IMPACTS OF URBANIZATION ON ENVIRONMENTAL RESOURCES: A LAND USE PLANNING PERSPECTIVE

by

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ABSTRACT

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The main purpose of this thesis is to (1) study the impacts of urbanization on environmental resources, and (2) propose land use planning strategies to avoid or at least minimize the impacts from future land use planning and decision making process. Urbanization, one of the major drivers of land use change, has profound impacts on environmental resources. It has been revealed that more than one third of the U.S. water resources have already been impaired or polluted, and many species have become endangered or threatened with some already gone extinct and more on line. My analysis of the impact of urbanization on environmental resources in Austin, Texas has found that more than 10 percent of the existing urban developments are in environmentally critical areas.

Since 1950 the demographic trend of the United States of America has reversed its pattern from rural to urban. Now more than 80 percent of the U.S. population lives in urban areas, of which only one third lives in urban core and rest in the suburbs. Many surveys and research estimates show that this trend is more likely to continue for another few decades. Therefore, the environmental impacts of urbanization are certain to intensify unless we change our land use planning and decision making process. This thesis proposes two major strategies

of land use planning: “Where to” strategy and “How to” strategy. These two strategies are based on the premise that recognition and protection of environmental resources must be on the top of land use planning and decision making hierarchy process.

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CHAPTER 1

INTRODUCTION

1.1 Background

Humans have been using land and its resources for centuries in a pursuit of their better lives. The way humans have used land and exploited its resources over time is a serious problem (Cieslewicz, 2002) as it has altered land cover and impacted the functioning of the ecosystem. With the advent of agriculture, modern technology, and the rise of capitalist mode of economy, the exploitation of land and its resources has increased dramatically. In the last few decades, land use practices (agriculture, mining, logging, housing, recreation, etc) have become so intensive and predominant that we can see their impacts in forms of uncontrolled development (urbanization and sprawl), deteriorating environmental quality, loss of prime agricultural lands, destruction of wetlands, and loss of fish and wildlife habitats everywhere on the earth. Such impacts have reduced the local capacity of lands to support both ecosystem and human enterprise at global scale. Therefore the effect of land use change is no longer a local environmental problem but a global one (Houghton, 1994). To address such a problem of global scale, detailed information on existing land use pattern and sound knowledge about changes in land use through time is important for legislators, planners, and State and local governmental officials (J. R. Anderson, Hardy, Roach, & Witmer, 1976).

Cities are growing faster all over the world. There will be nearly 2 billion new city residents accounting for around 60 percent of the world's population by 2030 leading to a severe damage of natural resources and ecosystems (The Nature Conservancy, 2008). When cities grow, it requires more land and resources to support the growth. This leads to change in land use causing environmental problems such as air and water pollution, loss of open space and biodiversity, heat island effects, and so on. Based on the fact that global human population is growing and rural to urban migration is increasing, the urbanization trend will continue to happen at least for another few decades. This continuation of urbanization pattern will increase land and resource consumption, and exacerbate the environmental problems which have already posed threats to our planet and cost billions of dollars to our economy. Therefore, planners, governments, planning agencies and others should acknowledge these problems immediately and put environmental perspective into land use planning and decision making process effectively and promptly.

1.2 Purpose of the Study

The main purpose of this thesis is to (1) study the impact of urbanization on environmental resources, and (2) propose land use planning strategies to avoid or at least minimize the impacts from future land use planning and decision making process. This thesis defines urbanization as a major driver of land use change, which causes environmental problems. There are unlimited numbers of urbanization induced environmental problems of many scales - issues of air and water quality at the local scale and the issue of global warming and climate change at the global scale. This thesis does not involve in the discussion of all of these issues. Instead, it focuses on the immediate and noticeable impacts of urbanization on our natural environment, that is, the loss of land and its resources such as wetlands, biodiversity, etc.

1.3 Research Questions

Based on the purpose of the study, the thesis attempts to answer the following questions:

1. How does urbanization impact environmental resources?
2. Why is it important to understand the relationship between ecosystem and urbanization?

3. What are the important environmental resources that need to be considered in land use planning?
4. Why and how could land use planning play a vital role in avoiding or at least minimizing the impact of urbanization on environmental resources?

These questions are addressed in five major chapters of the thesis.

1.3.1 Understanding Land Use Change and Urbanization

This chapter deals with the first question with a theme that urbanization is one of the main causes of land use change, which ultimately causes environmental problems. It includes definitions, and discussions of land use change, urbanization, and land use planning in the context of the United States of America. This part of the thesis initiates a discussion on why land use change due to urbanization is one of the major causes of environmental problems.

1.3.2 Understanding Ecosystem and Urbanization

This part of the thesis discusses the importance of ecosystem and its relationship with human beings. Here, the thesis attempts to explain how humans have disconnected themselves from ecosystem (nature) as they have become more technocrats and urbanized. It includes the discussion about ecosystem services, urban population growth and the increasing trend of urbanization in the United States.

1.3.3 Environmental Impact Analysis of a Selected Urban Area

This chapter analyzes the environmental impact of urbanization in a selected urban area based on the important environmental resources of that area. The analysis is based on the information collected from literature reviews. It involves the use of Geographic Information System (GIS) tool called ArcGIS and its extensions.

1.3.4 Understanding Environmental Resources in Land Use Planning

This part of the thesis explains the role of land use planning in avoiding or at least minimizing the environmental impacts of urbanization from future urban growth. It proposes two major strategies that can be used in future land use planning and decision making process.

a. What are the bases of identifying and recognizing environmental resources?

b. What are measures to protect environmental resources in land use decisions?

1.3.5 Conclusion and Recommendation

And finally, the thesis will attempt to emphasize on the role of land use planning to alleviate the existing environmental problems based on the discussions of the first three parts of the report. This part also includes a brief review of planning practices and policies that are in place such as smart growth, compact development, new urbanism, etc. And if appropriate it will suggest ways to improve the existing land use policies.

1.4 Research Strategy

Research strategy of this study involves two methods. First is the review of books, journal articles, and professional reports from various governmental and non-governmental agencies. Second is the use of GIS as a tool to analyze the impact of urbanization on environment in a selected urban area based on the literature reviews and identified important environmental factors. In addition I will incorporate my knowledge about land use and environment based on courses I have taken, research works I have done, and interactions with colleagues, experts and professors.

CHAPTER 2

UNDERSTANDING LAND USE CHANGE AND URBANIZATION

2.1 Introduction to Land Use Change

Land use change is the change in land cover and land use. Land cover is the physical state of the land surface which includes both natural amenities (crop lands, mountains, vegetation, soil type, biodiversity, water resources) and man-made structures (buildings, pavements) (Meyer, 1995). Change in land cover usually happens in two ways- land cover conversion and land cover modification (Lambin, Geist, & Rindfuss, 2006, p. 4). Land cover conversion is a change in the overall classification of land cover through a complete replacement of one type of land cover by another type due to change in urban extent, agricultural expansion or deforestation. Where as, land cover modification is simply a change in the character of land cover without undergoing its overall classification (Lambin, Geist, & Lepers, 2003, p. 213-214). Land use refers to the way human beings employ and exploit land cover for several purposes (Lambin et al., 2006, p. 216; Meyer, 1995) such as farming, mining, housing, logging, or recreation. Therefore, land use change is the exploitation of land cover through its conversion and/or modification over time primarily to serve human needs.

2.1.1. Causes of Land Use Change

There are several causes of land use change. Identifying causes of land use change requires the understanding of land use decision making process which is influenced by several factors (Lambin et al., 2006, p. 216-217). Many researchers and scholars have explained proximate and underlying causes of land use change to understand the land use decision making process. Proximate causes of land use change involve a direct and immediate physical action on land cover at local level such as individual farms, households, or communities (Lambin et al., 2006, p. 216-217; Ojima, Galvin, & Turner, 1994). The underlying causes of land use change are the fundamental forces that alter one or more proximate causes and operate at regional or even global level (Lambin et al., 2006, p. 216-217). Some of the identified most commonly used fundamental forces are technological, economic, political, institutional, demographic and cultural (Geist et al., 2006, p. 43). In the context of the United States, these underlying causes/fundamental forces are also the causes of urbanization which in turn is the driver of land use change.

2.2 Connection between Land Use Change and Urbanization

In a more general sense, urbanization is the concentration of population due to the process of movement and redistribution (Geruson & McGrath, 1977, p. 3). Here movement and redistribution refers to the spatial location and relocation of human population, resources, and industries in a landscape. Broadly speaking, urbanization in the US was the output of two major processes – economic growth and city growth (Geruson & McGrath, 1977). Growth of city and economy was brought about by the political independence of the U. S., rapid expansion of overall population, development of railroads and rapid spread of automobiles, and the high level of agricultural productivity (Bairoch, 1988).

The process of urbanization results in a dense settlement called an urban area. The conglomeration of urban areas including cities and their suburbs linked economically and socially constitutes a system called a metropolitan area or region (Geruson & McGrath, 1977, p. 3). This definition of metropolitan area has left out one of the major linkages of the system, an ecological linkage, exploitation of which has created the system itself. Rostow (1977) argues that metropolitan area (urban area) is a result of capitalism which promotes diffusion of habitat and activities based on economic functioning and administrative activities. Here diffusion of habitat and activities refers to the consumption of land to locate industrial activities, administrative divisions, new housing units and other infrastructures. He further asserts that metropolitan or urban area "reduces the importance of the physical environment in the determination of the system of functional and social relations, abolishes the distinction between rural and urban, and places in the forefront of the space/society dynamic the historical conjuncture of the social relations that constitute its basis" (Rostow, 1977). Therefore, one of the goals of this thesis is to make the ecological linkage visible.

Although roughly 5 percent of the people were city dwellers in 1789 when the United States adopted its constitution (Geruson & McGrath, 1977, p. 40), this number has increased to 6 percent in 1820 and 14 percent in 1850 (Bairoch, 1988) and more than 80 percent of people live in cities now (Frank & Stoops, 2002). Figure 2.1 shows how the U.S. population has become increasingly urban in the last century.

