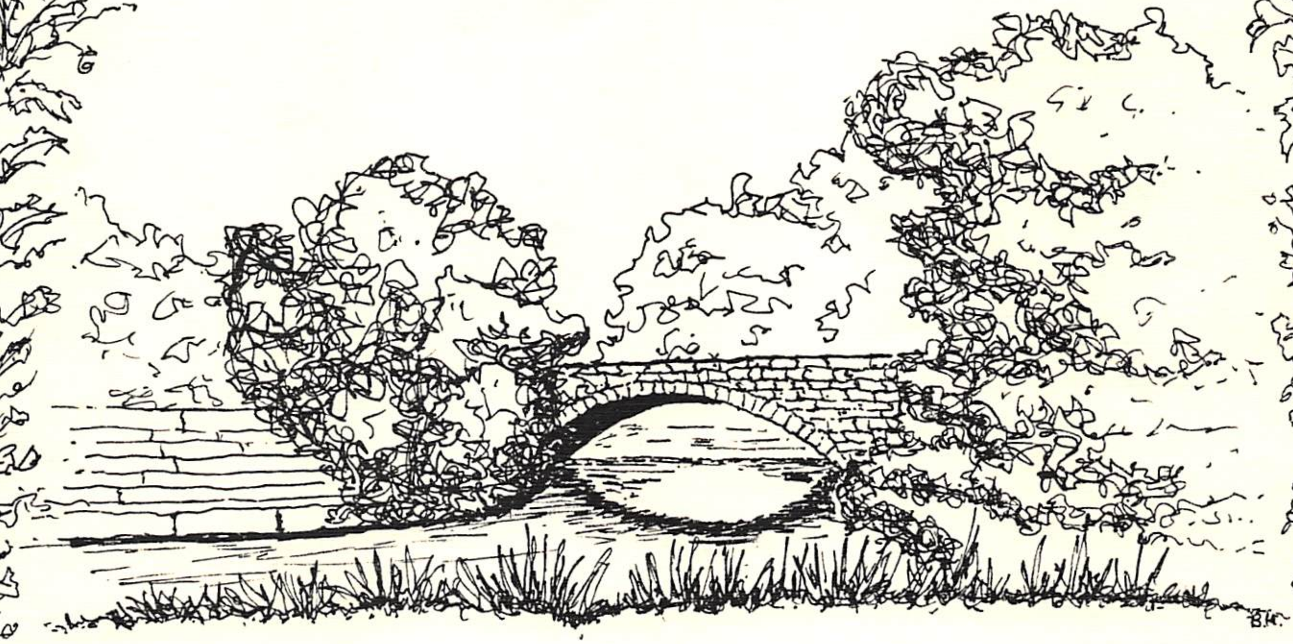
A Bright Future, Rich in History



A master plan update for the town of Uxbridge, Massachusetts.

University of Massachusetts at Amherst, Department of Landscape Architecture and Regional Planning, BSLA, Studio IV, Landscape Planning Studio,
Spring 1992

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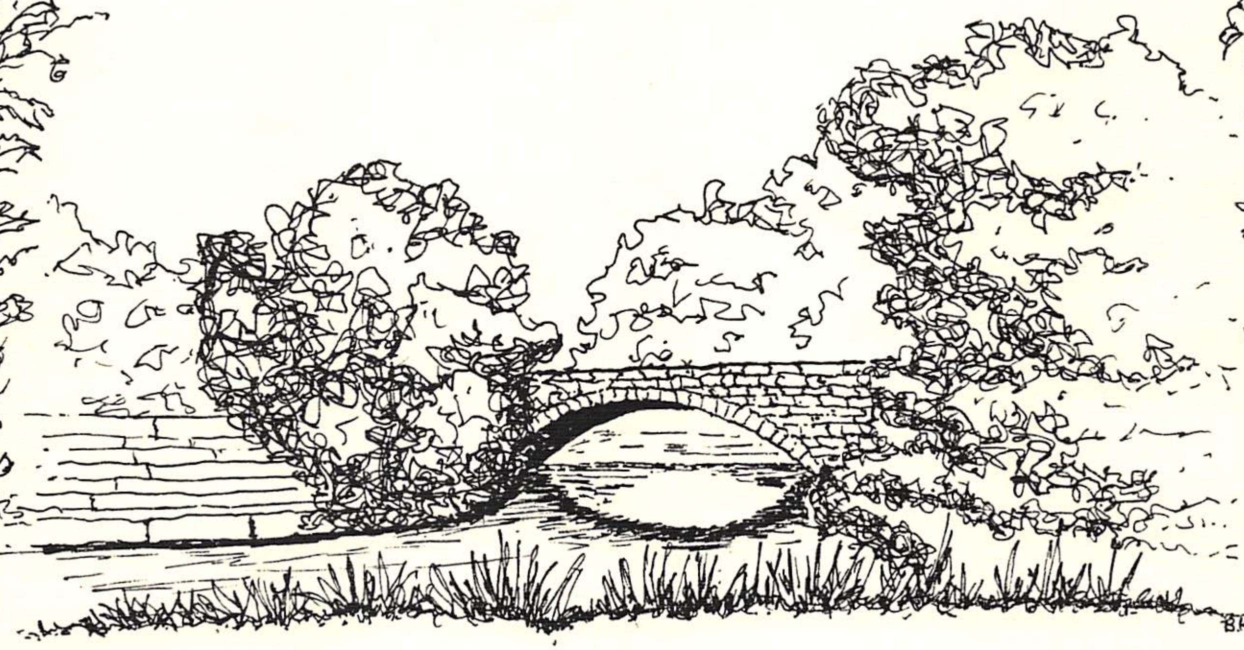

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A Bright Future, Rich in History

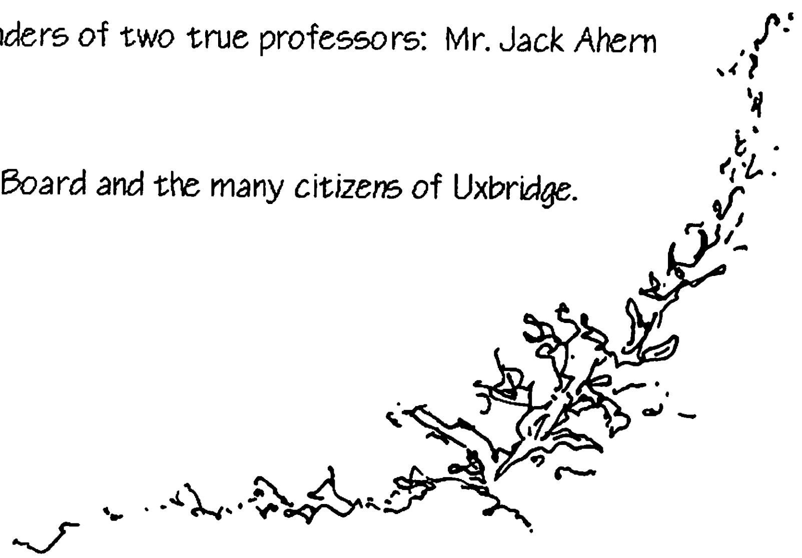
A master plan update for the town of Uxbridge, Massachusetts.

Conducted by the third year Landscape Architecture students at the University of Massachusetts at Amherst.

Directed by the thoughts and wonders of two true professors: Mr. Jack Ahern and Dr. Julius Gy. Fabos.

Brought to reality by the Planning Board and the many citizens of Uxbridge.

Spring of the year 1992.



EXECUTIVE SUMMARY

The opportunity to update the Master Plan for the town of Uxbridge has come at an ideal time due to the following recent developments:

> The Blackstone River Valley National Heritage Corridor Commission, BRVNHCC, has completed several studies within the Blackstone region, which will provide this master planning effort with much valuable information.
>
> The METLAND research team has assembled all available computer data and has developed useful analysis and assessments of the Blackstone region within Massachusetts.
>
> The town of Uxbridge has access to a set of digital data, developed by the private consulting firm, IEP, therefore much of the master planning work can be done on the computer facilities using the GIS software system.
>
> The BRVNHCC is interested in developing a more detailed plan for the Uxbridge portion of the future Blackstone Greenway.
>
> Most importantly, the Planning Board of Uxbridge has shown tremendous interest, energy, and creativity to influence the future of Uxbridge through this planning exercise.

This study developed master plan alternatives challenging the status quo by compositing the assessments from each research group. A compromise between the buildout scenario, where all developable lands were developed, and the ecological bias scenario, where all significant lands were preserved, was prepared. This alternative entails the preservation of the most significant lands and the wise, regulated development of remaining lands.

Findings

The Environmental Scan found Uxbridge to be in a prime location for major development. Two forces, the Blackstone River

Valley National Heritage Corridor Commission and the upgrading of Route 146, will create a large potential for jobs, tourism, and a greenway.

The Greenway group found approximately 30% of the town land to be a significant framework on which to build a greenway connecting the towns north and south of Uxbridge. Much of this framework is already established and preserved, and needs to be strengthened through linkages. This framework is a composite of the ecological, recreational, and historical areas of the town. This group recommends that the significant areas or sites in the town be recognized and linked to the greenway.

The Critical and Special resources group found approximately 40% of the town lands are sand and gravel deposits, however, due to prior development, 20% of these deposits are unusable. This group recommends careful planning, such as delayed development on or near deposits, to avoid rendering deposits useless. Approximately 25% of the town's land is prime farmland, of which 3% is most significant. It is recommended that this extremely small percentage of land and limited resource be preserved for its view and aesthetic potential, and its potential to produce crops. Approximately 20% of the town's lands are aquifers, while the aquifer recharge areas, essentially the same as the sand and gravel deposits, cover approximately 40% of the town. The group found there to be enough usable water to support the existing population and theoretically support a population of approximately 60,000. It is recommended that a buffer be established around these areas to protect from contamination.

The Hazards group found approximately 10% of the town lies within the 1% probability, or 100 year floodplain. It is recommended that the West, Mumford, and Blackstone rivers and their floodplains be used for open space landuse such as agriculture or recreation and not for structures. It is highly possible that approximately 4% of the town could contaminate ground water due to proximity to aquifers. It is recommended that careful planning of areas surrounding aquifers be protected by establishing a buffer around them. In addition, the group found air and noise pollution to not be a major concern of the present, however if significant growth is to occur, setback lines for development from the primary routes could mitigate future problems.

The Visual Amenities group found the Blackstone River area to be a most significant amenity, defined by high promontories, the edge of the valley, and the river itself. This area, in addition to other scenic roads, comprise approximately 1% of the town. Protection of this small amount of land would maintain scenic quality and rural town character.

The Development Suitabilities group mapped the basic ground work for the alternatives and found approximately 60% of the town is suitable for some type of development (roughly 3% is most suitable for industrial development and 15% is most suitable for residential development). These areas exclude the already developed lands and the restricted lands, such as wetlands. Other lands were found to be suitable with conditions. For these lands it is recommended that conditions be placed on them to avoid uninformed development practices.

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Professor MacConnel, for the lecture regarding mapping techniques.

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Steve O'Niel, Department of Public Works, for figures from recent highway surveys.

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Uxbridge Fire Department, for the list of underground storage tanks.

Uxbridge Police Department, for the information on the dangerous roads and intersections.

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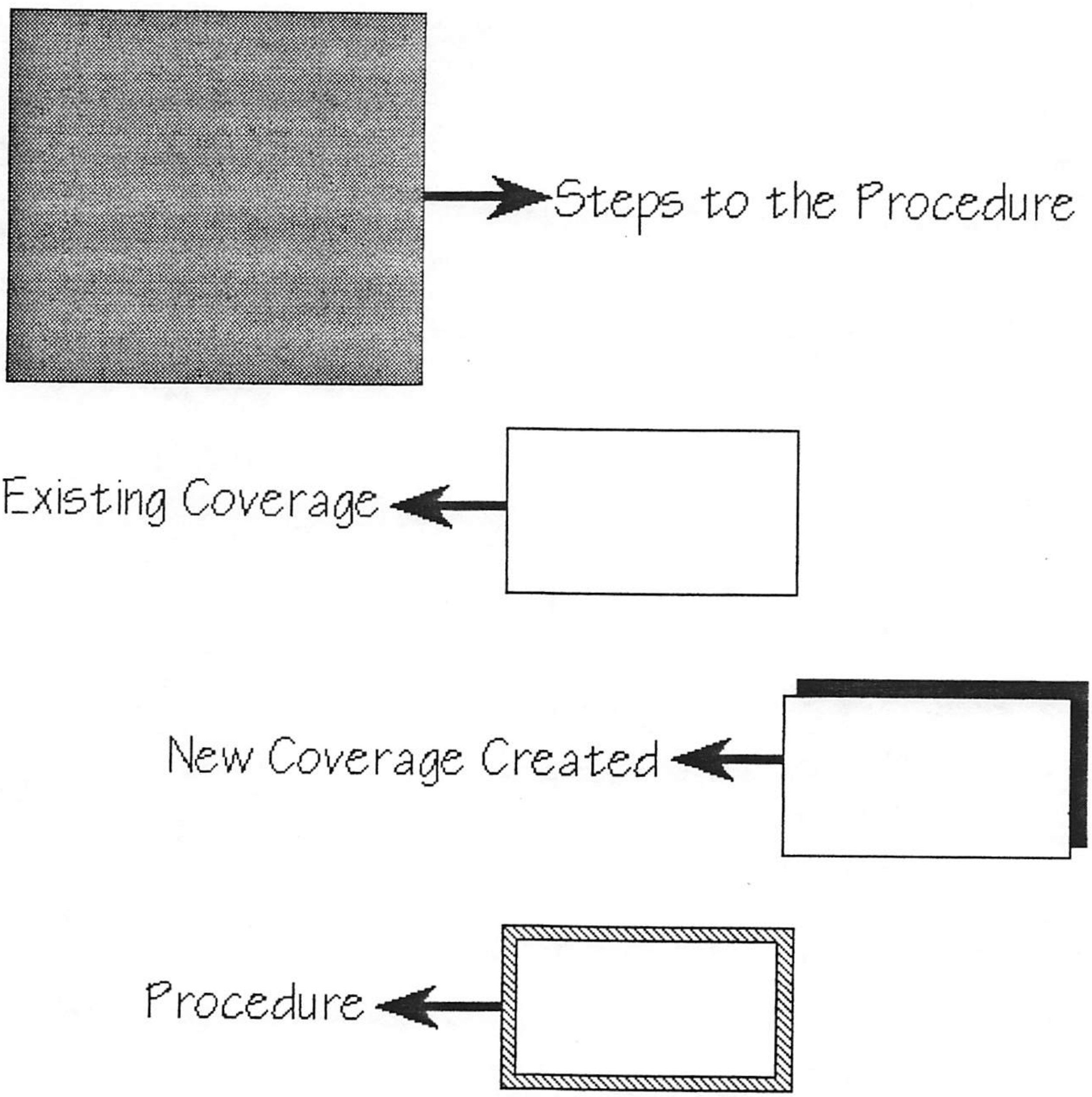
Jo Zeneski, Butch LeBlanc, Advisory Board, for pertinent information concerning development issues in the town.

Shiela, Dale, and Leslie, of the Landscape Architecture and Regional Planning Department, for helping the Coordinating group accomplish what was necessary.

Key to Flow Charts in Report



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INTRODUCTION

Uxbridge is a small town of approximately 10,000 people located south of Worcester. This town of 19,181 acres was settled in 1727, and like many areas in Massachusetts underwent rapid growth due to the establishment of woolen and cotton mills. The Blackstone and Mumford rivers provided the necessary water power for these industries as well as transportation. For twenty years the Blackstone Canal provided a critical link connecting downtown Worcester with Providence until outdated by the coming of the railroad in the 1840's. Despite the similarities between Uxbridge and neighboring towns, Uxbridge is unique because it contains the richest and best preserved remains of the industrial era and there is a cooccurance of these historical sites with recreational and cultural areas.

Presently, the two major forces which effect the town's future significantly are the National Park Service and the upgrade of the major highway through the area. Uxbridge is located on the Blackstone River whose meandering course creates a natural corridor between Worcester and Providence. In 1986 the Blackstone River Valley was designated a National Heritage Corridor, acknowledging it as the first industrial region in America. The Blackstone River Valley National Heritage Corridor Commission (BRVNHCC) was established to ensure the appropriate planning of the region, encouraging towns to preserve and protect the cultural and natural resources of the Valley.

As population mobility increases, the pattern of urban growth spreads farther away from the Boston nucleus. Route 128 linked the surrounding towns and enabled people to live in the suburbs and commute to the city. Soon development spread beyond Route 128 and Route 495 was developed, and in turn, all the towns along its path were destined for rapid growth and development. These routes are commonly referred to as beltways around Boston. Eventually, Route 146, now the primary link between Worcester and Providence, will become the third beltway and the town of Uxbridge will be faced with major growth pressures. However, with an appropriate framework, Uxbridge may turn this threat into an opportunity if provided with the information to make judicious decisions.

This study has been undertaken to upgrade the town's Master Plan of the mid-sixties, providing the necessary framework which will enable Uxbridge to become a successful interface between city and countryside and keep the rural character while allowing for growth and economic development.

A landscape planning approach based on landscape architecture principles will be developed which will ultimately achieve balanced land use through appropriate or sustainable development. Consequently, the study group gained insight into land use changes at the town level and addressed the often conflicting issues of preservation, protection, and development.

To attain this goal, several objectives were developed. The first required the analysis and assessment of natural and cultural features of the town. The second objective was to search out opportunities for development. Finally, the third objective was to develop a series of alternative plans addressing land use issues.

To achieve these objectives, and ultimately the goal, the study group was divided into eight teams:

The Coordinating Team was responsible for the organization of the study groups and the material generated by them. In addition, this team formatted the report and graphic materials and built a scale model of the town at a scale of 1: 10,000, representing the final alternative.

The Environmental Scan team examined the regional impacts on Uxbridge. External forces were studied such as impacts from growth and developments in Rhode Island, Route 146 improvements, how the BRVNHCC plans and activities impact the town, and how these forces will impact the cultural, taxation, and economic trends in the area.

The Greenway Planning and Linkages team focused on recreational needs and opportunities. They developed a greenway plan which would be a network of interconnected public areas, considering historical and cultural resources, restoration opportunities, landscape preservation and restoration.

The Planning the Protection and Wise Use of Critical Resources team focused on significant natural supplies of ground and surface water, agricultural resources, and earth resources such as sand and gravel.

The Hazards team identified and assessed issues of concern such as flood plains, air and noise pollution, and contaminated sites. These hazards were assessed for their impact on both existing and potential development zones.

The Visual and Rural Qualities Team identified and assessed scenic roadways, viewsheds, and the overall rural quality of the town.

In contrast to the previous teams whose findings are designed to influence landscape protection, the Development Suitabilities team was asked to focus on the analysis and assessment information from the other teams in order to identify and evaluate development patterns. This information included the physical, topoclimatic, visual suitabilities, and existing or potential infrastructure.

The Plan Alternatives team was vital to the completion of the project. They responded to the information generated by the previous six teams and developed several alternative future land use scenarios. The first scenario represents the total buildout of Uxbridge, showing the future if current zoning were implemented. The second scenario represents a landscape bias, where all significant lands are protected, such as wetlands, or preserved, such as significant historical sites. Finally, alternatives representing a compromise of the information, considering major factors as well as responding to the needs of the community. An in depth survey was developed and distributed to representatives of the town to get a sense of the major concerns of the community. The report which follows describes the efforts of each team and the final results of the study.

Environmental Scan

Chapter 1

INTRODUCTION

The Environmental Scan analyzes and assesses the regional growth factors influencing the development of Uxbridge, Massachusetts. From the factors, the threats and opportunities associated with them were estimated. The two major factors identified by the environmental scan which will have the greatest potential to affect land conversion in Uxbridge are the Blackstone River Valley National Heritage Corridor (B.R.V.N.H.C.) and the new interchange connecting Route 146 to the Massachusetts Turnpike. The results of the Route 128 and 495 highway belt around Boston have shown to be the major factors influencing development in their respective areas, like in the early 1950's and 1970's. The improvement, upgrading, and connection of Route 146 to the Massachusetts Turnpike will, in effect, act as the third belt way around Boston. This development, along with the potential increase in tourism, which may result from the implementation of the B.R.V.N.H.C., will create an unprecedented impact on the Uxbridge region. The proposal for an airport in the town is a direct result of these factors and supports the fact that Uxbridge lies in a highly developable area. The B.R.V.N.H.C., if fully developed, would potentially have a tremendous effect on the development of Uxbridge. The reason for this possible surge in development is the increase in tourism. Up to 5,000,000 people may visit the valley if the corridor is used to its potential and development is necessary to accommodate these people within the next 20 to 50 years. The need to protect and develop this valuable resource is great if Uxbridge and the region are to take advantage of this great opportunity.

Goal

To present to Uxbridge the possible threats and opportunities associated with growth and development resulting from the regional contextual changes such as the 146 interchange and the B.R.V.N.H.C. and determine how these may affect the future town character and developmental trends of Uxbridge.

Objectives

1: To estimate the impact of Route 146 based on the effect of the first two beltways around Boston, Routes 128 and 495, and their impact on land conversion between the years 1950-1970, 1970 - 1980, and 1980 - 1990.

2: To examine the potential positive and negative impacts of the B.R.V.N.H.C. by using case studies of similar parks and greenways.

THE BLACKSTONE RIVER NATIONAL HERITAGE CORRIDOR

Significance

"The Blackstone River Valley National Heritage Corridor (B.R.V.N.H.C.) is one of the richest and best preserved repositories of landscape in America" (B.R.V.N.H.C.C., 1989, p. 1). In the 1700's there was a major regional contextual change for the Blackstone River Valley with the birth of the Industrial Revolution in the United States. Today, with the effort to rebuild the region with the implementation of the B.R.V.N.H.C., there is another major regional contextual change occuring. A corridor such as the Blackstone can provide a region with recreational, ecological, historical and cultural amenities. These amenities make the area favorable for residential and commercial development as the quality of life is increased. The effects of this new cultural/ heritage greenway are almost entirely positive economically and culturally.

The potential for the greenway to become a state wide and even a nation wide series of linked open spaces is promising. The B.R.V.N.H.C. itself is needed to link together the fragmented pieces of history and culture. This is critical to create a sense of identity for the region. (Graduate Studio IV, 1991, p. xiv)

State of Assessment Procedure

Both *Wheels of Change* and *The Blackstone River Valley Study* are comprehensive studies on the B.R.V.N.H.C. These studies, done by graduate landscape architecture studios at the University of Massachusetts, research the effects of related parks and greenways, such as the Lowell National Park, to predict the impacts and results of the B.R.V.N.H.C. (See Fig. 1-1)

Charles Little's 1990 book on greenways called *Greenways For America* discusses in detail established greenways throughout the United States. In his study of these greenways he identifies the threats and opportunities (for the most part opportunities) associated with them. He advocates greenways as an essential addition to the American landscape which would link together the historical and cultural amenities of an entire region.

Using the approach of all three of these models, the study was able to compare and contrast areas and situations similar to that of the Blackstone River Valley. The Lowell National Park in Massachusetts, the Burke-Gilman trail in Seattle, and the Riverpark Project in Chattanooga were used to determine the possible impacts of the B.R.V.N.H.C.. The research on the Lowell National Park was useful in estimating the potential use of the B.R.V.N.H.C.. The Burke-Gilman Trail gave information pertaining to land value within and near greenways, and the results of the Riverpark Project were used to determine the future economic impacts of the B.R.V.N.H.C..

Adapted Approach

Charles Little's method of analyzing existing and established greenways to determine their possible impacts and outcomes was adapted. Team I also adapted the approach used by the Graduate Studio VI. They also studied established greenways to determine the possible impacts of the B.R.V.N.H.C. Both of these approaches provided the Environmental Scan with a framework in which to identify possible threats and opportunities of the B.R.V.N.H.C. In order for this approach to work, greenways which are similar to the Blackstone were used so that accurate projections could be made.

Introduction to Model (See Figure 1-2)

Step 1: To analyze greenway literature such as *Greenways for America* by Charles Little, and *Wheels of Change,* `and *The Blackstone Report,* both done by graduate landscape architecture studios in order to locate information pertaining to land use patterns, economics and amenities.

BLACKSTONE RIVER VALLEY NATIONAL HERITAGE CORRIDOR

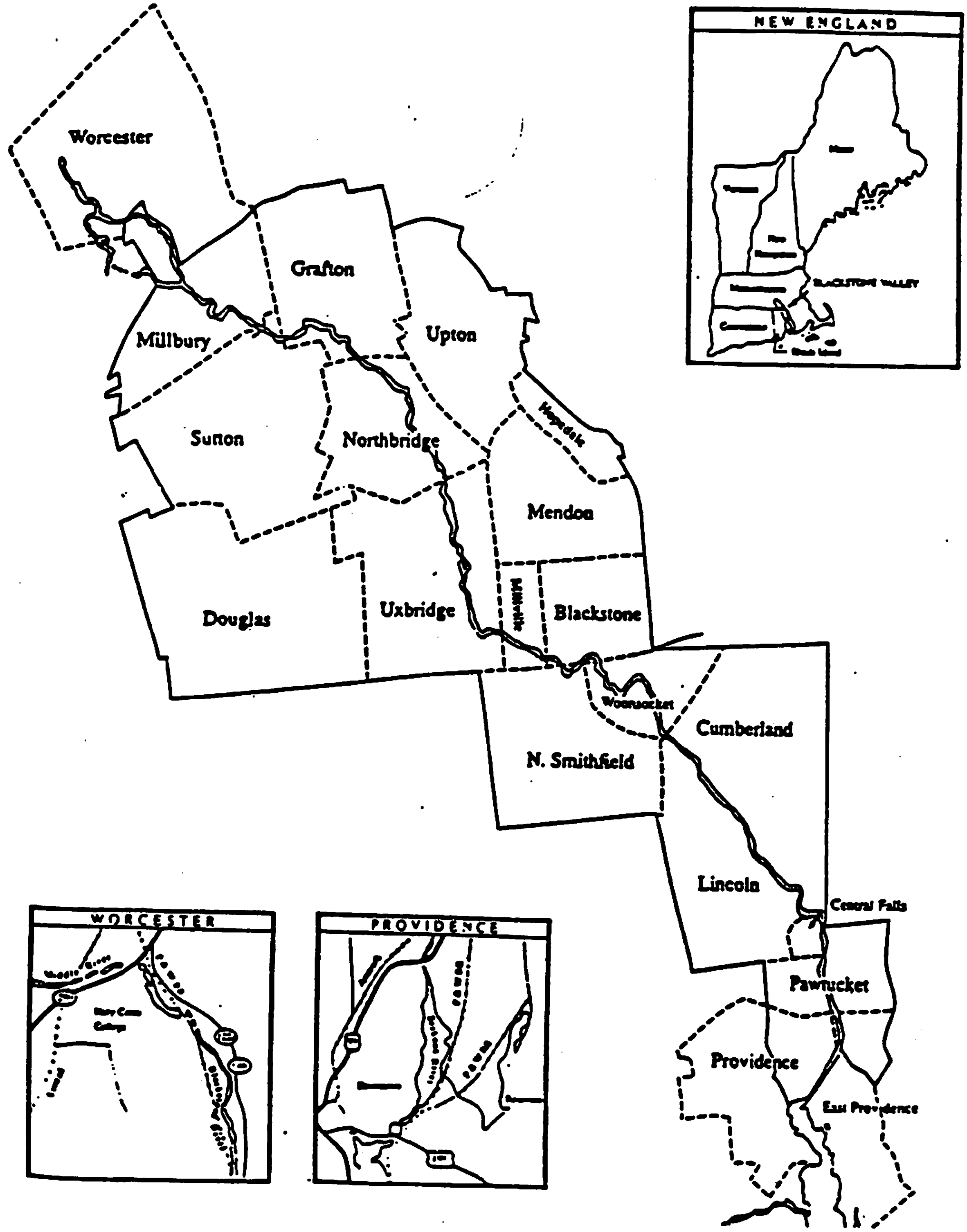


Figure 1-1: **The B.R.V.N.H.C.** 18 towns are included in the B.R.V.N.H.C., 12 are located in Massachusetts.

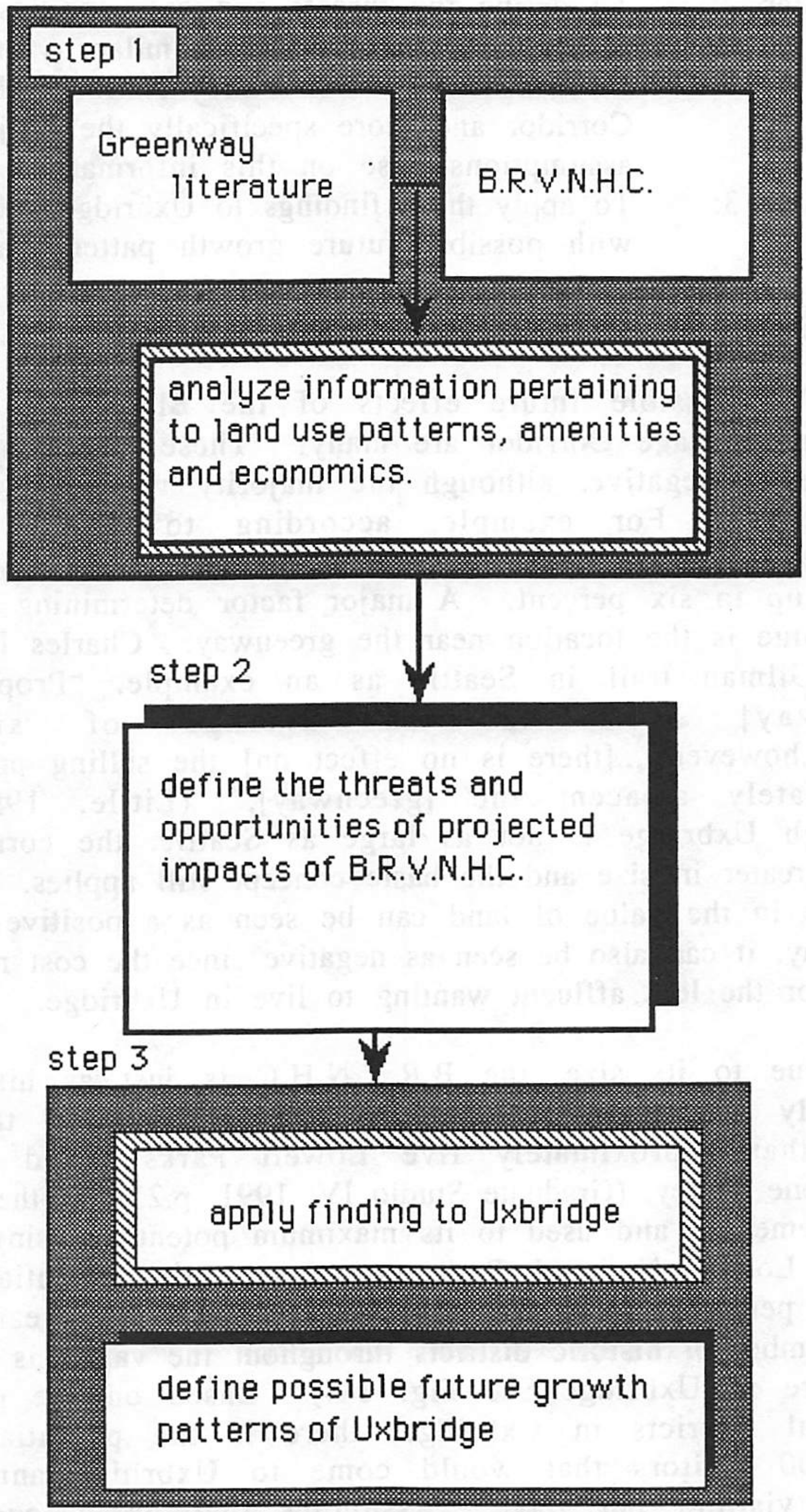


Figure 1-2: Procedure framework used to estimate possible impacts of the B.R.V.N.H.C.

Step 2: To define the threats and opportunities associated with greenways similar to that of the Blackstone River Valley National Heritage Corridor and more specifically the projected assumptions base on this information.

Step 3: To apply these findings to Uxbridge and come up with possible future growth patterns and impacts.

Findings

The possible future effects of the Blackstone River Valley National Heritage Corridor are many. These effects may be either positive or negative, although the majority would be positive (See Fig. 1-3). For example, according to Charles Little, the implementation of greenways have the potential to increase land values up to six percent. A major factor determining the effect on land value is the location near the greenway. Charles Little uses the Burke-Gilman trail in Seattle as an example. "Property near [a greenway] sells for an average of six percent more.....however......[there is no effect on] the selling price of homes immediately adjacent the [greenway]." (Little, 1990, p. 186) Although Uxbridge is not as large as Seattle, the corridor itself is much greater in size and the basic concept still applies. Although the increase in the value of land can be seen as a positive result of the greenway, it can also be seen as negative since the cost may be out of reach for the less affluent wanting to live in Uxbridge.

Due to its size, the B.R.V.N.H.C is just as historically and culturally significant as the Lowell National Park, the difference being that approximately five Lowell Parks could fit into the Blackstone Valley. (Graduate Studio IV, 1991, p.21) If the B.R.V.N.H.C is implemented and used to its maximum potential, using the impacts of the Lowell National Park as a basis, the potential number of visitors per year would be about 5,000,000 by the year 2030. The total number of historic districts throughout the valley is 20, and 6 of them are in Uxbridge.(See Fig. 1-4) Based on the percentage of historical districts in Uxbridge, there is the potential for up to 1,500,000 visitors that would come to Uxbridge annually, about 12,000 visitors per day. Assuming that about one third stay overnight there would be the need to accommodate 4,200 additional people, which translates into a need for about 1680 rooms and or camp ground sites. Another scenario would see a minimum of approximately 2,500 visitors per year distributed throughout the

Possible effects of Blackstone River Valley National Heritage corridor

	positive	negative
1	increased property value	price out the lower class
2	increased development	decentralization
3	more public recreational areas	none
4	improves aesthetic quality	none
5	provides jobs	none
6	ecological stability	none

Figure 1-3: Effects of the B.R.V.N.H.C. positive and negative impacts found by studying similar parks and greenways.

Total Historic Districts

B.R.V.N.H.C. 20
Uxbridge 6

Visitors *

	B.R.V.N.H.C.	Uxbridge
anuually	5,000,000	1,500,000
daily	41,700	12,000
overnight	13,875	4,200
result	3,500	1,680 accommodations

* based on assumptions made after studying effects of other greenways.

Figure 1-4: Tourism Impacts Estimated visitor impacts based on the percentage of historical districts in Uxbridge.

eighteen town greenway. In this case, the effect on the development and growth of Uxbridge would be minimal. The recent plan for a bikeway though the corridor (Wheels of Change 1991) suggests the previous scenario.

With this possible increase in tourism there would also be a possible increase in development which would be needed to accommodate this new economy. This would result in the creation of new job opportunities. An example of a greenway having a positive effect on the economy is the Riverpark project in Chattanooga, here "the primary social benefit is economic." (Little, 1990, p.184) It has provided many new jobs as a result of the new investment and interest in the area.

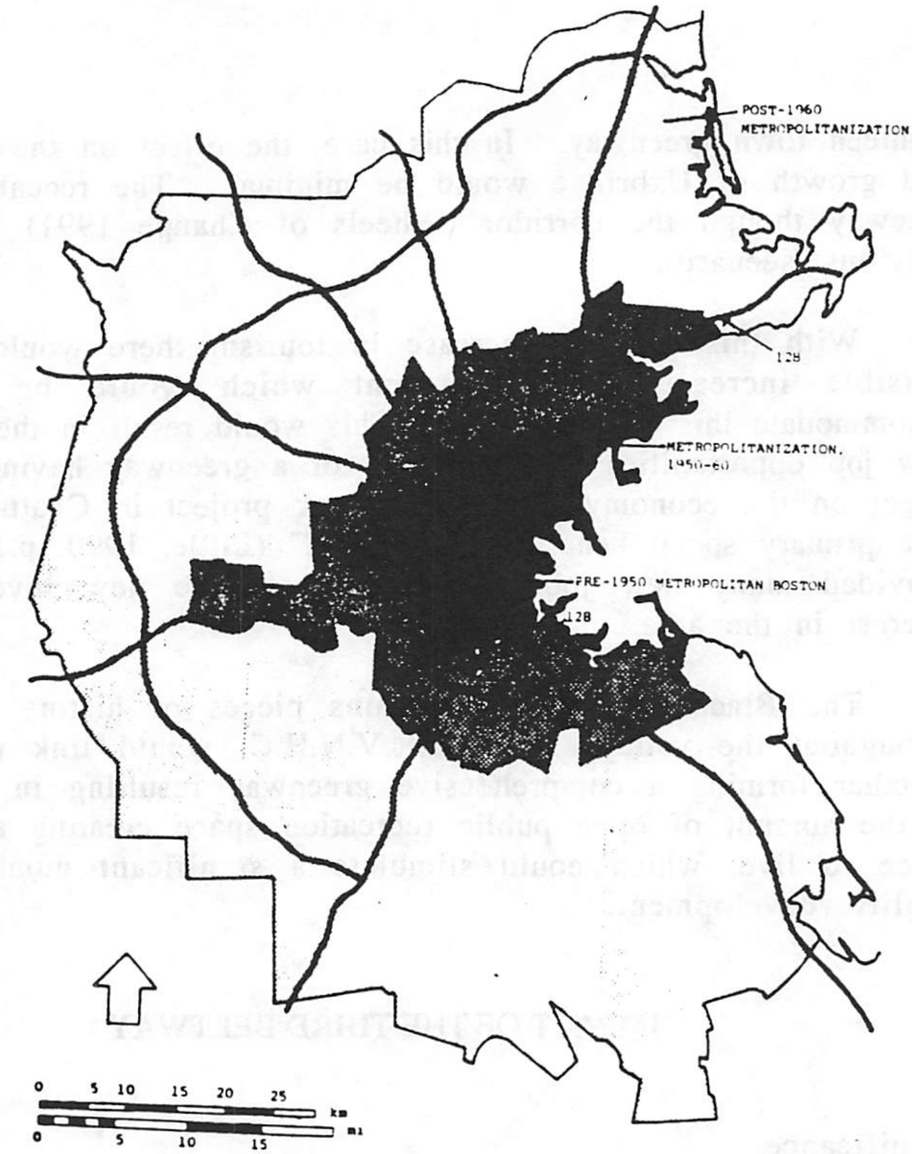
The Blackstone Valley contains pieces of history and culture throughout the valley. The B.R.V.N.H.C. would link these pieces together forming a comprehensive greenway resulting in an increase in the amount of open public recreation space creating an attractive place to live, which could stimulate a significant number of high quality development.

IMPACT OF THE THIRD BELTWAY

Significance

In post World War Two, decentrilization of Boston have been taking place. The National Defense Highway installment of the early 1950's constructed the first beltway around Boston which was Route 128. The emergence of the automobile is a unparalleled instrument in the development into the rural portions of the landscape. Highways have become the chosen system of transportation, travel, trade and an every day reality within our lives. The importance of transportation systems, particularly highways, to the development and continued growth of a region is widely recognized. (Highway location analysis M.I.T Report No. 5, 1962, p.5) People can only build on land which is accessible. (Fabos, 1985, p 135)

The interstate highway system for the New England area radiates around Boston. (See Fig 1-5) The first major highway was Route 128, which was built in the 1950's, it was called The Miracle Highway because it impacted the decentrilization away from Boston.



Dark tone: Pre Route 128 development
Medium tone: Route 128 band
Light tone: Route 495 band

Figure 1-5: Boston Metropolis. The decentralized Boston metropolis after 1970 spread over one-third of Massachusetts. This lower-density development has an impact on about 2,500 square miles of landscape. This area is 50 times larger than the Boston metropolis at the turn of the century. (Fabos 1985)

This impacted about 250 square miles of the greater Boston metropolitan region. Within two decades the Boston Metropolitan region doubled from 250 square miles to 500 square miles. Twenty years later, Interstate 495, which is approximately 16 miles west of Route 128, was installed to relieve the pressures of Route 128. But instead of relieving the traffic congestion and overpopulation of Route 128, similar consequences had resulted. The total area of development now, since the implementation of Interstate 495 has increased, is over 2500 square miles! Currently, Routes 146-190 are quickly becoming the third beltway which stretches from Leominster, Massachusetts, in which Interstate 190 connects Worcester to Leominster, and 146 which links Worcester and Providence, Rhode Island and possibly back to Interstate 95. (See Fig. 1-6) The economic, social, esthetic and political impact of each link and its feedback effect on traffic generation should be considered in the macrosystem problem. (Highway Location Analysis, p.5) The impact of Route 146-190 will intertwine with the Route 495 west development and could go east as far as the Wachusett Mountain located in central Massachusetts.

<u>State of Assessment Procedure</u>

The first procedure was carried out in three phases. Those phases are: National, Metropolitan, and local levels. In 1966, a greek theorist, Constantine Dioxiadis predicted that within one hundred years that the population of the earth will double, also within the North Atlantic region of the United States will be interconnecting into one single city. In the 1960's Gottman, a city planner, hypothesized about the northeastern United States saying that from Washington D.C. to Maine would form one single city, or a megalopolis. (Fabos, 1985)

Within the second phase, by using the data from the Masachusetts Department of Public Works, The Massachusetts Agricultural Experiment Station, The United States Census Bureau. The Blackstone Valley master plan, and numerous experts, publications, graphs, and charts were used within this report. The census and Massachusetts Department of Public Works data were used to get the travel counts. The experts and various publications on highway engineering, City Planning and the population and land use planning.

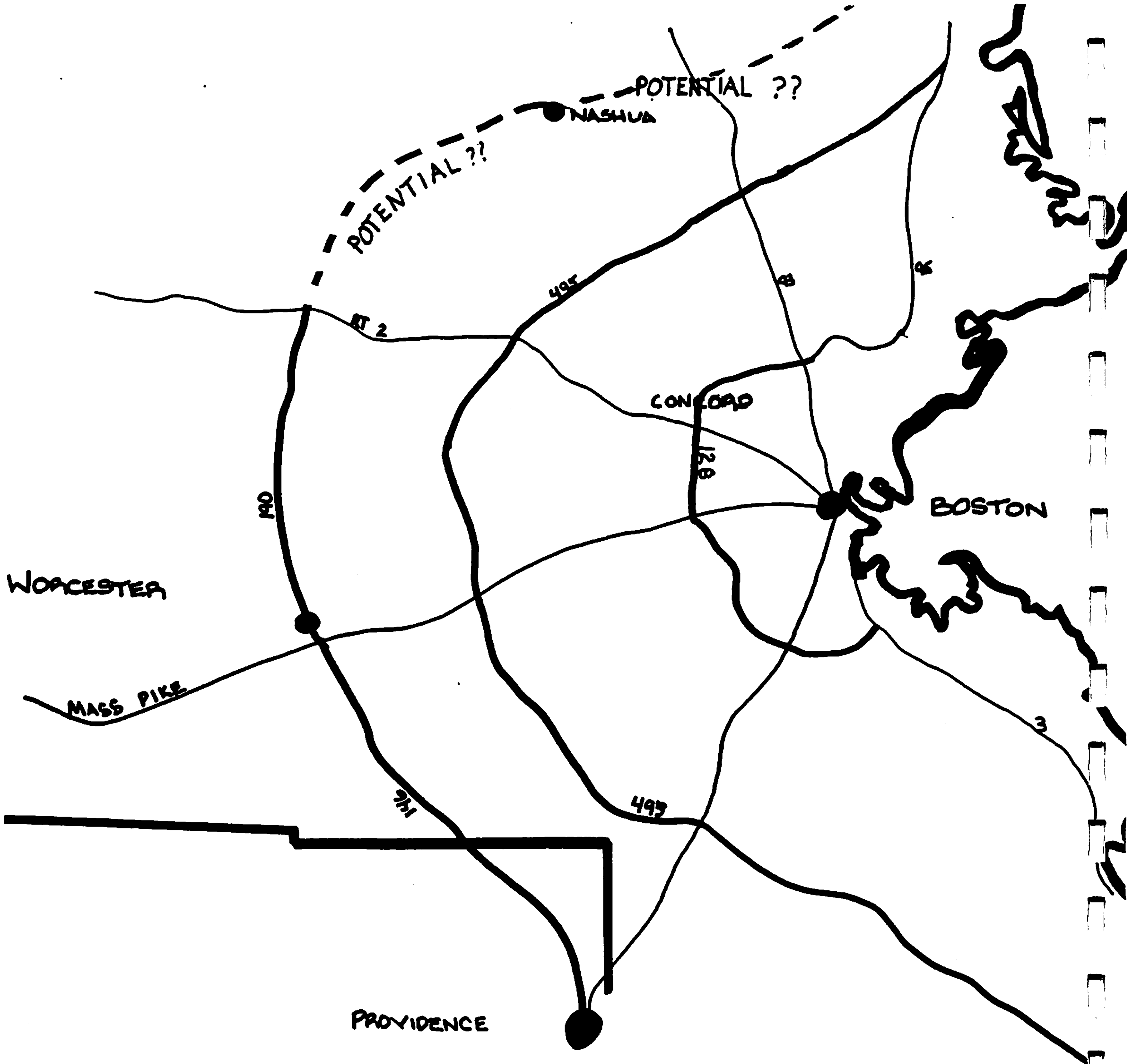


Figure 1-6: Beltways. The major beltways that project around the metropolitan-Boston area with emphasis on the 128, 495 and projected 146 beltway that can be upgraded as a limited acess highway. (detail of interchange see Fig1-12)

The purpose of these specific sources were to provide a framework so that the mistakes of the past will not be projected into the future.

<u>Adapted Approach</u>

Within the national level of investigation, Gottman and Dioxiadis were recommended to research. (See Fig 1-7) At the metropolitan level, land use maps from the Massachusetts agricultural experiment station were used as a case study, charts and economic maps from highway engineers and experts on this subject were used. The case study of Milford and Norwood proved to be well worth towns to conduct a study of. Both towns were quite rural before major interstates affected their character. The surbanization and land use change map and population map (See Fig. 1-8) start to show a pattern. Same as the Highway Development Map indicates, the major highway accessibility, growth and traffic volumes are projected in this case (See Fig 1-9, 1-10). This pattern reflects the decentralization of Boston that is taking place, especially around the beltways.

At the local level, the Interstate 146 connection to Route 20 via Interstate 190 shows the accessibility to and from the major contributors to the projected third beltway. (See Fig. 1-11) The information received from the Massachusetts Department of Public Works is a highway count on Routes 128, 495 and 146 (See Fig. 1-12). This graph is showing the same information as the metropolitan level, especially in the 495 and 146 traffic count where the traffic practically triples and on route 146 the traffic increases over 30 percent.

<u>Introduction to Model</u> (See Figure 1-13)

Procedure 1
- Step 1: To look at the Megalopolis at the national level.
- Step 2: To analyze and Map the results.
  - Result: Analyze the growth pattern

Procedure 2
- Step 1: To look at the case study of Milford and Norwood, Highway accessibility and development and population change within the metropolitan region.
- Step 2: Results of the impact.

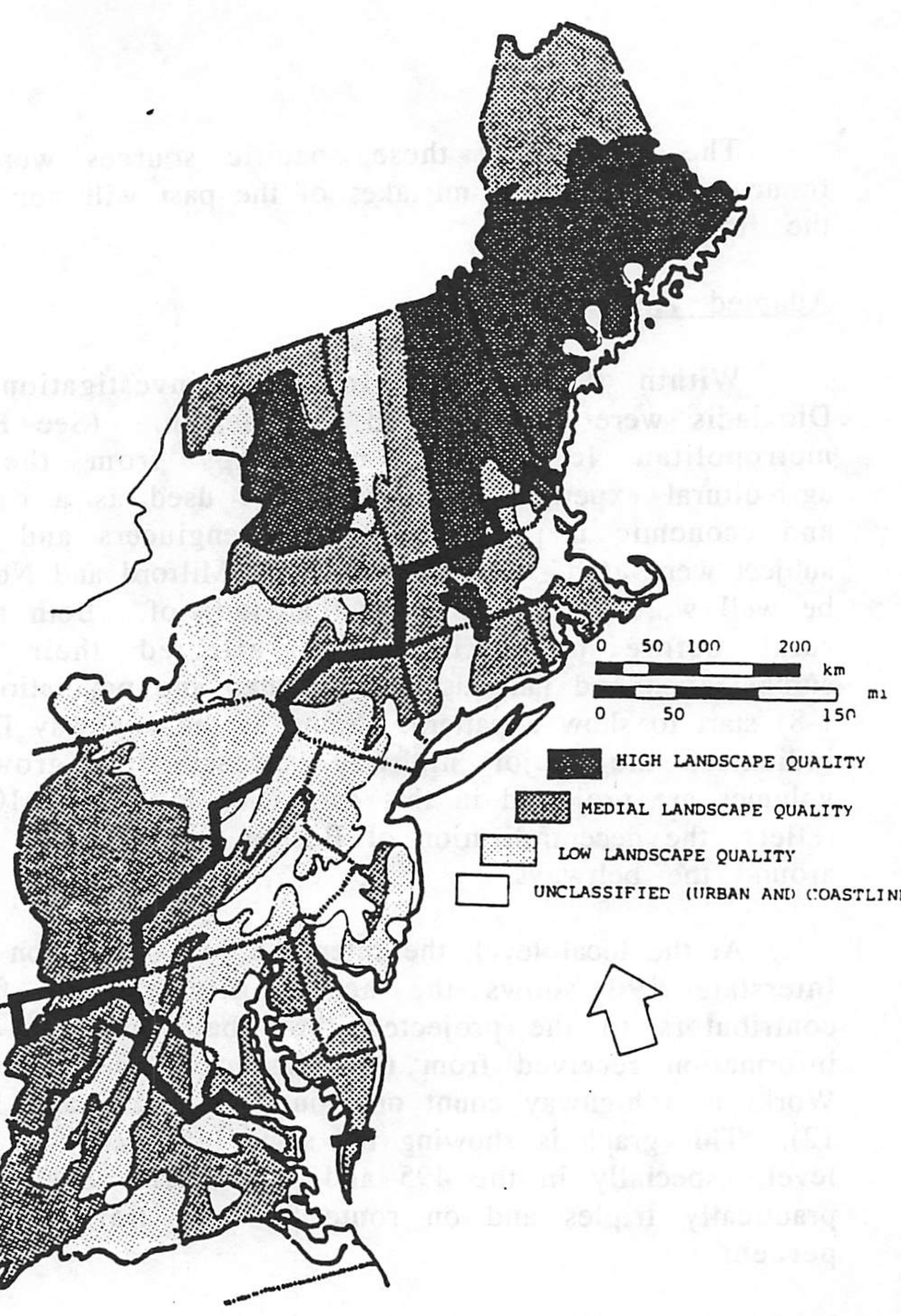


Figure 1-7: Megalopolis. Megalopolitan development has occured largely within the Atlantic Coastal Plain. (Fabos 1985)

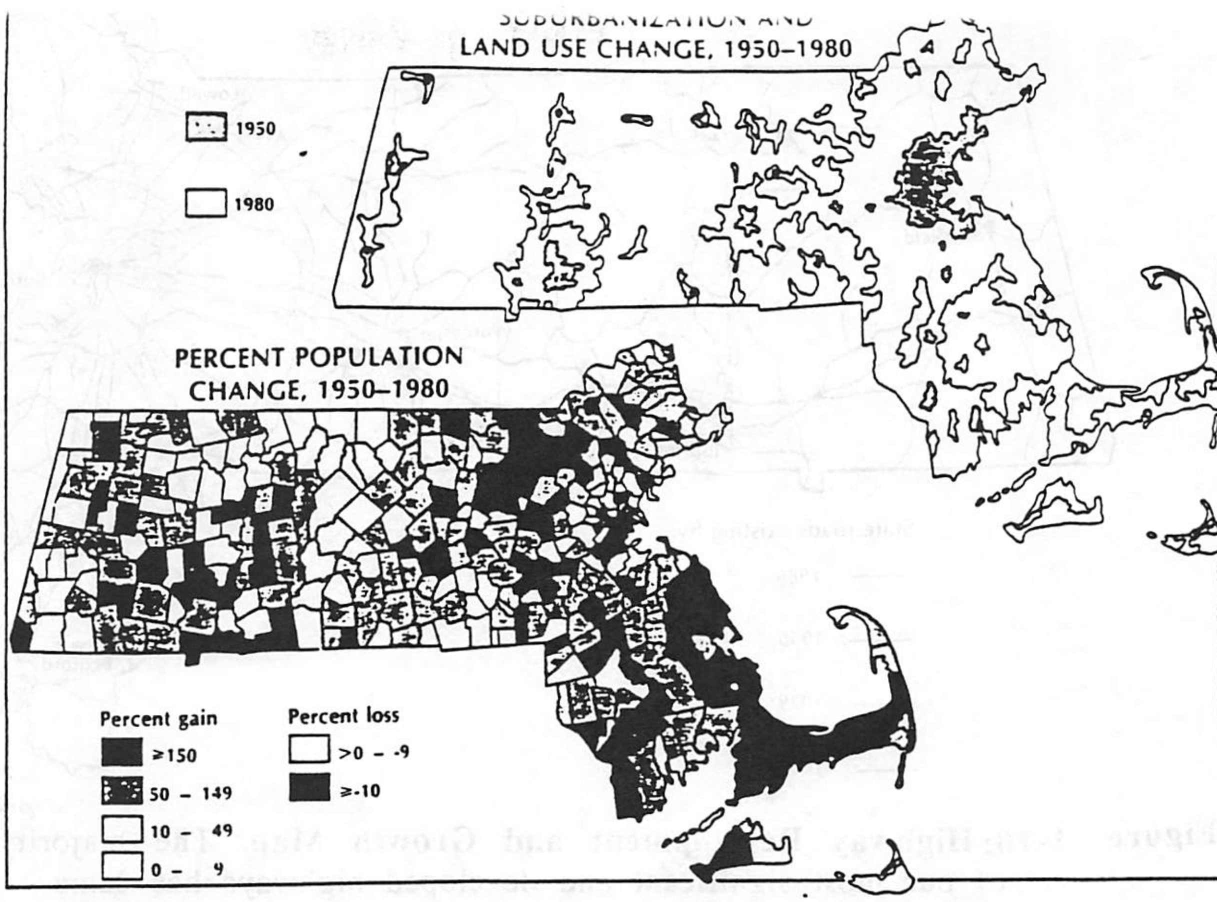


Figure 1-8: Suburban, Land Use and Population Maps, 1950-1980.
The population, surburban, and land usechange shows an incredible shift to rural Massachusetts.

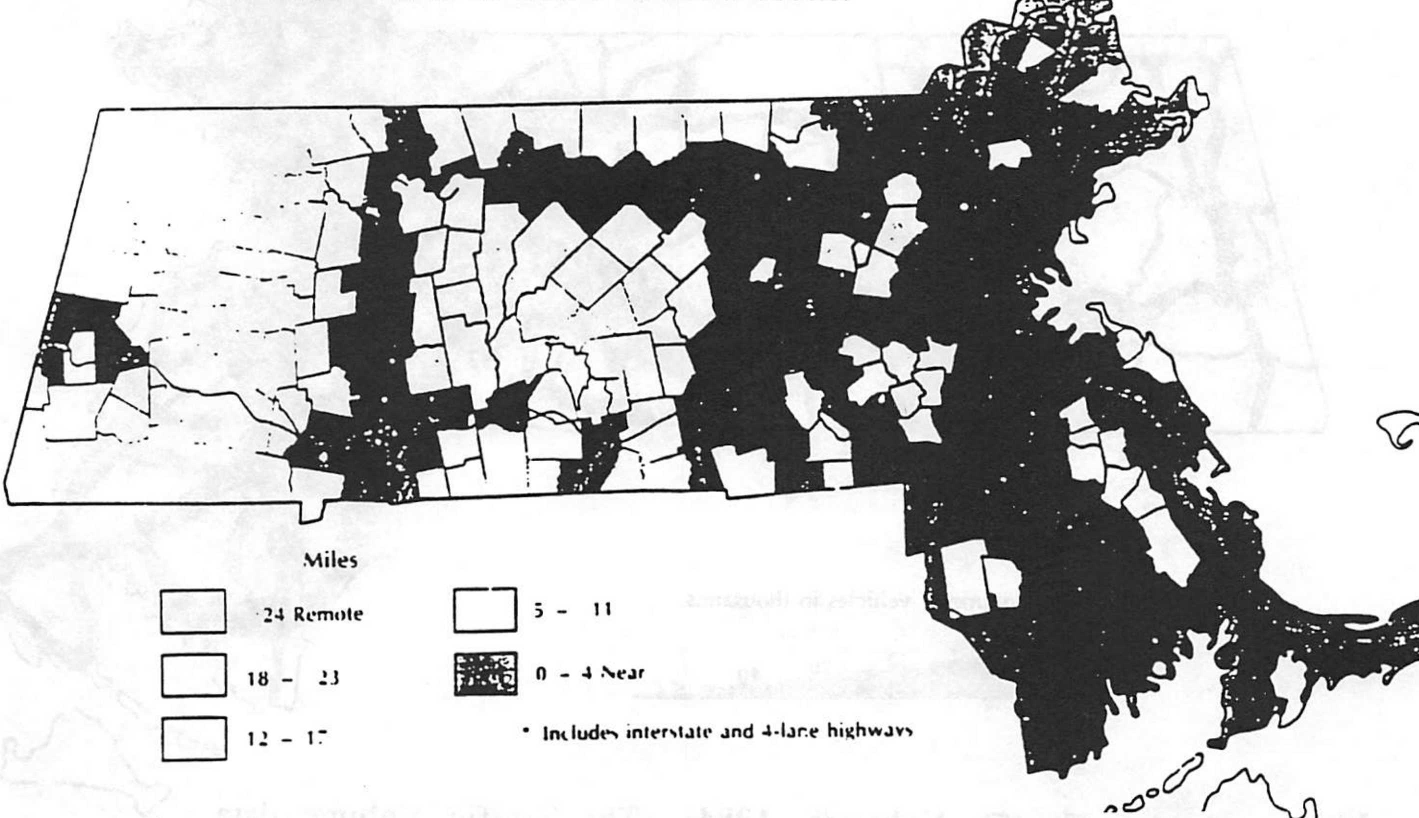


Figure 1-9: Major Highway Accessibility - 1988. The beltways prove to provide a significant alteration within our landscape and acess to rural Massachusetts

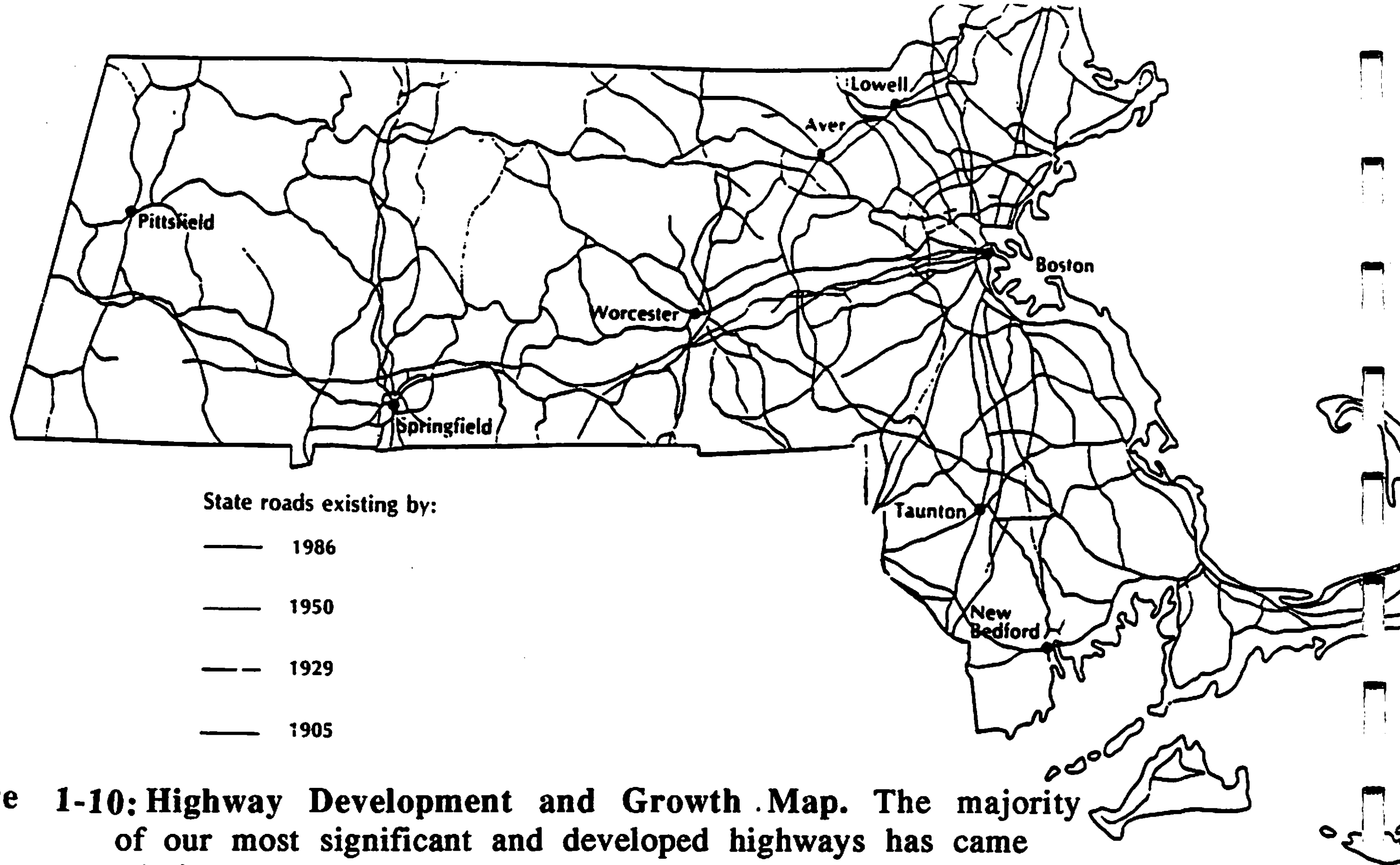


Figure 1-10: Highway Development and Growth Map. The majority of our most significant and developed highways has came within the past forty years.

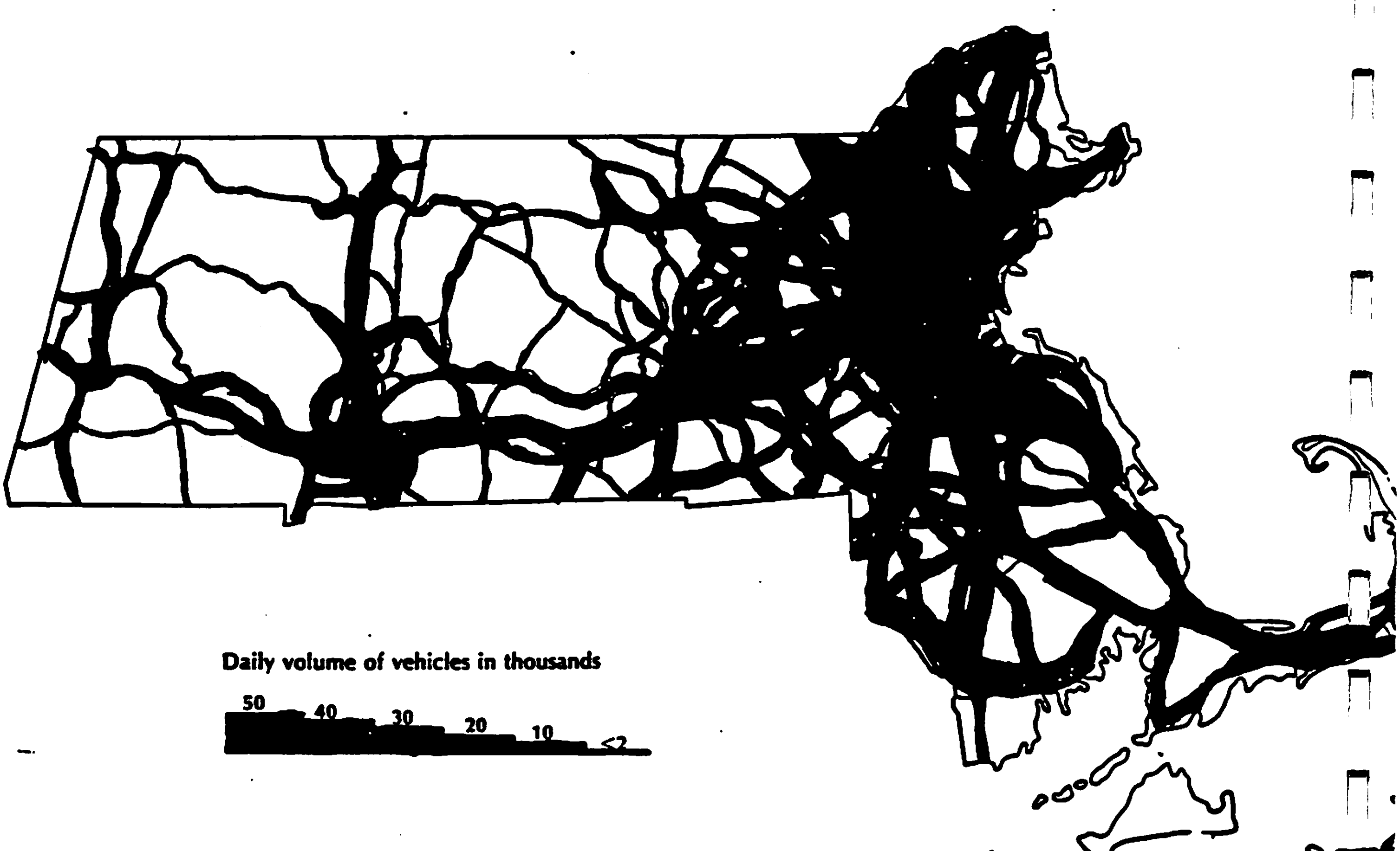


Figure 1-11: Traffic Volumes, 1984. The Traffic Volume data projected here shows The daily volume of traffic in thousands.

