SUSTAINABLE URBAN NEIGHBORHOODS

By

KARA SUZANNE STRONG

A THESIS PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF SCIENCE IN ARCHITECTURAL STUDIES

UNIVERSITY OF FLORIDA

2001

ACKNOWLEDGMENTS

I want to thank my thesis committee for their assistance in the completion of this thesis. Professor Nancy Clark focused my research and balanced the concerns of the other committee members. Professor Ira Winarsky provided excellent assistance in researching sustainability while Professor Luoni kept my case-study design appropriate to an urban environment.

I would also like to thank Professor Peter Prugh for his helpful advice in establishing my goals while studying at the University of Florida. Brad Guy, from the Center for Construction and Environment assisted me with his technical knowledge of all things sustainable. Jason Thiel, of the Jacksonville Economic Development Commission, provided valuable insight and information about the area in which I generated my thesis case-study.

Most importantly, I would like to thank David E. Johnson for his constant support and understanding. I never would have considered undertaking graduate research without his instigation. I especially appreciated his unceasing willingness to review my work as it evolved. The clarity of this document is largely thanks to him.

TABLE OF CONTENTS

page

APPENDICES

LIST OF TABLES

LIST OF FIGURES

Abstract of Thesis Presented to the Graduate School
of the University of Florida in Partial Fulfillment of the
Requirements for the Degree of Master of Science in Architectural Studies

SUSTAINABLE URBAN NEIGHBORHOODS

By

Kara Suzanne Strong

December 2001

Chairman: Nancy Clark
Major Department: Architecture

Many inner city neighborhoods in the United States suffer from neglect and underutilization while suburban sprawl increases. Creating new housing subdivisions in formerly rural environments and the consequent overdependence on the automobile is environmentally unsustainable. A more sustainable alternative involves reusing previously developed land in an environmentally sensitive manner. Cities provide an excellent opportunity for creating dense sustainable neighborhoods that use existing infrastructure while providing a direct connection to employment and services. This thesis proposes a methodology for designing sustainable urban neighborhoods that integrate green materials, energy-efficient buildings and sustainable development practices in formerly underdeveloped areas.

Analogous to natural ecosystems, a successful sustainable urban neighborhood functions interdependently. As much as current technology allows, each component within the neighborhood is designed to limit external resource needs and generated wastes. Within the neighborhood, resources are used more efficiently by designing the sustainable urban neighborhood from the smallest component to the largest system. Materials are carefully selected for their minimal environmental impact and are detailed to generate minimal

construction waste and to allow ease of disassembly. Each building is designed to use natural systems for heating, cooling, and ventilation while allowing flexibility for future adaptations. Land uses within the neighborhood are organized to maximize transportation alternatives while maintaining the closed-loop system. By incorporating the proposed neighborhood's local vision, climate, infrastructure, resources, and circulation patterns, descriptive recommendations were developed for the design of a sustainable urban neighborhood.

To test this methodology, an existing urban neighborhood was designed using the proposed guidelines. Jacksonville, Florida is an example of a largely underdeveloped central city surrounded by sprawling suburbs. The Brooklyn neighborhood in particular currently suffers from economic neglect and may soon be redeveloped by the City. While the city's vision recommends a transit-oriented development in order to minimize transportation requirements, the sustainable urban neighborhood alternative proposes a design that encourages energy efficiency throughout the development.

The proposed Brooklyn design shows that a sustainable urban neighborhood is more sensitive to natural systems and requires less energy to maintain. When compared to the current zoning or approved master plan, the proposed sustainable urban neighborhood has a greater variety of transportation alternatives while decreasing the amount of paved surfaces. Stormwater is retained naturally within the site that requires minimal cost to install and maintain; and it can recharge the aquifer. The increased percentage of mixed-use development generates an active neighborhood and enables resources to be used efficiently. The efficiency of the design is reinforced through the analysis of the prototype house. When compared to conventional construction and design, the prototype generates approximately seven thousand pounds less carbon dioxide per year and requires 22% less energy to operate than conventional construction. The analysis suggests that using the proposed guidelines for designing sustainable urban neighborhoods creates energy-efficient communities.