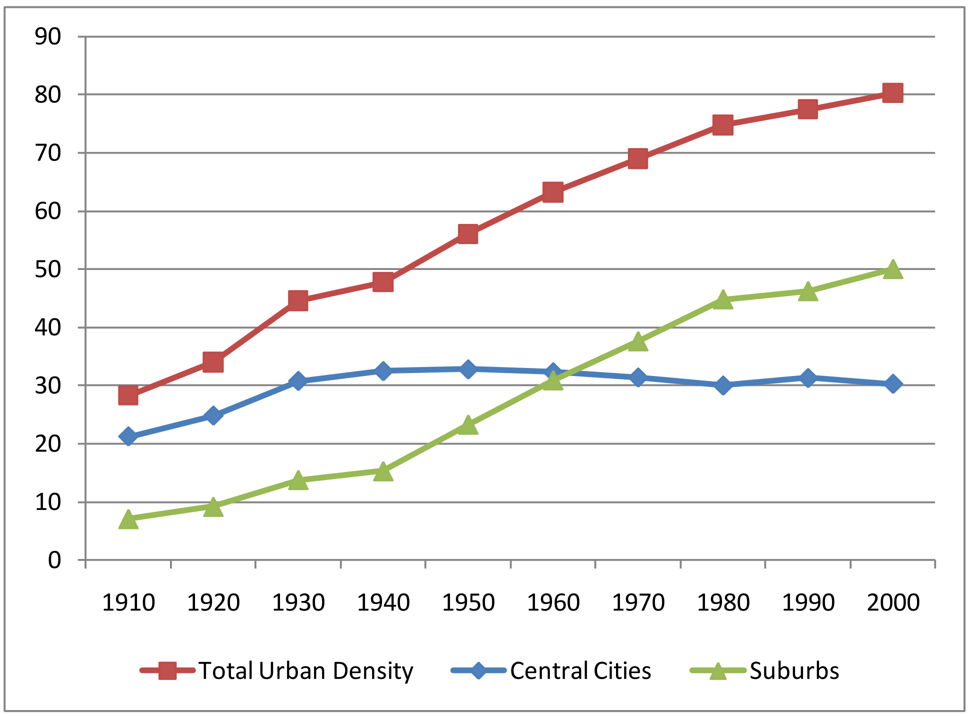

Figure 2.1 U.S. Urban Population (percent) in Central Cities and Suburbs
Source: U.S. Census Bureau 2000

It can be generalized that population density increases with increase in population. This holds true only for the confined area. For example, if the total land area of Texas remains the same, but net migration of people increases, then the over all population density of Texas increases. But if we consider an urban area within Texas, the land area of which is subject to change (usually increase) with time to accommodate influx of people and businesses, the population density may not necessarily increase, instead decrease.

Although overall population density of the U.S. is increasing over years, the amount of land that is consumed for urban development has superseded the population density. This is mainly due to the movement of people from urban core and rural areas to suburbs. In a period of 15 years from 1982 to 1997, the amount of urban land in the contiguous U.S. including Hawaii increased by 39.3% where as urban densities decreased by about 13%. In the states with growth management regulations, urban land increased by about 49% and urban densities decreased by 9.5%. In the states without growth management regulations, urban land increased by about 37% and urban densities decreased by about 16% (Anthony, 2004, p. 385).

CHAPTER 3

UNDERSTANDING ECOSYSTEM AND URBANIZATION

3.1 Introduction to Ecology and Ecosystem

The Ecological Society of America defines ecology as “the study of the relationships between living organisms, including humans, and their physical environment” (Ecological Society of America, 1997). In the discipline of ecology, ‘physical environment’ refers to things such as temperature, water, wind, soil etc. (Mackenzie, Ball, & Virdee, 2001, p. 1). An ecosystem is a particular level of organization in a natural world containing a diverse set of living and non-living components which are self sustained; regulated by positive and negative feedback loops; and characterized by flows of energy and movement of matters on cyclic pathways (Istock, Rees, & Stearns, 1974,p. 25-28). Animal and plant species are the living components of the ecosystem where as temperature, air, water, and soil are the non-living components upon which living components depend for survival. These natural components of ecosystems are environmental resources from which an array of benefits can be generated for human consumptions.

3.2 Ecosystem and its Services

Ecosystems provide services to living organisms including humans. Ecosystem services are the conditions and processes which are driven by solar energy, and generated by a complex of natural biogeochemical cycles such as carbon, nitrogen, sulfur etc. and life cycles such as bacteria, trees etc., (Daily, 1997, p. 3-4). Services provided by ecosystems are generated from resources such as soil, water, and animal and plant species (biodiversity) as summarized in table 3.1.

Table 3.1 Services Provided by Ecosystem

Ecosystem Services	Sources
Climate stability	(Alexander, Schneider, & Lagerquist, 1997, p. 71)
Biodiversity, ecosystem stability & productivity	(Tilman, 1997, p. 94)
Buffering and moderation of the hydrological cycle, physical support of plants, retention and delivery of nutrients to plants, disposal of wastes and dead organic matter, renewal of soil fertility, regulation of major element cycles	(Daily, Matson, & Vitousek, 1997, p. 117)
Pollination of crops and natural vegetation	(Nabhan & Buchmann, 1997, p. 133)
Natural pest control services and stability of agricultural systems	(Naylor & Ehrlich, 1997)
Global material cycling; transformation, detoxification and sequestration of pollutants and societal wastes; ecotourism, recreation and retirement; support of diverse human cultures	(Peterson & Lubchenco, 1997, p. 178)
Water for drinking, irrigation, and manufacturing; goods such as fish and waterfowl; and non-extractive benefits including recreation, transportation, flood control, bird and wildlife habitat and the dilution of pollutants	(Postel & Carpenter, 1997, p. 210)
Control of soil erosion; regulation of rainfall regimes; Albedo connection; climate regulation; biodiversity habitats	(Myers, 1997)
Maintenance of the composition of the atmosphere; conservation of soil	(Sala & Paruelo, 1997)

3.3 Ecosystem and its Resources

Environmental resources of ecosystem and their services to humans are infinite and precious. Some of the resources that are fundamental to the natural balance of the ecosystem and in the mean time that are subject to human intrusion are soil, water and biodiversity.

3.3.1 Soil

Daily et al. (1997) define soil as a complex and dynamic ecosystem which sustains physical processes and chemical transformations vital to terrestrial life (p. 113). Soil provides services to all forms of life ranging from microorganism to plants and animals including humans. Apart from its ecological or biological services, importance of soil is deeply rooted to the foundation of human civilization through cultural, immaterial, religious and spiritual belief systems (Winiwarter & Blum, 2006). Montgomery (2007) has linked the importance of soil to the very existence of human civilization as "civilizations don't disappear overnight. They don't choose to fail. More often they falter and then decline as their soil disappears over generations" (p. 6-7). He claims that soil is central to the longevity of any civilization (ancient or digital) and therefore we must respect soil as the living foundation for material wealth and treat it as an investment and a valuable inheritance (p. 6, 246). However, the importance and value of soil are unnoticed and underscored in our society because of their availability and abundance; and more importantly because "soils are always under foot" (Warkentin, 2006, p. 367). Consequently, soils have been used without concern for their loss or degradation which always carries with it significant economic and environmental costs (Gregorich, Sparling, & Gregorich, 2006, p. 407; Showers, 2006, p. 372).

3.3.2 Water Resources

Water is the most fundamental natural resource which is renewable but finite (Committee on Water Resources Activities & National Research Council, 2009, p. 1; Smith, Howes, & Kimball, 2007, p. 121-123). In the U.S. for the year 2005, approximately 410,000 million gallons per day of water was extracted for various uses such as domestic, agriculture, industrial, recreation and so on. Around 80 percent of the extracted water came from surface water (Barber, 2009). Sources of surface water are mostly rivers, streams, lakes, and wetlands including oceans. These water resources are within or adjacent to our land. Therefore, activities on land affect water resources directly or indirectly.

Importance of water is not limited to human consumption, but it is extended to the functioning of a whole planet. Water itself is an ecosystem (aquatic ecosystem) which provides habitats for billions of known and unknown species of animals and plants. From a shallow and seasonal wetlands or floodplains to a deep ocean, from a drop of precipitation that infiltrates into the earth surface to a pile of polar ice caps, water cycles continuously into our environment and nurtures our planet.

According to the 2007 Gallup Earth Day poll, majority of Americans said that they worry “a great deal” about four different water related problems out of ten environmental problems (Carroll, 2010):

Table 3.2 Public Concerns about Environmental Problems

Environmental Problems	Percentage
Pollution of drinking water	58
Pollution of rivers, lakes, and reservoirs	53
Contamination of soil and water by toxic waste	52
Maintenance of the nation’s supply of fresh water for household needs	51
Air pollution	46
Damage to the earth’s ozone layer	43
The loss of tropical rain forests	43
The “greenhouse effect” or global warming	41
Extinction of plant and animal species	39
Acid rain	25

Source: Carroll, 2010

This type of public concern about water related issues shows the need of urgency or at least a serious attention in planning arena to conserve, preserve and protect our water resources. The table below shows the status of waters of the U. S. (Committee on Assessing and Valuing the Services of Aquatic and Related Terrestiral Ecosystems, National Research Council, 2004, p. 72).

According to the Convention on Wetlands of International Importance, also known as Ramsar Convention, wetlands are the “areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters” and this is the most widely used and acceptable definition (Scott & Jones, 1995). According to the Section 404 of the Clean Water Act, wetlands are “those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of hydrophytic vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas” (United States Environmental Protection Agency (USEPA), 2010). Wetlands, also known as marshes, swamps, and bogs, are the transitional lands between terrestrial and aquatic systems where either the land is covered with shallow water or the water table is at or near the surface. Wetlands are the most ecologically and economically important ecosystems of the nation (Tiner, 2009, p. xi).

3.3.3 Biodiversity

Generally, biodiversity refers to the richness of animal and plant species that are native to a particular habitat or ecosystem. Each species present in an ecosystem serves specific function through food web and life cycle. A change in species diversity alters the biogeochemical cycles and affects the overall functioning of the system. Therefore, the stability, functioning, and sustainability of ecosystems depend on biodiversity (Tilman, 1997, p. 109).

3.4 Impacts of Urbanization on Ecosystem Resources

Although ecosystem services provide myriad of functions and services that create value for human users and are central to the continuation of human civilization, humans have obscured the existence and importance of ecosystem services in a hurry to celebrate urban fantasy (Committee on Assessing and Valuing the Services of Aquatic and Related Terrestiral Ecosystems, National Research Council, 2004, p. 17; Daily, 1997, p. 7). Van der Ryn & Cowan (2007) express the reality of increasing disconnection of humans with nature as:

> "[we] live in two interpenetrating worlds. The first is the living world [natural world], which has been forged in an evolutionary crucible over a period of four billion years. The second is the world of roads and cities, farms and artifacts [human designed world], that people have been designing for themselves over the last few millennia" (p. 33).

The growth and prosperity of the human designed world has come from the expense of the resources of the natural world. Sim Van Der Ryn and Stuart Cowan claim that the "designed mess we have made of our neighborhoods, cities, and ecosystems owes much to the lack of a coherent philosophy, vision, and practice of design that is grounded in a rich understanding of ecology" (p. 33). There is a huge gap between these two worlds- living or natural world and human designed or cultural world that has distanced humans from nature. To bridge this gap and link humans with nature, we need an ecological thinking in planning practice (Van der Ryn & Cowan, 2007, p. 33). As proposed by Ryn and Cowan we can apply conservation, regeneration, and stewardship strategies into the land use planning and decision making process (p. 37).

3.4.1 Impact Urbanization on Soil

Land use change driven by urbanization has put cities on soils that are best suited for other uses such as food and fiber, forests and wetlands (Scheyer & Hipple, 2005, p. 6). New homes, buildings, roads and other structures are being built everyday. Are these developments guided by sound knowledge about the soil information of the area? Are planners, developers and planning agencies making intellectual and serious judgment in allocating lands based on soil information for different uses? And do they really care about soil at all? The overall answer to these questions is a big ‘NO’ because almost all developments that have happened and are continuing to happen are guided by economic benefits.