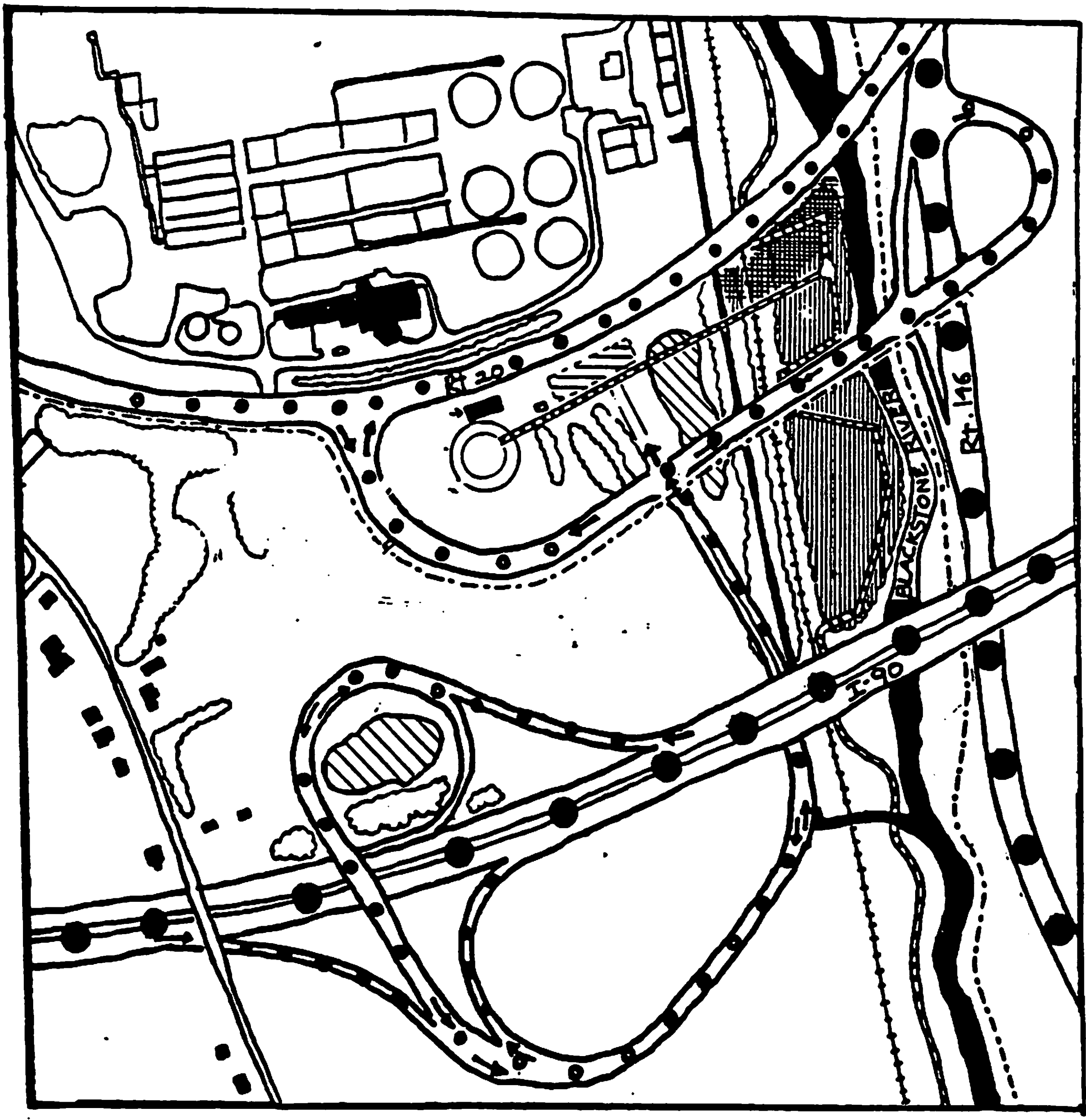


Figure 1-12: Proposed 146 Connector. The proposed 146 connector will combine with route 20 and then link with Interstate 190.

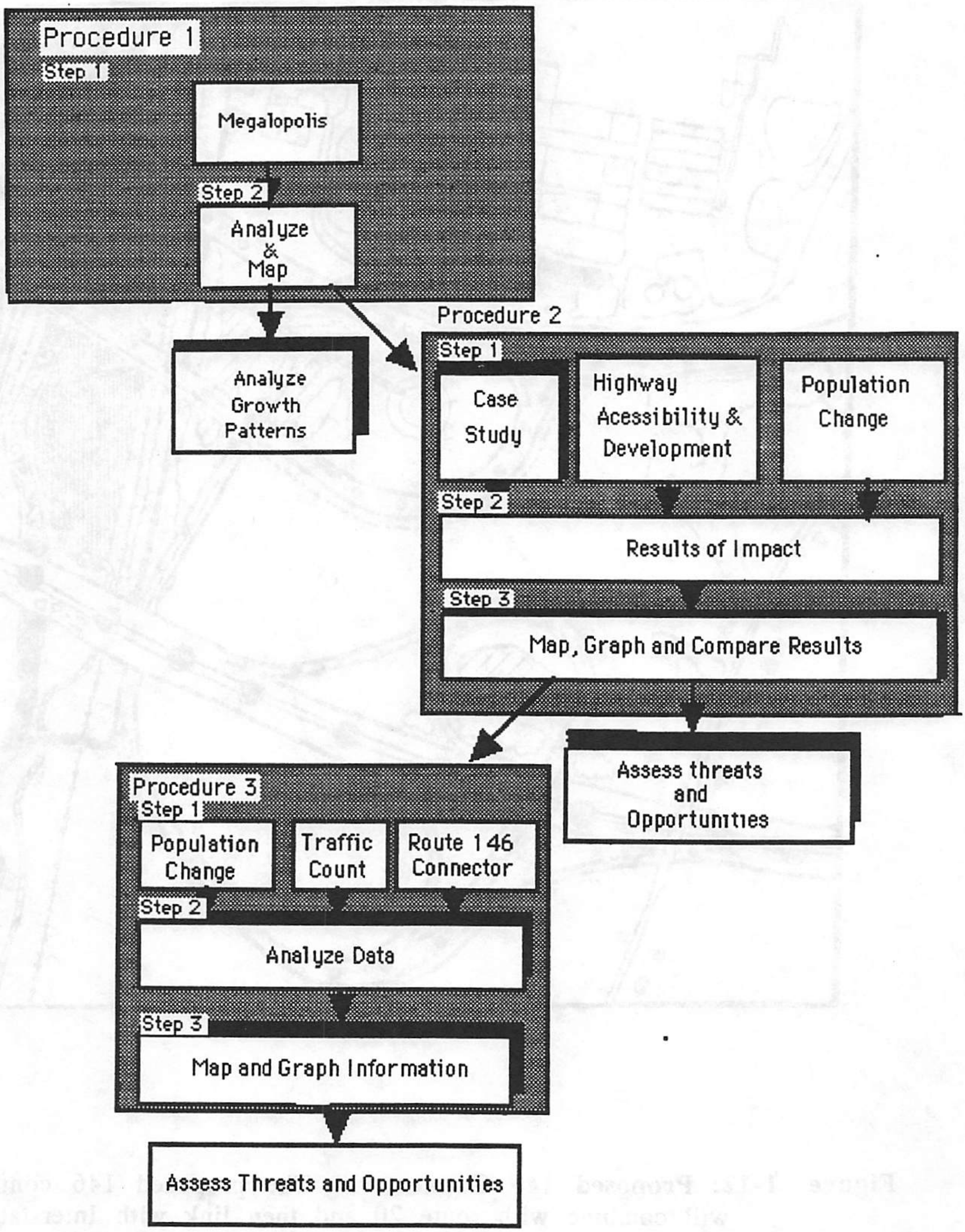


Figure 1-13: **Phases.** Framework for the three procedure study on the 146 beltway.

Step 3: Map, graph and compare results.
Result: Assess threats and opportunities.

Procedure 3
Step 1: Look at the population change, traffic count, and 146 connecter at the local level.
Step 2: Analyze data
Step 3: Map and graph information
Result: Assess threats and opportunities

Findings

At the national level, the megalopolis is taking shape (See Fig 1-6). The east coast is one of the most heavily populated regions within the country. Presently, if the way building is increasing, the megalopolis will soon take form.

At the metropolitan level, (Figs 1-7, 1-8 and 1-9) one can see that there is a incredible amount of rural space being utilized. Within a case study of Milford and Norwood, the Land Use maps show a significant increase in urban land use. For example, a commercial zone in Milford was 40 acres in 1953, in 1971 the change in acres rose over 300 percent to 153 acres! Another example is light residential. In 1951, the total of acres was 815, in 1971 the acres jumped to 1986, another significant increase. Route 495 had a significant role in the sudden increase with the life of Milford. The town of Norwood follows the same pattern of Milford. In 1951, the industrial acreage was 186, by 1971 the amount of acres was up to 343. Another dramatic leap was heavy and light residential. Combined in 1951, the total of acres was 1653, in 1971 the total was 1425 combined acres! The same trends we see on Route 128. Again from a trajectory done from Boston to Uxbridge in 1970, the total acres was 100,600. In 1980 the total was 105,050 and in 1990 the total increased to 136,742. Population change maps, Census data, Highway accessibility and development maps show that there is and has been a population and land use increase within the beltways, decentralization of Boston is taking place.

At the local level, the figures from the Massachusetts Department of Public Works show the same results. In a highway traffic count on Routes 128, 495 and 146, the numbers are following the same pattern. (Fig.1-14) In 1970, the Route 495 traffic count was 10,750 vehicles a day. In 1980, the traffic count rose to 15,200, and

<u>Traffic Count of the 3 Highway Change over 3 Decades</u>

	Route 128	**Route 495**	**Route 146**
1970	100,600	10,750	8,850
1980	105,050	15,200	11,600
1990	136,742	45,200	14,500

Figure 1-14: Travel Counts. These are daily travel counts from Route 128, 495 and 146. (Figures recieved from Massachusetts Department of Public Works)

in 1990 the count skyrocketed to a whopping 45,200! The maps of Massachusetts (Fig. 1-7 and 1-9) show an incredible increase in land use and population within this region. Growth took place throughout the state, but especially along the outer ring of Interstate-495 around Boston, in Plymouth County, Cape Cod, and within the areas around Lowell and much of Worcester County. There was a significant number of retirees moving to Cape Cod, and high income families chose undeveloped towns with access to metropolitan areas. Effects of Route 146 (Fig. 1-15) are listed, including the positive and negative effects with mitigation.

In summary, Uxbridge could come in contact with a second revolution of development. (The first being the mills in the beginning of the century.) The major factors contributing to this would be the third beltway and the potential greenway. The two could pose a significant increase within development, both commercial and residential, population, revenue, possible outside tax dollars, and a higher standard of living for the people.

Effects of Route 146

Positive	Negative	Mitigation
1. Increase accessibility	Increase traffic & noise	Grouth management
2. Increased development	over development	Planning
3. Provide jobs	may be compatible with work force	Retraining
4.Increase Economic activity	Increase land value	Redistribution of Taxes
5. Third Beltway	Increase developmental sprawl	Planning
6. Development at exits	May not be appropriate at all exits	Zone development away

Figure 1-15: **Effects of Route 146 Interchange.** This table addresses the 6 major factors in highway development

Greenway

Chapter 2

INTRODUCTION

The word 'greenway' is a relatively new word for an old idea. Olmsted's Emerald Necklace is certainly a greenway; Robert Moses' Parkways are considered by some to be greenways, and Ebenezer Howard surrounded his Garden Cities with greenbelts. Charles Little categorizes five major types of greenways: the urban riverside greenway, recreational greenways, ecologically significant natural corridors, scenic and historical routes and the comprehensive greenway(Little, 1990, p.4-5). For the purpose of this report, team two has adopted the definition put forth by Julius Fabos..."greenways refer to planned networks of preserved, protected and managed lands set aside for ecological, aesthetic, recreation or cultural/historical uses." (Fabos, 1991, P.1)

The goal of this team is to establish a greenway network that will protect the ecologically sensitive areas, preserve the rural nature of the town and incorporate recreational and historical resources and opportunities.

The objectives of this study are:

1: To preserve ecologically sensitive areas.
2: To assess and plan for recreational opportunities within the network.
3: To assess historical and cultural resources for preservation.
4: To link the above resources together by means of roads, trails and waterways.

GREENWAYS

Significance

Preservation of natural resources and fragile ecological systems has become an important planning issue for towns and cities. Planners now recognize these areas as major elements contributing to the health and well being of a community or region. However, preservation recently has been by land acquisition. While this method will certainly protect land acquired, these parcels are often isolated from each other. The preservation picture may look like a series of dots on a map. The greenway concept is one of connecting these dots.

All life forms have value, therefore managing for diversity should become a priority. One way of providing for this diversity of life is by connecting ecological areas. Species in isolated areas have minimal opportunities for species interaction. The longer an area is isolated by development, the fewer species this area will have.(Ahern, 1991, p. 77) By connecting these areas, more species interaction occurs providing more biodiversity.

Historically, preservation and recreation have gone hand in hand. Olmsted, while solving the drainage problem of Boston's Muddy River, preserved the landscape along the river and transformed it into a linkage between some parks in the city. It became the backbone for his Emerald Necklace. Thus, Olmsted found preservation and recreation linkages to be compatible.

A network of ecological, recreation and cultural areas can provide a buffer from development, improving the aesthetic quality where people live. The vision, as put forth by Fabos, is to be able to look at a map of a region or town and to have the greenway network be as salient as the present roadway system.

In the following chapter ecological, recreation and historical/cultural areas of the Town of Uxbridge will be analyzed and assessed, through adapted state of the art procedures, producing an assessment map in each of the three concentrations. The final procedure will be to create a composite map showing significant ecological, historical and recreation areas based on size, location and linkage potential to a greenway network. (See Fig. 2-1).

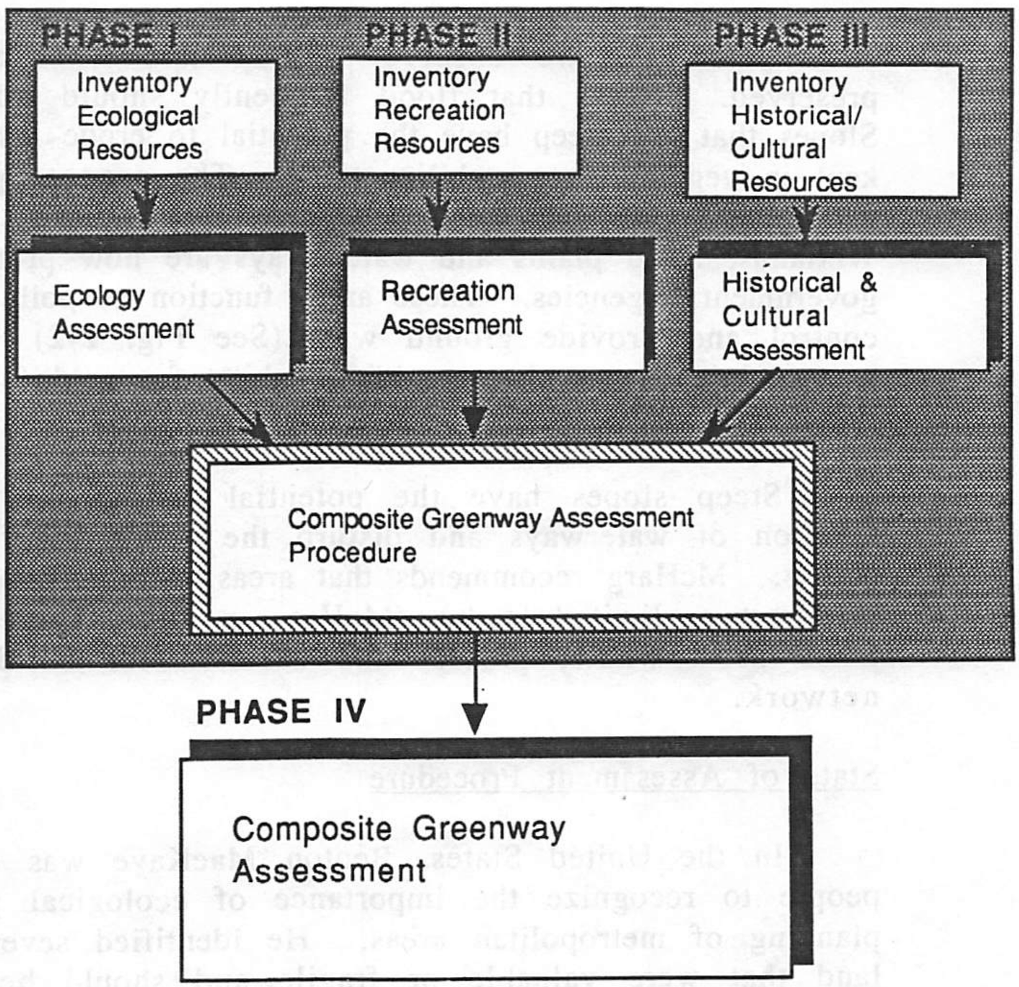


Figure 2 - 1: Framework for Greenway Planning.

PRESERVATION (ECOLOGY)

Significance

Nature, if we observe, will dictate what areas should be preserved. Areas that flood frequently should not be developed. Slopes that are steep have the potential to erode and thus should be kept in vegetation to stabilize them. The need to preserve sensitive ecological areas has been recognized by society in recent times. Wetlands, flood plains and water ways are now protected by various government agencies. These areas function as pollution filters, flood control and provide ground water.(See Fig. 2-2) Many of these protected lands are also providing habitat for wildlife. By connecting these areas more biodiversity is allowed.

Steep slopes have the potential for erosion that can cause siltation of waterways and disturb the ecological function of these bodies. McHarg recommends that areas of steep slopes be preserved in forest or limited landuse.(McHarg, p.60) These protected areas, taken as a whole, provide the skeleton for building a greenway network.

State of Assessment Procedure

In the United States, Benton MacKaye was one of the first people to recognize the importance of ecological processes in the planning of metropolitan areas. He identified several categories of land that were valuable or fragile and should be protected from development. These areas included ridges, steep slopes, canyons, flood plains, swamps, lakes and shore lines. MacKaye contended that these occurrences in the landscape could act as natural levees to control the spread of development.(Fabos, 1985, p.22)

Eugene Odum, an ecologist, developed a land use model listing all land uses into four categories: 1.) protection, 2.) production, 3.) compromise and 4.) urban/industrial. (Fabos, 1985, p.24) From these categories, it is obvious that man was included in Odum's model. Land unsuitable for development because of ecological sensitivity would be protected. In this category would be wetlands, floodplains,steep slopes etc. Tilled land, forested land and orchards would be considered productive land. A compromise might be land

Figure 2 - 2: A wetland area along Chockalog Road which aids in flood control.

with a steep slope where development may be limited to one unit per three acres. Urban/industrial land would be land that is resilient and could sustain development. The METLAND landscape planning process was adapted from Odum's compartmental model. The METLAND procedure is broken down into two parts. In the first part land uses are analyzed and placed into groups each with similar ecological characteristics. The second part assesses the denudation potential of an area based on slope and soil qualities. The two parts are compared for compatibility. (Ahern, 1991, P.81)

The conservation network model is yet another approach to land preservation based on wildlife habitat. Indicator species and their habitats are used as the basis for landscape planning in rural or suburban areas. (Ahern, 1991, P.82)

The purpose of these procedures is to provide a framework for planners to use that will protect ecologically sensitive areas and in so doing preserve these resources for future generations.

Adapted Approach

MacKaye and Odum were developing ecology models before many environmental laws were passed. Today, all wetlands and waterways are protected by various laws and various government agencies. From these protected lands and the MacKaye approach of protecting sensitive ecological areas, a procedure was adapted. (See Fig. 2-3 and 2-4)

Introduction to Model

Procedure 1

Step 1: Inventory wetland resources.
Step 2: Inventory floodplain areas.
Step 3: Inventory ponds and streams.
Step 4: Protected land assessment procedure.
Wetlands were rated very significant because they are protected under the Massachusetts Wetlands Protection Act.
Floodplains were rated significant since building in the floodplain is controlled by requirements of the Federal Emergency Management Agency.

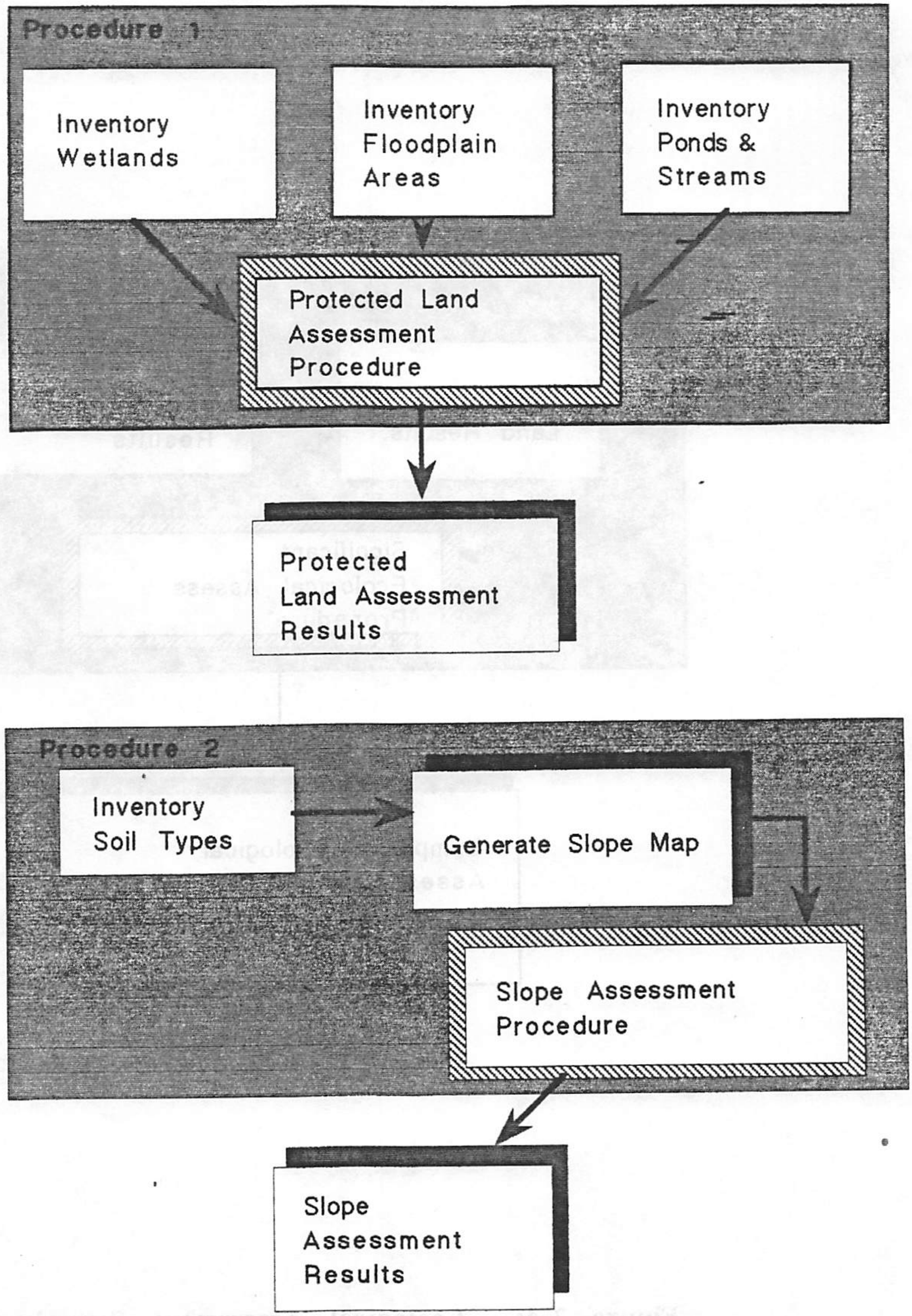


Figure 2-3: Protected Land and Slope Assessment

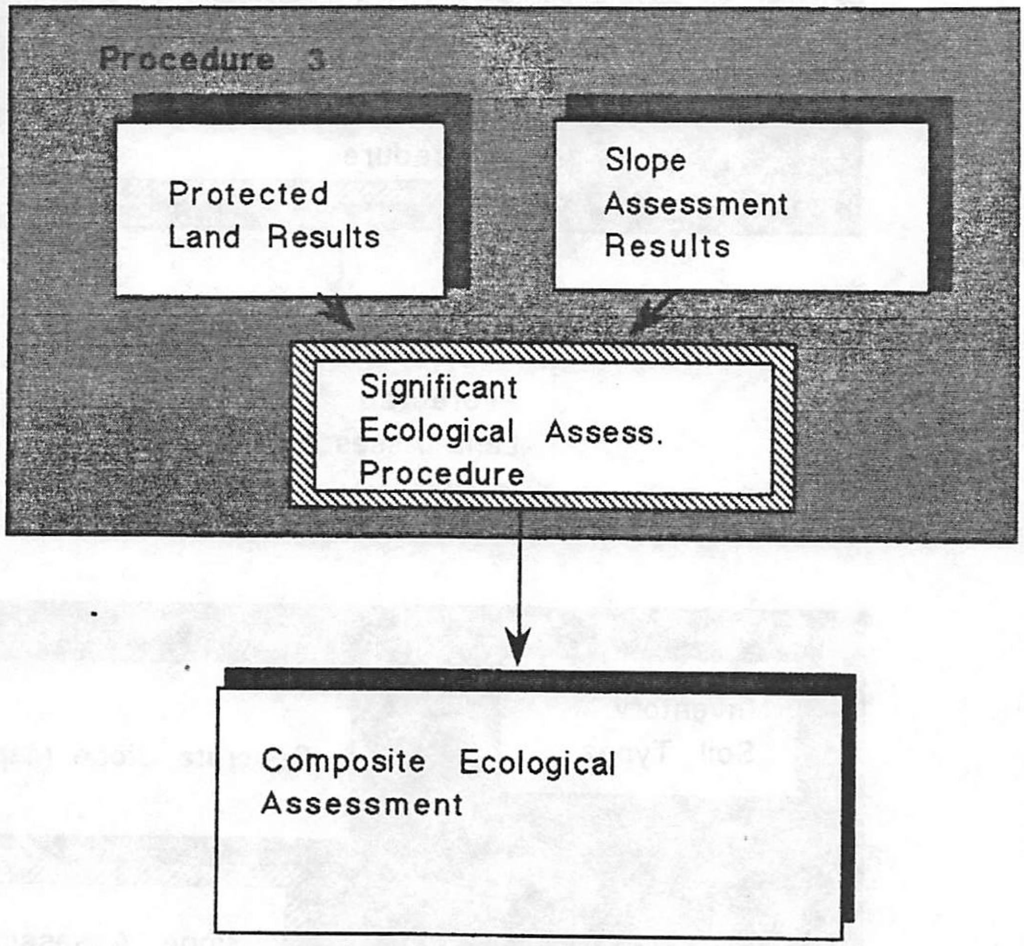


Figure 2-4: Ecological Assessment Procedure

Ponds and streams were rated very significant in that they are the network and lifeblood of the wetland areas.

Step 5: Protected land assessment results.

Procedure 2:

Step 6: Inventory soil types from Soil Conservation Service Map.

Step 7: Generate slope map from SCS Map. Slopes categorized as less than 15% and greater than 15%.

Step 8: Slope assessment procedure.
Slopes greater than 15% were rated very significant because of erosion potential. Slopes 8-15% were rated significant because of erosion potential.

Step 9: Slope assessment results.

Procedure 3:

Step 10: Overlay protected land assessment results and slope assessment results.

Step 11: Ecological assessment procedure.
Combine assessments into one Map and create 100' buffer to wetlands and waterbodies.

Step 12: Composite ecological assessment

Findings

Uxbridge contains approximately two thousand seventy-six (2076) acres of wetland, which comprises 10.8% of the town. Seven of these wetlands are forty acres or larger, with fourteen sites containing between twenty and forty acres. The larger wetlands are associated with the Blackstone, West and Mumford Rivers. There is a substantial wetland in the southeast corner of the town associated with the Ironstone Reservoir and a wetland in the southwest area associated with Chockalog and Cedar Swamp Ponds. Most activities in wetlands are regulated under the Massachusetts Wetlands Protection Act. However, pressure to develop continues to threaten wetland areas. The paving or filling of wetlands increases the rate of runoff, reduces the flood storage capacity and raises the peak water flow leading to greater storm damage. These areas should be preserved to ensure their continued ecological function.

Approximately two thousand nine (2009) acres of Uxbridge are designated Floodplain. The one hundred year floodplain consists of land with a one percent chance of inundation each year. The majority of the town's floodplains lie along the Blackstone, West and Mumford Rivers, still, some of the floodplain is associated with other waterbodies such as Ironstone Reservoir, Cedar Swamp Brook, Laurel Brook, Emerson Brook, Lee Reservoir, Whiten Pond Lackey Pond, and Rivulet Pond. Unregulated development of floodplains can cause increased flooding down stream. This poses a potential hazard to people and property in the immediate flood plain areas as well as down stream, who may be threatened by water contamination from damaged septic systems and by debris swept down stream from flooded properties. These areas should be regulated or preserved.

Approximately twelve hundred (1200) acres of Uxbridge are on slopes of greater than 15%, this comprises 6.5% of the town. These sites are scattered throughout the town, occurring most frequently in the north central area. Approximately 18.7% of the town has slopes between 8-15%. These areas are also scattered throughout the town. The majority of land within the town lies in the 3-8% slope category with 14.3% lying in the 0-3% slope category. Thinner soil coverage, minimal absorption and increased runoff and erosion potential, which can cause siltation in waterbodies, are the ecological problems associated with slopes greater than 15%.

The protection of the wetlands, floodplains and slopes greater than 15% would comprise approximately three thousand two hundred eighty-five (3285) acres or 17.3% of the town. With the addition of the 100' buffer surrounding wetlands and waterbodies, the combined percentage is 24.7%.See Fig. 2-5) Preservation of these areas will help prevent unnecessary costs to human lives and property due to flood or erosion problems, while at the same time protecting the present integrity of wetland systems and their benefits. Further more, preservation of these lands adds to quality of life by maintaining the flora and fauna indigenous to the region and providing a buffer to developed areas.

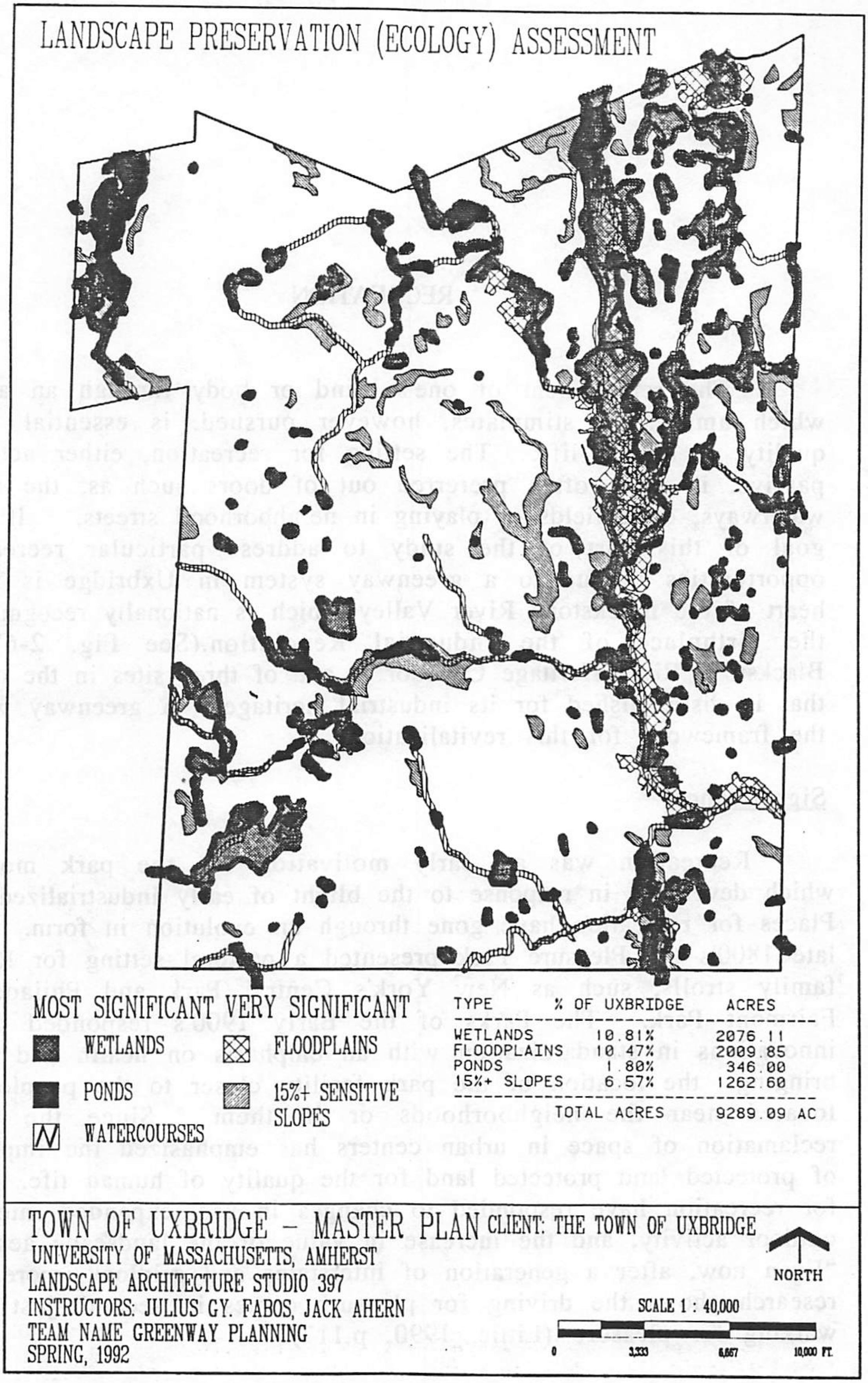


Figure 2-5: Landscape Preservation Assessment Map

RECREATION

The refreshment of one's mind or body through an activity which amuses or stimulates, however pursued, is essential to the quality of human life. The setting for recreation, either active or passive, is quite often preferred out of doors such as, the woods, waterways, open fields or playing in neighborhood streets. It is the goal of this part of the study to address particular recreational opportunities unique to a greenway system in Uxbridge is in the heart of the Blackstone River Valley which is nationally recognized as the birthplace of the Industrial Revolution.(See Fig. 2-6) The Blackstone River Heritage Corridor is one of three sites in the country that is distinguished for its industrial heritage. A greenway will be the framework for this revitalization

Significance

Recreation was an early motivation for the park movement which developed in response to the blight of early industrialized cities. Places for recreation have gone through an evolution in form. In the late 1800's the Pleasure Park presented a pastoral setting for leisurely family strolls, such as New York's Central Park and Philadelphia's Fairmont Park. The Parks of the Early 1900's responded to new innovations in standardization with an emphasis on health and fitness, bringing the location of the park facility closer to the people, often located near the neighborhoods or in them. Since the 1960's, reclamation of space in urban centers has emphasized the importance of protected land protected land for the quality of human life. Places for recreation have responded to changes in use, expanded interest in outdoor activity, and the increase in value of the landscape aesthetics. "Even now, after a generation of interstates and gridlock, more recent research shows the driving for pleasure comes in second, just behind walking for pleasure."(Little, 1990, p.117)

Recognizing the distinctive value of the landscape can provide simple pleasures for our lives. Greenways will play an integral role in the sensitive, intelligent use of the landscape. Here is how greenways

Figure 2-6: View of Capron's Pond from recreation area in down town Uxbridge.

are envisioned by a proponent: "I imagine a beautiful, preserved, protected and sensitively used landscape for recreation, enjoyment and learning. I see a landscape which is linked together along the network nature provided us with. I envision a landscape which provides great benefits, from high quality water to nature and wildlife protection." (Fabos, 1991, p.16)

By utilizing the total landscape in greenways, such as existing open spaces, old canal towpaths, and old rail beds, the landscape can be experienced through a continuous movement. The integration of these elements can create access to the landscape for recreation, away from the interruptions of asphalt roads, parking lots, and tall buildings.

It was the task of the Greenway Team to develop a greenway with recreational resources integrated into the network. To this end existing recreational sites were inventoried, and assessed for potential use.

State of Assessment Procedure

The evolution of recreational places has been orchestrated by several visionary people. Frederick Law Olmsted envisioned a general park system in Boston's Back Bay Fens area, which resulted in the prototype procedure for linking areas of open space. He not only incorporated different geographical locations into one network, he also planned for the balance of transportation, sanitation and recreation. This was one of the first multi-purpose or "comprehensive" efforts. His plan was threefold: "to make an engineering solution the occasion for creating a needed municipal open space; to link newly annexed communities to the historic municipal center and to provide a variety of forms of recreation" (Fabos, 1968, p. 59). The significance of his work reveals an early interpretation of greenways orchestrating the successful integration of multiple issues. This example stands for the forward thought of a greenway and its many benefits for a community.

The Hadley River Corridor study provided a similar study problem as the Blackstone River Valley National Heritage Corridor. Their process involved an evaluation of all existing recreation areas and of large open areas and site specific areas along the shore of the Connecticut River. Further suitability for recreational sites was determined by slopes, soils, and vegetation. Similar evaluative criteria was adapted from this approach. Guidelines for our greenway were different and taken into account.

A case study of the Rio Grand Valley State Park Identified the Biophysical Land Units (BLU) method (developed by the bureau of land management) for mapping four basic features: vegetation, soil, terrain, and hydrology. Their significance determined the impact of recreation on the areas.

Adapted Approach

The Blackstone River is a part of the regional history from Worcester, Massachusetts to Pawtucket, Rhode Island. The Blackstone River and the connected waterways offer significant recreational opportunities for the residents of Uxbridge and surrounding towns. The existing recreational sites were identified and assessed based on the following greenway related criteria adapted from the Connecticut River Corridor study: the Rio Granby Case Study, size, ownership, and diversity of activities. This study has been limited to hiking/bicycling, canoe launches and picnicking as a representative sample of greenway related activities. (See Fig. 2-7)

Each of these criteria's are evaluated as follows :

**Size*- The proximity of the sites to the potential greenway
**Ownership*-Private significant
Town very significant
State/Federal most significant
**Diversity*-Number of greenway related activities (hiking, bicycling, swimming, picnicking)

Introduction to Model

Step 1: (a) Identify *existing* recreational nodes:
- recreation areas
- picnic areas
- canoe launches

(b) Assess nodes for:
- size
- diversity of activity
- ownership

Step 2: Identify *existing* linkages:

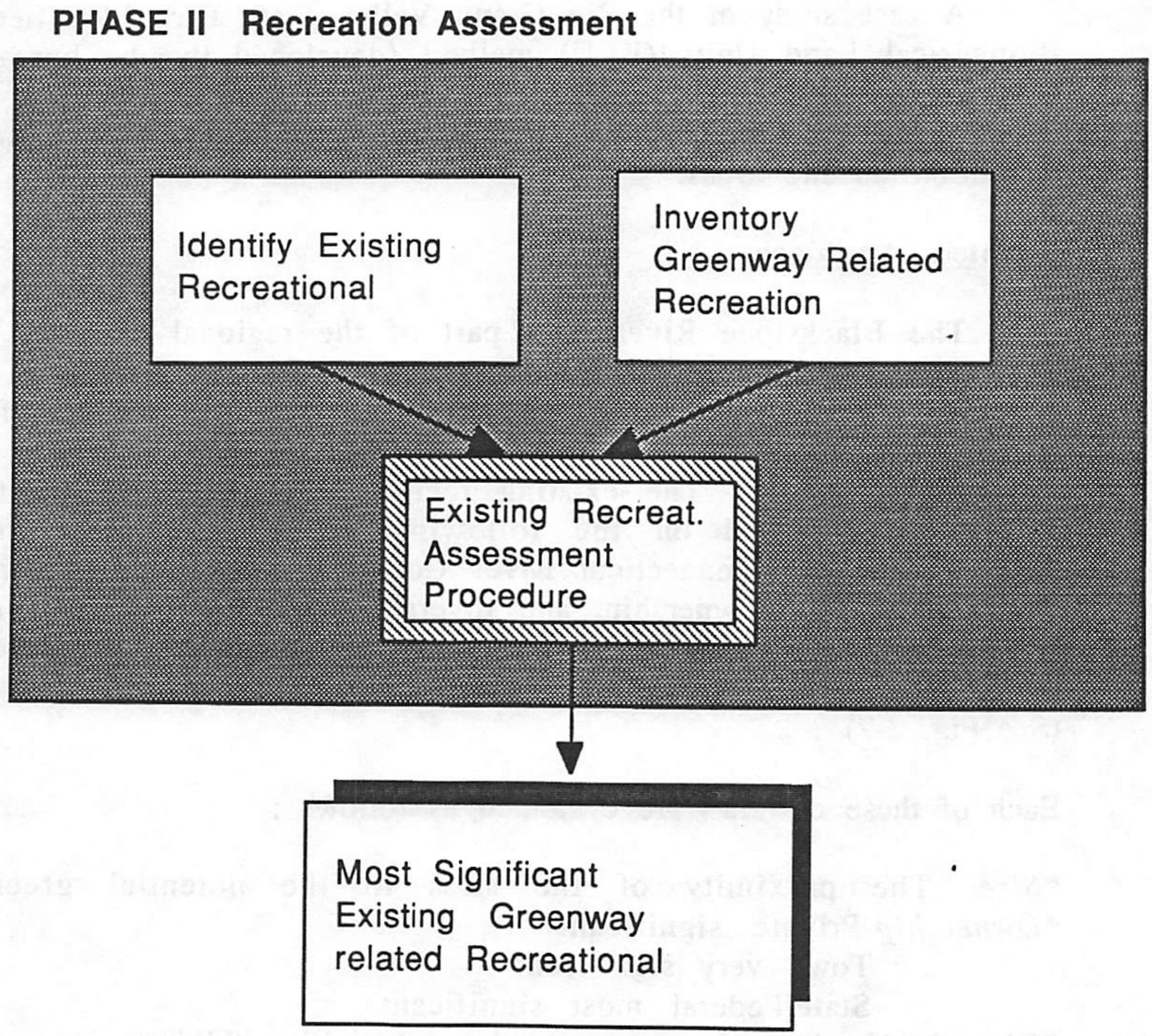


Figure 2-7: Recreation Assessment Procedure

* trail systems
* waterways
* scenic roads

Step 3: Overlay *existing* nodes over linkages
Step 4: Provide for final composite assessment.

Findings

The existing protected recreation sites were assessed by ownership, size, and diversity of greenway related activities. Our findings reveal that 1076 acres or 6.87% of the total land area of Uxbridge is protected for recreation use. These areas are unique in that they offer significant greenway related recreation activities. 898.60 acres or 4.88% are classified as most significant offering a diverse range of recreation activities such as hiking, bicycling, canoeing and picnicking. These sites have more than 51 acres per parcel, except for the Blackstone Heritage Park which has 38 acres. The size was weighed less significant due to the park's physical proximity to the Blackstone River Corridor, which is the most significant part of the greenway network. These parcels were also rated for their compatibility for coming under the auspices of the commission.

Sites that were rated very significant comprised 343.62 acres or 1.79%. These sites were mostly limited by the diversity of greenway related recreational opportunities. (See Fig.2-8) Two parcels of interest are owned by Laurel Brook. They were in this category due to their private ownership. These sites comprise 500 acres and offer many greenway related activities, therefore regarding these criteria, are most significant. Sites that were rated significant comprised 77.26 acres or .40%. These sites were limited by their diversity of activities and size. There are six picnic sites in town, most are on existing recreation lands.

A trail system in the Uxbridge area is being developed by the Equestrian riding club, which has incorporated old trails, scenic roads, and an abandoned rail bed into a continuous trail system. The trails offer a significant linkage along the river, to the southwest and into the surrounding towns. These trails need to be expanded to connect several significant parcels of land, such as the Town Forest, Taft Park and the 100 acres parcel on Sutton Street. There are six picnic sites in town, most are on existing recreation lands.

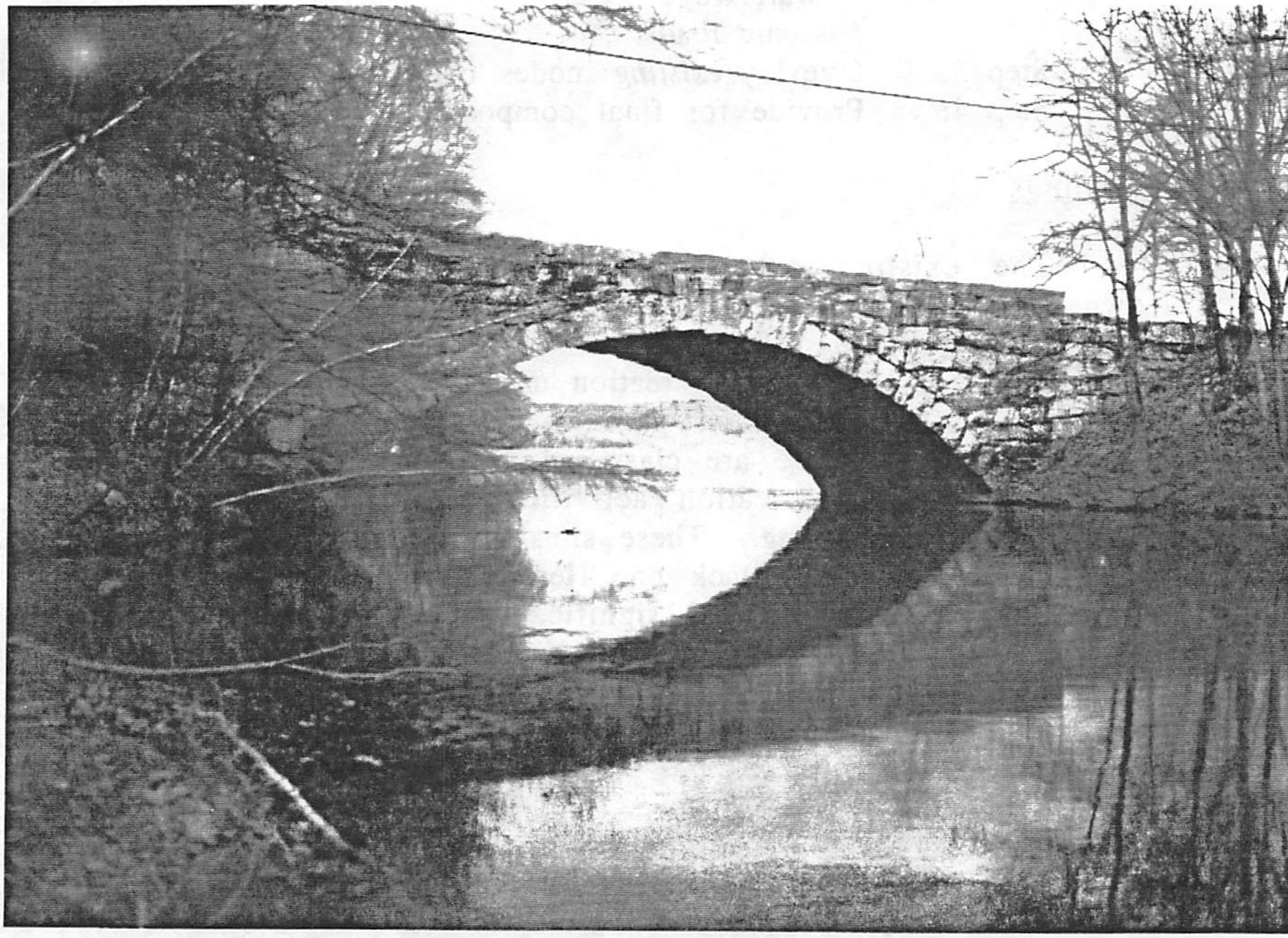


Figure 2-8: One of the many recreation resources of Uxbridge, Charles Ballou Recreation Area

This initial assessment shows many beautiful areas and opportunities for recreation along a greenway network. It also reveals the need to link additional open land for recreational use. These could be picnic sites, swimming beaches, additional canoe launches or scenic areas.(See Fig. 2-9)

The METLAND research team is currently preparing a detailed assessment of the potential recreation sites. The final report will be available by mid-summer. This will provide the final assessment of recreation opportunities from which to develop a complete greenway plan.

The future impacts, as assessed by the Environmental Scan Team, reveal that 12,000 people could visit Uxbridge on a daily basis. This demonstrate the need, emphatically, to plan the land use to maximize cultural/recreational opportunities and to be sensitive to the protected lands.

HISTORIC AND CULTURAL RESOURCES

Significance

Historical resources can be described as sites, structures, or objects that have played a role in the area's past events, while cultural resources also include those places and objects which reflect the current ways of life in an area (Connecticut River Greenway Study, 1984). Charles Little, in Greenways for America, expresses the importance of integrating historic and cultural resources in the planning and implementation of a comprehensive greenway network. Little envisions greenways as a way to "...acquaint as many people as possible with the scenic and historic features..." that are part of the landscape (Little, 1990).

The town of Uxbridge takes pride in their rich historical and cultural heritage. Throughout Uxbridge, the National Register of Historic Places have surveyed many of these historic resources. Integrating these resources into the greenway network would educate the visitors as well as the residents and also enhance the town's sense of place and character.(See Fig, 2-10)

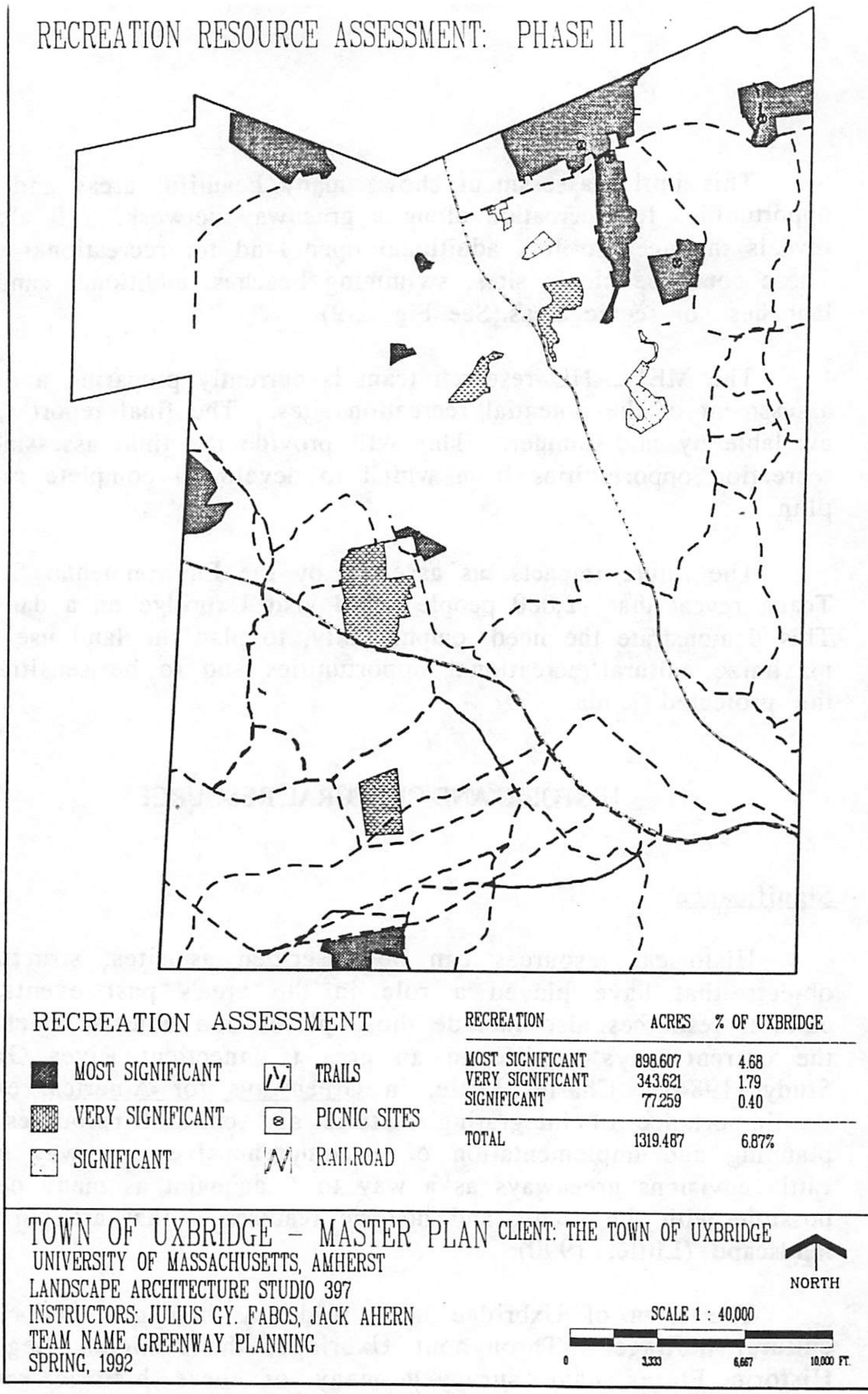


Figure 2-9: Recreation Assessment Map

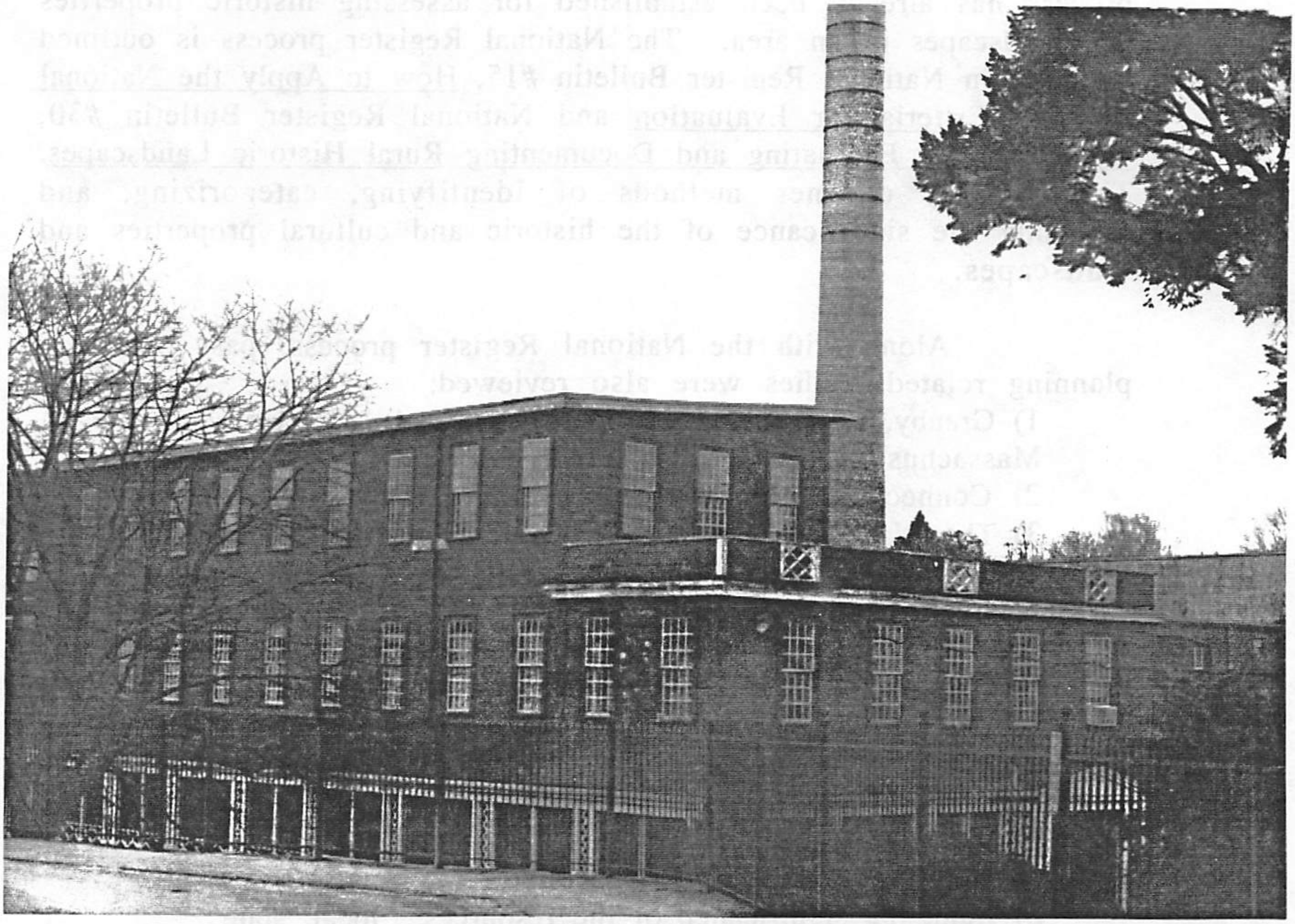


Figure 2-10: Bernat Mill- a reminder of the American industrial revolution.

State of Assessment Procedure

In the National Register of Historic Places a step by step process has already been established for assessing historic properties and landscapes in an area. The National Register process is outlined in detail in National Register Bulletin #15, How to Apply the National Register Criteria for Evaluation and National Register Bulletin #30, Guidelines for Evaluating and Documenting Rural Historic Landscapes. This process outlines methods of identifying, categorizing, and assessing the significance of the historic and cultural properties and landscapes.

Along with the National Register process, past greenway planning related studies were also reviewed:

1) Granby, Connecticut: A Land Use Study, University of Massachusetts at Amherst, Studio IV, 1991.
2) Connecticut River Greenway Study, 1984.
3) The Blackstone River Valley National Heritage Corridor: A Greenway Planning Study, University of Massachusetts at Amherst, Studio IX, 1991.

In these studies, a step by step procedure for assessing significant historic and cultural properties and landscapes followed that of the National Register process:

1) Identify historic and cultural resources using the National Register of Historic Places for the town.
2) Rank the significance of the resources: local, state, or national.
3) Determine how to rate significance in relation to type of planning.
4) Define the historic and cultural districts.

Adapted Approach

From the National Registry of Historic Places, six districts in the town of Uxbridge, Massachusetts have already been identified. From reviewing the above literature and studies, the step by step process will be adapted for assessing the historic and cultural sites for the town of Uxbridge. The following steps will be taken to assess any additional historic and cultural sites that are not already identified by the National Registry of Historic Places (see fig. 2-11).

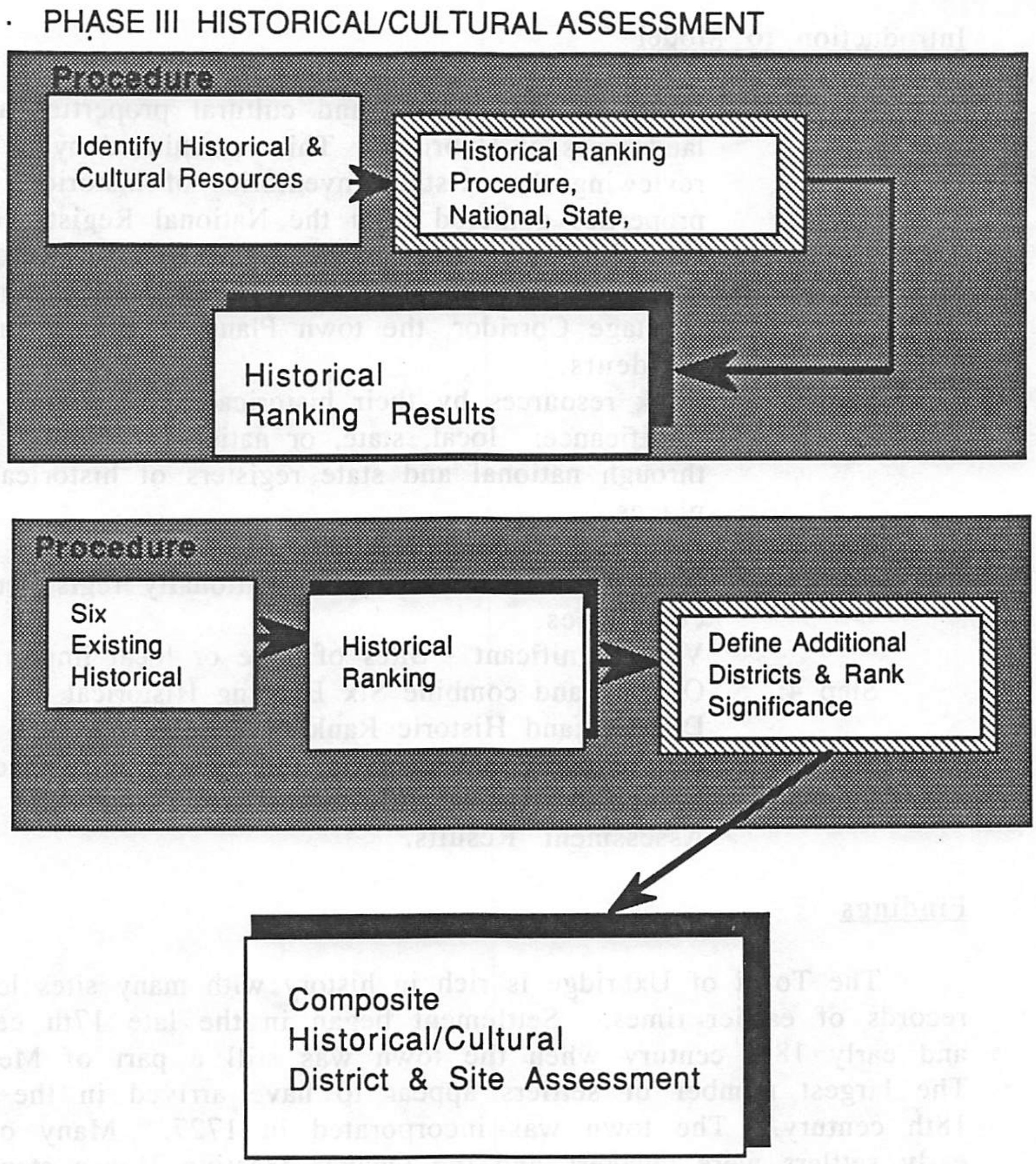


Figure 2-11: Historical/Cultural Assessment Procedure.

Introduction to Model

Step 1: Inventory the historic and cultural properties and landscapes of Uxbridge. This is achieved by reviewing the existing inventories of historic properties gathered from the National Register of Historic Places and Districts, the Historic Resources Inventory for the Blackstone River Valley National Heritage Corridor, the town Planning Board, and the residents.

Step 2: Rank resources by their historical and cultural significance: local, state, or national. This is found through national and state registers of historical places.

Step 3: Historical ranking results:
Most Significant - All sites nationally registered and cemeteries.
Very Significant - Sites of state or local importance.

Step 4: Overlay and combine Six Existing Historical Districts and Historic Ranking Results.

Step 5: Define additional districts and rank significance.

Step 6: Composite Historical/Cultural Districts and Site Assessment Results.

Findings

The Town of Uxbridge is rich in history with many sites leaving records of earlier times. Settlement began in the late 17th century and early 18th century when the town was still a part of Mendon. The largest number of settlers appear to have arrived in the early 18th century. The town was incorporated in 1727. Many of the early settlers were Quakers and the Quaker Meeting House stands in testimony to their presence on Route 146A.