CHAPTER 1
INTRODUCTION

Nature of the Problem

Due to human consumption and destruction of natural resources, the earth's natural systems have been stressed nearly to the point of collapse. The temperature of the Earth's surface is strongly influenced by the existence, density, and composition of its atmosphere. Many gases in the Earth's atmosphere such as water vapor, carbon dioxide, methane, and nitrous oxide absorb infrared radiation reradiated from the surface, trapping heat in the lower atmosphere.[1] Without this natural greenhouse effect, the Earth would be a frozen planet. Since the Industrial Revolution, anthropogenic emissions have greatly increased the concentrations of greenhouse gases and are now beginning to affect the climate. Carbon dioxide, the most significant anthropogenic greenhouse gas, has increased in atmospheric concentration by 31% since 1750. Approximately 75% of anthropogenic emissions of carbon dioxide originate from fossil fuel burning; the remainder is mostly due to deforestation.[2] The increase in concentration of greenhouse gases in the atmosphere has led to increased global temperatures (1° F since 1961), reduced snow and ice cover (a 10% reduction since the late 1960s) and rising sea levels (approximate six inches during the 20th century).[3]

---

[1] Paul McArdle et al., Emissions of Greenhouse Gases in the United States 1999 [online] (Washington D.C.: Energy Information Administration, Office of Integrated Analysis and Forecasting, U.S. Department of Energy, 2000 [cited 13 April 2001]); File no. DOE/EIA-0573(99), available from ftp://ftp.eia.doe.gov/pub/oiaf/1605/cdrom/pdf/ggrpt/057399.pdf, 1.

[2] Daniel L. Albritton et al., Summary for Policymakers: A Report of Working Group 1 of the Intergovernmental Panel on Climate Change [online] (Geneva, Switzerland: Intergovernmental Panel on Climate Change, 2000 [cited 13 April 2001]); available from http://www.ipcc.ch/pub/spm22-01.pdf, 7.

[3] Ibid., 14.

The United States contributes more to greenhouse gas emissions than any other nation. While the country constitutes only 4.6% of the world's population,[4] it emits 24.7% of the world's carbon dioxide emissions from fossil fuels,[5] These emissions are divided into the sectors of transportation (33% of total US emissions), industrial (32%), residential (19%) and commercial (16%).[6] Given that motorized vehicles contribute approximately 85% of carbon dioxide emissions in the transportation sector,[7] this suggests that US vehicle emissions alone contribute nearly 7% of world carbon dioxide emissions.[8]

Within the construction industry, fossil fuel dependency can be reduced in several ways. This thesis recommends reducing the need for vehicular transportation, which is the single largest anthropogenic contributor to the greenhouse effect. The current practice of constructing new subdivisions on former greenspaces requires long commutes into the city to access employment. Between 1969 and 1995, the average commute, in miles, has increased 25%, and in 1995 commuting comprised 31% of all vehicular travel.[9] To reverse this trend, this thesis recommends constructing new mixed-use neighborhoods in underdeveloped urban areas. The

---

[4] U.S. Census Bureau. POPClocks [online] (Washington D.C.: Census Bureau, 2001 [cited 13 April 2001]); available from http://www.census.gov/main/www/popclock.html.

[5] Michael J Grillot et al., International Energy Annual 1999 [online] (Washington D.C.: Energy Information Administration, Office of Energy Markets and End Use, U.S. Department of Energy [cited 13 April 2001]); File no. DOE/EIA-0219(99), available from http://www.eia.doe.gov/pub/pdf/international/021999.pdf, 227-228. In the United States, 98% of carbon dioxide emissions resulted from the combustion of fossil fuels, from Paul McArdle et al., Emissions of Greenhouse Gases, viii.

[6] McArdle et al., Emissions of Greenhouse Gases, ix.

[7] U.S. Department of Transportation, Bureau of Transportation Statistics, Transportation Indicators [online] (Washington D.C.: Department of Transportation, 2001 [cited 13 April 2001]); available from http://bts.gov/transtu/indicators/Environment.pdf, 90.

[8] An amount which, if accurate, exceeds the carbon dioxide emissions of fossil fuels for every other country, save China. See Michael J Grillot et al., International Energy Annual 1999, 227-228.