Marcotullio, Braimoh, & Onishi (2008) have documented the impact of urbanization on soil. Urbanization alters the biological, chemical and physical properties of soil and there by degrading its quality in a way that it leads to loss of vegetation, poor water infiltration, accumulation of heavy metal, excess water runoff and soil erosion. Soil quality is often degraded by soil erosion. The stability of slopes (both natural and artificial) determines the vulnerability of landslides or slope failures. Encroachment of urban land into nearby forested or vegetated areas, and the expansion of built up areas and transportation networks into steeper terrain destabilizing slopes lead to slope failures (Beek, Cammeraat, Andreu, & Mickovski, 2008, p. 18-19). In the U.S., landslides cause $1-2 billion in damages and more than 25 fatalities each year. Urban and recreational developments into hillside areas have put more people and property into risk of landslide hazards (U.S. Geological Survey, 2010). Recently, a portion of Pacific Coast Highway, located in a hilly terrain of Dana Point, California, was closed for about a week due to possible landslide (The Orange County Register, 2010) .A Pierce County road in Washington was shut down for repair due to mudslide (KIROTV.com, 2010).

3.4.2 Impact of Urbanization on Water Resources

Population growth, increasing trend of urbanization, and land use and climate change have affected water availability and quality in the U.S. (Committee on the Review of Water and Environmental Research Systems (WATERS) Network & National Research Council, 2010, p. 6) in such a way that nation’s water resources are increasingly becoming limited (Committee on Water Resources Activities & National Research Council, 2009, p. 16; Smith et al., 2007, p. 123). In many parts of the country, conflicts over water resources have already occurred and the situation will deteriorate in future (Committee on Water Resources Activities &

National Research Council, 2009, p. 49). Although the quality of water has significantly improved in last few decades due to the government regulations and environmental protection programs such as Clean Water Act and the Safe Drinking Water Act, more than one third of rivers and streams in the U.S. are impaired or polluted and most of the aquatic ecosystems together with their biota have been lost or diminished to a great number due to non point source contamination of surface and ground water from agricultural and urban lands (Committee on Assessing and Valuing the Services of Aquatic and Related Terrestiral Ecosystems, National Research Council, 2004; Committee on Water Resources Activities & National Research Council, 2009).

Table 3.3 Status of Water Resources in the United States

Water Body Type	Total Size	Amount Assessed (% of total	Impaired (% of assessed)	Leading Sources of Impairment
Rivers and streams	3,692,830 miles	699,946 miles (19%)	269,258 miles (39%)	Agriculture, hydrologic modifications, urban runoff and storm sewers, forestry, municipal point sources, resource extraction
Lakes, reservoirs and ponds	40,603,893 acres	17,339,080 acres (43%)	7,702,370 acres (45%)	Agriculture, hydrologic medications, urban runoff and storm sewers, atmospheric deposition, municipal point sources, land disposal
Coastal resources: Estuaries	87,369 sq. miles	31,072 sq. miles (36%)	15,676 sq. miles (51%)	Municipal point sources, urban runoff/storm sewers, industrial discharges, atmospheric deposition, agriculture, hydrologic modifications, resource extraction

Table 3.3 – *Continued*

Coastal Resources: Great Lakes shoreline	5,521 miles	5,066 miles (92%)	3,955 miles (78%)	Contaminated sediments, urban runoff/storm sewers, agriculture, atmospheric deposition, habitat modification, land disposal, septic tanks
Coastal resources: Ocean shoreline waters	58,618 miles	3,221 miles (6%)	434 miles (14%)	Urban runoff/strom sewers, nonpoint sources, land disposal, septic tanks, municipal point sources, industrial discharges, construction
Wetlands	105,500,000 acres	8,282,133 acres (8%)	3,442,985 acres (42%)	Agriculture, construction, hydrologic modifications, urban runoff, silviculture, habitat modifications

At some point in time, the conterminous United States contained more than 220 million acres of wetlands. However, in 2004, the total area of wetlands was reduced to an estimated 107.7 million acres, which accounts for 5.5 percent of the surface area of the conterminous United States (Dahl, 2006, p. 43). There was a net gain of 191,750 acres of wetlands between 1998 and 2004. However this gain was due to the conversion of agricultural lands or the combined effort of conservation measures and restoration of previously impaired wetlands. In the same time period, the reports shows that there was an estimated loss of 88,960 acres (39% of the loss) due to urban development, 51,440 acres (22 % of the loss) due to rural development, and 18,000 acres (8 % of the loss) due to drainage or filling for silviculture. The rest of the loss, 70,100 ac res (31%) was attributed to deep water habitats (Dahl, 2006, p. 47).

3.4.1 Impact of Urbanization on Biodiversity

Urbanization alters habitat through housing, road construction, pavement, devegetation, plantation of non-native species, land fragmentation etc. Residential development associated with expansion of roads, utilities etc. poses threat to wildlife through loss, degradation, and fragmentation of habitat (Theobald, Miller, & Hobbs, 1997, p. 26). Habitat alteration from urbanization is so drastic and widespread that it results in the endangerment and extinction of species accompanied by long lasting habitat loss (McKinney, 2002). Apart from reducing the richness of native species, urbanization increases the dominance of nonnative species in the area thereby causing biological homogenization (Mckinney, 2006).

NatureServe, in collaboration with member natural heritage programs in all 50 states, has maintained a database of around 30,000 imperiled species i.e. about 15% of the total known species of the U.S. since 1999 (Wilcove & Master, 2005, p. 415). According to the NatureServe, Texas ranks second in 'diversity', third in 'endemism', fourth in 'extinctions' and eleventh in 'risk' based on the state-wide distribution analyses of 21,395 plant and animal species of the 50 states including District of Columbia.

Table 3.4 Biodiversity Status of Texas

Analysis Measures	Number of Species	Rank
Diversity	6,273	2
Risk (in percent)	10.10%	11
Endemism	340	3
Extinctions	54	3

Source: Stein, 2002, p. 11-15

Diversity refers to species richness, endemism refers to unique to particular state, Extinctions refers to global extinction of species and Risk refers to the percentage of a state's plant and animal species at risk of extinction (Stein, 2002, p. 6-8). Texas ranks first in diversity of birds and reptiles species, second in diversity of mammal and plant species, and fourth in the diversity of amphibians.

Table 3.5 Diversity and Risk of Species in Texas

Species Categories	Number of Species	Diversity Rank	Risk Rank	Percent at Risk
Vascular Plant	4,509	2	11	9.4
Mammal	159	2	9	10.7
Bird	477	1	6	2.9
Reptile	149	1	9	14.1
Amphibian	71	5	7	21.1
Freshwater Fish	175	12	8	23.4

Source: Stein, 2002, p. 16 - 21

More than ten percent of native species in one out of every four states of the U.S. are at risk of extinction (Stein, 2002, p. 2). Habitat loss, which affects about 85% of the imperiled species, is the leading cause of species endangerment. Spread of non-native species is the second most threat, which affects 49% of the imperiled species (Wilcove, Rothstein, Dubow, Phillips, & Losos, 1998, p. 607; Wilcove & Master, 2005, p. 416).

Invasion of non-native species, urbanization and agriculture are the three leading causes of species endangerment due to habitat loss. Urbanization, which endangered 64 species in Florida, 61 in California and 26 in Texas, is the second most threat to species endangerment. In the combined area of Utah, Nevada, and Idaho, where the majority of land is owned by public and unavailable for development, only 2 species were endangered by urbanization. Roads including highways through their construction, maintenance and use have endangered 94 species (Czech, Krausman, & Devers, 2000, p. 594-598).

Of the 6,400 imperiled species identified by NatureServe, 4,173 species were analyzed in the mainland U.S, which showed approximately 60 percent are found in one or more of the mainland metropolitan areas, with 31 percent found exclusively within metropolitan areas. It is a clear demonstration of our traditional reckless planning approach which ignored the importance of critical environmental habitats and continued to develop. It means the future of these species depends upon the growth patterns of metropolitan areas (Ewing, Kostyack, Chen, Stein, & Ernst, 2005, p. 14-15)

CHAPTER 4

ENVIRONMENTAL IMPACT ANALYSIS OF A SELECTED URBAN AREA

4.1 Selected Study Area

Austin is the capital city of the state of Texas since 1846 when Texas became the 28th state of the United States of America. It is located in the Central Texas Hill Country, approximately 192 miles from Dallas to its north, 79 miles from San Antonio to its south, and 162 miles from Houston to its southeast. Austin, the seat of Travis County, lies in the Austin-San Marcos Metropolitan Statistical Area. (Austin City Connection, 1995).

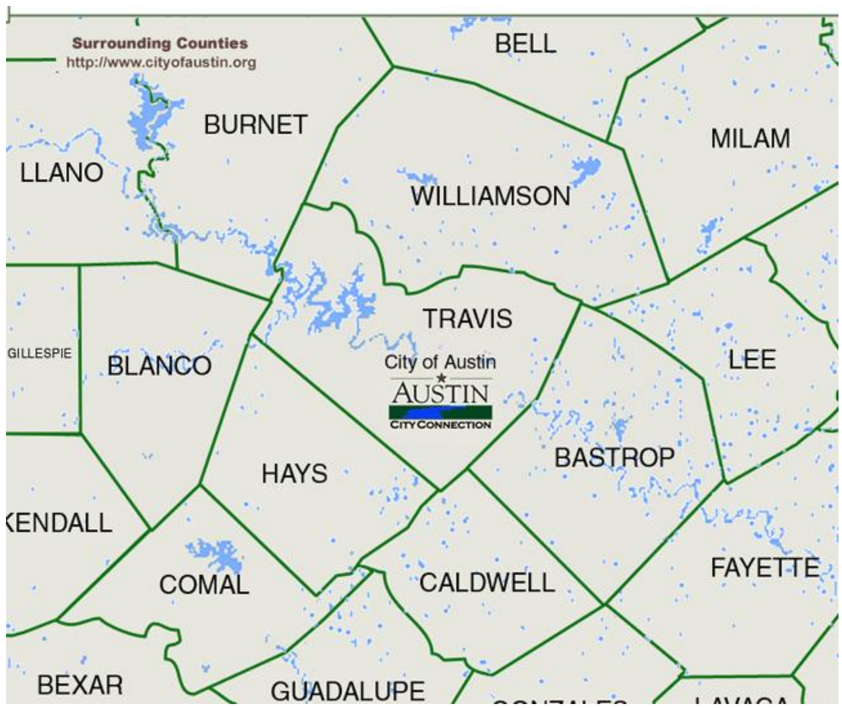

Figure 4.1 City of Austin with Surrounding Counties
Source: http://www.ci.austin.tx.us/help/countymap.htm

Austin is the fourth largest city in Texas and the 16th most populous city in the U.S. And it has been projected that the city will experience an intense level of urban sprawl/development in coming years (Robinson, 2010). Figures 4.1 and 4.2 show how population and number of housing unit in Austin are growing continuously since 1950. This trend of growth leads to the consumption of more land. If environmental resources are ignored while accommodating this kind of growth, more environmentally sensitive areas will be lost. Therefore, I selected City of Austin as a study area for my research to observe how urbanization has impacted environmental resources of the study area over time. Although majority of Austin is situated in Travis County, its boundary is extended to Hays and Williamson Counties. Therefore, I also included all three Counties for the purpose of analysis.

