequate conditions for traditional SSDS's, indicating that year 2010 residential development could be achieved. However, it is likely the case that residential development projects would have to be distributed in various areas of town since finding one area with conditions suitable for the development of 148 properties is improbable. There is less certainty as to whether 763 SSDS developable parcels exist in town. Some portion of such a larger residential development would likely require implementation of mounded systems, alternate innovative technologies, and/or possibly use of package treatment plants.

Shirley

The population of the town of Shirley is projected to increase by 29% by 2010. Currently, approximately 10% of the town's population is served by the Shirley municipal sewer system, which discharges to the Devens wastewater treatment plant. With the on-going expansion of the sewer district, by 2010 it is projected that approximately 75% of the town's population will discharge wastewater to the municipal system. Based on this increase in population and increase in service area, the projected 2010 residential wastewater discharge to the municipal sewer is 0.34 mgd, a 1133% increase from the estimated current discharge of 0.03 mgd (See Table 3.3-9). The projected residential discharge rate to municipal sewers at buildout, using ENSR's existing population estimates and assuming 75% discharge to sewers, is 0.76 mgd, which represents a 2533% increase over current discharges.

Table 3.3-9 Projected Residential Wastewater Discharges to Municipal Sewer System for Shirley

	Population	% Connected to Shirley Municipal Sewer	Number of Users	Wastewater Discharge to Sewers (mgd)	Additional Discharge to Sewers
Existing	5800[a]	10%	580	0.03	--
2010	7493[b]	75%	5620	0.34	1133%
Buildout	16780[c]	75%	12585	0.76	2533%

[a]Population based on 1998 population values presented in Table 2.4-1
[b]Population projections based on ENSR regression analysis
[c]Population projection based on existing population (presented in first row) plus the incremental increase in population presented in MRPC buildout analysis.

Non-residential discharges (which include a 0.6 mgd discharge from MCI-Shirley), currently comprise 96% of the total discharge to the municipal sewer system. Non-residential flows are projected to increase at the rate of residential population increase (29%), from 0.69 mgd to 0.89 mgd in 2010 (See Table 3.3-10). The total projected wastewater discharge to the Shirley municipal sewer system in 2010 is 1.24 mgd. The estimated total wastewater discharge to municipal sewers at buildout, based on the estimate of existing non-residential wastewater discharges plus the incremental increase in non-residential discharges presented in the MRPC buildout, is 1.65 mgd. Wastewater from the Shirley municipal system flows to the Devens WWTF, a 3.0 mgd average daily capacity facility. Arbitrarily assuming that the Devens existing wastewater flow of 0.4 mgd stays constant by year 2010, and adding in the Shirley 2010 flow of 1.24 mgd, results in a total year 2010 flow to the WWTF of 1.74 mgd. Absent addition of other regional flows (e.g. from Ayer, Lancaster, or Harvard), the Devens WWTF should be capable of handling the projected 2010 flow from Shirley.

The projected buildout total flow of 1.65 mgd would represent 55% of the total capacity of the Devens WWTF. Assuming that projected Devens buildout wastewater flow would be 3.2 mgd (see below section on Devens) the total buildout flow to the Devens WWTF would be 4.85 mgd. This would exceed the WWTF's 3.0 mgd capacity

Table 3.3-10 Total Projected Wastewater Discharges to Municipal Sewer System for Shirley

	% Non-residential Discharge	Residential Discharge (mgd)	Non-residential Discharge (mgd)	Total Usage (mgd)
Existing	96%	0.03	0.69[a]	0.72
2010	74%	0.34	0.89[b]	1.24
Buildout	56%	0.76	0.89[c]	1.65

[a]Non-residential discharge based on estimated total discharge minus the calculated estimated residential discharge.

[b]Projected non-residential discharge estimated based on the assumption that non-residential discharge increases at the same percentage rate as increase in residential population.

[c]Projected buildout non-residential discharge estimated by adding 80% of the incremental increase in non-residential water demand presented in the MRPC buildout analysis to the estimated "existing" non-residential discharge presented in the first row.

Approximately 90% of the town's residential population is currently not connected to the town sewer system and is served by individual on-site subsurface sewage disposal systems (SSDS's). By the year 2010, with the expansion of the sewer district, the proportion of the town's population not served by town sewers will be reduced to 25%. As shown in Table 3.3-11, assuming an average of 3.2 people per residential lot (based on 1998 population and household information presented MRPC buildout for Shirley) and based on an existing population of 5,220 users, there are currently an estimated 1,632 residential properties with SSDS's.

Table 3.3-11 Projected Residential Wastewater Discharges to On-site Subsurface Sewage Disposal Systems (SSDS's) in Shirley

	Population	% with SSDS's	Number of Users	Number of Residential Properties with SSDS's[d]	Additional Lots with SSDS's	Wastewater Discharge to SSDS's (mgd)
Existing	5800[a]	90%	5220	1631	--	0.31
2010	7493[b]	25%	1873	585	(-1046)	0.11
Buildout	16780[c]	25%	4195	1311	(-320)	0.25

[a]Population based on 1998 population values presented in Table 2.4-1

[b]Population projections based on ENSR regression analysis

[c]Population projection based on existing population (presented in first row) plus the incremental increase in population presented in MRPC buildout analysis.

[d]Number of households with SSDS's estimated based on 3.2 users per household (as per MRPC buildout)

Assuming that the sewer district is expanded to service 75% of the residential population and considering an overall population growth rate of 20%, the number of residential properties with SSDS's in 2010 is projected as 585 (a decrease of 1,046 from existing). This drop in the number of SSDS's is misleading, however, since it is primarily due to the decommissioning of SSDS's at existing developed residential properties. The number of properties with SSDS's in 2010 is projected to decrease because the 29% increase in population is offset by a 750% increase in properties served by municipal sewers. Were it not for the expansion of the sewer district, the projected number of properties of SSDS's in 2010 would be 2,107 or 476 more properties than existing. Assuming 25% of these new properties would be served by SSDS's, it is projected that 119 new properties with SSDS's will be required in 2010.

The projected number of residences with SSDS's at buildout is 1,311, a decrease of 320 from existing. If not for the expansion of the sewer district, the projected number of properties of SSDS's at buildout would be 4,719 or 30,88 more properties than existing. Assuming 25% of these new properties would be served by SSDS's, it is projected that 772 new properties with SSDS's would be required at buildout.

In most of the town of Shirley, soil, groundwater level, and depth to bedrock properties are not to be ideally suited for SSDS's. There are likely one to two hundred potentially developable lots with adequate conditions for traditional SSDS's, indicating that year 2010 residential development could be achieved. However, it is likely the case that residential development projects would have to be distributed in various areas of town since finding one area with conditions suitable for the development of 119 properties is doubtful. There is less certainty as to whether 772 SSDS developable parcels exist in town. Some portion of such a larger residential development would likely require implementation of mounded systems, alternate innovative technologies, and/or possibly use of package treatment plants. The Title 5-acceptable alternatives to traditional SSDS's may actually cause an increase in development in areas not serviced by municipal service. Increased service by the municipal sewer system would likely be required to achieve buildout.

<u>Devens</u>

Based on the levels of development established in the Reuse Plan, average daily wastewater flows are projected to increase by the year 2010 from approximately 0.4 MGD from Devens in 1995 (Devens only) to 1.6 MGD (ENSR, 1995) under the Reuse Plan for Devens, not including the estimated 1.24 MGD projected for 2010 from Shirley. Under buildout, wastewater generation could increase to 3.2 MGD average (Devens only) plus any increases from Shirley of 1.65 MGD. From Devens alone, there would be a net increase of 1.6 MGD.

There is a question as to the implication that the Devens WWTF may have excess capacity, which may not be the case. In the WWTF Plan (finalized in 1998) it was assumed that during the interim operation phase that the Rapid Infiltration Beds (RIBS) had a capacity of 3 mgd and that the existing facility would operate with a groundwater discharge under the Administrative Consent Order (ACO). If either MCI Shirley or Town of Ayer connect to the system, the capacity of the RIBS may be exceeded.

3.4 Population, Housing and Open Space

The following is an analysis of population, housing and open space trends associated with the Nashua River Watershed area incorporating the communities of Ayer, Harvard, Lancaster and Shirley and the portion of these towns within the Devens Commerce Center.

3.4.1 Population

Introduction

The economic prosperity that a revitalized Devens and I-495/Route 2 region has brought to the towns of Ayer, Harvard, Lancaster and Shirley comes at a price. Demand for new single-family housing continues to incrementally reduce the overall acreage of unprotected open space and places further demands on groundwater resources. The influx of new resident commuters has placed additional burdens on the region's local and state-maintained transportation infrastructure, and increased the cost of housing for those both living in the region and those moving here as a result of the employment opportunities Devens and other commercial and industrial developments provide.

To better understand the implications of this regional development on housing, transportation, groundwater resources and open space, a population projection from 1999 to 2010 was completed. Using a series of indicators (building permits from 1990 to 1998 and town population figures from 1995 to 1998), the regression analysis calculated the number of future residents within the towns of Ayer, Harvard, Lancaster and Shirley and extrapolated the population projection from 1999 to 2010. A series of factors had to be considered when using a regression analysis to perform this linear projection, principally the closure of Fort Devens and the loss of a significant number of transient military families from the four towns being studied.

The regression analysis was designed to contend with the region's population absent those military personnel assigned to Fort Devens. Because the baseline datapoint for the regression was 1995 and would provide only a limited number of data points to 1999, a series of indicators from each of the four towns had to be considered. These indicators, when calculated individually and averaged collectively, provide a very realistic estimate of each town's population in the year 2010.

The population projections to 2010 are vital to determine what the future impacts of further development might be on regional groundwater resources, wastewater discharges, and open space within the four towns surrounding the Devens Commerce Center. Following is the population projections for Ayer, Harvard, Lancaster and Shirley utilizing the regression analysis.

Regression Analysis

Due to the closure of Fort Devens, relatively stable, non-migratory population figures were not available for either town within the study area until 1995. Assumptions regarding future growth are difficult due to limited historical population data. A cohort survival population projection was considered due to its ability to reliably project future populations not overly encumbered by a migratory segment of the population. However, up-to-date cohort specific population information was not available, and a regression analysis was undertaken to make sound planning assumptions regarding how the towns might grow between 1999 and 2010.

Regression analysis is an economic forecasting model that uses linear projections to determine future trends based on a number of variables. Using regression analysis, it is possible to determine (for planning purposes) what the future growth rate of a town may be. To determine what the population of a town would be in 2010, a series of data points (population figures from 1995, 1996, 1997 and 1998) were used. A linear projection using regression was extrapolated out to the year 2010, which provides a general idea of what the population will be from the year 1999 to 2010.

The population figures provided for the regression analysis are made up of a very limited number of data points. While this is a numerical, calculable drawback, it is necessary to use population figures after 1995 so as not to bias the extrapolation with military personnel from Fort Devens. As previously stated, the number of reliable data points are few and this does limit the accuracy and validity of the population regression.

To offset this problem and provide a clearer picture of what may occur in each town between 1999 and 2010, residential building permits were examined between 1990 and 1998. Building permits are indicative of how a town is growing and are not as subject to the variables of a transient military population. Ten years of residential building permits were plotted using the regression analysis, depicting how each town will develop over the next ten years.

Combined, the population and building permit extrapolation using regression assist in the depiction of what each town will likely look by the year 2010. Below are the figures associated with the regression for each town, examining both population and building permit information. ENSR has estimated population for the year 2010 based on an averaging of population and building permit projections.

Ayer

The Town of Ayer's population was 6,871 in 1990. Of this total, there were 642 Devens residents and 6,229 residents outside the fenceline. Between 1990 and 1998 the town (outside the fenceline) grew approximately 18%, to 7378. The regression analysis indicated that the town will continue to experience accelerated residential development. According to the regression, an additional 4.1 units of housing will be added to the last data point (59 units) per year. Thus, in 1999, 63.1 units will be constructed, and in 2000, 67.2 units will be constructed, etc.

In 2010, it is estimated that there will be an additional 1,028 new residential homes constructed in Ayer. Assuming that an additional 2.5 persons will reside in each new home, an additional 2,570 persons would reside in Ayer by 2010, increasing the town's population to 9,948 persons, without Devens. Since the data was limited (due to the closure of Devens), ENSR also conducted a regression analysis of population and estimated that the population in Ayer may be 8,885. The average of these two projections is 9,417. Between 1998 and 2010, Ayer's population would increase approximately 28%.

The build-out analysis conducted by MRPC indicated that the population could increase by 4,806 future residents based on new residential units that could be constructed based on current zoning. The population is projected to increase in Ayer by an average of 3% over the next ten years. Total buildout for Ayer is estimated at 12,184, or a 65% increase compared to 1998.

Harvard

The Town of Harvard's population was 12,329 in 1990. Of this total, there were 7,667 Devens residents and 4,662 residents outside the fenceline. Between 1990 and 1998, the town (outside the fenceline) grew approximately 13%, to 5,263.

Using the results of the regression, it is estimated that the town of Harvard will continue to experience accelerated residential development. According to the regression, an additional 1.3 units will be added to the last data point available (13 units) per year. Thus, in 1999, 14.3 units will be constructed, and in 2000, 15.6 units will be constructed, etc.

In 2010, it is estimated that there will be an additional 257 new residential homes constructed in Harvard. Assuming that an additional 2.5 persons will reside in each new home, an additional 643 persons would reside in Harvard by 2010, increasing the town's population to 5,906 persons, not including Devens, which is addressed separately. Given the limited number of data (due to the closure of Devens), ENSR also conducted a regression analysis of population, which resulted in an estimated population of 5,964 by 2010. The average of these two projections is 5,935, a 13% increase between 1998 and 2010.

The build-out analysis prepared by MRPC projects that the future population could increase by 12,172 persons considering the potential for over 3300 lots and an average family size of 3.7 persons per household. Total population for Harvard at full buildout is estimated at 17,435, a 231% increase from 1998.

Lancaster

The Town of Lancaster's population was 6,661 in 1990. There were no Devens personnel residing in Lancaster. Between 1990 and 1998, the town population declined approximately 2%, to 6,542.

Using the results of the regression, it is estimated that the town will experience increased residential development. According to the regression, an additional 5 units will be added to the last data point available (39 units) per year. Thus, in 1999, 44 units will be constructed, and in 2000, 49 units will be constructed, etc.

By 2010, it is estimated that there will be an additional 858 new residential homes constructed in Lancaster. Assuming than an additional 2.5 persons will reside in each new home, an additional 2,145 persons would reside in Lancaster by 2010, increasing the town's population to 8,687 persons. ENSR also conducted a regression analysis of population statistics and projected a population of 7,058 by 2010. The average therefore, was estimated at 7,873 for 2010, an increase of 20%.