Industrial development began in 1810 with the opening of the Day Woolen Mill. Other mills followed including the Ironstone Manufacturing Co., Rivulet Manufacturing Co. and Uxbridge Woolen Co., who all utilized the water power of one of the three rivers which flow through Uxbridge. Manufacturing became the mainstay of the town. The opening of the Blackstone Canal allowed commercial development between Providence and Worcester. Transportation was further improved by the opening of the Providence and Worcester Railroad in the 1840's. The Civil War brought about a great demand for woolen coats for the soldiers and the Uxbridge mills were kept busy filling government contracts. Steam power began to come into use in the 1870's and 1880's to supplement the water power. The large manufacturing cities, such as Worcester and Lawrence brought about the need for larger plants in order for Uxbridge to stay competitive. Mills that were active and expanded at that time were the Waucantuck Mill, the Central Woolen Mill and the Rivulet Mill, which is a historical site of national designation.

This vast heritage remains in the designation of six historical districts recorded in the National Register. They are Uxbridge Common District, the Wheelock District, the Central Woolen Mill District, Waucantack Mill Complex, Rogetson Village and Rilvulet Mill Complex. Within these districts, and scattered throughout the town, are forty-one historical sites. Twenty-two are recorded in the National Register with nineteen sites of state or local significance. In addition, there are thirty-two cemeteries, twenty-six of which are family cemeteries which tell their own stories of the past. (See Fig. 2-12) The Uxbridge Historical Commission has spent much time and research surveying these family plots. "Each marker was photographed, measured, and documented concerning condition, placement, material, size, shape, decoration and record of full inscription." (Uxbridge Historical Commission, Family Cemetery Survey.)

The wealth of history within the town of Uxbridge is important not only to Uxbridge but to the region as a whole. Preservation of these sites will ensure that future generations will better understand the ongoing dynamics and evolution of townships.(See Fig. 2-13)

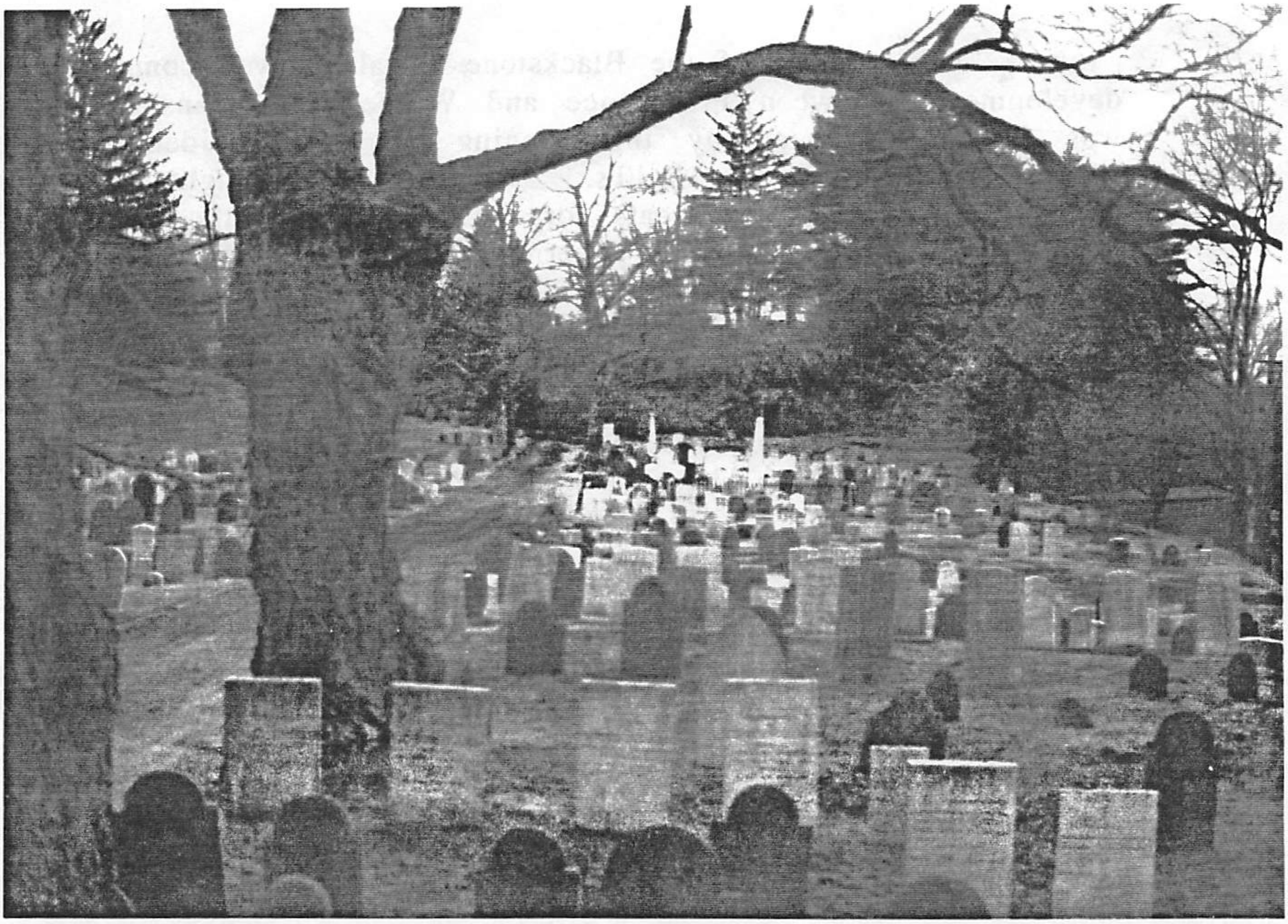


Figure 2-12: Prospect Hill Cemetery - a site that tells its own story of the past.

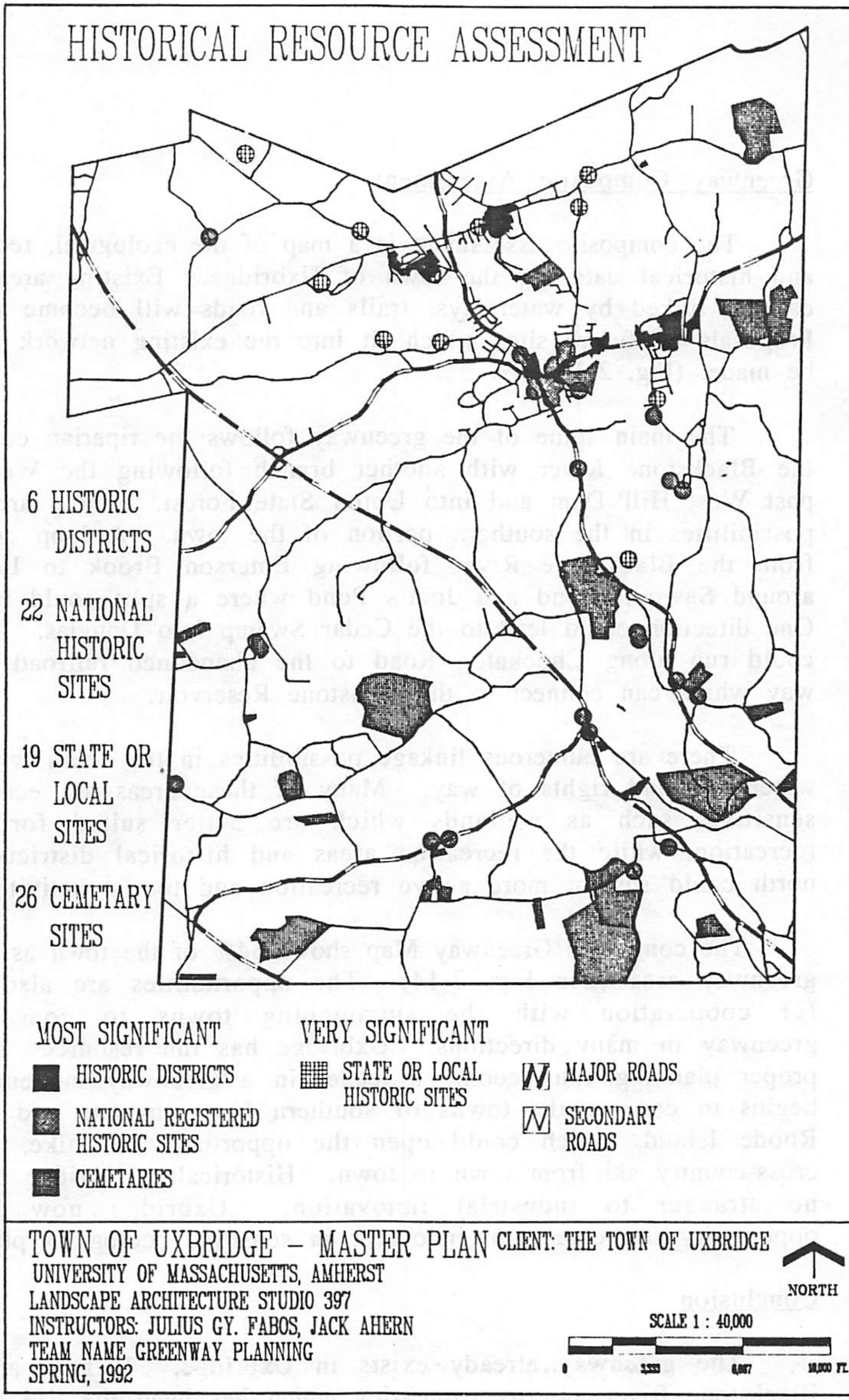


Figure 2-13: Historical Assessment Map

Greenway Composite Assessment

The composite assessment is a map of the ecological, recreational and historical data for the town of Uxbridge. Existing areas which can be linked by waterways, trails and roads will become apparent. Proposals on future sites which fit into the existing network can then be made. (Fig. 2-14)

The main spine of the greenway follows the riparian corridor of the Blackstone River with another branch following the West River past West Hill Dam and into Upton State Forest. There are several possibilities in the southern portion of the town. A loop could run from the Blackstone River following Emerson Brook to Lee Pond around Sawmill Pond and Joel's Pond where a split could be made. One direction could lead to the Cedar Swamp into Douglas. An other could run along Chockalog Road to the abandoned railroad right of way which can connect to the Ironstone Reservoir.

There are numerous linkage possibilities in the south with trails, waterways and rights of way. Many of these areas are ecologically sensitive, such as wetlands which are better suited for passive recreation, while the recreation areas and historical districts in the north could sustain more active recreation and tourist activities.

The composite Greenway Map shows 34% of the town as potential greenway areas.(See Fig. 2-14) The opportunities are also present for cooperation with the surrounding towns to continue the greenway in many directions. Uxbridge has the resources and with proper planning can become a leader in a greenway movement that begins to connect the towns of southern Massachusetts and northern Rhode Island, which could open the opportunity to hike, walk or cross-country ski from town to town. Historically Uxbridge has been no stranger to industrial innovation. Uxbridge now has the opportunity to become an innovator in sensitive ecological planning.

Conclusion

The greenway already exists in Uxbridge. It runs along the Blackstone River and its tributaries which has been the life blood of the town since its beginning.(See Fig. 2-15) Nature provides the framework for a connected greenway system in the form of

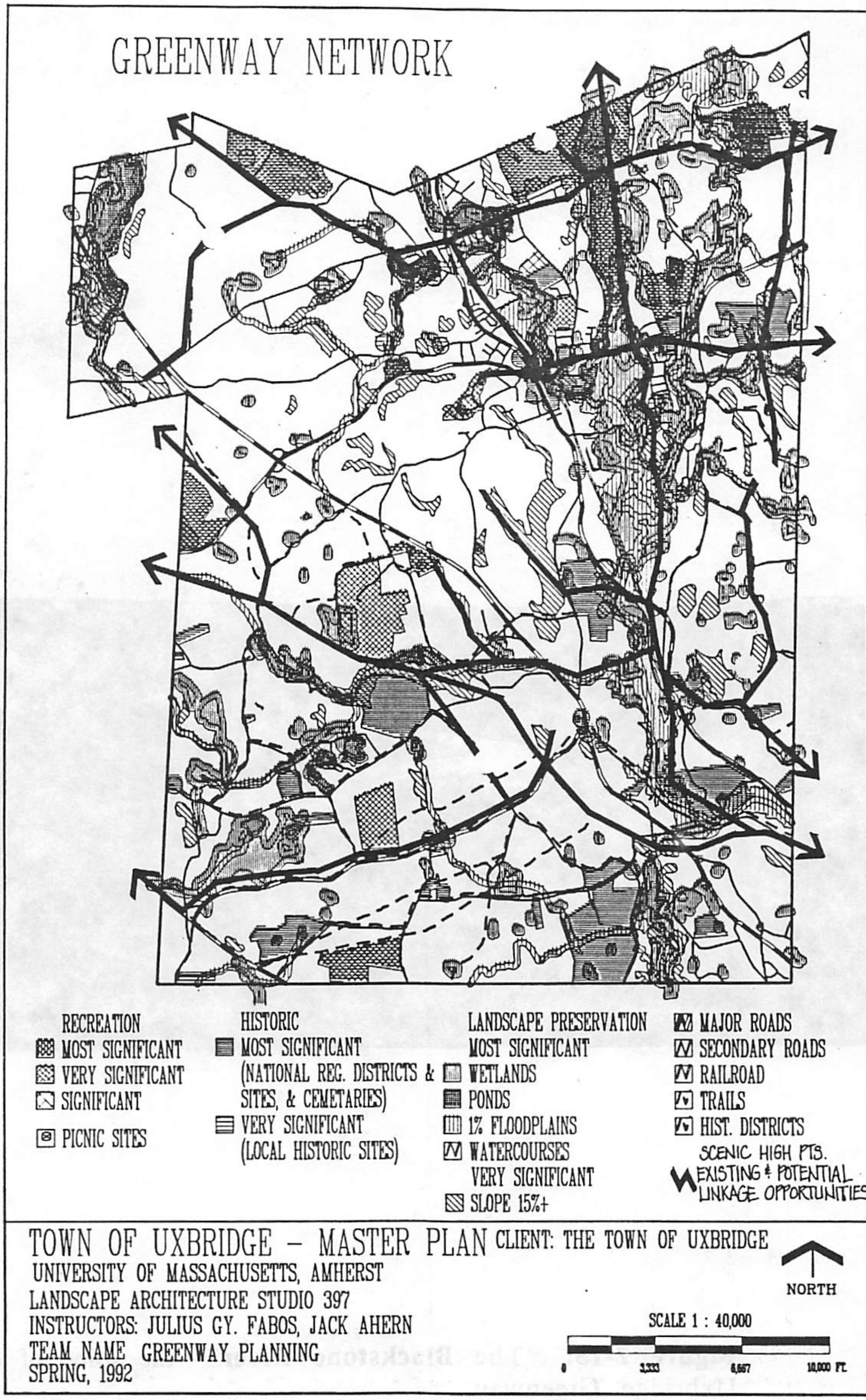


Figure 2-14: Composite Greenway Assessment Map

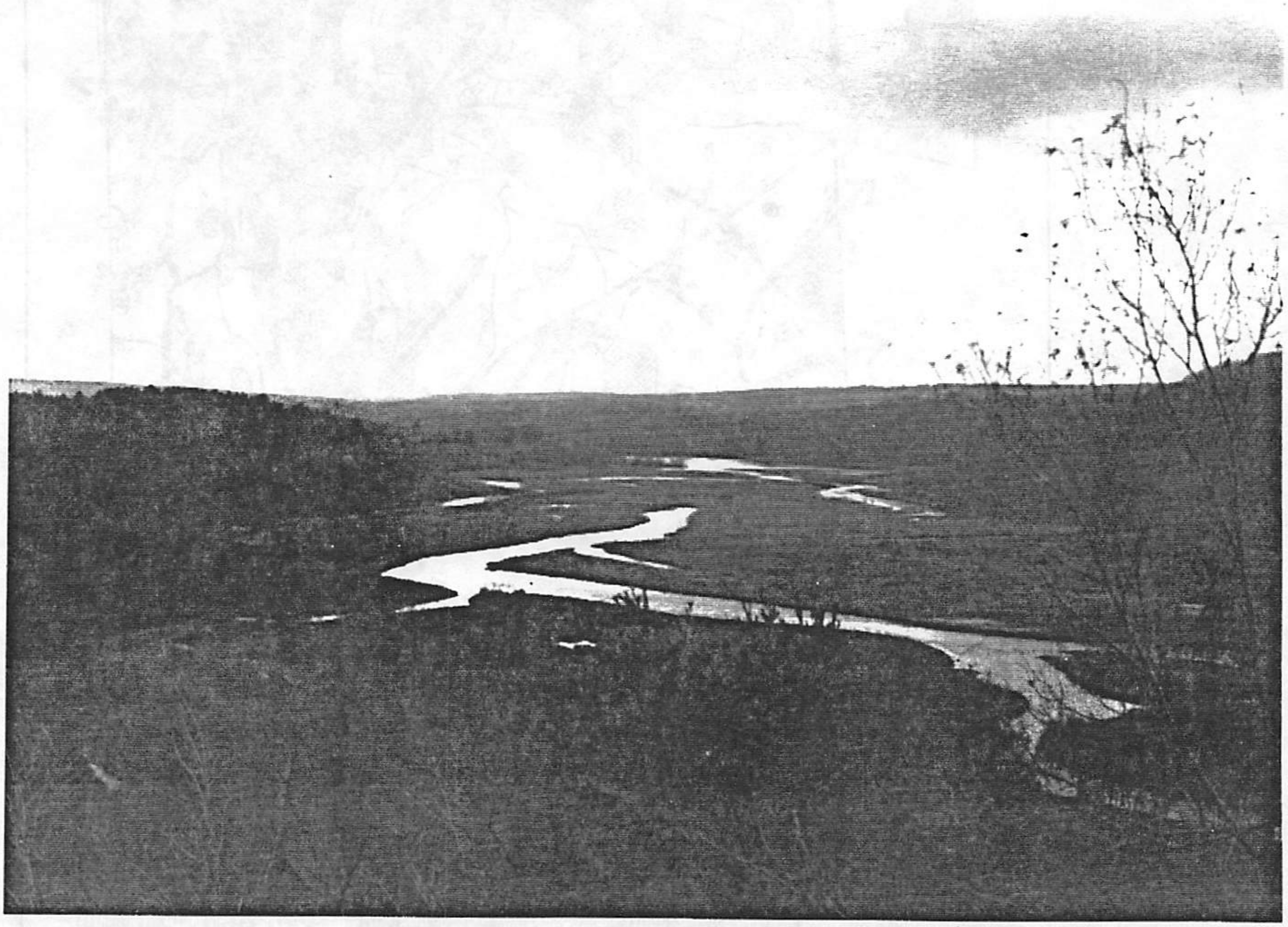


Figure 2-15: The Blackstone River - the spine of the Uxbridge Greenway.

waterways, wetlands and steep slopes. All that is required is the recognition of these features as valuable ecological systems that can be utilized and connected to the many historical and recreational areas.

Congress has recognized the national significance of the Blackstone River valley by establishing the Blackstone River Valley National Heritage Corridor and a commission to help develop a vision of the valley's potential. Uxbridge as a part of this corridor can further that vision by preserving its rich landscapes as well as the structures and sites that represent the history of the American Industrial Revolution in the form of the Uxbridge greenway.

Critical Resources

Chapter 3

INTRODUCTION

Critical and special resources are natural resources contained within the town that are unique, scarce, or rare. Critical resources would be defined as resources a town cannot live without, such as water and sand and gravel. Special resources would simply be other resources, unique to the town, that may be very beneficial in some other way. Two types of critical and special resources are defined for this study, renewable and non-renewable. Renewable resources can be recharged, such as ground water which is recouped from annual precipitation. Non-renewable resources can not be replenished, and once they are used, they are gone forever, such as mineral resources like sand and gravel, or agricultural soils.

The town of Uxbridge is very fortunate in its abundance of current ground water supply and sand and gravel resources. Upon observation and detailed study, the town seems to be adequately served by three wells with very high quality drinking water. They are also preparing for the future with three proposed new sources, one of them (the Bernat wells) is in the process of being connected to the existing system. Geological surveys and numerous visible sand and gravel pits throughout the entire limits of the town indicate a plentiful and well used supply of that resource. However, the same area that this resource occupies happens to be a part of the towns aquifer recharge area. This co-occurance will be of major concern in this report.

Other potential special resources in Uxbridge, such as granite and timber, have not been studied in this report, but may be of interest at a future date.

The purpose of this study is to make Uxbridge aware of its critical and special resources so that the town can protect them, and/or make informed decisions on how to manage and use them wisely.

Goal:

To protect and assess the critical and special resources so they can be managed for proper use and to accommodate the future growth of Uxbridge.

Objectives:

1: To identify and assess existing underground water supplies according to the location, quality and quantity of water, and to identify viable management options for these resources.

2: To assess significant areas of sand and gravel deposits and identify those areas where delayed development should be an option.

3: To identify and assess significant agricultural lands and examine preservation options for valuable agricultural areas.

GROUND WATER

Significance

The availability of surface and/or ground sources of water in useable supplies is necessary and critical to the economic growth of any town or region. High quality-high yield water supply sites are particularly important economic resources (METLAND Caswell/Fabos 1979 p.59). Uxbridge is a very fortunate town in this manner because of its high quality of water.

Although seldom exploited in the past, ground water reservoirs contain the largest existing storage of fresh water. If the ground water is withdrawn at rates of a safe yield, they are practically inexhaustible source of water. For the most part ground water in general is "clean" with the exception of polluted run-off from development (Gupta 1973).

Development can affect the ground water by increasing surface run-off, limiting infiltration, and altering ground water quality. Contaminants can enter the ground water supply if contaminants or contaminated sites (such as 21E sites) are located over the aquifers in a pervious recharge area (Refer to Hazards Ch.4). Also, in developed areas, precipitation that would normally be absorbed into the water table is carried away over buildings, parking lots, roads, driveways, and other impervious surfaces, into storm drains and swales that empty into nearby streams and rivers: This could deplete the ground water supply by reducing its capacity to recharge.

Ground water yielding aquifers and aquifer recharge areas are today of considerable benefit to developing metropolitan areas and so warrant protection from all those types of development (e.g. residential, commercial, highway) which can lead to the elimination and/or pollution of their available supplies. Development near the recharge area or on or near any part of the aquifer may result in ground water pollution. However, where the aquifer is separated from the surface by an impermeable layer of clay or other material, development on the aquifer may be possible (METLAND Caswell/Fabos 1979 pp.59-60). The town's largest potential aquifer area extends from north to south in the town's eastern half, underlying the Blackstone, Mumford, and West Rivers. Generally speaking, its central portions are identified as having potential high-yield (greater than 250 gallons per minute (gpm)). These areas are surrounded by areas identified as having potential medium-yield (50-250gpm) and, on the outer edges, potential low-yield (less than 50 gpm). (Blackstone Valley, 1989, p65).

State of Assessment Procedure

Existing techniques for ground water assessment have been provided by geologists and hydrologists. They have come up with site investigations which employ any one of several seismic, gravitational, and electrical geophysical techniques. The ground water assessment involves actual drilling of test wells. Pump tests are then run to determine the safe-yield and the transmissibility of each groundwater source (METLAND Caswell/Fabos, 1979, pp61-62).

An aquifer is a geologic unit that yields significant quantities of water. An aquifer can consist of fractured bedrock or surficial geologic deposits such as sand and gravel. Although most soils are capable of supporting a single domestic well, an aquifer represents a much larger resource, often capable of meeting municipal system demands. In order to determine whether aquifer yields are sufficient to support municipal water supplies, detailed ground water availability and delineation studies would be required (IEP report). Generally speaking, yields should be of sufficient quantity to meet demand; risk of contamination should be low, and the aquifer should be of sufficient size to enable consistent yields over time.

The aquifers map depicts the location of potential high-, medium-, and low-yield aquifer areas in Uxbridge. The sources for this information are MassGIS aquifer maps, which are based on

USGS/ Massachusetts Division of Water Resources Hydrologic Atlas Maps.

Adapted Approach

Since assessed data was available, the team obtained additional facts about the towns ground water supply that were used as follows:

In the town of Uxbridge there are large aquifer and aquifer recharge areas (See Figs. 3-1&2). With an average rate of yield per person per day, a total output needed from the wells can be determined.

There are three wells being used for the town's water supply. With the total output of these wells, the amount of growth the town could theoretically support can be determined, assuming the supply was used to its maximum. If the town's proposed wells were to go on line, the population could increase to even a greater extent.

The people of Uxbridge withdraw 0.8 million gallons per day (Mg/d) from the existing wells. The Blackstone wells (on Blackstone St.), that are currently on line yield two wells at 500 gallons per minute (g/m) (1.5Mg/d) and one other at 800g/m (1.2Mg/d) (See Fig. 3-3). These combined give a total output estimated output of 2.6Mg/d (Water supply annual statistical report). The town also has another well area, the Bernat wells. Larry Bombara (head of Uxbridge D.P.W.) states that this area could provide as much water as the Blackstone wells, 2.6Mg/d. The combination of all these areas the output totals an estimated 5 Mg/d at maximum yield.

There are areas that have been proposed for future water supplies to the town, namely the Cnassen well and the Hutnak test hole (See Fig. 3-1). The areas were tested for maximum yield by the firm of Haley & Ward. When tested, the Cnassen well area (located in southeastern Uxbridge, on the Quaker Highway) produced 350g/m (0.5Mg/d) and the Hutnak area (located in the northeast, on Menden St.) was tested to yield 600 g/m (0.8Mg/d). At these rates, the new wells could potentially supply an additional 1.3Mg/d to the town.

Knowing the average gallons of water used by each person per day, and the full potential of the wells, the maximum population that can be supported by these supplies may be estimated. First a g/d per person has to be calculated, but this calculation has to account for

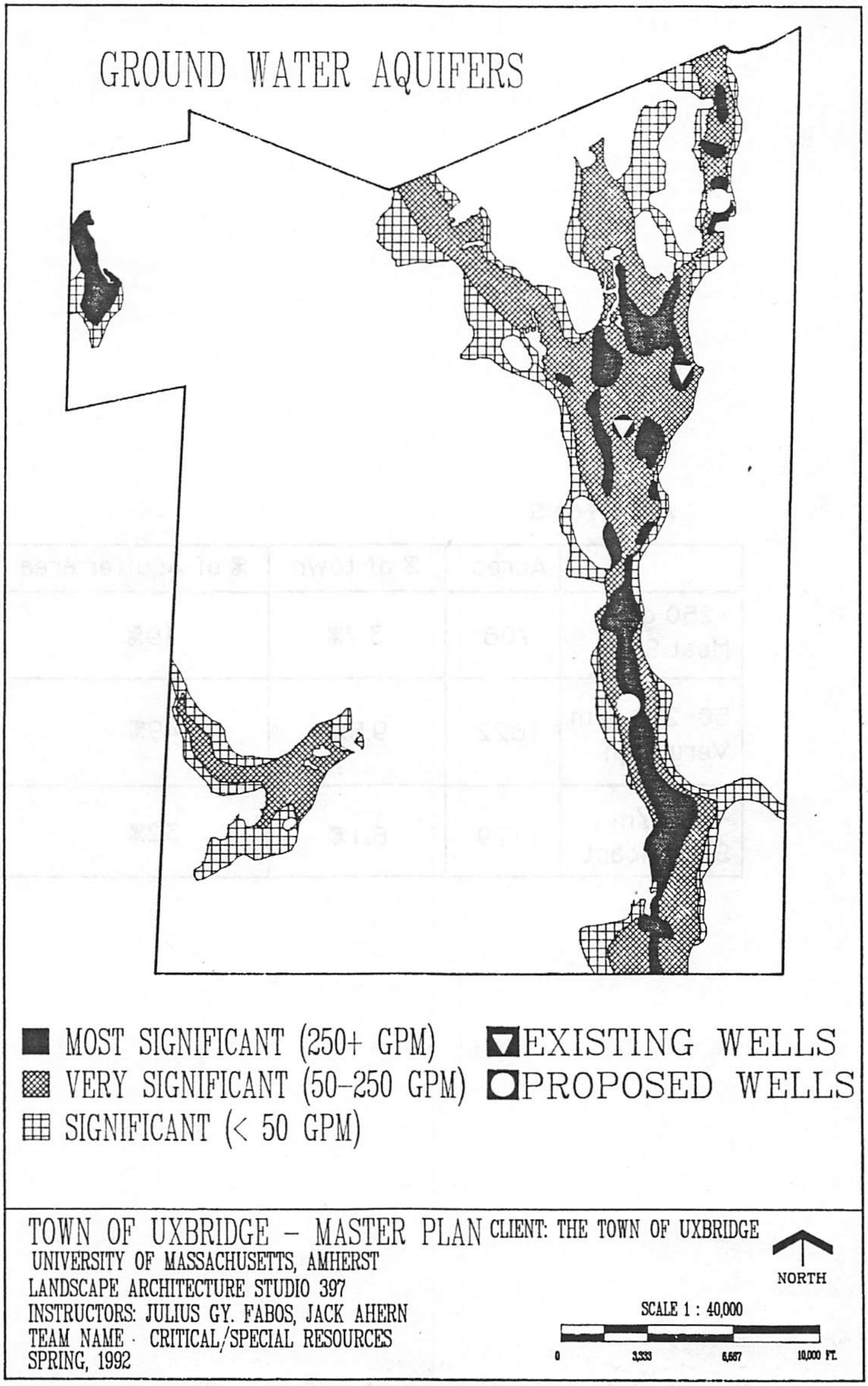


Figure 3-1: Ground Water Map. Areas of high, medium and low output are shown with existing and proposed well locations. See figure 2-2 for statistics.

Aquifers

	Acres	% of town	% of Aquifer area
+250 g/m Most Sign.	708	3.7%	19%
50-250 g/m Very Sign.	1822	9.5%	49%
- 50 g/m Significant	1179	6.1%	32%

Figure 3-2: Statistics on Aquifers. The acreage and percents are given for the areas designated on the map (Fig. 2-1) as Most Significant, Very Significant and Significant.

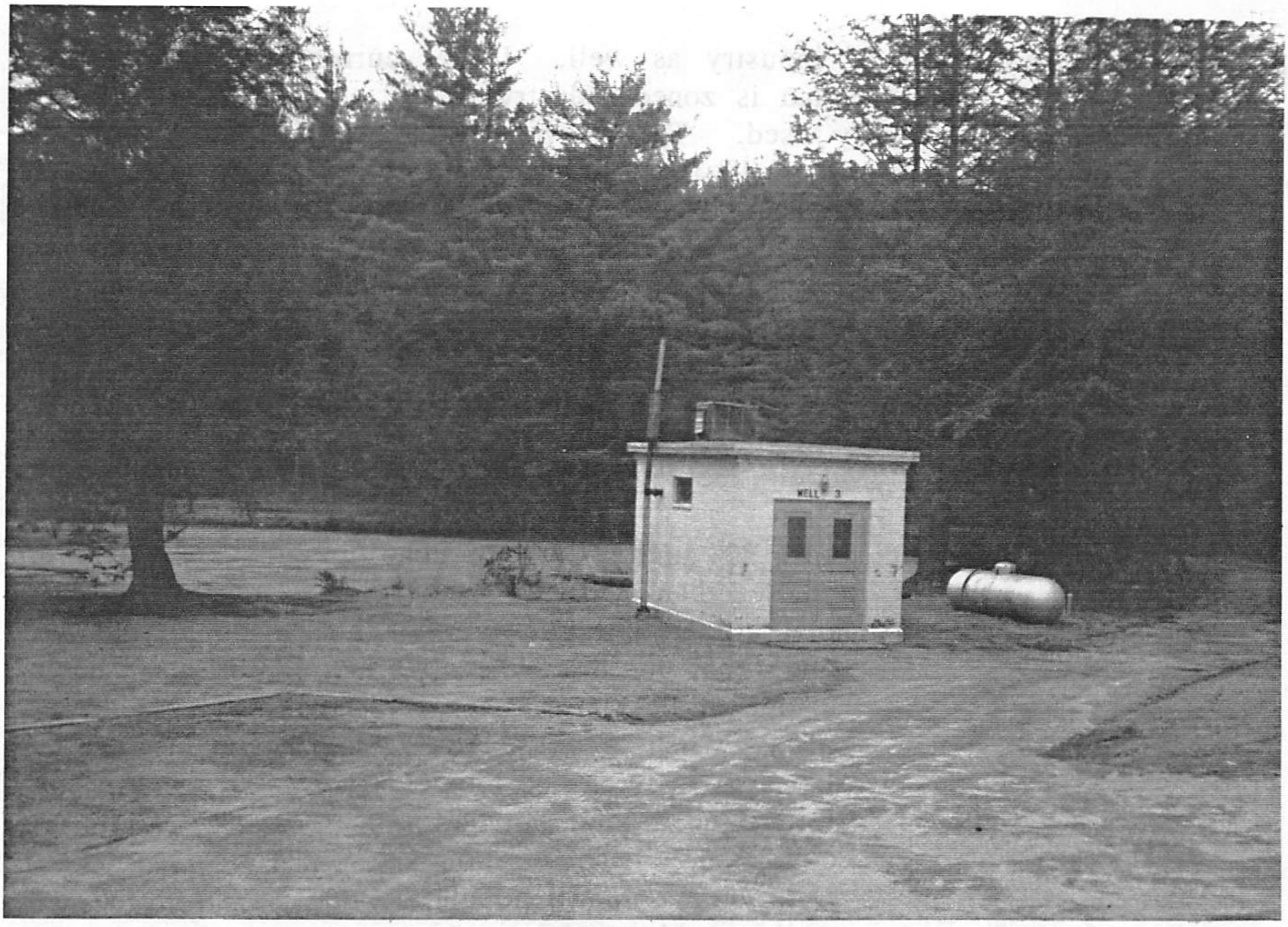


Figure 3-3: Well Number 3. Well No. 3, located near Blackstone St., is one of the wells now serving the town. This well site, along with the Bernat wells and future Cnassen and Hutnak wells must be protected from contamination.

future growth of industry as well. Under current zoning, the total area of Uxbridge that is zoned industry is 891 acres, of that area 237 acres is currently used. This leaves 654 acres not being used for industrial purposes. If these unused industrial zones were to be developed, it would be a 275% increase in industry. Currently, based on the town's annual water report to the state, industrial use represents 0.11% of the total water used by the town. With these figures, it was calculated that the current documented use of 80 gallons per person, per day would increase to 100 gallons per person, per day with a full buildout of industrial zoned land.

Introduction to Model (See Fig. 3-4)

Step 1: Use the aquifer map to determine the areas that are greater than 250 g/m (most significant), the areas that are 50-250 g/m (very significant), and the areas that are less than 50 g/m (significant). The source of this information is the Mass GIS aquifer maps, which are based on USGS/Massachusetts Division of Water Resources Hydrologic Atlas Maps.

Step 2: Determine a total population that existing wells could support.

Step 3: Determine a total population that the proposed wells could support.

Step 4: Combine the two totals of the existing and the proposed wells to estimate a buildout population for the town.

Step 5: Assess the town water supply and determine if it is adequate.

Step 6: Assess existing buffers and propose new ones if needed.

Findings

The aquifer area is 19.3% of the total acreage of the town. These areas are divided into three categories, high, medium, and low yielding. High output represents 3.7%, medium output represents 9.5%, and low output represents 6.1% of the total area in town (See Figs. 3-1&2). The aquifer recharge area is essentially the same area of sand and gravel deposits, and covers 41.3% of the town. Of that percentage, 14.9% is developed on. This could be a reason for creating buffer zones around these areas.

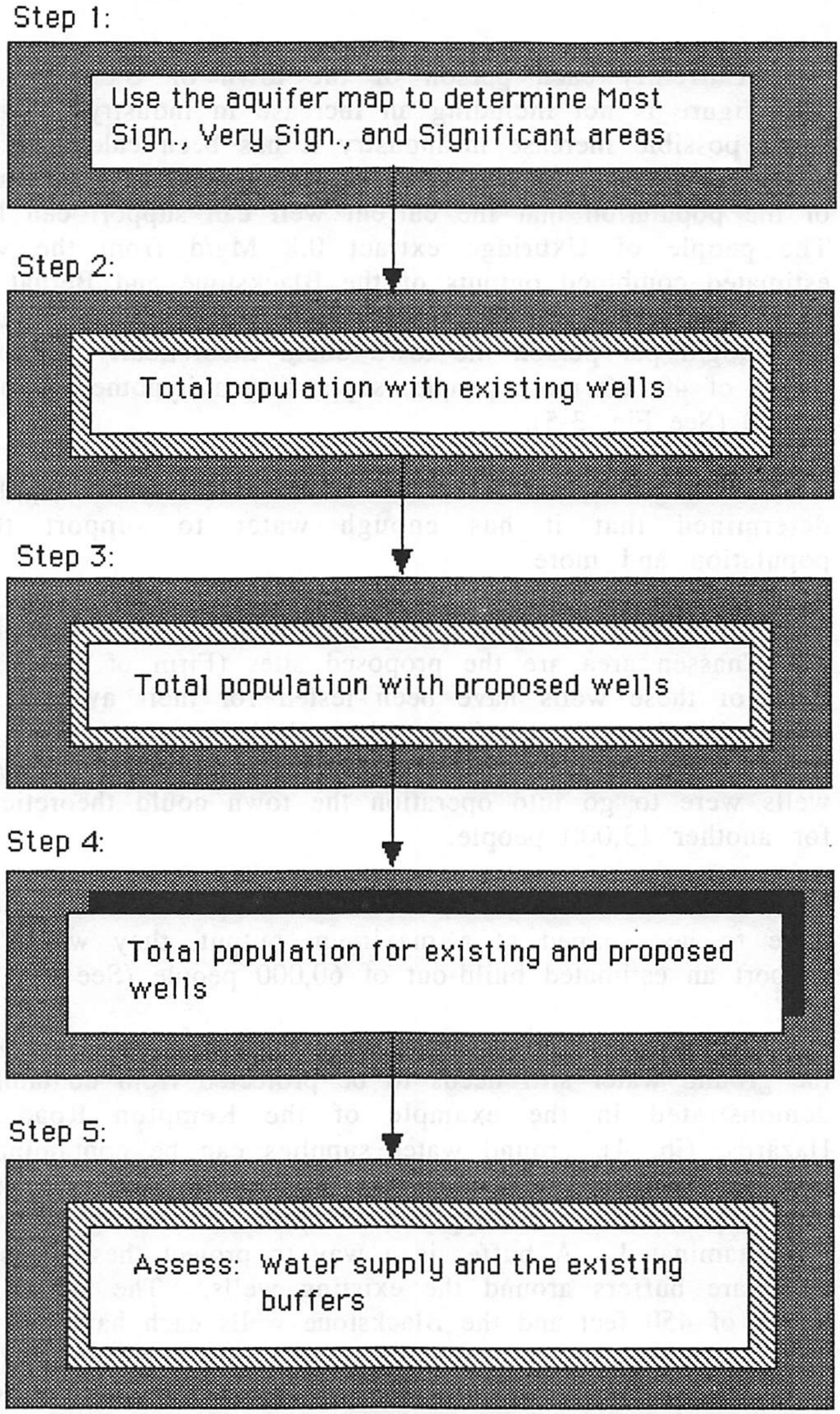


Figure 3-4: Outline of Steps. This flow chart outlines the steps taken in the adapted procedure for ground water supply.

Currently each person of the town of Uxbridge uses 80g/d. This figure is not including an increase in industry. To compensate for a possible increase in industry it has been calculated that 100g/d is used by each person. With the figure 100g/d per person, the size of the population that the current well can support can be analyzed. The people of Uxbridge extract 0.8 Mg/d from the wells. The estimated combined outputs of the Blackstone and Bernat wells totals 5Mg/d. This leaves an estimated 4Mg/d that is not being used. Using the 100g/d per person the town could theoretically support a growth influx of 40,000 more people, supporting a hypothetical population of 50,000 (See Fig. 3-5).

Through the studies done on the town's water supply it can be determined that it has enough water to support the existing population and more.

More wells are being proposed for the town. The Hutnak area, and Cnassen area are the proposed sites (Firm of Haley and Ward). Each of these wells have been tested for their average daily yield, and it has been assessed that they all have a very high output (See Figs. 3-1&2). Their total combined daily output is 1.3Mg/d. If these wells were to go into operation the town could theoretically provide for another 13,000 people.

It is concluded that, if all the wells (existing and proposed) were to be pumped at a maximum output, they would be able to support an estimated build-out of 60,000 people (See Fig. 3-5).

The town's water supply may appear to be very plentiful, but the ground water still needs to be protected from contamination. As demonstrated in the example of the Kempton Road wells (See Hazards, Ch. 4), ground water supplies can be contaminated through pervious soils or recharge areas, and to considerable depths. The town's plentiful water supply could turn into no supply very quickly, if contaminated. A buffer is a way to protect these sites. Currently there are buffers around the existing wells. The Bernat well has a buffer of 450 feet and the Blackstone wells each have a buffer of 400 feet. It would be recommended that a larger buffer of 1000 feet be used around the proposed wells, because of the high potential yields and critical nature of this resource.

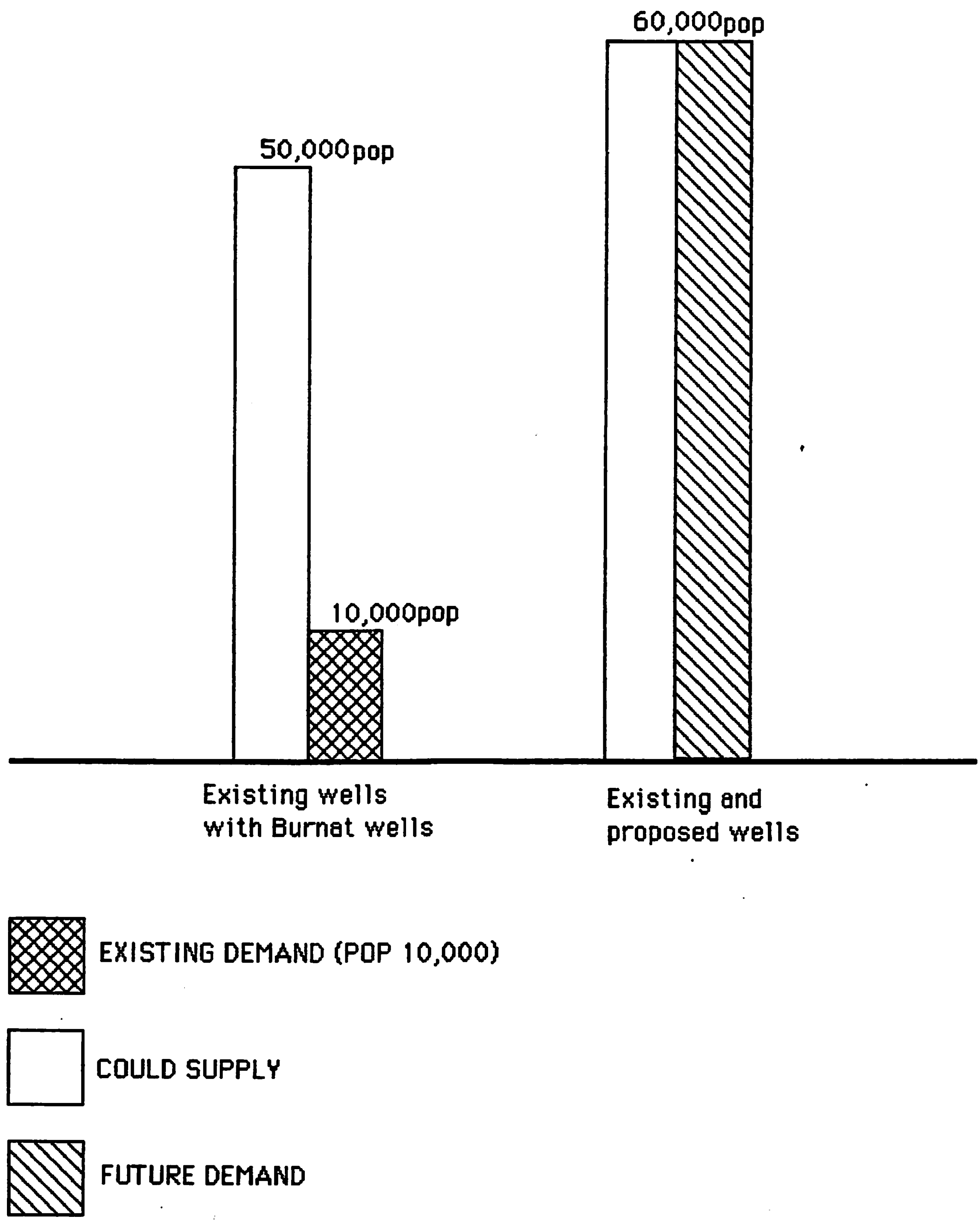


Figure 3-5: Water Supply Bar Graph. The bar graph shows that the town has more than enough water now, and that with proposed future supplies it could theoretically support a population of 60,000. The main issue of concern is the protection of these supplies.

SAND AND GRAVEL

Significance

All developing landscapes are major users of sand and gravel, which are a basic component of bituminous and concrete and therefore essential in the building and maintenance of roads. Since the nature of sand and gravel has a high volume/low unit value, transportation costs constitute a very large part of total use costs (METLAND Caswell/Fabos, 1977, p.88). These transportation costs are quite low in the town of Uxbridge, as they have a very ample supply of sand and gravel at the present time.

Although the state itself is rich in potential sand and gravel supplies, it has expanded, and with expansion comes the depletion of many deposits. More importantly, development (especially suburbanization) over sand and gravel deposits can eliminate huge amounts of land and opportunities for mining. This then makes the left over sand and gravel deposits much more valuable within the state. Studies have been done in the Boston Metropolitan region to show that each person uses about 2.6 tons of sand and gravel per year (New England River Basins Commission, 1974). At these rates, sand and gravel supplies can be used up at rates much higher than expected.

Ideal sand and gravel deposits would be located near a major road, and would be away from residences to avoid conflicts of interest due to noise and truck traffic.

State of Assessment Procedure

Both geologists and soil scientists have been concerned with the assessment of sand and gravel. They have broadly interpreted soil types as having "slight", "moderate", or "severe" limitations for sand and gravel supply. These interpretations are primarily useful for very general assessment of aggregate potential in the landscape. The most common way of assessing sand and gravel has been developed by geologists. A surficial geology map is the most general technique, but a map of this type has not yet been prepared for the town of Uxbridge. Seismic and other subsurface geophysical tests comprise the second level technique to gain more specific information on promising deposits as well as depth and height to the water table. At the third level, site tests in the form of auger borings are made. These tests determine the potential use of the materials by providing data on size, evenness, shape of the particles, and the overall quality of the aggregate supply (METLAND Research Report, Caswell and Fabos, 1979, p 89.)

Adapted Approach

The sand and gravel supply assessment technique is based on the interaction or combination of two landscape conditions: 1) the natural potential of the surficial material to yield usable sand and gravel and 2) the degree from to which the overlying land use detracts from that potential. There also is a third factor which is important to the practical usability of a sand and gravel supply is the state of existing municipal legislation (METLAND Caswell/Fabos 1979 p.90).

Since Uxbridge does not have a surficial geology map, the depth of the sand and gravel deposits had to be assessed in a different way. Six sand and gravel sites were visited in the town and it was estimated that the average depth of the mined areas was about 15 feet. Using this depth of 15 feet, the amount of sand and gravel per acre was estimated multiplying it by the known area. There are approximately 653,400 cubic feet per acre.

The town's D.P.W. alone uses an average of 8350 tons per year (D.P.W. official). This does not include any private development or other uses. This number represents approximately 1670 lbs of sand and gravel per person per year. Using an average weight of gravel of 100lbs per cubic foot (Merriman & Wiggin, American Civil Engineers Handbook), this also represents 1/4 of an acre of sand gravel area per year used by the current population.

Once the sand and gravel areas were mapped from the given data base, the overlaying land uses were mapped over it. Areas that had already been developed were omitted as potential supply areas and were given an 800 foot buffer to avoid noise and other conflicts due to mining activities.

Next a wetland map was overlaid and wetlands that occur on sand and gravel deposits were identified. These areas were also excluded as potential mining, due to state laws that protect them.

These wetlands were also given a 100 foot buffer as is recommended by the state.

To rate the remaining areas of usable sand and gravel, the greenway map (See chp. 2, Fig. 2-14) was overlaid to identify areas of sand and gravel that did not interfere with the greenway goal. These areas that did not co-occur with greenway planning were rated as MOST SIGNIFICANT, and all remaining areas were rated as VERY SIGNIFICANT.

Introduction to Model (See Fig. 3-6)

Step 1: Use sand and gravel map given by Mass GIS, which are based on USGS. Plot areas of sand and gravel deposits. Plot the land use.

Step 2: Overlay the wetlands map, prepared by Mass GIS, and from that create a 100 foot buffer around these areas. Cushion developed areas by an 800 foot buffer.

Step 3: Take the remaining areas of usable sand and gravel and rate them as MOST SIGNIFICANT or VERY SIGNIFICANT based on their co-occurances with the greenway map.

Step 4: Using limited average annual usage of sand and gravel and estimating how much sand and gravel would be used in the future, determine the amount per year if a buildout was to occur and how long this supply would last.

Findings

According to the 1985 land use map prepared by IEP (Interdisciplinary Environmental Planners), sand and gravel make up 6930 acres (36%) of the town of Uxbridge (See Fig. 3-7). From this total acreage, it can be determined that the percent of this sand and gravel precluded by development is 17%. The 800 foot buffer areas around developed areas take up another 8.5%. There is another 415 acres (6%) of wetlands that occur on sand and gravel, and their 100 foot buffer consumes another 3% of useable quantities. Therefore, it can also be determined that, out of the existing supply (6390 acres), the unused sand and gravel totals 64%. The areas that were rated as MOST SIGNIFICANT comprised approximately 2200 acres or 31% of

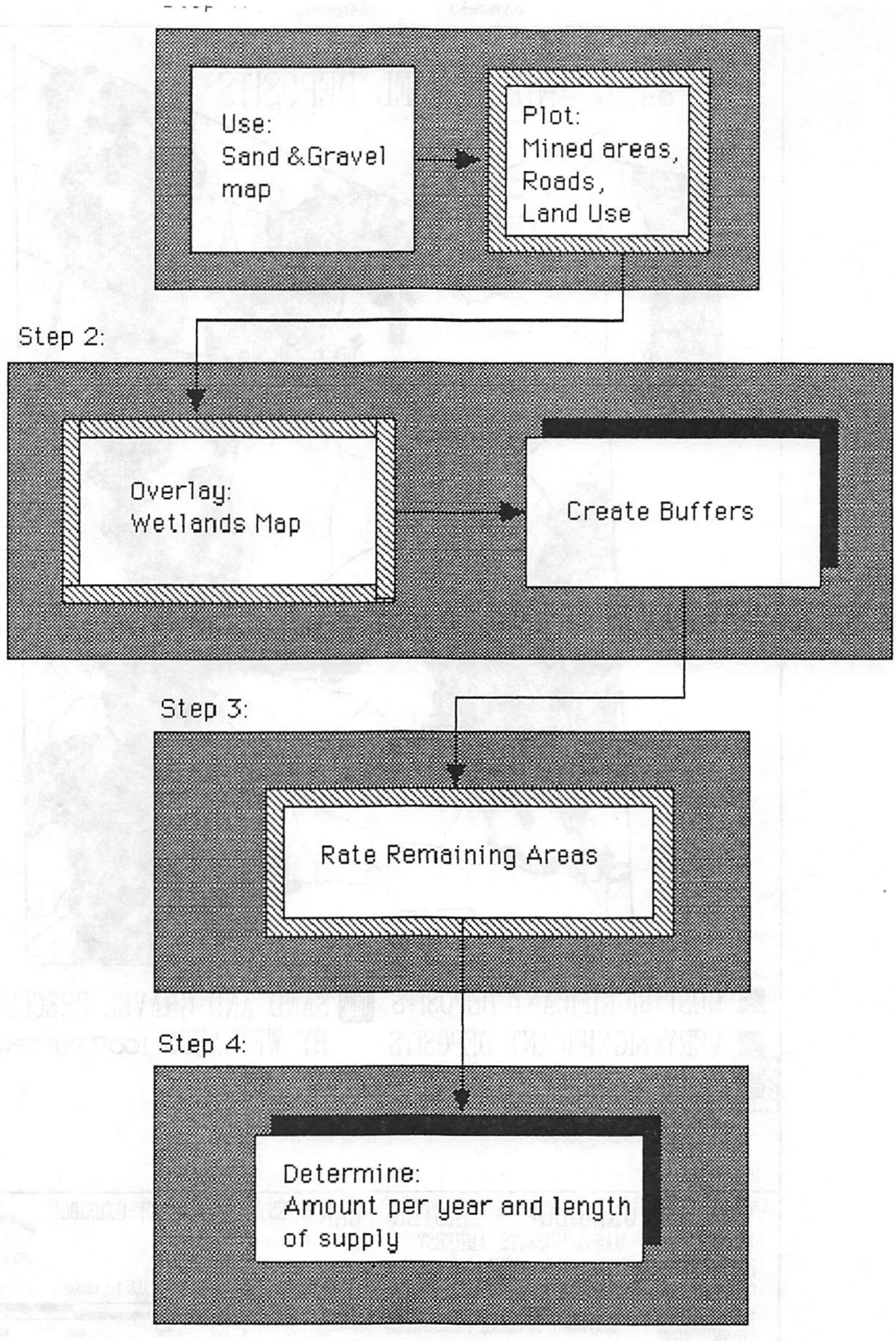


Figure 3-6: Outline of Steps. This flow chart outlines the steps taken in the adapted procedure for sand and gravel.

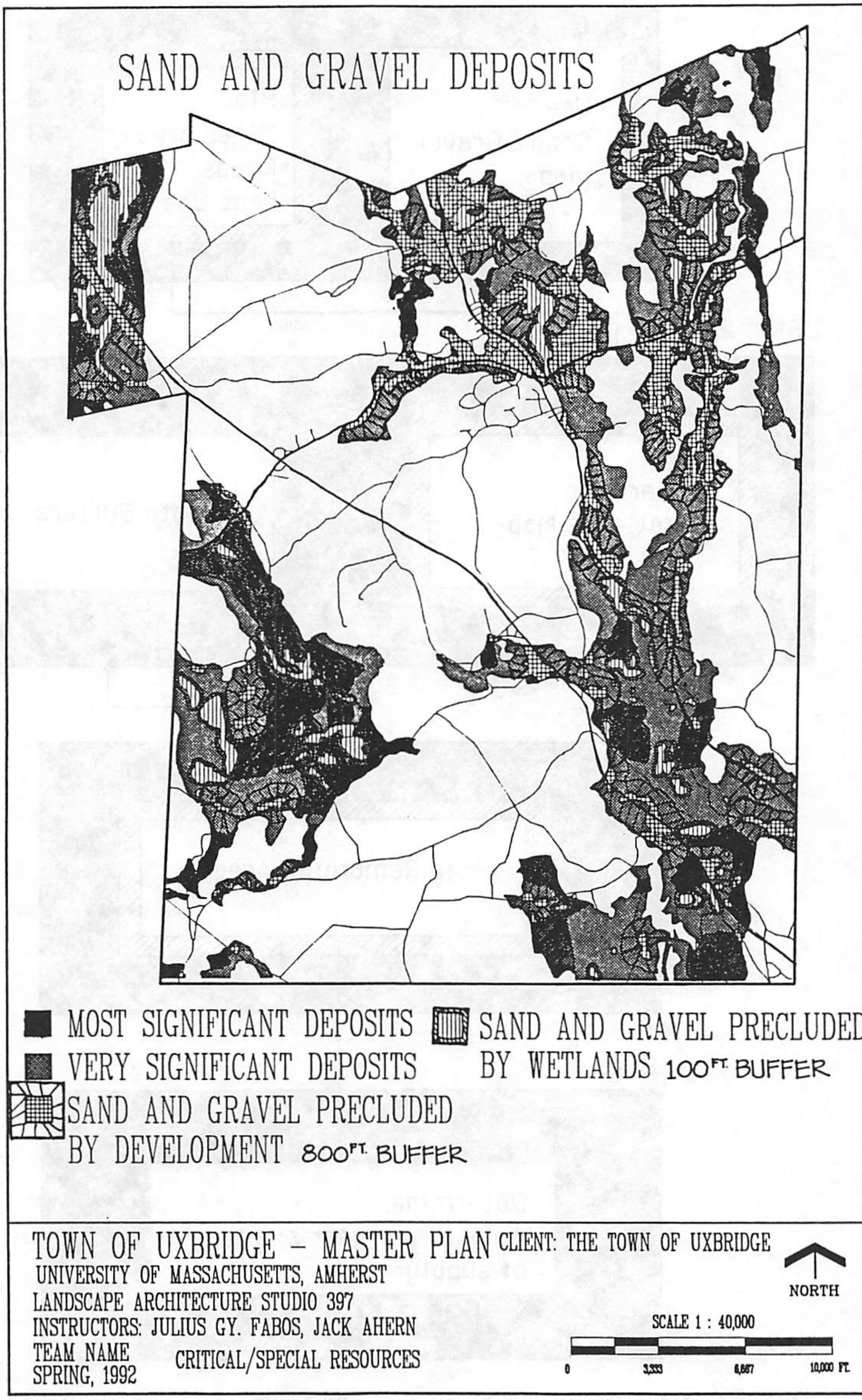


Figure 3-7: Sand and Gravel Map. The areas marked as Most Significant are areas of sand and gravel that are now available and do not conflict with greenway plans.

Sand and Gravel

	ACRES	% of town	%of Sand and Gravel
TOTAL Sand & Gravel	6930	36%	100%
Precluded by Development	1179	6%	17%
800 ft. Buffer	600	3.5%	8.5%
Precluded by Wetlands	415	2%	6%
100 ft. Buffer	200	1%	3%
Most Significant Deposits	2200	11.5%	31%
Very Significant Deposits	2300	12%	33%

Figure 3-8: Statistics on Sand and Gravel. The total sand and gravel is further reduced by developed areas and wetland with their respective buffers, leaving the Most Significant and Very Significant deposits available for use.

the total sand and gravel in the town, and the areas rated as VERY SIGNIFICANT comprise approximately 2300 acres or 33%of the total sand and gravel in town. Approximately 0.2% of this area of the sand and gravel had been mined, as of 1985.

This team was only able to obtain limited figures on the amount of sand and gravel that has been used or is being mined from the town's supply. The town's D.P.W. alone uses 8350 tons (1/4 acre/yr) of sand and gravel yearly. Assuming 2.6 tons of sand and gravel per person per year, accounting for private use and future development increases, (See Significance section) the town would use approximately 4.5 acres of sand and gravel per year. If the 2200 acres of MOST SIGNIFICANT deposits were used exclusively, the town supply could last for approximately 500 years. This is a plentiful supply assuming these limited deposits are not developed. Huge amounts of land can be consumed in the process of suburbanization and it is very important that this plentiful resource is not covered over, or is used to its potential, before it is developed, as it can happen with great sweeps of land.

It is also possible to practice delayed development on these areas that have been mined of their sand and gravel. Delayed development is a concept that allows the mined areas to be used for certain kinds of development, after the resource has been extracted. Depending on the amount of money and site preparation needed, many types of development can occur on former sand and gravel sites. Extreme awareness that the sand and gravel deposits in Uxbridge also serve as aquifer recharge areas, should be maintained when deciding the handling of these areas (See Fig. 3-12).

After overlaying the current land use map, it was evident that conflicts within residential areas would hamper mining operations. Taking into consideration that mining operations emit up to 80 decibels of noise, a "noise buffer zone" had to be established. According to a noise annoyance survey, 45 decibels is the outdoor noise level which may produce the first signs of annoyance in persons living in a "quiet" low density neighborhoods, (Great Britain Committee on the Problem of Noise, 1963). According to this study, an average mining are emits 35 decibels more than is tolerable for a residential neighborhood. For this reason, a buffer zone of 800 feet was recommended by using the Composite Landscape Assessment Bulletin (METLAND Fabos/Caswell, 1976, p 94) and using the "forest" as the buffer zone type. One can assume that distance is not the only means of reducing noise to acceptable levels. Noise is reduced by 3 to 4.5 decibels for each doubling of distance. Thus, if distance alone is used to reduce the noise level, considerable land around the sand and gravel area is rendered unusable. Planners recommend the location of very noisy sources, like rock crushers, near the center of the sand pit, with the least sensitive uses closer to the noise source and the most sensitive uses further away from it. (American Planning Association, Report #347, Werth, 1980). High berms of earth could also be considered for additional noise buffering if compromises are made in buffered areas.

AGRICULTURAL PRODUCTIVITY

Significance

Based on the U.S.D.A. Soil Conservation Service's procedure for testing and classifying soils, over 50% of Uxbridge soils are extremely suited for crop production. Basically, there are two reasons that these lands were considered a special resource to the town: they have immense visual appeal, and they can be used for agricultural crops.

Although Uxbridge is not known for being a significant agricultural town, many of its most noticeable and pleasing amenities come from the views and character provided by the open agricultural farmlands within its boundaries. Pastures with stone walls, wildlife, grazing animals, grasses, and corn are among many important visual features of the town. They provide open green space and can be highly valued amenities by residents and businesses alike.

Whether this land is presently used or abandoned farmland, they also provide an excellent opportunity for crop production. The "Prime Agricultural Farmland" soils make up 24% of total acreage, and the farmland soils of "State or Local Importance" farmland soils make up 26% of the total acreage of the town. These lands of very high fertility were considered valuable resources to the town.

Agricultural lands are, by their nature, easiest to develop. The most highly valued of these have already been cleared, have gentle slopes, good soil drainage, and are easy to excavate. If these lands were the first to be developed, it would have a dramatic effect on the visual quality of the town. Imagine Uxbridge without any. It is important therefore, to develop the farmland wisely and protect areas considered to be most significant, keeping in mind that the town could grow considerably over the years, and future generations could suffer greatly from irresponsible development of these lands.

State of Assessment Procedure

In the past eighty years, soil surveys have been very general because of the use of a small sample survey. However, in the past 40 years, soil surveys have become much more accurate due to more rigorous field surveys. The U.S. Department of Agriculture's Soil Conservation Service (SCS) have been leaders in using these more comprehensive soil studies, which are available to the general public through the local county offices. From these surveys the SCS has developed what is today a widely used and highly practical agricultural assessment procedure.

The SCS surveys classifies all soil types into one of eight classes for crop productivity. These classes are based on the soil characteristics such as depth, drainage, stoniness, acidity, texture, erosiveness, slope and climatic association, all of which affect the suitability of the soil for agriculture. Class I soils are those most suitable for crop production, while Class VIII soils are those least suitable for crop production. (METLAND Research Bulletin No. 637, 1977, p 29).

The above classifications are used as a basis by the SCS to further classify agricultural land in their inventory of the nation's prime farmlands. They classify farmland into two groups: "Prime Farmland" and farmland of "State or Local Importance". These groups are described as:

Prime Farmland soils are those that have a favorable combination of physical and chemical characteristics for producing food, feed forage, fiber, and oilseed crops. These soils are capable of producing high crop yields when suitable treated and managed in accordance with acceptable farming methods. These soils also have adequate and dependable precipitation, a favorable temperature and growing season, acceptable acidity or alkalinity, and few or no surface stones. In addition, they are permeable to water and air, and are not excessively erodible or saturated with water for long periods of time, and they either do not flood frequently or are protected from flooding.

State or Locally Important Farmland soils are those that fail to meet one or more of the requirements of prime farmland but are still important for the production of food, feed, fiber, or forage crops. They include soils that are nearly prime farmland and that economically produce high yields of crops when treated and managed according to acceptable farming methods. (U.S.D.A. S.C.S. Important Farmlands in Massachusetts, 1989, p 8)

Another more comprehensive approach by METLAND rates agricultural land on the natural suitability of the soil for agriculture and the degree to which the over-lying land use detracts from that suitability. (METLAND Research Report, Caswell, 1975)

Findings may be further evaluated by an extensive rating system developed by the Pioneer Planning Commission. Parcels are rated on a point system, based on predominant land use, the size of the farm parcel, farmland soils (percent of Prime & State or Locally Important farmland) and collateral environmental objectives. This point system is outlined as follows:

The rating schedule for farmland parcels is adapted from the Southwick Study 1990 (Pioneer Valley Planning Commission Method.)

1. Predominant Land Use

-Active Agriculture (cropland, orchard, nursery)	25 points
-Hay and pasture	12
-Woods	5

2. Size of Farm

200+ acres	15 points
150-199 acres	1
100-149 acres	10
50-99 acres	7
25-49 acres	5
10-24 acres	2
0-9 acres	0

3. Farmland Soils

A. Percent of soils classified prime

75-100%	25 points
50-74%	18
25-49%	12
10-24%	7
0-9%	0

B. Percent of soils classified of state and local Importance

75-100%	13 points
50-74%	9
25-49%	5
10-24%	3
0-9%	1

4. Collateral Environmental Objectives

Adjacent to farmland or conservation land	5 points
25+% of Parcel or Greater than 5 acres in FEMA 100 year floodplain	5
Contains wetlands	2

5. Total Weight/Priority for Preservation

55-75 points	Most Significant
50-54	Highly Significant
40-49	Significant
25-39	Notable
5-24	OtherAgricultural Land

Adapted Approach

The procedure used in the evaluation of significant agricultural land is based on all of the above methods and adapted to suit the particular needs of this study. Time limitations were the main reason for these adaptations.