[9] Patricia S. Hu and Jennifer R. Young, Summary of Travel Trends: 1995 Nationwide Personal Transportation Survey [online], prepared for the U.S. Department of Transportation, Federal Highway Administration (Washington D.C.: U.S. Department of Transportation [cited 27 May 2001]); available from http://www-cta.ornl.gov/npts/1995/DOC/trends_report.pdf, 13. The remainder of vehicle travel consists of shopping (13% of total travel), personal business (21%), social and recreational (23%) and miscellaneous (30%).

new development can then reuse existing infrastructure while preserving existing rural land. If Americans return to living within the city while using alternative forms of transportation, the nation can begin to reduce its dependency on the automobile.

While constructing new neighborhoods in existing cities can decrease the consumption of fossils fuels by reducing American dependence on cars, a more sustainable urban neighborhood also results in reduced commercial and residential use of fossil fuels. Considering that the construction industry consumes 30% of the total national energy,[10] more efficiently designed structures significantly reduce American energy requirements. This goal is accomplished by replicating natural climax ecosystems with a diversity of systems that are interconnected and energy-efficient. Specifically, a sustainable urban neighborhood must consider material selection, building design and the development layout in order to reduce its external energy requirements and waste.

Sustainable Urban Neighborhoods as Part of a Natural System

Ideally, a sustainable urban neighborhood functions similar to natural systems. Natural systems strive to maintain a balance, or steady-state between its various components, eventually reaching climax status.[11] In climax ecosystems, all available energies are used within the system. The system reuses or recycles all waste, maximizing its available power. Greater diversity increases the stability of the system by making it less susceptible to external disturbances. A disturbance may affect one component of the system, but it should not damage the entire ecosystem, as it might in a monoculture system. Instead, the climax ecosystem should repair the damage to the system and return to equilibrium.

---

[10] Charles J. Kibert, Jan Sendzimir and Brad Guy, "Construction ecology and metabolism: natural system analogues for a sustainable built environment," Construction Management and Economics 18 (2000): 913.

[11] Paragraph is summarized from Howard T. Odum, Elisabeth C. Odum and Mark T. Brown, Environment and Society in Florida (Boca Raton, FL: Lewis Publishers, 1998), 63-71.

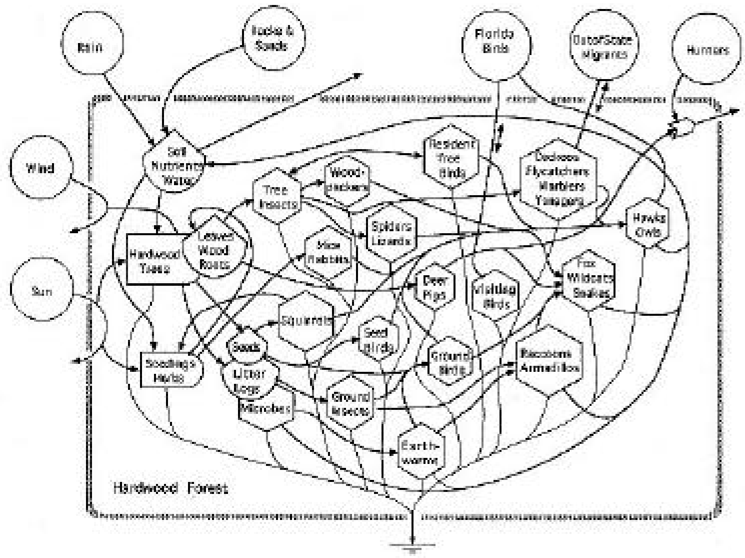

Figure 1: System Diagram of an Evergreen Hardwood Forest. Howard T. Odum, Elisabeth C. Odum and Mark T. Brown, Environment and Society in Florida (Boca Raton, FL: Lewis Publishers, 1998), 210.

The energy model of the sustainable urban neighborhood represents the interconnectedness of the proposed system. While energy flows from low energy sources to higher ones, reusing or recycling wastes within the neighborhood reduces its external energy requirements. Since all of the products used within the neighborhood cannot be produced within an urban environment, this model shows the additional components as part of the ecological footprint for the neighborhood. Sensitive design responses reducs the neighborhood's required support region by minimizing the need for components not produced within the neighborhood.