Based on the build-out analysis, it is estimated that the Town of Lancaster could gain an additional 7,352 new residents based on current zoning for a total population at full build-out of 13,894, an increase of 112% from 1998. Lancaster is expected to experience continued and accelerated residential growth and thus increases in its population base over the next ten years.

Shirley

The Town of Shirley's population was 6,118 in 1990. Of this total, there were 728 Devens residents and 5,390 residents outside the fenceline. Between 1990 and 1998, the town (outside the fenceline) grew approximately 8%, to 5,800.

Using the results of the regression analysis, it is estimated that the town will continue to experience accelerated residential development. According to the regression, an additional 4.1 units will be added to the last data point available (53 units) per year. Thus, in 1999, 57.1 units will be constructed, and in 2000, 61.2 units will be constructed, etc.

In 2010, it is estimated that there will be an additional 956 new residential homes constructed in Shirley. Assuming that an additional 2.5 persons will reside in each new home, an additional 2,390 persons would reside in Shirley by 2010, increasing the town's population to 8,190 persons. Due to the limited data set since the closure of Devens, ENSR conducted a regression analysis of population, resulting in a projection of 8,190. The average between the two projections, 7,493, represents an increase of 29% from 1998.

Based on the build-out analysis, MPRC projected an additional 10,980 residents are possible under current zoning for a total population of 16,780, or 189% since 1998, at full build-out.

Devens

In 1990, prior to the closure Fort Devens, the resident population was 9,037 (Table 3.4-1 displays the population by town). Based on descriptions provided in the Fort Devens EIS (ENSR, 1995), in 1998, the only residents of Devens were the prison population at the BOP facility (estimated at 1,000), the residents of the Job Corps facility (estimated at 300), and the residents of Sylvia's Haven (estimated at 200) for a total population of 1,500.

Projected for the year 2010, the Reuse Plan's residential population could be approximately 705, or 2.5 residents for each of 282 residential units. Combined with the 1998 population, total population in 2010 would be 2,205. The total population estimated at Build Out would be 3,010 (an additional 705 for a doubling of residential units plus an additional 100 residents at Sylvia's Haven).

Study Area Population Summary

Table 3.4-1 below indicates that the total population is increasing steadily with the influx of new business at the Devens Commerce Center, the I-495 region and the surrounding areas. Between 1998 and 2010, the area's population could increase by nearly 6,000 residents, which is a 23% increase. At full build-out the area's population could increase by 35,310, a 241% increase from 1998.

Table 3.4-1 Study Area Population

Town (w/o Devens)	1990	1998	2010	Percent Change 1998-2010	Build-out Analysis New Res./Total Pop.	Percent Change 1998-Buildout
Ayer (Devens	6,229 642)	7,378	9,417	28%	4,806/12,184	65%
Harvard (Devens	4,662 7,667)	5,263	5,935	13%	12,172/17,435	231%
Lancaster (Devens	6,661 0)	6,542	7,873	20%	7,352/13,894	112%
Shirley (Devens	5,390 728)	5,800	7,493	29%	10,890/16,780	189%
Totals (Towns) **Devens**	**22,942** **9,037**	**24,983** **1,500**	**30,718** **2,205**	**23%** **50%**	**35,310/60,293** **1,510/3,010**	**141%** **100%**
Source: MISER 1990, Towns of Ayer, Harvard, Lancaster, and Shirley 1998; ENSR Projections for 2010; MRPC for Buildout.						

3.4.2 Housing

The assessment of housing trends was based on a review of building permit activity within each community and a review of the build-out analysis prepared by the Montachusett Regional Planning Commission staff. It is expected that each community will continue to experience growth in the housing sector unless the market demand shifts and growth controls are enacted to slow the number of new units through changes in local development bylaws.

Ayer

In 1998, The Town of Ayer had a total of 3,255 units, including single family, multi-family and manufactured housing. Between 1990 and 1998 permits for 364 units were issued by the Building Department or 45 permits/year, the highest in the region. By 2010, approximately 1,028 units of new residential construction could occur.

Ayer has a considerable high number of multi-family units accounting for 45% of the total housing stock. It also has over 100 manufactured housing units. Approximately 13% of the land area in Ayer (6,062 acres) is devoted to residential development. This is relatively low as compared to other communities in the region (OSRP, 1999).

It is expected that the Town will continue to feel growth pressures for residential development due to land availability and the relatively competitive prices for developable land. It is projected that the community could realize the addition of 2,089 units, based on current zoning, a majority of which would be single family residences within new subdivisions and as infill within existing neighborhoods.

Harvard

In 1998, the Town of Harvard had a total of 1962 units of housing of which 80% were single-family units. The number of multi-family units in the Town of Harvard is estimated at 386 units. The Building Department has issued 163 permits for new construction between 1990 and 1998, averaging 20 new units per year. This is the lowest number of new housing starts in the study area. This is due mainly to large lot zoning (i.e. minimum lot size is 1.5 acres to 4.5 acres) and the cost of land in this community.

By 2010, approximately 257 new units of residential construction could occur. Based on the build-out analysis, it is predicted that an additional 3,203 units can be constructed in Harvard under current zoning. Approximately 95% of these new units will be single family residences. A small percentage of the additional housing would be multi-family (5%) due to high land costs and difficulty in receiving approvals for these types of developments under current zoning.

Lancaster

In 1998, the Town had a total of 2,198 units of which 68% were single family detached, 18% multi-family and 14% were classified as manufactured housing. The Lancaster Building Department issued a total of 191 building permits from 1990 to 1998, averaging 24 units per year.

By 2010, approximately 858 units of new residential construction could occur. The build-out analysis predicts that an additional 2,372 single-family units could be developed under current zoning within Lancaster. It is anticipated that 10% of these additional housing would be multi-family units.

Shirley

Shirley had a total of 2,400 dwelling units composed primarily of 1,490 single-family detached units (62%) and 631 multi-family units (26%). This predominantly rural community has the highest concentration of manufactured housing units within the study area estimated at 279 units or 12% of the total housing stock.

By 2010, approximately 956 new units of residential construction could occur. The build-out study estimated that an additional 3,475 dwelling units, 90% single- and 10% multi-family, could be built in Shirley under current zoning. The construction of a new sanitary sewer system, availability of large tracts of land and a sustained housing market demand are creating development pressure within the community. Several large subdivision plans have come before local boards for approval and will place additional burdens upon local infrastructure and school system capacities.

Devens

There are 282 units of housing identified in the Reuse Plan which were not occupied in 1995 but are assumed to be introduced to the market for the year 2010 projections. For buildout, ENSR has assumed an additional 282 units would be constructed.

Table 3.4-2 below depicts the potential increases in the number of additional housing units that are projected over the next ten years based on current trends and its relationship to the total build-out.

Table 3.4-2 Study Area Housing

Town	Total Housing Units 1998	Projected Housing Starts 1999-2010	Percent Change 1998-2010	Build-Out Projections Add./Total
Ayer	3,255	1,028/85 per year	30%	2,089/5,344
Harvard	3,304	257/21 per year	7%	3,203/6,507
Lancaster	2,198	858/72 per year	39%	2,372/4,570
Shirley	2,400	956/80 per year	40%	3,475/5,875
Devens	0	282	NA	282/564
Totals	11,157	3,097	28%	11,139/22,296
Source: MISER and ENSR, 1998				

3.4.3 Open Space

Ayer

Ayer has been able to set aside over 575 acres of land resources for conservation and recreation purposes. The Conservation Commission controls approximately 180 acres of land located primarily within the outlying areas of the community. These conservation lands are located within large tracts of land estimated at over 3,000 acres, according to the OSRP (1998). The Open Space and Recreation Plan identified a number of proposals that would contribute towards improving and expanding the amount of protected conservation and recreation lands throughout the community. These include the following.

- Develop strategies for improving local waters as sources of drinking water and recreational pursuits;
- Devise methods to keep certain lands in their natural state and to gain greater access to wooded and wetlands areas;
- Offer broader range of cultural, educational and recreational activities for all age groups;
- Develop better management of recreational areas and facilities; and,
- Work towards linking open space and recreational areas within the Town and adjacent communities.

The Town of Ayer is projected to have an additional 1,028 permits issued for housing over the next ten years based on the regression analysis. A total of 822 acres of developable land would be lost to new housing starts between year 2000 and 2010, assuming continued market demand. The build-out analysis performed by MRPC estimated that Ayer has a total of 1,924 acres of developable land remaining or 60% of its total land area. Based on this analysis, a total of 40% of Ayer's remaining developable land area will be subject to housing development pressure. However, if including industrial and commercial development pressure, the area of land impacted would be greater than the 40% of remaining developable land.

Based on a review of the Town's Open Space plan and existing resource data, specific areas that should be targeted for acquisition or other protective measures include areas proposed for new and expanded water supply (Horgan Property) near the Nashua River and lands near the great ponds including Sandy Pond, Fletcher's Pond, Spectacle Pond and Long Pond to name a few. In addition, access to water bodies for recreational purposes are also high on the list and recommended by the 1998 OSRP. Improving passive recreational activities near the Nonacoicus Brook and along the Nashua River are priority locations.

Harvard

The Harvard Open Space and Recreation Plan (OSRP) identified a total of 2,860 acres of land that are protected for open space, conservation and recreational purposes. The Town has acquired over 100 parcels of land through acquisition, gift, tax title and conveyances. Over 1,680 acres of land are currently protected as conservation land managed by the Conservation Commission. Maintaining the rural, bucolic and historic character of the Town is of the utmost importance to its residents as noted in the OSRP.

Harvard is projected to issue a total of 257 permits for new housing starts over the next ten years (2000-2010) based on the regression analysis. This would result in the loss of approximately 514 acres of land or based on an average lot size of 2.0 acres. The build-out analysis predicted that a total of 3,203 residential lots and 5.9 million SF of commercial development could be created on 7,435 acres of remaining developable land or 50% of Harvard's total land area.

The future OSRP action plan, promotes the acquisition of land and the establishment of conservation easements in close proximity to:

- the Town Common,
- land near Bare Hill Pond and other water bodies,
- agricultural lands and,
- linkages for expanding greenways.

or 14% of the South Post lies within the Town of Harvard along the Nashua River. An approximately 700 acre area (a portion of the Oxbow Wildlife Refuge) and is permanently protected. Linkages to it from other areas of Harvard, such as the Watt Farm, and the Bolton Flats further south are important to preserve wildlife corridors and other sensitive ecological resources in the area.

Lancaster

The Town of Lancaster has 1,148 acres of protected open space according to the OSRP prepared by the Montachusett Regional Planning Commission (MRPC). A majority of these areas are located within the Nashua River Greenway, the focal point of the open space protection program in the Town.

The greenway concept is widely supported by Lancaster residents and efforts are continuing to purchase additional areas and links to the Greenway to eventually establish a Nashua River Trail.

Lancaster, the largest of the four towns (total acreage), is projected to issue 858 permits for new housing starts between 1999 and 2010. Based on two-acre zoning, a total of 1,373 acres of developable land or 19% of the total developable land (7,158 acres) could be consumed during this ten-year period. The build-out analysis estimated that an additional 2,368 dwelling units/lots as well as 23 million com/ind SF could be developed under current zoning conditions. The remaining developable land represents 40% of Lancaster's total land area of 18,046 acres.

Lancaster has identified the need to further protect land parcels along the Nashua River, as part of a unified trail system and to link existing conservation areas for enhancing wildlife habitats and corridors.

The OSRP recommends that efforts be directed towards the acquisition and or the creation of conservation restrictions on lands near the Lancaster Town Forest, adjacent to the North Branch of the Nashua River and north of the Bolton Flats Wildlife Management Area. These are the more prominent location for pursuing open space protection, as they are associated with large contiguous parcels.

The entire South Post of Fort Devens (4,880 acres), which is located entirely within the Town of Lancaster, is scheduled for transfer to the US Fish and Wildlife Service if the Army ever determines the property to be excess to the mission of national security. This area would then be permanently protected.

Shirley

The Open Space and Recreation Plan developed for the Town of Shirley identified a total of 1900 acres of protected open space representing over 19% of total land area. A majority of the land holdings consist of federal and state wildlife management areas located along the banks of the Nashua River. Maintaining the Town's rural character and protecting its water supply and creating linkages to protect habitat areas serve as the foundation for land acquisition efforts.

The Town is presently facing significant development pressure from developers looking to construct subdivisions on large tracts of back land throughout the Town.

The Town of Shirley could realize an increase of 955 new housing starts between 1999 and 2010 based on the regression analysis. This could result in the loss of approximately 765 acres of developable land area or 21% of the total developable land area (3,706 acres) remaining in Shirley. The build-out analysis projects that 3,359 units of housing and 3.4 million SF of commercial/industrial floor area is possible under current zoning. The remaining developable land area represents 40% of the total land area of the community.

Shirley has large tracts of undeveloped land that are being sought after for residential subdivisions and for other types of developments. The approach that has been proposed in the Open Space Plan (1996) and reiterated in the Shirley Master Plan (2000) update is the establishment of two open space corridors, including a cultural and a natural greenway corridor. The Cultural Greenway would travel north/south starting at the Shaker Village in the south and traveling north along existing roadways (*Center, Parker and Townsend roads*) through Shirley Village and Shirley Center and eventually terminating in North Shirley. The purpose of this cultural greenway would be to preserve the central corridor of Shirley as an important historic resource including historic residences and neighborhoods, tree-lined country roads, and open fields/ forested areas.

The establishment of a natural greenway that incorporates existing protected lands along the Nashua and Squannacook River systems would represent the other greenway proposal. Linking together undeveloped land parcels along the eastern boundary of Shirley will provide enhanced protection for wildlife habitats, ponds, wetlands and floodplains. These areas will be compromised unless actions are taken to acquire or place conservation restrictions on lands that link existing protected open space areas.

Devens

The Devens Open Space and Recreation plan, prepared in 1996, established a series of guidelines and management approaches for all open space areas within the Open Space and Recreation Zone. The goals of this plan are in concert with those of the four communities. Approximately 1,000 acres of land has been set aside for recreation and conservation uses, not including the 836 acres that was transferred to the U.S. Fish and Wildlife Service to expand the Oxbow Wildlife Refuge Area. The open space areas were categorized under the DEM Land Stewardship Classification System including Conservation (515 acres), linkage areas (255 acres), Intensive use areas (136 acres) and preservation areas (95 acres) for determining proper use and management.

In addition to setting up these zones, several conservation restrictions were established to protect environmentally sensitive areas. These areas include Mirror Lake and Little Mirror Lake, ASP Bog and Wetland B and, Cold Spring Brook and Wetland C.