Soils were assessed as Prime Farmland or farmland of State or Local Importance, and parcels were evaluated using most of the criteria outlined by the Pioneer Valley Planning Commission above. However, these criteria were used more generally than in the above outline. Rather than being rated on a point system they were evaluated on their general co-occurances with one another.

The best combination is currently used farmland or abandoned agriculture (open land) that occurs over soils rated as Prime Farmland, while also being contiguous parcels totaling 50 acres or more. These areas were rated MOST SIGNIFICANT (See Fig. 3-9).

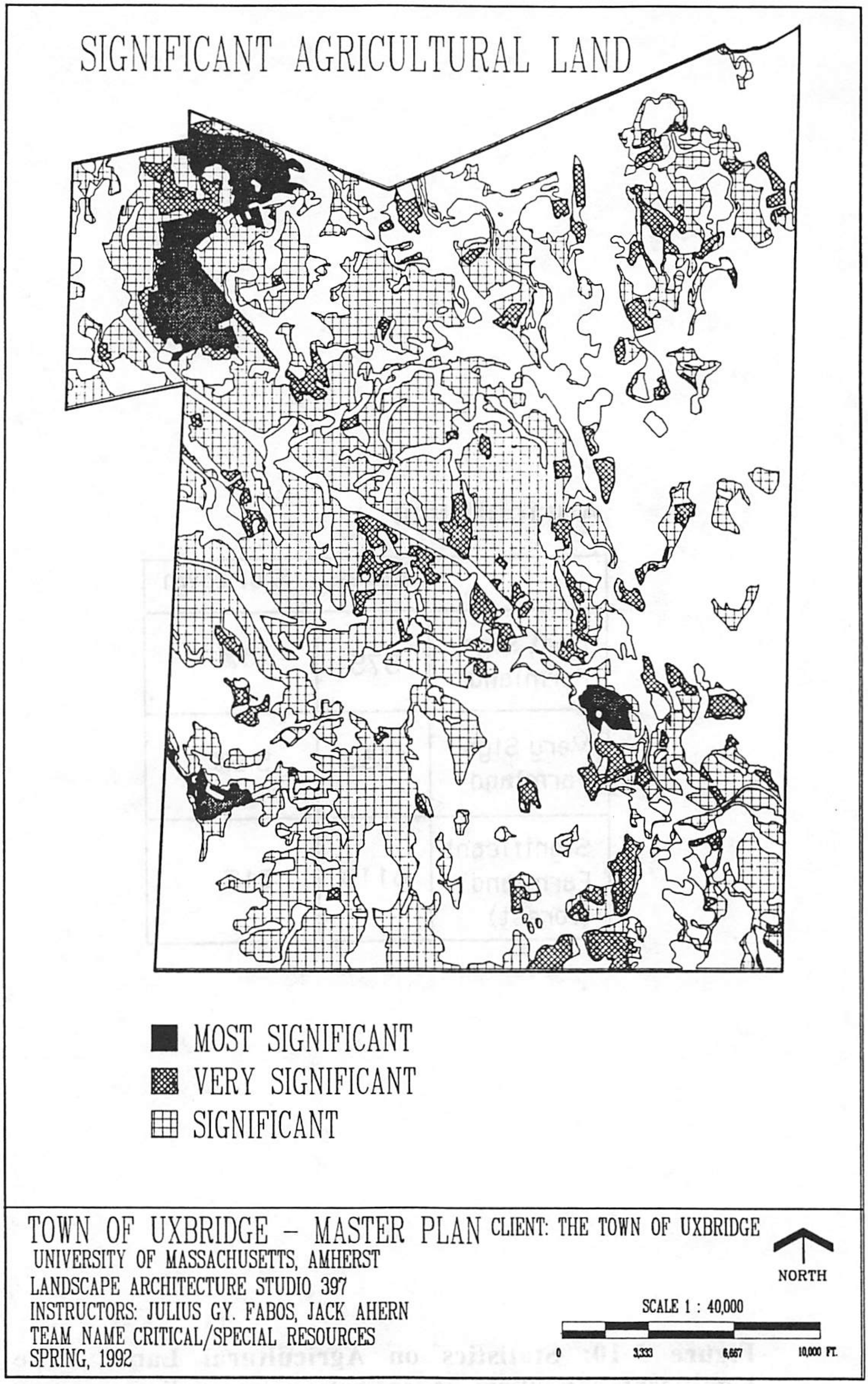


Figure 3-9: Agricultural Land Map. A very small percent of land is rated as Most Significant farmland mostly in the northwest. Very Significant farmland is also very scarce. See figure 2-10 for statistics.

Agricultural

	Acres	% of town
Most Sign. Farmland	575	3%
Very Sign. Farmland	1080	5.6%
Significant Farmland (forest)	6110	31%

Figure 3-10: Statistics on Agricultural Land. The Most Significant agriculture is an extremely small percentage of the town. Fertile forest land is more plentiful, but is not considered that significant.

The second best combination is currently used farmland or abandon agriculture (open land) that occurs over soils rated as farmland of State or Local Significance. These parcels also include the above described areas of less than 50 contiguous acres. These areas were rated VERY SIGNIFICANT (See Fig. 3-9).

The final combination is forested areas which occur on soils rated as either Prime Farmland or farmland of State or Local Importance. These areas were rated as SIGNIFICANT (See Fig. 3-9).

<u>Introduction to Model</u> (See Fig. 3-11)

Step 1: From the GIS (Geographic Information System) computer database provided by Mass GIS, METLAND, I.E.P., and others, information was processed to produce a map showing soils rated as Prime Farmland or farmland of State or Local Importance.

Step 2: Next, the above map was overlaid with a 1985 land use map. The land uses were divided into specific categories of pasture, cropland, forest and open land (abandoned agriculture, etc.). All other land uses were grouped into one category and were excluded as potential agricultural land.

Step 3: From the resulting composite map, a preliminary rating of MOST SIGNIFICANT is given to existing cropland, pasture, and abandoned agriculture that occur on soils that have been identified as Prime Farmland.

Step 4: Existing cropland, pasture and abandoned agriculture that occur on soils that have been identified as State or Locally Important, are then rated as VERY SIGNIFICANT.

Step 5: Next, forested areas that occur on soils identified as either Prime Farmland, or farmland of State or Local Importance are rated as SIGNIFICANT. All other areas of forest are excluded from further study.

Step 6: Finally, areas that were given a preliminary rating of MOST SIGNIFICANT in Step 3, are reassessed on the basis of the size of the contiguous land mass that they form. If the mass is 50 acres or greater

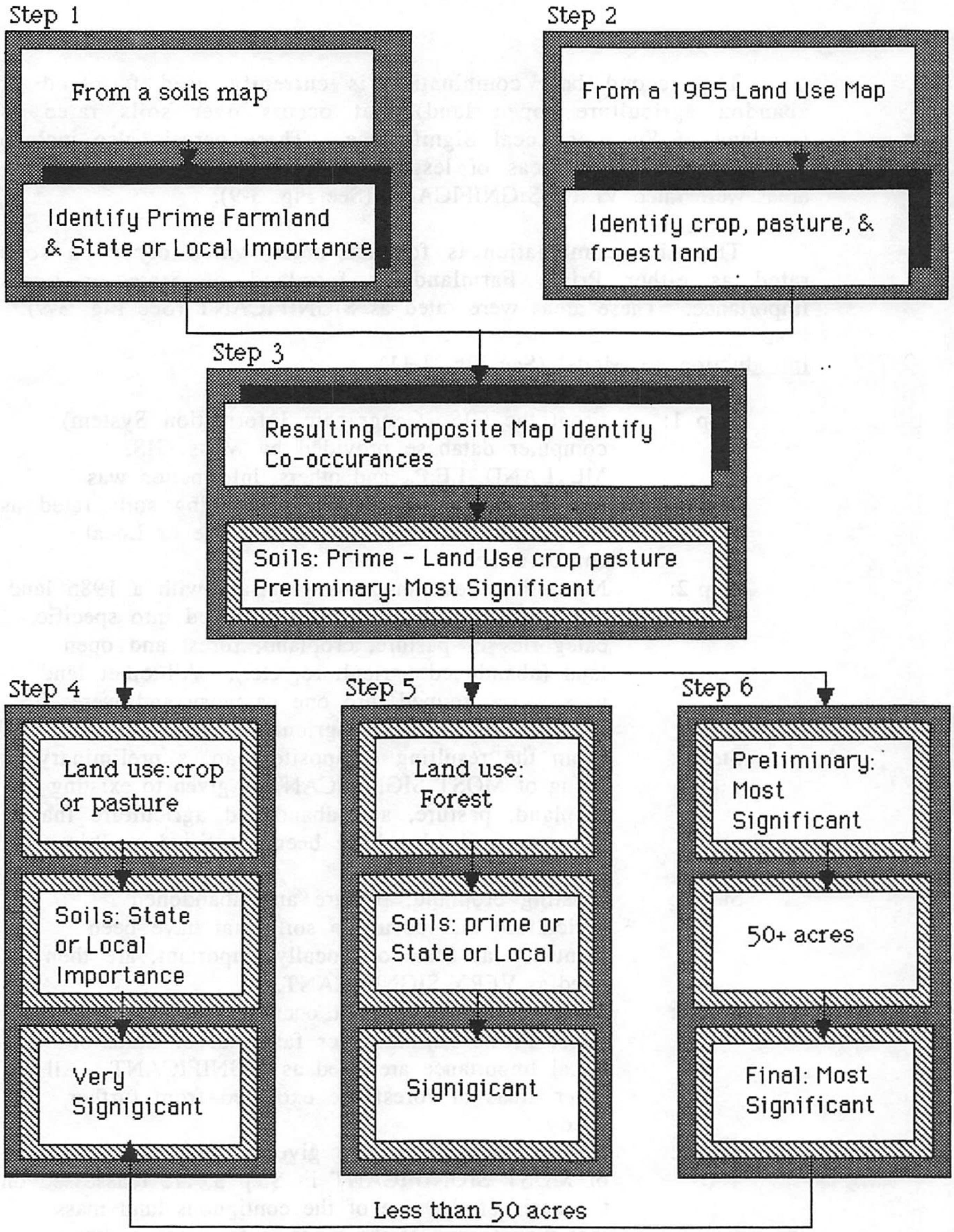


Figure 3-11: Outline of Steps. This flow chart outlines the steps taken in the adapted procedure for agricultural land.

the parcels are given a final rating of MOST SIGNIFICANT. All smaller and fragmented parcels are lowered to the next highest rating of VERY SIGNIFICANT. All these areas are shown in map form showing percentages of each (See Figs. 3-9 &10).

Findings

The town of Uxbridge has a varied topography of hills and valleys cut by glaciers (See Fig. 3-12). In general the low lying valleys contain deposits of sand and gravel produced by outwash from these glaciers, and they make up what is essentially the aquifer recharge area. The soils most suitable for crop production generally occur at the higher elevations. About 25% of the towns total land area occurs on soils identified as Prime Farmland and about 26% occurs on soils having State or Local Importance. This comprises over half the total land area in Uxbridge. This area is represents 7766 acres.

The area that were rated as MOST SIGNIFICANT comprise 3% of the total land area, and is all existing cropland, pasture or openland (abandon agriculture, areas of no vegetation, etc.) and represents 575 acres. This very small percentage of land, of 50 or more contiguous acres (not necessarily owned by the same person), occurs mostly in the northwestern portion of the town, and contains Uxbridge's only two remaining dairy farms. It is recommended that this extremely small percentage of land be preserved by the town for its best rated view and aesthetic potential, and its potential for producing large yields of crops. It is now an extremely limited resource in the town and should be precluded from development.

VERY SIGNIFICANT areas of agricultural land make up 5.6% of the total land area and represent 1080 acres. This too is a very small percentage of land in town. These areas combined to make contiguous masses of less than 50 acres and are widely scattered throughout the town in more or less an even pattern. These areas also occur for the most part in the higher elevations of town, and provide optimum views and aesthetic potential as well as being highly suited for producing crops (See Fig. 3-13). Many are surrounded by stone walls and provide pleasing breaks in the forested landscape. This is also a very limited percentage of land in Uxbridge and it is recommended that the town do everything to

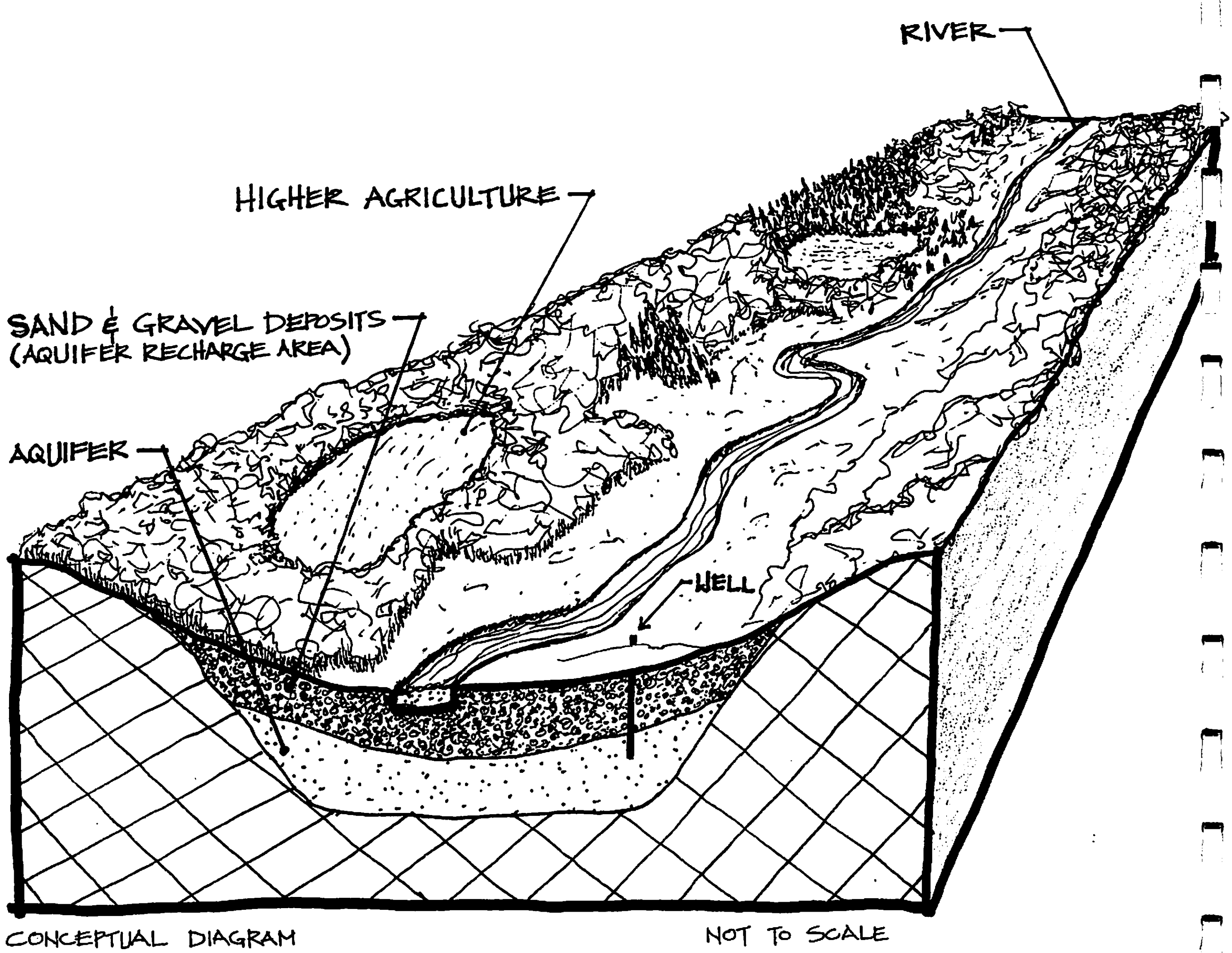


Figure 3-12: Conceptual Diagram. The topography in the town was cut by glaciers. These glaciers left deposits of sand and gravel in the lower valley areas which also serves as a recharge area for the ground water aquifers. Agricultural land occurs mostly in the higher regions.

Figure 3-13: Northwest Uxbridge. This Sutton St. parcel is within the 3% of land rated as Most Significant for agricultural land. It offers the best soils for producing crops, and high aesthetic quality contributing to the town's rural character. This is also one of two remaining dairy farms in Uxbridge.

protect it. There are some alternatives for protecting prime agricultural land and some are listed in the next section of the findings (See Some Preservation Alternatives).

Areas that were rated as SIGNIFICANT are forested lands occuring on soils that are highly suited for agriculture. This fertile forested land mostly forms large blocks of area throughout the town and comprises 31% of the town's total land area. This represents 6100 acres. It is recommended that these areas be recognized as important to a small degree. Clearing land for agriculture in this age is not usually economically rewarding, and is not that likely to happen, however, it is always an option and could provide the town with future agricultural land.

This study concludes that 39.6% of the total area of Uxbridge is, in varying degrees, significant to the town in terms of agricultural land (See Fig. 3-14 for final composte map).

Some Preservation Alternatives

These are some brief descriptions of alternatives for the preservation of agricultural land used by other towns. These may be used as models, and can be investigated further by the town if they are actually considered for implementation.

State Level:

The Department of Food and Agriculture (DFA) has pursued three programs based on Executive Order #193, issued in March 1981 by then Governor Edward J. King, defining benefits of agricultural land to the Commonwealth:

1. The Agricultural Preservation Restriction Program. This program is a less than fee simple acquisition program in which the state purchases development rights to agricultural land.
2. Chapter 61A. This is a tax abatement program where owners of land in active agricultural use may file for a reduced tax assessment based on the actual use rather than the highest valued use. Any subsequent conversion to non-agricultural use must be accompanied by repayment of the tax savings.
3. The Massachusetts Right to Farm Law. This provides for the creation of Agricultural Incentive Areas. Incentive areas are a weak form of overlay zoning which provide positive incentives for continued agricultural use. (Research Bulletin No. 732, 1991)

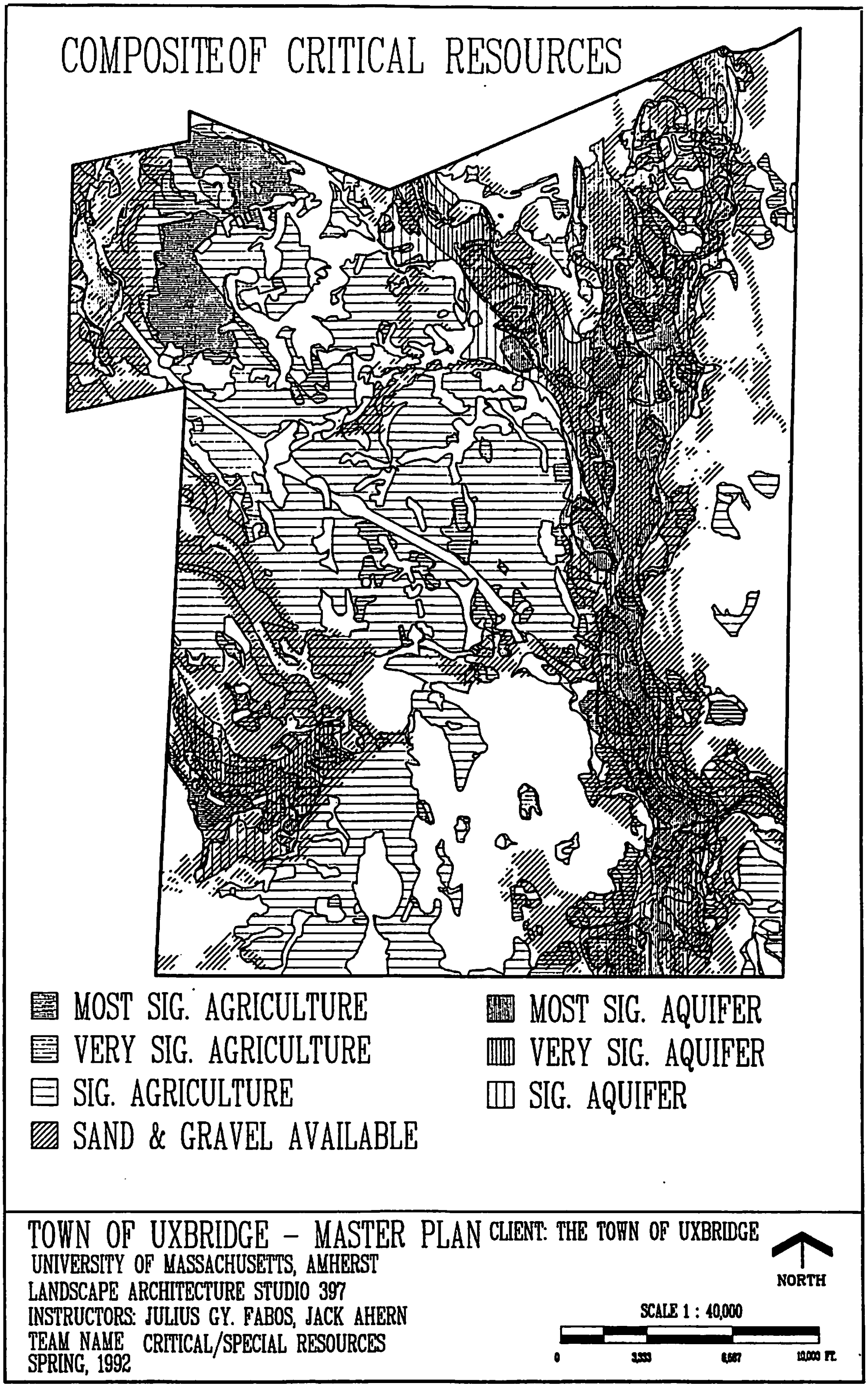


Figure 3-14: Composite Map of Critical/Special Resources. This composite map shows how sand and gravel deposits overlay aquifer areas and sometimes conflict with prime agricultural land.

Regional Level:

The Pioneer Valley Planning Commission offered their professional support to the Pioneer Valley in two programs to the town of Hadley, Massachusetts:

1. A mapping program that is intended to provide support for planning efforts at the local level. This program uses an active parcel mapping program of agricultural resources.
2. An assistance program where they act as planning consultants for development projects that will affect the agricultural resource base of the town.

Local Level:

Hadley Massachusetts has set up three active agricultural preservation programs in their town.

1. The local agricultural Incentive Area Committee defines the boundaries for a proposed incentive areas and fulfills the mapping and procedural responsibilities outlined above.
2. Committed funds are set aside by the town to contribute to state purchases of development rights which take place in the town.
3. The Growth Management Committee in conjunction with the P.V.C.C., and the Incentive Area Committee, develop boundaries and guidelines for a new zoning district which would require cluster style development on agricultural land, preserving the portion of the site most suitable for dedicated agricultural use.

Hazards

Chapter 4

INTRODUCTION

Hazards are a source of danger in our everyday lives that can sometimes be avoided with a informed approach to land use planning. There is a need to determine what a reasonable threat to human life or the environment might be. This study shall examine these threats and separate the potential from the harmful ones.

In analyzing the potential hazards in the town of Uxbridge, Massachusetts, they were narrowed down to the ones that pose a reasonable threat to society and the community. These include natural hazards such as flooding, as well as man made hazards that are associated with the town of Uxbridge. Cultural hazards are more prevalent in our study for us to explore noise pollution, air pollution, threat of water contamination, and dangerous roads and intersections.

Flooding is one of the most ubiquitous hazards to exist in the world that involves damage. The existing floodplain must be respected in determination of future building and development of the land. As development takes over the floodplains of the river basins and stream banks other areas of the Blackstone River Valley are threatened. Floodplains are consumed on a yearly basis, and therefore should be considered for preservation. On the other hand, 100 year floodplains need to be looked at very closely so they do not become over developed and therefore more susceptible to flooding.

The hazards of noise and air pollution are mostly misinterpreted and ignored by the public. Because of the numerous changes in transportation routes or commercial and industrial development, people fail to notice the potential hazards associated with noise and air pollution. The smaller incremental changes which can be quite significant are for the most part ignored. For example, when a road is widened in a community and commercial and residential development is added, increased levels of noise and air pollution usually go unnoticed by the public. Only when major industrial plants are proposed in a community does any conflict arise. (Fabos & Caswell 1977, pg.128).

Groundwater is the most valuable of all resources. It has a larger capacity than any fresh water body and the capacity to replenish itself indefinitely. It is an essential factor to the economic growth of a town. A major problem associated with groundwater is that its quality can be greatly reduced by polluted surface runoff and infiltration. To use groundwater as a permanent water resource could save cost, construction, and maintenance of surface storage systems (Fabos & Caswell, 1977, pg.128).

In the past forty plus years with the rapid post World War II decentralization and rise of population, there has been an increase in highways to transport people throughout the area. Increased roads translate into more intersections and the conflict associated with crossings. Congestion, inadequate road widths, and outdated traffic lights all contribute to the hazards of vehicular travel. The absence of traffic lights or the reduction of sight lines due to vegetative growth has caused several deaths and injuries to both pedestrians and persons in the vehicles themselves. It has also been observed that residences which are for sale in more travelled roads do not tend to sell quickly. Increased volume and problem areas on the roadways are directly related to noise and air pollution.

The purpose of this study was to locate the potential hazards in the town of Uxbridge and provide guidelines for future planning development with the assistance of maps. By adapting procedures and techniques from METLAND research bulletin #637 along with information received from the town of Uxbridge the following hazards were assessed: 1% floodplains, groundwater contamination, air pollution, noise pollution, and dangerous roads and intersections. (Metland is an organization developed through grants, research, and studio classes that deals with regional landscape planning issues).

Goals:

1. To provide information which will direct future planning or development in consideration to the hazardous zones and enable the community to avoid development of future hazards.

Objectives:

1. To keep irresponsible development from the present and future 1% floodplains.

2. To assess the quality and purity of groundwater.

3. To encourage development in areas of lower air and noise pollution.

4. To identify hazardous intersections and propose alternatives.

FLOOD HAZARDS

Significance

Flooding is one of the most important hazards because of its widespread occurrence and threat to human life. Each year, world - wide damage due to flooding represents a loss of billions of dollars and hundreds or even thousands of lives. It is one of the largest factors in determining the location of a development's boundary, but too often its destruction is brought about by ignorance.

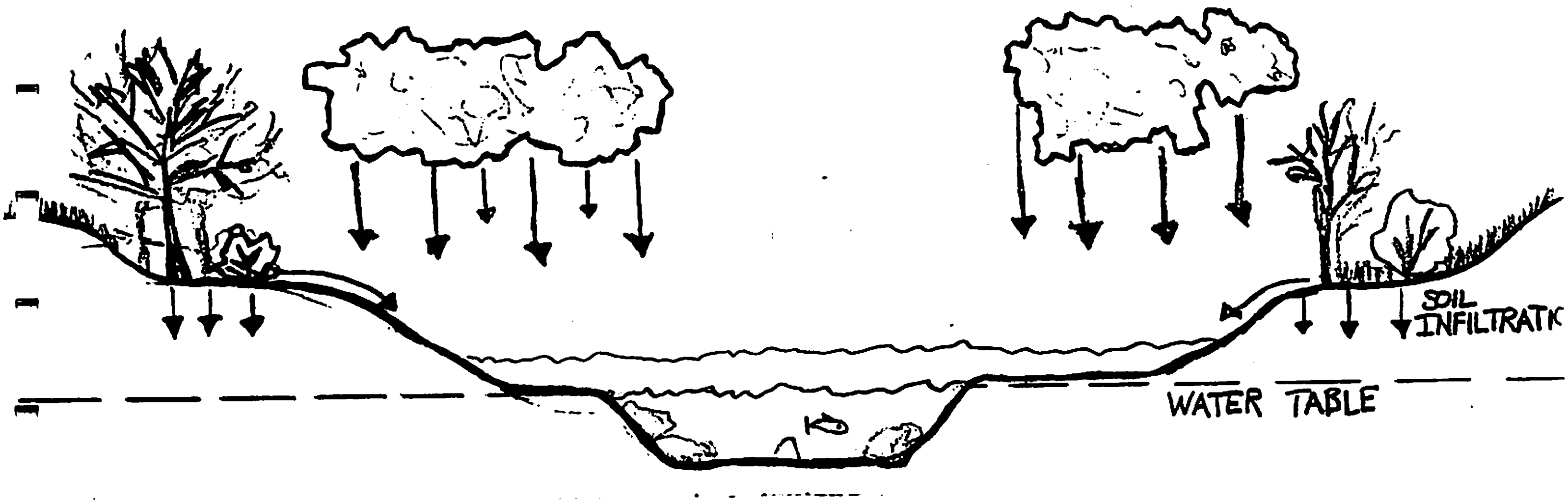
The edges of a floodplain are not always delineated like they are on paper because of the frequent fluctuation in seasonal precipitation and fluctuations in average temperatures causing excessive snow melt, rainfall or storms. Measures must be taken to avoid future development in floodplains (Fabos & Caswell, 1977). The future impermeable floodplain is defined as the extent of land that may at some point in the future become flood prone. Urbanization, which is relatively safe today because it lies outside the 1% probability floodplain, will in the future be subject to flooding hazards (Fig. 4-1). With the increase of impermeable surfaces, the decrease of infiltration into the soil, and an increase in surface runoff, more precipitation that falls in the town will enter streams as overland flow, raising the water level to a higher level (Fig.4-2). By looking at this information, one can conclude that certain determinants of the size and shape of a floodplain depend upon the present and future development on or near the permeable surface of the floodplain fringe (Fig. 4-3).

State of Assessment Procedure

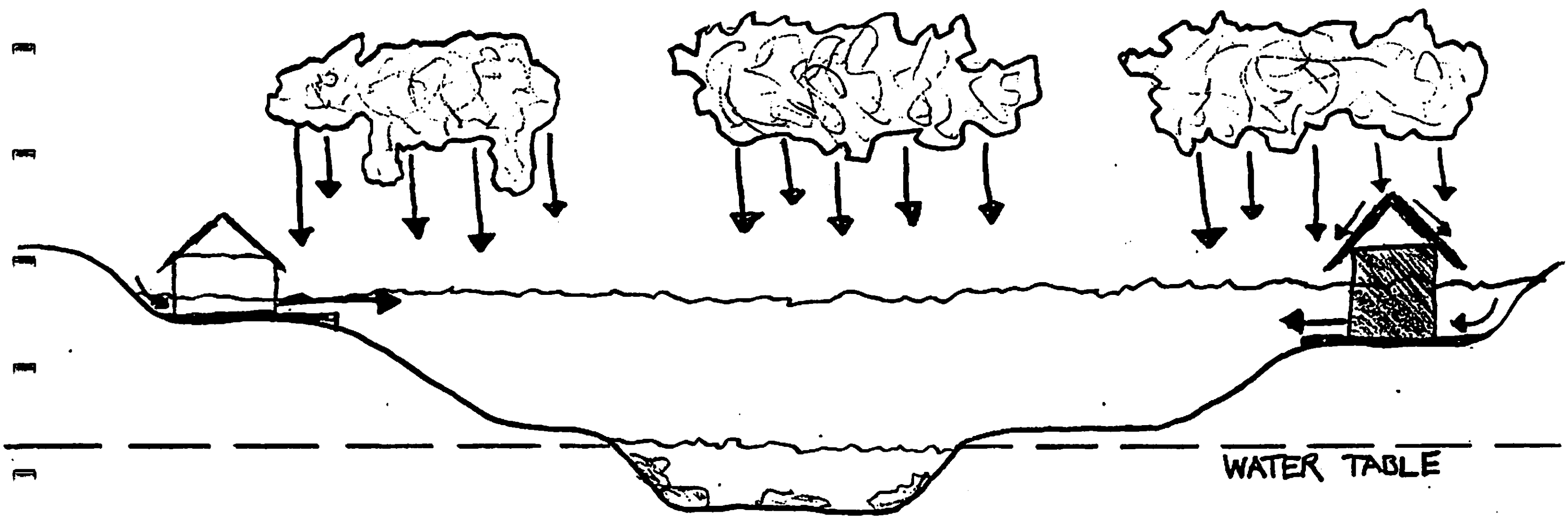
Flood protection is undertaken by planners, civil engineers, and many other people that are interested in their surrounding environment. This interest enables planners to zone floodplains against the more damage prone types of development, such as housing, industry, and commercial facilities. Devices such as dikes, dams, or levees are used to control the fluctuations of the 1% probability flood. The mapping accuracy of the flow and volume are determined from the amount and location of gauging stations along that watershed.

Along with the mapping comes statistics and mathematical models that show the historical floods. The potential threat of increased urbanization can direct the increase or decrease of a floodplain. Two complicated statistical techniques (Gumbel Distribution and Log Pearson Type III) are used by the Army Corps of

Figure 4-1 Waterway Recreation Along Toe Path. The 1% Floodplain should not be eliminated from use. Recreation, open space and geenway linkages are a few opportunities for the land within the floodplain boundary.



1% FLOODPLAIN



FUTURE 1% FLOODPLAIN

Figure 4-2 1% Floodplain Sections. With the increase of impermeable surfaces, and a decrease of inflitration, the 1% floodplain will expand.

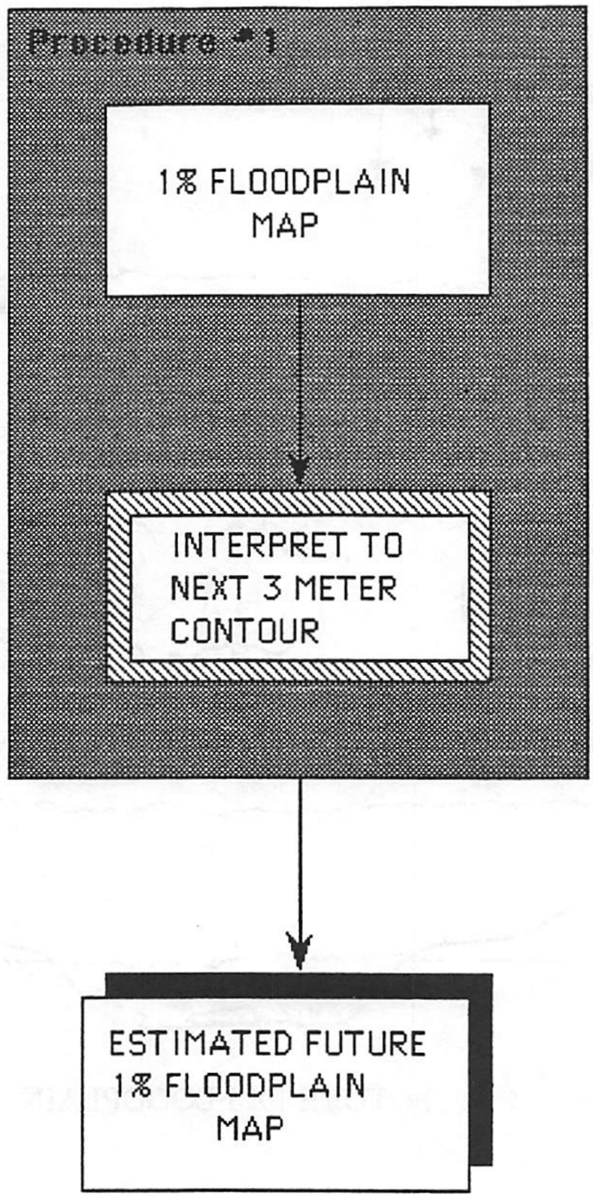


Figure 4 - 3 -- Floodplain Procedure Model. This chart shows the procedures of assessing the future 1% floodplain map.

Engineers and Soil Conservation Service to convert the data per gauging station into amount of discharge in cubic feet of water. Once the discharge is determined, the 1% probability flood is determined using a stage-rating curve. This determines the stage (height in feet above bankfull water level) which is obtained for all streams and rivers (Fabos & Caswell, 1977, p. 130-134).

Adapted Approach

The technique developed by the METLAND team for assessing flood hazard in metropolitan areas in New England is designed to account for the significant fact that, with increased metropolitanization, the permeable floodplains of the region are in reality dynamic rather than static. Through this objective, the present 100 year, 1% probability floodplain, and the Future 1% Floodplain can be assessed (Fabos & Caswell, 1977, p. 132).

To calculate the 1% probability floodplain map, the U.S.G.S. Topographical Map and a Flood Insurance Map were used to establish boundaries for the 1% probability floodplain on the designated river basins. Then we estimated the future 1% floodplain after a buildout was calculated by using the 1% probability floodplain map and going up to the next three meter or ten foot contour and proposing that no major buildout be done in this area because this is estimated to be the future 1% probability floodplain in Uxbridge, Massachusetts (Fig 4-4). Do to the lack of a hydrologist and time the Future 1% Floodplain was estimated to the best of our ability. This will give the town of Uxbridge an idea of where it lies until they can get it done by a professional.

Introduction to Model

Step 1: A flood insurance map is used to determine the boundaries of the 1% probability floodplain on the designated rivers.

Step 2: The 1% probability flood boundaries are plotted on a U.S.G.S. topographical map.

Step 3: A future 1% probability floodplain is determined by the location of the first order and the lower elevations of the streams which show the greatest results of the 1% floodplain. Then, the future impermeable floodplain was derived by expanding the adjusted 1% probability floodplain boundary line to the next three meter contour.

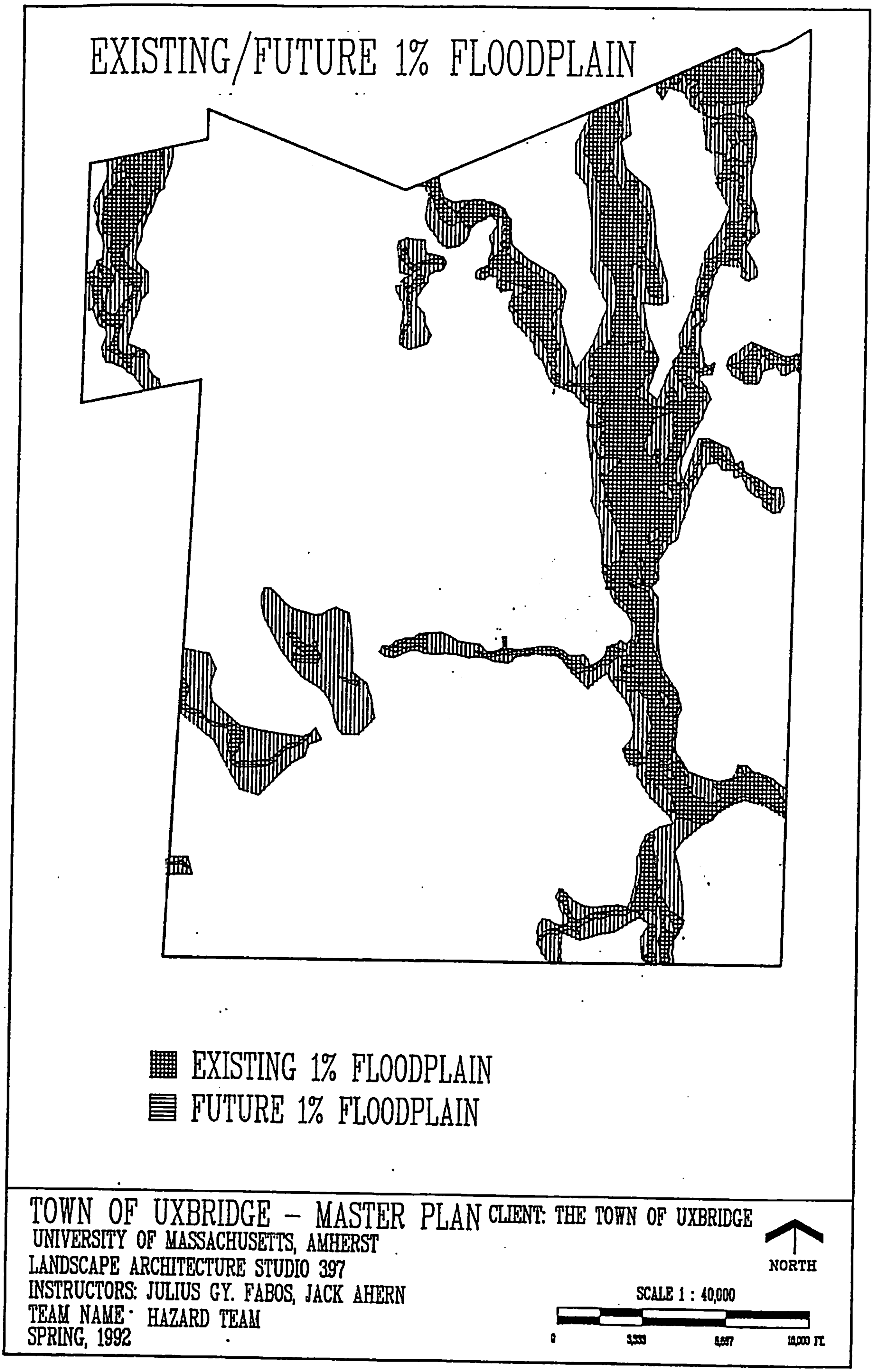


Figure 4-4 1% Floodplain Assessment Map. Shows the boundaries of present and future 1% probability floodplain.

Findings

From our assessment of the 1% probability floodplain, it was determined that the floodplain areas were distributed north to south on the eastern part of Uxbridge and do not currently pose a threat to development. Approximately 11.1% of the towns total acreage lies within floodplains. These areas are subject to high potential flooding. In Uxbridge three major rivers make up the majority of the floodplains the West, Mumford, and Blackstone Rivers. These areas should be utilized for open space land use such as agriculture and recreation. Structures should not be placed in these floodplain zones.

From the assessment of the future impermeable floodplain, 3% of the town's total acreage of land could at some point in the future become flooded. These areas primarily exist in the eastern portion of Uxbridge running north to south where the three rivers run. Large amounts of paving and structures can sufficiently inhibit the infiltration of rainwater and meltwater into the ground. As a result of any type of development in this area, surface run-off increases which swell nearby rivers and streams. The end result is the overflow of river banks and further extension of the 1% Probability Floodplain.

GROUND WATER CONTAMINATION

Significance

Subsurface water or ground water is a crucial factor in the determination of a town's physical and economic growth. Unlike surface water, ground water utilizes the earth's surface as a protector against evaporation and many surface pollutants caused by runoff. Ground water gathers in underground reservoirs supplied by precipitation followed by infiltration through the earth's surface. Infiltration through the earth's various soil and rock levels filters the water and consequently deposits the water in voids underground. Groundwater moves much slower than surface water. Movements can be as little as a few thousandths of a centimeter per day to as much as several thousand meters per day, depending on the storage capacity and permeability of the rock (Encyclopedia Britanica Macropaedia, Vol. 20).

Groundwater is an invaluable resource to the town for a variety of reasons. First, precipitation supplies the ground water table; therefore it contains a very small percentage of pathogenic organisms. It is pure and clean and subject to siltation or the influx of man-made pollutants. Secondly, groundwater reservoirs contain the largest existing storage of freshwater which makes the supply basically inexhaustible (Fabos & Caswell p.60) even if withdrawn at reasonable rates or if a short drought should occur. Thirdly, groundwater is free of sedimentation or foreign particles which are stirred up or suspended in surface water. Fourthly, groundwater is available in many areas which are deprived of dependable surface water supplies. This is due in part that over the years, nature has been actively storing this water in water bearing strata - commonly known as aquifers (Encyclopedia Britanica Macropaedia Vol. 20 p.781). An aquifer is a geological unit that yields significant quantities of water. An aquifer can consist of fractured bedrock or surficial geologic deposits such as sand or gravel. Although most soils are capable of supporting a single domestic well, an aquifer represents a much larger resource, often capable of meeting municipal system demands (IEP, Inc. Ground Water p.64). The acknowledgement and use of such a resource, if neglected, could be a permanent mistake in the region.

Aquifers of the region need to be located and development standards need to be implemented to protect an invaluable human resource from contamination. Contamination can result from the increased use of pesticides and chemicals and also erosional products and chemicals washed from fields and roads. The contamination by communal and industrial wastes and by agricultural fertilizers is not only a serious threat to human society but also to the earth's entire hydrographic system (Encyclopedia Britanica Macropaedia Vol. 20 p.792). Ecologically sensitive agricultural practices can reduce the affects of contamination. The economic growth results from the increase of residential, industrial and commercial areas must be weighed heavily against this invaluable resource. The need arises to protect this resource against irresponsible development. For a sustainable society cannot be achieved without the consideration of usable ground water.

State of Assessment

Towns and states have established techniques to assess groundwater quality. There are three levels of investigation ranging from the very general to the extremely specific. The first level consists of a general location of the groundwater supply by remote sensing. This intricate process consists of thermal and infrared photography to produce information of groundwater potential for a region (Fabos & Caswell, 1977). Infrared photography detects slight temperature and denotes its cooler characteristics compared to the surface water. Geysers, springs, and groundwater leakage into the sea are just some of the capabilities of this most recent approach (Encyclopaedia Britanica Maclopedia).

The second part of the testing stage classifies different geologic characteristics using a surficial geology map. This will show the different materials that encompass the earth's surface. The formation of these soils determined the rate and volume of run-off and infiltration. The more permeable a deposit, the greater the likelihood of a large groundwater supply. Finally, an assessment is made of the size of the total groundwater resources. This can be achieved by employing "The Connecticut Method" (Cervione, 1972), which stated simply, correlates the total groundwater outflow of an area, with the percent of stratified drift (i.e. permeable surficial materials) on the area which underlines major drainage basins (Fabos & Caswell, 1977).

Groundwater quality is a function which encompasses such fields as environmental science, environmental engineering, and general public health planning. These professions deal with two main aspects of groundwater quality. First, the identification of all the major pollutants that currently exist in the water, and secondly, how much and to what degree are these pollutants affecting the people (Fabos & Caswell, 1977, p.62).

Adapted Approach

In assessment of the potential threats to groundwater the METLAND assessment technique for groundwater quality was used. This technique called for the examining of the type of contamination and its effects on the groundwater and its dependants. These techniques assess the result of land types on the overall quality of the groundwater. This relationship depends on the chemicals needed for the upkeep of the land use. Simply explained, land uses that allow pollutants to enter the natural water system are seen to reduce the quality of that water (Fabos & Caswell, 1977).

Introduction to Model

To determine the source of the groundwater contamination, four steps are needed in the process of identifying land use types that affect the water quality. Primary areas of concern that determine these sites are commercial, industrial and agricultural land (Fig. 4-5).

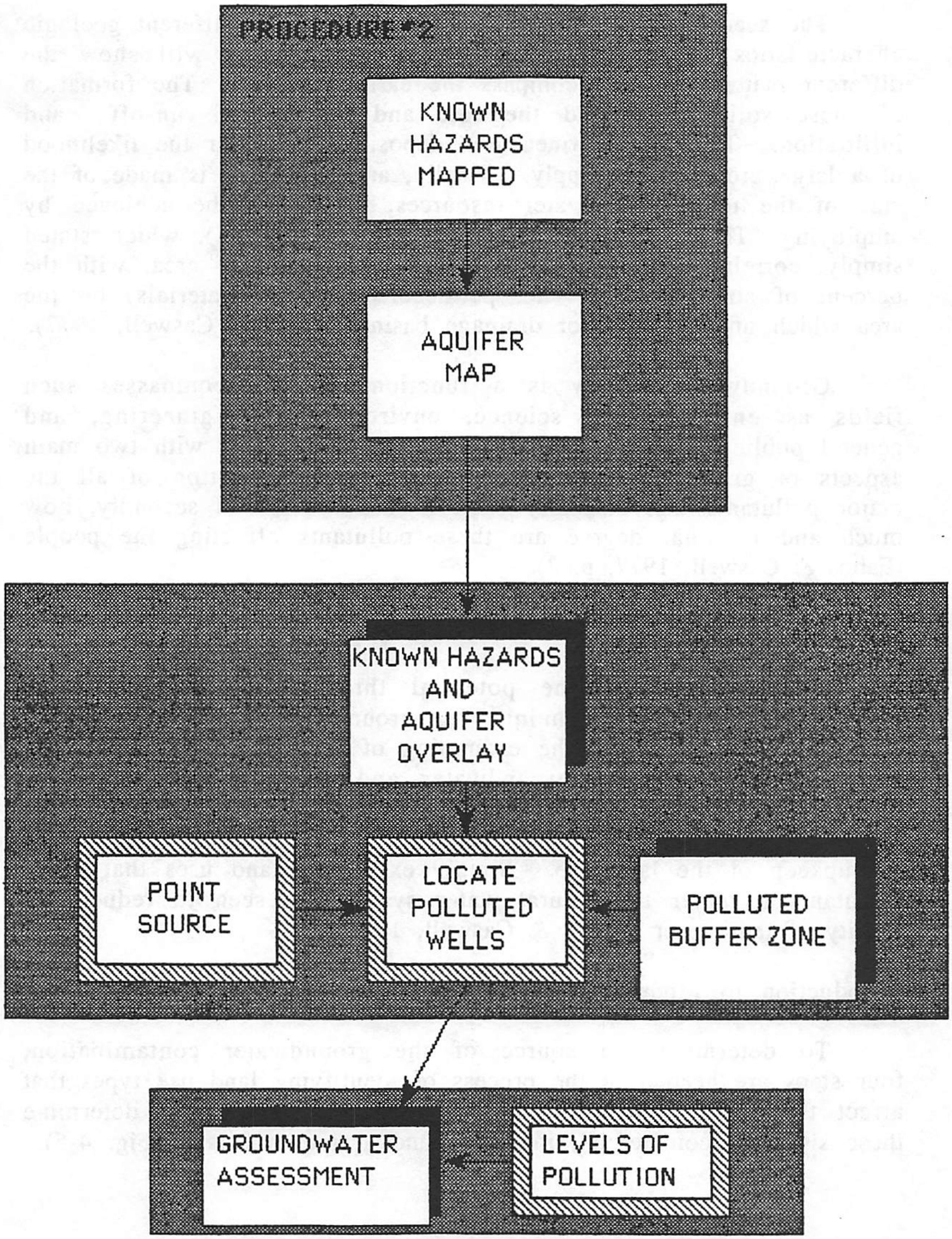


Figure 4-5 Groundwater Assessment Procedure Model. This chart shows the process of groundwater quality assessment.

Step 1: Locate all land uses that involve the use of any possible polluting agents. Such examples are agricultural farmlands that use fertilizers & pesticides for the upkeep of the land. Urban residential is another land use that involves contaminated private wells in the groundwater from volatile organic compound. Also known contaminated 21E sites will be sited.

The 21E sites (Fig. 4-6) are a major concern because of the release of volatile contamination into the private wells and of petroleum spills into the groundwater. All presently known contaminated sites and potentially contaminating spills are located because of their threat to groundwater. These locations of contamination in the town of Uxbridge are produced on a map and the known underground storage tank permits are included (Fig. 4-7) within the research of groundwater. These results are mapped by certain land uses in a category ranging from most to least contaminated.

Step 2: A determination of groundwater flow is established. This results from the use of an aquifer/recharge map. Direction of flow is north to south from the assessment done by Interdisciplinary Environmental Planners (IEP).

Step 3: Location of contaminated wells. This was derived from the monitoring study done by the Town of Uxbridge per order of the Department of Environmental Protection. The polluted wells on Kempton Rd. show excessive volatile organic compounds. These are classified in the quality of drinking water as hazardous.

Step 4: Denoting different land types into different levels of contamination. Certain land uses have a higher degree of pollution not only now but also in the potential future. Levels of high to low potential contamination are plotted for different land types. These areas correspond to 1) urban residential 2) 21E sites and 3) private wells which are mapped.

21 E Sites in Uxbridge, Ma.

Site Name	Address
1. Strathmore Shire Realty	152 Hartford St.
2. Stanley Woolen Mills	140 Mendon St.
3. Roy's Mobil Station	N. Main & Mendon Sts.
4. Ramelli Ford	124 North Main St.
5. Purtain Cleaners	North Main St.

21 E Spills in Uxbridge, Ma. (Reported 1986-1991)

Spill Name	Address	Material
1. Helen Transportation Storage	Chestnut St.	#2 Fuel Oil
2. Drum Piping	Chestnut St.	Waste Oil
3. Gas Pipeline	Chestnut St.	Waste Oil
4. Mclay Property	Church St.	#2 Fuel Oil
5. Fafard Construction	Crowshield Rd.	Drums-Iron
6. Bernat Mill Complex	Depot St.	Transformer Oil
7. M.V. Accident	Depot St.	Diesel-Antifreeze
8. Boston Edison	Douglas Pike	Paint
9.	Elwood St.	Transformer Oil
10. Industrial Runoff	Ironstone Rd.	Industrial Runoff
11. Hazardous Release	Landfill	Diethylamine
12. Asphalt Paving Waste	Johnson Rd.	Asphalt Waste
13. Asbestos Dumping	127 N. Main St.	Asbestos
14. Ramelli Ford	N. Main St.	Gasoline
15. L&W Welding	No. Main. St.	Unknown
16. Replacement Auto Parts	248 N. Main St.	Gasoline
17. Helen's Service Station	255 N. Main St.	Gasoline
18. UST Removal	58 N. Main St.	#2 Fuel Oil
19. Hood Construction Property	River Rd.	Gasoline
20.	Rock Meadow Rd.	Unknown
21. @ Intersection Of Elmwood St.	Rte. 146	#2 Fuel Oil
22. Truck Accident	Rte. !6	Diesel Fuel
23. Resident Tank Replacement	5 South Garden St.	#2 Fuel Oil

Figure 4-6 21E Sites and Spills in Uxbridge, Ma.

TOWN OF UXBRIDGE, MA.

UNDERGROUND STORAGE TANK PERMITS
AS OF FEB. 27, 1992

1.	Ronald Smith, Albee Rd. and Millville Rd.	(REMOVED)
2.	Helen Transportation, 255 North Main St.	
3.	Industrial Foundry Corp. Elmdale Rd.	
4.	The Grove Corp. Rt. 146A, Quaker Highway	
5.	Holland's Express, West Hartford Ave.	(REMOVED)
6.	Bloem's Garage, North Main St.	
7.	Commonwealth of Massachusetts, D.P.W. Douglas St.	
8.	Mael Brothers Farm, West River Rd.	(REMOVED)
9.	Edward T. Sullivan, 244 North Main St.	(TRANSFERRED)
10.	James Pacquetts, North Main and Hartford Ave.	
11.	North Uxbridge Coal and Fuel , North Main St.	(REMOVED)
12.	Nick Dee Chevrolet, 169 North Main St.	(REMOVED)
13.	Cumberland Farms, Douglas St.	
14.	Schnorr Construction, Rt. 146A, Quaker Highway	
15.	Town Of Uxbridge D.P.W. Hecla St.	
16.	Roy's Mobil, Main and Mendon St.	(REMOVED)
17.	Cocke-n- Kettle, South Main St.	
18.	Ronald E. Adam, Rt. 146A, Quaker Highway	
19.	Stanley Woolen Company, Mendon St.	
20.	Quaker Realty Trust, Rt. 146A, Quaker Highway	
21.	Donald McMahon, Hood's Truck Stop, Rt. 146A, Quaker Highway	(REMOVED)
22.	Quaker Realty Trust, Hood's Sand and Gravel, Rt. 146A, Quaker Highway	(REMOVED)
23.	William and Kathleen Audette, Mr. Bill's, 244 North Main St.	
24.	New England Telephone, Court St.	
25.	Rick's Autobody, Rt. 146A, Quaker Highway	

Figure 4-7 Underground Storage Tank Permits in Uxbridge, Massachusetts as of Feb. 27, 1992.

Findings

Based on the analysis of potential point sources for groundwater contamination, we estimated that there currently exists about 4% of the towns land which could contaminate the groundwater supply. At the present time, 46% of commercial zoning and 57% of industrial zoning in Uxbridge is above the aquifer (IEP). The major source of pollution in the town of Uxbridge is the 21E Sites. The known 21E Sites,which are designated contaminated areas, all lie within a mile or closer to the existing aquifer. This poses a serious threat due to the amount of gasoline and oil that can leach into the ground. The public and private underground oil tanks also lie very close to the aquifer and are time bombs ready to go off. It may take a while before a leak is identified, only a small amount of contamination (e.g.: gas or oil) is necessary to destroy hundreds of thousands of gallons of usable drinking water. Volatile organic compounds, which are toxic, were found in private wells on Kempton Road in early July of 1991. A dozen or more residents had to have temporary water lines installed by the Department of Public Works (D.P.W.) because their water was contaminated. The cost of the damage was over $760,000 and the towns of Uxbridge and Millville were looking towards the state for help. The point source is believed to have originated from abandoned 55 gallon rusted barrels on a vacant lot in Millville. The 21E Sites, contaminated wells, and underground tanks are mapped (Fig. 4-8).

NOISE POLLUTION

Significance

Noise pollution has the potential to be a serious threat to physical and psychological health. In some urban and metropolitan areas, noise pollution can actually create or enhance stress related bodily disorders such as ulcers, heart disease and indigestion. It has been estimated that over 40 million people in the United States are periodically exposed to outdoor noise levels that are potentially hazardous to their hearing. Research has also indicated that millions of people have been exposed to increasing levels of noise at the rate of one decibel (measured sound level) per year (Fabos & Caswell, 1977, pg. 154).

People are continuously subjected to noises in urban and metropolitan areas that often exceed levels known to cause some degree of permanent hearing loss. It is sometimes common in residences on the outskirts of cities to find people who lose the use

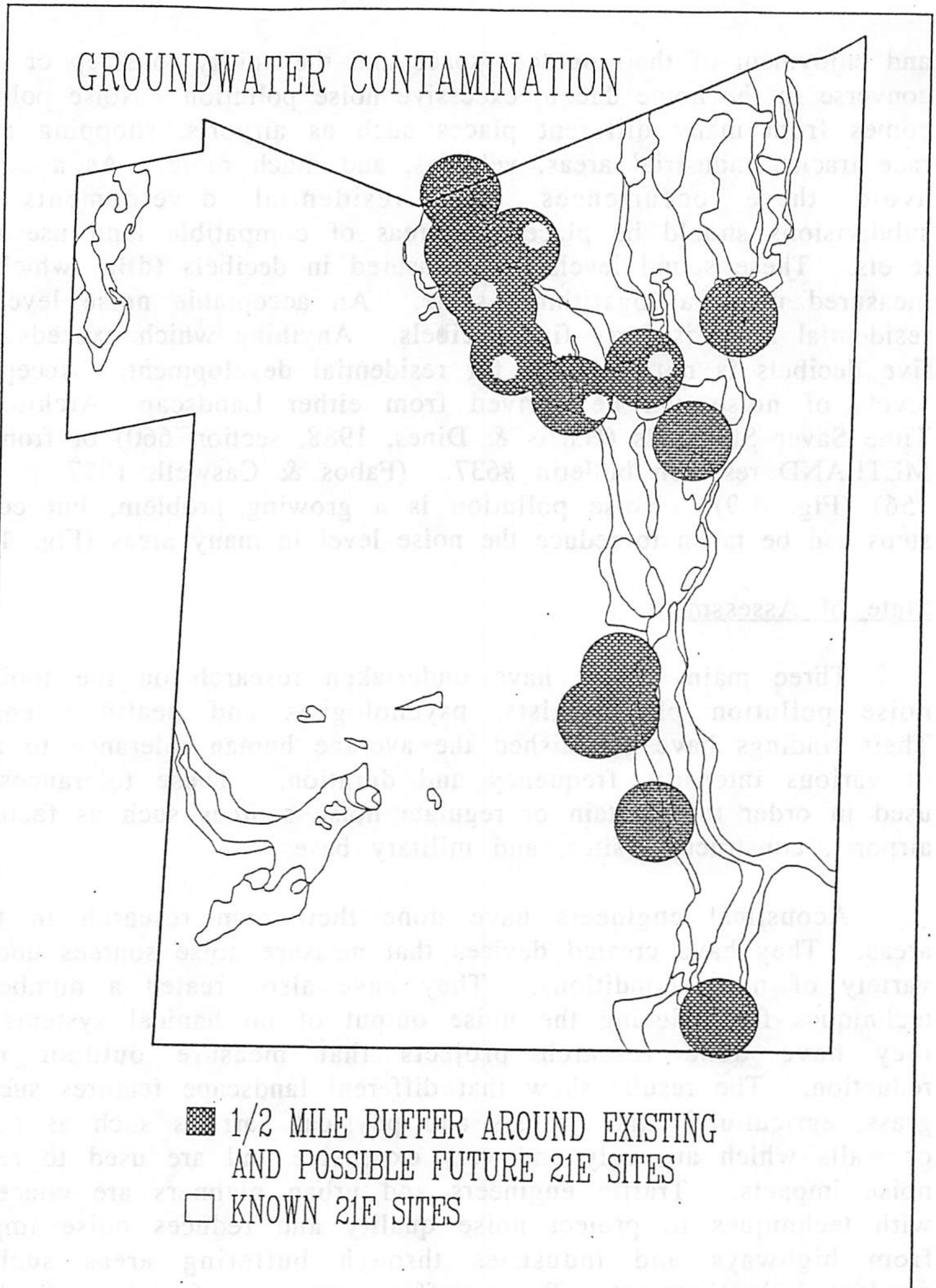


Figure 4-8 Groundwater Assessment Map. This map identifies the 21E Sites and the location of the underground private tanks.

and enjoyment of their outdoor space and the ability to sleep or converse in the home due to excessive noise pollution. Noise pollution comes from many different places such as airports, shopping malls, race tracks, industrial areas, vehicles, and much more. As a step to avoid these occurrences, new residential developments and subdivisions should be placed in areas of compatible land use noise levels. These sound levels are measured in decibels (dBa) which are measured using a logarithmic scale. An acceptable noise level for residential areas is forty five decibels. Anything which exceeds forty five decibels is not welcome for residential development. Acceptable levels of noise can be derived from either Landscape Architecture Time Saver Standards (Harris & Dines, 1988, section 660) or from the METLAND research bulletin #637. (Fabos & Caswell, 1977, p. 154-156) (Fig. 4-9). Noise pollution is a growing problem, but certain steps can be taken to reduce the noise level in many areas (Fig. 4-10).

State of Assessment

Three main groups have undertaken research on the topic of noise pollution physiologists, psychologists and health scientists. Their findings have established the average human tolerance to noise of various intensity, frequency and duration. These tolerances are used in order to maintain or regulate noise sources such as factories, airports, construction sites, and military bases.

Acoustical engineers have done their own research in these areas. They have created devices that measure noise sources under a variety of noise conditions. They have also created a number of techniques for reducing the noise output of mechanical systems and they have done research projects that measure outdoor noise reduction. The results show that different landscape features such as grass, agricultural land, forests and physical barriers such as berms, or walls which are ugly and very expensive and are used to reduce noise impacts. Traffic engineers and urban planners are concerned with techniques to protect noise quality and reduces noise impacts from highways and industries through buffering areas such as residential development. These buffer zones (e.g. forests, agriculture) can control noise limits because the effects are spatially limited (Fabos & Caswell, 1977, p. 156-157).

Biological scientists and acoustical engineers have measured the level of noise generated by many land uses under different environmental conditions. They developed scales of noise measurement through research to observe the way people perceive noise. The research data is used by all groups including landscape planners who make decisions on land use and noise impacts. Figure 4-9 shows average noise levels estimates for all major land uses.

Land use Type	Land Use Noise Level (in dBa)
Tilled or tillable crop	35
Land supporting nurseries	40
Fruit orchard	40
Cemetery	40
Powerline or right of way	40
Estates	40
Clustered residential land	45
ACCEPTABLE FOR RESIDENTS------------	
Drive-in theater	50
Golf course	50
Townhouse or row houses	55
Garden apartments	55
Urban park	55
Alpine ski area	55
Tennis court	55
Light industry	60
Athletic field and stadium	65
Playground	65
Swimming pool	65
LOW HEARING DAMAGE-----------------	
--	
HIGH HEARING DAMAGE-----------------	
Commercial amusement park	70
Fairgrounds for agricultural fairs	70
Highway (strip) commercial	70
Dump, sanitary fill	70
Automobile dump	70
Urban core commercial	75
Railyard, including terminals	75
Truck or bus terminal	75
Heavy industrial	75
Race track	75
SEVERE DAMAGE OF HEARING------------	
Sand and gravel pit or quarry	80
Other mining	80
Airport, including strips & terminals	90

Table 4-9 Land Use Noise Levels and Groups. This table shows major land uses which generate noise levels in excess of 40 dBa.

Adapted Approach

The METLAND - Developed Assessment technique is a approach to noise assessment that is designed for land use planners. Inferences are made on a great number of noise measurements and combined into a method for simulating probable noise environments which result in a town from noise emissions on the basis of site - specific noise source and reduction measurement data. A mathematical model (developed by METLAND) is then used to calculate resultant noise levels on a general area from the land use.