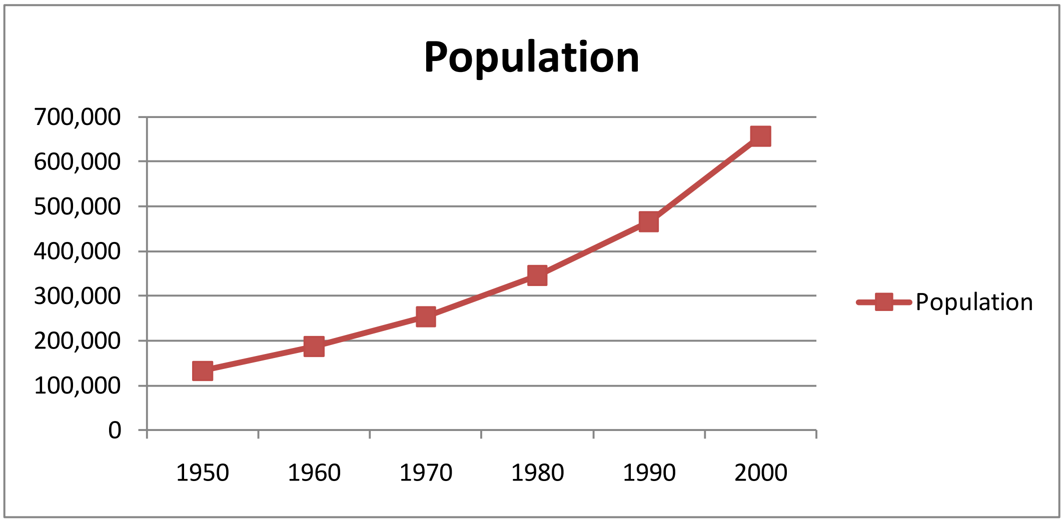

Figure 4.2 Austin Population Trend from 1950-2000

Such trend of growth leads to the consumption of more land. If environmental resources are ignored while accommodating this kind of growth, more acres of environmentally sensitive areas will be lost. Therefore, I selected City of Austin as a study area for my research to observe how urbanization has impacted environmental resources of the area over time. Although majority of Austin is situated in Travis County, its boundary is extended to Hays and Williamson Counties. Therefore, I also included all three Counties for the purpose of analysis.

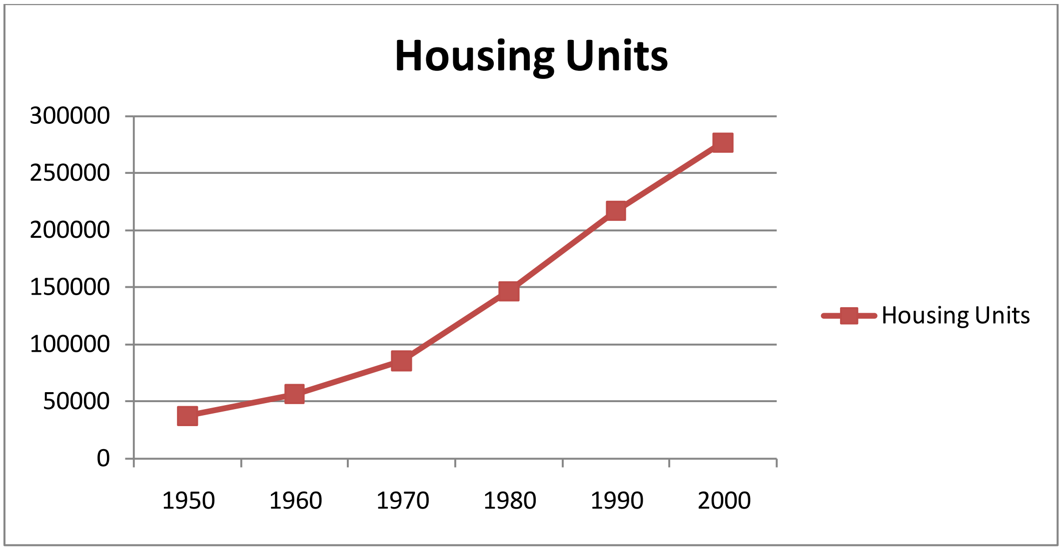

Figure 4.3 Austin Housing Units Trend from 1950-2000

4.2 Method of Analysis

I used a very simple and straightforward method to analyze the environmental impacts of urbanization in Austin area. It includes the (a) identification of environmental factors, (b) collection of required data, and (c) spatial analysis of the data using ArcGIS.

4.2.1. Identification of Environmental Factors

Environmental factors vary from place to place depending upon the geography and geology of the place. Based on the literature reviews, I identified following types of environmental factors to assess the environmental impact of urbanization in Austin.

(I) Slope: I divided slope into two major categories (a) less than 15%, (b) more than 15% to see where developments have already happened. It has been estimated that developments on land with slope more than 15% are vulnerable to damage due to slope failure, and soil erosion as discussed in Chapter 3.

(II) Water Bodies: I selected lakes, and major rivers and streams of the study area to analyze the proximity of development within or around these areas. As discussed in Chapter 3, these areas are important habitats for many plant and animal species apart from their recreational benefits.

(III) Wetlands: I used 720 feet buffer around the wetlands that are found in the study area. The reason for putting 720 feet buffer is to make sure animal species that could be present in the area would have enough space for feeding and breeding.

(IV) Floodplains: Flood zones are identified by a 100 year flood plains areas that are mapped by the Federal Emergency Management Agency (FEMA). I used 100-year floodplain areas as the basis for defining how vulnerable the developments are in case of flooding.

(V) Karst Features: Karst features are geological structures which have been documented as habitats for some of the endangered species in the study area by the United States Fish and Wildlife Service. There are around 8 federally endangered terrestrial karst invertebrates in the study area (U.S. Fish and Wildlife Service, Austin Ecological Services Field Office, 2006).

(VI) TEAP: TEAP stands for Texas Ecological Assessment Protocol. It is a Pilot Project (model) conducted by Texas Environmental Resource Stewards (TERS) in collaboration with the U.S. Environmental Protection Agency Region 6, Texas Parks and Wildlife Department and the Nature Conservancy to make the ecological assessment and identification of ecologically important resources in the state of Texas. TEAP identified five different areas (1%, 2-10%, 11-25%, 26-50% and 51-100%) of ecological importance in each eco- regions of Texas based on diversity, rarity and sustainability index. Top 1% represents ‘higher ecological importance’ and 51-100% represents ‘lower ecological importance’ (Osowski et al., 2005, p. 2, 79).

Austin, which lies within the Edwards Plateau eco-region, contains areas of relatively higher ecological importance (Osowski et al., 2005, p. 92). Although protecting every inch of the top 1% TEAP area may not guarantee the protection of biodiversity loss, it could significantly contribute in maintaining the biodiversity by protecting the identified ecologically important lands (Osowski et al., 2005, p. 119).

4.2.2. Collection of Required Data

I collected most of the data from the U.S. Census Bureau, City of Austin, and CAPCOG. The table below shows the data type and their sources:

Table 4.1 Collected Data and Their Sources

Data Type	Source
Population	U.S. Census Bureau
Housing Units	U.S. Census Bureau
GIS shape files (Land Use 2005, Counties, City Boundary, Texas Hydrology)	Capital Area Council of Governments (CAPCOG), City of Austin

4.2.3. Spatial Analysis Using ArcGIS

I applied ArcGIS 9.3 and its Spatial Analyst extension to make the spatial analysis of (a) total population and housing units by Census Block Groups, and (b) selected environmental resources for Austin. Since one of the goals of this research is to show how city/urban growth could impact environment, I extended the limit of my analysis to 5 mile ETJ of Austin and 3 Counties of Hays, Travis and Williamson. For the purpose of analysis, I categorized the total land of the study area into two categories based on 2005 land use data: (a) developed land, and (b) undeveloped land as shown in Table 4.2. The main reason to categorize the total land into two categories was to calculate how many lands (in square miles) that are environmentally sensitive or vulnerable for development have already been developed.

Table 4.2 Developed and Undeveloped Land Categories of the Study Area

Land Use Categories	Land Use Type
Single Family Residential	Developed
Multifamily Residential	Developed
Commercial	Developed
Industrial (manufacturing)	Developed
Utilities	Developed
Mobile Homes	Developed
Non taxable Tangible Personal Properties	Developed
Residential Inventory	Developed
Qualified Agricultural Land	Undeveloped
Non-Qualified Land	Undeveloped
Farm and Ranch Improvements	Undeveloped
Vacant Lots and Tracts	Undeveloped

4.3 Results of Analysis and Discussion

The analysis shows that significant amount of land that is not suitable for development for environmental concerns such as biodiversity, water quality, flood, slope failures, etc. has already been developed in the study area. Approximately 2.4 square miles of slope land, 49 square miles of wetlands and nearby water bodies land, 56 square miles of floodplains, 14 square miles of karst areas, and 34 square miles of TEAP (biodiversity) areas have been urbanized in the study area including 3 counties.

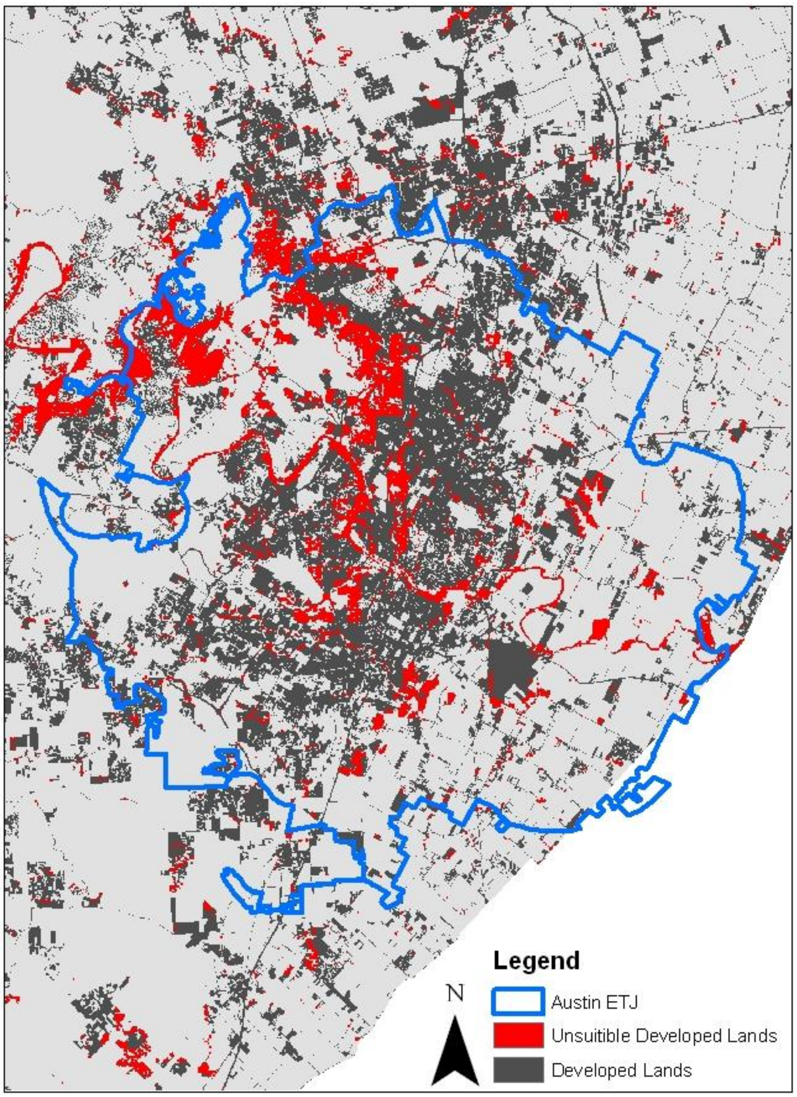

Figure 4.4 Developments on Environmentally Sensitive Areas in the Study Area

Some of the environmentally sensitive areas have been found to be overlapped. Accounting for this overlap, the analysis shows that more than 10 percent of the lands that are environmentally critical and sensitive have already been developed in the study area. McKinney (2006) claims that land modifications during urban growth have no prospect of recovery as they are long-term and often intensify with time. It means we have already lost 10 percent of the environmentally sensitive land in the study area with no prospect to recover them. Instead, the loss might amplify due to ongoing trend of growth. Figure 4.5 shows that population is dispersed throughout three counties, however the dispersion is uneven. The population projections for 2014 shows that population density is higher just outside the cities of Dripping Springs, Lago Vista, Leander, Liberty Hill, George Town, Hutto, Round Rock, Kyle, and Austin.