The development of additional recreational activities designed to serve the needs of adjacent communities is being addressed through the JBOS Open Space and Recreation Committee.

Table 3.4-3 Impacts to Developable Land

Town	Total Town Area	Developable Land Available 2000	Projected Growth in Residential Development 2000-2010	% Change 2000-2010
	(acres)	(acres)	(acres)	
Ayer	3,117	1,924	822	42%
Harvard	14,577	7,402	309	4%
Lancaster	18,046	7,158	1,373	19%
Shirley	9,358	3,706	765	20%
Totals	49,498	20,190	3,270	16%
Source: ENSR, 2000				

3.5 Traffic

3.5.1 Regional Transportation System Overview

It is not possible to estimate traffic growth directly from growth in population and employment for an area as large as the four communities participating in this study, although clearly the two items are related. Using sources such as ITE Trip Generation is appropriate for estimating traffic associated with new developments where the number of trips internal to the development (i.e. trips which both begin and end within the development) represent a tiny fraction of the total trips generated by the development. However, within the four-community study area many trips will be internal trips, representing shopping, social/recreational, and even many work trips. An additional element impacting roadways in the region are through trips, especially on Route 2, but also on some other roadways. Localized growth (or decline) in activity centers along I-495, I-190, and portions of Route 2 outside the study area can have a significant impact on traffic conditions along Route 2 and roadways connecting to it within the study area.

Tables 3.5-1 and 3.5.2 present the daily traffic volume estimates for the year 2010 at the locations listed in Tables 2.5-1 and 2.5-2 if recent growth rates continue. Traffic growth is assumed to be constant for each year rather than a constant percentage rate of growth in order to reduce the compounding impacts for roadways with high observed annual growth rates, such as the three main Devens gates. Also, roadways which were observed by the Devens Traffic Monitoring Program to have annual growth rates lower than the MRPC average annual growth factor of 2.08% had the MRPC growth factor applied to the observed 1998 volumes for this estimation. The MRPC regional growth factors (2.08% for rural roads, 1.67% for urban roads) are higher than the expected growth rate for population.

Table 3.5-1 Trends at MHD Permanent Count Locations

Town	Location	1997 AADT	Current Annual Growth Rate	Annual Increase AADT	2010 AADT at Current Trend	AADT Increase 1997-2010	AADT pctg. Increase	2010 AADT Volume/Lane
Lancaster	SR 2 west of SR 70	41,221	1.95%	804	51,671	10,450	25.35%	12,918
Fitchburg	SR 2 east of Oak Hill Road	36,500	1.79%	653	44,994	8,494	23.27%	11,248
Leominster	I-190 north of SR 117	32,420	2.83%	917	44,347	11,927	36.79%	11,087
Littleton	I-495 north of SR 119	92,300	3.00%	2,769	128,297	35,997	39.00%	21,383
Boxborough	I-495 south of SR 111	74,800	3.18%	2,379	105,722	30,922	41.34%	17,620

Table 3.5-2 Trends at Devens Traffic Monitoring Program Count Locations

Town	Location	1998 AADT	Current Annual Growth Rate	Annual Increase AADT	2010 AADT at Current Trend	AADT Increase 1998-2010	AADT pctg. Increase	2010 AADT Volume/Lane
Ayer	SR 110/111 south of Carlton Rotary	14,533	2.48%	360	18,858	4,325	29.76%	9,429
Ayer	SR 2A/110 east of Carlton Rotary	15,229	2.58%	393	19,944	4,715	30.96%	9,972
Ayer	SR 2A/111 west of Carlton Rotary	21,044	2.08%	438	26,297	5,253	24.96%	13,148
Ayer	Sandy Pond Rd north of Carlton Rotary	6,505	17.63%	1,147	20,267	13,762	211.56%	10,133
Ayer	Barnum Road west of Carlton Rotary	2,694	2.08%	56	3,366	672	24.96%	1,683
Ayer	SR 2A/110 at Ayer/Littleton line	11,958	11.62%	1,390	28,632	16,674	139.44%	14,316
Ayer	SR 2A at Ayer/Shirley line	8,643	2.08%	180	10,800	2,157	24.96%	5,400
Ayer	SR 111 at Ayer/Groton line	5,497	2.08%	114	6,869	1,372	24.96%	3,435
Harvard	SR 110/111 north of SR 2	12,813	2.08%	267	16,011	3,198	24.96%	8,006
Harvard	SR 110/111 south of SR 2	8,140	4.60%	374	12,633	4,493	55.20%	6,317
Harvard	Poor Farm Road east of SR 110/111	1,442	3.31%	48	2,015	573	39.72%	1,007
Shirley	Front Street west of Ayer Street	5,790	2.08%	120	7,235	1,445	24.96%	3,618
Lancaster	SR 2 west of SR 70	45,581	2.08%	948	56,958	11,377	24.96%	14,240
Littleton	SR 2 west of I-495	49,076	4.76%	2,336	77,108	28,032	57.12%	19,277
Littleton	SR 2 east of I-495	43,328	3.78%	1,638	62,982	19,654	45.36%	15,745
Leominster	SR 2 west of I-190	60,966	4.73%	2,884	95,570	34,604	56.76%	23,893
Ayer	Verbeck Gate	3,363	19.53%	657	11,245	7,882	234.36%	5,622
Lancaster	Jackson Gate	4,854	16.47%	799	14,447	9,593	197.64%	7,224
Lancaster	Barnum Gate	2,766	12.85%	355	7,031	4,265	154.20%	3,516

The growth trend from 1996-1998 at some locations appears too great to be sustained. These locations include Sandy Pond Road north of the Carlton Rotary and Route 2A/110 at the Ayer/Littleton line, both locations where the trending the traffic growth trend from 1996-1998 out to the year 2010 results in traffic volumes more than doubling (tripling for Sandy Pond Road). Also, three of the four count stations on Route 2 would experience traffic growth of approximately 50% through 2010 if the 1996-1998 trend were to continue.

Even with the cautions noted in the previous paragraph, it is apparent that the trend will be for significant increases in traffic on regional roadways. Use of the MRPC Growth rate results in a 25% increase in annual volumes on roadways. Table 3.5-3 lists data from the Highway Performance Monitoring System (HPMS) for vehicles/lane/day (vplpd) on different roadway types. Many of the roadways in the region will exceed the 90^{th} percentile for *urban* roadways by 2010 if current trends continue. Volumes on I-495 will approach or exceed 20,000 vplpd, a level at which significant recurring congestion can be expected. Closer to the study area, traffic volumes on Route 2 will approach 15,000 vplpd and may exceed this between I-495 and the 110/111 interchange. Traffic volumes entering the Carlton Rotary could increase by 25%-30%, with entering volumes from 110/111 and 2A/110 approaching the volumes entering from Main Street today.

Table 3.5-3 Annual Average Daily Traffic (AADT) per Lane

Functional Class	**Lanes**	**Average**	**90th percentile**
I. Rural			
Interstate	4-lanes	4,251	7,325
	6-lanes	8,500	13,299
Principal Arterial	2-lanes	2,268	6,425
	4-lanes	4,432	6,425
Minor Arterial	2-lanes	1,758	3,900
	4-lanes	2,752	5,518
Major Collector	2-lanes	1,062	2,665
	4-lanes	2,774	5,909
II. Urban			
Interstate	4-lanes	8,649	15,063
	6-lanes	12,940	21,000
Other Freeway/Xway	2-lanes	6,887	13,475
	4-lanes	7,448	14,000
Principal Arterial	2-lanes	4,823	9,000
	4-lanes	4,924	8,550
Minor Arterial	2-lanes	3,242	6,748
	4-lanes	3,993	7,065
Collector	2-lanes	1,737	4,025
	4-lanes	2,696	5,407
Note: The 90th percentile is the volume below which 90% of volumes fall Source: Highway Performance Monitoring System (HPMS) Database, Federal Highway Administration			

3.5.2 Trucks

The increase in truck traffic into and out of Devens is likely to slow over time as the emphasis of development at Devens shifts from intermodal rail-related uses towards the development of Office, R&D, Light Industrial and Manufacturing uses. While the Light Industrial and Manufacturing uses will still generate a significant number of truck trips, these uses are expected to generate fewer truck trips than intermodal uses generate. In addition, these new developments will be located farther from Barnum Gate than the intermodal uses (and generally closer to Jackson Gate) so a higher percentage of these trucks would be expected to use Jackson Road for access/egress.

While truck traffic growth associated with Devens is somewhat predictable due to the planned nature of the development it is harder to predict truck traffic growth along roadways outside of Devens. Recent growth in rail-related businesses along Route 2A/110 has been significant, but whether this growth will continue at these levels is unclear.

3.5.3 Peak Hour Conditions

It is not possible to estimate future peak hour and peak period traffic growth in the same manner as daily traffic growth, especially in locations where recurring congestion occurs. As recurring congestion increases, an increasing percentage of travelers will choose to alter either their routes or the starting time of their trips to minimize the impacts of congestion. Existing conditions on roadways monitored by the Devens Traffic Monitoring Program show that peak hour peak directional volumes are close to 10% of daily directional traffic, which is consistent with the general rule of thumb used when hourly volumes are not available. However, as daily freeway volumes approach 20,000 vplpd this rule of thumb results in volumes which approach or exceed the capacity of the roadway and cannot be maintained. For arterials and collector roadways, the effective hourly capacity of is harder to predict due to the number of other factors affecting traffic (curb cuts, cross streets, etc.) but hourly volumes exceeding 1,200 vehicles/lane are difficult to sustain along roadways with frequent curb cuts as are found in the study area.

4.0 ALTERNATIVES

4.1 Introduction

The alternatives presented in this section are generally applicable for each of the four communities, and will not be presented for the individual towns. Following are alternatives for each of the topics addressed by the CCbW program.

4.2 Water Supply

Each of the four towns has sought additional water supply, and various studies have been conducted to identify these opportunities. The recommendation of specific locations where additional supply may be available is out of the scope of this project. Clearly additional supply goes a long way towards meeting rising demand, and should be pursued. However, water resources are finite, and the goal of this section is to present alternatives to simply increase supply to meet demand and to present options to ensure a continued source of high quality water as demand and environmental pressures grow.

4.2.1 Maintain Water Quality and Quantity

As development in the four towns continues over the next 10 years and beyond, it is essential that existing water supplies do not become degraded. Critical areas must be identified and protected. Development should be planned and legislated with this goal as a top priority. In particular, aquifer recharge zones, which are hydraulically connected to the aquifers, should be granted special protection. In general, land set aside to maintain pervious surface and vegetation will contribute to the maintenance of water quality overall.

<u>Aquifer Recharge Zone Delineation</u>

The USGS has delineated the approximate location of the high and medium yield aquifers, which are shown on the maps of the four towns in Section 2.1. Many of the Zone II wellhead protection areas have also been delineated in the four town region. However, these delineations do not necessarily include all of the areas over which recharge occurs. There may be additional recharge areas that are not associated with existing wells, but may warrant protection because of their connection with the aquifer or for future use. Recharge areas are the most important part of the aquifer system for protection of water quality and water quantity. The towns could conduct a study, including review of available data, field work and numerical modeling, to delineate the aquifer recharge zones connected to the high yielding aquifers, and to refine the USGS delineation

Once delineated, strict zoning bylaws could be enacted for the aquifer recharge zone. The towns could create an aquifer protection overlay district to restrict or prohibit land use in the overlay district.

For example, underground storage, gas stations and bus terminals could be prohibited. Certain industries that may discharge potentially contaminated water could also be prohibited. Development that does take place in the recharge zone could be required to install recharge basins that mimic natural recharge.

Land Preservation

Many acres of land in the four towns are preserved or undevelopable due to their proximity to surface waters or existing drinking water wells. Land held in permanent open space contributes to both water quality and quantity by maintaining pervious surface and reducing exposure to possible contamination. Land acquisition and preservation achieves this goal, and ensures adequate open space within the traditionally rural communities. Land within the aquifer recharge zones should be restricted from any uses that could jeopardize the health of the aquifer. Additional acquisition and preservation should be focused in the vicinity of the major aquifers and near surface waters. Figure 4-1.1 presents general locations (hatched areas) that are presently undeveloped, but overlie high and/or medium yield aquifers. These areas, located in Ayer and Lancaster, may be prioritized for preservation of future water supply development.

Open space preservation can be mandated by zoning ordinances that permit residential development while maintaining open space. In Montgomery, PA, a Land Preservation District (http://www.epa.gov/owow/nps/ordinance/preservation.htm) was established to promote non-conventional development in the form of clustered communities surrounded by open space. The District has defined minimum lot sizes and road frontages as well as open space required of new development. The District has also identified natural features and environmentally significant areas that should be preserved on a county-wide scale. This ordinance, however, relies on using open space for septic fields, which could conflict with requirements of Title 5 for Massachusetts communities. Zoning bylaws could be adopted in by town or by region to promote both development and open space. In some cases in Massachusetts, cluster bylaws have been used to serve the same purpose as that in the Montgomery bylaw.