METLAND has developed a set of 'noise planning guidelines' to assist planners in controlling small - scale noise impacts based on the amount of the noise reduction provided by types and lengths of noise buffering landscape elements.

The implementation of source maps is required to apply this technique. The maps include a land use map and U.S.G.S. topographical map of the town being assessed. The step by step procedure for our assessment technique is as follows (Fig. 4-10).

Phase 1: Procedure for delineating noise source areas in a town or small region.

Step 1: Assign a characteristic noise level to each land use type and gather land uses into noise groups.
Step 2: Create a land use noise source map.
Step 3: Produce a highway noise source map.

Phase 2: Determine transmission loss areas in the town being assessed.

Step 4: Produce transmission-loss map.

Phase 3: Determine noise pollution environments.

Introduction to Model

Adapting the METLAND - Assessment technique and the use of a nomograph obtained from Landscape Architecture Time Saver Standards, (Harris & Dines, 1988, section 660 - 4) the noise pollution assessment for Uxbridge was produced. The step by step process was organized as follows.

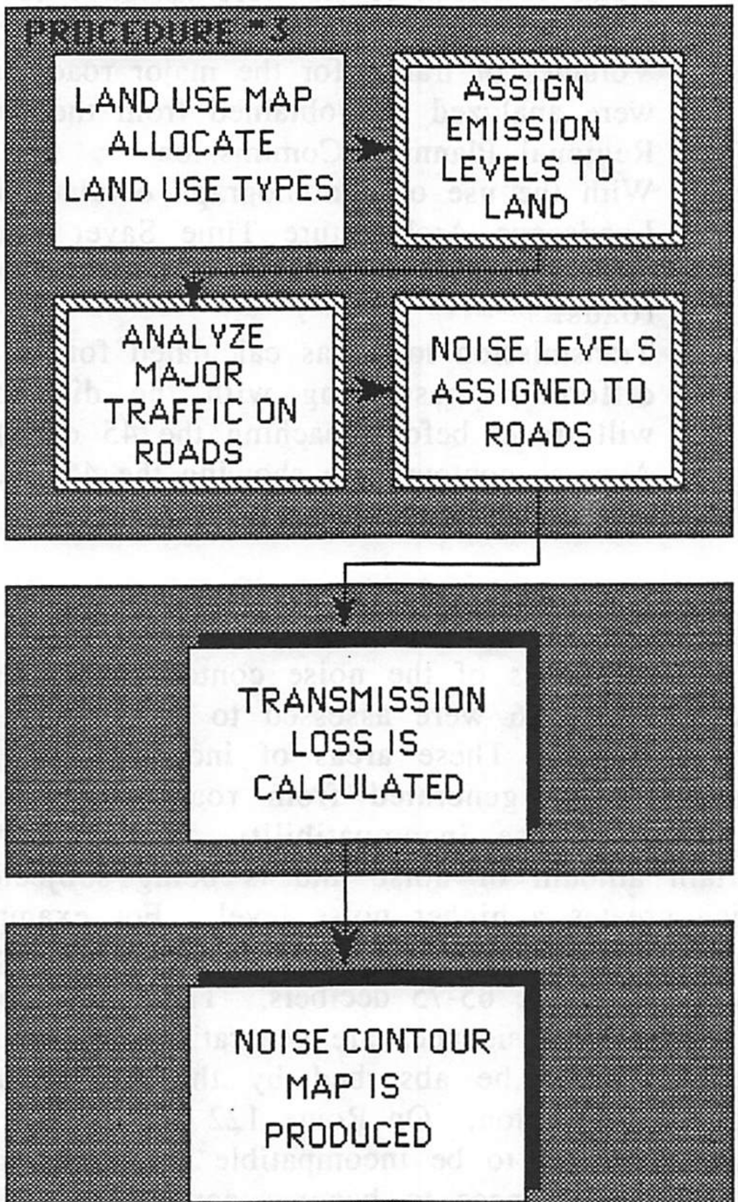


FIGURE 4 -10 · Noise Pollution Model. Shows adapted approach to procedures of analysis and assessment.

Step 1: A current land use map was used to allocate various land use in Uxbridge.

Step 2: Noise emission levels were assigned to industrial, commercial, and gravel pits.

Step 3: Volumes of traffic for the major roads in Uxbridge were analyzed and obtained from the Central Ma. Regional Planning Commission.

Step 4: With the use of a nomograph obtained from Landscape Architecture Time Saver Standards, noise levels in dB(a) were assigned to the main roads.

Step 5: Transmission loss was calculated for these different areas along with the distances the noise will travel before reaching the 45 dB(a) range.

Step 6: A noise contour map showing the 45 + dB(a) range is then produced.

Findings

Through the analysis of the noise contour map, residential areas along Routes 122, and 16 were assessed to be incompatible with the optimum decibel range. These areas of incompatibility were caused not only by the noise generated from road traffic but also from recreational areas. Noise incompatibility occurs when a land use creates a certain amount of noise and is being subjected to another land use which creates a higher noise level. For example, residences generally create a noise level of around 45 decibels (Fig. 4-11) while a busy roadway can create 65-75 decibels. There is a noise conflict of 20 decibels. Since the residences are generating a lower level of noise the extra decibels must be absorbed by the residential community, hence causing noise pollution. On Route 122 and 16 noise levels of 65 decibels were determined to be incompatible in the town of Uxbridge. In order for these residences to become compatible, they must build new subdivisions and development outside the 45 + decibel boundary (Fig. 4-12). Off Route 146, many industrial operations are susceptible to noise pollution but this is a perfect zone for the land around 146A which in the future is predicted to be the third belt around Boston. The other two beltways are 495, and 128 Uxbridge should watch the development around this highway. Another good example of use within the noise pollution area would be agriculture, an area like this could break down the noise levels. A noise and air pollution map was created of these areas (Fig. 4-13).

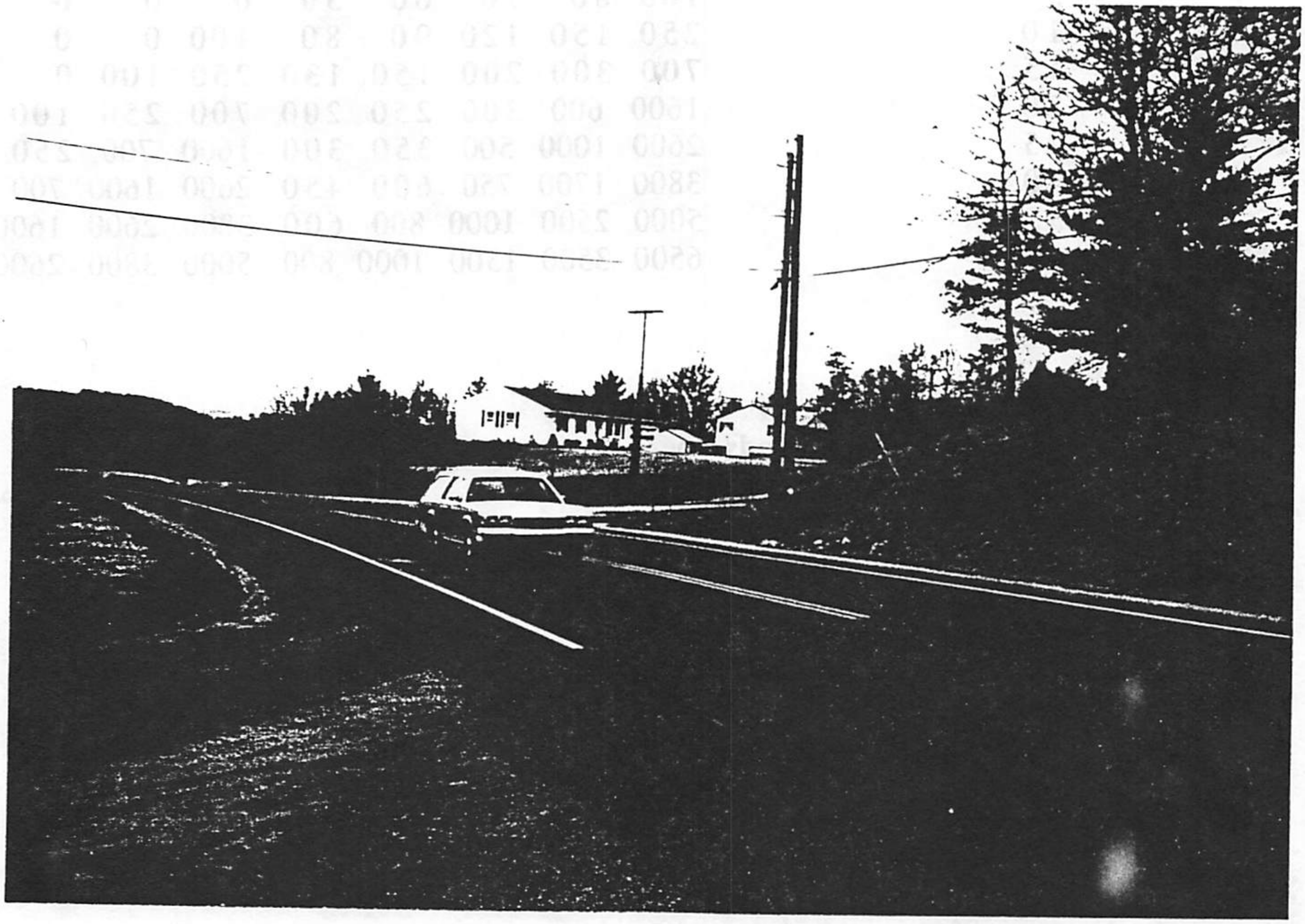


Figure 4-11 Residential Housing. This shows some of the noise and air pollution that is occuring on major routes such as 122 as well as the relationship to residential develpoment.

Total amount of noise reduction in dB	1	2	3	4	5	6	7	8
5	100	80	70	60	50	0	0	0
10	250	150	120	90	80	100	0	0
15	700	300	200	150	130	250	100	0
20	1600	600	300	250	200	700	250	100
25	2600	1000	500	350	300	1600	700	250
30	3800	1700	750	600	450	2600	1600	700
35	5000	2500	1000	800	600	3800	2600	1600
40	6500	3500	1300	1000	800	5000	3800	2600

Index

1=Open, level, barren landscape
2=Agricultural land or grass
3=Reverting field
4=Forest
5=Very dense forest
6=Barrier (h=5')
7=Barrier (h=10')
8=Barrier (h=15')

Figure 4-12 Source-Receiver Distances. This table shows distances required to produce amounts of noise reduction for eight alternative buffer zone types (in feet). In order for barriers to be as effective as indicated in reducing noise, the source should be linear (e.g. highway) or contained (e.g. parking lot) (Fabos & Caswell, pg. 175).

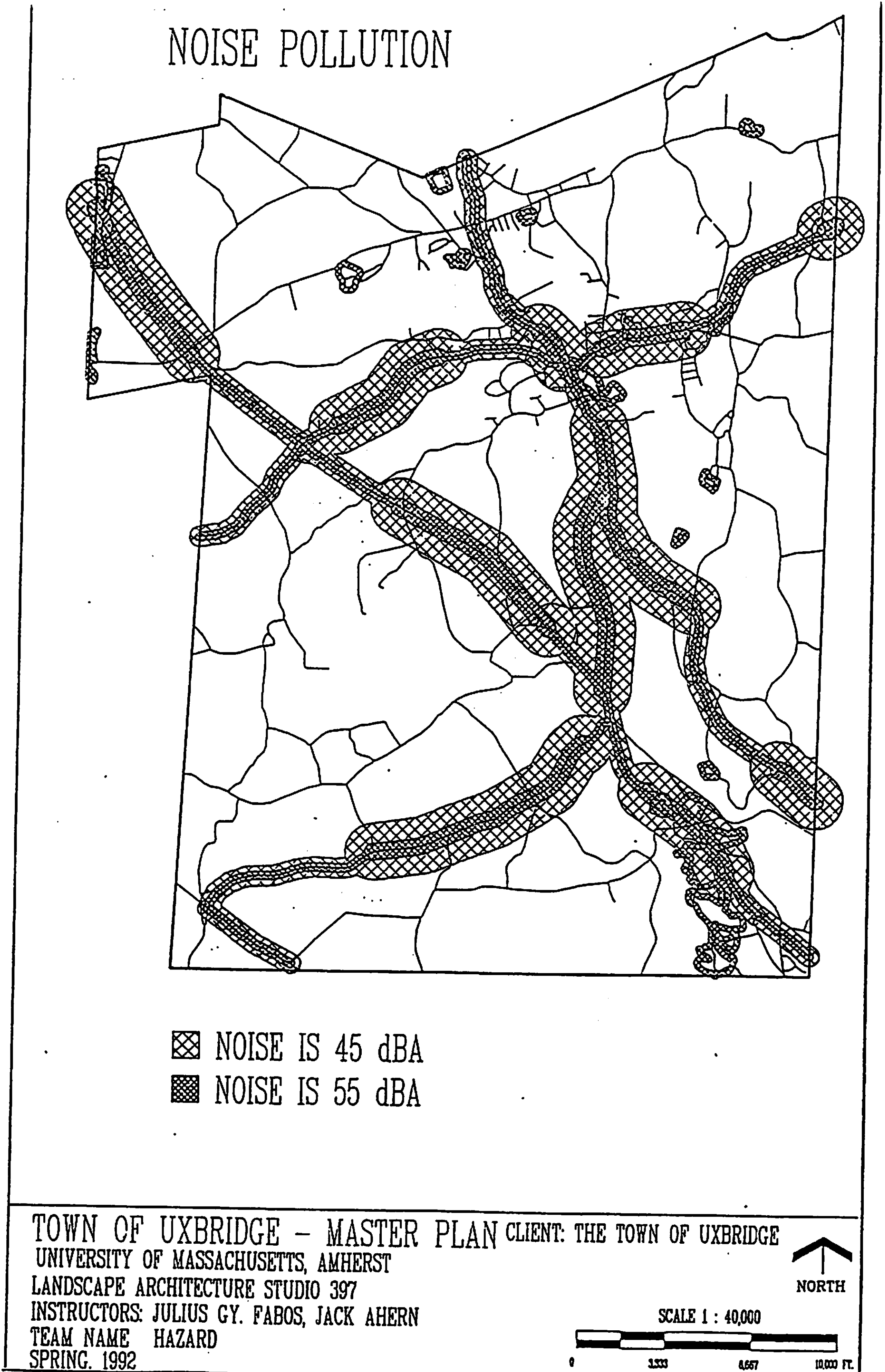


Figure 4-13 Noise and Air Pollution Base Map. Shows areas where noise and air pollution exceeds 45d(B)a and having unhealthy affects on the public.

AIR POLLUTION

Significance

The significant effects of air pollution have occurred in urban - metropolitan areas. Research has shown conclusive evidence linking air pollution to human death. There is evidence that links certain deaths due to cancer and emphysema to air pollutants and carbon monoxide. Deaths and illness of thousands of residents has occurred in industrial areas. In 1952 one of the most tragic episodes of atmospheric pollution occurred in London where approximately four thousand people died. Air pollution can kill plants and wildlife, and is even the cause of a major global problem known as acid rain. Inert materials such as concrete can actually be damaged from air pollution as well. It has been estimated by scientists in the United States that $10 billion dollars in economic loss to inert materials is due to air pollution. Air pollution also creates an aesthetically unpleasing environment from odors and dust particles that are formed. Air pollution should be identified so that planners can place residential and other sensitive developments in a cleaner and healthier location (Fabos & Caswell, 1977, p. 139-140).

State of Assessment Procedures

Air pollution assessment is well developed at the regional - metropolitan level which is important to planners for environmental planning purposes. Research studies done by climatologists and chemists show that air flow, topography and geographic location are the factors that influence the dispersal of pollutants in the atmosphere. Scientists have developed mathematical and computerized models designed to assess and predict air pollution. The models show open space buffer zones being appropriate planning devices to control air pollution. Regional planners assess air pollution at the regional - metropolitan level which is considered to be the most important level to planners. Land uses of different scales and types produce air pollution to varying degrees. Planners examine each type of pollution and their compatibility to their surrounding land use. After these factors are sorted out, the location of buffer strips can be determined to reduce the effects of air pollution (Fabos & Caswell, 1977, p. 140 - 141).

Adapted Approach

The METLAND-developed assessment technique is being used by more planners daily to assess air pollution. The process was determined by mapping the major noise pollution areas in Uxbridge, Massachusetts. Adapting procedures from the Metland-developed assessment technique and recommendations from Ann Spirn's "Granite Garden"(p.73) along with the information from the noise assessment of Uxbridge, the air pollution was mapped (Fig. 4-14).

Introduction to Model

Step 1: Utilize a current land use map to identify major land uses.

Step 2: Traffic counts from the Central Ma. Regional Planning Commission Traffic Count from 1983 - 1990 on the major roadways in Uxbridge. Speed limits were obtained from driving these roads.

Step 3: Using the noise contour map along with certain METLAND developed procedures, air pollution for the town was determined.

Findings

Air pollution in the town of Uxbridge was assessed not to be a major concern or an immediate problem. The main cause of air pollution is coming from automobiles. On Routes 146, 122, 16 and the Quaker Highway enough air pollution was detected to cause some basic health problems. In this aspect, a setback line, of thirty meters parallel to the center line of Routes 146, 122, 16 and Quaker Highway is recommended. This was adapted from Ann Spirn's research in the Granite Garden, and is suggested to help minimize risks. The land use within the setback line has enough reducing characteristics to lower the pollution to an acceptable level. For example, trees, grass and landform will absorb the pollutants which are produced by automobiles into their own systems and help to purify the surrounding air.

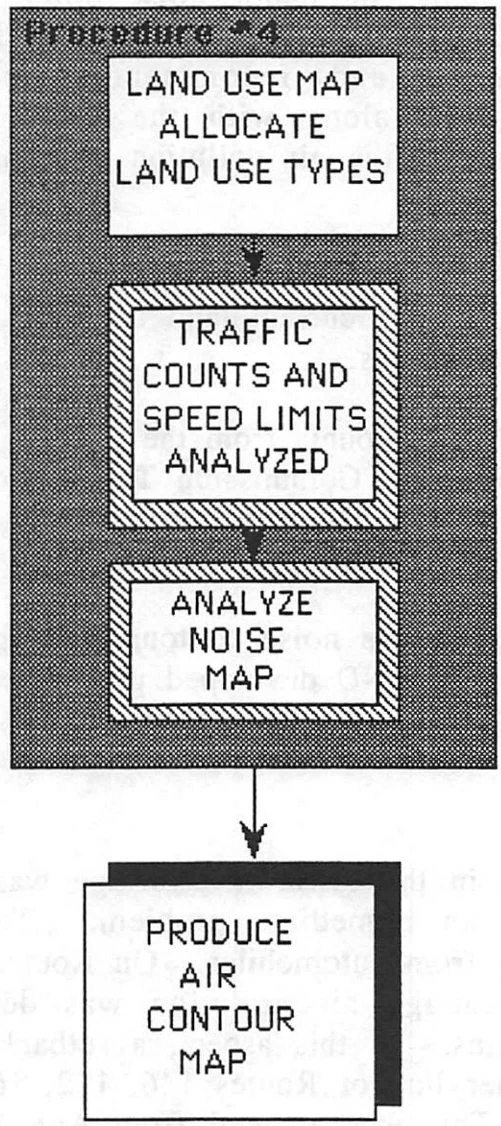


Figure 4-14 Air Pollution Assessment Model. Shows adapted approach to procedures in analysis and assessment.

HAZARDOUS ROADS AND INTERSECTIONS

Significance

The dangers of roads and intersections are certainly well known. Every year thousands of people die or are injured in traffic - related accidents. Throughout several regions of the country, a great increase in population has lead to increased traffic volume and in turn more roads and intersections. More and more residential areas, schools and commercial areas, along with these roads and intersections, have greatly increased the conflicts between pedestrian and vehicular traffic. Today, measures must be taken to prevent future life - threatening conflicts and to reduce those presently affecting our lives. Implementation of these measures is especially needed in our cities and towns where these hazardous conditions have already taken their toll.

State of Assessment Procedure

Roads and intersections are primarily assessed by traffic engineers and transportation engineers, they are also involved in the design and circulation of the roads and highways. This involves studying speeds, capacity, etc. Planners further assess these roads using traffic plans of towns. These, in turn, include traffic counts and volumes. The location of hazardous areas and information such as accidents, injuries, and deaths may be obtained from the local police department. The goals of the planners are to assure that the roads and intersections are designed safely for community use. After a careful analysis and assessment is complete, recommendations to future adjacent land use can be made. These recommendations include where to build residential areas and schools as opposed to commercial or industrial sites.

Adapted Approach

To determine hazardous roads and intersections in the town of Uxbridge, Ma, the team used the following steps (Fig. 4-15).

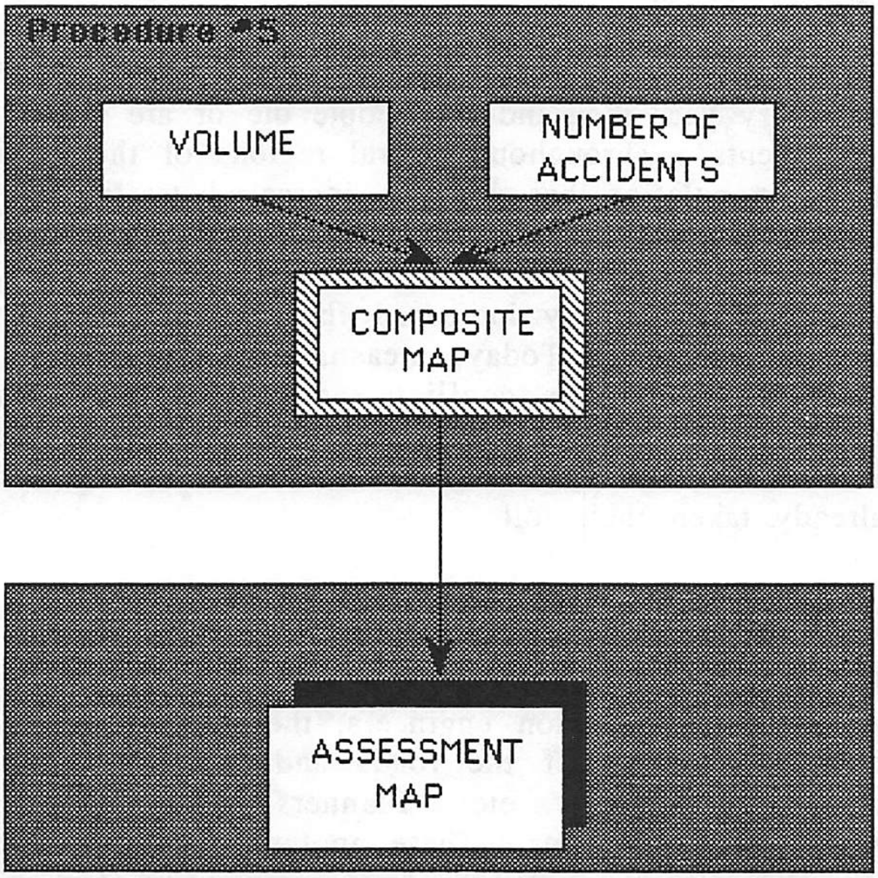


Figure 4-15 Hazardous Roads and Intersections Assessment Model.

Introduction to Model

Step 1: Analyze the current location of roads and intersections that pose a immediate or potential threat to society. This should include the current road conditions and volume. We received this information from the Uxbridge Police Department (Fig. 4-16).

Step 2: Determine the classification of streets, from light to heavy as given from the Regional Traffic Count Database (figure 4-17).

Step 3: Compute volumes of vehicular activity in roadway sections to determine major points of activity.

Step 4: Assess hazardous roads and intersections. The determination of these problem areas was derived through the personal experience of driving around the town of Uxbridge and observing poor sight lines, heavy volume, and the lack of traffic lights as well as some public opinion and help from the Uxbridge Police Department.

Findings

After analyzing traffic volume, three roads and three intersections were on the major concern list. The three roads are North Main Street, Mendon Street, and Quaker Highway. The average daily traffic exceeds 18,000 vehicles on the three roads mentioned (Fig. 4-18). The substantial number of vehicles accompanied by fairly high speeds pose a problem to pedestrians and other vehicles trying to enter the roads. These three roads combined had 96 accidents and 30 injuries in 1991(Fig. 4-19).

There are three intersections of concern, the first is 146A and 122 intersection (Fig.4-20) this is a very busy but dangerous intersection with a blind view from the stop sign looking right. The hazard team proposed a redesign of this intersection with an island and a stop sign (Fig.4-21) to make it easier to view the roads. The second is North Main Street and Cumberland Farm. The exit entry is a hazard in the intersection due to a sharp corner on the road and bad sight line. The team proposes to lower the speed limit and cut back some of the vegetation to prevent further accidents. The third intersection is North Main Street and Victory exit entry (Fig.4-22) is on one of the most heavily travelled roads in Uxbridge. This is

ROADS

LOCATION	#ACCIDENTS	#INJURIES
North Main St.	56	16
Mendon St.	23	7
Quaker Highway	17	7
East Hartford Ave.	17	2
West Hartford Ave.	15	8
South Main St.	14	3
Douglas St.	12	3

Figure 4-16 1991 Accident Report Totals on Hazardous Roads in Uxbridge. Shows the number of accidents, and injuries.

INTERSECTIONS

LOCATION	ACCIDENTS	INJURIES
North Main ST. & Cumberland Farms Parking Lot	17	1
North Main St. & Victory Parking Lot	15	1
West Hartford Ave. & Rivulet St.	4	2
Buxton St. & Big D Parking Lot	4	1
Mendon St. & Lynch's Parking Lot	3	3
East Hartford Ave. & Granite St.	2	0
146A & 122	2	1

Figure 4-17 1991 Accident Report Totals on Hazardous Intersections in Uxbridge, Ma. Shows the number of accidents, and injuries.

Central Massachusetts Regional Planning Commission
Regional Traffic Count Database
1983 - 1990

RTE. 146	
East of Rte. 146A	15184 24HR.
Douglas TL	14966 24HR.
South of Mill St.	14196 24HR.
TOTAL	**44346 24HR.**
RTE. 122	
Btwn Rte 16	13440 24HR.
North of Rte 16	11202 24HR.
Northbridge TL	10568 24HR.
South of Hartford Ave.	11068
24HR.	
South of High St.	9286 24HR.
South of Rte. 16	8734 24HR.
Millville TL	2232
24HR.	
TOTAL	**66530 24HR.**
RTE. 16	
East of Rte 122	12564 24HR.
Mendon TL	6908
24HR.	
West of Rte 122	6362 24HR.
East of Clarke St.	5545 24HR.
Douglas TL	3807 24HR.
TOTAL	**35186 24HR.**
QUAKER HIGHWAY	
South of Rte 122	6201 24HR.
TOTAL	**6201 24HR.**
LACKEY DAM RD.	
Douglas TL	5655 24HR.
TOTAL	**5655 24HR.**

Figure 4-18 Traffic Reports from 1983 - 1990 in Uxbridge, Ma.

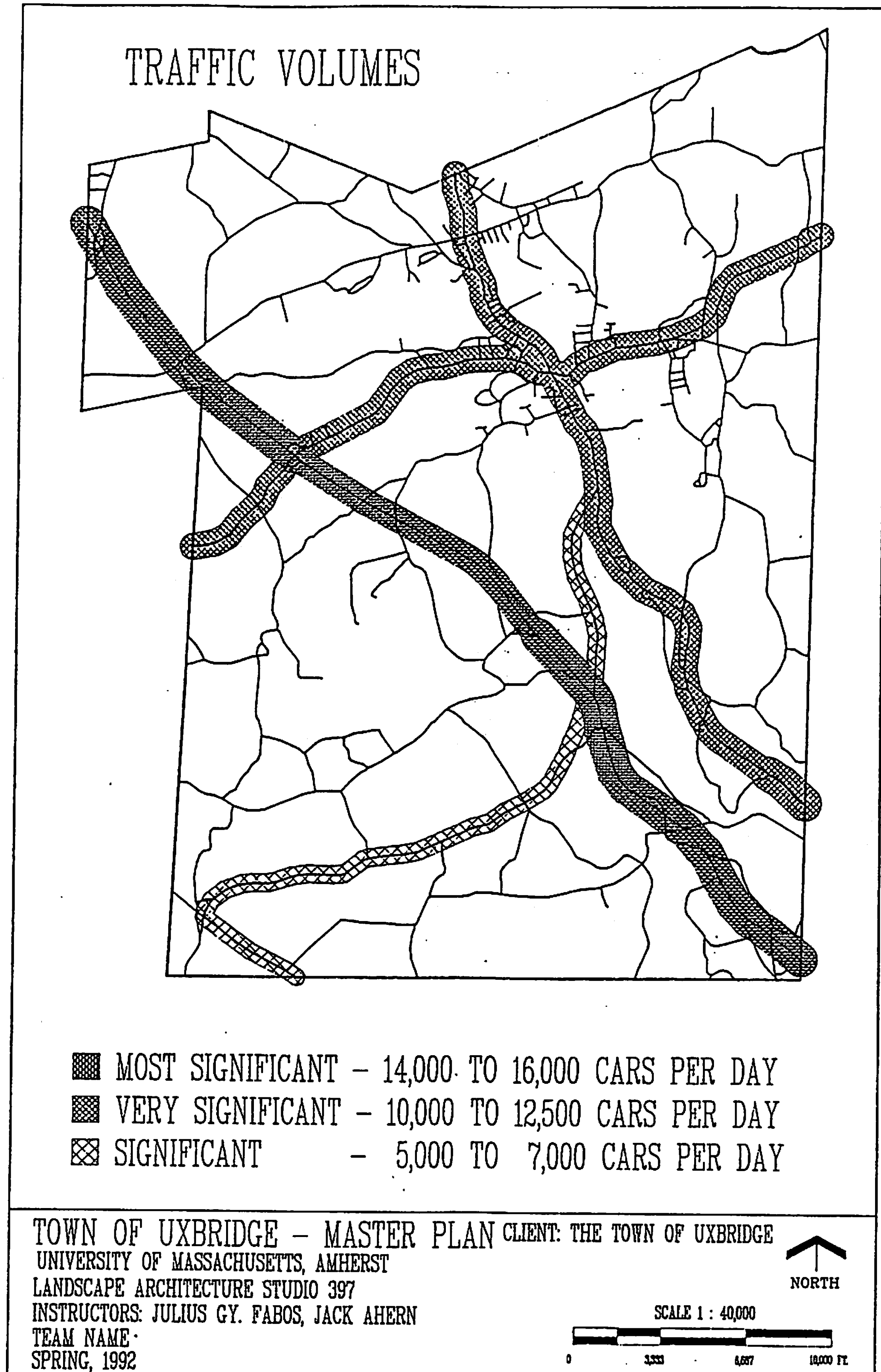


Figure 4-19 Hazardous Roads & Intersections Assessment Map. This map identifies the major roads and intersections in Uxbridge.

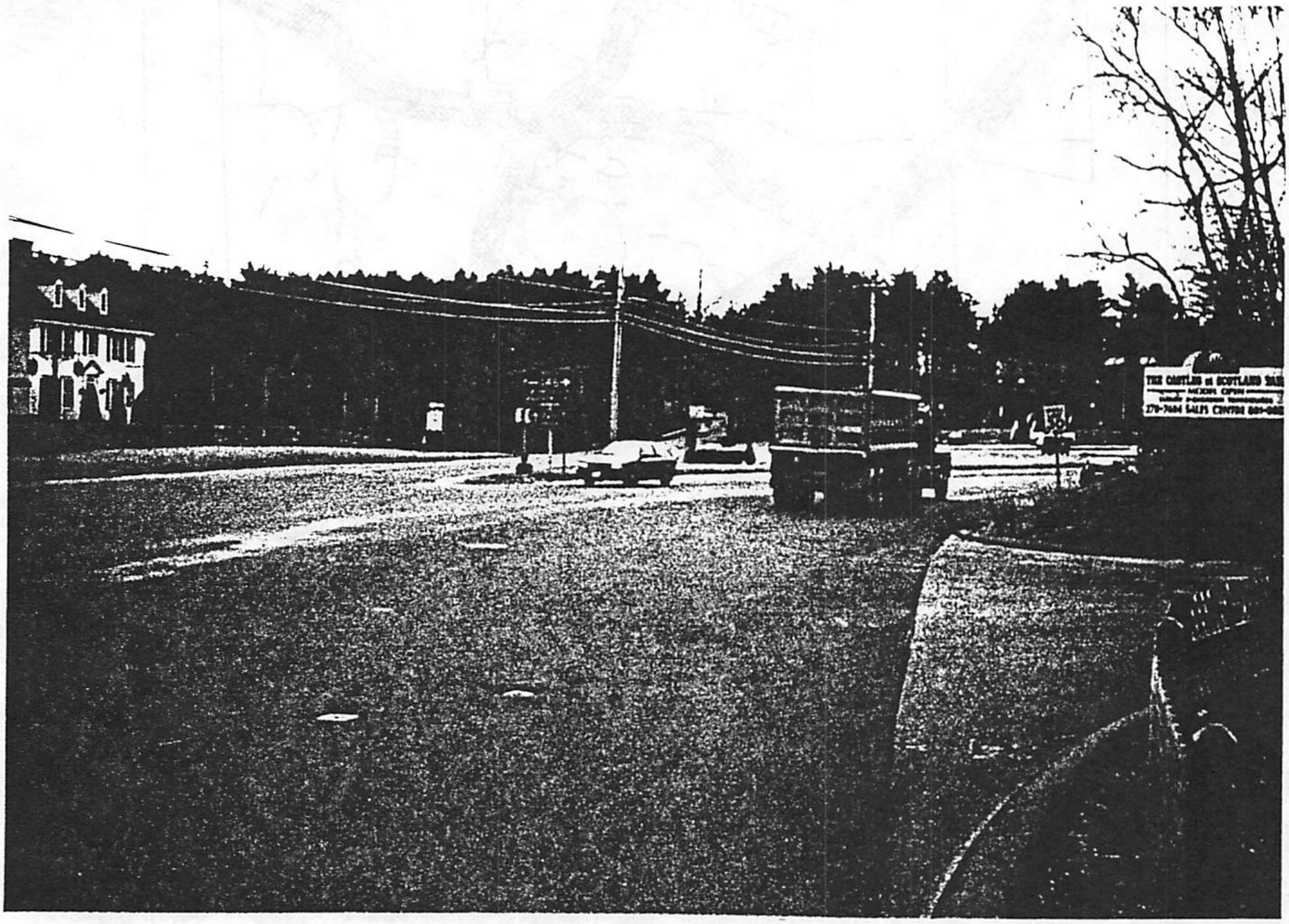


Figure 4-20 This shows the Traffic Intersection of 146A and 122. There is confussion on the drivers part on traffic flow and also a blind view of traffic coming from 122.

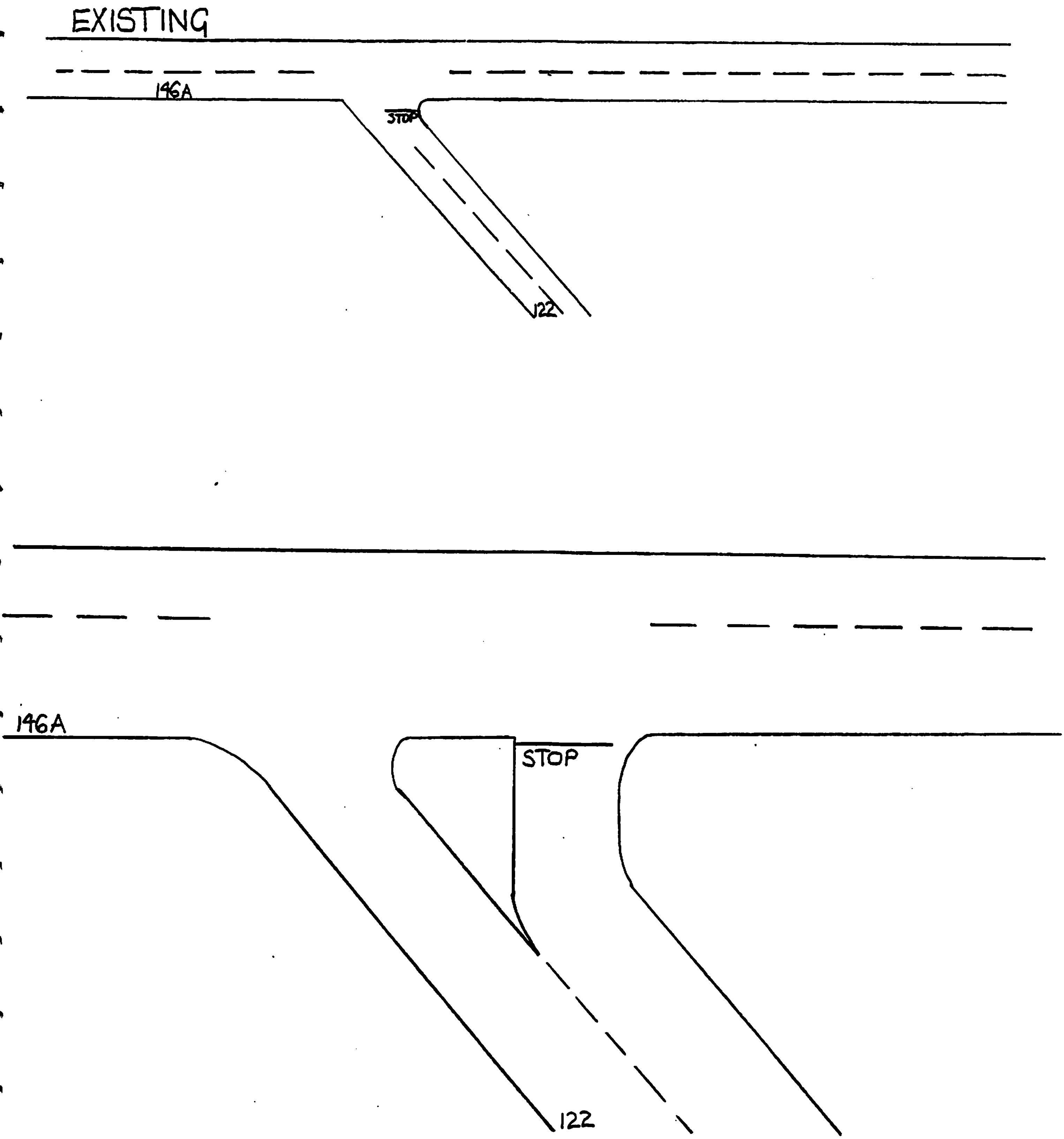


Figure 4-21 Possible Redesign Plan View of 146A and 122. As the intersection stands now it is very hazardous to drivers and pedestrians.

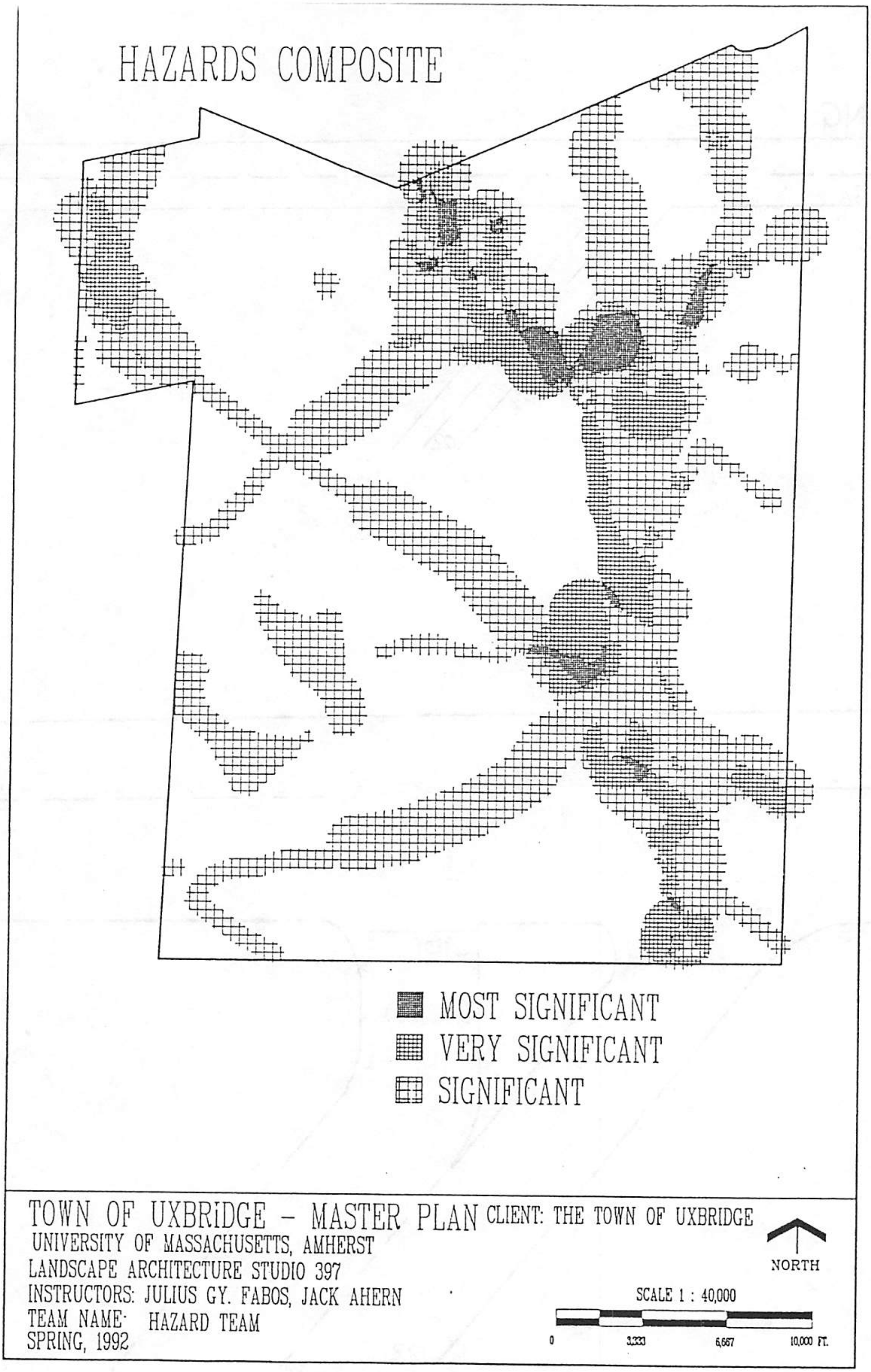


Figure 4-23 Composite Map of Hazards. Shows the hazard areas in the town of Uxbridge, Massachusetts.

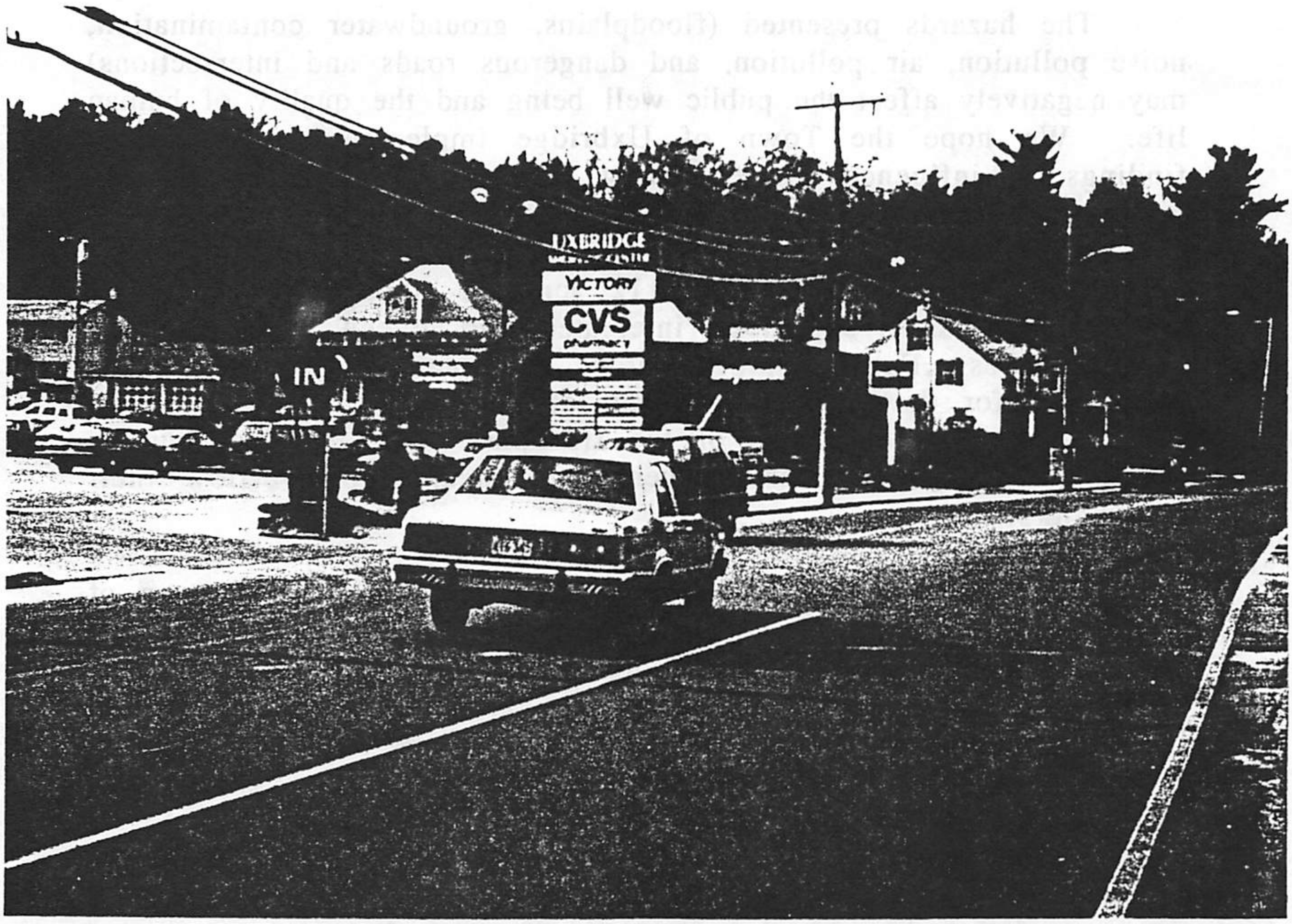


Figure 4-22 North Main St. & Victory Parking Lot. This photo clearly displays the confussion between the two drivers entering the parking area. This is one of the reasons why North Main St. & Victory Parking Lot was one of the most dangerous intersections in the town of Uxbridge, Massachusetts during 1991.

Uxbridge's most popular shopping district and many accidents occur at this point. This is due to the heavily travelled road and the unclear traffic flow on North Main Street.

Composite Summary

The hazards presented (floodplains, groundwater contamination, noise pollution, air pollution, and dangerous roads and intersections) may negatively affect the public well being and the quality of human life. We hope the Town of Uxbridge implements these hazard findings to influence future zoning and assist in future decision making and planning.

There are approximately 2,112 acres of floodplains within the town. These areas should be integrated into greenway opportunities and linkages .Future impermeable floodplains should not be considered for development. Urbanization in these areas decreases the water storing capacities of the floodplain soil, increases surface run off, and causes nearby rivers and streams to overflow their riverbanks.

There are approximately five existing 21E Sites in the town of Uxbridge, Massachusetts. These were found to have the highest levels of contamination, Strathmore Shire Realty, Stanley Woolen Mills, Roy's Mobil Station, Ramelli Ford, Purtain Cleaners and they all lie within a mile of underground aquifers. There were over a dozen families on Kempton Road whose private water supply was contaminated by volatile organic compound. It was believed to be coming from Millville, the next town over. These areas should be watched more carefully due to the damage they can cause to the water supply of the town.

Noise pollution at the present time does not affect many of the residential communities. In the future there could be communities incompatible due to their proximity within the 45+ decibel zone. In order for these residences to stay compatible with the surrounding land uses, they must create subdivisions away from these noise sources or change the zoning in the area so that commercial and industrial noise will not have such a large impact on them.

Air pollution was detected on Routes 146, 122, 16, and Quaker Highway. Although the air pollutants are not a serious threat presently, they could become a serious hazard to health as the town grows and traffic volume increases. Street trees should be planted along Routes 146, 122, 16, and Quaker Highway to help decrease the amount of air pollutants which are generated by vehicle traffic.

The analysis of traffic volume and road conditions determined three roads North Main Street, Mendon Street, and Quaker Highway hazardous. Three intersections North Main Street and Cumberland Farms exit entry, North Main Street and Victory exit entry, and 146A and 122 to be a major concern. The redesigning of 146A and 122 would help to control traffic volume and flow. To eliminate dangerous sight lines, vegetation should be cleared back to aid the view of oncoming traffic (Fig.4-23).

Visuals

Chapter 5

INTRODUCTION

This study provides guidelines for thoughtful planning and management of Uxbridge's visual resources and preservation of the town character. Visual amenity resources are those aspects in the landscape that provide interest and enjoyment to the public using or experiencing them. Some of these resources include various topographical features (Fig. 5-1), vegetation, all types of waterbodies, and historical/cultural influences. These various features are located, rated and assessed for the best management, protection or use. Our goal is to identify significant visual resources in the town of Uxbridge. This study will aid in the decisions toward recommendations influencing the planning of Uxbridge to best preserve the character of the town through preservation /protection development. The objective of our study is to find the most significant visual amenity resources, whose preservation or protection would benefit the community. As well, the determination of the visual quality of existing roadways in relation to landscape, viewshed (Fig. 5-2), and resource linkage to preserve the existing character of Uxbridge.

A. VISUAL AMENITIES

Significance

The visual amenity resource assessment locates areas that are visually significant and makes sure that they are protected or properly managed to maintain the visual resources. By locating these areas and preserving them, they can aid in maintaining the community's rural town character (Fig. 5-3). "...These visual, cultural resources exist for the enjoyment of the people today only because they have been preserved and protected for dozens and even hundreds of years." (Fabos and Caswell, 1976, p. 108) These areas, if saved by public ownership can maintain their uniqueness or visual quality for not only private but public enjoyment as well.

State of Assessment Procedure

The analysis and assessment procedure for visual resources is the adaptation of several visual amenity models. Research bulletin

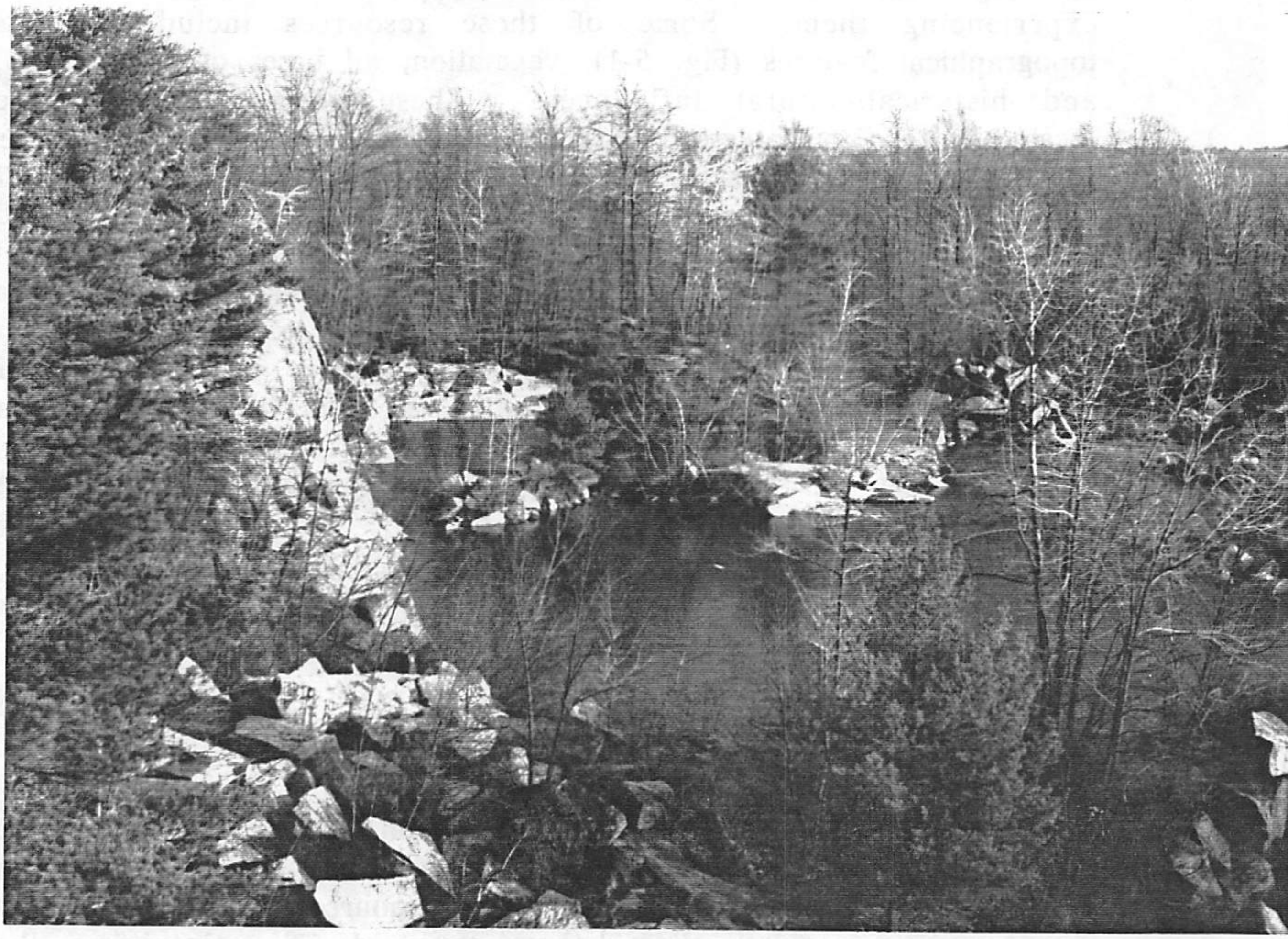


Figure 5-1 Topographical Visual Resources One of several quarries located on Quarry Hill which exhibit a hidden significant visual resource.

Figure 5-2 Visual Resource Viewshed Example of one of the many viewsheds that can be taken advantage of from various promontories and sceni roads throughout Uxbridge.

Figure 5-3 Community's Rural Character An example of an area that exhibits the rural quality of Uxbridge. If areas like this are not preserved the town character could be in jeopardy.

#653 from the METLAND model (Fabos, Greene and Joyner; 1978, p. 37-43) serves as the basis for the adapted approach used here. Some other sources which have aided in the process are Zube's Visual Assessment:The Expert Approach.; as well as the Granby, Southwick and Ludlow reports.

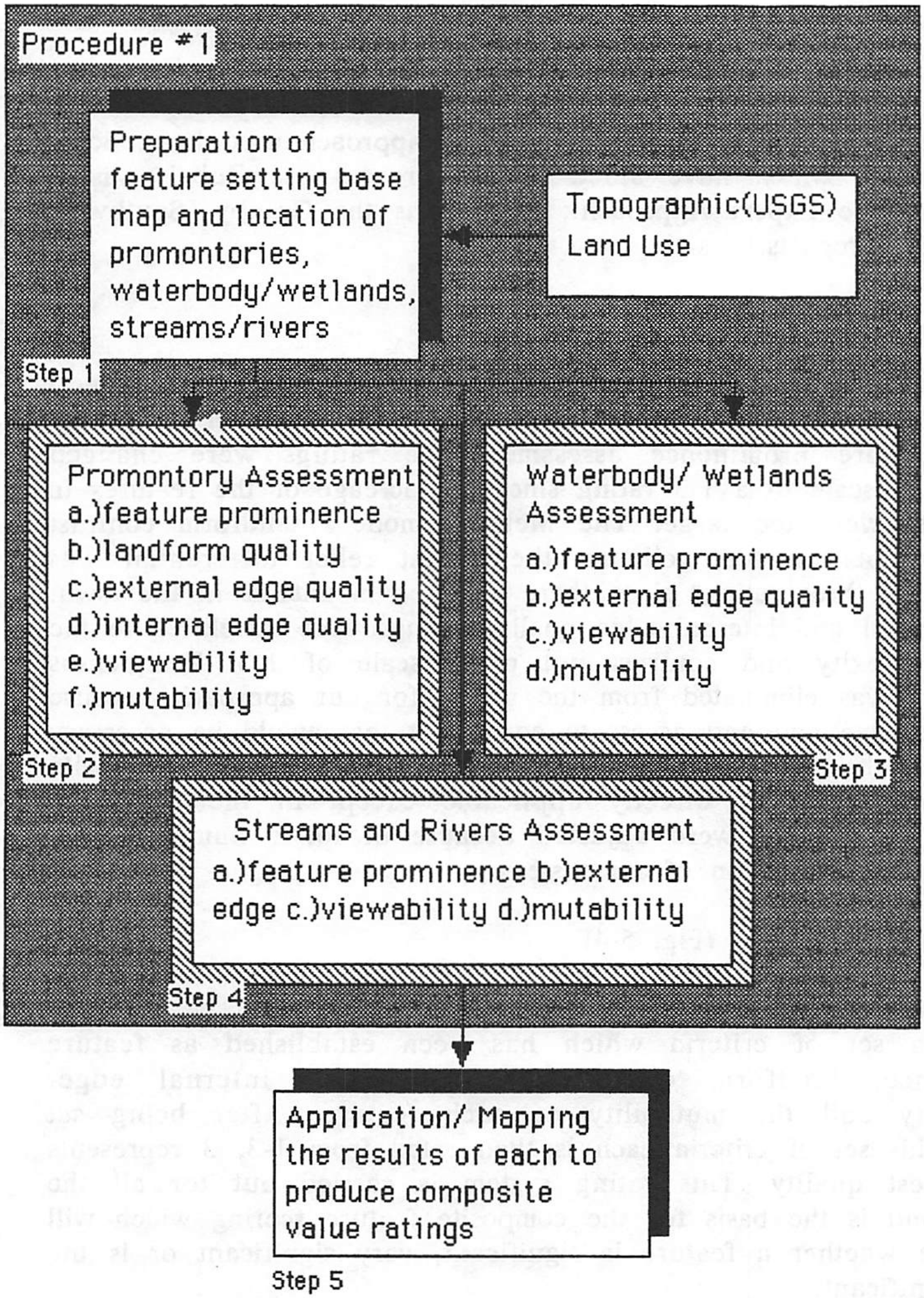
Adapted Approach

The METLAND model used here has been modified several ways to better suit our needs for assessing the Town of Uxbridge. Under feature prominence assessment the ratings were changed from a 1-5 scale to a 1-3 rating since the acreage of the features in the model were too large. The Metland model's landform contrast also did not transfer well, so the lowest relief differential was divided into three ratings since there were no mountains in the town. Both external and internal edge quality ratings were simplified to the edge complexity and contrast but on a scale of 1-3. Uniqueness assessment was eliminated from the model for our approach because of limited time and and access to equipment that would be necessary to gather the correct information. The mutability and composite feature scoring were directly applicable except in the composite totalling, the ratings were adjusted because of lower numbers as a result of the elimination of some steps.

Introduction to Model (Fig. 5-4)

Once the features have been located they can be assessed against a set of criteria which has been established as feature prominence, landform quality, external edge, internal edge, viewability and the mutability of each feature. After being set against this set of criteria each is then rated from 1-3, 3 represents the highest quality. This rating system is carried out for all the criteria and is the basis for the composite feature scoring which will determine whether a feature is significant, very significant or is the most significant.

Step 1: Involves the creation of a feature setting base map. In this step, the proper maps are gathered and from those water features are delineated, streams are divided into 1/2 mile sections for purpose of assessment, wetland areas are also mapped, and promontories.



Procedure #1

Visually significant landscape features are gathered from various maps and are identified. Each feature is then rated against a set of criteria.

Results: A composite feature scoring determines its significance.

Figure 5-4: Framework for assessment of visual amenity resources.

Step 2: Promontories are assessed first by locating areas that change drastically in elevation and therefore may afford views (Fig.5-5).

(a) The feature prominence assessment is simply determining the acreage of the various feature types. A promontory that is between 0-20 acres will receive a rating of 1 [significant] where as any of those features that are above 85 acres, will receive a 3 rating [most significant].

(b)Determine the landform quality assessment which is comprised of two parts. First, promontories are assessed by looking at their contrast. This is done by counting the number of contours between the feature and the surrounding landscape. The higher the relief differential the higher the rating. Then, if a promontory contains a "distinguishable landform" then that would add another point to the total landform quality rating.

(c) The external edge quality is made up of two factors; edge complexity and edge contrast. Edge complexity relates to how many switchbacks a promontory has along its horizontal edge. Edge contrast is determined by how the vertical edges surrounding the feature define the edge. Both of these are averaged together to produce an external edge rating of 1-3 in accordance with its significance.

(d) The internal edge quality rating applies to the amount of contrasting landform within the feature's borders as well as the edges that define the spaces within the feature.

(e) The viewability of a feature relates to how well it can be seen from other parts in the town. Promontories overall are able to be seen relatively well, but our assessment involved a rating of them, that is, if a particular promontory is viewable from many places throughout town, then it would get a rating of 3 [most significant]. Whereas a place that was secluded, yet still considered a promontory, would receive a lower rating.

(f) Determination of the mutability of the feature. "It is recognized that some landscape characteristics are typically more permanent (e.g.

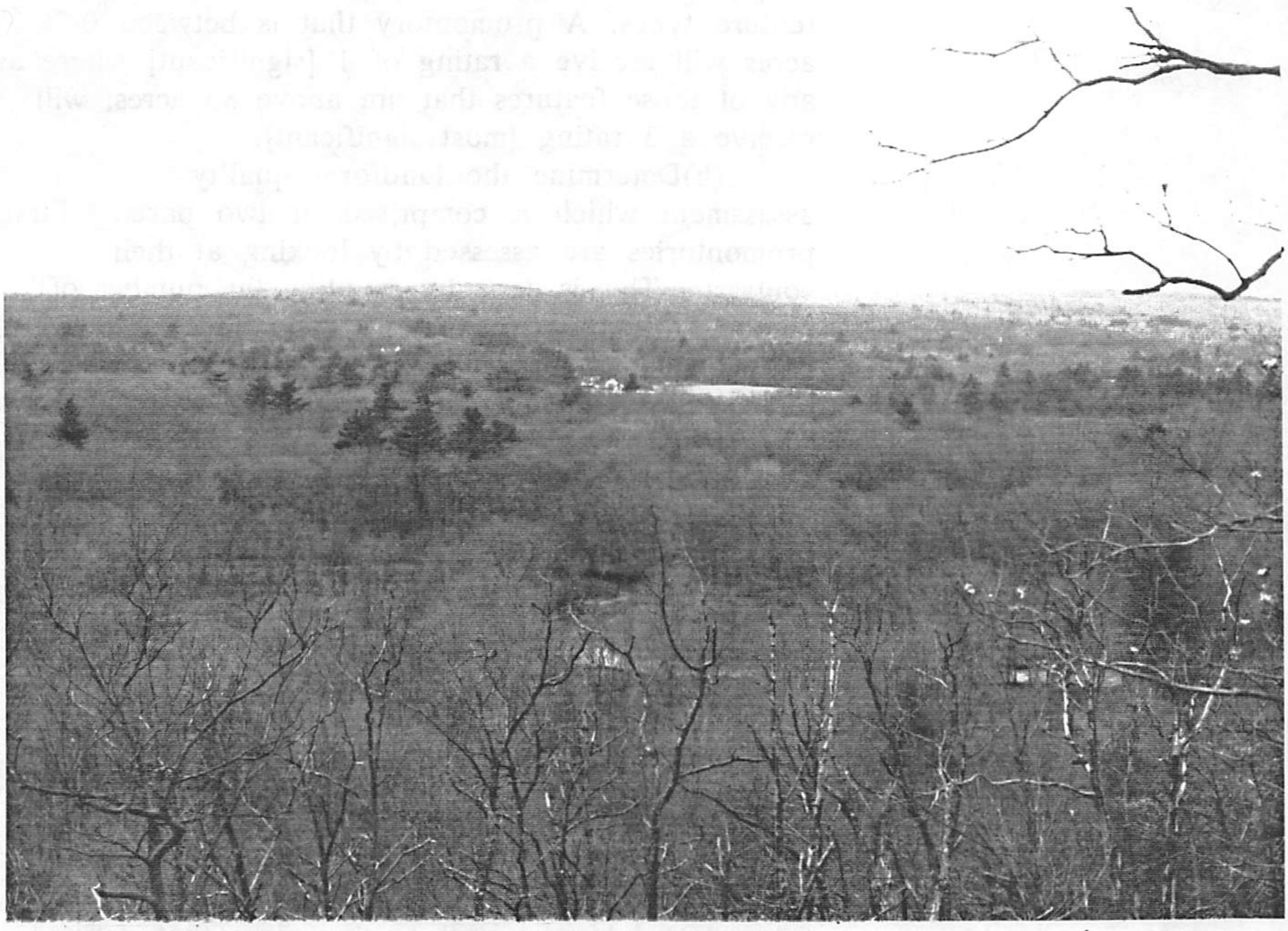


Figure 5-5 Pomontories Typical area that may be considered as a promontory since it is perched high above the rest of the town and can afford views. Eventhough this is a view from a neighboring town this is what can be achieved if the promontories are preserved and protected.

mountains) than others (e.g. wetlands)," (Fabos, Greene and Joyner, 1978, p. 41) and ones that could easily be changed such as a viewshed that can be built upon, would receive none or a low rating. Each set of criteria; prominence, landform quality, external and internal edge, is then multiplied by a modifier value.