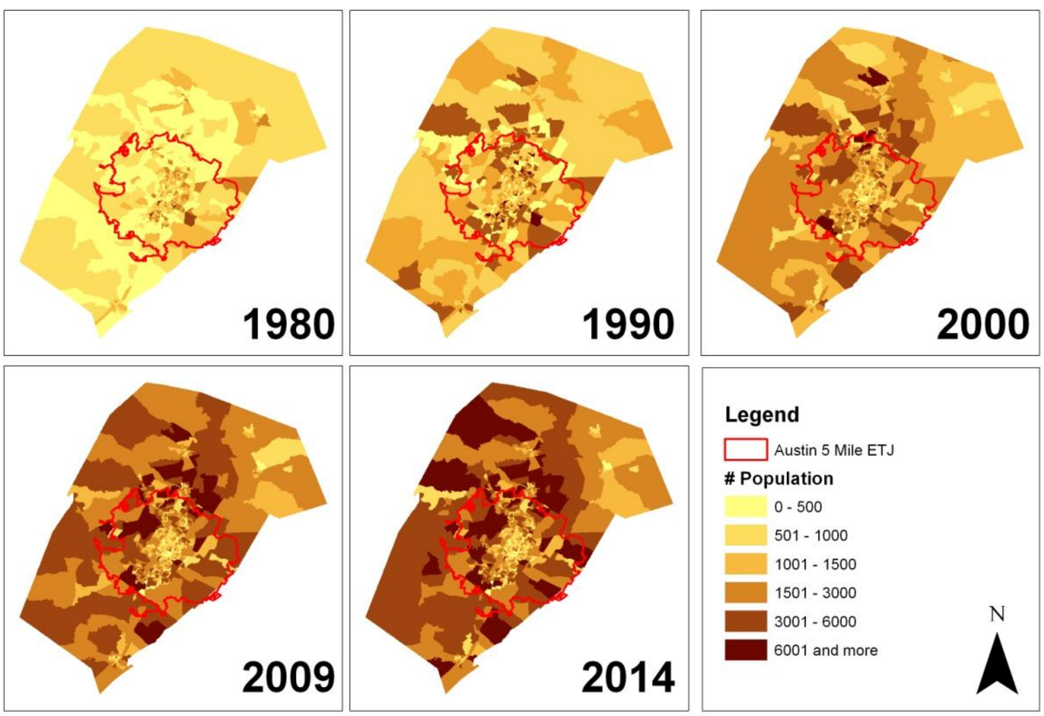

Figure 4.5 Population Distribution Pattern in the Study Area

Figure 4.6 shows housing clusters on the outskirts of the cities of Liberty Hill, George Town, Round Rock, Leander, and Austin. The increasing pattern of population growth and housing developments away from the city center correlates with the increasing trend of consumption of environmentally sensitive areas.

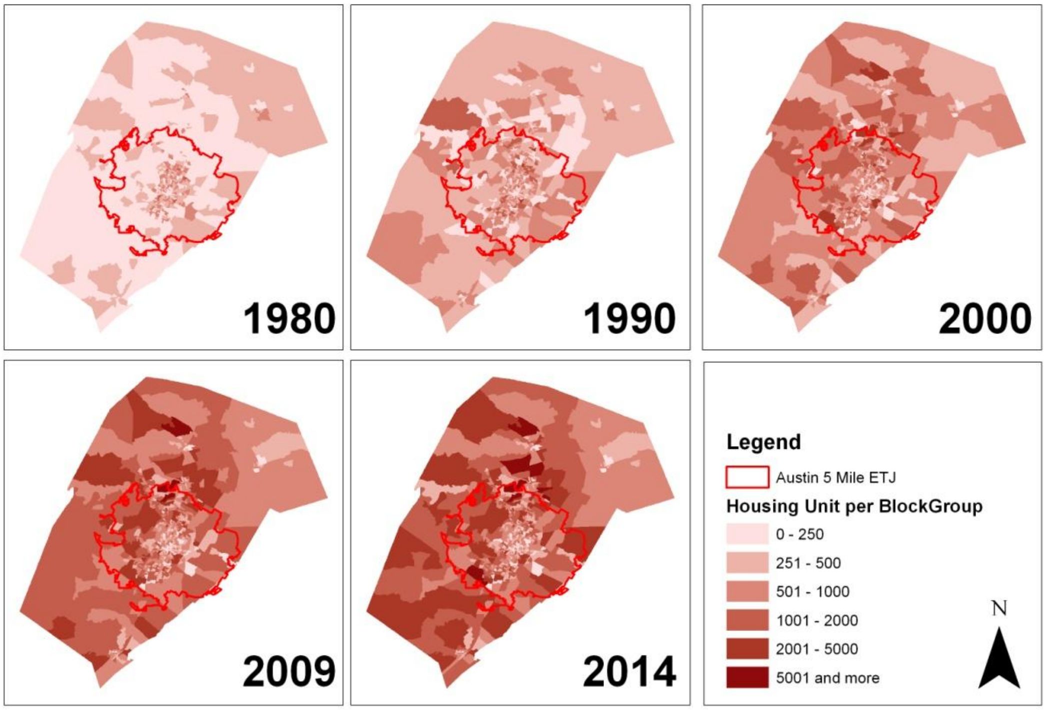

Figure 4.6 Distributions of Housing Units in the Study Area

4.3.1. Slope

Based on the analysis it was found that 1.05 square miles of land within the 5 mile ETJ of Austin that has already been developed have a slope greater than 15%. The total area of land with a slope greater than 15% in all 3 Counties was found to be 2.39 square miles.

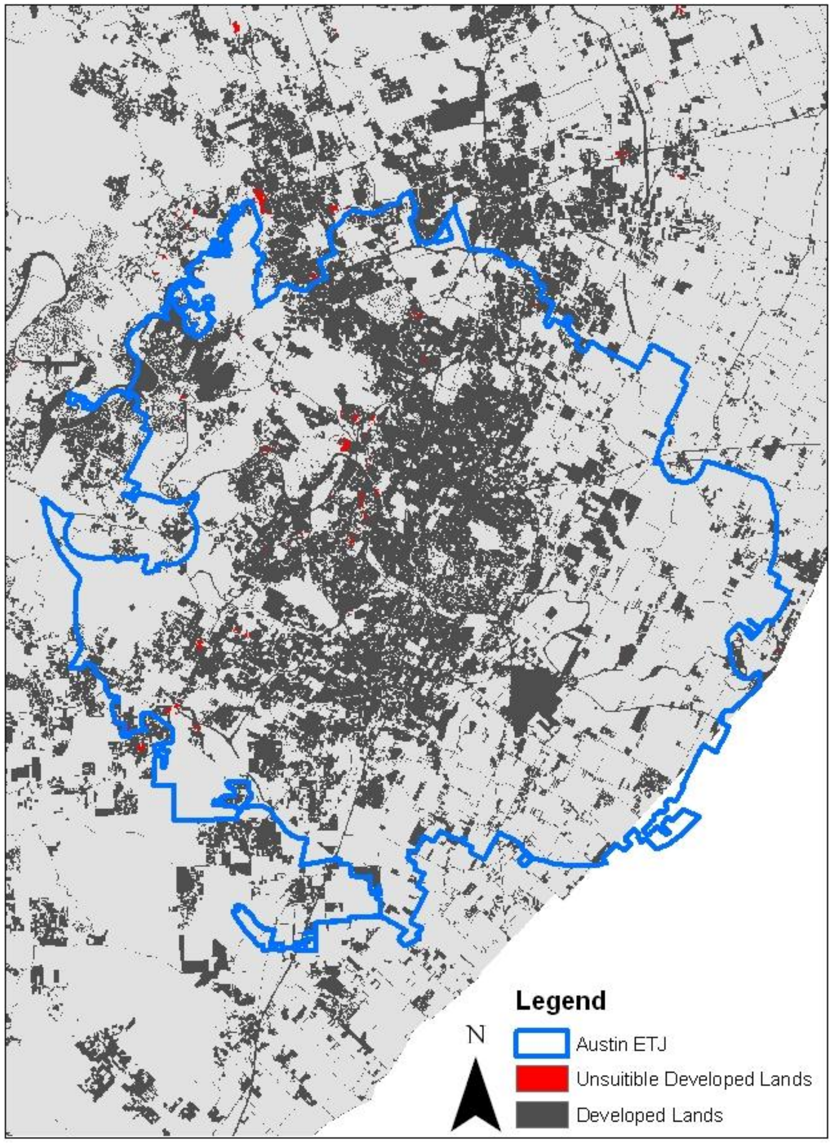

Figure 4.7 Developments on Land with Slope > 15 %

4.3.2. Water Bodies

Approximately 22 square miles of land that are within 720 feet from water bodies have already been developed within the Austin ETJ. The total developments that have happened in all three Counties constitute about 49 square miles of land that are within the buffer of 720 feet from water bodies. I used the buffer width of 720 feet based on the average of minimum and maximum values provided in Table 5.1. The same buffer width is used for wetlands as well.