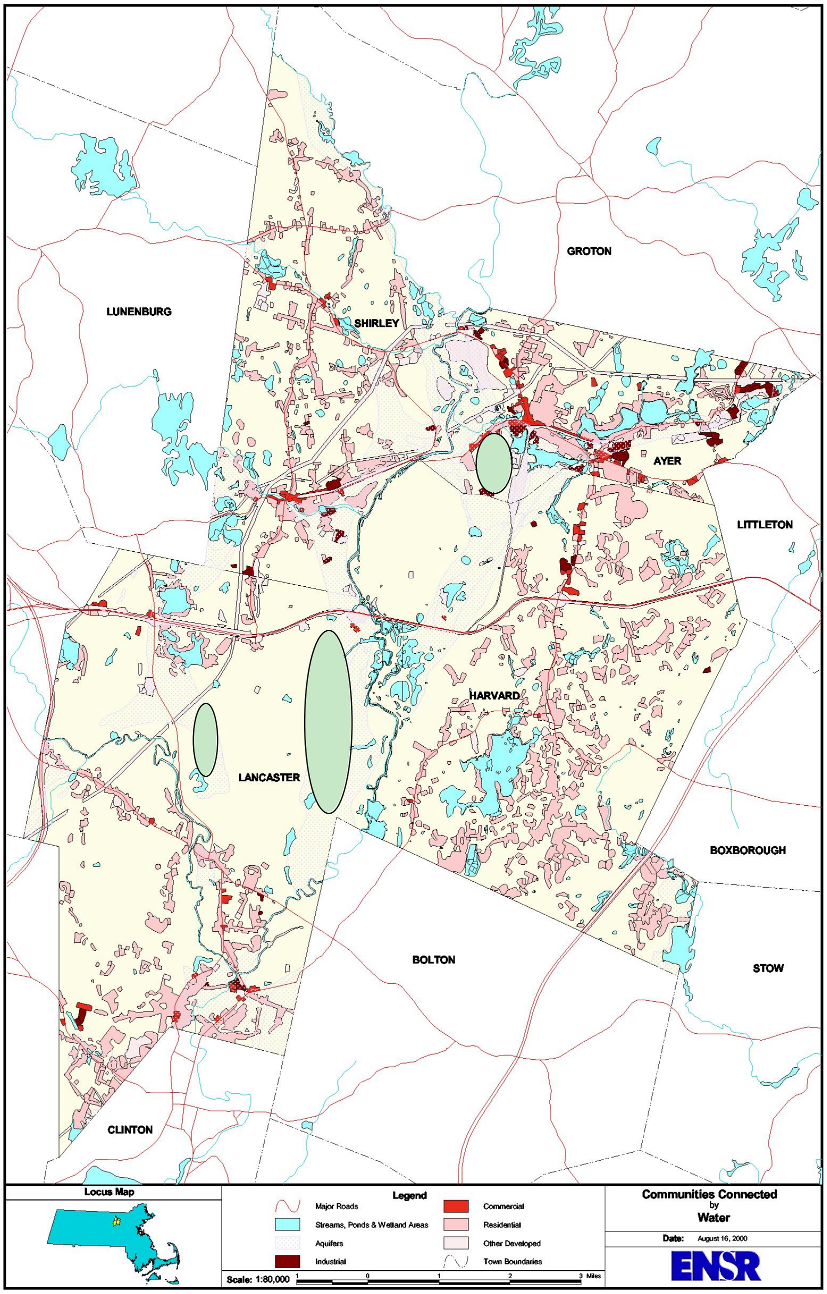
Increase Recharge

Aquifers are recharged when rainfall infiltrates into the subsurface, and by streams, rivers and lakes during some or all seasons of the year. Development can often alter these recharge patterns, reducing the amount of water that enters the aquifer. Active measures can be taken to ensure the maximum amount of recharge with the available water in the four towns region.

Enact/strengthen Recharge Basin Bylaws

Bylaws exist that require recharge basins to be installed with any new construction that may affect runoff and recharge patterns. The by-law objective is to mitigate the impact of new construction and associated paving on existing recharge patterns. However, in general, the recharge basins are not monitored and do not always function as designed. Local bylaws could be enacted to strengthen the

Figure 4-1.1 Areas to be Considered for Land Preservation



requirements and provide for monitoring of these small recharge basins to ensure maximum recharge to the underlying aquifer.

Artificial Aquifer Recharge

Water can be artificially recharged into the aquifer to help maintain groundwater table elevations, provide storage and prevent discharge water from leaving the watershed. Recharged water can be either treated wastewater or stormwater runoff, depending on the proximity of the recharge location to existing drinking water supplies.

Infiltration basins are the most common technique used in artificial aquifer recharge. Basins are constructed in areas of highly permeable soils, and are most effective when there are no impervious or low permeability layers between the basin and the underlying aquifer. Surficial soil pores can become clogged if the recharge water has a high solids concentration, although a fully developed aquatic community can increase soil permeability in the root zone.

When impermeable layers exist above the aquifer, or land is scarce, injection, or recharge wells can be used to recharge the aquifer. There are several disadvantages associated with this method, including clogging of the well screens or surrounding aquifers, leading to excessive buildup of water levels in the recharge wells. This method is still considered experimental in the United States.

There are technical, financial and regulatory issues associated with artificial recharge. A detailed study must be conducted to determine whether or not the system will work in a given geologic and hydrologic setting. If wastewater is to be recharged, the recharge must be in a location that will not affect the quality of current drinking water supplies. There are initial infrastructure costs as well as ongoing maintenance costs associated with a recharge system that may not be immediately or readily recoverable. Finally, extensive work will likely have to be done to demonstrate the need and the effectiveness of the system before necessary permits can be issued.

In eastern Massachusetts, the towns of Franklin and Holliston are currently considering artificial recharge systems. Franklin is developing a pilot project to recharge the groundwater with stormwater. The project has the support of the town, the DEP and the EPA, and is scheduled for construction in the later half of 2000. The pilot project has an estimated cost of $200,000 and is designed to handle peak rainfall/runoff events. Holliston is planning a project to recharge groundwater with locally treated sewage, but this project has been stalled due to high costs.

Although a somewhat new approach, particularly in the water rich eastern U.S., artificial recharge may be a viable method to maintain groundwater levels (which may enhance streamflows), keep water in the watershed and store water during wet periods, to be used during drier times.

4.2.2 Reduce Consumption

As development in the area continues, increasing demand on existing supplies, efforts may be made to reduce existing consumption, slowing the rate of demand. The primary water use in the four towns is residential use. A raised awareness about the issues concerning water supply will encourage residents to think about, and hopefully reduce, their water consumption. A tiered pricing structure may also encourage reduced consumption. Finally, any large industrial users may be able to implement reuse programs, which may significantly reduce their individual demand.

Water Conservation Education and Water Efficiency Programs

Water consumption can be reduced by developing water conservation education and water efficiency programs. Many communities around the country have implemented a water efficiency program and an educational campaign on water conservation and watershed management. Water conservation and education programs can include the distribution of educational material on water supply and management, and address bathroom fixtures, faulty septic systems, leaky sewer mains and landscaping. State regulatory agencies are beginning to turn down permit applications for new supplies until the community can demonstrate that adequate water conservation measures have been implemented.

For example, Connecticut law has required standards for water-efficient fixtures manufactured and sold in the state. Maximum flow requirements were placed on showerheads, urinals, faucets, and toilets. The state has also organized a retrofit program that requires all water distributors to give away free water-efficiency kits. Each kit contains one low-flow showerhead, two faucet aerators, one pair of toilet tank dams, one package of toilet leak detection tablets, and written information. The cost of the kits, $6-$7 each, is absorbed by water users through their rates (see http://www.epa.gov/OW/you/chap4.html)

There is a lot of educational information available concerning watershed management (including reduction of pollutants and the water cycle), water conservation (including in-home and landscape usage). The Environmental Protection Agency offers Environmental Education Grants to enhance the public's awareness and knowledge about environmental quality. Additionally, there are many smaller organizations (for example http://www.getwise.org/wwise/index.html, http://www.waterwiser.org/, http://eelink.net/grants-eespecificresources.html) that offer educational and grant programs geared at environmental awareness. An increased understanding of where drinking water comes from and where it goes can lead to decreased water demand and improved water quality.

Tiered Pricing

Water suppliers or water departments could implement a tiered pricing policy, where users are charged more for using an excessive amount of water. A base amount of water would be priced at the lowest cost per unit. The amount of water sold at the base price could be determined by residence size. Tiers could be established, such that when usage exceeds the base amount, the cost per unit increases. Several tiers and price increases could be established. Tiered pricing policies have been implemented in many water districts in California and other western states.

Wastewater Reuse

Industrial water use does not comprise a large percentage of the demand in the four towns region, although there is some industrial demand in Ayer, and an increasing demand at Devens. Depending on the industry, it may be possible to reuse wastewater and reduce demand. Wastewater reuse is particularly applicable when industrial water is used for cooling and other non-contaminating uses. The feasibility of wastewater reuse would depend on the individual industries. If new industries move into the region in the future, it may be possible to enact bylaws that require the industry to consider wastewater reuse as an alternative water supply. The Devens Enterprise Commission (Personal Communication with P. Lowitt, 2001) is advocating the use of industrial effluent and domestic gray water as sources of irrigation within the Devens site.

4.2.3 Regional Management

A regional water district could be implemented, with varying degrees of responsibility and jurisdiction. At a minimum, the district could oversee and coordinate water resources activities within the region, under the direction of a common goal or policy. The District could facilitate water transfers between towns when one town is low on supply and another has extra water. This would entail constructing and maintaining the infrastructure to move the water, and bookkeeping of the transfers. Alternatively, a regional water district could be established with the responsibility for all supply and distribution within the district. Examples of regional water districts are briefly described below.

The Cape Cod Regional Planning Commission (http://www.vsa.cape.com/~cccom/water/) maintains a Water Resources Office, involved in planning, permitting and implementation of water resources related projects. The Office works to support the region-wide goal for Cape Cod water, including maintenance of quality and quantity of the regional groundwater, improved ecological integrity of the regional surface waters, protection of shoreline areas and activities and to limit development in flood-prone areas. The Office also coordinates water-related activities with federal, state and local governments in the 15 communities that are part of the Planning Commission.

The South Connecticut Regional Water Authority (see http://www.rwater.com) supplies water to 12 communities in the New Haven, CT area. The Authority maintains wellfields and reservoirs, water treatment plants, protection programs and open space within the watershed. In western states, regional water control boards exist on a county-wide scale to facilitate all water management, supply and transfers and enforce water quality regulations.

The advantages to the regional water district include management of water resources on a watershed scale, a vehicle to match supply with demand and a greater ability to plan for future demand. Disadvantages may be increased costs for water and large initial costs to establish the required infrastructure. Several residents have expressed interest at previous CCbW meetings in water resources management on a more regional scale, and the establishment of a regional water district, as a new entity, or to develop a strong office of water at the existing Montachusett Regional Planning Commission, could support this goal.

4.3 Wastewater

By the year 2010, each of the four communities of interest will be facing a series of wastewater disposal constraints/issues including: the maintenance of existing and construction of new subsurface sewage disposal systems (SSDS's) that comply with the requirements Massachusetts Title 5, the expansion of existing or construct new municipal wastewater treatment systems and wastewater treatment facilities (WWTF's) to handle increased flows, and the potential need to discharge municipal wastewater to regional WWTF's located outside of the communities.

Each of the communities, either individually or preferably on a regional basis, will need to perform a detailed characterization of sewage disposal needs. A detailed evaluation of soils, geologic and hydrogeologic conditions will likely be required to determine which areas of the communities will be suitable for "traditional" SSDS's, which areas might be suitable for innovative/alternative SSDS's, and which areas will require off-site treatment and disposal of wastewater. The capacities and expansion potential of existing local (Ayer WWTF) and regional (Devens WWTF and MWRA Clinton WWTF) wastewater treatment facilities and associated sewer mains and pump stations will also have to be evaluated. Potential locations for new WWTF's and/or wastewater discharge points (either to groundwater or surface water) will also need to be determined.

The section that follows discusses the range of potential wastewater disposal alternatives that will merit consideration for each of the communities. As an example of the type of detailed alternatives analysis that could be required, an overview of a recently completed wastewater disposal option analysis is provided. This evaluation, performed for the town of Holliston, Massachusetts, was recently described in the Journal of the New England Water Environment Association (Bell et.al., 2000).

4.3.1 Case Study - Holliston, Massachusetts Alternatives Evaluation

The town of Holliston (population 14,000) is a residential community that is similar in size and suburban character to the four towns of interest. Holliston is currently served 100% by individual on-site subsurface sewage disposal systems (SSDS). Board of Health records from 1972 to 1998 indicated that 9% of the town's SSDS had failed during this 26-year period. Based on stringent Title 5 limitations related to the location of SSDS's within wellhead protection areas and limitations based on site soil conditions, depth to bedrock, depth to groundwater, and lot size constraints, it is expected that a much greater proportion of systems will be classified as failures at the time of future property transfers. In response to this concern, Holliston has decided to construct a wastewater collection and transmission system and, in April 1998, filed an Environmental Notification Form providing a preliminary design for a proposed system to the state for Massachusetts Environmental Policy Act (MEPA) review and comment.

In response to the ENF, the Executive Office of Environmental Affairs (EOEA) issued a MEPA Certificate that required the town to prepare an Environmental Impact Report (EIR) for the project. The EIR process presented by MEPA was a three-phase process, requiring that the town 1) perform a "Needs Analysis and Screening of Alternatives", 2) develop a "Comprehensive Wastewater Management Plan and Draft EIR" (CWMP/EIR), and 3) develop a "Final Comprehensive Wastewater Management Plan and EIR".

The needs analysis/alternatives screening process performed by the town and its environmental consultant (Earth Tech) included the following:

- a review of Board of Health records, assessor's files, and soil surveys to determine existing land use, soil/groundwater conditions, and determine areas of town with existing or potential subsurface sewage disposal problems
- in areas identified as potential "problem areas", an alternatives analysis was performed, evaluating the such wastewater treatment alternatives as innovative/alternative SSDS's, communal (multi-user) SSDS systems, implementation of local (in-town) wastewater treatment and disposal systems, use of regional wastewater treatment facilities, and a combination of the various treatment/disposal alternatives
- the alternatives evaluation include consideration of environmental, technical, and economic factors

The findings of the needs analysis/alternatives screening process were reviewed during the CWMP/EIR process. A final list of "areas of wastewater disposal need" was developed. Potential wastewater disposal solutions for each of these problem areas were identified. As a last step, a list of six "town-wide" alternatives for managing wastewater disposal in problem areas was developed. Town-wide alternatives considered included:

- Alternatives 1 and 2 - Route all of the wastewater from the town's problem areas (estimated at 1.1 mgd) to a regional WWTF located in the neighboring town of Medway (Charles River Pollution Control District (CRPCD) WWTF. Alternatives 1 and 2 differed only in the location of the point of connection.
- Alternative 3 and 4 - Send 20% of the towns wastewater to CRPCD and treat the remaining 80% using in-town WWTF's (two WWTF's served by four treated effluent groundwater

infiltration disposal areas). Alternatives 3 and 4 differed only in the location of the point of connection

- Alternative 5 - Send 10% of the town's wastewater to the CRPDC WWTF. Where site conditions are appropriate treat and dispose of wastewater using on-site innovative/alternative SSDS's. Any remaining wastewater would be treated and disposed using in in-town WWTF's and associated groundwater disposal areas.
- Alternative 6 - Collect and treat 100% of the wastewater from problem areas at in-town facilities (two WWTF's served by four treated effluent groundwater infiltration disposal areas).

In the end, the town selected Alternative 6. Although not the least cost solution, it provided the town with complete control of wastewater treatment and disposal systems, provided for local recharge of aquifers, and addressed EPA and DEP concerns related to increasing surface water discharges to the Charles River at the CRPCD WWTF. Although the case study of Holliston is not 100% applicable to the four towns of interest of this study, parallels can be drawn.