Step 3: The next step is to assess all waterbodies and wetlands.

(a) The feature prominence of waterbodies is done by measuring the acreage. A waterbody that has a size score of from 0-10 acres will receive a 1 [significant] rating and others that are over 20 acres will get a [most significant] rating of 3.

1.) Wetlands that have a size score of from 0-25 acres will receive a rating of 1 [significant], 26-50 will receive a 2 [very significant] and wetlands 51 acres and over receive a 3 [most significant].

(b) The external edge quality for waterbodies is determined by both edge complexity and edge contrast. From GIS, by dividing the number of feet per acre, ratings were determined and ones that scored between 0-325 feet per acre got a 1 and from 325-500 received a 2 and the rest that were above 500 got a 3 rating. Edge contrast is determined by how the vertical edges surrounding define the waterbody's space; this is also rated on a scale of 1-3 and then both are averaged together to produce an external edge rating in accordance with their significance.

1.)After the number of feet of external edge per acre are divided, then wetlands scoring within 0-450 receive a 1 [significant], others that score within 451-650 feet per acre receive a 2 [very significant] and wetlands scoring above 650 got a 3 [most significant].

(c) The viewability of a waterbody or wetland determines how well it is visible from various points throughout town. A feature that was located at the bottom of a valley and was very large got a high viewability rating, 3 [most significant] as opposed to one that was small and was located near the top of a hill since it can't be seen as well from many points.

(d) The mutability of a waterbody or wetland relates to its permanence in the landscape. Most likely, all the waterbodies and wetlands will continue to exist but the way that they were assessed was if they were more likely to lose their significance (e.g. If waterlilies and cattails, etc. become invasive and start to cover the feature then it will receive a low rating of 1, but if it maintains its scenic quality it would then receive a most significant rating of 3.

Step 4: The final features that were assessed were all major streams and rivers.

(a) The prominence assessment for all streams and rivers is done by simply by determining the size. The longer and wider a waterway is the higher the prominence rating. A smaller stream or rivulet that is not as big would get a low rating of 1.

(b) The edge complexity and contrast that make up the external edge rating for streams and rivers. Concerning complexity, the more switchbacks and curves a waterway has, the more significant it would be and therefore get a higher rating. Anywhere from 0-2.5 switchbacks per mile, the rating would be a 1 [significant] , from 2.5-3.2 would be a 2 [very significant] and more than 3.2 switchbacks per mile would receive a 3 rating [most significant].

(c) The viewability of the streams and rivers was also done the same way as the rest. The larger rivers located near the major town development received a higher rating because of their visibility; whereas the smaller streams in the hills rated low because they can only be seen from a few points.

(d) The mutability of streams and rivers relates to their permanence in the landscape. The way that this was assessed was if there was a river that remained wet all year-round it would receive a high rating of 3. Smaller streams that had a tendency to dry up at times got a low mutability rating of 1.

Step 5: The composite step. This step involves the compilation of each visual amenity's resource value. The result is then a total score. A rating of 0-8 rates significant, from 9-16 is very significant and from 17-25 receives a most significant rating and then all are plotted on a continuum.

<u>Findings</u>

The findings for the Visual Amenity Resource Assessment are based upon the composite assessment results shown on the matrix (Fig. 5-6) as well as the map (Fig. 5-7). The areas of concern are identified by letters on the map and the matrix refers to those letters. The general district that rated very high on the significance scale was the area around the Blackstone River. The combination of high promontories at the edge of the valley and the river at the bottom made for a very scenic district. For example, Goat Hill rated very high since it scored a 2 in prominence; 3 in landform quality; 2 in external edge; 3 in internal edge; 3 in viewability and 3 for the mutability of a feature. The overall findings for the 28 identified areas are split into three different sections of town, and all of those areas combined comprise a mere 311 acres (1.6% of the town). There are 4 areas rating as significant, most of which are waterbodies. 15 areas are rated as very significant and these features are spread evenly throughout the categories. Finally, the most significantly rated areas were Goat, Chapin, East St./Blackstone Rd., Railroad and Eiffel Hill as well as Lackey Pond and the Mumford, Blackstone and the West Rivers. The majority of the most significant scenic lands in Uxbridge were located around the central and northeastern portions of the Blackstone river valley. The total acreage of the most significant scenic lands was 168.74 acres (only .879% of the total town acreage). These extremely small amounts of land, in comparison to the rest of the town, would be all it takes to maintain the significant visual amenity resource of Uxbridge.

Worksheet1

	A	B	C	D	E	F	G	H	I
1	FEATURE	PROMINENCE	LANDFORM QUALITY	EXTERNAL EDGE	INTERNAL EDGE	VIEWABILITY	MUTABILITY		COMPOSITE
2	A	3	1	2	2	2	3		11
3	B	2	3	2	3	3	3		16
4	C	2	2	1	2	2	3		12
5	D	2	1	1	1	3	3		11
6	E	2	2	2	2	2	3		13
7	F	1	2	2	2	2	3		12
8	G	1	2	1	2	3	3		12
9	H	3	1	3	1	2	3		13
10	I	2	1	1	1	1	3		9
11	J	3	2	1	2	3	3		14
12	K	2	1	2	1	2	3		11
13	L	2	1	3	1	2	3		12
14	M	2	3	3	3	1	3		14
15	N	3		1		3	3		10
16	O	3		3		3	3		12
17	P	2		1		3	3		9
18	Q	1		2		2	3		8
19	R	2		1		1	3		7
20	S	1		2		1	3		7
21	T	2		2		2	3		9
22	U	1		1		1	3		6
23	V	3		1		2	3		9
24	W	3		3		3	3		12
25	X	3		3		3	3		12
26	Y	3		3		3	3		12
27	Z	3		3		3	1		10
28	AA	2		2		3	2		9
29	BB	3		2		3	3		11
30	CC	1		2		3	3		9

Figure 5-6 Total Composite Ratings

0-6	7-12	13 +
Significant	Very Significant	Most Significant

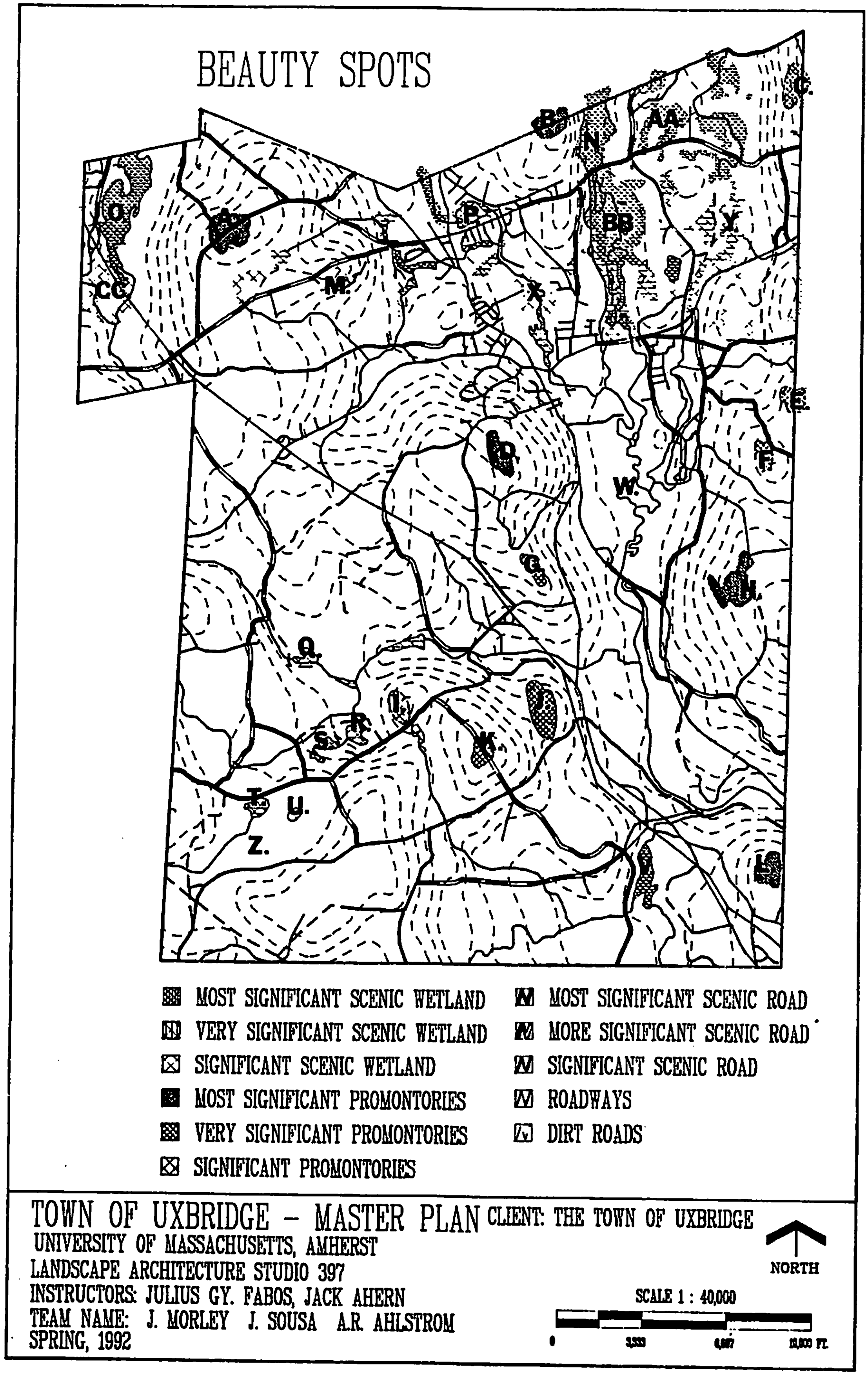


Figure 5-7 Composite Map Locating Beauty Spots

SCENIC ROADS

Significance

The designation of scenic roads, when it is combined with appropriate development guidelines, can help to preserve the character of a town such as Uxbridge as it progresses into its future. The realization of this act is evident within the town from its current designation of a third of its roads as scenic (Uxbridge's Historical Committee).

These roads have have been chosen by recommendation and by two thirds majority vote at town meeting. The criteria for assessing the quality or value of the road are unclear as Massachusetts General Law Chapter 40 subsection 15 c does not establish a specific criteria, leaving the responsibility to the individual townships. The sole purpose of this law is to put the proposal of any work done within the public right of way, by the town, in front of review before town meeting.

This study is designed to provide the town with a better guideline for establishing the significance of existing roads through criteria based on the expert approach. It "involves the evaluation (assessment) of landscape quality by skilled and trained observers" (Zube, Sell and Taylor). This approach has been adapted to assess the unique qualities of the town of Uxbridge for this study. These criteria can also assist in the location and extent of development along the scenic roadways to preserve the historic and rural character which identifies the town as Uxbridge.

State of Assessment Procedure

The aspects for determining the scenic quality of roads differs from region to region or town to town; thus, within the town of Uxbridge, an adaptation must be derived from the expert studies such as the METLAND Research Bulletin # 653 (Fabos, Green, and Joyner, Sept. 1978) which discusses in depth the analysis and assessment procedures for determining the significance of visual amenities; METLAND Research Bulletin #734 The River Corridors : Present Opportunities For Computer Aided Landscape Planning (Kim, Gross, and Fabos, Summer 1991) for its discussion of visual sequencing and context of the landscape ; Model For Evaluation of the Visual and Cultural Resources of the South East New England Region (Riotte, Fabos and Zube) for their adaptation of the N. A. R (North Atlantic Region) study; Looking at the Vineyard (Lynch, Sasaki and Assoc.) for field notation methods; and The Scenic Highway Assessment Procedure for Massachusetts Highways (Denig and Holden for the Massachusetts Department of Public Works, 1975) for the establishment of a larger scale process for state and regional roads.

Adapted Approach

The following approach was adapted primarily from The Scenic Highway Assessment Procedure For Massachusetts Highways (Denig and Holden, 1975) to apply specifically to Uxbridge, MA. The assessment groupings can be broken into three primary categories:

The Context- The landscape type on which the road is located (Figure 5-8, adapted from N.A.R Landscape Continuum, Boyle et al., 1971, p. 21). This breaks down the landscape into seven types:

- uplands - those rolling hills of higher elevation
- lowlands - the undulating hills of lower elevation
- river planes - the flat landscapes often near riverways
- water bodies - rivers and ponds
- town centers - areas of dense development
- farm land - those areas cleared for agricultural use
- forest land - those areas of dense vegetation

The roads can then be rated for diversity by the amount of landscape types the road travels through. (The more types the greater the significance) and contrast, by the amount of times the landscape types dramatically change. If the road breaks from forested hills to flat farmland, that is a dramatic change: but if the change is from forested hills to forested flatland then there is little visual contrast.

The Viewsheds - Large scale unobscured views (Fig. 5-9). These spots are rated for significance according to the quantity of landscape types contained within the view (i.e.: Does the view contain forests? hills? water? town centers? farmlands? etc.). The more types contained within the view, the greater the significance. The extent of the view or the distance one can see also plays an important role. The further the eye can see

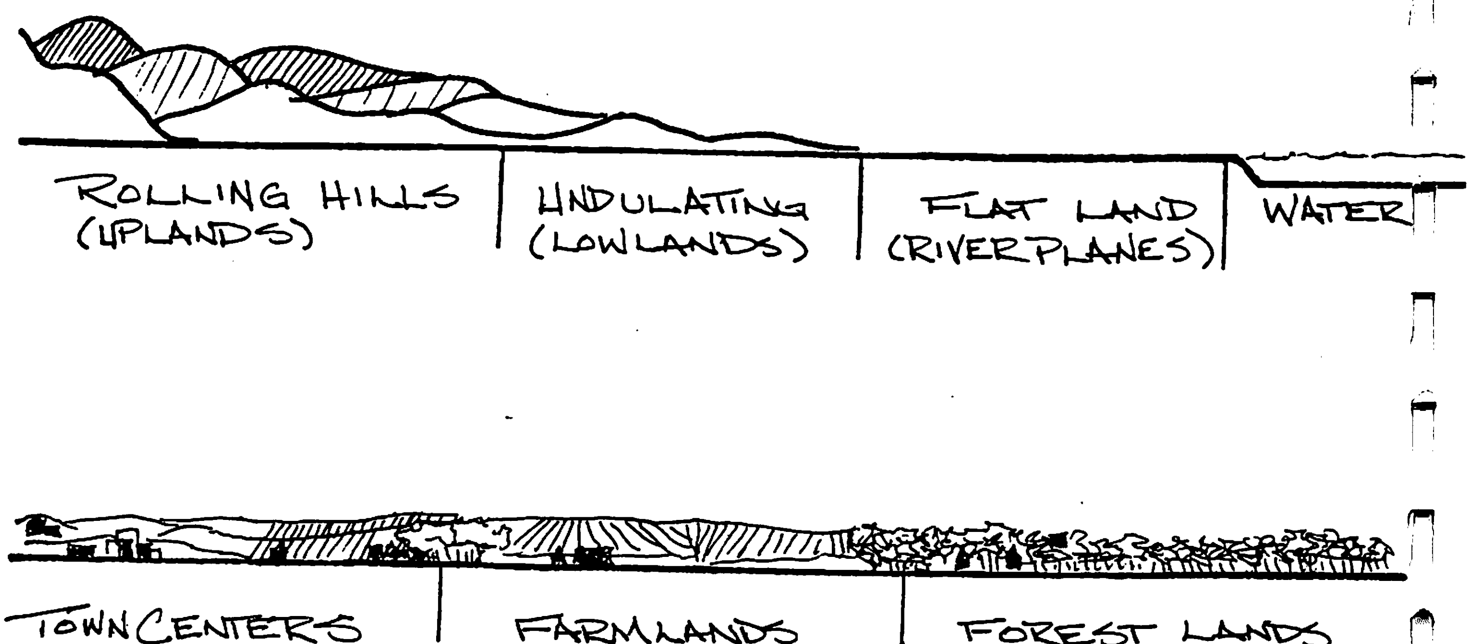


Figure 5-8: Landscape type continuum adapted from N.A.R. landscape continuum (Boyle et al, 1971, p.21).

Figure 5-9: This viewshed from Blackstone St. represents a good example of a large scale view.

Figure 5-10: The immediate or spatial view is exhibited along South St. as you enter into Uxbridge from Rhode Island.

Figure 5-11: This view from the corner of East St. and Blackstone St. represents a locally significant vista.

Figure 5-12: The regionally significant view is best described by the vista provided at 100 Acre Farm.

Figure 5-13: The prominant stone walks along the roadsides add to the scenic quality while echoing the past agricultural landscape.

Figure 5-14: The Farnum House on Mendon St. adds to the visual significance of a roadway due to it's historical importance.

Figure 5-15: The Quaker Meeting House along the Quake Highway, although difficult to notice from the road, is another example of a historical attractor.

Figure 5-16: Special attractor elements such as these large sugar maples on Rawson St. add to the significance of the scenic road.

the greater the significance. For example, if it is an immediate or spatial view (Fig. 5-10) it would be classified as significant, a local view (Fig. 5-11), very significant, and a regionally expansive view (Fig. 5-12) most significant.

The Sequence - The amount of vertical and horizontal changes along the roadway. This depends upon the changes in:
elevation - where the road frequently rises and falls
direction - where the road frequently curves
so as to reveal the segments of the road in a visual sequence. Within this category there is an addition of special elements both attractors such as stone walls (Fig. 5-13), historic sites (Figs. 5-14 and 5-15), large street trees (Fig. 5-16), other unique elements like water falls which add to the scenic rating (positive points): while misfit elements or detractors such as gravel pits, salvage yards, landfills, parking lots, heavy industry. and the likes would detract from the rating (negative points).

Introduction To Model

All the roads of Uxbridge with scenic potential are divided into one-half mile lengths or greater, will be assessed as "Significant", "Very Significant", and "Most Significant" according to the following procedure (Fig. 5-17). The process used will be a refinement of the aforementioned adapted approach that places the criteria onto value continuums to determine the significance of the road as a whole.

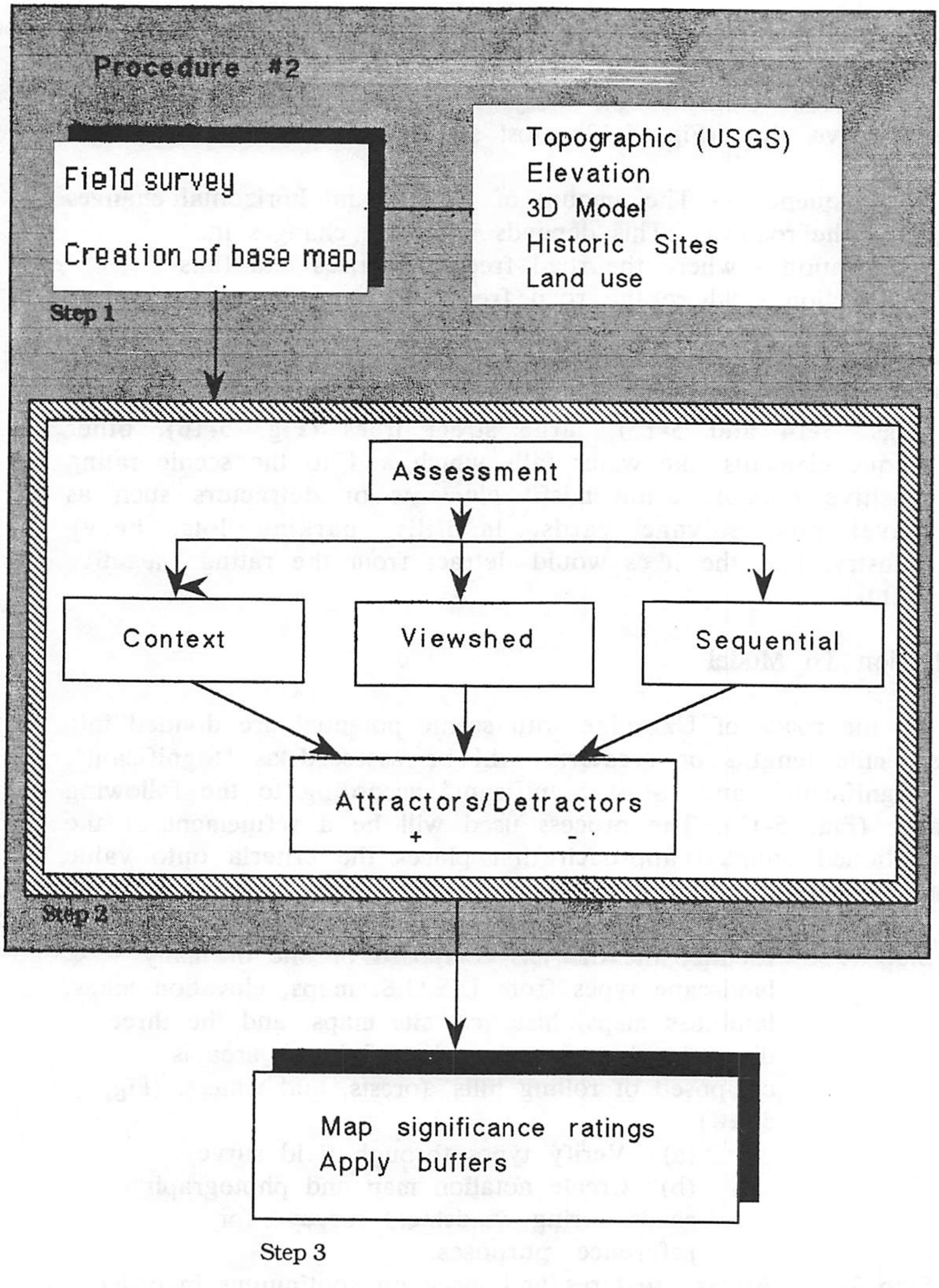
Step 1: Identify the districts composed of one or many landscape types from U.S.G.S. maps, elevation maps, land use maps, historical site maps, and the three dimensional model. (i.e.: Laurel brook area is composed of rolling hills, forests, and waters. (Fig. 5-18)

(a) Verify types through field survey.

(b) Create notation map and photograph roads during windshield survey for reference purposes.

Step 2: Assess features and place on continuums in order to calculate rating for the road .

(a) Context Rating equals the total amount of landuse types the road travels through (Diversity) and the total amount of dramatic changes between



Procedure#2: Landscape types are identified from various mapand field surveys. Roads are then rated according to three criteria. Results: scenic roads, identify by significance and buffers accordingly.

Figure 5-17: Framework for the assessment of scenic roads.

Figure 5-18: Laurel St. exhibits high diversity in sequential travel with varied vegetation, it's undulating hills and it's winding curves.

landscape types along the road (Contrast).
- Diversity receives a rate of:

  Five points - if the road contains six or seven of the landscape types .

  Three points - if the road contains four or five of the landscape types .

  One point - if the road has only two or three of the landscape types .
- Contrast is rated by the addition of one point for every dramatic change along the road (i.e.: Three changes receives 3 points).

(b) Viewshed Rating equals the total amount of viewsheds as rated by their extent (distance) and the number of landscape types contained in the view.
- Extent receives a rate of:

  Five points - if the view is long enough to contain other towns or regions

  Three points - if the view contains only local elements.

  One point - if the view is only of an immediate space such as a farm surrounded by woodland.
- Number of landscapes types contained within the view receives a rating comparable to the number of types (i.e.: two types rates two points).

(c) Sequential Rating equals the frequency of vertical and horizontal changes along the road.
- Elevational changes receive a rating of:

  Five points - for frequent changes such as the rise and fall of Laurel road.

  One point - for infrequent changes such as along the Quaker Highway.
- Directional receives a rating of:

  Five points - for frequent curves such as along Chapin street

  One point - for Infrequent curves such as route 146.

(d) Special Elements are a summation based purely on a quantity rating of attractors (positive points) and detractors (negative points).
- Attractors add one point
- Detractors subtract one point

(e) The totalling of the above categories and placing that value onto a final continuum determines the final significance of each road segment.

- "significant" has a rating of ten to twenty
- "very significant" has a rating of twenty-one to thirty
- "most significant" has a rating of thirty-one or above.

Step 3: Finally, mapping the results and applying varying buffer zones (100 and 200 feet) exhibits the possible extents of protected areas necessary to preserve the character of the roadways in Uxbridge (Fig. 5-19).

Findings

Within the town of Uxbridge it has been found that fifty miles or forty three percent of Uxbridge's roads, greater than one-half mile total length, have significant scenic quality. Through the continuum rating system, the roads have been rated at varying degrees of significance. Roads such as Rawson St., (Figs. 5-20 and 5-21) Sutton St., and Williams St. exhibited outstanding scenic viewsheds over the expanses of farmland. Streets like Chapin and Laurel, which meander though the undulating knolls while peeking out through the forest walls to the rural landscape, have outstanding sequential quality. Both of these examples merited a rating of "Most Significant". Fourteen miles (14%) of roads within the town fall under this designation. West St. and Pond St., which help make up the twenty miles (20%) of the "Very Significant" roads, provided shorter views with a subtle diversity in the sequential experience, while roads like Aldrich St., and Richardson St. revealed beautiful stone walls amongst the gentle windings through the uniform forests, represent a portion of the remaining sixteen miles (12%) roads which rated as "Significant".

These roads are dispersed fairly evenly through out the town of Uxbridge, which represents a firm foundation for the preservation of the rural character of the town. The town benefits from the variety of its roads in that diversity is the key to survival.

The scenic roads need to be recognized and protected due to the vulnerability of their rating and the percentage of roads should

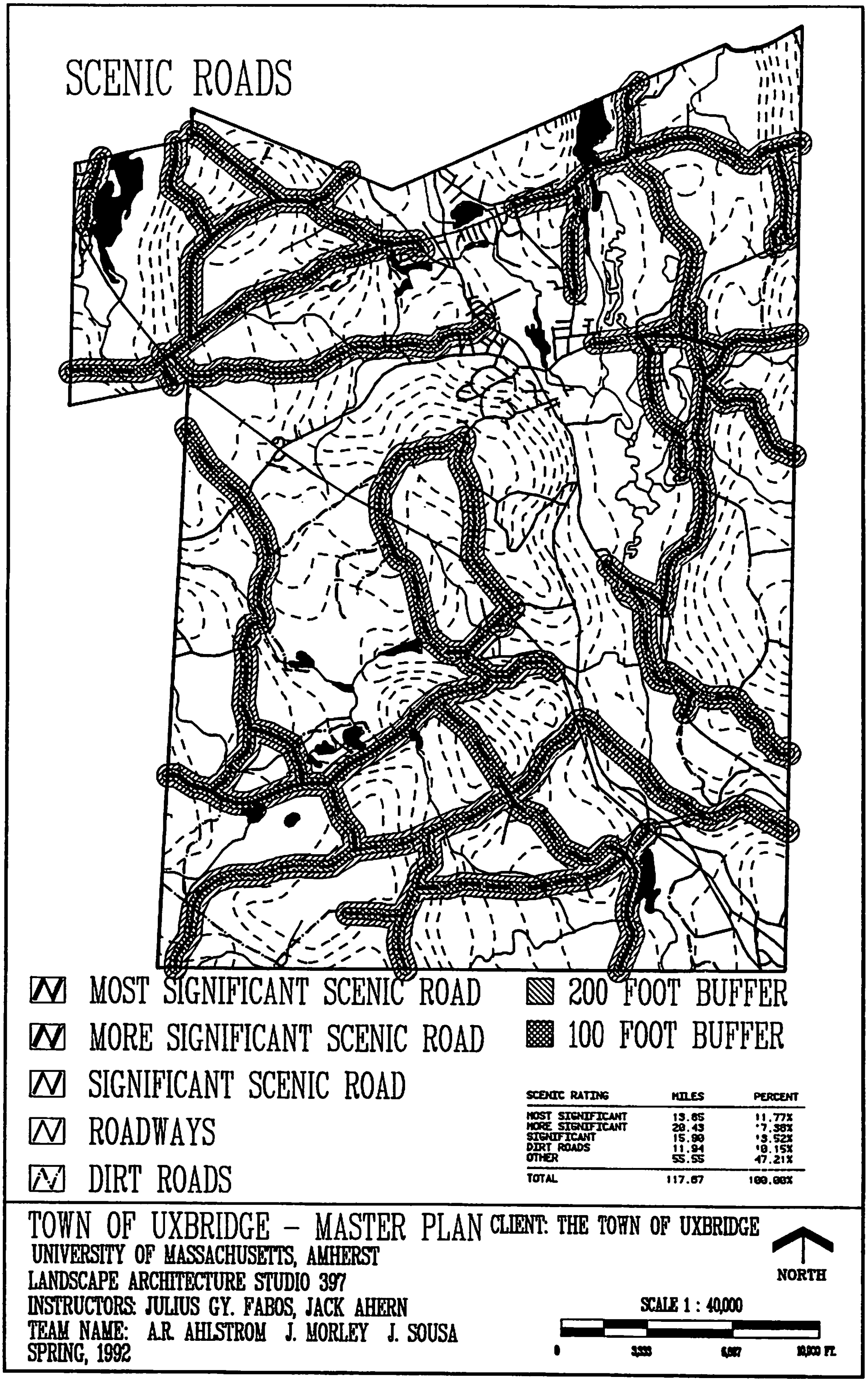


Figure 5-19: This map represents the identification and two recommended preservation zones of the town of Uxbridge. The results of which, were derived though the procedure mentioned.

Figure 5-20: An example of a viewshed along a most significant scenic road such as Rawson can be seen in its immediate view of farm lands.

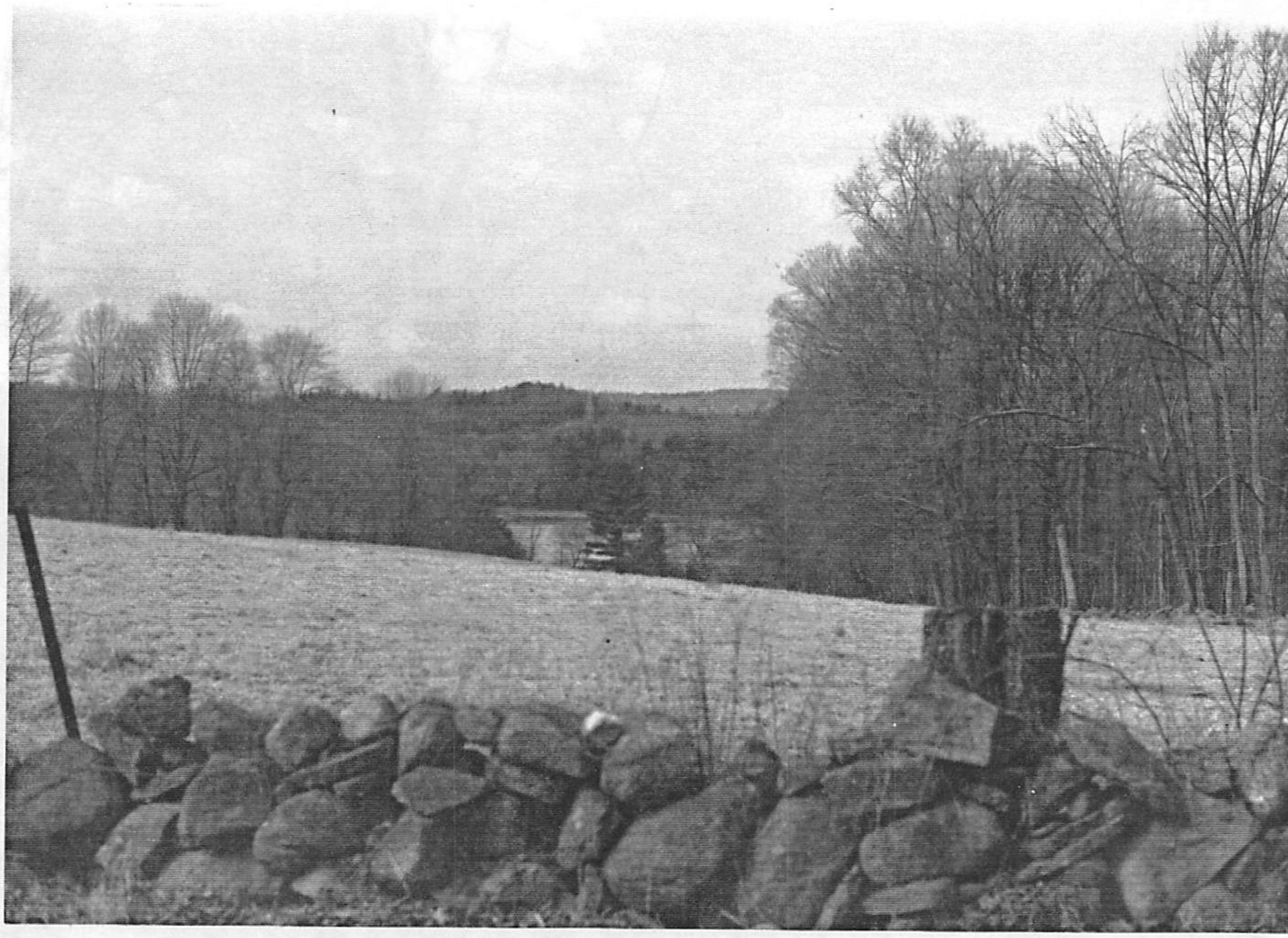


Figure 5-21: The immediate viewshed is contrasted with it's regionally significant view of Lackey Pond and bordering town of Sutton.

be maintained during future development. If development along these roads is not done with care, the development has the possibility of jeopardizing the significance of the road visually and possibly denying the road of the character which tells you that Uxbridge is home. (Fig. 5-22)

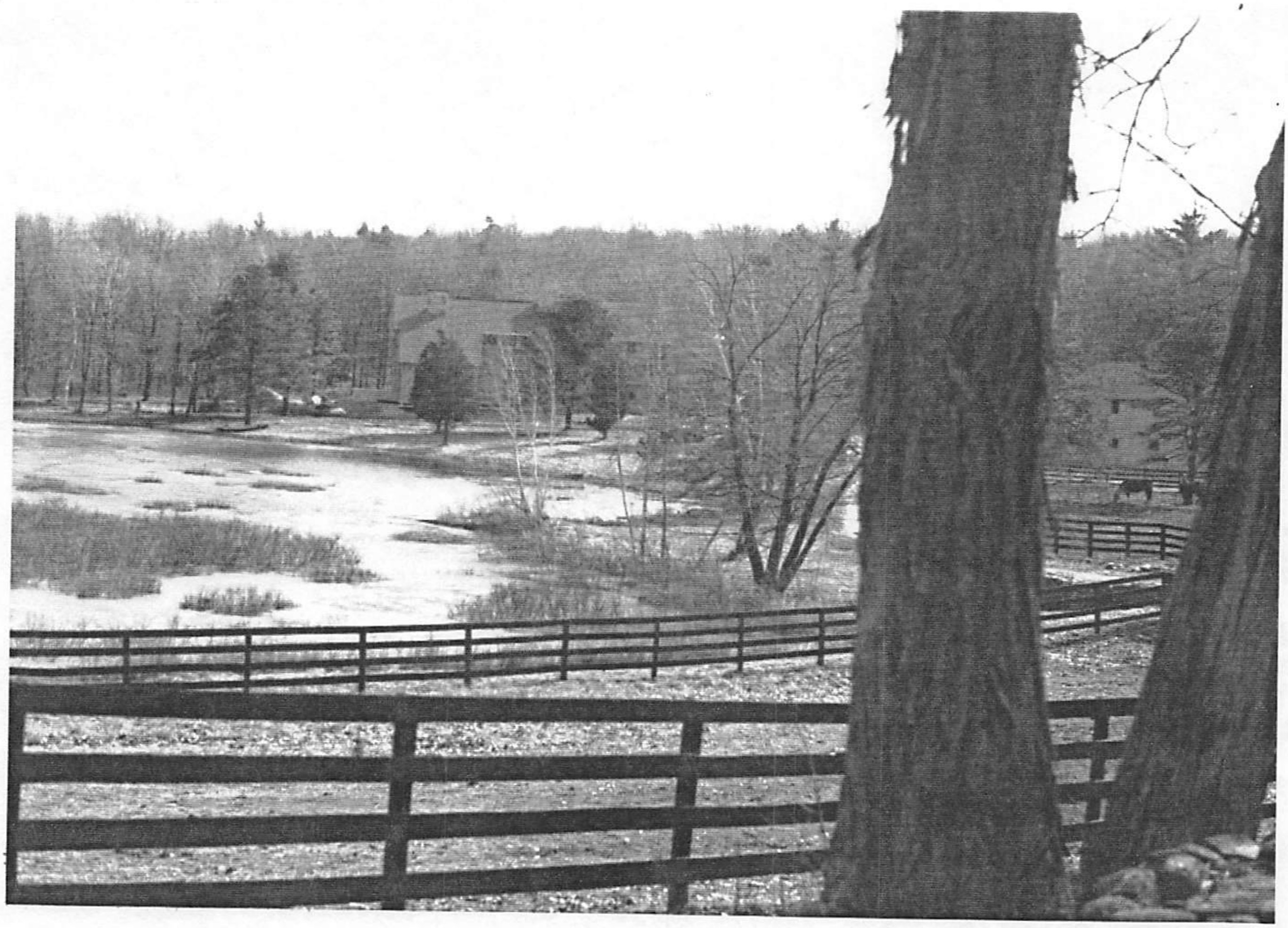


Figure 5-22: This farm house beside the wetlands along Chocolog Road represents the rural character that makes Uxbridge home.

Development Suitabilities

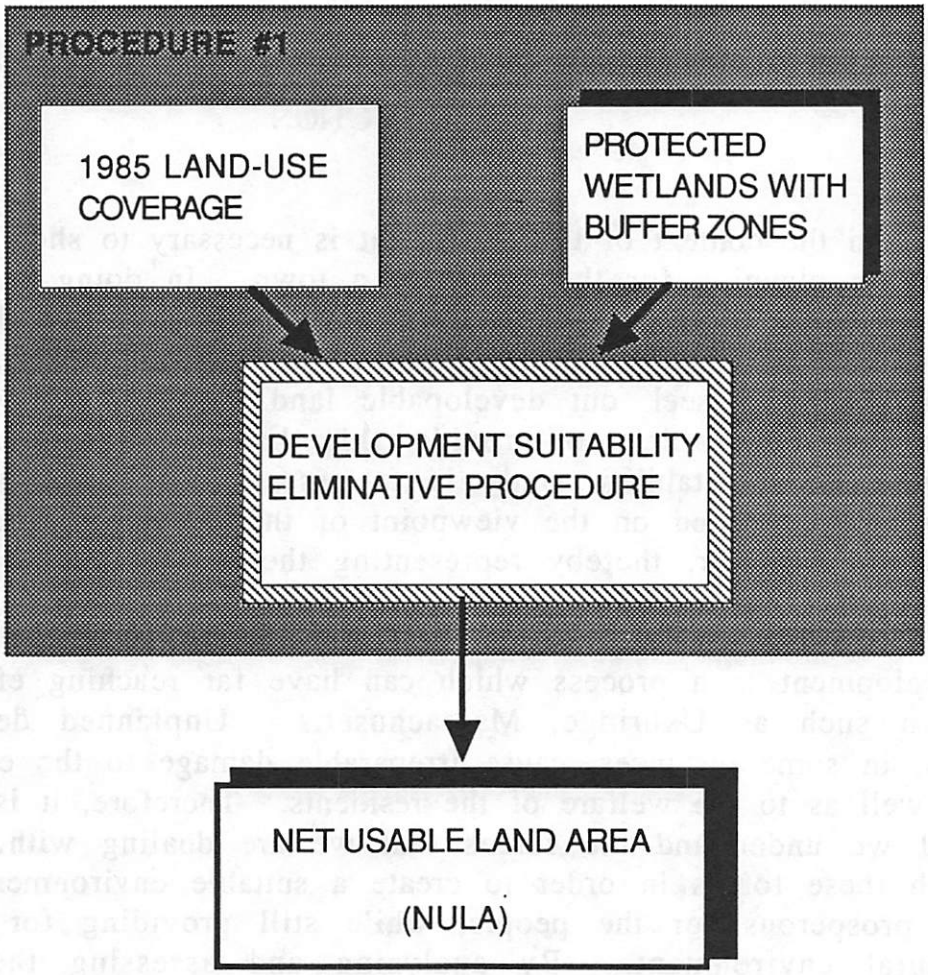
Chapter 6

INTRODUCTION

In the context of this study, it is necessary to show a balanced view in planning for the future of a town. In doing so, the study must focus on both assessments designed to curtail development from environmentally sensitive areas, as well as those assessments which actually seek out developable land. (Fabos, Caswell, p.185) Therefore, in order to provide this balance, the focus of the development suitability study is to assess those areas suitable for development based on the viewpoint of the developer, and the home buyer/land leaser, thereby representing their needs as well.

However, the designation of land for specific types of development is a process which can have far reaching effects for a town such as Uxbridge, Massachusetts. Unplanned developments can, in some instances, cause irreparable damage to the environment, as well as to the welfare of the residents. Therefore, it is imperative that we understand the forces that we are dealing with, and work with these forces in order to create a suitable environment that will be prosperous for the people, while still providing for a healthy, natural environment. By analyzing and assessing the land for industrial and residential use, those areas that are suitable for development can be identifyed based on the respective needs for both land use types. In doing so, people can plan for the future of a town which may potentially expand to great extents within the next decade. At the same time, sufficient development can be accommodated while still protecting critical resources and avoiding hazards. Obviously, all lands in the town do not possess a perfect mixture of the features which would constitute prime development lands. However, with the making of a few concessions, provisions can still be made based upon future development needs.

The first step in our development suitability study is to create a procedure to identify and eliminate all developed or undevelopable land from the landuse map.(See Fig. 6-1) These lands would include all previously developed lands, as well as those areas restricted from development by law. This would specifically include wetlands and



Procedure #1

Eliminate from consideration legally restricted or already developed areas as they are unsuitable for development.

Results: Coverage/Map of Net Usable Land Area

FIG. 6-1 ELIMINATIVE PROCEDURES FOR ALREADY DEVELOPED LAND AND PROTECTED ECOLOGICAL AREAS

their buffer zones. The land that is remaining is available for future development.(See Fig. 6-2) Next, the development suitability assessment for the town of Uxbridge was broken down into three significant component factors of suitability, which were then assigned values. These factors were: physical suitability, topoclimatic suitability, and visual suitability. The values determined were then composited and weighed against one another in order to develop a composite assessment map. The resulting composite assessment was then overlaid with four modifying factors. These are the availability of water and sewer lines and proximity to historic districts. The overlay process was based on a rating system developed for the purpose of assessing both residential and industrial needs. Each has its own criteria depending upon the component factor being assessed. This map can visually display those areas which are suitable for industrial and residential use, as well as to what extent they are suitable (most, moderate, or suitable with condition).

Physical suitability is determined by the inherent characteristics of the land, and how these factors affect development. This can be assessed with consideration of depth to bedrock, depth to seasonally high water table, location of wetland/buffer zones, flood plains, soil characteristics, and slopes. These physical characteristics, in most instances, determine much of the cost of site preparation and construction. The more one understands and responds to their surroundings, the less money is spent in forcing development upon unsuitable land. These cost savings translate into more affordable housing, less expensive industrial site developments, and a greater ability to set aside land for open space. Also, by working within the limits of the land, one is able to protect the land from harmful by-products of unsuitable development, such as the contamination of wetland regions by the runoff from residential or industrial sites. This is especially important in that protecting the environment is a basic social responsibility, not only for the present, but for future generations as well.

Topoclimatic suitability is less tangible, but important none the less to determining the correct siting of development. Topoclimate is based on the forces of nature (sun, wind, natural barriers, etc.) and how they affect a given area. This can be broken down into solar

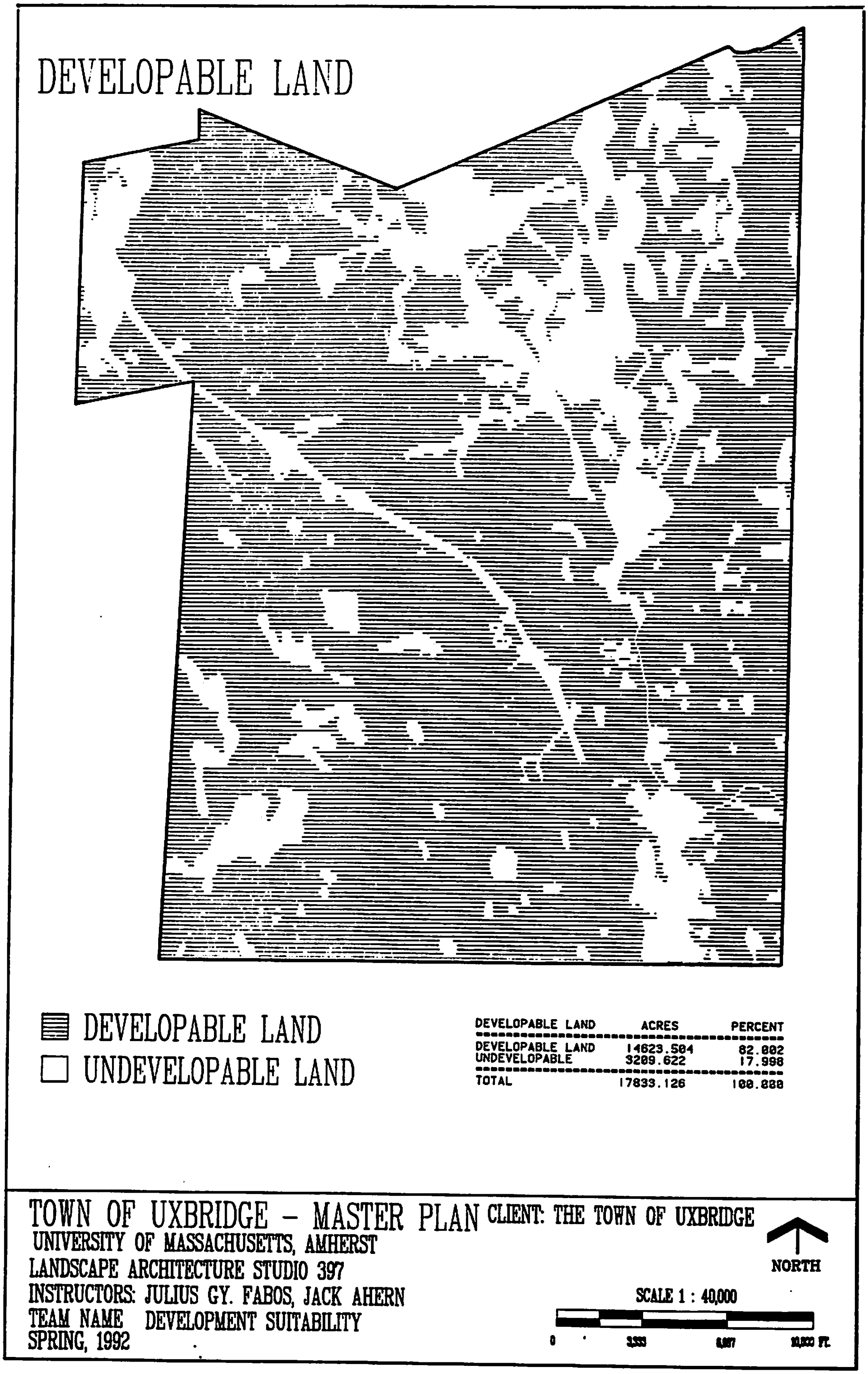


Fig. 6-2: Developable and undevelopable lands. Areas that are already developed/restricted and areas that are potentialy developable.

receipt, prevailing winds, and vegetation location and species. The benefits of correct topographic location for a site usually can be seen in the post development costs, such as heating for homes, protection from strong wind currents, as well as general human comfort, among others. The process by which one creates a suitable microclimate for a given site is dependent upon many of the larger scale regional climatic factors. Uxbridge is located in a temperate climate zone, thereby making the topoclimatic response different than in, say, a hot arid or hot humid zone.

By responding to these natural forces, a developer can increase the physical comfort within a site, while actually saving money for the land owner (and simultaneously increasing the value of the development). In today's energy conscious society, in which the costs for post-development needs is ever increasing, it makes economic sense to respond to nature and save money in the long run, rather than go ahead blindly with short term, cost-cutting development.

Visual development suitability also plays a significant role in determining the post-construction value and desirability of a site. By considering view potential, we can determine how much people will be willing to pay for a site in a given location. This would include finding those areas at higher elevations, as well as determining the vegetative cover of those areas. Obviously, a house which overlooks an industrial site is not going to demand the same amount of money as one with a view to the undisturbed valley. It can also be determined that land which is preserved from specific types of development can help in maintaining the visual character of a region, such as the Blackstone River Valley. However, from the perspective of the developer/ home buyer, this would not be a factor in assessing the suitability of a site for development. The perspective of preserving the region based upon public needs primarily concerns the visual assessment team, and not the development suitability team.

There are other, modifying factors which enter into this process as well. Public service resources play a significant role in determining the cost of development, as well as land value. This would specifically include the availability of water and sewer lines for development purposes. Running new or larger pipes to a site over long distances or over hilly terrain can raise construction costs significantly. The proximity of a site to major roads and railroads can also be either detrimental or advantageous to certain types of development. And finally, the identification and location of historic districts can raise land value for residential use, while eliminating (or, limiting) the potential for industrial use. Historic districts are a rich resource that, in many cases, have been untapped, except for in large scale restoration projects (such as Lowell, MA.). These have thus become a major focus for many new developments in towns and cities all over New England. The restoration or proliferation of these districts can be a major new source of income for towns and cities, such as Uxbridge, which has a rich history that can be worked into the landscape.

The availability of basic emergency services, such as fire, police, and medical, as well as public open spaces, and cultural resources are important factors to consider. Cultural resources would include a strong resource of libraries, schools and cultural centers that could make a town much more attractive to residents, and developers alike. And finally, current zoning regulations and parcel ownership play a determining role in making final decisions for the development suitability of a specific site. Although these regulations are subject to change, it is here where the politics of deciding the future of a town's development come into play.

For the purpose of this assessment of the development suitability, emergency services, public open spaces, and cultural resources were not factored into the assessment procedure. These factors are generally consistent within the town, and therefore do not serve to differentiate between specific areas within Uxbridge. Therefore they do not play a determining role in assessing a site based upon this study's suitability criteria. The development suitability team's main goal is to seek out and assess all of the sites within Uxbridge which are suitable for industrial and residential development, independent of other factors more subject to change.

Goal: To improve the quality, increase comfort, and decrease the cost of life within the town of Uxbridge by directing new development to those areas which would be best suited for people to live and work.

Objectives:
1. To determine those areas most suited for industrial and residential development based on physical factors.
2. To determine those areas most suited for residential development based on topoclimatic conditions.
3. To determine those areas most suited for residential development based on potential views.

PHYSICAL SUITABILITIES

Significance

The physical suitability of a site is based on the inherent capability and constraints of the land. It is a function of the following factors: depth to bedrock, depth to water table, slopes and drainage, wetland, and wetland buffer zones, and flood plain areas. These can by subdivided into two groups: those factors which have legal and regulatory restrictions, and those which are cost saving or desirability factors.

The criteria for the cost deciding factors would be based on the least amount of change needed to develop the land. In other words, the more you work within the constraints of the land, the less you have to work against it. Depth to bedrock dictates the need for blasting within a site for the installation of footings, foundations, as well as any changes in landform, and thereby has the potential to increase development costs. Depth to water table may also play a role in construction costs as well. A high water table increases the need for the installation of pump systems to keep basements dry, as well as increasing the potential for contaminants seeping into the ground water. Drainage characteristics dictate percolation rates, and therefore the ability to accept a septic system. Steep slopes increase the rate of runoff, and can cause downstream sedimentation. They also cannot accommodate septic systems, and therefore require available sewer lines.

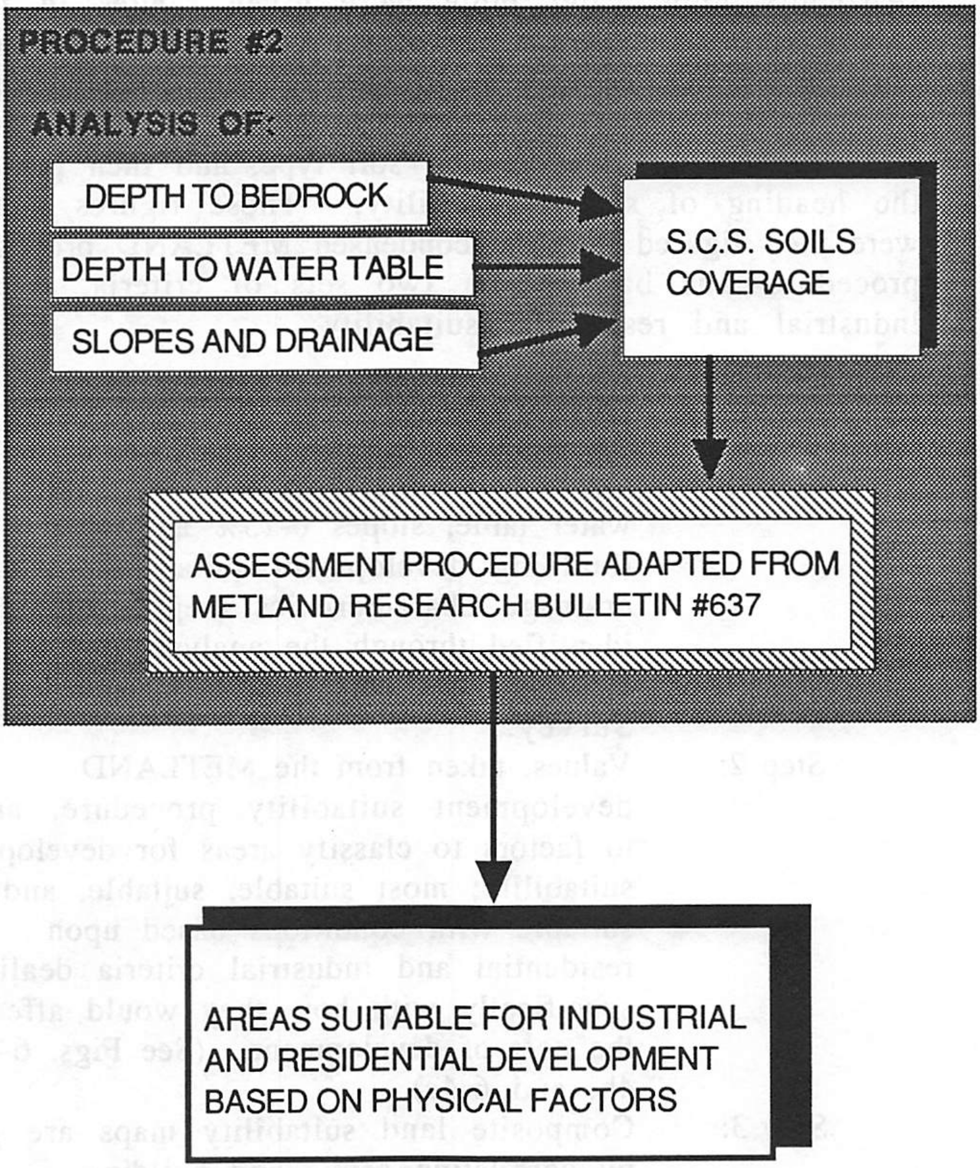
The criteria for legal and regulatory factors would be based on the environmental laws and regulations for a given region. Massachusetts wetland regulation laws restrict any kind of development on wetland/buffer zones, as well as run off from any nearby developments. Therefore, any development near a wetland would face increased costs of dealing with runoff, and seepage into these restricted regions, while those on wetlands or buffer zones would be prohibited by law.

State of Assessment Procedure

Although physical development suitabilities can be related to numerous professions, there are currently only four significant professions which use this information: Soil Scientists, Environmental Geologists, City and Town Planners, and Landscape Architects. These disciplines are concerned with the specific characteristics of soils, surficial geology, depth to water table, as well as other aspects of hydrology. Although much of this information is obtained from field surveys, most can be obtained from the Worcester County Soil Survey booklet (SCS,1982). This survey allows for the classification of various areas that are best suited for development. The METLAND research group has also developed a procedure for assessing development suitability based on the McHargian overlay method (Design with Nature, 1969), which was modified to include a wider variety of suitability factors for consideration. This can be found in the METLAND Research Bulletin #637 (Fabos, Caswell, 1977).

Adapted Approach

The METLAND Research Bulletin #637 (Fabos, Caswell, 1977, pp.188-208) procedure was adapted for the process of assessing physical suitabilities (See Fig. 6-3). For the purpose of this study, the procedure was condensed to include four significant component factors. They are: depth to bedrock, depth to seasonally high water table, degree of slope, and drainage characteristics. These are then assigned values of most suitable, suitable, and suitable with conditions. Information for these values was taken from soil information interpreted by the Worcester County Soil Survey (SCS, 1982).



Procedure #2

Analyze depth to bedrock, depth to water table, slopes, and soil percolation rates. Then assess based on industrial and residential development suiability criteria based on septic suitability, and building development suitability. (see fig.__)
Results: Coverage/map for areas most, moderately, and least suitable for residential and industrial use.

FIG. 6-3 AREAS SUITABLE FOR INDUSTRIAL AND RESIDENTIAL DEVELOPMENT BASED UPON PHYSICAL FACTORS

Based upon this information, depth to bedrock and depth to seasonally high water table were given ranges in feet, and slopes were given ranges for degree of slope. These were then correlated under the heading of building development suitability. Drainage was given a composite rating based upon various characteristics of each soil type, and then placed under the heading of septic suitability. These figures and ratings were then figured into the condensed METLAND procedure. The procedure was based upon two sets of criteria, those being industrial and residential suitability.

Introduction to Model

Step 1: Depth to bedrock, depth to seasonally high water table, slopes 0-15% and greater (building development suitability) and drainage characteristics (septic suitability) are identified through the analysis of the Uxbridge soil map, and Worcester County Soil Survey.

Step 2: Values, taken from the METLAND development suitability procedure, are given to factors to classify areas for development suitability; most suitable, suitable, and suitable with conditions based upon residential and industrial criteria dealing specifically with how they would affect the cost of development. (See Figs. 6-4a, 6-4b, and 6-4c)

Step 3: Composite land suitability maps are produced by correlating septic and building development suitability based upon residential and industrial criteria (See Figs. 6-5 and 6-6). From here, the composite physical development suitability assessment is then factored into the overall procedure by overlaying the results with the topoclimatic and visual assessment results.

Fig.6-4a

RESIDENTIAL AND INDUSTRIAL DEVELOPMENT

	DEPTH TO WATER TABLE		
DEPTH TO BEDROCK	0-2'	2-5'	>5'
0-3'	SUITABLE W/ CONDITION	SUITABLE W/ CONDITION	SUITABLE
3-6'	SUITABLE W/ CONDITION	SUITABLE	MOST SUITABLE
>6'	SUITABLE	MOST SUITABLE	MOST SUITABLE

FIG.6-4B

BUILDING DEVELOPMENT SUITABILITY FOR INDUSTRIAL USE

	DEPTH TO WATER TABLE AND BEDROCK		
SLOPES	MOST SUITABLE	SUITABLE	SUITABLE W/CONDITION
O - 3%	MOST SUITABLE	MOST SUITABLE	SUITABLE W/CONDITION
3 - 8%	SUITABLE	SUITABLE	SUITABLE W/CONDITION
> 8%	SUITABLE W/CONDITION	SUITABLE W/CONDITION	SUITABLE W/CONDITION

FIG.6-3C

BUILDING DEVELOPMENT SUITABILITY FOR RESIDENTIAL USE

	DEPTH TO WATER TABLE AND BEDROCK		
SLOPES	MOST SUITABLE	SUITABLE	SUITABLE W/CONDITION
O - 8%	MOST SUITABLE	MOST SUITABLE	SUITABLE
8 - 15%	MOST SUITABLE	SUITABLE	SUITABLE
> 15%	SUITABLE	SUITABLE W/CONDITION	SUITABLE W/CONDITION

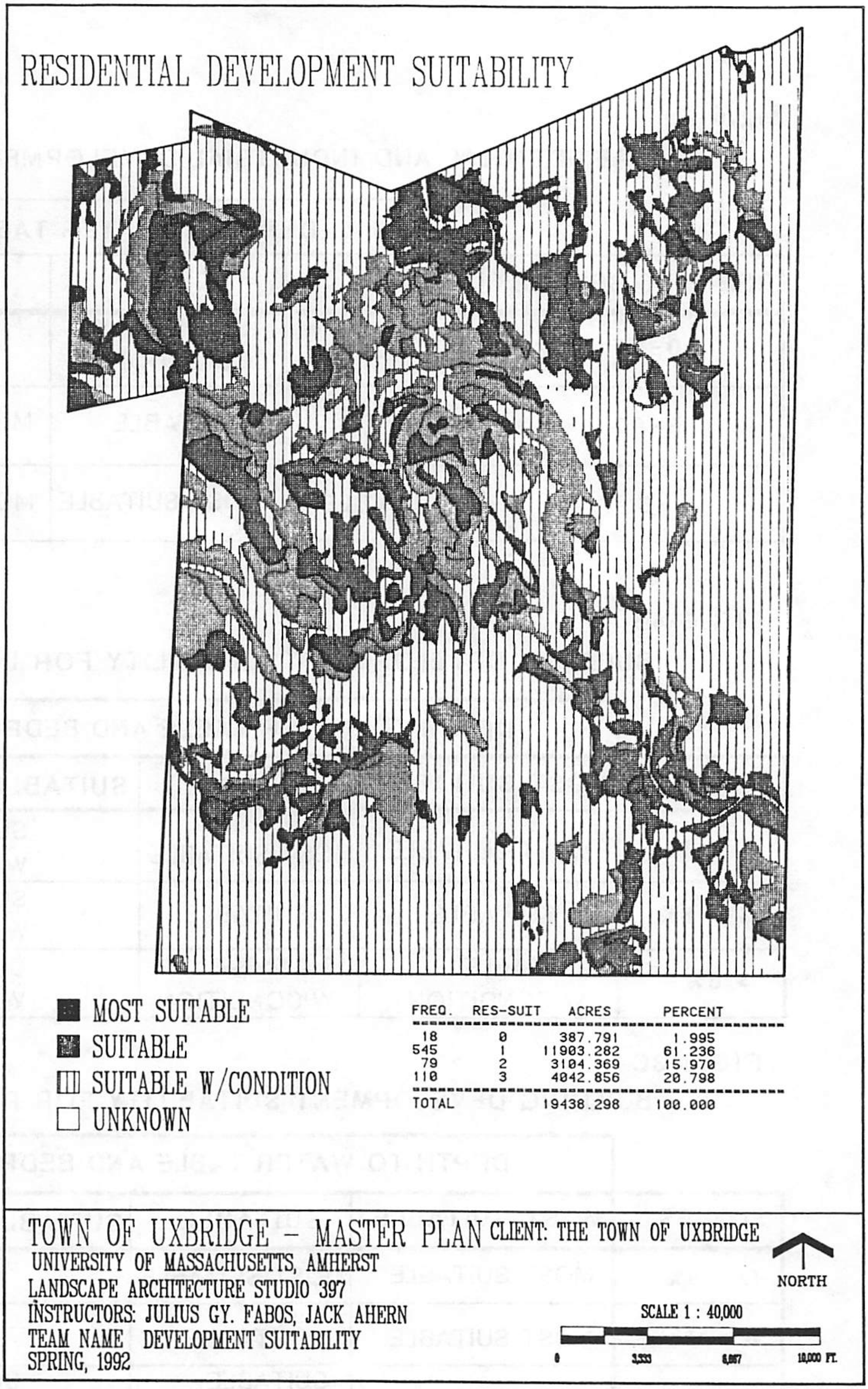


Fig. 6-5: Physical suitability for residential development. Areas of residential suitability according to criteria shown in fig. 6-4a,6-4c.