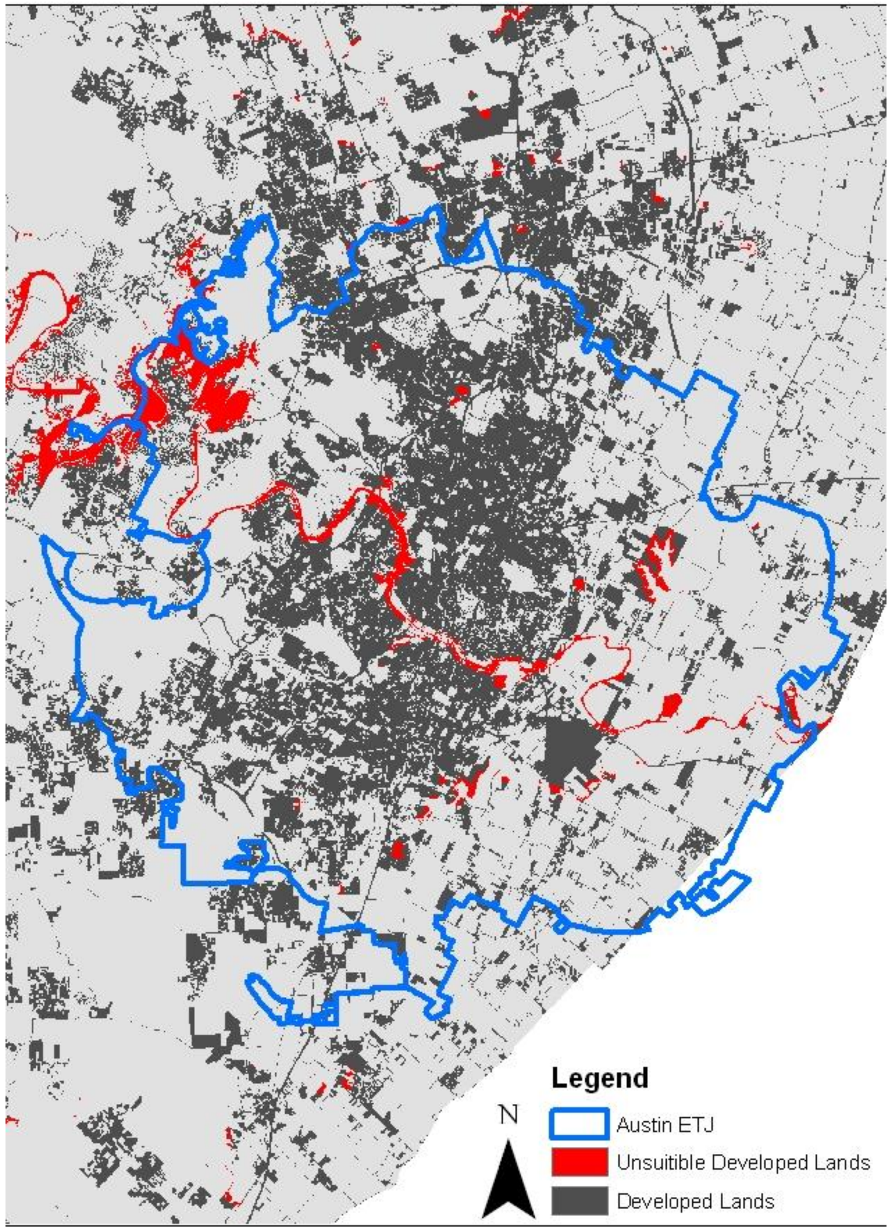

Figure 4.8 Developments within 720 feet from Water Bodies

4.3.3. Wetlands

No presence of well defined wetlands was found within the Austin ETJ. However, the way city is expanding, we can see its encroachment in southeast to some of the nearby wetlands in near future. The analysis of 3 Counties revealed that around 0.206 square miles of land within the buffer distance of 720 feet from wetlands have already been developed.

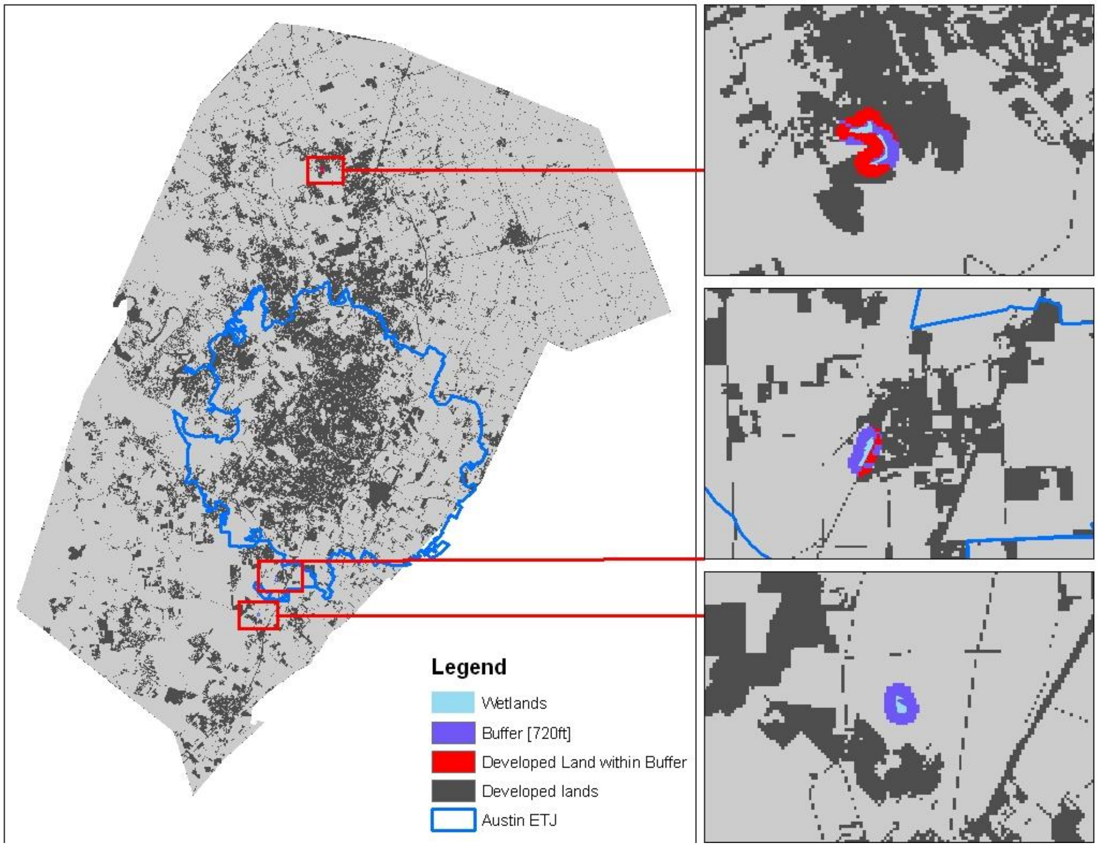

Figure 4.9 Developments within 720 feet from Wetlands

4.3.4. Floodplains

Approximately 25 square miles of land within the Austin ETJ and 56 square miles within in 3 counties that have already been developed are in 100 year floodplains.

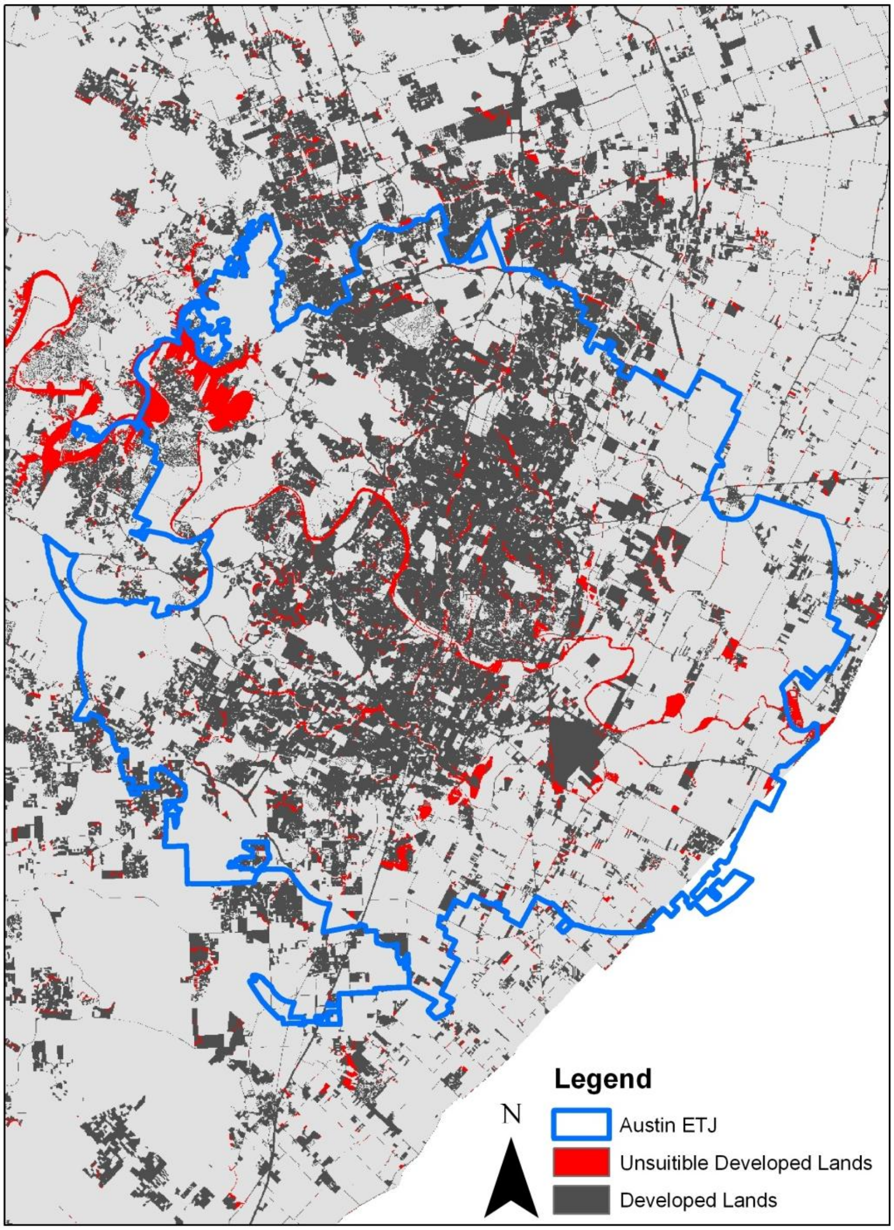

Figure 4.10 Developments on 100-year Floodplains

4.3.5. Karst Features

Approximately 6.45 square miles of land that are already developed within the Austin ETJ belong to Kasrt features (high probability). This area is more than double (14.03 square miles) while accounting for all 3 Counties.