4.3.2 Identification of Areas with Wastewater Disposal Need

The need to identify the areas with greatest need for improved wastewater disposal varies from town to town. In Ayer, a significantly developed community with 90% of its population served by town sewers, any "needs analysis" will have to focus more on expansion of municipal service and less on the suitability of existing and future developed parcels for SSDS's. In Harvard, which is served 100% by SSDS's, the "needs analysis" will likely focus more on land suitability for SSDS's and less on development of municipal wastewater treatment. In the partially sewered communities of Lancaster and Shirley, sewer expansion and SSDS suitability will likely receive equal attention.

For the assessment presented in this report, evaluation of the suitability of land for SSDS's was limited to identification of protected resource area with limitations on use of SSDS's (e.g., wetland areas, wellhead protections Zone 1's and Zone 2's, etc.) and a review of county soil survey maps for areas deemed "unsuitable" for SSDS's. This effectiveness of such a screening level review is limited by the general non-site specific nature of the data. Although county soil surveys indicate that a major portion of the land in the four towns is "severely limited" for use of soil adsorption systems, we know that such systems have been and are being used in these communities, with some degree of success. We also know that rates of system failure, both physical failure and Title 5 compliance failure, are rising at a significant rate. A definitive identification of areas with soil and groundwater conditions that would significantly hinder use of traditional SSDS's would necessarily involve review of Board of Health Title 5 inspection records, as recorded during the transfer of properties and/or during the development of new SSDS's. Such a review would provide a parcelized database that would identify developed areas with the most adverse conditions for traditional SSDS systems and will provide supporting data for assessment of the suitability of the various innovative/alternative SSDS's at these locations. This

Board of Health data may have to be supplemented by a program of soil borings and percolation testing in undeveloped areas and/or in developed areas in which few real estate transactions have taken place.

As an example, in the Town of Holliston wastewater disposal evaluation, the town was divided into 28 subareas. A "rating criteria matrix" was developed which assigned points to each areas based on actual failures, imminent failures (e.g., located within a Zone 1), high likelihood of imminent failure (e.g., built before 1978, small (< 1/2 acre) lot size, groundwater limitations, soil limitations, pumped out more than twice each year), and health and water quality issues (e.g., development density . 2 systems per acre, system within 100 feet of surface water or wetland, system within a Zone 2). Actual failures were assigned 4 points, imminent failures were assigned 3 points, systems with high likelihood of imminent failure were assigned 2 points, and systems with health and water quality issues were assigned 1 point. Results of this parcel-by-parcel analysis were compared with a more regionally based evaluation of soils, groundwater levels, system ages, and lot sizes and the relative "need" of each area of the 28 areas was determined.

4.3.3 Individual On-site Subsurface Sewage Disposal System Alternatives

As discussed briefly in Section 2.3.4, there are numerous alternative subsurface sewage disposal systems. The traditional system consists of a septic tank (settling of solids and removal of floating oil and scum), a distribution box (distribution of flow to various areas in the soil absorption system), and a soil absorption system or leaching field (discharge of partially clarified effluent to groundwater). Traditional subsurface sewage disposal systems are the most cost-effective means of disposing sanitary wastewater. With age, the soil absorption capacity of leaching fields can become diminished, resulting in system failure. The stringent requirements of Massachusetts Title 5 subsurface sewage disposal regulations, which are enforced as part of property transfer process, have also led to the "regulatory failure" of a large number of SSDS's. Specifically, Title 5 requirements related to minimum depth of soil absorption systems to high groundwater, minimum depth to bedrock, minimum and maximum soil percolation rates, and proximity of soil absorption systems to wetlands, surface waters, and water supply contribution areas have made construction of traditional SSDS's impossible (without obtaining a variance) on a large number of residential properties.

In response to this problem, numerous alternative/innovative systems have been developed to provide the necessary level of treatment prior to groundwater discharge. A least cost alternative has been the use of mounded soil absorption systems. By constructing the bottom the leaching field at a higher elevation (often above existing grade), minimum separation distances between the bottom of the leaching field and high groundwater elevation and/or bedrock elevation can be achieved. Installation of such systems create a large mounded area on a previously flat property, adversely affecting the aesthetic value of the property. For this reason, many communities are hesitant to approve widespread use of mounded systems.

The Commonwealth of Massachusetts has developed a list of "innovative and alternative" (I/A) subsurface sewage disposal technologies approved for use in Massachusetts. I/A systems are defined as systems that "provide additions or alternatives to one or more of the components of a conventional system while providing at least an equivalent degree of environmental and public health protection". The most recent list (November, 1999) of I/A systems certified for general use include:

- Recirculating Sand Filter - effluent from the septic tank is circulated through a sand filter with a majority of the filtered effluent returned (recirculated) to the septic tank and a small portion of filtered effluent released to the leaching field.
- RUCK Filter System - system requires two septic tanks, one for black water (sanitary effluent) one for grey water (discharges from showers, sinks, washer machines, etc.). Effluent from black water septic system is passed through a "RUCK" layered sand and crushed stone filter prior to discharge to the leaching field.
- Intermittent Sand Filter (Saneco) - effluent from the septic tank is intermittently applied to a sand filter with a gravel underdrain. Filtered effluent is discharged to the leaching field.
- Trickling Filter Treatment Systems (AWT Bioclere) - effluent from the septic tank flows through a trickling filter (biological treatment) prior to discharge to the leaching field
- Fixed Activated Sludge Treatment (FAST) Systems (Bio-Microbics, Smith & Loveless) - traditional septic tank is replaced with two chamber FAST treatment tank; settling takes place in the first chamber and aerated activated sludge biological treatment takes place in the second chamber. Treated effluent discharged to the leaching field.
- Sequencing Batch Reactor (SBR) Systems (Cromaglass, Norweco) - traditional septic tank is replaced by a three-chamber (typically fiberglass) sequencing batch reactor; primary settling takes place in the chamber, aeration and mixing takes place in the second chamber, and final settling/clarification takes place in the third chamber. Treated effluent is discharged to the leaching field.
- Alternative Soil Absorption System - (Cultec, Hancor, Infiltrator, PSA) - traditional leaching field is replaced by an open-bottom polyethylene leaching chamber. Systems provides for increased infiltration rates allowing for a reduction in the area required for a leaching field.
- Alternative Soil Absorption System - (Eljen) - stone layer of a traditional leaching field is replaced by a multi-layer biomat consisting of a plastic core encased by upper and lower layers of geotextile fabric. Systems provides for increased biological treatment in the leaching field and increased infiltration rates.

Areas with conditions unsuitable for traditional septic systems would be evaluated for the potential suitability of these various I/A systems. Factors such as soil conditions, depth to groundwater, and depth to bedrock would be considered when evaluating the potential suitability of such systems. Use of I/A systems could play a significant role in the development of the 100% non-sewered town of Harvard and in development of non-sewered sections of Ayer, Lancaster, and Shirley.

4.3.4 Communal Wastewater Treatment System Alternatives

If a given area of town is found to be unsuitable for individual on-site traditional and/or I/A systems, an evaluation should be performed to determine if a communal, multi-user wastewater treatment and disposal system would be viable. Communal systems could serve two or three houses, larger multi-unit cluster developments, and/or non-residential commercial and institutional districts.

One communal system that could be considered would be a large subsurface sewage disposal system. This system would receive flows from multiple users and would incorporate components of a traditional SSDS's (septic tank, leaching field), possibly supplemented by I/A technologies. If I/A technologies are required, a multi-user communal SSDS would have the advantage of distributing the increase capital costs and operation and maintenance costs of such over a larger group of users. Implementation of a communal SSDS would depend on the availability of a land parcel with the appropriate area and soil/groundwater characteristics for such a system.

An alternative to a large communal SSDS would be the construction of a small above ground wastewater treatment facility (WWTF), often referred to a package wastewater treatment plant. Such a facility could treat the wastewater from multiple users and the treated effluent could be discharge to the ground (via infiltration beds) or to a surface water. Such a system could relieve the users from the stringent requirements of Title 5 regulations. A groundwater discharge permit or surface water discharge permit would be required. The cost of construction and operation of a WWTF would likely be greater than that of a communal SSDS, indicating that a greater number of users would likely be required to provide for a cost effective use of such a communal system. The ideal communal WWTF would have treatment systems and groundwater disposal infiltration beds on the same site. If such an ideal situation does not exist (as was the case in the Holliston study), treated effluent could be routed to a separate site with suitable soil absorption properties.

The need to implement communal systems in partially sewered communities such as Ayer, Shirley, and Lancaster would be expected to be low, due to the potential to connect to municipal sewers. Communal systems could, however, play a significant role in the development of Harvard, especially if there continues to be no plans for construction of municipal sewer systems.

4.3.5 Local (Municipal) and Regional Wastewater Treatment Alternatives

If the percentage of town subareas with identified significant wastewater treatment/disposal problems is high, a comparative evaluation of implementation of local (in-town) wastewater treatment systems and of use of regional (out-of-town) wastewater treatment facilities would be required. Before construction of a large in-town WWTF can be considered, an appropriate site for the construction of such a facility and for disposal of treated effluent must be identified. In the town of Holliston evaluation, the proposed two WWTF sites were separate from the proposed four treated effluent groundwater infiltration disposal sites. If appropriate site(s) are not available or if flows are not sufficient to make construction of a WWTF cost effective, routing of town flows to a regional WWTF should be considered.

Ayer is the only one of the four communities of interest with an in-town WWTF. The "local" treatment evaluation for Ayer will likely focus on the decision to either expand the existing facility to accept anticipated higher flows or to divert a portion or all of facility flows to a regional (Devens) WWTF. The decision criteria to be used in this on-going process will involve balancing the additional capital and operation and maintenance cost of an expanded Ayer WWTF against the capital costs and user fees associated with connecting to the Devens WWTF. Of course, Devens' willingness to accept flows from Ayer will also play a determining role.

Harvard's residential wastewater flows, both existing and year, are relatively low. Absent the type significant residential development indicated by the buildout analysis and/or significant non-residential development, implementation of a centralized town of Harvard WWTF is unlikely. Communal alternatives and implementation of innovative/alternative SSDS systems are more likely solutions to wastewater disposal problems. If the magnitude of non-residential development indicated in the buildout analysis were to occur, routing of such discharges to an existing regional facility (such as the Devens WWTF) would likely be given strong consideration.

Lancaster, although partially sewered, is expected to incur residential and non-residential growth by 2010 that will result in wastewater discharge quantities that exceed the current allocation for discharge to the MWRA Clinton WWTF. If, as expected, obtaining permission to increase the allocation is problematic, the town may need to alternate disposal options which could include a combination of innovative/alternative SSDS's, communal systems, construction of an in-town WWTF and/or routing of a portion of flow to an alternate regional WWTF (e.g. Devens).

Shirley has evaluated in-town wastewater treatment and disposal and determined that best alternative is to route flows from its sewered areas to the Devens WWTF. Since the town is currently routing flows to this regional WWTF, there is a strong possibility that future increased flows could also be routed to Devens. If this is the case, the community may not need to consider construction of an in-town WWTF to accommodate future growth. Whereas some portion of the future development will take place in non-sewered areas, alternatives such as innovative/alternative SSDS's and communal treatment systems may merit consideration.

4.3.6 Wastewater Program Funding Alternatives

Although limited, Massachusetts Department of Environmental Protection in conjunction with the United States Environmental Protection Agency, manages several grant and loan programs which can provide a portion of the funding required for municipal wastewater treatment and disposal option evaluation studies and subsequent design and construction. A list of potential funding programs includes:

- Section 604(b) Water Quality Management Program - provides grants for water quality assessment and management planning evaluations such as evaluations of the environmental resource protection related effectiveness of stormwater best management practices, local control measures (bylaws, regulations), and educational programs. Also can be used for studies of local water quality assessments, water supply protection and development planning and wetlands assessments.
- Section 319 Nonpoint Source Program - provides grants for implementation projects that address "the prevention, control, and abatement of nonpoint source pollution".
- Clean Water State Revolving Loan Fund (SRF) Program - provides low-cost subsidized loans to municipalities and water districts for planning, design, and construction of projects, including new wastewater treatment facilities and upgrades of existing facilities, infiltration/inflow correction, wastewater collection systems, control of combined sewer overflows, and nonpoint source pollution abatement projects such as landfill capping, community programs for upgrading septic systems (Title 5), and stormwater remediation. Non-structural projects (e.g., planning evaluations) are also eligible.

4.4 Population, Housing and Open Space

Local Cities and Towns are constantly attempting to grapple with growth and ways they can control it. Growth is inevitable and is primarily dealt with through local zoning bylaws and overlay districts designed to protect water supply recharge areas and significant environmental resources. Growth patterns are subject to a number of variables such as population (in/out migration), employment opportunities, land values, schools, infrastructure and quality of life issues to name a few.

The study area population is expected to increase by approximately 13% on average by the year 2010. The populations of Ayer and Shirley have been growing steadily since 1990 and are expected to continue over the next ten years. Ayer is projected to increase its total population by 20% between 2000–2010. The Town of Harvard, which grew by 18% between the years of 1990 and 1998, is projected to have 13% rise in population from 2000 to 2010. Much of this new population growth can be attributed to employment growth in the region, including business opportunities along the Route 495/128 beltways and Devens, land availability, new housing developments and quality of life issues.

The Towns of Lancaster and Shirley lost population between 1990 and 1998 due in large part to the closure of Devens and the loss of jobs in the region as a result. Shirley's population deceased by 5% and Lancaster's decreased by 2%. The transformation of Devens into a regional business park has sparked growth in the neighboring Towns with both Shirley and Lancaster expected to grow considerably in population. Shirley is projected to increase by 17% and Lancaster by 8% over the next decade.

4.4.1 Existing Growth Controls

In order to evaluate appropriate growth controls for area communities, it is necessary to inventory current bylaws that have been enacted within each town. The following table will highlight mechanisms that have been adopted by the area communities for growth management purposes.

Table 4.4-1 Inventory of Land Use Control Bylaws

Bylaws/Plans	Ayer	Harvard	Lancaster	Shirley	Devens
Aquifer Protection Bylaw	X			X	X
Rate of Development Bylaw	X		X		
Open Space/Cluster Development Bylaw		X	X	X	
Floodplain Protection Bylaw				X	
Wetland Protection Bylaw		X		X	X
Water Supply Prot. Overlay District				X	X
Master Plan	1997	1988/update underway	1967	1999	1995
Open Space and Recreation Plan	1998	1995	2000	1995	1995
Earth Removal Bylaw		X	X		
Water Resource District			X		
Historic District bylaw		X			
Scenic Roads bylaw		X			

4.4.2 Growth Management Bylaws

The following are a series of growth management bylaws that could be used to assist town handle the ever-increasing development pressure and allow them to control or regulate the amount or intensity of activity within different areas of the community. Open space, historic areas, water supply recharge areas, critical habitats and scenic view sheds are examples of important environmental resources that can be given enhanced protection through adoption of additional overlay districts and bylaws.