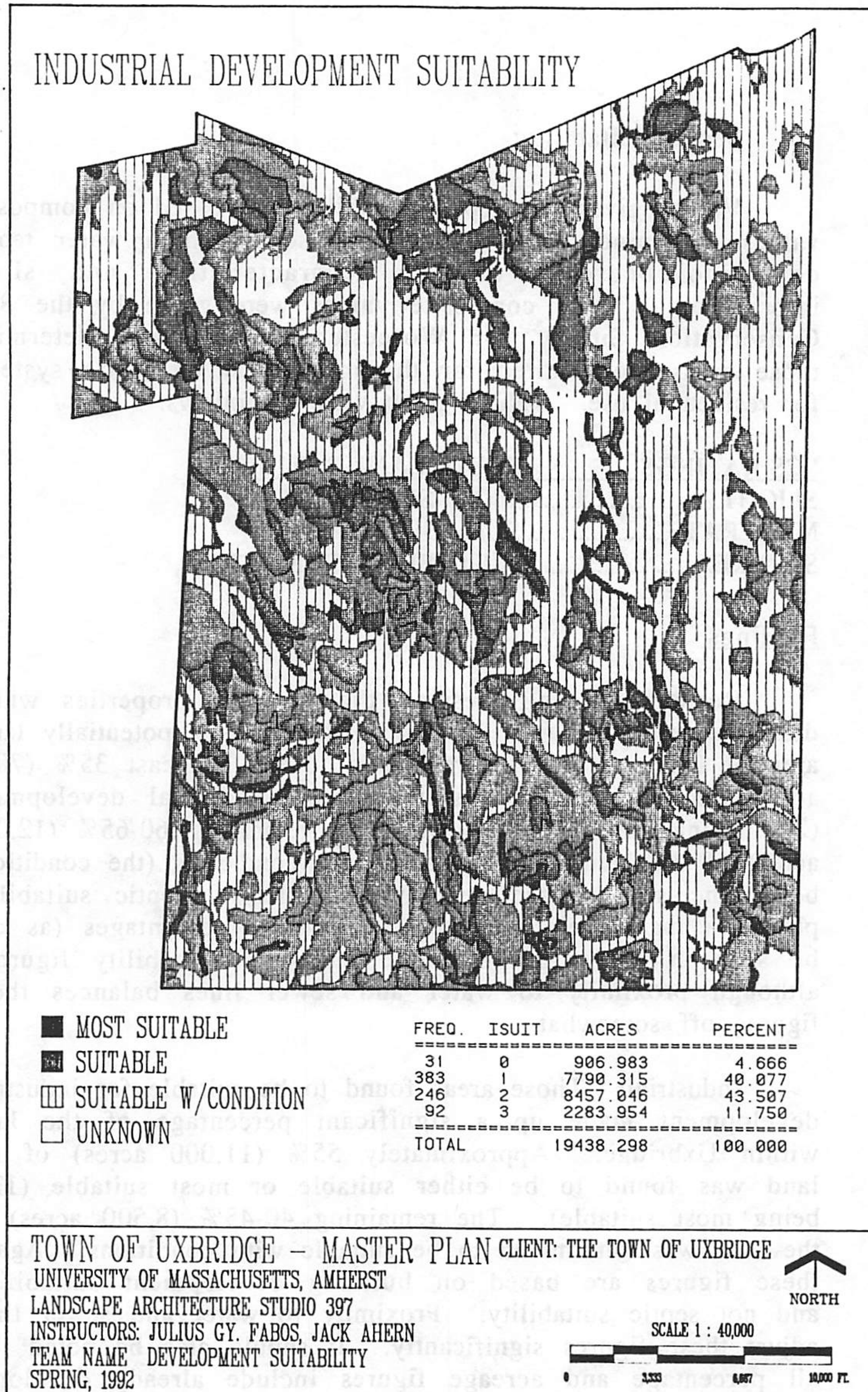


Fig. 6-6: Physical suitability for industrial development. Areas of industrial suitability according to criteria shown in fig. 6-4a,6-4b.

Septic suitability:

Values given for septic suitability are based on composite values determined from depth to seasonally high water table, depth to bedrock, drainage characteristics, and slope information. These composite values were given by the Soil Conservation Survey for Worcester County, and determine those areas most suited for the installation of septic systems for residential use. Values given were as follows:

SCS RATINGS	EQUIVILANT RATINGS
SLIGHT................................	MOST SUITABLE
MODERATE........................	SUITABLE
SEVERE..............................	SUITABLE W/CONDITION

Findings

Residential: In assessing the physical properties which define Uxbridge, it was found that there was a potentially large area of land suitable for residential use. At least 35% (7000 acres) of the land was suitable for residential development (20% being most suitable), while the remaining 60-65% (12,000 acres) of the land being suitable with conditions (the conditions being the size of the developers wallet). Septic suitability played a major role in determining these percentages (as can be seen in the disproportionate industrial suitability figures), although proximity to water and sewer lines balances these figures off somewhat.

Industrial: Those areas found to be suitable for industrial development made up a significant percentage of the land within Uxbridge. Approximately 55% (11,000 acres) of the land was found to be either suitable or most suitable (12% being most suitable). The remaining 40-45% (8,500 acres) of the land was determined to be suitable with conditions. Again, these figures are based on building development suitability, and not septic suitability. Proximity to water and sewer lines adjust these figures significantly. It should also be noted that all percentage and acreage figures include already developed areas, as well as those areas restricted from development (wetlands and wetland buffer zones). These areas are, however, taken into account in the composite assessment (See Composite Findings).

TOPOCLIMATIC SUITABILITY

Significance

The assessment of the topoclimate is an important factor to consider in determining site suitability. The assessment of the topoclimatic conditions considers areas more suited for development based on their relation to climatic conditions. This procedure is important in the development process since proper assessment of the climatic conditions will locate areas for development in locations that will not be faced with extreme climatic conditions. The beneficial results of developing in areas which are less affected by the topoclimate are less dependency on the non-renewable energy sources, decreased impact on air quality, lower utility costs and greater human comfort.

There are many factors which significantly influence the degree of climatic impact upon a site. Many of those factors are: solar orientation, prevailing winds, vegetation, topography, soil moisture, and large bodies of water. Solar orientation is determined primarily by topography. Ideally, in the Northeast, optimum solar gain is achieved on the southern slopes while northern slopes are less optimum. Unlike northern slopes, southern slopes receive more sun, therefore they are subject to less extreme and shorter periods of cooler temperatures. Southern slopes are also less effected by winter winds that prevail from the Northwest. Strategic locations of vegetation in the northwest corner of a development can also lessen the effect of winter winds. Deciduous vegetation can also provide for cooling summer shade if it is used on the southern side of a site. With proper location of a site, and the use of vegetation in strategic locations, long term energy costs can be drastically reduced.

State of Assessment Procedure

Topoclimatic development in the Northeast is primarily concerned with the 'underheated period'. Although the Northeast does experience times of "over heating", they are much less significant than the "under heated period" since they can be overcome by the planting of deciduous trees in southern locations.

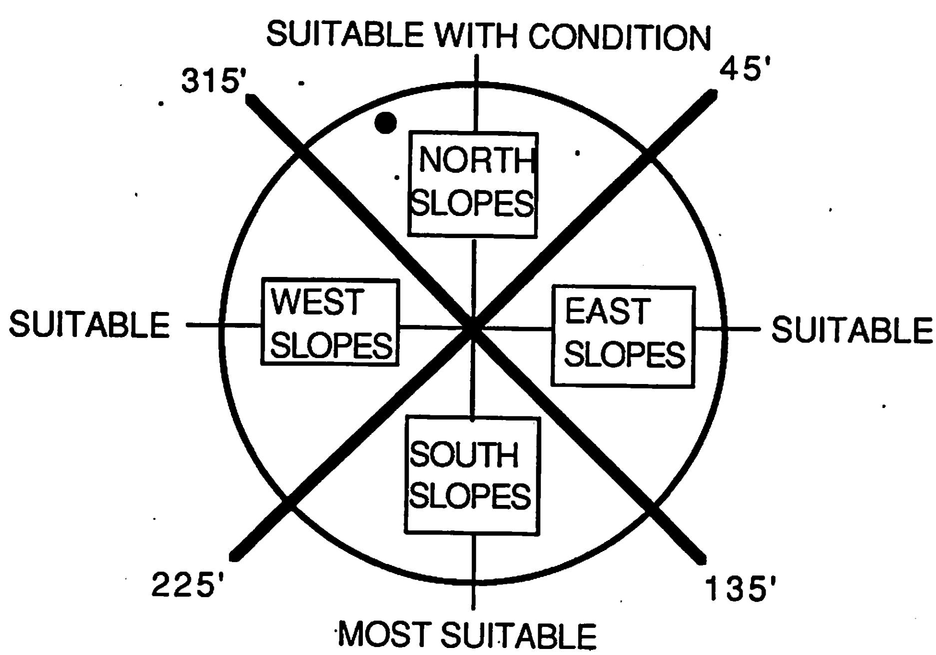
Since energy costs are on a steady rise, many professionals are concerning themselves with the affects of topoclimatic conditions.

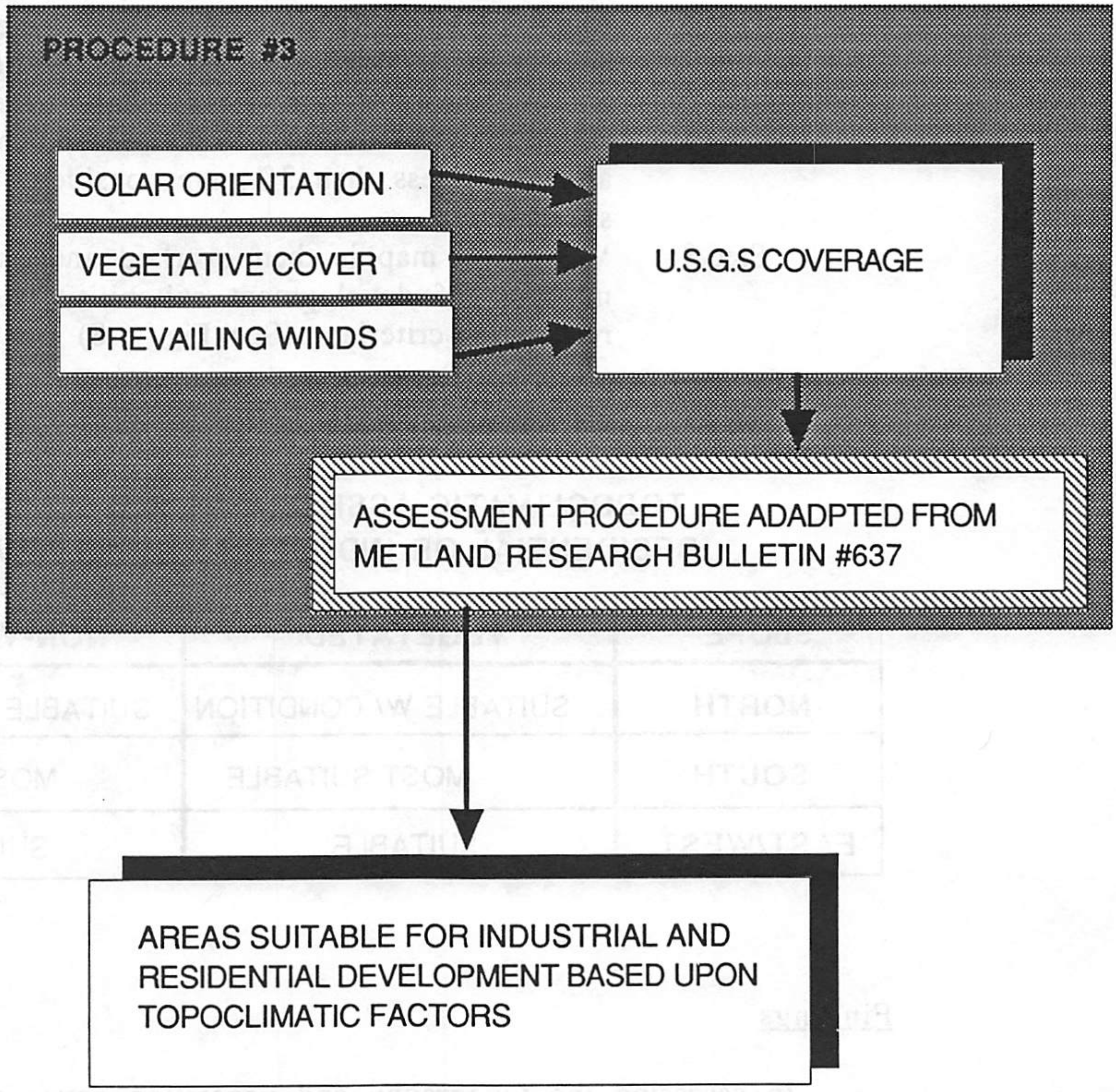
The assessment procedure which was followed gave suitability ratings to the factors that effect the topoclimatic conditions with regards to being least to most suitable for development. The three main factors that were assessed with regards to topoclimate are prevailing winds, solar orientation, and vegetation coverage. The site was rated according to the degree to which these factors effected the site.

Adapted Approach

The assessment procedure (See Fig. 6-7) which was followed was modelled after the METLAND - Developed Assessment Technique (Fabos, Caswell., 1977, p.208-223). After considering solar orientation, vegetation coverage and effects by winds, a "most suitable" to "suitable with condition" system of rating was given to areas according to their suitability for residential and commercial development.

Step 1: Use topography map to analyze uncommitted lands for protection against strong Northwest winds and solar orientation. Slope orientation is determined as:





Procedure #3

Analysis of solar orientation, vegetative cover, and prevailing winds based on residential development suitability criteria.

Results: Coverage/map of areas most, moderately, and least suitable for industrial and residential use.

FIG. 6-7 TOPOCLIMATIC DEVELOPMENT SUITABILITY PROCEDURE

Step 2: Assign values to each slope orientation. Slopes whose orientation is Southeast/Southwest are found to be most suited for development, Eastern and Western slopes are suitable for development and Northeast/ Northwestern slopes are found to be suitable with condition for development. Flat lands are (slope less than 3%) are considered to be suitable.

Step 3: Vegetation map is then overlaid and used as a modifier of development suitability based upon residential criteria. (See Fig. 6-8)

FIG. 6-8

TOPOCLIMATIC ASSESSMENT RESULTS FOR RESIDENTIAL OR INDUSTRIAL DEVELOPMENT

SLOPE	VEGETATED	NON-VEGETATED
NORTH	SUITABLE W/ CONDITION	SUITABLE W/ CONDITION
SOUTH	MOST SUITABLE	MOST SUITABLE
EAST/WEST	SUITABLE	SUITABLE

Findings

In assessing the topography and vegetation cover of Uxbridge to determine the topoclimatic suitability for residential use, it was found that the majority of the land is suitable for development. Approximately 85% (16,500 acres) of the land was found to be suitable (15% being most suitable) for development. This translates into potential energy cost savings for future home owners, as well as higher property values. There were only found to be approximately 3000 acres (15%) of land that were suitable with conditions for development. It should be noted that the flat lands of the valley floor were determined to be suitable for development based on topoclimatic conditions. This was due to the fact that prevailing winds do not affect flat areas as significantly as they do slopes. This is not to say, however, that further analysis would not be necessary

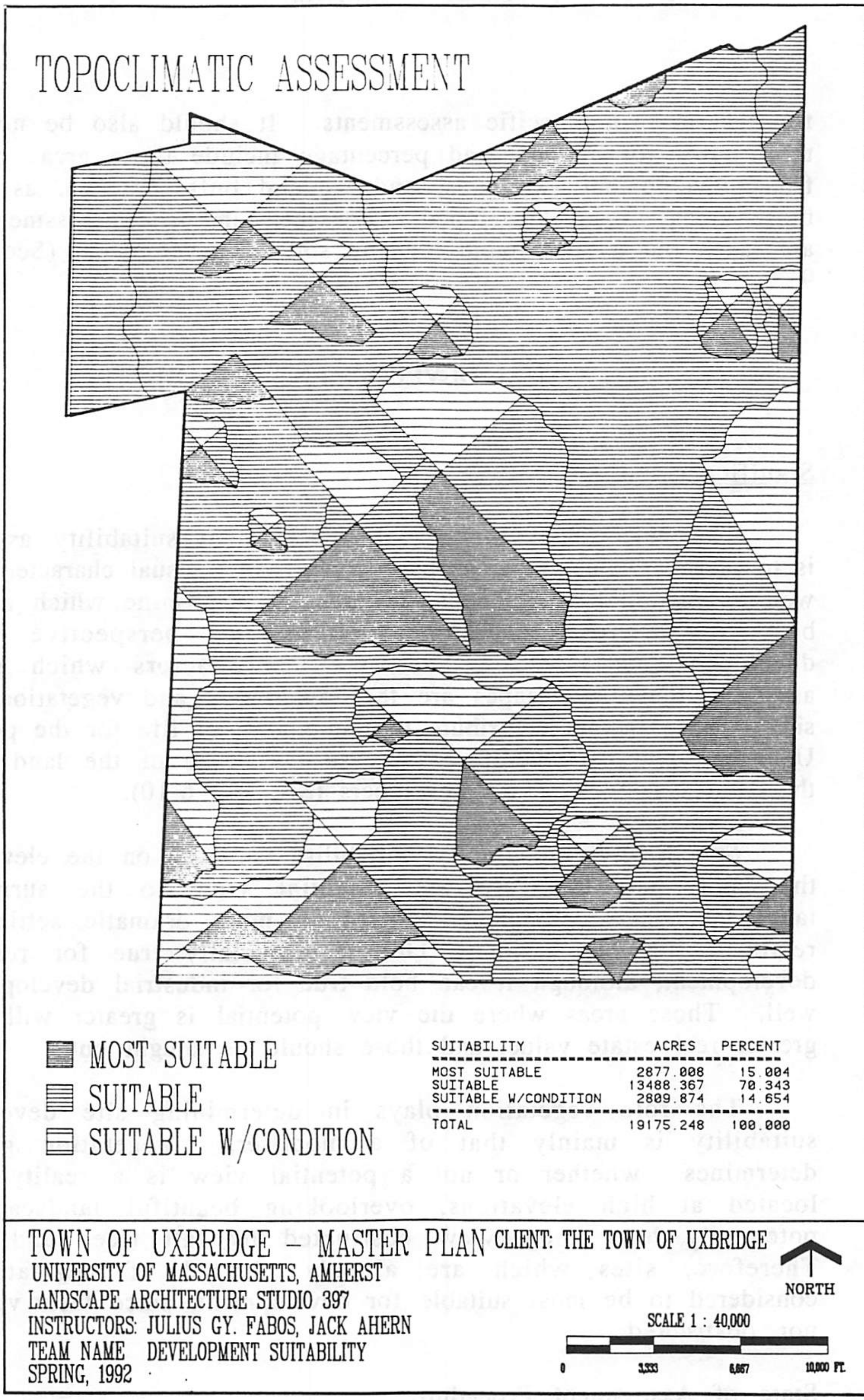


Fig. 6-9: Topoclimatic suitability map. Showing north, south, east, and west slopes with their respective development suitability ratings.

for accurate site specific assessments. It should also be noted that the figures for acreage and percentage include those areas restricted from development (wetlands, and wetland buffer zones), as well as those areas already developed. For the composite assessment, these are taken out as unsuitable for any sort of development (See Fig. 6-9).

VISUAL DEVELOPMENT SUITABILITIES

Significance

The purpose of the visual development suitability assessment is to place a value on areas based on existing visual characteristics, as well as potential view sheds, in order to determine which areas are best suited for development from the perspective of the developer/home buyer. The significant factors which go into assessing these landscapes are the topography and vegetation of the site. These factors contribute to the quality of life for the people of Uxbridge, and can therefore increase the value of the land to both the owners as well as the developers (See Fig. 6-10).

Specifically, topographic suitability is based on the elevation of the land, and therefore the potential view to the surrounding landscape. Developments located in more dramatic settings will retain higher land values. This is especially true for residential development, although it can hold true for industrial development as well. Those areas where the view potential is greater will have a greater real estate value, and those should be sought out.

The role vegetation plays in determining site development suitability is mainly that of a modifier. Vegetation generally determines whether or not a potential view is a reality. Sites located at high elevations, overlooking beautiful landscapes can potentially have their view obstructed by tall trees and shrubs. Therefore, sites which are already cleared of vegetation are considered to be most suitable for development, since their views are not obstructed.

State of Assessment Procedure

This procedure for assessing the visual quality of a site was

Fig. 6-10: Example of most suitable visual conditions. Shows example of optimum view potential from higher elevation.

developed by the Metropolitan Landscape Planning Model (METLAND). The basis of this procedure is that sites with potential views have higher land values. Therefore, developers should seek out these areas to increase the value of their residential developments. Developers can offset the cost of, for instance, the blasting of bedrock if their site is located high on top of a promontory due to the fact that people are more willing to pay the added cost for a house with a view.

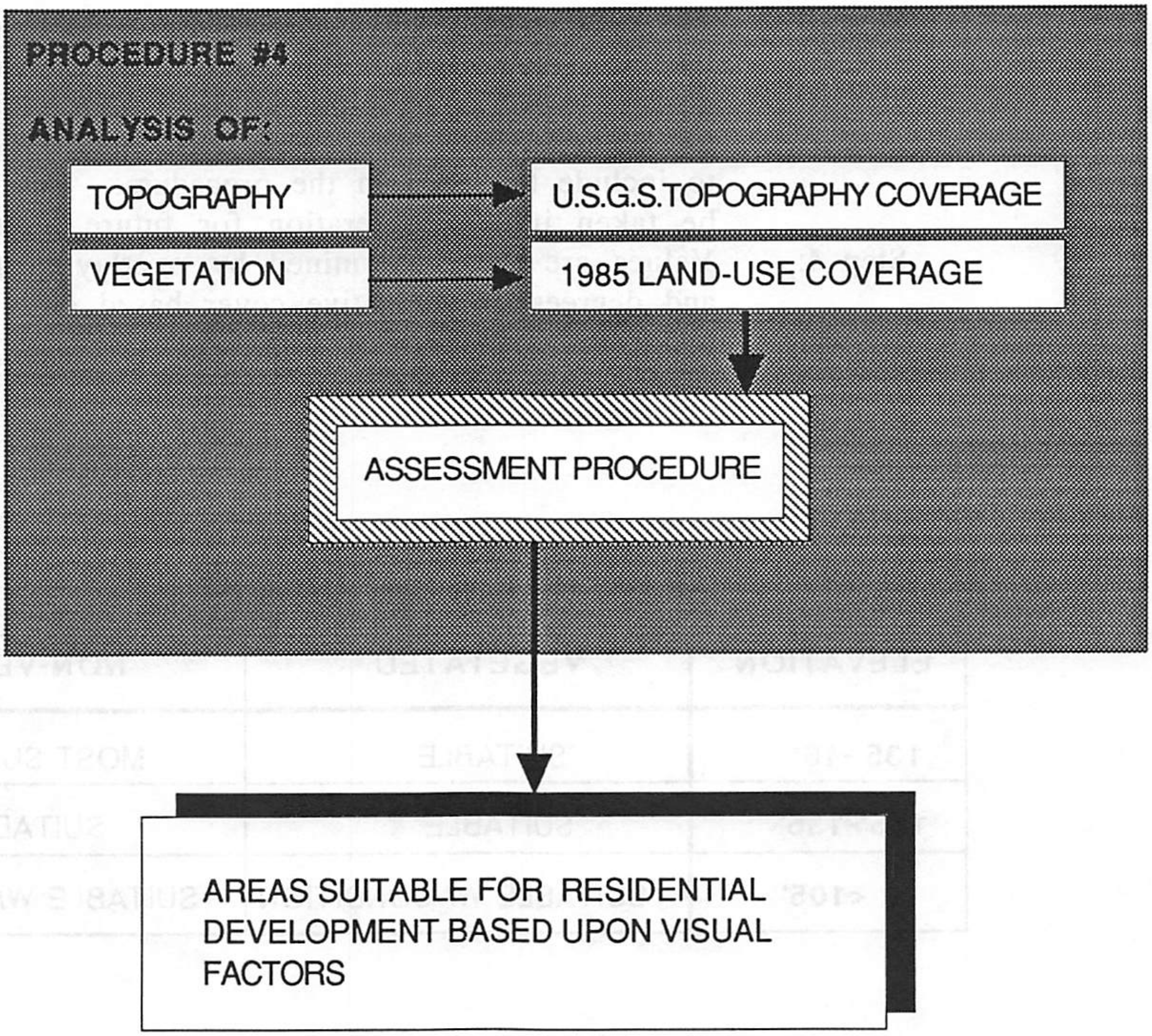
Adapted Approach

For the purpose of this assessment, procedures were adapted from the METLAND Research BULLETIN #653 (Fabos, Greene and Joyner, 1978, p.60). The adapted procedure (See Fig. 6-11) was condensed to include two major variables to determine potential view. First, topographical information was taken from the USGS map to determine elevations. Next, vegetative maps were overlaid to determine ratings for visual development suitabilities based upon criteria for residential development suitability. The resulting coverage is mapped out to show all suitable land for residential suitability based on visual factors.

Introduction to Model

Step 1: Areas available for development are separated into those with view potentials that are extensive, moderate and limited. These categories are determined by the elevation of a given site. Areas with a higher elevation have a greater potential for expansive views, thereby making them more valuable land for the developer/home owner.

Step 2: Vegetation is then factored in by determinig which areas have significant vegetative cover, and which are open plots. Those areas which are clear of significant vegetative cover are determined to be more suitable for development in that their view potential is not blocked or hampered by shrub or tree masses. Those with significant amounts of vegetation are considered to be less suitable for development.



Procedure #4

Analyze topography (elevation) and vegetation, and then assess based upon residential development suitability criteria.

Results: Coverage/map of areas most, moderately, and least suitable for residential use.

FIG. 6-11 VISUAL DEVELOPMENT SUITABILITY PROCEDURE

Step 3: The next step of the procedure is to examine the land use map of Uxbridge to find areas whose view potentials are compatible with neighboring land use. Due to time constraints, our team was unable to include this step in the procedure. Yet, it should be taken into consideration for future development.

Step 4: Values are then determined by overlaying factors and degrees of vegetative cover based on residential criteria (See Fig. 6-12).

Fig.6-12

VISUAL ASSESSMENT RESULTS FOR RESIDENTIAL DEVELOPMENT

ELEVATION	VEGETATED	NON-VEGETATED
135'-165'	SUITABLE	MOST SUITABLE
105'-135'	SUITABLE	SUITABLE
<105'	SUITABLE W/ CONDITION	SUITABLE W/ CONDITION

Findings

Through the analysis and assessment process of the visual characteristics of the town of Uxbridge, our study concluded that approximately fifty-one percent of the town favors development according to the visual characteristics which were studied. The areas of highest suitability consist of approximately 5,800 acres, or thirty percent of the town, and lie primarily on the western edge of the town. The remaining seventy percent of the land is found throughout the valley and lowlands that run through the center of the town. (See Fig. 6-13)

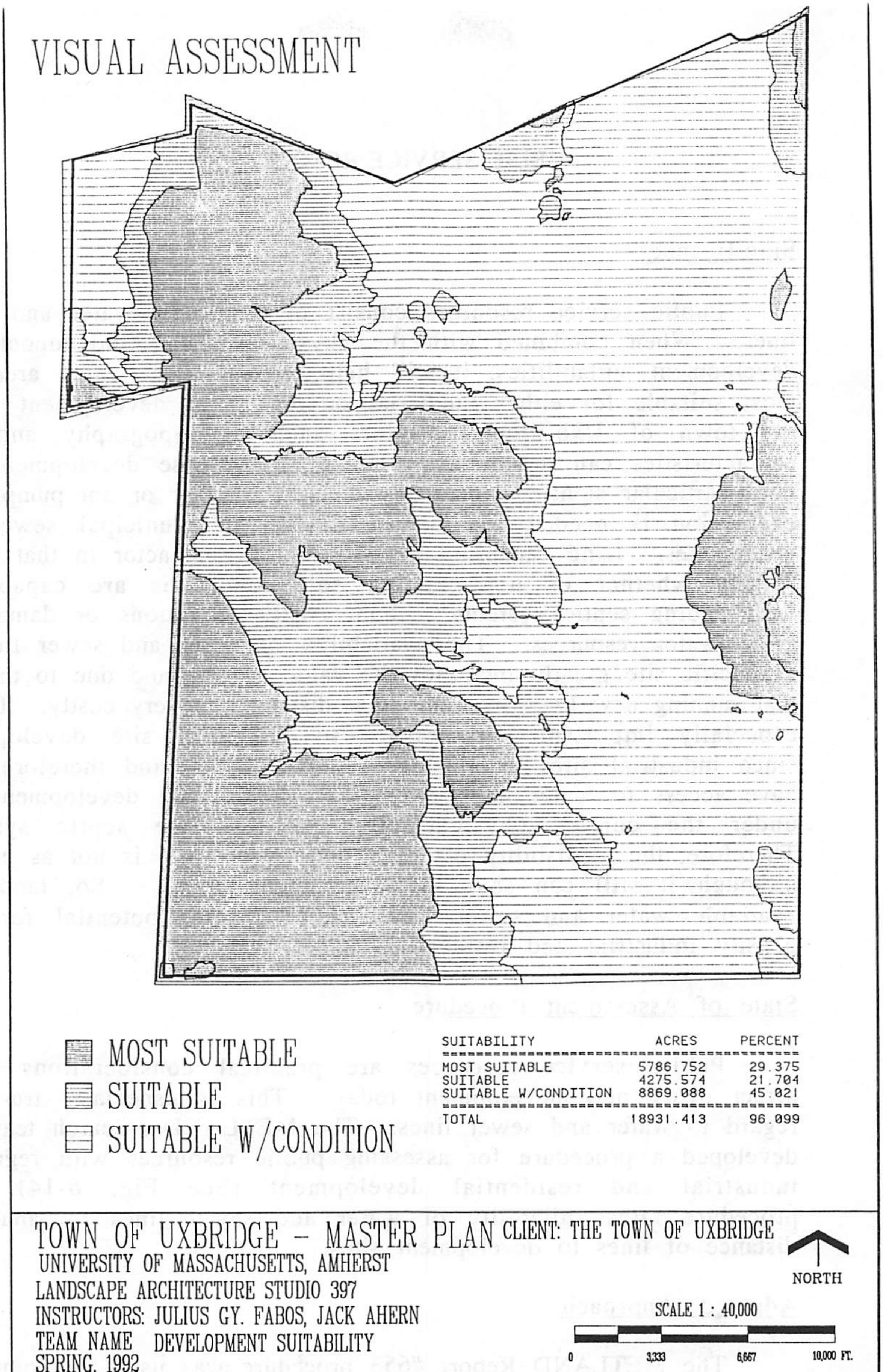


Fig. 6-13: Visual suitability map. Showing areas of visual suitability with higher elevations being more suitable than lower elevations.

PUBLIC SERVICE RESOURCES

Significance

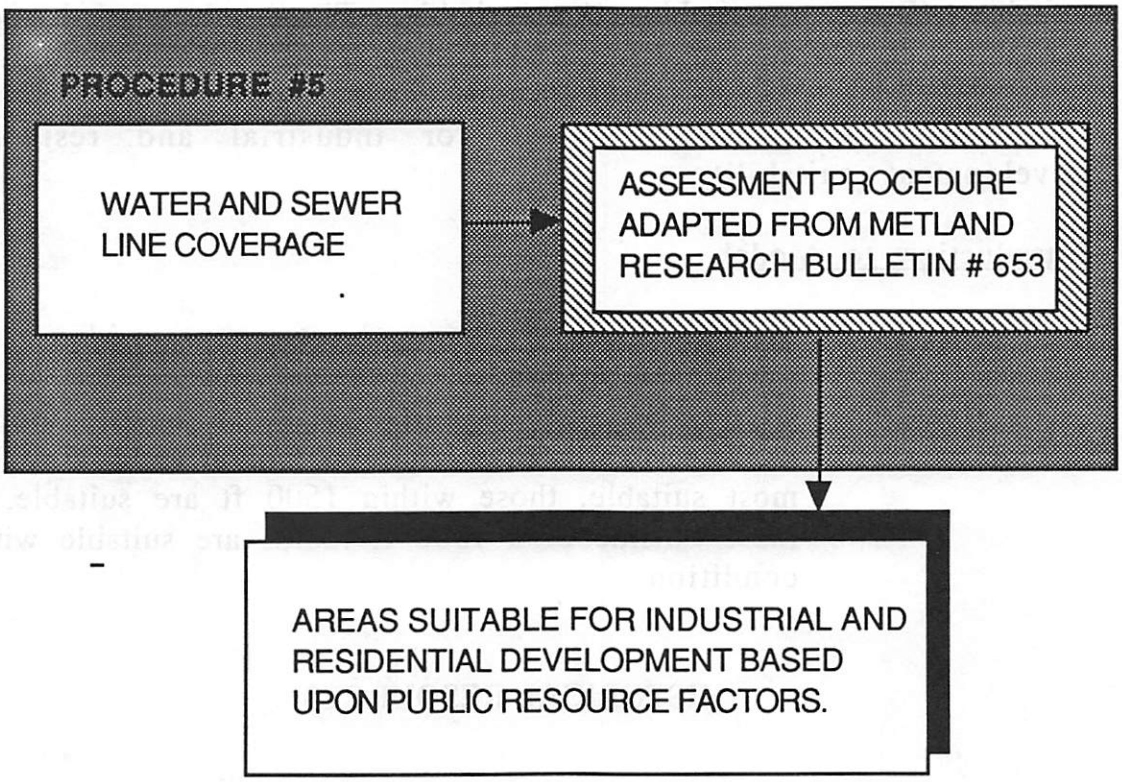
Public service resources consist of municipal water and sewer lines. When combined with the physical, visual, and topoclimatic development suitabilities, it will help to determine which areas are most suitable for either industrial or residential development within the town of Uxbridge. Factors such as topography and soil characteristics can drastically increase or decrease development cost of a particular sight. Topography dictates whether or not pumping or excavation is needed for the installation of municipal sewer and water lines. Land capability plays a significant factor in that it can signify whether or not existing soil conditions are capable of withstanding septic systems without costly alterations or damage to groundwater resources. The availability of water and sewer lines to a specific site greatly increases the value of the land due to the fact that running new lines in from great distances is very costly. This is especially important with regard to industrial site development, since industrial sites cannot use septic systems, and therefore must have access to water and sewer lines. Residential development can, under the correct physical circumstances, use septic systems. Therefore, the availability of water and sewer lines is not as critical, although it still can save in development costs. So, land with available water and sewer lines has a greater potential for high density industrial and residential usage.

State of Assessment Procedure

Public service resources are practical considerations which affect every new development today. This is especially true with regard to water and sewer lines. The METLAND research team has developed a procedure for assessing public resources with regard to industrial and residential development (See Fig. 6-14). This procedure rates suitability of water and sewer lines by analyzing distance of lines to development sites.

Adapted Approach

The METLAND Report #653 procedure was used for composing a public resources assessment (Fabos, Greene, Joyner, 1978). Their



Procedure #5
Analysis of existing water and sewer lines. Assessment of industrial and residential development suitability based upon distance from existing lines. Results: Coverage/map of areas most, moderately, and least suitable for residential and industrial use.

FIG. 6-14 PUBLIC RESOURCES DEVELOPMENT SUITABILITY PROCEDURE

assessment contains two phases. First the individual resources are mapped and assessed and are given values as follows: (A) most suitable (B) very suitable (C) suitable. These values are based on proximity to development, although they differ for residential and industrial use. Secondly, these individual maps are combined with the composite assessment maps for industrial and residential development suitability.

Introduction to Model

Step 1: Map all existing water and sewer lines within the town of Uxbridge.

Step 2: Give values of suitability based on the proximity to the specific resource; those within 1000 ft are most suitable, those within 1500 ft are suitable, and those outside of a 1500 ft radius are suitable with condition.

HISTORICAL RESOURCES

Significance

Many towns throughout New England are becoming more and more anxious to learn about their historical significance. Not only are the towns anxious to learn, but they are now becoming aware of the importance to preserve and restore their historical integrity. Many citizens believe that strong links between the community and its historical resources are vital aspects of todays society, in that their cultures are represented by their past. Significant historical resources can be described as "sites, structures or objects which have played a role in the area's past events." Professionals such as historians and historic preservationists locate and record places, sites, and structures that are of historical significance, while professionals such as landscape architects, architects, planners and others in the design field strive to maintain and reinforce the heritage of the community. Through the process of revitalizing historic structures back to their original condition and purpose, or renovating a structure to suit a new purpose, designers are successfully putting these structures to good use.

In New England, the residents are well aware of the role that water powered mills had in establishing many of the cities and towns that are present today. Uxbridge is an excellent example of how a town was influenced by historic mills and canals. This is why efforts are being made by the Blackstone River Valley Heritage Corridor Commission to preserve parts of the Blackstone River which runs through Uxbridge through the use of a greenway. The main goal for the inter-state commission which is working on the greenway project is to propose a greenway between the cities of Worcester and Blackstone which would link significant historical, cultural and recreation resources, as well as to propose ways to protect and restore the landscape along the corridor. The multi-million dollar planning project is one of only three heritage corridor projects in the United States.

The identification of these historic districts can play a significant role in planning for the future of these small New England towns. By practicing infill development techniques, in which high density residential developments are sited in and around (in this case) historic districts, developers, as well as residents can benefit in many ways. For example, in the case of Uxbridge, there are historic districts located in and around the downtown area. By concentrating cluster type development around an existing town center, developers can save money by connecting with existing water and sewer lines, instead of running costly new ones. This would also help to preserve the character of the outer limits of the town by not splicing the existing landscape into small plots of suburban development. Also, by locating new developments within a close proximity to historic districts, the value of the developments would, in turn, be greatly increased due to the quality of the environment, and the cultural richness of the area.

State of Assessment Procedure

All historic resources can be assessed as being of local, state or national significance. The sources which rate the significance of these places are national and state registers of historic places, archaeological and historic accounts, regional guide books, publications from professional organization, local societies and finally, opinions of local officials and residents. The first step of this procedure is to identify and inventory any resources that may be listed in the above sources. Following the inventory process, the historic resources are rated according to their intensity to designate specific areas as historic districts. Finally, available lands are rated according to their distance from these historical districts.

Due to time constraints, the development suitability team was unable to use the historical information in the assessment process which was used to create the composite assessment map. The approach which could be adapted for this procedure is outlined to show how this process can be carried out.

Adapted Approach

An approach (See Fig. 6-15) which can be used to assess the historical significance of sites and structures is based on finding areas which are identified as historic districts. The first step is to identify all historic districts in the town of Uxbridge according to their concentration. The next step is to give ratings to developable areas according to their distance from the historic districts. Those sites located within a quarter mile of the historic districts will be given a higher rating for residential development, and a lower rating for industrial development. Those located beyond the quarter mile radius will be given a higher industrial rating and a lower residential rating. The reason for the lower industrial rating for sites near a historic district is that modern industrial sites do not serve to preserve the "historical integrity" of a town. Ideally, they should be located elsewhere. The next and final step is to develope a composite development suitability rating for both industrial and residential development based upon their respective criteria. This would then be used as a modifier for the composite assessment of the physical, topoclimatic, visual, and public resource development suitability factors.

Introduction to Model

Step 1: Identify all historic districts within downtown Uxbridge based on their intensity of location.

Step 2: Assign values to areas based upon proximity to designated historic districts:

	Residential	Industrial
within 1/4 mile....................	most suitable	suit. w/conditions
within 1/2 mile....................	suitable	suitable
outside 1/2 mile..................	suit. w/conditons	most suitable

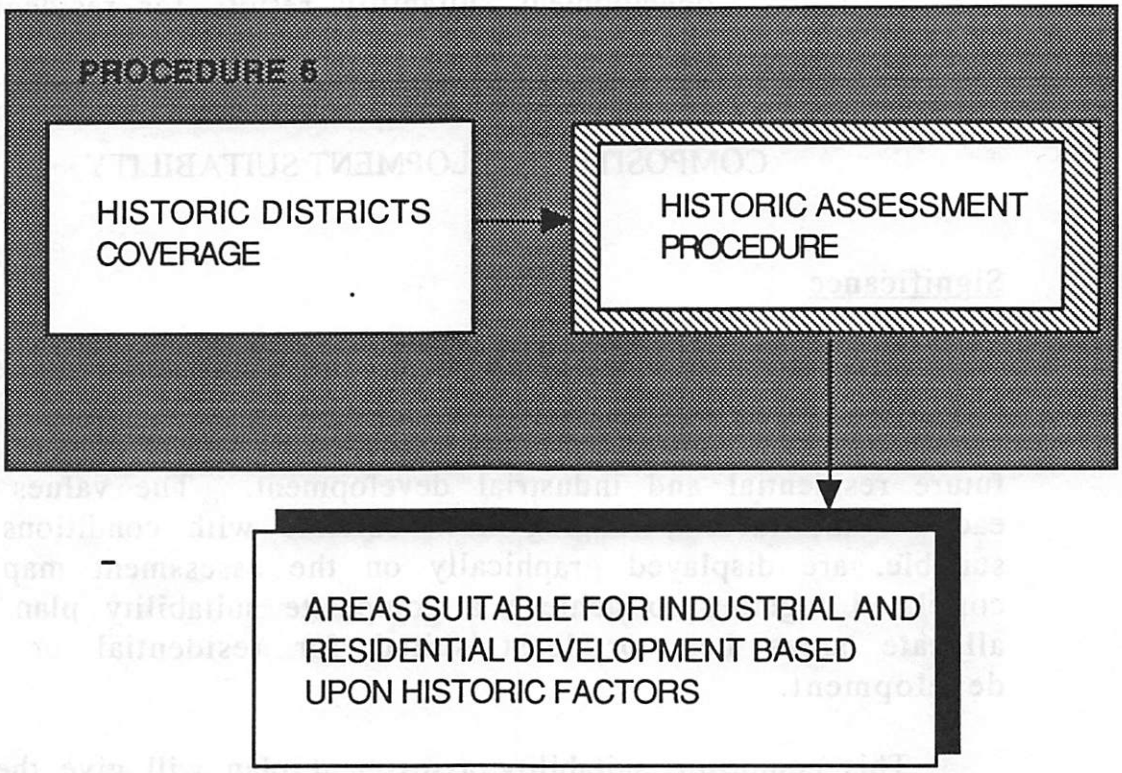


FIG. 6-15 HISTORIC DEVELOPMENTAL SUITABILITY PROCEDURE.

Step 3: Overlay historic district information with composite development suitability results for residential and industrial use.

COMPOSITE DEVELOPMENT SUITABILITY

Significance

All information gathered from the assessment procedures of physical, topoclimatic, visual, historical and public resource suitabilities are correlated into a composite development map for future residential and industrial development. The values given to each of the factors, ranging from suitable with conditions to most suitable, are displayed graphically on the assessment map and are correlated together to achieve a composite suitability plan that will allocate areas best or least suited for residential or industrial development.

This composite suitability assessment plan will give the town of Uxbridge a base from which they can plan for future development based upon their changing needs. From this, developers and home owners/land leasers can properly select their sites in the interest of saving money, while also avoiding potentially destructive development.

With the integration of the Blackstone River National Heritage Corridor into the infrastructure of Uxbridge, and the town's need for industrial expansion, there will be an ever increasing need for this information base. Proper planning for future needs will enable the town to use its available land to its greatest potential while not paying the penalties, as so many other towns and cities have, of uninformed, short-sighted development practices. This translates to protecting the environment, while still providing sufficient land for the future developmental needs of the town. This composite suitability map will lay the groundwork from which the other teams in this land use study will be able to further create a plan for the future of Uxbridge, from which the town may then be able to work with.

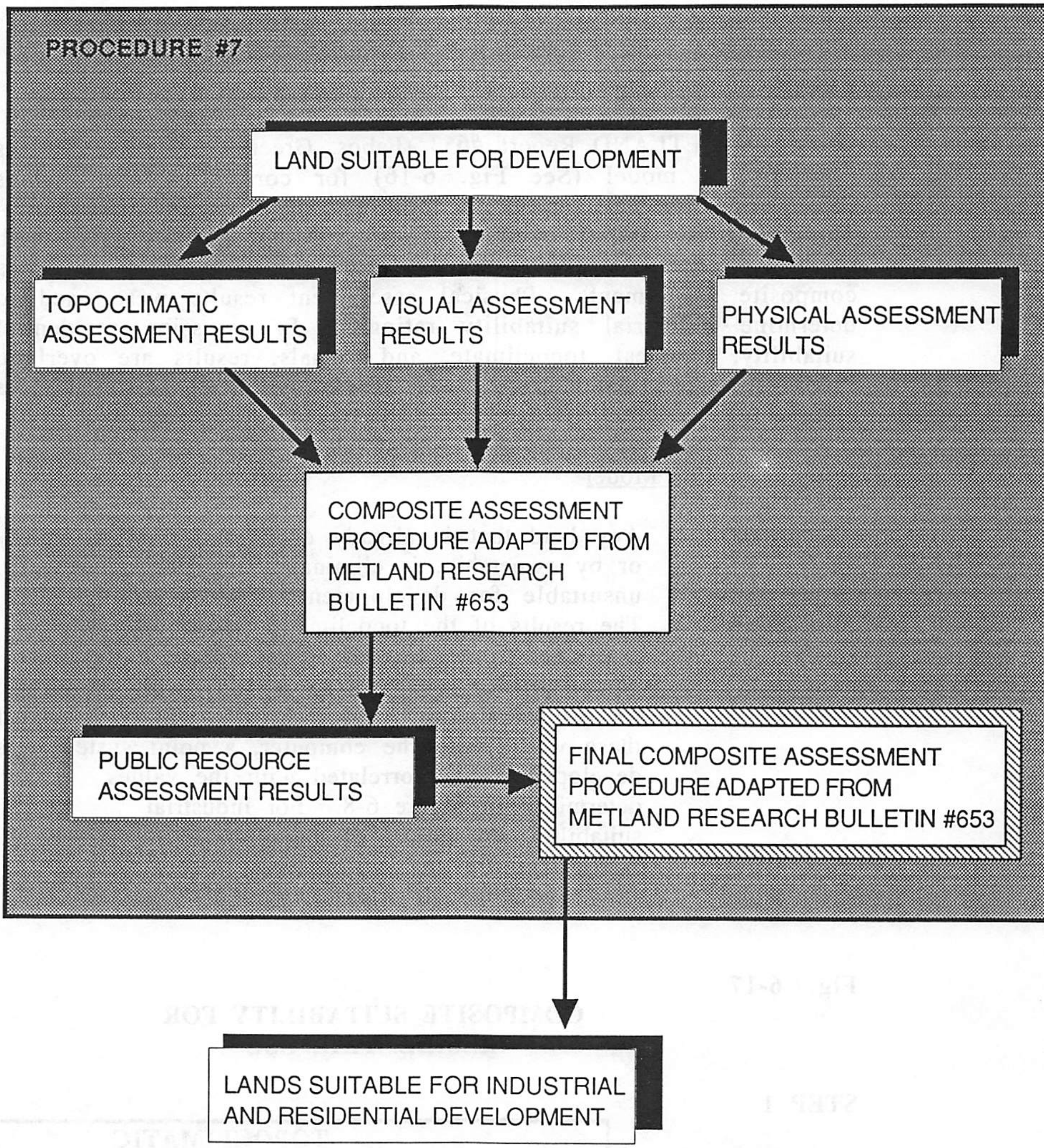


FIG.6-16 COMPOSITE DEVELOPMENT SUITABILITY PROCEDURE

Adapted Approach

The METLAND Report #653 (Fabos, Greene, Joyner, 1978) has developed a model (See Fig. 6-16) for correlating the various information on all maps concerning development suitability. Through a process of overlays, composite values of suitable with conditions, suitable and most suitable are given in order to produce a composite assessment. Physical assessment results were used to determine industrial suitability ratings. In assessing residential suitability, physical, topoclimate, and visuals, results are overlaid. Public service (water and sewer lines) is then overlaid as a modifying factor.

Introduction to Model

Step 1: Any land that is already committed, either legally or by ownership, is eliminated and determined unsuitable for development.

Step 2: The results of the topoclimatic, visual and physical assessments are overlaid to determine those areas most suitable, suitable, and suitable with condition for residential use. (See Fig. 6-17) In order to put these values into the computer, a point system was developed which correlated with the values determined in Figure 6-8. For industrial suitability, the results of the physical suitability assessment are the determining factors. (See Fig. 6-4b)

Fig. 6-17

COMPOSITE SUITABILITY FOR RESIDENTIAL USE

STEP 1

	TOPOCLIMATIC		
PHYSICAL	MOST SUITABLE	SUITABLE	SUIT. W/ COND.
MOST SUITABLE	MOST SUITABLE	MOST SUITABLE	SUITABLE
SUITABLE	MOST SUITABLE	SUITABLE	SUITABLE
SUIT. W/ COND.	SUITABLE	SUIT. W/ COND.	SUITABLE W/ COND.

STEP 2

	PHYSICAL	AND	TOPOCLIMATIC
VISUAL	MOST SUITABLE	SUITABLE	SUITABLE W/COND
MOST SUITABLE	MOST SUITABLE	SUITABLE	SUITABLE
SUITABLE	MOST SUITABLE	SUITABLE	SUITABLE W/COND.
SUIT. W/COND.	SUITABLE	SUITABLE	SUITABLE W/COND.

Step 3: The results of the residential composite and industrial assessments are combined with the public resource assessment. Based upon criteria for industrial and residential suitability, a value system is again applied to the composite results (See Fig. 6-18). These values are then given a numerical value based upon their rating.

Fig. 6-18

COMPOSITE SUITABILITY BASED ON PROXIMITY TO EXISTING WATER AN SEWER LINES

	DISTANCE TO WATER AND SEWER LINES		
SUIT. RATING	<1000'	<1500'	>1500'
MOST SUITABLE	MOST SUITABLE	MOST SUITABLE	SUITABLE (INDUSTRIAL) SUIT. W/COND.(RES.)
SUITABLE	MOST SUITABLE	SUITABLE	SUIT.W/COND.(INDUSTRIAL) SUITABLE (RES.)
SUIT. W/COND.	SUITABLE	SUIT. W/COND.	SUIT. W/CONDITION

Step 4: A final composite land use suitability map is developed which displays those areas which are most suitable, suitable, least suitable, and suitable with conditions for both residential and industrial

development, as well as those areas which are unsuitable for any sort of development.
This was done by overlaying the three separate coverages for composite industrial suitability, residential suitability, and committed lands.

Findings

The final composite assessment revealed many of the areas that pose opportunities for development, as well as those areas which have certain shortcomings (See Fig. 6-19). First and foremost, 24% (5000 acres) was determined to be committed lands; that being land already developed or restricted from development by law (wetlands and wetland buffer zones). The effects of water and sewer lines being overlaid as a modifying factor, and the elimination of committed lands were extreme, especially with regard to industrial suitability. Approximately 13% (2600 acres) of all non-committed lands were determined to be suitable for industrial development (3% being most suitable), with the other 60% (11,000 acres) being suitable with conditions.

In assessing suitability for residential development, it was found that approximately 50% (10,000 acres) of the available land in Uxbridge is suitable (15% being most suitable), while the remaining 25% (4500 acres) is suitable with condition. From this it can be interpreted that there are large areas suitable for future population growth, however, those areas that are most suitable are not as prominent, and therefore should be used for that which they are best suited. The same is also true for those areas suitable and most suitable for industrial use. Since these areas are not prominent within Uxbridge, they should be zoned for industrial use. This will help to absorb any influx of future development in that these areas will provide for economic expansion, while also allowing for less expensive development, and therefore more money for the town and its people.

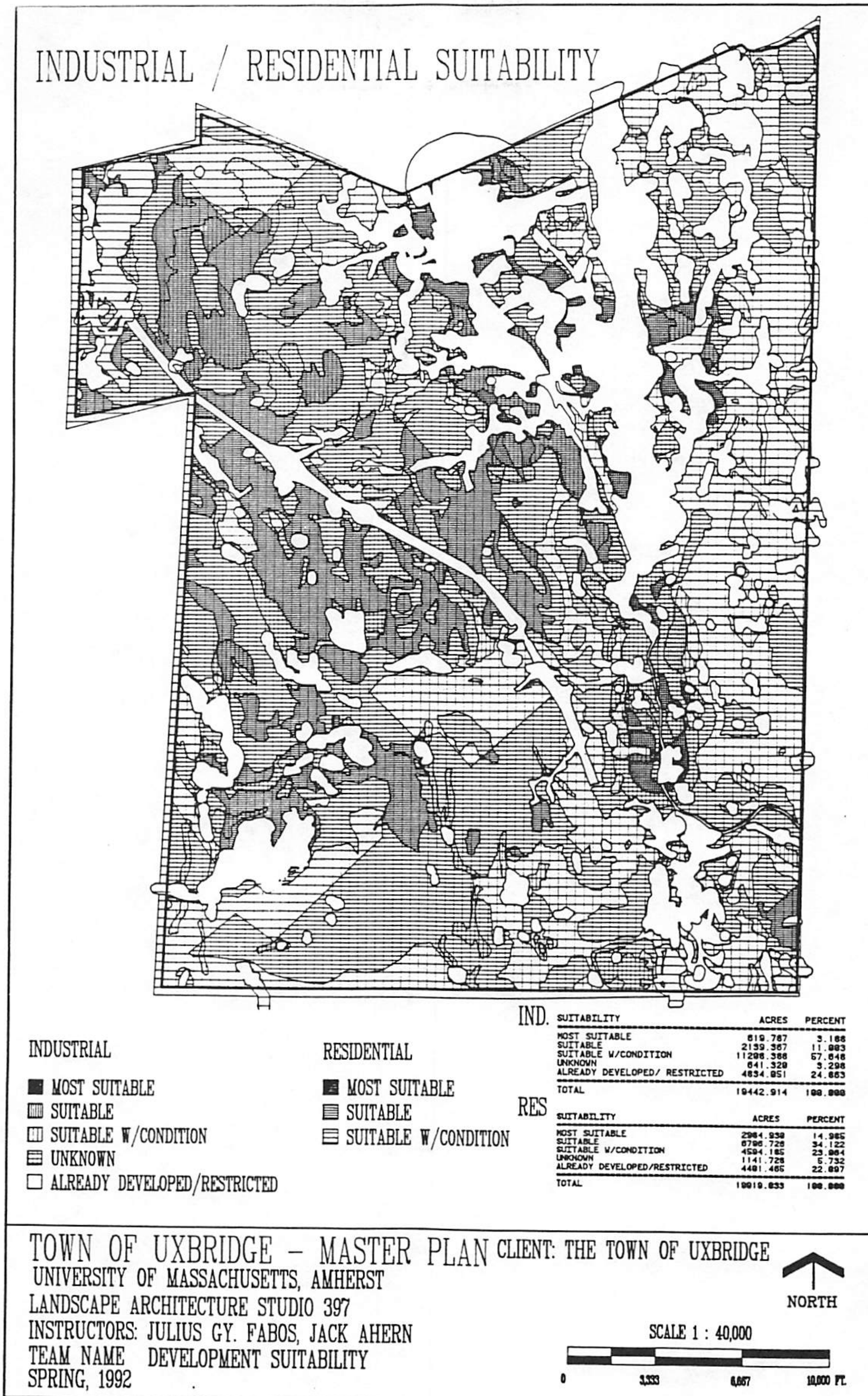


Fig. 6-19: Composite suitability map for industrial and residential development. Determined by overlaying the physical, topoclimatic, and visual assessment maps, with buffer zones for water and sewer lines used as a modifying factor.

Plan Alternatives

Chapter 7

PlanAlternatives

Team VII

Team Members

Matt Clemente
Jackie Perchard
Lauren Standish

TABLE OF CONTENTS

INTRODUCTION

Uxbridge, like many communities, is faced with the problem of planning for the future growth of its town. With the aid of the Geographic Information System (G.I.S.) these problems can be addressed and a master plan developed by the generation of many different alternatives or scenarios to help in the planning process. This method of planning gives the town a wide range of options by looking at such issues as the community's future growth pattern, areas of critical resources, important environmental areas, and a range of development opportunities.

This kind of planning becomes significant when similar growth pressures in character to route 128 and 495 can be predicted with the upgrade of route 146 as a major transportation link through the state. In contrast, the town has many historic resources which stem back to the start of the Industrial Revolution in the United States. There are also many environmental resources which combine with the historic resources to make Uxbridge a unique town to live in. It is essential that a master plan be developed to maintain this quality but also to allow the town to grow into a prosperous community.

There are two phases of this team's study that will provide different options for future growth of Uxbridge. The first phase will take the current zoning regulations and develop to the towns maximum capacity. The second phase is to give plan alternatives based on values of significance and suitable land development. This phase is based a landscape approach which can combine a more sustainable development with an ecological balance for the town of Uxbridge.

SIGNIFICANCE

The greatest asset of Uxbridge is that it is located within the boundaries of the Blackstone River Valley National Heritage Corridor (B.R.V.N.H.C.). With this comes a need to establish a master plan to decide the future role that Uxbridge will take within the corridor. If a National Heritage Corridor is developed say by the year 2000 it would mean up to 5 million visitors a year could pass through Uxbridge. With the pressures of tourism, comes the pressures of providing tourism service, such as hotels, restaurants, campgrounds, gas stations, and other small commercial businesses.

Another critical issue facing Uxbridge and its present rural character is the upgrading of route 146 into a limited access highway.

Route 146 is becoming a third beltway encompassing Boston as well as a major link between the Massachusetts Turnpike, at Worcester, and Providence Rhode Island. When this upgrade is made it will slice through the town more than it presently does now and develop growth pressures of its own kind .

These are two significant examples of why the town of Uxbridge has to gain control of its current natural and critical resources and to gain development where it is best suited.

STATE OF THE ASSESSMENT

It is important for the residents of Uxbridge to see that are many ways that there town can develop. The path which the town does decide on can be achieved by looking at many different alternatives and choosing the most acceptable for future growth. The following case studies were found to be a useful source and an influence in the work of this team.

A) Buildout Scenario

The following case study was developed for the Massachusetts Water Resources Authority (MWRA) by the University of Massachusetts in 1989. (LaCour, Fabos, Ahern & Mullin 1989). The study was an evaluation of the effectiveness of existing zoning by-laws for the future protection of water quality from changing landuses in the Wachusett Reservoir. The following is the step by step framework developed by the research team based on the implementation tool of the G.I.S..

Step one : Collect and transform zoning regulations into a digital data base.
Step two : Analyses the landuse/land cover changes from 1970-1985.
Step three: Update and analyze the landuse/land cover data from 1985-1989.
Step four : Apply the impact of special permits and zoning variances on development trends.
Step five : Produce possible build-out scenarios based on current zoning regulations and the effects of special permits and variances.
Step six : Produce an alternative buildout scenario with a 200' buffer on each side of every stream and a 400' buffer around each water body.

B) Methods to Generate Alternatives

The following case study was developed by METLAND Research Team of 1978 (METLAND, #653, Joyner,Fabos, Schuliner 1978). The objective was to develop plan formation and elevation procedures and applications. Their procedure was to develop plan alternatives that would represent different phases of development. Three phases of plan alternatives were produced. The first was a “composite landscape value”, which illustrated potential development which a region might support under the assumption that landscape preservation and protection held precedence.over all other objectives. The second phase was a “status quo”, which illustrated the future growth under its present growth policies. It assumes that the community or region will eventually be fully developed within these assumed guidelines.

The third phase of the METLAND study was what influenced the work of team seven's procedure for plan alternatives for the town of Uxbridge. METLAND developed a series of alternatives that would respond to the community, recognize the significant critical and natural resources and to guide development where it is best suited. To develop these alternatives, METLAND implemented steps to be preformed to formulate each alternative.

The <u>first step</u> is to select an objective mix and appropiate criteria which reflect the goals of resource conservation, hazard avoidance and development suitabilities. (Figure 7-1).

The <u>second step</u> is the search and selection of one or more spatial alternatives which meet the criteria of the objectives selected. The purpose of this is to create a spacial picture illustrating the major landscape patterns of compatibility and conflict. Compatibility and conflict are defined here to be conditions on the landscape where the co-occurances of a set of landscape values are either mutually supportive for a given use (compatibility), or are contradictory for a given use (conflict).

Ratings of significance are applied to each category within the parameter depending on which landscape objective or which development objective is being generated. This could include such objectives as a bias towards land preservation or protection, hazard areas effecting future development, or identifying areas that are best suited for development. The findings are implemented by these different resulting objectives. The result of this step is a map of "candidate" areas for future development or landscape preservation or protection.

The final step is the assignment of future land activities of each of these "candidate" areas based on the prescribed allowable or intended use delineated in the zoning by-laws. After a run, which seems to satisfy the specific objective, it would be overlayed with a zoning regulations map.

HYPOTHETICAL SEARCHB EXAMPLE

OBJECTIVE	CRITERIA SPECIFICATION RUN 1	RUN 2
Agriculture Productivity	BC	BC
Wildlife Productivity	BC	ABC[1]
Water	BC	BC
Forest Productivity	BCD	BCD
Sand and Gravel	BC	BC
Air Pollution	BC	BC
Noise Pollution	BC	BC
Flooding	BC	BC
Physical D.S.	AB	ABC[2]
Topoclimate D.S.	AB	AB
Visual D.S.	ABC	ABC
ACRES	200	1150

[1] Lower wildlife objective by trading of A quality areas.

[2] Lower physical development cost objective by developing of less suitable class C quality areas.

A=most significant B=very significant
C=significant

FIG. 7-1: METLAND matrix table determining initial objective mix and criteria. Search runs for the generation of alternatives were done to adhere to different objectives. In step two the values will be used to create a "spacial picture" illustrating major landscape patterns of compatibility and conflict.

Then, whenever an area of land is classified as appropriate for development and also zoned for development it is hypothetically converted to that zone use. If a co-occurance of landuse occurs then decisions would have to be made as to the future landuse of that area will be. Such decision could implement a delayed development zone which would prolong the development and possibly find future development best suited in another area. In general the results of these overlays generate future growth alternatives for the development of a master plan.

2) The following case study was done by the METLAND Research team (METLAND #637, Fabos et.al, 1977). Their objective was to provide assessment procedures and a framework of evaluation in a metropolitan landscape. Their site was the developed city of Burlington , Massachusetts. The following is the step by step framework developed by the research team;

<u>Step 1</u>: Develop weighting procedures for all landscape variables in the landscape. Economic analysis, viewpoints of interest, and special population groups could effect the place in which they would like to live.

<u>Step 2:</u> Prepare composite assessment maps using each weighting procedure to determine the agreement and conflict among the different weightings.

<u>Step 3:</u> Prepare composite assessments maps which represent an acceptable compromise among the different weightings used.

<u>Step 4:</u> Develop landuse and growth objectives which correspond to scenarios of desired living environment.

<u>Step 5:</u> Evaluate the consequences of each scenario on the compromise assessment of the landscape which was produced in step 3.

<u>Step 6:</u> Propose an acceptable landuse and growth objective or scenario.

<u>Step 7:</u> Identify or develop effective devices for planning implementations.

C) IMPLEMENTATION STRATEGIES

The town of Uxbridge has an array of techniques for landscape protection and land conservation available to it. These techniques have been broken down into three major categories, which are fee-simple acquisition, less-than-fee acquisition, and zoning techniques. For a more indepth explanation of these techniques, refer to Preserving Open Space in Rural and Suburban Communities, compiled by the Center for Rural Massachusetts at the University of Massachusetts, Amherst. Team seven recommends that the town of Uxbridge implement mostly those creative zoning techniques such as a transfer of development rights and overlay districts for a cost-effective approach to preserving rural character while still initiating economic growth.

Fee-Simple Acquisition:

The state of Massachusetts helps towns finance conservation projects through a self-help program. This type of state aid provides grants for up to 80% of the acquisition costs. These acquisition lands result in permanent protection of the land and the public is in control of the land. Two disadvantages to this approach are the expense incured and the future management. The fee-simple acquisition is the most expensive technique in order to preserve undeveloped land, after fee-acquisition a new owner of conservation land would be responsible for management and upkeep of the land which may involve a significant amount of time and money.

1.) Department of Environmental Management (DEM): This agency has funds for the acquisition of state conservation and recreation areas. For example beaches, riverfronts, long distance trails, and historic sites can be acquisitioned through this agency.

Less-than-Fee Acquisition:

Less-than-fee acquisition is limited to only a piece of land, generally in the form of development rights, scenic easements or rights of ways. The cost for this type of acquisition is less than that of the fee-simple acquisition with the cost differential depending on the rights being acquire and the location and developability of the land. Some drawbacks to this approach are the potential for future confusion between owners and residual interests, and the lack of a provision for public access to many properties.

1) Agricultural Preservation Restriction (APR) Program: This program allows the farmers to sell their development rights to the Massachusetts Department of Food and Agriculture(DFA), often providing the farmer the capacity to continue farming operations.

Tax Classification: Chapters 61 and 61A:

Chapters 61 and 61A of the general laws allows for the valuation of forest and agricultural land based on it's productivity as resource land, not as it's development potential. This provision allows the owners of these farms and forests to avoid huge property taxes.