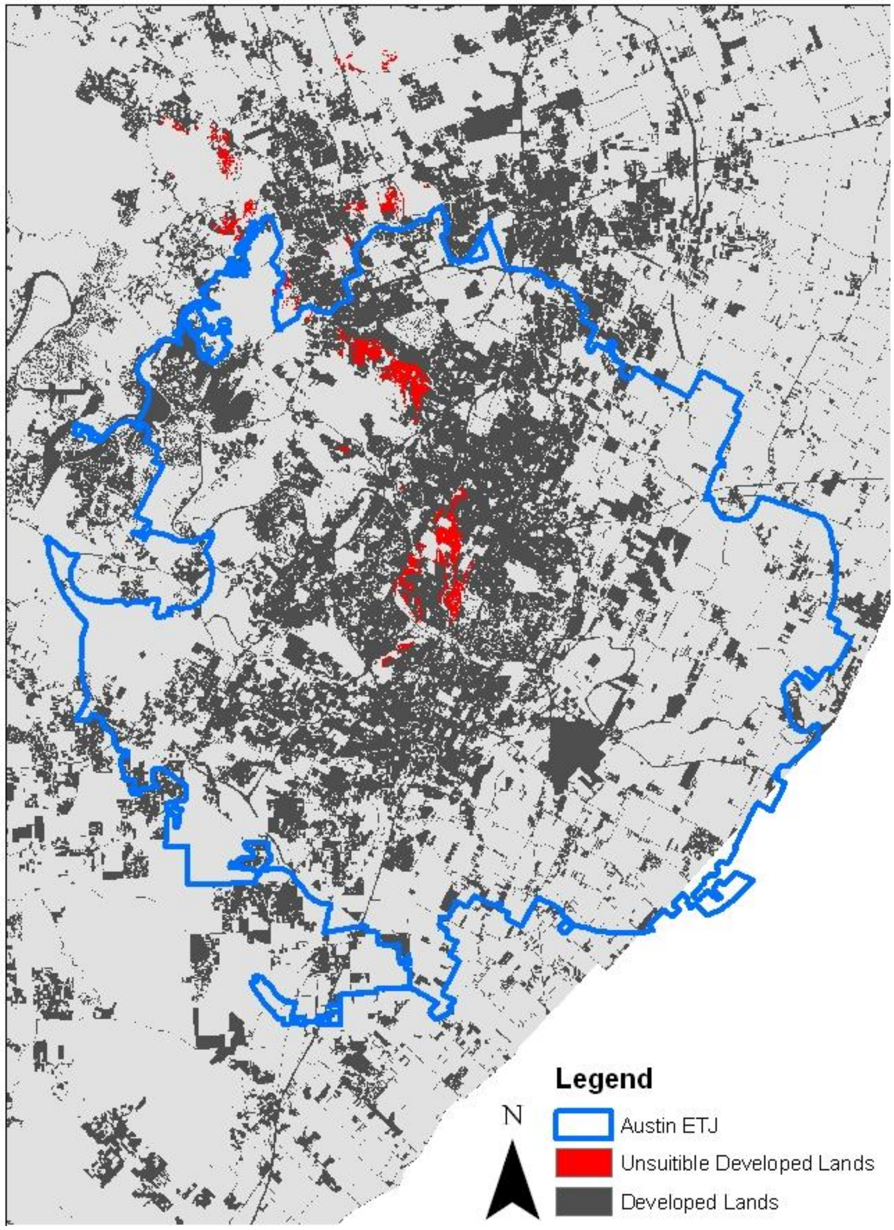

Figure 4.11 Developments on Karst Features

4.3.6. TEAP

About 21.68 square miles of developed land within the Austin ETJ are found to be in top 1% TEAP area. This number increased to 33.72 square miles when accounting for all 3 Counties.

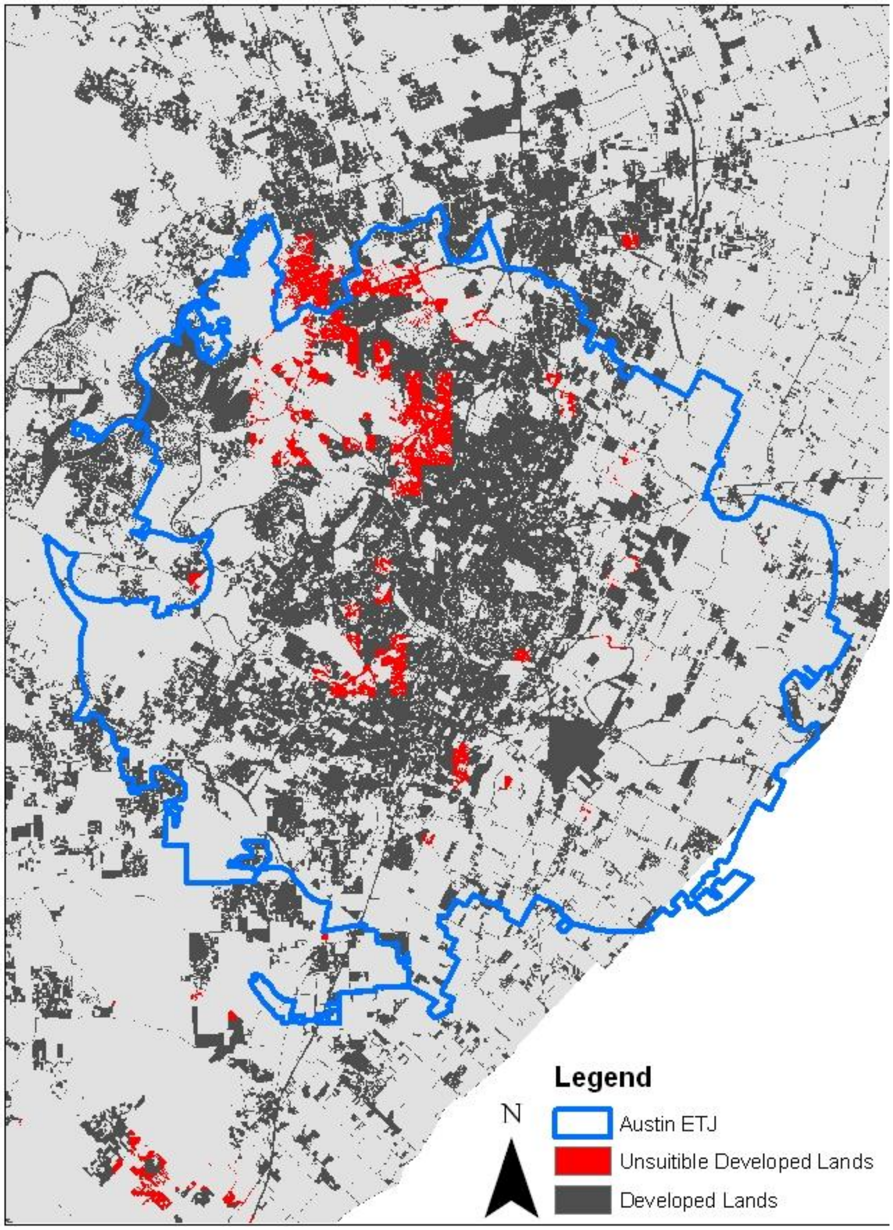

Figure 4.12 Developments on TEAP Area

CHAPTER 5

UNDERSTANDING ENVIRONMENTAL RESOURCES IN LAND USE PLANNING

5.1 Introduction

Both human population and economic activities are growing rapidly. In next 20 years, the world will add more than two billion people in urban areas. The U.S. population will hit nearly 400 million by 2050, which is more than a 50 % increase from the 1990 population size (Day, 1996). Based on the current urban population trend, there will be around additional 80 million urban residents in next four decades. Currently, the average household size is 2.6 and the median lot size per single family including mobile homes is 0.27 acre (Sullivan, 2010). It means by 2050, there will be a need of more than 30 million new housing units (U.S. Census Bureau, American Community Survey, 2010) and 8.1 million acres (12,600 square miles) of land to accommodate the future urban population growth. If we consider other infrastructure developments such as roads and transportation, recreation and businesses, the amount of required land will increase substantially.

5.2 Role of Land Use Planning

The role of land use planning is vital to determine the future land use pattern and development. According to Dale et al. (2000), the main purpose of land use planning is to ensure the sustainability of three major societal attributes. These attributes are: (1) infrastructure (jobs, roads, schools, firehouses, etc.), (2) environmental resources (open spaces, parks, watersheds, natural areas, wetlands, etc.), and (3) public health and safety (avoidance of flood plains, unstable soils, fire hazards, etc.), p. 657. Although all three attributes are important and should be considered in land use planning, the priority must be given to the protection and sustainable use of environmental resources. It is because the (a) security and viability of infrastructures and assurance of public health and safety are greatly determined by the availability and quality of environmental resources, (b) land use decisions of last few decades have already caused major long term damage to our natural environment, most of these damages intensify with time and have no prospect of recovery (Mckinney, 2006), and (c) the continuation of the same old land use decisions would damage more resources causing imbalance to our ecosystem, costing billions of dollars to our economy, and posing threat to human civilization.

In order to avoid or at least minimize damage to our valuable environmental resources from future land use decisions, I am proposing two major strategies in land use planning and decision making process: (1) “Where to” strategy, and (2) “How to” strategy. These two strategies are based on the premise that population and economic growth must be accommodated by smart and wise development where environment comes first. To put this premise in the words of Van der Ryn & Cowan (2007), we need to incorporate ecological vision into our future development guided by the principles of “make nature visible” and “design with nature”. Environmental damage of urban growth can be averted by protecting environmental resources of our ecosystem. Protection of environmental resources can be achieved through the kind of land use decisions and plans that ensure “where to” develop and “how to” develop without jeopardizing environment.

5.3 “Where to” Strategy

The “Where to” strategy is a selection process which finds the best place (land) for development. The selection process ensures that no development would happen in the areas of ecological importance. The areas of ecological importance are the areas where we find environmental resources that are vital to the functioning of our ecosystem. Environmental resources are the naturally engineered and manufactured products of our ecosystem through which we obtain countless and invaluable services as discussed in chapter 3. These are the tools through which human civilizations have been shaped and reshaped through time. These are the essential components of our ecosystem which have been either forgotten or neglected in land use decision making process. These are the victims of anthropogenic processes –

population and economic growth. Environmental resources are natural assets that have been used, overused and most often exploited by humans to satisfy their mounting demands, to quest for luxuries, and to chase unbound standards of living.

The "Where to" strategy seeks for the immediate, intellectual, and serious attention of planners, developers, planning agencies, governments and citizens for the protection of environmental resources because (a) we have already damaged or exploited environmental resources enough to endanger many plant and animal species, and (b) we can not afford to lose *Homo sapiens* from this whole ecosystem. Protection of resources involves all or at least one of the measures of conservation, preservation and regeneration. Now has come time for everybody to participate actively in a mission to conserve the resources that are left, preserve the ones that are threatened or endangered, and regenerate the resources that we have depleted or made extinct. This mission of conservation, preservation and regeneration of our environment depends upon our ability and willingness to recognize environmental resources and their importance while making land use decisions and performing land use practices.

5.3.1 Recognizing Environmental Resources

The main goal of "Where to" strategy is to recognize critical environmental resources that must be protected from development. Acquiring knowledge about the local environmental conditions is a prerequisite to recognize critical environmental resources. Environment varies from place to place so do the environmental resources and their characteristics. There are at least ten physiographic regions and provinces in the United States and Canada which have distinct characteristic landforms, drainage, soils, climate, vegetation, and land use (Marsh, 2010, p. 36). For example, the state of Texas which lies in the 'Interior Plains' region has different environmental characteristics than that of the state of Colorado which lies in the 'Rocky Mountain' region. Even within Texas, there are seven different physiographic provinces (Bureau of Economic Geology & The University of Texas at Austin, 1996) and eighteen different eco-regions (Osowski et al., 2005). It means environmental characteristics of one part of Texas could be different from that of other based on the physiographic provinces and eco-regions they are situated in. Different places (cities, counties, metropolitan areas etc.) have different types of ecosystems. The ability of ecosystem to provide the goods and services for human needs is directly impacted by land use choices we make. Therefore, it is very important to acquire 'local environmental information' of the place in order to identify important environmental resources of that place. Such information could then be used in land use planning and decision making process.