<u>Rate of Development Bylaw</u>

The purpose of this bylaw is to limit the number of building permits issued for residential construction each year so that the impact from this activity does not exceed the Town's ability to accommodate or provide essential public services. In most cases, local communities are ill equipped to handle new development and the town's present infrastructure, such as police and fire protection, schools, roads, water supply and wastewater facilities are taxed and require increases in state and local monies to offset the impacts. While this approach will not change the ultimate build-out population, it does slow the rate of growth to allow for improvement to the delivery of services.

The Town of Ayer is the only community within the study area that has adopted a Development Rate Limitation bylaw. The building Department issues only 32 permits for new dwelling units on an annual basis. No one person or organization can be issued more than six permits/year. Exemptions may be issued for dwelling units that are built under the State of Massachusetts Affordable Housing Program and for low and moderate income housing.

Open Space Residential Development Bylaw

This type of bylaw is also referred to as a cluster or flexible development bylaw. The purpose and intent of this bylaw is to

- encourage preservation of open space ,
- protect agricultural and forest land,
- protect other natural resource areas such as wetlands, water bodies and wildlife habitat,
- protect historic and archeological resources,
- facilitate the construction and maintenance of utilities, streets and public services,
- allow for greater flexibility in design, and,
- to minimize disturbance on the site.

This OSRD bylaw attempts to remove the need to have large parcels of land, provide incentives to developers to cluster, provide for flexible zoning requirements, such as reduced lot size, frontage and setbacks, to require the provision for open space for recreation and or conservation purposes.

Generally, the site should have a minimum of 5 contiguous acres. The lot size can be reduced as much as 50% with a minimum set at 15,000 SF. The OSRD suggests a minimum of 60% of the upland area be set aside as open space to be managed by either the Town (*Conservation Commission),* a non-profit organization or conveyed to a corporation or trust that is set up by the owners of the residential units (*homeowner's association*). If the land is not conveyed to the town, then a permanent restriction is put in place such as a conservation or agricultural preservation restriction in accordance with M.G.L. c. 184 Section 31.

Only the communities of Harvard and Shirley presently have an open space development bylaw that encourages clustering of units on a smaller parcel of land.

Aquifer Protection Bylaw (APOD)

This bylaw is designed to assist communities protect groundwater resources and particularly drinking water supplies from contamination through inappropriate land use. The development of an Aquifer Protection Overlay District (APOD) map is the primary feature that will identify the location of well (wellheads) sites, zones of contribution and aquifer recharge areas. The APOD is generally consistent with the wellhead locations and the Zone II areas that are approved by the Massachusetts Department of Environmental Protection.

The bylaw will address uses that are prohibited since they pose potential groundwater contamination. Uses located or proposed within an APOD will require the issuance of a Special Permit from the Planning Board or other permit granting authority. Examples of uses that generally require a Special permit are:

- subdivisions with 10 or more lots
- construction of to or more units
- any nonresidential use over 40,000 SF in either lot size or gross floor area
- any construction activity that results in 10,000 SF or more of impervious surfaces, and,
- any use that disposes of more than 2,000 gallons per day of wastewater, unless it is connected to a pubic wastewater treatment facility.

This bylaw also addresses nitrogen management and stormwater control that are associated with groundwater protection. Performance standards are noted within the model bylaw for each.

The Towns of Ayer and Shirley and the Devens Commerce Center (which includes portions of Ayer and Harvard) have adopted aquifer protection bylaws within their zoning ordinances.

Wetlands and Wildlife Habitat Bylaw

Massachusetts communities are allowed to adopt more stringent regulations for protecting wetlands and wildlife resource areas that exceed the general requirements of the Massachusetts Wetland Protection Act. The purpose of the local bylaw is to provide communities with a more detailed set of regulations that address inland wetlands, vernal pools, limiting wetland alternation and replication, charging fees for consultants to assist with project reviews and protecting wetland buffers.

The Cape Cod Commission in its regional reviews for development projects within Cape Communities does not permit wetland alterations (no net loss) and does not support attempts at wetland replication. Impacts generally need to be handled through restoration of degraded areas and by supporting environmental improvement projects.

Local Towns can strengthen the requirements for any development activity that is located within the wetland buffer zone, usually 100' from the edge of a wetland resource area. Also the MWPA, under the Rivers Protection Act, limits development within 200 feet of a river, pond and lake located outside of an urban area. Certain performance standards can be adopted for up to 200 feet from a resource area in order to protect the integrity of the wetland system.

4.4.3 Additional Legislative Actions

Community Preservation Act

This program will provide funds for purchasing open space, providing affordable housing and for historic preservation. This law will allow communities to establish a fund for these activities through a surcharge on the local property tax and or with a real estate transfer tax.

Sustainable Development Act

This pending legislation will look at measures to protect the environment by avoiding low density development and sprawl activities. Specifics are yet to be resolved.

Land and Water Conservation Fund

This is a federal program that was used principally for the acquisition of land for national, state and local parks. While it has been inactive for many years, permanent funding is now being considered by Congress for funding open space preservation projects.

4.5 Traffic

There is a long lead time for many of the improvements listed below, and it is likely that some options, especially those with high capital costs, may not be fully constructable by the year 2010. However, it still makes sense to present these here because they need to be considered in the long-range planning process, and could even be under construction by 2010.

4.5.1 Highway Alternatives

4.5.1.1 Route 2 Alternatives

Improve Jackson Road interchange

VHB has developed designs to modify this interchange to eliminate the weave on Route 2 eastbound at this interchange and to increase the distance of the acceleration/deceleration lanes. Improvements in the westbound direction could include lengthening of the acceleration/deceleration lanes as well, although there are no significant weaving problems in this direction.

Safety/capacity improvements at interchanges on Route 2 between Jackson Road and I-190

The existing on- and off-ramps on Route 2 between Jackson Road and I-190 are characterized by very short or non-existent acceleration lanes. Improvements would involve providing adequate acceleration/deceleration lanes to enable vehicles to safely enter and exit Route 2. This would also reduce the disruptions to traffic flow during peak periods which occurs at these interchanges.

Widen Route 2

Eastbound AM peak hour traffic volumes on Route 2 west of Devens, at 1,700 vehicles/lane, are already approaching the capacity of the roadway to handle. Significant additional employment growth at Devens, as well as continued population growth west of Devens by persons working along the I-495 corridor, could push the demand beyond the capacity of the existing roadway to handle. While it is unlikely that these conditions will occur

There are basically two alternatives for providing additional roadway capacity:

- provide an additional travel lane in each direction
- provide a single reversible lane to increase capacity in the peak direction only

With either construction option, the additional capacity could be designated for high-occupancy vehicles (HOVs) or for general purpose traffic. The choice of whether to provide capacity for HOV or general-purpose travel will have some impact the design decisions (e.g. HOV lanes will require access to Devens and possibly other ramps in the corridor).

Add new interchange between 110/111 and Jackson Road

This interchange would be located about halfway between the two existing interchanges, near the proposed Devens R&D Park, and would connect with Patton Road for circulation within Devens. The primary benefit of a new interchange would be to divert traffic (especially trucks) presently accessing the Devens Industrial area via the 110/111 interchange and Carlton Rotary away from that route, although some traffic would also be diverted from the Jackson Road interchange.

4.5.1.2 Alternatives on Other Roadways

Signalize Carlton Rotary

The Carlton Rotary experiences significant backups on several of its approaches, especially from East Main Street which backs up during both peaks and during some offpeak hours. Signalization would reduce the length of these backups, but would require significant reconstruction of the roadways, including elimination of the rotary proper, for queue storage.

Develop connector roadway from 110/111 into Devens which bypasses Carlton Rotary

This option would build a connector roadway providing access from 110/111 north of Route 2 into Devens. The primary benefit of a new connector roadway would be to divert traffic (especially trucks) presently accessing the Devens Industrial area via the 110/111 interchange and Carlton Rotary away from that route. However, there are a number of residences on or near the path of any such connector roadway who would be negatively impacted by the construction of such a connector.

Other intersection improvements

In addition to Carlton Rotary there are a number of intersections at which significant delays have been identified for one or more approach. The most frequently cited examples are the intersections of Main and Park Street in Ayer and the Route 2A/111 intersection in Ayer. These two heavily used intersections are prime candidates for signalization to improve traffic flow.

Other locations which are probably not candidates for short-term signalization may still be improved by measures such as removing visual impediments to line-of-sight for stopped traffic and providing dedicated left-turn lanes on the major roadways. Increasing volumes on major east-west roadways such as Route 2A and Route 117 may warrant improvements even for intersecting roadways which are not experiencing significant traffic growth.

4.5.2 Transit Alternatives

Increase service on MBTA Commuter Rail

Provision of more frequent commuter rail service will attract more riders to commuter rail. Presently, the Fitchburg Line offers 10 trains each way between Fitchburg and Boston, although there are no peak hour services operating in the offpeak direction, limiting the usefulness of commuter rail for commuting into Ayer, Shirley, and Devens. The chief impediment to increasing the number of trains on the MBTA's Fitchburg Line is that there is only a single track for much of the distance west of the South Acton station, which limits the ability of the commuter rail operator to schedule trains close together. It will be quite expensive to add a second track through this area, and the construction would be disruptive to areas which would not directly benefit by this (e.g. West Acton).

Expand parking capacity at commuter rail stations

In addition to train frequencies, an additional factor limiting the usefulness of commuter rail is the availability of parking spaces at individual spaces. If lots consistently fill up with riders of the earliest AM peak period trains potential riders of later peak trains or of offpeak services will choose to drive instead.

Develop park-and-ride lots

Park-and-Ride lots could serve as locations where commuter carpools could come together, or as locations where bus services could stop. These can be developed fairly cheaply where land is available. Locations close to Route 2 would be better suited to express bus intercepts, and would also attract some usage from residents west of the study area, while locations away from Route 2 (e.g. along Route 2A west of 111) would be better candidates for carpool lots.

Develop circulator transit services between Devens and Ayer, Shirley

Development of circulator transit services connecting the major Devens centers with the town centers in Ayer and Shirley (including the commuter rail stations) could help provide a non-auto alternative for local trips.

Expand MART services

MART provides public transit for the MRPC region, but presently provides fixed-route services only between Fitchburg, Gardner, and Leominster, although in the past some service was provided to Fort Devens. Expansion of MART service into the study area, in particular serving Devens and Ayer, may be desirable.

4.5.3 Transportation Demand Management Solutions

The effectiveness of a TDM program is typically measured in terms of reducing the number and/or timing of employee trips made in single occupant vehicles (SOVs). This can be accomplished through a variety of means that either reduce the overall number of trips or change when and by which means of travel the trips take place. A typical TDM program consists of the following four key elements:

- Programs that offer alternatives to driving alone
- Design features for new developments that are intended to influence travel behavior

- Programs to reduce daily and peak-period travel

These programs are typically organized by a Transportation Management Association (TMA). There are several TMAs currently operating in suburban environments and information on these can be found at www.masscommute.com. The services that are typically offered, as well as some guiding principles for planning related to demand management are described below.

Programs that Offer Alternatives to Driving Alone

In addition, to transit, the main alternatives to driving alone are ridesharing, walking, and bicycling. Ridesharing is typically promoted through carpool and vanpool matching program, by offering preferential parking spaces for program participants near employee entrances, and through other promotional programs. Walking and bicycling, while alternatives for those who reside nearby, are nevertheless worthwhile alternatives to incorporate into future roadway plans, (i.e., including sidewalks for pedestrians) as well as site plans for new developments.

Design Features and Other Project Amenities Intended to Influence Travel Behavior

An important principle in managing transportation demand is to promote mixed use developments with pedestrian-friendly streets, transit services, and bicycle facilities, which encourage less automobile use than stand-alone commercial developments. This is accomplished by ensuring that new buildings contain sidewalks designed to facilitate pedestrian travel, and feature adequate clear zones, street trees, lighting, benches and other supporting features.

Walking paths through parking areas should be designed to protect pedestrians from motor vehicles and to guide them to the closest buildings. Pedestrian facilities between development sites and adjacent land uses should also be provided to encourage walking to nearby homes and businesses.

The promote bicycle use both by employees visitors, clearly marked bicycle pathways are needed that connect with area bicycle routes and facilities.

Programs to Reduce Daily and Peak-Period Travel

To supplement the programs aimed at reducing SOV travel, employers typically offer a guaranteed ride home program, telecommuting, programs to match work hours to transit hours, a compressed work week, and flexible work hours for ridesharers.

5.0 ACTION PLAN

5.1 Introduction

The goal of the CCbW program is the development of a first-time-ever regional plan for the four communities to prepare for and manage growth resulting from Devens and other regional demands. It is envisioned that this Nashua River Basin subregional plan will foster economic vitality without sacrificing environmental and cultural resources valued by each community. The key issues and goals of this program are:

- *Water*: Assuring a safe water supply for future generations.
- *Waste Water and Septic Disposal:* Preserving water quality through safe and dependable waste water treatment and septic disposal
- *Population Growth*: Managing population growth without damaging or depleting municipal services and limited natural resources.
- *Housing*: Providing sustainable housing development that provides for all segments of the population without depleting valued natural, municipal and fiscal resources.
- *Open Space*: Preserving open space including the protection of important water resources, wetlands and habitat.
- *Traffic:* Preventing traffic congestion and its negative impact on the communities' character and quality of life.

This regional plan is but a first step in working together cooperatively to manage growth of the Devens area. Understanding the patterns of development that have occurred and the infrastructure that can support the anticipated growth are critical. Patterns in the region are shown in Figure 5.1-1. The environmental resources that are highly sensitive to development must also be recognized and are shown in Figure 5.1-2. Finally, identifying undeveloped lands that are vulnerable to future development based on current zoning is key in developing specific actions that should be taken to attain the goals expressed through the CCbW program (Figure 5.1-3).

A common theme expressed during the course of this program has been to target development to those areas with existing infrastructure while protecting sensitive resources. Overlaying areas vulnerable to development on maps of the existing infrastructure and sensitive resources was the focus of a public workshops held in November 2000 and January 2001. Following are specific actions that were identified through that process. The GIS data generated through this program is provided to the towns and specific recommendations on how to manage this regional database are also provided in this report.

Figure 5.1-1 Infrastructure Base Map

Figure 5.1-2 Resource Base Map

Figure 5.1-3 Overlay Map-Developable Land

It is important to recognize that many of the issues addressed in this study are larger than the four-town Devens subregion: they concern watershed management and growth management of the entire Nashua River basin. As a result, certain actions recommended identify institutions and agencies that are beyond the geographic boundaries of the four-town (JBOS) Devens subregion.