Conservation Land Trusts:

Land trusts are private, non-profit organizations dedicated to the preservation of open space or resource land. Land trusts can preserve space by several techniques; gifts from private land owners, purchase through an organized fund raiser campaign, pass "through" projects which hold the land until state or local money can be acquired, and limited or partial development.

Land Banking:

Land banking is used for growing communities and regions to acquire and hold land for a variety of purposes in anticipation of metropolitan development.

Alternatives to Traditional Zoning:

These techniques allow the town to preserve significant undeveloped land so as to retain rural quality while remaining inexpensive. A few major alternatives to traditional zoning techniques are discussed below:

1) Cluster: The protection of open space may be achieved through the clustering of development on a portion of the site, allowing the remaining portion to be open land.

2) Overlay Districts: These districts are designed to protect important watershed or groundwater recharge areas. Overlay districts provide an overlay of additional safeguards such as reduced density and limitations on the use of impervious surfaces or hazardous materials for development on sensitive areas.

3) Site Plan Review: This technique is used to require screening or buffering of new development thus providing the appearance of open space.

4) Transfer of Development Rights (TDR): TDR allows for the transfer of development rights from one parcel to another to achieve open space preservation objectives.

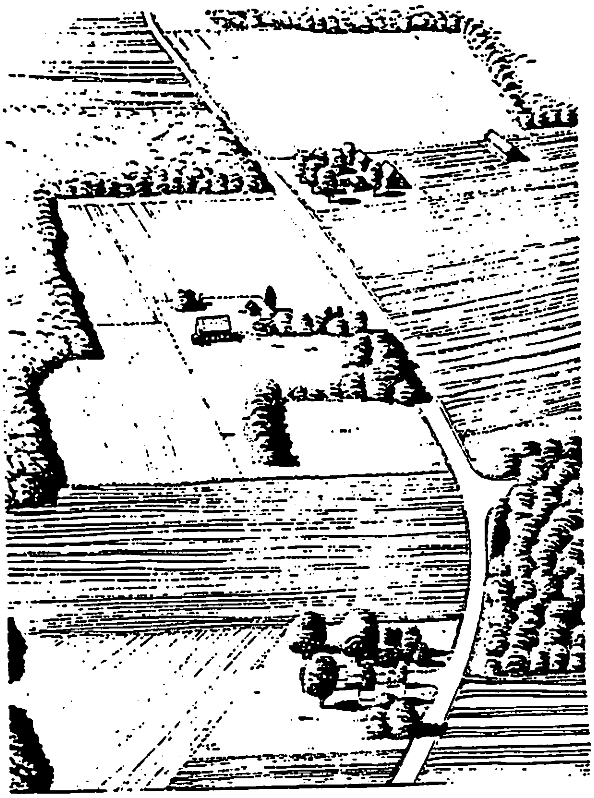
D) DESIGN DEVICES AND ALTERNATIVES

The devices shown here have been developed, mostly by landscape architects during the recent decades. The publication, Dealing with Change in the Connecticut River Valley: A Design Manual for Conservation and Development, compiled by the Center for Rural Massachusetts, has summarized these devices most effectively of the publication entrees.(Yaro, 1988, p.11)

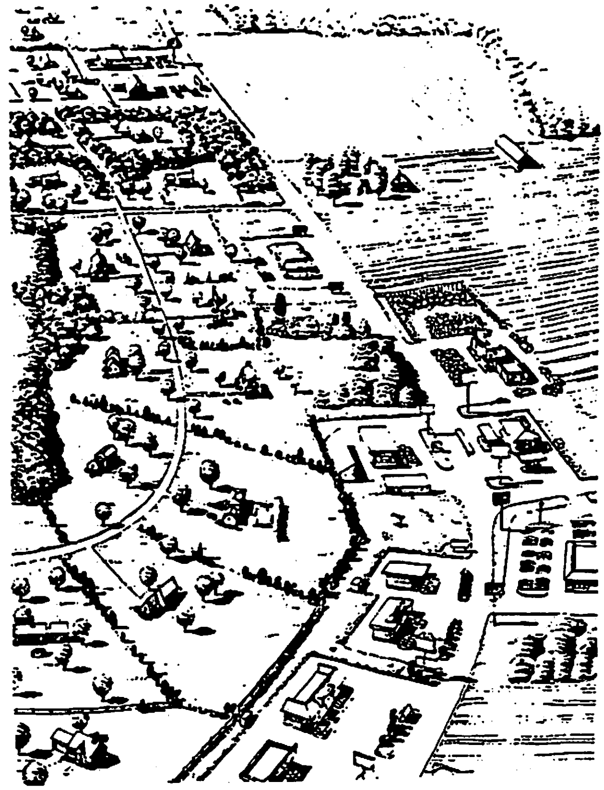
Site One: Rogaleski Farm(see p.26- 37)

Existing Conditions: 180 acres, landuse; cropland, state highway,landcover; field,forest, utilities; town water and sewer, zoning; highway commercial /large lot residential.(Fig. 7-2A)

Conventional Development Scenario: residential lot sizes of 1 acre with 100' road frontage, new residential subdivision on farmland with 30' paved roadways and overhead utilities. Strip commercial development along state highway with illuminated signs,parking lots and other roadside clutter resulting in total destruction of farmland, rural character and visual quality.(Fig. 7-2B)



A



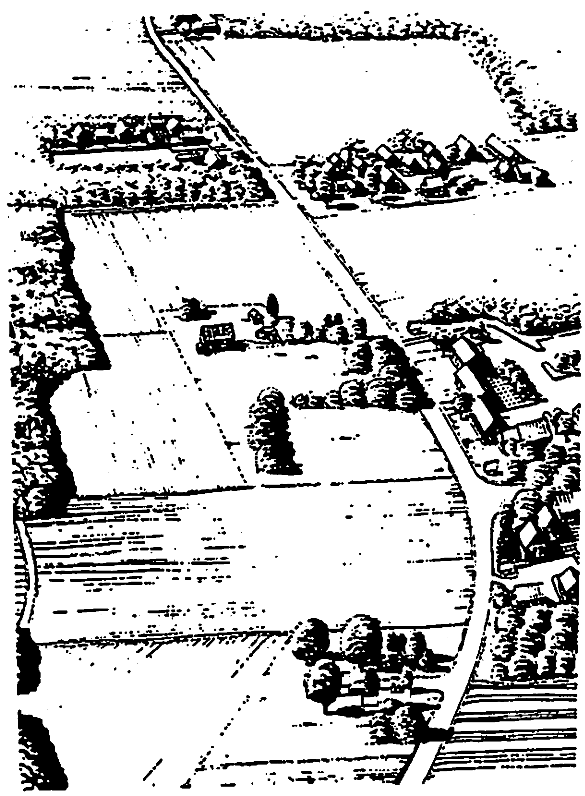
B

Fig. 7-2:

A. The Rogaleski Farm before development, this land is zoned highway commercial and large lot residential.

B. The Rogaleski Farm after conventional development, with 30 foot wide paved road and commercial strip development

C. After creative development, the Rogaleski Farm would cluster development in the woods.



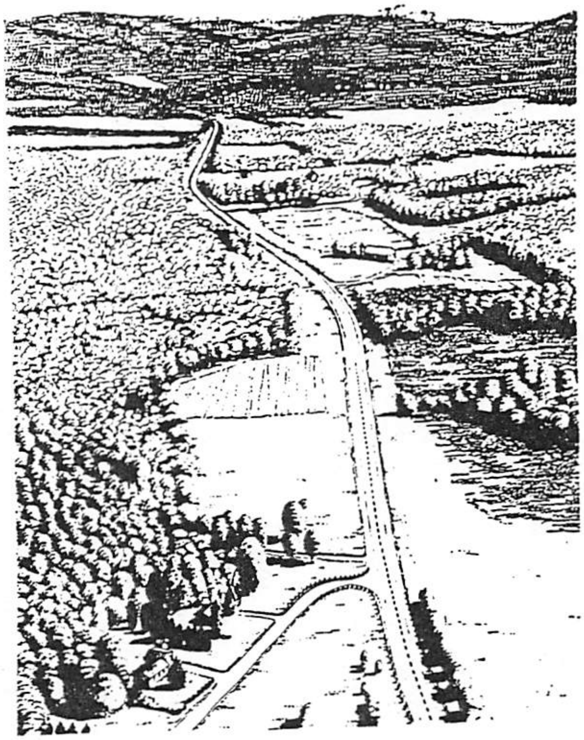
C.

Creative Development Scenario: commercial development clustered in woods and at major intersections, signage and lighting controls, underground utilities, parking and storage located behind buildings. Residential lot sizes varying from 10,000 s.f. to 20,000 s.f.,elderly and affordable housing included in residential zone, new residences reflecting vernacular architecture, moderate road widths avoiding farmland and fitting to the topography, development rights sold to Massachusetts Department of Food and Agricultural, fee title to farmland sold at reduced cost to nearby farmer who continues to farm the land.(Fig. 7-2C)

Site Two : Megamall on State Route 12(see p.60-69)

Existing Conditions: landuse; dairyfarm, scattered residential, landcover; field,forest and wetland, utilities; town water and sewer, zoning; highway commercial/industrial. Former farm on major state highway owned by reality trust, prime scenic farmland zoned for roadside strip development, no zoning controls on parking, signage, lighting or architecture, rising development pressure make large scale commercial development imminent. (Fig. 7-3A)

Conventional Development Scenario: regional shopping mall proposed for both sides of route 12, block-like buildings set in uninterrupted areas of asphalt parking, four 200s.f. illuminated plastic signs located along highway, fields destroyed, wetlands partially filled, typical self-service gas station/convenience store located adjacent to mall. (Fig. 7-3B)



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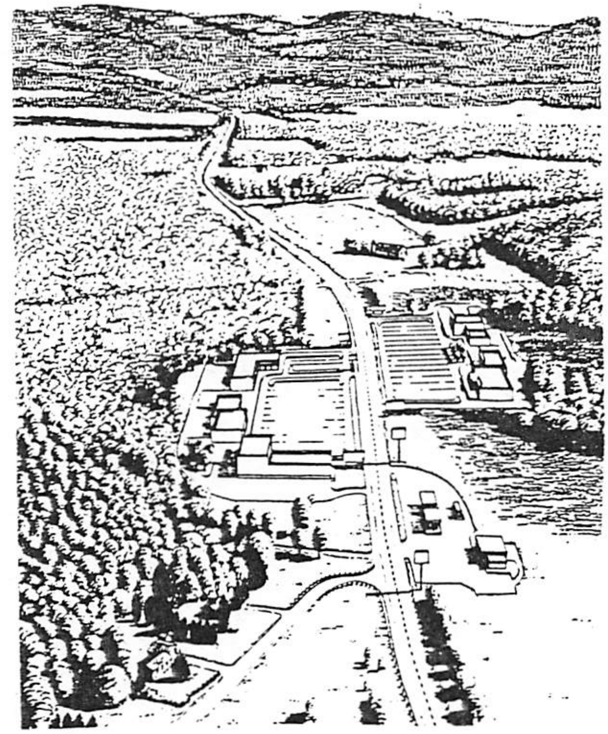


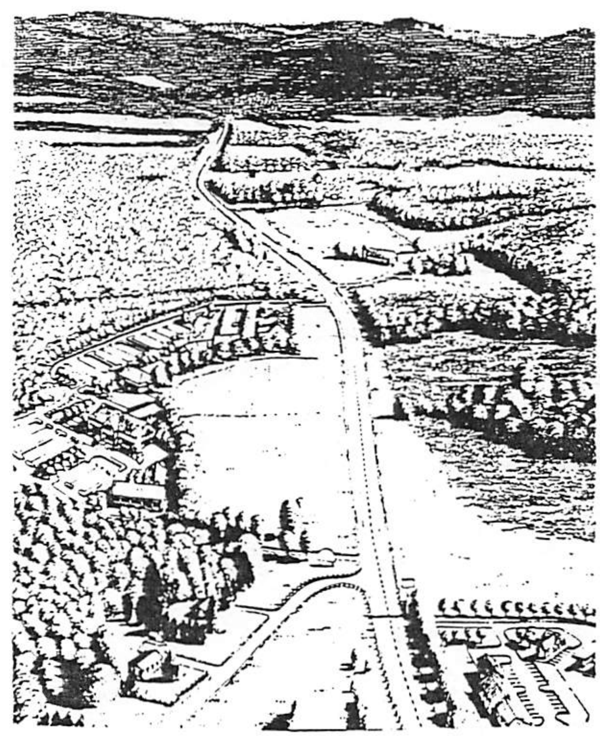
B

FIG. 7-3:

A. The Megamall on state route 12 is currently zoned commercial/industry.

B. The Megamall under conventional development. The rural quality is lost within the large amount of parking lots.

C. With creative development, such as Planned Unit Development, the mall buildings would be located in the woods at the edge of the edge.



C

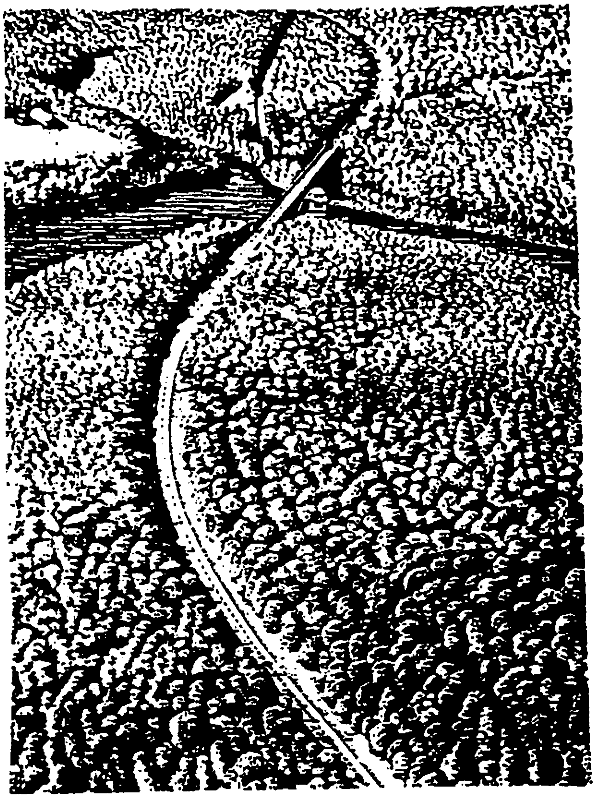
Creative Development Scenario: town enacts "Planned Unit Development" by-law, including site plan review, mall buildings located in woods at edge of field, parking screened in rear, signage controls reduce size and visual impact of proposed signs, proposed lights are shielded, color-corrected metal halide, architecture of mall and gas station blends in with local.character,fields,wetlands, and scenic views are preserved.(Fig. 7-3C)

Site Three: Foster Simmons' Golden Goose(see p.92-103)

Existing Conditions: landuse; forestry, major state highway, landcover; forest, road, river, utilities; town sewer, water available, zoning; highway commercial. (Fig. 7-4A)

Conventional Development Scenario: commercial frontage lots sold for roadside strip development, multi-family condos sited on bluff overlooking river, banks of gorge clearcut to provide views for condos, poorly sited and designed roadside tourist development destroys tourist potential of area, numerous curb cuts to new development creates a highway safety hazard. (Fig. 7-4B)

Creative Development Scenario: tourist commercial node located adjacent to highway, parking screened in rear, attractive architecture forms strong edge along road, a second commercial node set back in woods around central open space, reduced number of curb cuts, clear signage improve safety, over 3/4 of roadside woodland preserved by clustering commercial development, multi-family condos clustered away from sensitive gorge area around central common. (Fig. 7-4C)



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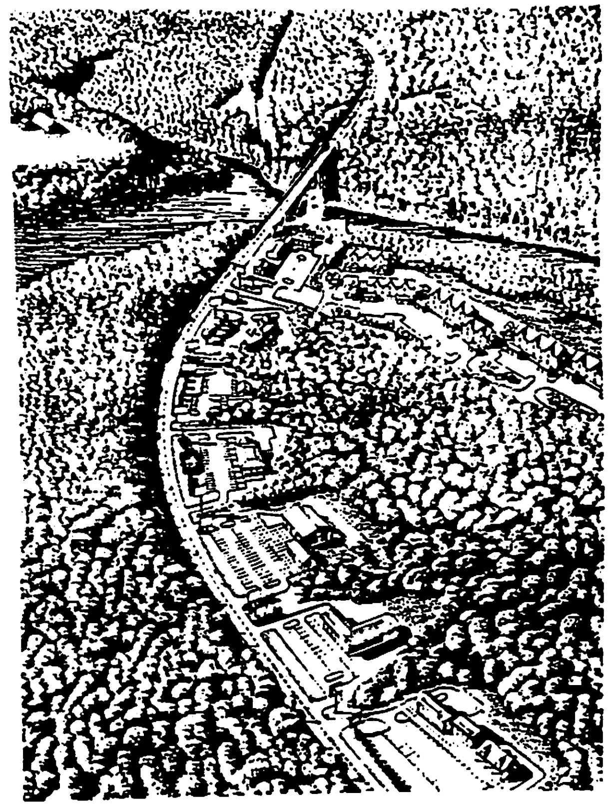
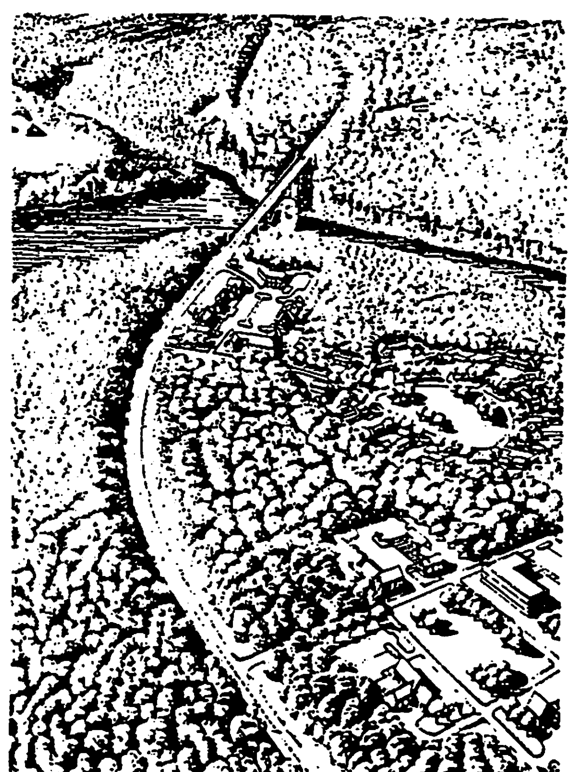


B

FIG. 7-4:
A. Foster Simons' Golden Goose is located along a major state highway and is currently zoned highway commercial and multi-family residential.
B. Under current zoning the land would be converted into a commercial strio along the state highway.
C. After creative development, the commercial and residential development are tucked within the woods.



C

PHASE 1: BUILD OUT

SIGNIFICANCE

The purpose of this phase is to provide the town of Uxbridge with the worst case scenario. This alternative assumes that present growth policies will continue to be used to influence development. It also assumes that the community will eventually be fully developed within assumed guidelines. Using the powerful modeling capabilities of G.I.S., it will be possible to produce a relatively accurate picture of a build-out scenario.

The result of the build-out scenario will be the production of a number of useful statistical data. We will be able to estimate the quantity of development (# of lots, total population, additional water use etc.) as well as the density of the type of development (residential, commercial, industrial) that is most likely to occur under the present zoning regulations.

ADAPTED APPROACH

The following is a step by step procedure as to how team 7 applied and concluded their findings in the build-out for the town of Uxbridge (Fig. 7-5).

<u>Step one</u> is to eliminate landuse that has already been developed. These landuses are residential, commercial, industrial, institutional, and roads (Table 1).

<u>Step two</u> is to eliminate land protected from development. These landuses are public open space, semi-public open spaces, land conservation trusts, and recreation (Table 2).

<u>Step Three</u> is exclude all other areas that are undevelopable due to major constraints. These landuses are waterbodies and wetlands (Table 3).

CLUB LOC
MAINE
Portland, ME
513-515 Warren Ave
MASSACHUSETTS
Medford, MA
909 The Fellsway
Weymouth, MA
Stoughton
901 Technolo
NEW HA
Salem
70 Cluff
NEW

…our is to combine all of the above into … category to produce a composite map …ving all undevelopable land (Table 4).

Step Five is to produce a map showing all developable land minus the areas of protection, constraints, and what has already been developed (Table 5).

Step Six is the next step towards achieving the build-out. This step is to overlay the current zoning coverage onto the developable land. This will reveal what zone every piece of developable land falls under (Table 6).

Step Seven will take the total area of developable land per zone and subtract 15%, and respectively necessary for road development. The remaining 85% is then divided by the minimum lot size in that zone. The quotient is the number of units that can be built until complete saturation occurs. This process is repeated until the total area of developable land in Uxbridge is built-out (Table 7).

FINDINGS

Uxbridge land area is approximately 20,000 acres with a population of about 10,500. The town's current developed land to open space ratio is 1:7, which means that for every acre of developed land there are seven acres of undeveloped land.

Due to existing development and other major constraints about 35% of the town is unavailable for future development leaving 65% or 12,542.35 acres available for development (Table 5). Most of this land area is zoned for residential use with housing units in Res.A, one unit per acre in Res.B & C and one unit per two acre in agricultural area.(Table 7). According to the build-out scenario 7139.41 additional housing units

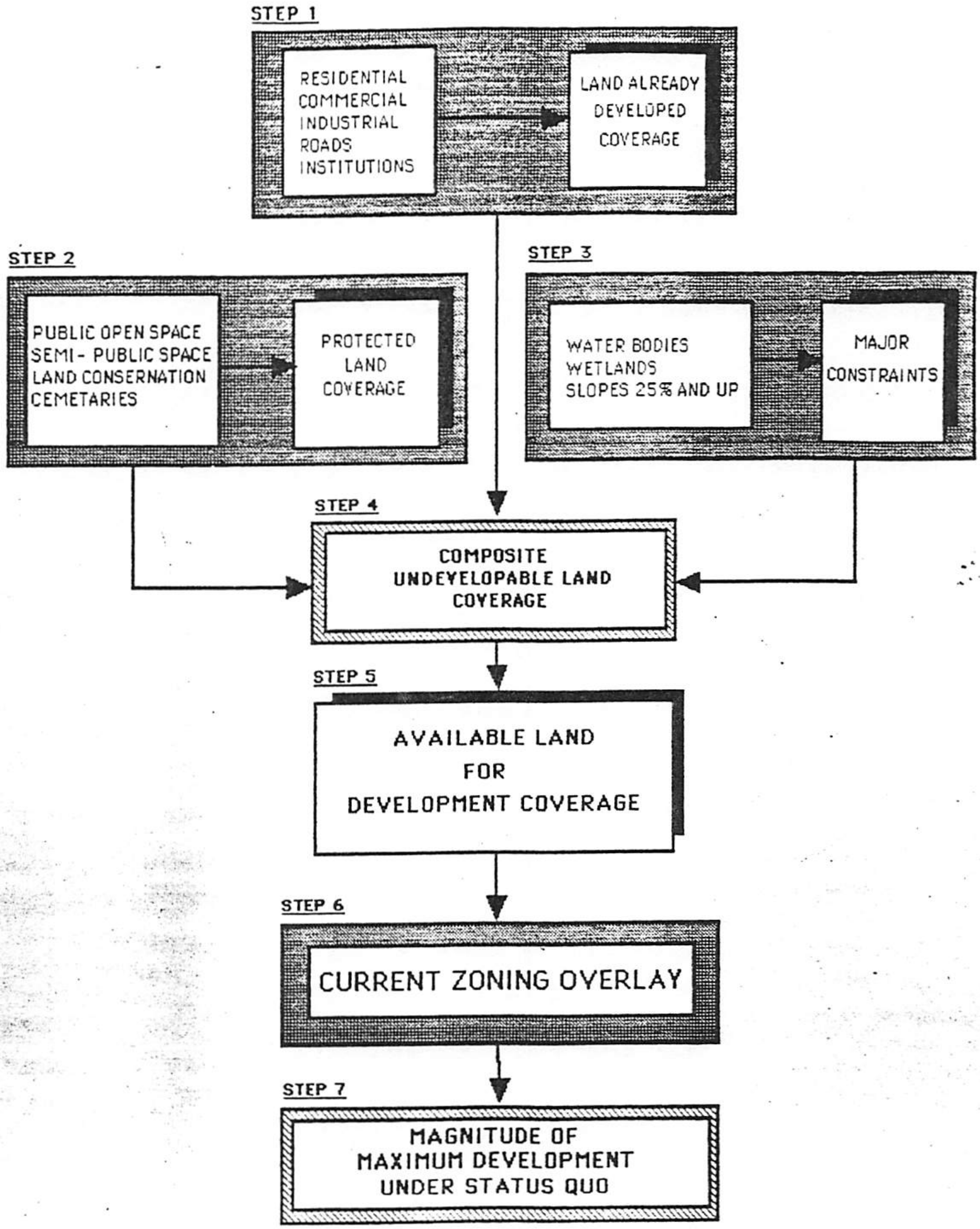


FIG 7-5: The procedural model for the Build OUt phase, which takes the current zoning of Uxbridge and shows its effect on the towns current character.

TABLE #1

LAND USE (ZONE)	TOATAL ACRES	% OF UXBRIDGE
RESIDENTIAL	1823.9	9.51
COMMERCIAL	123.4	0.64
INDUSTRIAL	237.2	1.24
ROADS	578.62	3.11
TOTALS	2763.12	14.5

TABLE #1: CURRENT DEVELOPED LAND IN UXBRIDGE ACCORDING TO THE 1985 LAND USE

TABLE #2

LAND USE	TOATAL ACRES	% OF UXBRIDGE
PUBLIC OPEN SPACE		
CEMENTARIES		
TOTALS	1111.19	5.8

TABLE #2: CURRENT PROTECTED LANDS IN UXBRIDGE.

TABLE #3

LAND USE	TOATAL ACRES	% OF UXBRIDGE
WATER BODIES	346.1	1.8
WETLANDS	2076.1	10.9
SLOPES 25% +		
TOTALS	2672.71	14

TABLE #3: CURRENT LAND UNDEVELOPABLE DUE TO MAJOR CONSTRAINTS IN UXBRIDGE

TABLE #4

DEVELOPMENT RESTRICITON TYPE	TOTAL ACRES	% OF UXBRIDGE
DEVELOPED LAND	2763.12	14.5
PROTECTED LAND	1111.19	5.8
MAJOR CONSTRAINTS	2672.71	14
TOTALS	6547.02	34.3

TABLE #4: COMPOSITE TABLE(TABLES 1,2,3) OF TOTAL LAND THAT IS UNDEVELOPAE

TABLE #5

TOTAL ACRES OF UXBRIDGE	19089.369
(-) DEVELOPMENT RESTRICITIONS	6547.02
TOATAL ACRES TO BE DEVELOPED	12542.34

TABLE #5: TOTAL LAND AVAILABLE FOR DEVELOPMENT.

TABLE #6

LAND USE (ZONE)	AVALIABLE LAND-USE ACRES
AGRICULTURE (1UNIT/2ACRES)	7743.155
RESIDENTIAL A (1 UNIT/20000 SF)	318.705
RESIDENTIAL B (1 UNIT/ I ACRE)	443.145
RESIDENTIAL C (1 UNIT/ 1 ACRE)	3391.798
INDUSTRIAL (1 UNIT/ 30,000 SF)	537.355
COMMERCIAL (1 UINT/ 15,000 SF)	108.196

TABLE #6: TOTAL LAND AVAILABLE FOR DEVELOPMENT PER ZONE.

TABLE #7A

LAND USE TYPE	ACRES AVAL.	ROADS	TOTAL ACRES	(X) MIN. LOT SIZE	(=) # OF UNITS	2.5 PEOPLE
AGRICULTURE	7743.155	1161.47	6581.69	1 UNIT/ 2 ACRES	3290.84	8227.10625
RESIDENTIAL A	318.705	47.81	270.90	1 UNIT/ 20,000 SF	588.90	1472.25543
RESIDENTIAL B C	3834.943	575.24	3259.70	1 UNIT/ I ACRE	3259.70	8149.2575
INDUSTRIAL	537.555	80.6	456.95	1 UNIT/ 30,000 SF	662.25	
COMMERCIAL	108.196	16.22	91.98	1 UNIT/ 15,000 SF	270.52	

ADDITIONAL POPULATION	17848.6192
OLD POPULATION	10500
NEW POPULATION	**28348.619**

TABLE #7A: LOOKING AT THE POPULATION OF UXBRIDGE UNDER CURRENT ZONING AND ASSUMMING THAT THERE WILL BE 2.4 PEOPLE/ NEW HOUSING UNIT.

TABLE #7B

LAND USE TYPE	ACRES AVAL.	ROADS	TOTAL ACRES	(X) MIN. LOT SIZE	(=) # OF UNITS	4.0 PEOPLE
AGRICULTURE	7743.155	1161.47	6581.69	1 UNIT/ 2 ACRES	3290.84	13163.37
RESIDENTIAL A	318.705	47.81	270.90	1 UNIT/ 20,000 SF	588.90	2355.6087
RESIDENTIAL B C	3834.943	575.24	3259.70	1 UNIT/ I ACRE	3259.70	13038.812
INDUSTRIAL	537.555	80.6	456.95	1 UNIT/ 30,000 SF	662.25	
COMMERCIAL	108.196	16.22	91.98	1 UNIT/ 15,000 SF	270.52	

ADDITIONAL POPULATION	28557.7907
OLD POPULATION	10500
NEW POPULATION	**39057.791**

TABLE #7A B: LOOKING AT THE POPULATION OF UXBRIDGE UNDER CURRENT ZONING AND ASSUMMING THAT THERE WILL BE (2.4) 4.0 PEOPLE/ NEW HOUSING UNIT.

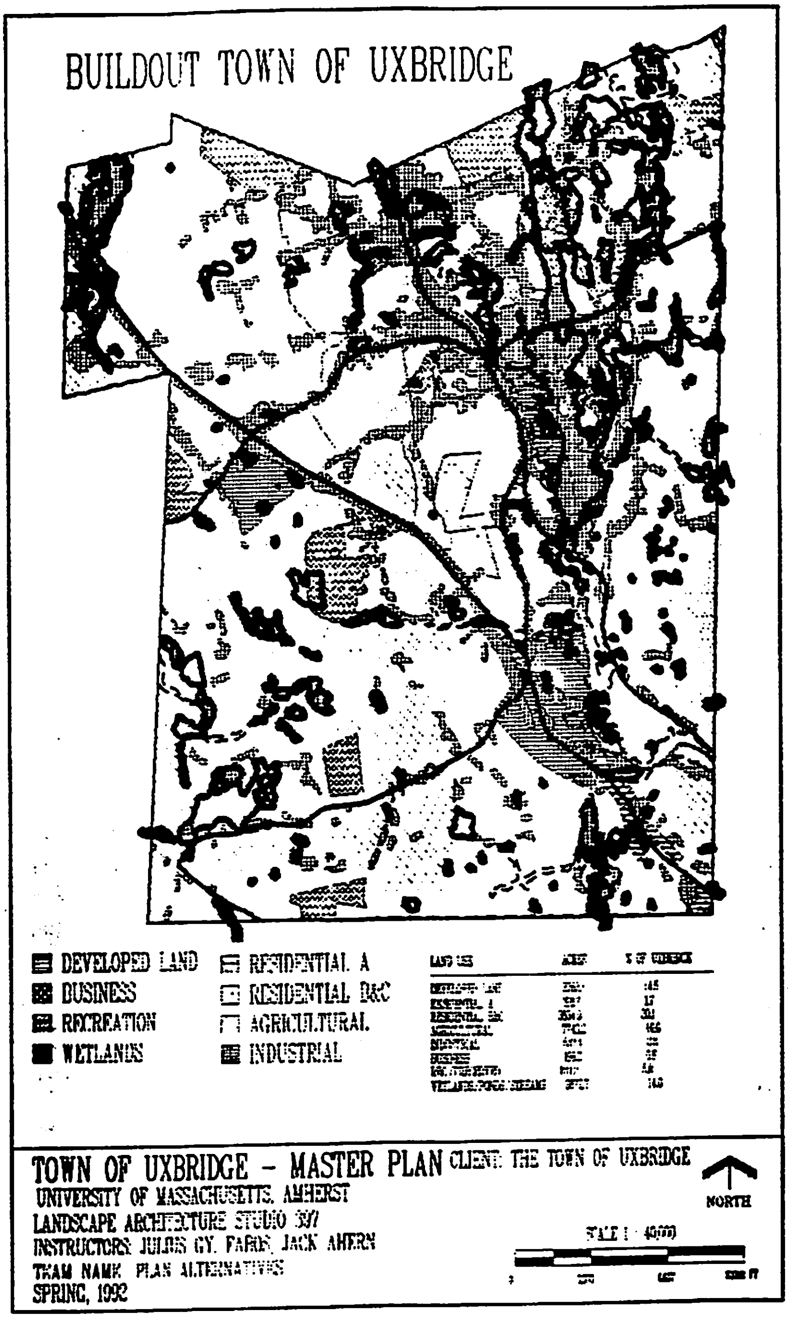


Fig. 7-6: The map of the Build Out of the town of Uxbridge under current zoning.

would be added to Uxbridge's current community, by multiplying the number of units times people per unit the additional residents may be computed. Using 2.5 people per unit the additional population created by these housing units would be approximately 18,000 people. Using 4.0 people per unit the additional population created by these housing units would be approximately 30,000 people.(Table 7).

If we look at the current numbers for each type of development, we see that four times as many housing units have occured, three times as many industrial lots, and twice as many commercial buildings could be developed. Estimating that this density were to occur, the town would have to produce an estimated one hundred gallons per person per day and would have to have approximately seventy-eight thousand tons of sand and gravel per year at hand (Dines, 1991). Other natural resources would also be significantly be impaired. Wildlife corridors would diminish. Additional police and fire protection, additional schools would have to be added, shopping facilities and other services would be needed(Fig. 7-6)

From this projection into the future under the status-quo, we can identify these significant issues and plan accordingly. Ironically, Uxbridge has the opportunity to plan for this new growth and to respond with a growth management plan that will protect their critical and natural resource and guide development where it is best suited. The town has ample resources to accommodate all it's needs, while protecting all critical and valuable resources in an equitable manner.

PHASE II PLAN ALTERNATIVES

SIGNIFICANCE

Landscape Architects, Planners and other professionals claim up to one third of the total landscape should be protected. Uxbridge has an excellent opportunity to direct its future landuse to adhere to this claim and developed a well balanced community.

The significance of this phase is to incorporate the specific criteria assessed in teams two through six and to propose an optimum solution for the future landuse of the town.

ADAPTED APPROACH

Team sevens approach began by creating a composite assessment of all he critical and natural resources and for the development suitabilities of the town (Fig 7-7). The result of this composite assessment show areas that are overlaying with each other or have co-occurrances. These co-occurrances can be either be found to be conflicting or compatible. For example, if a scenic promontory lies within a development suitability area then there is a conflict as to whether that area should be developed or not. On the other hand, if that same scenic promontory is located in an area that is not suitable for development then there is not a conflict and there is a stronger argument for protecting this area.

At this point of the study a matrix table was developed to simplify the composite assessment and to produce objective alternatives (Fig 7-8). The matrix table is structured in a way that all the resources, hazards and suitabilities are represented with their significant values. There is a possibility of fifty four different suitability:objective combinations that would result in different alternatives. Different alternatives would result depending on the objective bias. For example, if a landscape sensitivity is the objective, than all of the significant values would be weighted heavily to preserve them. If a residential development is the objective than only those values that would support development would be included in the alternative.

With each alternative, a resulting map would be produced identifying areas that are best suited for development and which areas are better to protect. The following alternatives where produced by team seven.

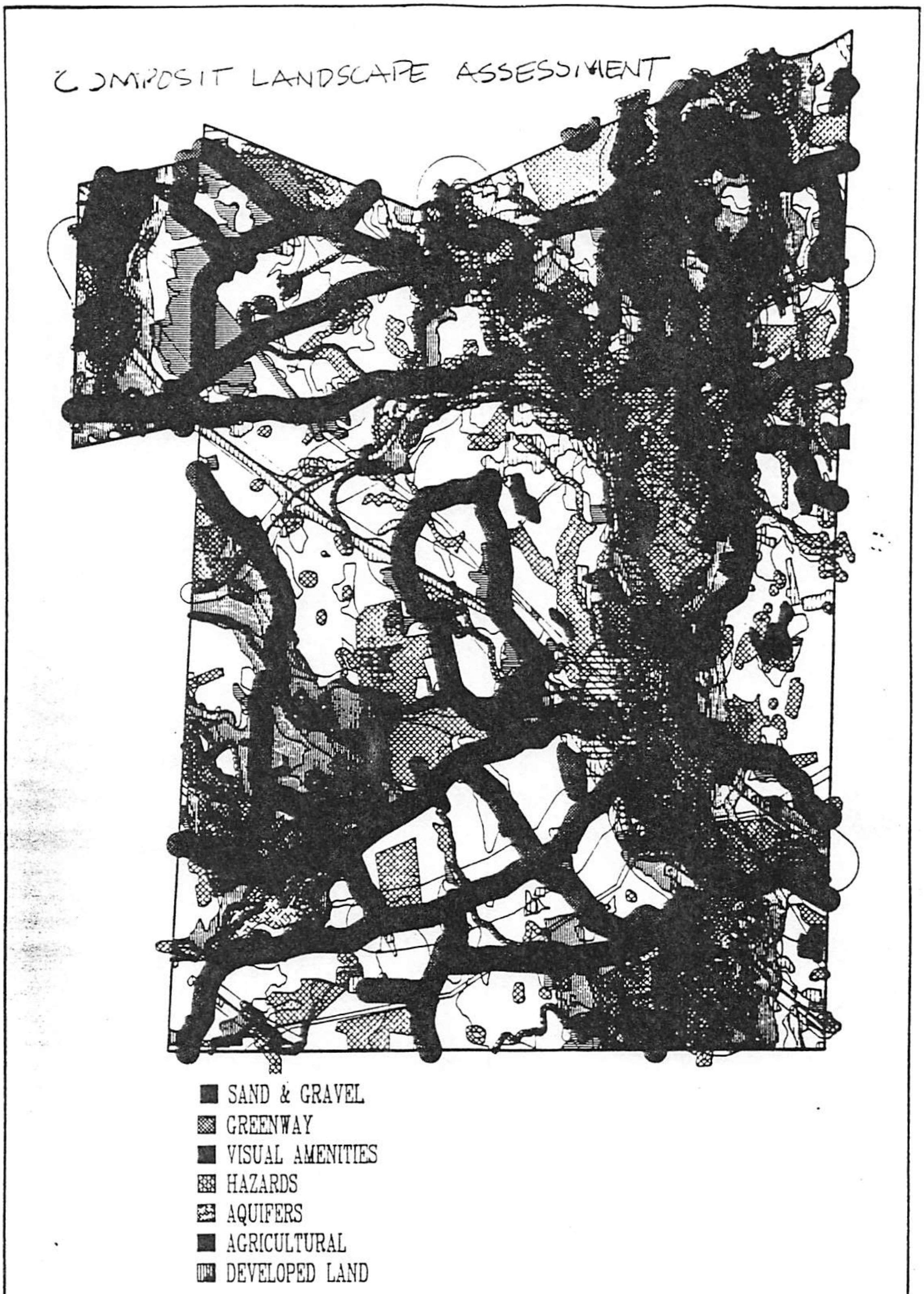


Fig. 7-7 Composite Assessment Map showing all significant resources and development suitabilities of Uxbridge.

ASSESSMENT OF RESOURCES	APROACH #1 VALUE OF SIGNICANCE			APROACH #2 VALUE OF SIGNICANCE		APROACH #3 VALUE OF SIGNICANCE
PROTECTION TYPE	MS	VS	S	MS	VS	MS
GREENWAY						
ECOLOGICAL PRESER.						
CULTURAL/HISTORIC						
RECREATION						
CRITICAL/SPECIAL						
AGRI. LANDS						
AQUIFERS						
SAND AND GRAVEL						
HAZARDS						
FLOOD						
NOISE AND AIR						
VISUAL SUITABILITY						
SCENIC ROADS						
SCENIC VISTAS						
DEVELOP. TYPE	MS	VS	S	MS	VS	MS
DEV. SUITABILITY						
RESIDENTIAL						
PHYSICAL						
TOPO CLIMATE						
VISUAL						
INDUSTRIAL						

Fig. 7-8 The procedure model for phase II, showing the significant values of each criteria and the plan alternatives produced by team VII.

Alternative One

As Landscape Architects with a strong land ethnic the first alternative began by preserving all of the significant areas from each teams assessment (Fig. 7-9). This alternative became the Landscape Sensitivity map of Uxbridge that indicated that all of Uxbridge minus about 10% was considered to be a significant resource.
A town showing clearly that it has been blessed by GOD and another reason as to why a good master plan should be developed.

In addition to the Landscape Architect's and Planners view, half of the people surveyed representing the town's master plan committees, supported this view as well (Survey 1992, Town of Uxbridge, appendix ??). The outcome of this alternative if implemented, would be, that over half of the town would be protected from development. Certainly the amount of preservation and protection eliminates serious consideration for this alternative.

Alternative Two

But also knowing that a town has to grow in order for it to be prosperous the method of generating the second and third alternative was to moderate the significant values to favor more development. By this method, areas for protection are being reduced and areas of development are being increased.
In the second alternative, all significant areas have been eliminated from protection and only the most and highly significant areas are being valued (Fig. 7-10). The results from this alternative concluded that around 45% of the total town would be protected from development.

Alternative Three

Alternative three represents the other half of the view surveyed from the town master plan committee. Alternative three further reduced the protection of the towns resources to only the most significant areas and all of the protected scenic roads (Fig. 7-11). It was concluded that by protecting the quality of these scenic roads it would not reduce the amount of development. Instead, the same amount of development currently allowed would be constructed without being impertinent to the existing scenic qualities. This can be implemented by locating development appropriately in wooded areas, by implementing development regulations and by implementing sufficient road setbacks.

The result of alternative three would protect around one third of the total land in the town . These significant areas identified constitutes the professionals norm to

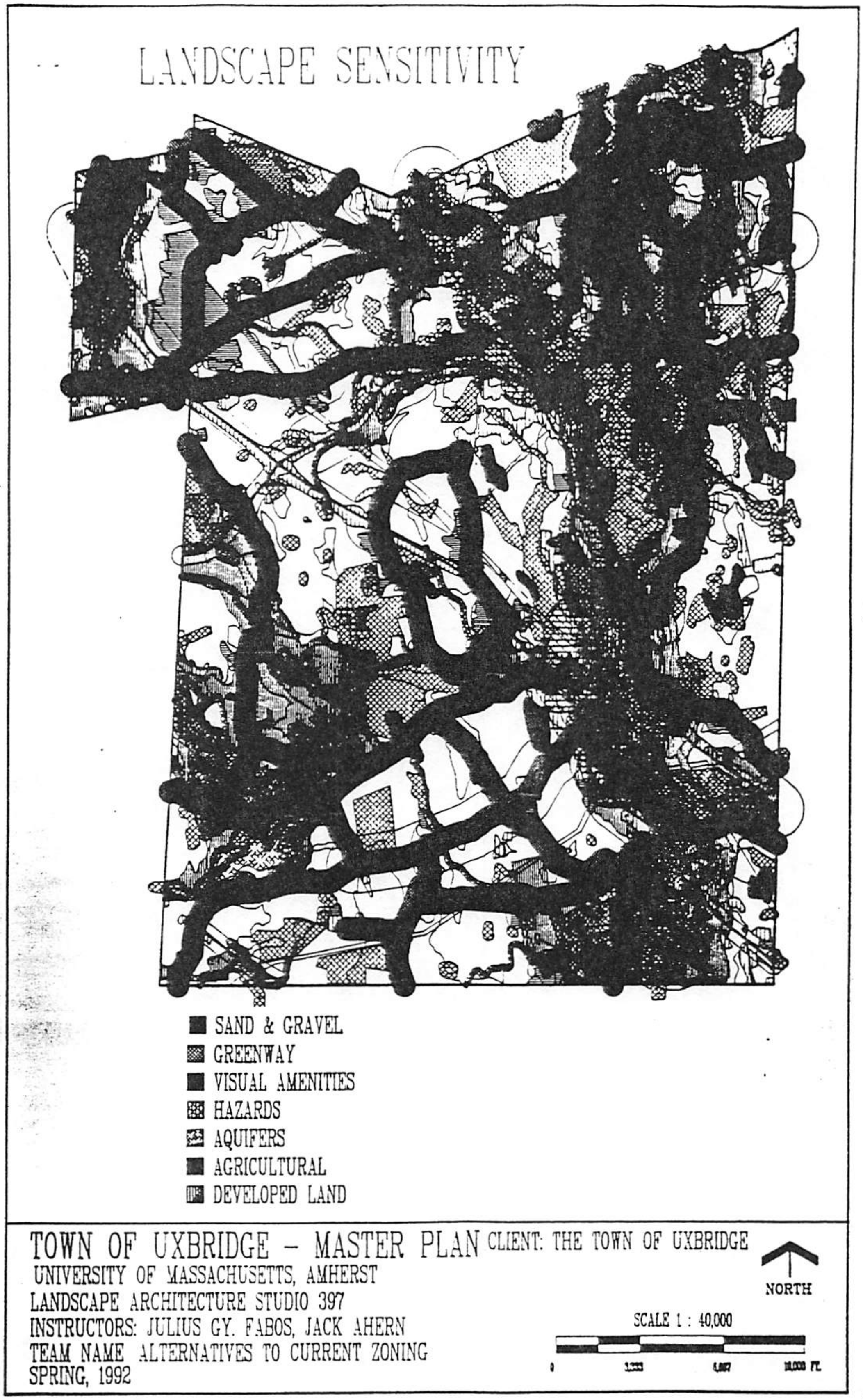


Fig. 7-9 Map showing all significant natural and critical resources to produce a "Landscape Sensitivity" map of Uxbridge estimating over one half of the town would be protected from development.

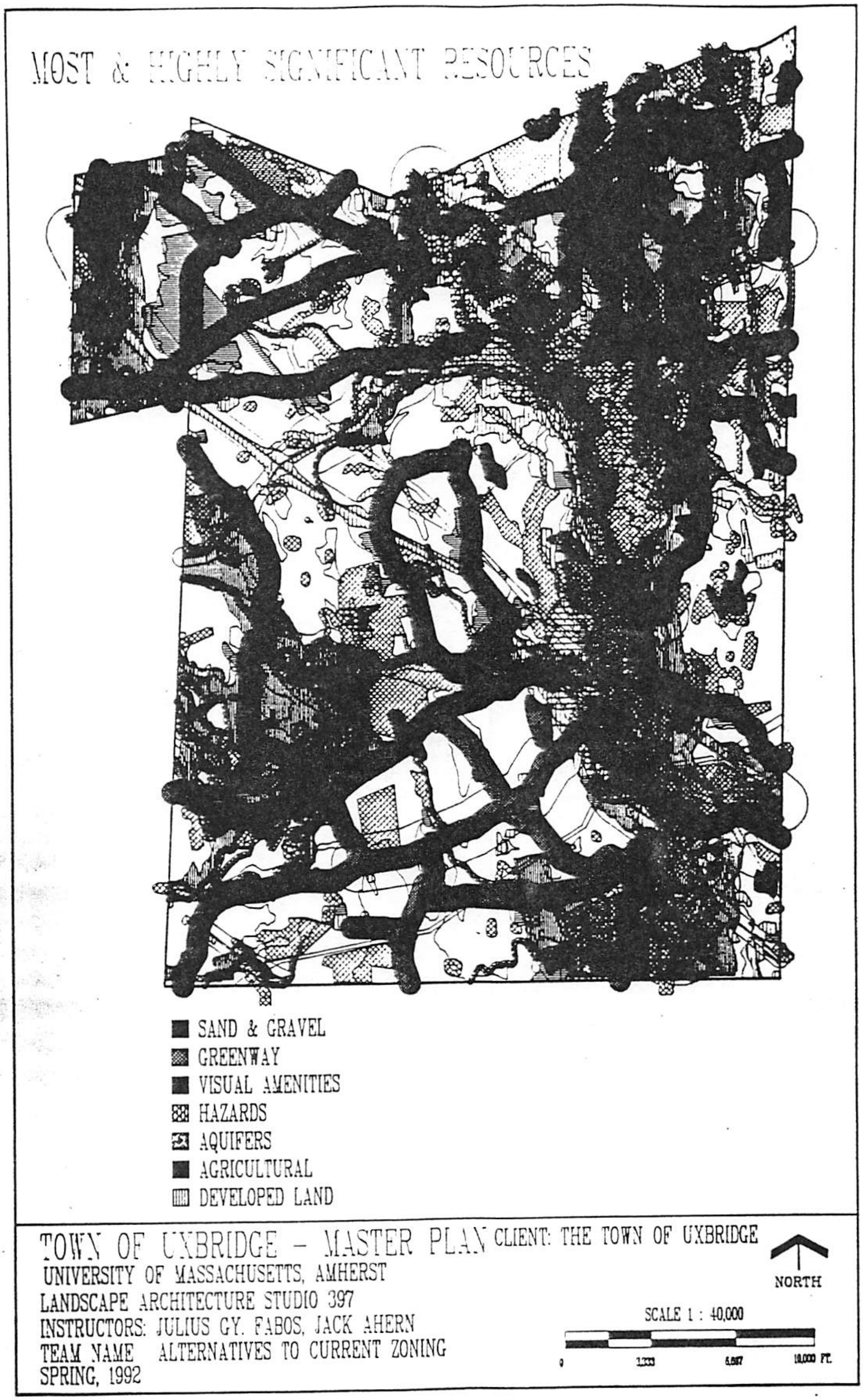


Fig. 7-10 Map showing most and highly significant areas resulting in around 45% of total land would be protected from development.

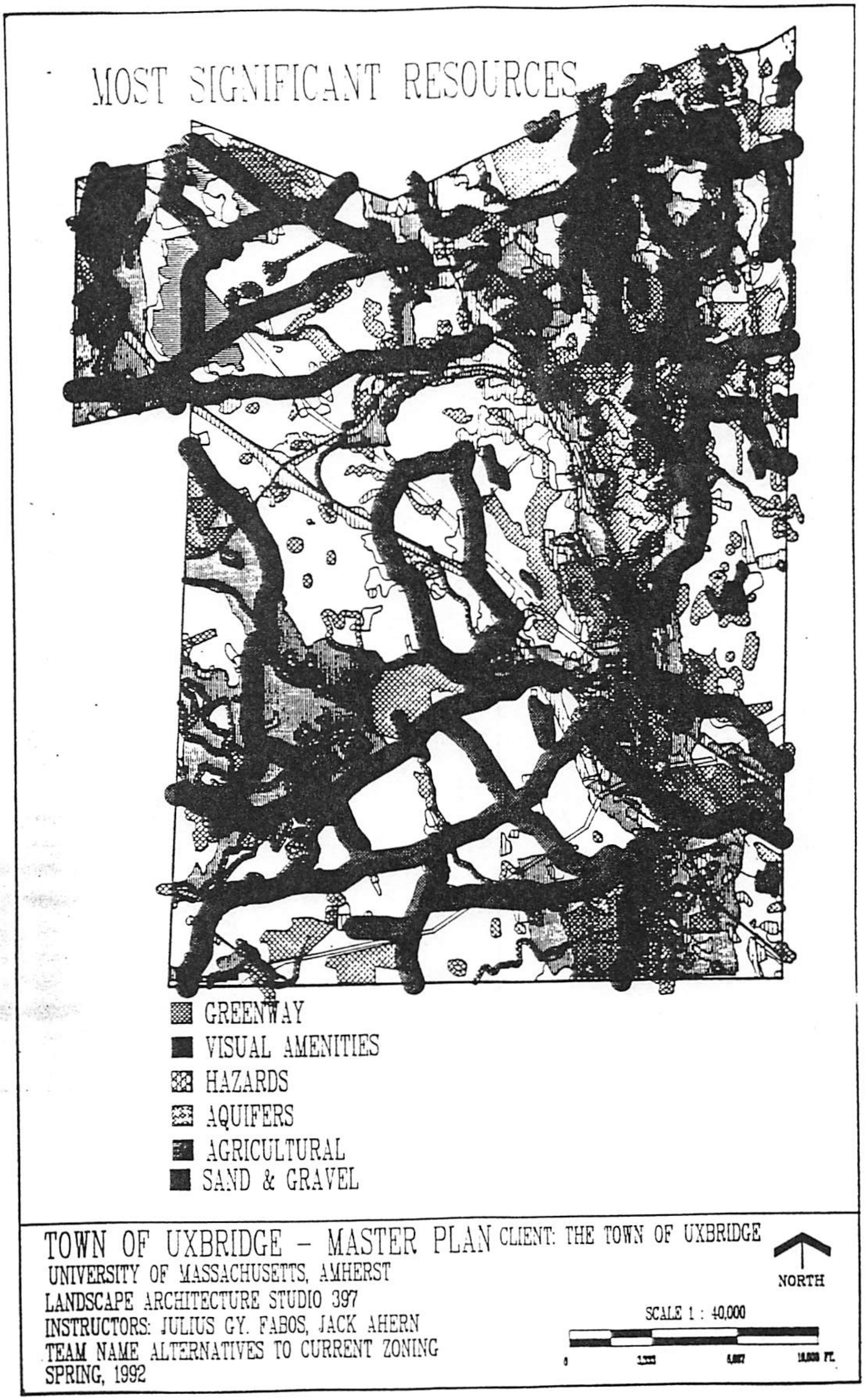


Fig. 7-11 Map showing only the most significant areas resulting in around 1/3 of total land to be protected and included in a "Greenway Corridor".

protect one third of the total landscape from development.
This norm, which is found in alternative three, is especially appropriate to the town of Uxbridge as it achieves the following;

1) The protection of a most important greenway corridor
2) The protection of the towns most essential or critical resource that of water
3) It will avoid development in all floodplain areas, viable wetland ecosystem areas and areas with steep slopes over 15%
4) It will provide ample recreational sources for the town
5) It will protect the significant historical resources which is a major concern of the B.R.V.N.H.C.

In summary, this alternative would protect all the essential areas from development, would maintain the existing landscape quality and would provide the same amount or greater development that is permitted by the current zoning. This is the basis of team VII's recommendation for the "Proposed Greenway Zoning Alternative".

Proposed Greenway Zoning Alternatives

By identifying areas best suited for development and areas needed for protection, the next step was to establish appropriate land use zones (Fig. 7-12). Four different residential zones were established with different densities. Three different industrial/commercial zones were established and 35% of the total landscape was preserved under a greenway protection zone.

Residential Zones

Following policy one, the highest residential density falls with in the village center zone (Fig. 7-13). This zone provides a density of two units per acre. The zoning map also calls for a delayed village center zone which co-occurs with sand and gravel deposits. This will allow for sand and gravel excavation to continue and with appropriate development guidelines for future residential landuse which can be developed with minimal impact on the landscape.

A medium residential zone will have a density of one unit per two acres, known as the rural village zone. There are two low density residential zones, one being one unit per three acres known as a rural agricultural zone, and the other being one unit per five acre density, called the greenway residential zone.

The placement of these zones reflects the existing quality of the surrounding landscape of each type of residential zone. For example, the high density residential zone was located on areas highly suitable for development and also near the existing route 146 for easier accessibility. The greenway residential zone compliments the established B.R.V.N.H.C. by providing a low density which will have minimal impact on the current characteristics of the valley.

The proposed Greenway Zoning Policy would establish 51% of Uxbridge as additional residential land use. This constitutes 9800 acres of new development. Under policy one, Uxbridge would add around 9500 units and under policy two the new development would constitute around 7100 units.

Under the current zoning policies, 8000 units could be built under conventional methods. With the Greenway Zoning Policy the same number of units can be obtained with minimal impact to the existing landscape and with a greenway network established.

Through implementation strategies and design devices, areas of development as well as areas of protection can be balanced and protected to further preserve the present character of Uxbridge as well as to make a stronger inner link of the greenway network. The most important aspect of the proposed stratageis and devices are, that this Greenway Zoning Alternative would not cost anything to the town and would not add to the loss of current land owners property values. The transfer development rights (TDR) strategy especially provides owners with equitable development.

Industrial Zones

According to planning norms for a town to be prosperous, 10% of its total land should be reserved for industrial use. It was appropriate that these zones be located on areas suitable for industrial development, be easily accessible along the main inter sections of route 146 and as much as possible within the currently zoned industrial areas. Thus, a new prime industrial/commercial zone is proposed at the current inter section of route 146 and Douglas Road which will produce 4% of the total industrial landuse. The remaining 6% will be delayed industrial zones located along the south exits of route 146 co-occuring with sand and gravel deposits and mostly lie within existing industrial zones.

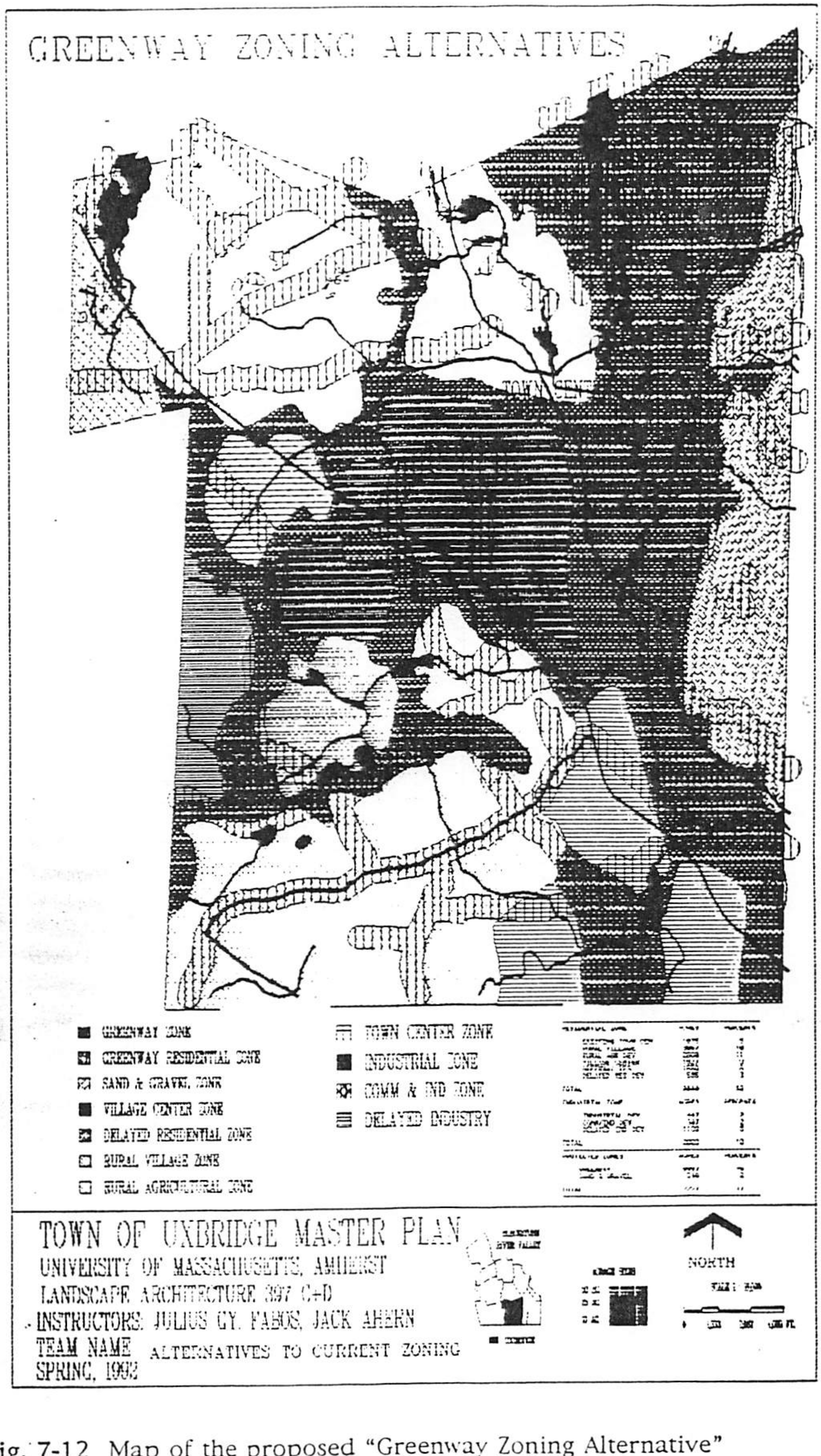


Fig. 7-12 Map of the proposed "Greenway Zoning Alternative" 51% of total land would be in residential landuse zone, 34.8% in a preserved Greenway zone and 10.5% in an industrial landuse zone.

	ACRES	% OF UXBRIDGE	POLICY #1	POLICY #2
VILLAGE ZONE:			3 UNITS/ A	2 UNITS/ A
TUCKER HILL	1299.7	6.8	3899.1	2599.4
LEE VILLAGE	326.8	1.7	980.4	653.6
DELAYED VILLAGE ZONE:			3 UNITS/ A	2 UNITS/ A
LAURAL BROOK	504.7	2.6	1514.1	1009.4
RURAL VILLAGE ZONE:			1/2 UNIT/ A	1/2 UNIT/ A
CHESTNUT HILL	2405.7	12.5	1202.8	1202.8
HAPPY HOLLOW	650.9	3.4	325.5	325.5
RURAL AGRICULTURAL ZONE:			1/3 UNIT/ A	1/3 UNIT/ A
CASTLE HILL	3056.6	15.9	1018.8	1018.8
GREENWAY RESIDENTIAL ZONE:			1/3 UNIT/ A	1/5 UNIT/ A
BLACKSTONE RIDGE	1555.8	8.1	518.6	311.2
RESIDENTIAL TOTALS:	9800.2	51	9459.7	7120.7

GREENWAY:	6686.5	34.8

INDUSTRIAL:		
SCADDEN	447	2.3
DELAYED INDUSTRIAL:		
COLEMAN	525	2.7
HOOD	361	1.9
IRONSTONE	302.9	1.6
COMMERCIAL/ INDUSTRIAL:		
DOUGLAS	387.2	2
INDUSTRIAL TOTALS:	2023.1	10.5

TOWN CENTER:	1074.9	5.6

SAND AND GRAVEL:	542.2	2.8

Fig. 7-13 Proposed landuse zones and their density under the Greenway Zoning Alternative.
Note: Residential zones have two policies, policy two is recommended, however if a higher density is needed policy one may be followed.

Greenway Zone

The last objective was to protect lands from development to be included in the greenway network. With the greenway zoning alternative, 35% of the total land in Uxbridge is under protection and preservation. The heart of the greenway is naturally within the B.V.N.H.C. with linkages provided between the different zones through existing scenic roads and other preserved lands which recreation can be provided in various ways.

Conventional Development vs. Greenway Zoning Alternative

Lets compare the conventional development with the proposed greenway zoning alternatives to the existing landscape of Uxbridge. Under the greenway zoning alternative, the rural quality will have little change, diversity will be provided, critical and natural resources would be protected, hazard areas can be avoided and a greenway network established.

Under conventional development only 2% of the total land would be reserved for industrial use instead of the preferred norm of 10% that would be established under the greenway zoning alternative. The same number of residential units would be permitted, by the protection of visual amenities an approximate real estate increase of 10-15% would occur. The other benefits are as follows (see Fig. 7-14).

	GREENWAY	CONVENTIONAL
NUMBER OF DEVELOPED UNITS	FROM 7100 TO 9500	8000 +/-
INDUSTRIAL AREAS (ACRES)	2023.1	400 +/-
OPEN SPACE	35%	15%
RURAL QUALITY	SAME AS TODAY	WALL TO WALL SUBURBIA
RECREATION OPPORTUNITIES	AMPLE	MINIMAL
DIVERSITY IN HOUSING	AMPLE DIVERSITY	HOMOGENEOUS
CRITICAL RESOURCES	PRESERVED	VULNERABLE
HAZARD POTENTIAL	CAN BE AVOIDED	POTENTIAL INCREASE
REAL ESTATE VALUE	10- 15% INCREASE	CURRENT VALUE

Fig. 7-14 Comparing the proposed Greenway Zoning Alternative to the conventional development.

CONCLUSION

With the completion of route 146 resulting in added growth pressures and with the establishment of the B.R.V.N.H.C. resulting in a possible 1.5 million tourists per year through Uxbridge, a master plan is critically needed to guide the future landuses of development and to preserve Uxbridge's current rural character.

The results of team VII's work, have provided the town of Uxbridge with a greenway zoning alternative. Within this alternative, areas have been identified for residential and industrial development as well as areas of critical and natural resources that need to be protected.

With the proposed greenway zoning alternative, a framework for the future development of a master plan can be established. This study also provides a wealth of information as well as a vision to guide the town of Uxbridge's future.

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