Local environmental information includes information about topography, geology, hydrology, vegetation and wildlife of that area. Each of these features may have certain characteristics based on their aesthetic values, conservation levels, ecological functions, economical values, and public health and safety issues. To understand local environmental information, the up-to-date record of 'environmental inventory' is essential. The environmental inventory is a collection of data and related information including characteristics of environmental resources present in a planning area (Berke, Godschalk, Kaiser, & Rodriguez, 2006)**.**

5.4 "How to" Strategy

The "How to" strategy comes into play after the identification of the best land for development through "Where to" strategy. It is a two step process. The first step focuses on the measures to protect critical environmental resources recognized by "Where to" strategy. For example, the "How to" strategy emphasizes on (a) what types of soil and slope are suitable for development, and (b) how close to wetlands, floodplains, lakes, rivers, endangered species hotspots ,and wildlife and other preserved habitats should developments happen. The second step focuses on the types of developments on the available land that respect ecological diversity, environmental security, economic viability, human creativity and sense of community. This is the step where planners, designers and builders can apply different planning approaches, design guidelines, and sustainability standards such as 'compact development', ‘LEED’, ‘new urbanism’ and ‘smart growth’ for the proposed development. In overall, the “How to” strategy seeks for the cooperative participation of businesses and developers for effective regulatory compliance, and enthusiastic involvement of citizens for non-regulatory compliance (Paehlke, 1998).

5.4.1 Step1: Measures to Protect Environmental Resources Recognized by “Where to” Strategy

After critical environmental resources are identified through the “Where to” strategy, the first task of “How to” strategy is to find out measures to protect those resources from development. In some cases developments should be prohibited completely, where as in other cases developments can be allowed with some specific guidelines depending upon the types and characteristics of the resources.

Marsh (2010) suggests that the optimum slopes for all kinds of land developments range from 0.05 to 3 %. However, the maximum allowable slope for housing is 20-25 %, highways with speed limit of 60 to 70 miles per hour is 4-5 %, other roads with speed limit of 50 miles per hour or less is 7-12%, and industrial sites is 3-4%. McHarg (1992) recommends that land with slope greater than 12 degree (20 %) is not suitable for urban development for the risk of soil erosion due to slope failure (p. 60). Marsh (2010) recommends that developments on land with organic and clayey soils should be avoided because (a) organic soils may lead to subsidence and drainage problems, (b) organic soils support valued communities of plants and animals, and (c) clayey soils provide poor foundation drainage due to shrinking and swelling with changes in soil moisture.

Many researchers and resource agencies have set ‘buffer’ requirements to minimize or prevent potential damage to water resources such as wetlands, streams, lakes and rivers including animal and plant species supported by them. A ‘buffer’ is a transitional land between the natural resources and the land that is subject to development (Castelle, Johnson, & Conolly, 1994). A buffer of 3 to 200 meters, depending upon the characteristics of natural resources and proposed development, is effective to protect wetlands and streams under most conditions

(Castelle et al., 1994). Several states have maintained different sets of buffer requirements for the protection of their water resources. For example, Idaho requires a minimum buffer of 75 feet for streams used for human water supply or fisheries and a minimum buffer of 5 feet for headwater streams with no fishery; Washington requires a buffer width of 5-100 feet; California's buffer width ranges from 50 to 200 feet based on stream slope and class; and in Oregon, a buffer of 25-100 feet or 3 times the width of streams is required (Belt, O'Laughlin, & Merrill, 1992). Semlitsch & Bodie (2003) argue that buffer width standards set by many states and resource agencies are not sufficient enough to protect terrestrial habitats surrounding wetlands, streams and rivers. They conclude that species groups of amphibians and reptiles with maximum mean values as shown in the table would likely to encompass all other groups and therefore that value could be used as the protection buffer.

Table 5.1 Buffer Requirement for Amphibians and Reptiles

Group	Mean Minimum (in meters)	Mean Maximum (in meters)
Frogs	205	368
Salamanders	117	218
Amphibians	159	290
Snakes	168	304
Turtles	123	287
Reptiles	127	289
Herpetofauna	142	289

Source: Semlitsch & Bodie (2003)

Apart from setting buffer width, more stringent measures are required to protect some of the environmental resources. Environmental areas of endangered or threatened species and critical habitat preserves identified by federal and state governments must be restricted completely from any kind of urban development. Land areas that are susceptible to flood risks should be avoided from development. According to FEMA, areas with at least one percent annual chance of flooding (26 % chance of flooding over the life of 30-year mortgage) are categorized as ‘Special Flood Hazard Area or SFHA’. FEMA requires homeowners within SFHA to buy flood insurance for their safety (Federal Emergency Management Agency, 2010). However, for reasons other than public health and safety such as biodiversity maintenance, water purification, agriculture productivity, etc, floodplains must be restricted from development (Tockner & Stanford, 2002).

5.4.2 Step2: Types of Development on the Available Land through “Where to” Strategy

Human demand for resources is often magnified by ‘lifestyle factors’ (Jarnagin, 2006). “How to” strategy is based on the assumption that individuals should choose the life style that is in harmony with nature. For example, individuals need to understand the environmental implications and health and safety issues of their choice to live in a single family house in an acre of land far from the city center because it is spacious; to live in a house adjacent to a lake or river because it is scenic; to build a house in a floodplain or wetland with all sorts of concrete impoundments because the damage will be covered by floodplain insurance in case of flooding. Sagoff (2005) claims that individuals display incompatible preferences as ‘citizens’ and ‘consumers’ stating that “I have an “Ecology Now” sticker on a car that drips oil everywhere it’s parked” (p. 133). He further argues that individuals should act as ‘citizens’ in making decisions about environmental resources rather than “as the “rational man” of economic theory simply because economic theory demands it” (p. 134). Dale et al. (2000) asserts that development on environmentally sensitive areas should be avoided by choice rather than regulations. For example, since the adoption of Endangered Species Act in 1973, over dozen species have gone extinct as opposed to its goal of halting and reversing the trend of species extinction (O'Connell, 1992, p. 142; Rohlf, 1991, p. 274). Paehlke (1998) argues that these kinds of environmental issues can be overcome through communities that are promoted and encouraged rather than regulated.

The “How to” strategy seeks for the new version of ‘American dream’ in order to make it compatible with the reality of changing environment. Calthorpe (1993) argues that the present days mesh of the metropolis (urban growth) is the reflection of the outdated ‘American dream’ and demand for the new vision of ‘American dream’:

> “The old suburban dream is increasingly out of sync with today’s culture. Our household makeup has changed dramatically, the work place and work force have been transformed, average family wealth is shrinking, and serious environmental concerns have surfaced. But we continue to build post-World War II suburbs as if families were large and had only one breadwinner, as if the jobs were all downtown, as if land and energy were endless, and as if another lane on the freeway would end traffic congestion.
>
> Over the last twenty years these patterns of growth have become more and more dysfunctional. Finally they have come to produce environments which often frustrate rather than enhance everyday life. Suburban sprawl increases pollution, saps inner-city development, and generates enormous costs – costs which ultimately must be paid by taxpayers, consumers, businesses, and the environment. The problems are not to be solved by limiting the scope, program, or location of development – they must be resolved by rethinking the nature and quality of growth itself, in every context” (p. 15).

The new version of ‘American dream’ favors the kind of development that promotes ecological and cultural diversity, provides environmental security, ensures economic viability, respects human creativity, and establishes the sense of community.

CHAPTER 6

CONCLUSION

In the context of the U.S., land use planning and policy making decisions are entrusted to local governments such as cities (Leung, 1989, p. 13). Usually, local governments regulate land development through building codes, platting regulations and zoning laws (Lahde, 1982, p. 2). Most of the cities adopt a future or long range plan called ‘master plan’ to determine the type of development in their cities. The ‘master plan’ is prepared by a ‘planning commission’ and approved by ‘public hearings’. It shows that land use planning and decision making process involves a participation of local pubic, professionals, legal experts, planners and many. Therefore, decisions made by these groups of people determine the future land development patterns and their implications to economy and environment. However, these decisions are neither untouched from politics nor free from vested economic interests. From each individual to enterprise and cities, everybody wants to grow continuously: growth is central to American politics and a secular religion of American society (Ophuls & Boyan, 2005, p. 191). As a result, despite the fact that land developments are regulated through codes, laws and regulations, most often lands are allocated in terms of real estate values, profits, and political pressures. We, voters, planners, professionals, developers, policy makers should understand that natural environment is too precious to be allocated on the basis of profits (T. L. Anderson & Leal, 1998, p. 207). If humans fail to live in harmony with nature, catastrophe is inevitable (Torgerson, 1998, p. 115).

Environmental resources are classic public goods of our society. The societal cost of making a poor or wrong decision about the allocation of these resources is enormous if we value each species that is extinct, and each acre of wetland that is lost. Only the well-informed and educated citizens can make better decisions and produce classic public goods (T. L. Anderson & Leal, 1998, p. 220). Therefore, citizens must be educated, and well informed about the benefits of natural ecosystems against having a big lot house far from the city center in an environmentally sensitive area. In addition, citizens must also consider it their obligation not only rights to be well informed about the future land use plans of their city and the impacts of these plans in the environment. Citizens, besides thinking about their stock market, retirement plan, Medicare and social security, should also concern themselves about the security of natural amenities.

Traditional administrative codes, laws and regulations alone neither did protect our environment nor will promise us security from natural catastrophe, unless we reverse our thinking towards environment. Reversing our thinking from contemporary profit laden mind to a fair ground of harmony between humans and nature requires a sense of "obligation to civilization to continue civilization" (Sagoff, 2005, p. 155). The continuation of civilization depends upon what we pass to our next generation. Should we pass our next generation the community with less biodiversity and more ecological hot spots, less wetlands and more paved lands, and more impaired rivers and less water or the community with full of environmental amenities? Our decisions matter.

First of all, land use or city planners should acquire knowledge and be well-informed about the local environment of their community (city) and make environmental inventory. The environmental inventory would provide a list of important environment factors that need to be considered while making planning decisions. Planners could obtain these information either by collaborating with federal and non-profit organizations such as EPA, USGS, Nature Conservancy, NatureServe, etc., and research groups or by doing their own research such as site visits, public participation, etc. Secondly, they should make environmental assessment of the future land use plans and identify the risks associated with the plans. Third, they should inform the planning commission and citizens about the environmental inventory and probable environmental implications of proposed or future land use plans without being biased with any political affiliation or economic profit.

Many argue that urbanization is one of the major drivers of land use change. Through land use change, it modifies natural landscape for several purposes such as housing, transportation, recreation and so on. Such modifications of natural land into urban land have provided space and opportunities for billions of people to live, work and raise their standards of living. Many believe that cities (urban areas) are ecosystems in themselves, called ‘urban ecosystems’ where we see complex and interesting interactions of social, biological, and physical components (Nilon, Berkowitz, & Hollweg, 2003, p. 2). But it is important to understand that urban ecosystems constitute only a small part of the larger ecosystem required to support the urban population (Rees, 2003, p. 123-124). Therefore, we must protect, not neglect, the whole natural ecosystems upon which humans depend for survival. We must not continue using urbanization as a weapon to dominate natural ecosystem. We need to bring a fundamental change in our thinking of understanding urbanization. We must not understand urbanization as an evil to environment. It is just a name given to the process how cities grow by size with increasing population growth and demand for goods and services. What we must understand is - urbanization does not drive land use change in an environmentally detrimental way without our decisions about how to use land and its resources.

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