5.2 Water Supply

The general concerns of the residents of the four town region centered primarily around the desire to preserve open space. This concern is directly related to the protection of water supply by the preservation of open space within and nearby to aquifer recharge areas. Zone II delineations provide the first level of protection for a wellhead recharge area. However, total protection is not provided, and the towns may desire additional protection to these sensitive areas. This additional protection could be enacted for all recharge areas surrounding drinking water wells in each of the four towns. Land preservation within an aquifer recharge area, combined with preservation of adjacent tracts, will provide contiguous areas of open space, which is beneficial for water supply, as well as wildlife habitat and recreation. Critical water supply resources are shown in Figure 5.1-2.

5.2.1 Wellhead Protection

Wellhead protection is a means to ensure that subsurface drinking water supplies do not become contaminated from activities occurring within the recharge zone. A Zone II delineation is required by the DEP for wells withdrawing more than100,000 gal/day. The Zone II delineation provides some protection, but additional protection of the recharge area may be desired. Additionally, protection should be sought for smaller water supply wells that do not fall under the Zone II program. The following outline provides steps required to protect existing groundwater resources. In general, protection above and beyond that required by the state under the Drinking Water Regulations must be undertaken at a community level, generally through town meetings or by the board of health.

a. Delineate Zone II aquifer recharge area if it doesn't already exist. Zone II delineations are implemented by the DEP for all wells withdrawing 100,000+ gallons per day.

b. Identify existing potential sources of groundwater contamination within the Zone II (above and underground storage tanks, waste accumulation areas, maintenance areas etc).

c. If significant potential for groundwater contamination is identified, develop a monitoring plan to detect early signs of contamination. This plan should be designed to sample groundwater downgradient of the potential contamination source but upgradient of the drinking water wells. The plan should include the specification of recommended monitoring locations, modeling parameters and sampling frequency and define the means by which data will be assessed and reported. If contaminants leak or are spilled into the groundwater, they will be detected prior to the contamination of the water supply.

d. Develop an Emergency Response Plan to contain contamination and protect groundwater. This plan should include an evaluation of risk to the water supply system and discuss potential response actions.

e. Establish an Aquifer Overlay district for the Zone II areas that exclude potential development/use that may cause groundwater contamination (beyond the uses excluded by the state designation of the Zone II area). Additional regulation at a community level (which in this case includes Devens, as applicable) can be enacted through a combination of zoning bylaws, general bylaws or local ordinances and health regulations. See the DEP document "Making Wellhead Protection Work in Massachusetts" (http://www.state.ma.us/dep/brp/dws/files/whpguide.pdf) and "Developing a Local Wellhead Protection Plan (http://www.state.ma.us/dep/brp/dws/dwspubs.htm#swap (this site also contains zoning and bylaw models)) for a step-by step guide to achieving adequate wellhead protection.

- Areas to be considered:
  - Spectacle Pond, Ayer
  - Grove Pond, Ayer/Harvard/Devens
  - Patterson/McPherson Wells, Shirley
  - Catacunemaug Well, Shirley

5.2.2 Land Preservation To Protect Water Supply

All towns expressed an interest in preserving open space, particularly large or contiguous tracts, for multiple purposes, including the preservation of aquifer recharge areas and the maintenance of the groundwater quality. The local Conservation Commission should take an active part in the acquisition of land within the Zone II delineation. Beyond the methods outlined above, there are other means by which to preserve open space that are not directly related to drinking water supply. Some of these methods are discussed in Section 5.4 on Open Space.

- Areas to be considered:
  - Spectacle Pond
  - Grove Pond
  - Long Pond
  - Bowers Brook (Ayer/Harvard)

5.2.3 Aquifer Recharge, Wastewater Reuse

Water can be artificially recharged into the aquifer to help maintain groundwater table elevations, provide storage and prevent discharge water from leaving the watershed. Recharged water can be either treated wastewater or stormwater runoff, depending on the proximity of the recharge location to existing drinking water supplies.

The feasibility of establishing an artificial recharge basin from both a regulatory and a geologic prospective must be determined. The primary necessity of an artificial recharge project is the identification of an appropriate site. A site must be located with the following attributes:

- The surface area must be highly permeable;
- The site must be hydraulically well connected to the regional aquifer; and
- The location can not be upgradient from any existing water supplies.

If an appropriate site can be identified, regulatory and public support must be sought, as well as adequate funding. Artificial recharge systems are fairly new concepts in the eastern United States, and may be burdened with several constraints that are technical, social, economic and political. However, it is a potentially viable solution to many of the concerns raised within the towns (establishment of open space, maintenance of water supply, reduction of water export out of the watershed) and may be worth consideration.

- Areas to be considered:
  - Each of the four communities and Devens, as applicable

5.3 Wastewater

The projected population growth and commercial development in the four communities will result in a corresponding increase in wastewater generation. Each community will need to evaluate the role that individual on-site subsurface sewage disposal systems, local communal "package" wastewater treatment facilities (e.g., the town of Holliston's approach), larger town-based wastewater treatment facilities (e.g., the Ayer WWTF), and larger regional wastewater treatment facilities (e.g., Devens WWTF and the MWRA's Clinton WWTF) could play in managing the increased wastewater flows.

Recommended Actions

- Perform a thorough wastewater treatment and disposal option evaluation in each community. Seek funding through available state and federal grant and loan programs. Evaluate the potential for the continued use of individual on-site subsurface sewage disposal systems based on evaluation of the geographical soil/groundwater condition constraints in the town. Identify neighborhoods or areas of town with In areas with significant constraints, evaluate the potential for "communal" subsurface sewage disposal solutions such as "package" wastewater treatment facilities and/or alternate locations of wastewater disposal soil absorption systems. The study should include an evaluation of the potential to implement alternative subsurface sewage disposal systems. The role of existing (e.g., Ayer WWTF) and or potential centralized town wastewater treatment facilities should be evaluated along with the potential to route flows to regional wastewater treatment facilities.

- Steer development towards sewered areas of town (sewer districts) where infrastructure exists to effectively manage the increased wastewater volumes (Figure 5.1-1).
- Use growth management tools to limit growth and development outside of the sewer districts (see Section 5.4 for a discussion of these tools).
- Coordinate individual community wastewater disposal evaluations and assess to what degree a regional approach will best benefit all involved.

5.4 Population, Housing and Open Space

With growth in many sectors of the local and regional economies expected to increase over the next ten years (2000-2010), the population within each of the four communities could realize significant growth. This will ultimately put additional pressure on the availability of land or sites for affordable housing and open space preservation opportunities. The local communities need to work collectively on establishing growth management strategies that will address regional housing growth and affordability as well as open space protection and trail linkages that cross town lines. The establishment of similar growth management bylaws should be promoted in each of the communities so that opportunities for undertaking regionally based projects can be streamlined.

The following are a series of actions that can be implemented to address these issues on a local or regional basis.

5.4.1 Housing

General Recommendations

- Concentrate new housing developments in areas that have established infrastructure, such as water and sewer connections, existing road network and other utilities including gas and electric service.
- Encourage affordable housing opportunities within established town centers or central business districts within each of the four communities. The use of upper stories of

commercial buildings for apartments and condominiums would be an appropriate use provided parking is available.

- Promote incentives for the creation of affordable housing opportunities by allowing density bonuses within residential zoning districts that offer sewer and/or water connections.
- Prepare an inventory of all historic structures to determine potential adaptive reuse for affordable housing and new rental units.
- Develop a Regional Housing Plan for the study area that would establish goals and objectives for addressing housing needs, affordability and possible sites for new housing opportunities.

Administrative Actions

- *Prepare Development Rate Limitation* bylaws within the Towns of Harvard and Lancaster that will limit the issuance of building permits for new construction based on each community's ability to accommodate the new development and provide requisite public services including schools, emergency services and other support activities.
- Review and update the *housing element* within each Community Master Plan to determine if the goals and objectives set forth in the plan are being implemented and under whose responsibility. The Town of Lancaster needs to update its Master Plan (last Plan update adopted in 1967) to address housing issues for the ensuing five to ten years.
- *Create a Regional Housing Initiative Committee* for the study area whose purpose will be to prepare and implement a Community Preservation Plan (CPP) under the requirements and regulations set forth by the Massachusetts Community Preservation Act, adopted in September 2000. This legislation provides up to $30,000 per community for the creation of a CPP that would serve as the basis for securing additional grants and loans to develop affordable housing units. It may be appropriate to set up an affordable housing fund in which the four towns could pool their allotments and prepare a regional housing strategy.
- Prepare a *Regional Transfer of Development Rights* bylaw as a method for protecting sensitive resource areas and promoting the use of residential clustering. This bylaw, in essence, allows for the orderly transfer of proposed development rights from one parcel (referred to as the sending or transferring district) to another area (referred to as the receiving district).
- Promote the concept of *Conservation Subdivision Design*, or clustering, within each community for the purposes of preserving community character, protecting agricultural areas, reducing environmental impacts, protecting property rights and encouraging creative design. By reducing lot size, length of roads and the use of community septic systems or tie-in with public sewer, more of the site remain in its natural state.

5.4.2 Open Space

Rampant growth and development (sprawl) within our Cities and Towns and along our major thoroughfares are outpacing opportunities to protect valuable open spaces and linkages for the creation of open space corridors for recreational use and wildlife habitat preservation. Approximately 1/3 of the state's land mass will be developed by the year 2010, according to information provided by the Trustees of Reservations. This scattered development growth is slowly causing impacts to the scenic and ecological integrity of the landscape that needs to be addressed on a local, regional and state level. Regional organizations such as the Nashua River Watershed Association (NRWA), the Montachusett Regional Planning Commission (MRPC), MassDevelopment, the Devens Enterprise Commission and the Joint Boards of Selectmen will need to form a united front if changes in current development patterns are to occur.

The following are a series of action recommendations for addressing the preservation of open space areas within the study area.

General Recommendations

- Open Space and Recreation Plans have been prepared by each of the communities as well as for Devens over the last five years. The JBOS Communities Connected by Water Program should support and promote the goals, objectives and action plans that have been approved in each of the communities. These plans will need to be updated every five years in order for the communities to receive grant and loan funds from the state to purchase land or acquire conservation restrictions for preserving open space, unique natural and historic sites and areas.
- Work closely with the Nashua River Watershed Association and other advocacy groups in the conservation of open spaces for enhancement of water quality, wildlife habitat, farms, forests and recreational uses within the watershed;
- Support the efforts of the Nashua River Watershed Association and its Watershed Team in its effort to accurately map resource areas through the use of MRIP, a geographical information system database, which will ultimately develop a prioritization plan for protection of open space and important natural resources within the watershed.
- Link permanently protected conservation areas together through additional land purchases and conservation restrictions to create open space corridors for walking trail systems and wildlife habitat preservation;
- Direct growth to areas that have infrastructure in place, including water and sewer connections;
- Develop inter-community trail systems for hiking and biking purposes;

- Develop a *Natural Resource River Corridor* that would stretch from the northern tip of Shirley along the Squannacook River and link up with the Nashua River heading south through Lancaster and Harvard to protect the riverfront areas through land acquisition and conservation easements and restrictions;

- Establish criteria for identifying and prioritizing open space parcels for conservation and recreation purposes. Examples of environmental criteria would include medium and high yield aquifers, unique natural areas, wildlife habitats, water resources, scenic vistas, cultural resources and public recreational opportunities.

- Develop a regional open space plan for the four towns and Devens with local communities' goals/strategies developed from the current local plans and specific regional implementation strategies. Joint plans are given priority for state funds under the EOEA Self-Help program. This plan should address trails, wildlife habitat corridors, aquifer protection areas, and other watershed issues. The basis for identifying these systems is provided in Figure 5.1-2.

<u>Administrative Actions</u>

- Utilize the state's "Scenic Road" classification to protect tree and stone wall-lined roads in the four-town region.

- Protect Agricultural lands through the establishment of local Transfer of Development Rights (TDR) bylaw

- Encourage the use of the M.G.L; Chapter 61, which allows for certain lands to be assessed based on its use (agriculture) as opposed to its market value.

- The Towns of Harvard and Lancaster should prepare Aquifer Protection Overlay District bylaws to protect their high and medium yield aquifers recharge areas.

- Purchase additional land parcels near and adjacent to existing and future water supply wells such as the Spectacle Pond Well site in Ayer.

- Establish a regional community preservation fund for the four communities, through the use of funding provided under the Community Preservation Act and the through a surcharge on local property taxes. The fund would be used to purchase land and acquire conservation restrictions for protecting open space for conservation and recreation purposes.

- Develop a Regional Aquifer Protection Overlay District that is designed to incorporate and expand upon current APOD bylaws that are currently adopted within the Towns of Ayer and Shirley. This bylaw would serve as a model that could be adopted at the local level and be administered by the Planning Board or other Special Permit granting authority.

Specific Recommendations

This section addresses more detailed recommendations within certain specific areas of each community.

Ayer

- Protect areas near and around municipal well sites near the Nashua River such as the Horgan Property.
- Acquire Land for public access to local water bodies including; Sandy Pond, Fletcher's Pond Spectacle Pond, Long Pond;
- Improve passive recreation activities near the Nonacoicus Brook and the Nashua River.

Harvard

- Promote the acquisition of land and establish Conservation easements for the following: Town Common area; Bear Hill Pond and other water bodies; agricultural land; linkages for expanding greenways, expansion of the Oxbow Wildlife Refuge area (permanently protected) to include the Watt Farm, and areas near the Bolton Flats area.

Lancaster

- Further protect land parcels along the Nashua River to create a unified trail system along the Nashua River and to link existing conservation areas for enhancing wildlife corridors
- Acquire additional land parcels near the Lancaster Town Forest
- Acquire land near the North Branch of the Nashua River
- Acquire Land to the north of Bolton Flats Wildlife Management area, as necessary.

Shirley

- Establish open space corridors to link natural and historic resources. The master plan, prepared by the Planning Board in June 2000 proposed the following:
  - Establishment of a *Cultural Greenway* which would connect historic properties along a north/south axis from Shaker Village, through Shirley Center and terminating in North Shirley. This corridor would run along Center, Parker and Townsend Roads.

– Promote the development of a *Natural Greenway* which would incorporate lands along the Nashua and Squannacook River systems. They would link together undeveloped lands along the eastern boundary of Shirley to enhance protection for wildlife habitats, ponds, wetland and floodplains.