Similar to all natural systems, energy flows from the sun, wind and rain are the foundation for the entire system. The energy flows create the local microclimate and ecosystems and they fuel local industries and agriculture. The ecosystems in turn support urban agriculture and other vital green spaces within the neighborhood. These resources also create renewable materials for use in residential, commercial and industrial sectors.

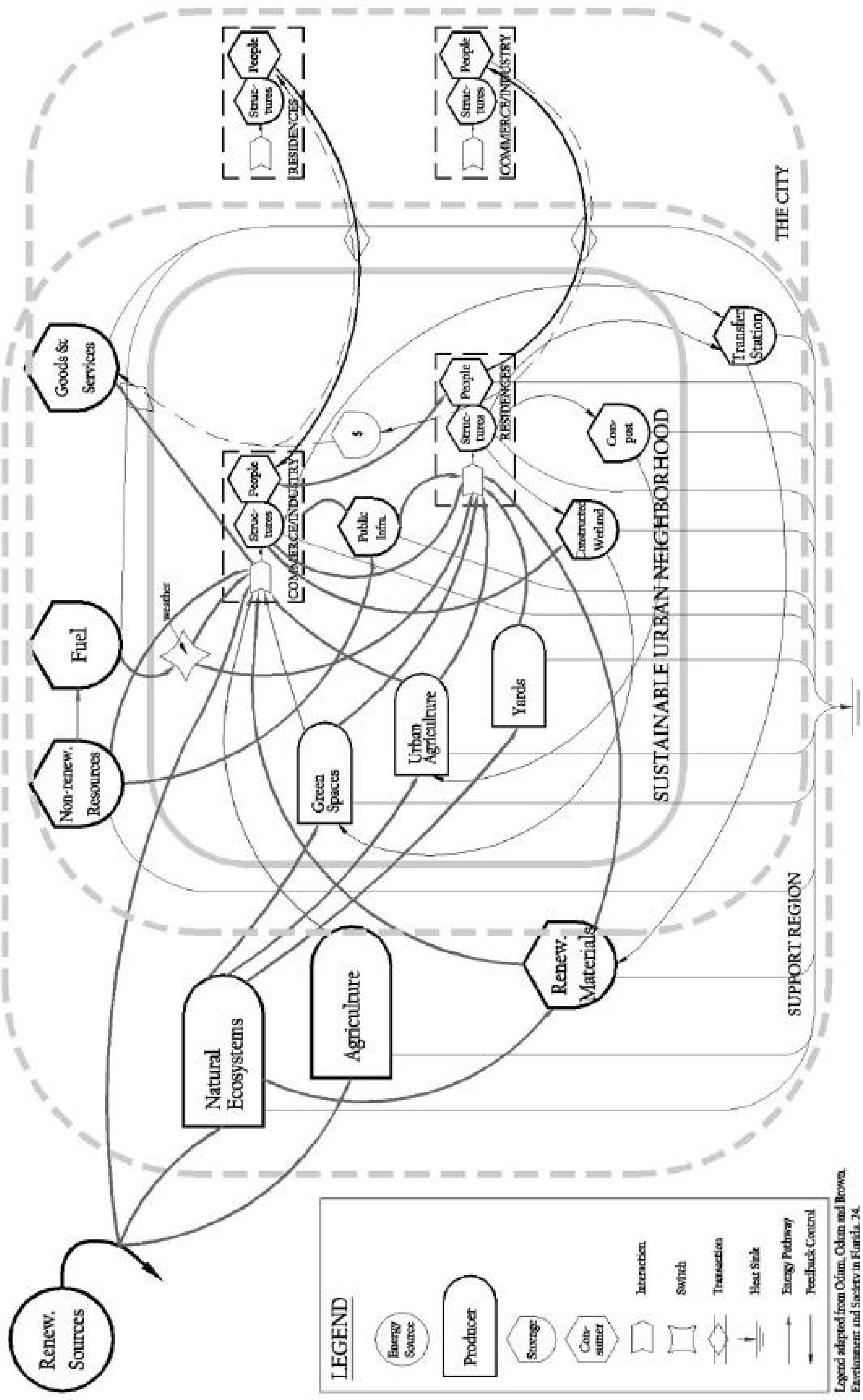

Figure 2: System Diagram of a Sustainable Urban Neighborhood.