Devens

- Over 1,000 acres have been set aside for open space and recreation. Open Space was characterized based on the DEM Land Stewardship Classification System including: Conservation (515 acres); Linkage areas (255 acres); Intensive uses (136 acres); Preservation areas (95 acres). Appropriate protection of the areas is recommended.
- Conservation restrictions were established for the following areas: Mirror Lake and Little Mirror Lake; ASP Bog and Wetland B; Cold Spring Brook and Wetland C.
- Create a buffer along Cold Spring Brook to the east of Barnum Road.

5.5 Transportation Action Plan

There were several consensus action items for transportation identified during the project workshops. Workshop participants were generally supportive of improvements to transit, in particular by providing more parking at the commuter rail stations. Participants also realized that many traffic issues could not be addressed solely within the four communities and would require a more regional approach (e.g. involving Littleton in addressing Route 2A traffic issues).

No consensus was apparent on one major area of concern: reducing truck volumes on Ayer Road and in general getting Devens traffic off of local roadways. This lack of consensus reflects in part uncertainty as to how much of the truck traffic along Ayer Road is Devens traffic and how much is oriented towards other locations in Ayer or Littleton. It also reflects sharp differences of opinion both over whether a southeastern access road to Devens is needed and over where to locate such an access if it is built. The Devens 5-year plan update in 2001 offers an opportunity to develop data sources to support future actions to address truck traffic on Ayer Road (e.g., data on the origins and destinations of truck traffic on Ayer Road and Route 2A and on the trucking requirements and routing decisions of local businesses should provide a basis for projecting the potential truck diversions due to transportation improvements as well as the potential for additional truck traffic due to new businesses).

The following are a series of action recommendations that can be implemented to address regional transportation issues.

General Recommendations

- Expand parking capacity at commuter rail stations.

- Post signs on Ayer Road alerting drivers, especially trucks, that Old Mill Road is not an access road to Devens.
- Improve Jackson Road interchange to eliminate weave on Route 2 eastbound and provide adequate acceleration/deceleration lanes on both directions of Route 2 .
- Collect data on origins & destinations of truck traffic along Ayer Road.
- Address traffic issues related to activity at Devens more fully during the Devens 5-year plan update in 2001.
- Add signage at Verbeck and Barnum Gates reminding truck drivers that Jackson Gate must be used for all but local trips.

Administrative Actions

- Establish a Transportation Management Association (TMA) to help organize and promote alternatives to driving alone, design features for new developments which encourage less automobile use, and programs to reduce overall travel. Devens currently uses a system called Caravans for Commuters in which the current industries have a contract with that vendor. This free carpooling service provides caravans to the groups of participating employees. Incentives include a guaranteed ride home (even in cases of emergencies during the day), reserved parking spaces, and the driver also keeps the caravan over the weekend. Although it is presently a private service among the operating companies at Devens, perhaps this service could be extended to the neighboring communities (Source, B. DaSilva, MADEP, Jan. 2001).
- Get adjacent communities involved in regional planning process addressing concerns along roadways (e.g. Littleton for route 2A, Leominster & Bolton for route 117).

5.6 Regional Solutions

5.6.1 Accommodating Growth at Devens

The CCbW planning efforts have produced a number of useful meetings and products, chief among these is the opportunity to view growth related impacts on the Devens region in a regional context. The major findings of this study are that growth within the region should be directed to areas which have the appropriate infrastructure and resource protection measures in place to support it. While keeping in mind that the original purpose and scope of this program was to look at growth in the Devens towns (including that generated by Devens itself), Devens may also be considered as a solution to the growth-related issues noted in the report.

At the final workshop, held in January 2001, Devens was identified as an appropriate "receiving" area for development, as discussed below. The following is an elaboration of ideas provided by Peter Lowitt, the DEC Administrator, who recommended these actions (with consensus of those in attendance at the workshop).

- Mass Development has suggested increasing the number of housing units allowed at Devens by 1000 and the commercial and industrial development by 2 million square feet.. To do this the Devens By-Laws will need to be amended by town meeting in the three communities and Chapter 498 amended.
- Ayer, Harvard, Lancaster and Shirley identified open space preservation priorities as part of the Communities Connected by Water planning program. (The Community Preservation Act requires preservation priorities be put in place by communities voting to implement this legislation).
- A Transfer of Development Rights Program could be created whereby the four communities' priority preservation areas could be designated sending zones (amendments to each communities zoning by-laws will be needed) and Devens would be the receiving zone. (i.e. the communities would preserve their open space and Devens would receive the development). Property owners get value for the development rights of their property, land is preserved in the communities and housing is sent to Devens where our infrastructure and resource protection measures can accommodate it.
- A fund would have to be set aside by MassDevelopment for the purchase of these development rights. Perhaps a yield plan could be developed for the preservation priority properties which would determine how many dwelling units could reasonably be developed under existing zoning and this would become the maximum unit cap. Then MassDevelopment could develop the property in its entirety (the whole 1000 units and use a portion of the proceeds from the land sale to fund the purchase of development rights program.)
- MassDevelopment should specify that the 1000 units be developed as a new urbanist community in harmony with the existing urban design fabric of Devens.
- Land costs should be subsidized with the developer being required to build a school which solves the regional schooling needs of Devens in close consultation with the host communities. (For example, if Harvard wanted a high school to be located at Devens, the Harvard School Committee could work closely with Devens and arrange for its current high school to convert to another elementary or middle school when the Harvard/Devens facility came on line with people going to school in the communities in which they are located.
- Housing affordability commitments of 25% can be continued and the host communities protected from unplanned comprehensive permits through amendment to Chapter 498.

- 10% + of the housing built could be reserved for offer to new and existing firms at Devens to create a jobs-housing balance and reduce environmental impacts of commuting to work while providing a marketing incentive for MassDevelopment.
- DEC would work with the new urbanist developer and MassDevelopment to craft an innovative development district (as called for in the by-laws) to assist in the implementation of these initiatives.
- The DEC would develop a rebate program which would rebate a portion of a firm's development fees if they qualified as silver under the US Green Building Council¹s LEED (Leading Energy Efficiency and Design) certification program. Facilities choosing not to seek certification would pay a surcharge making the program revenue neutral. Current facilities built in compliance with DEC Regulations would receive scores in the low 20s under the LEED certification program (26 points are required for bronze certification).
- The workshop participants suggested that perhaps of portion of the fees generated by the new development (C & I - perhaps the housing would be offset with a school solution?) be directed to host communities.
- Traffic issues could be systematically addressed through community support of and participation in a Devens Transportation Management Association which MassDevelopment, the DEC, and the Chamber of Commerce are currently working to deliver.

5.6.2 Other Actions Requiring Regional Solutions

The following needs/actions/recommendations were also identified in the final workshop as of regional concern.

5.6.2.1 General

- Need to develop and promote regional mechanisms for carrying forward decisions, including the JBOS, the NRWA, MRPC, and others
- Need to incorporate Devens in Action Plan implementation
- Maintain JBOS and regularly-scheduled meetings
- Re-establish transportation committee which was discontinued after Reuse Plan finalized
- Need to educate people on participation – need group to take lead on this (maybe NRWA or MRPC)

5.6.2.2 Specific

The following specific actions/recommendations were identified at the final workshop, by topic, as requiring regional solutions.

Water

- Need to ensure a safe water supply.
- Towns should not deal with water issues in isolation.
- This is a regional issue – bigger than the 4 towns.
- Suggestion that NRWA be the mechanism for creating / promoting this regional approach. (NRWA representative unable to respond as to whether they could do this – noted this would constitute a change of role for NRWA which their board would need to consider)
- Water needs to be addressed on a watershed basis (larger than 4-towns, it includes all towns in Nashua River Watershed).
- EOEA Watershed Team Leader noted it has nearly completed an I/O analysis of the region. Devens towns view aquifer as an unlimited supply. An important action would be for more indepth analysis of I/O, including Devens for the 4-towns subbasin.
- Nashua River is net exporter of water in most of its sub-basins. The river basin provides water for 2/3 of the state. There's been a 15% decrease in net flows in Nashua in the last 20 years.
- Question raised as to how sensitive aquifer levels are to rainfall variations.
- Land use/zoning decisions affect water balance. Sewer use results in increased consumption.
- Devens should promote use of gray water for irrigation purposes.
- Set up a regional district to protect water supplies (covering Nashua River watershed -- larger than 4-towns area)
- Maybe establish a joint board of water commissioners but must have authority to act/supercede local jurisdiction. Would take an act of legislature. There is a statewide "water conservation and management law" pending on Beacon Hill.
- JBOS provides a mechanism for watershed/water resource protection.
- Suggestion made to set up a Nashua River Watershed District with regulating authority – consensus was that region not ready to take this step. Nashoba Associated Boards of Health is a good model to use and is a good resource to consult.

- Noted that Executive Order 418 process can be used to support development of a water budget and land protection for water supply, through the environmental assessment component
- Towns and region should consider location of environmental risky businesses away from town water supplies -- each town could do this independently.

Wastewater / Septic

- DEP is looking at wasteload allocation and DEM is scrutinizing Water Management Act permits now.
- There is a need to set up a wastewater advisory committee of 4-towns and Devens to plan jointly.
- Sewering is currently addressed in isolation by each town, but should be addressed regionally, especially in the context of sewer districts vs. septic systems

Housing / Development

Question were raised about use of the Devens infrastructure to accommodate region's growth. Key points of discussion follow.

- MassDevelopment talking about increasing current 282 unit level by about 1,000 units
- Suggestion made by DEC staff that if towns identify land for open space through Community Preservation Act then MassDevelopment could develop equivalent housing capacity out of 1,000 units. Preservation areas are sending zones and Devens becomes receiving zones for housing, other types of development. Essentially, Devens and towns could implement a Transfer of Development Rights program to accommodate region's growth within this area using its existing infrastructure.
- Following this suggestion, questions were raised as to how this would work with regard to affordable housing goals, Devens Reuse Plan, etc. Towns could get credit for affordable housing goals. Noted that these questions not answered yet.
- Larger issue noted that whether Devens will become a 5^{th} town in region or whether the portions of Devens which are part of the individual towns will have control / revenue / etc. returned to them has yet to be resolved
- Devens 5-year review committee will look at this issue more closely. The future of Devens needs to be clarified (independent jurisdiction or reabsorbed in existing towns).

- Economic and social impacts of growth not addressed through CCbW program. Also, need a realistic assessment of commercial development the region could support. How and where allocated? Move commercial development to Devens???
- Use local Community Preservation Committees in the ongoing Devens reuse review. The 5-year review committees could take lead in looking at Devens/towns collaborations.

<u>Open Space</u>

- Ask state agencies for more money (or higher priority on existing money) for acquiring lands for open space. Nashua River corridor/basin should be made a priority acquisition area for state funding.
- Use the Community Preservation Act to create linkage once act is adopted by towns. Use the act's authorities with NRWA to take lead on regional open space planning.

<u>Transportation</u>

- Mentioned that Community Preservation Act might be used for transportation benefits (not clear how). Use EO 418 funding to address at regional level.
- Re-establish transportation committee whish was discontinued after Reuse Plan finalized.
- Desire for more/better commuter rail service. Consolidate rail stations?
- Consider potential for satellite parking lots with shuttles to existing stations.
- Add outbound peak service to allow reverse commuters to use commuter rail

5.7 Database/GIS Recommendations

The GIS database and maps on the CDROM included with this report were created using Environmental Systems Research Institute (ESRI) ArcView and ArcInfo GIS. The basic data layers include town boundaries, roads, railways, landuse, open space, wetlands, waterbodies, aquifers, DEP wellheads & protection zones, NHESP estimated and priority habitats, wildlife habitats identified by Mass Audubon, and the developed and developable lands created from the MRPC build-out analysis. The data layer descriptions (metadata) provide detailed information about the source of the data and are also included on the CDROM. Following are recommendations for using this data in furthering the goals of the CCbW program.

- In order to use and maintain the GIS database on the CDROM, it is recommended that the user have an industry-standard PC (Windows 95 or better) and GIS software. The ESRI family of GIS software is generally considered to be the industry standard, although other GIS programs are available to read and manipulate the data. The costs (in money, time, and personnel) and configuration of a GIS will vary directly with the level of capability desired. The capability of a GIS can be broken down into three levels: a free GIS, a desktop GIS, and a dedicated GIS service operation. The database produced for this project can be used by any of the three configurations, each having different capabilities.

- A simple GIS can be free, if a typical PC with a Windows operating system is available. ArcExplorer is a free GIS software available for download at www.esri.com. The software comes with a tutorial and takes a good part of a day to learn. Explorer allows one to view multiple map layers (ESRI only: shapefiles, Arc/Info coverages, Spatial Database Engine layers), display pictures, locate street addresses, measure distances, identify and query geographic attribute data, create and print letter-sized maps (with very limited graphic flexibility), and interactively view data on the web (without having to download it). With ArcExplorer, you cannot develop new data, edit existing data, or perform complex analyses.

- A basic desktop GIS system, using ArcView, costs around ~$3000 for the computer, a small color printer, and the software. It takes longer to learn (about a week just to get started) but has much greater functionality than a free GIS. In addition to the capabilities of ArcExplorer, ArcView allows one to create and edit spatial and tabular data, make larger and better quality maps (i.e., add pictures, tables, charts, different fonts, graphics, etc.), and perform more complex spatial analyses. The Avenue programming language within ArcView allows one to customize the graphical user interface and create custom buttons, menus, applications, and macros. With ArcView, you can also use packaged ArcView applications, such as EPA's "BASINS" (www.epa.gov/ost/basins) which integrates GIS in performing watershed – and water-quality based studies. In addition to knowing how to use the software, you will need to understand some cartographic concepts, particularly scale and projection. Some people have trouble with ArcView because of data layers with different projections, or because the zoom is off (i.e., zoomed in to ground level or zoomed out to Mars). ESRI offers online GIS courses (www.esri.com) and GIS classes are offered at many colleges and universities.

- A production level GIS system, using Arc/Info, will cost around $30,000 for a few computers, printers (including a large-format plotter), GPS, peripherals, and software. At this level, at least one full time GIS specialist is employed and start up time can range from a few weeks to a few months. This type of system is used for generating large amounts of spatial data, performing high-level vector and cell-based (raster) modeling, routing analyses, and advanced cartographic mapping.

- Though the simple, ArcExplorer GIS can be used to visualize the contents of this database, the basic desktop GIS (ArcView) and an experienced GIS user is the minimum requirement for the ability to maintain and update the data. Situations will occur when access to a production level GIS is necessary, but these tasks can be out-sourced to consultants or graduate students.

CONTENTS

CONTENTS (Cont'd)

CONTENTS (Cont'd)

LIST OF TABLES

LIST OF TABLES (Cont'd)

LIST OF FIGURES