Goods required by the neighborhood are processed by the commercial sector. The people within and without the neighborhood supply the labor to produce these goods and other functions within the city. Money circulates through the local economy, flowing in from the sale of goods processed by the neighborhood and flowing out to pay for services not generated within the neighborhood.

Fuel and power sources required by the sustainable urban neighborhood are ideally generated from renewable sources, such as sun, wind and rain. During periods when these sources are unavailable, fuels from non-renewable sources are utilized. The components within the neighborhood are designed to minimize energy and goods produced from nonrenewable sources.

Wastes generated by the sustainable urban neighborhood are recycled back into the system and used as an energy source. Wastewater can be treated within the neighborhood and used for irrigation while food wastes can be composted and used for fertilizer. Whenever possible, waste products are sorted for recycling and waste construction materials are salvaged and reused in other neighborhood construction projects. Reusing neighborhood wastes locally reduces external energy requirements.

The interconnected nature of the sustainable urban neighborhood energy model suggests that components should not be added or removed without considering the impact to the overall system. Each component has unique energy requirements and generates wastes that the system must accept. If the system cannot adapt to the proposed change, external energy sources are required in order to the restore balance within the system. An interdependent neighborhood requires a smaller support region than a conventional one, but the interdependent neighborhood requires greater sensitivity during its design, development and operation.

Elements of a Sustainable Urban Neighborhood

By definition, a sustainable development occurs only when the development is balanced between ecological viability, economical feasibility and social desirability.[12] The ecological objectives of any sustainable development should include restoring the natural ecosystem and maximizing the diversity of natural systems. No development is possible unless it can be constructed within the means of its developers. The social objectives of a sustainable development require the design to be a response to the needs of those intended to live within its boundaries. This involves local participation in the design process, maintaining a cultural identity, and allowing for social mobility. Although the emphasis given to each of these objectives is subject to interpretation, all of them should be included in a truly sustainable development.[13]

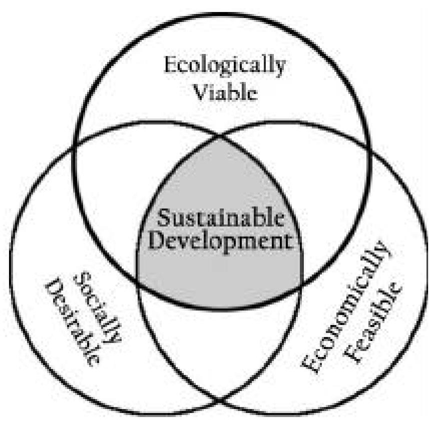

Figure 3: Components of Sustainable Development. Adapted from C. Lee Campbell and Walter W. Heck, Principles of Sustainable Development, ed. F. Douglas Muschett (Delray Beach, FL: St. Lucie Press, 1997), 56.

This thesis focuses on the ecological feasibility of the proposed guidelines. Specifically, this thesis compares the inputs and outflows of the existing neighborhood to the proposed

---

[12] C. Lee Campbell and Walter W. Heck, Principles of Sustainable Development, ed. F. Douglas Muschett (Delray Beach, FL: St. Lucie Press, 1997), 56.

[13] Ibid., 55.

sustainable urban neighborhood. Social desirability and economic feasibility are addressed through the review and application of reports produced by the local government.

Benefits of Urban Development

On average, fifteen percent of American urban land is vacant. The strategic reuse of urban vacant land and abandoned structures represents a key opportunity to encourage greater density and reduce the development of suburban or rural greenfields.[14] Building in urban environments allows developments to use existing infrastructure, such as utilities, water and roadway systems, which constitutes significant expenditures in greenfield development. People who live within central cities are less dependent on automobiles for transportation because of the close proximity of employment and services. A properly planned urban neighborhood provides opportunities for their residents to walk, bicycle or take public transportation to other parts of the city.

Neighborhood Scale

This thesis attempts to develop the sustainable urban neighborhood as part of a natural system. The urban neighborhood is perhaps the smallest unit that one can visualize all of the components as part of a natural system. The sustainable urban neighborhood is presented at three separate scales in order to focus on specific components of the system (see Figure 2). These components are designed sustainably within the scale under consideration and with the overall system. For example, the neighborhood scale addresses the major components and land uses and how they connect and interrelate to form a cohesive system. The building scale of this thesis increases the focus of the project by approximately fifty times in order to visualize individual structures. This scale includes not only the building forms, but also the internal and external systems adjacent to the buildings. The materials scale takes an even closer view of the

[14] Michael A. Pagano and Ann O'M. Bowman, "Vacant Land in Cities: An Urban Resource," The Brookings Institution [online] (Washington D.C., December 2000 [cited April 27, 2001]); available from http://brook.edu/es/urban/pagano/paganofinal.pdf, 1.

neighborhood. At this scale, the thesis considers both the selection of materials and how the materials are connected to form energy-efficient buildings.

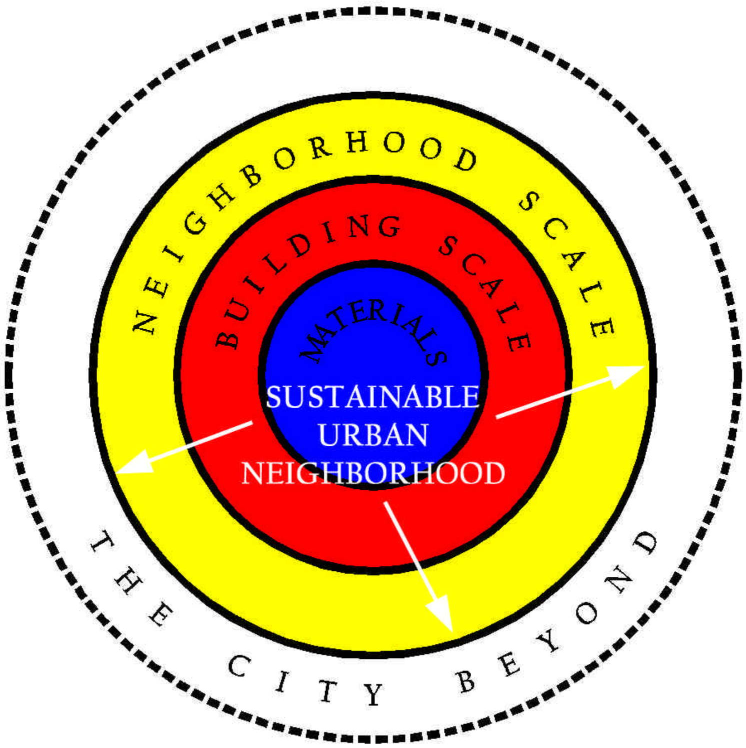

Figure 4: Cross Sectional Model of a Sustainable Urban Neighborhood

Methodology of Investigation

This thesis begins the investigation of sustainable urban neighborhoods by considering precedents for each scale. By analyzing existing theories for sustainable developments, energy-efficient structures and green materials, this research helps define the ideal components of the sustainable urban neighborhood.

Next, the thesis defines the guidelines for creating sustainable urban neighborhoods from the neighborhood, building and material scales. These guidelines are sufficiently general so that they can be applied to any urban environment.

To test the hypothesis that an existing urban environment can be redeveloped sustainably, the remainder of the thesis focuses on a case-study of a sustainable urban neighborhood designed based on the guidelines presented in chapter three. Chapter four summarizes the local vision and existing site conditions. Chapter five illustrates the proposed neighborhood design, requirements for energy-efficient structures and recommended green materials. Chapter six compared the proposed neighborhood design to the current zoning and the local vision as well as the environmental benefits of the prototype house to a more conventional one.

The final chapter summarizes the lessons learned in the formation and testing of this thesis. A series of observations and a final conclusion addresses the viability of developing guidelines for sustainable urban neighborhoods.

CHAPTER 2
HISTORICAL CONTRIBUTIONS TO SUSTAINABILITY

A sustainable urban neighborhood should be designed at three different scales: the use of materials, how the materials combine to form structures, and the organization of structures within the overall neighborhood. Each scale must be designed environmentally sensitive within itself and it must also be integrated within the entire system. Therefore, consideration of how each scale has been designed sustainably in the past in order determines how it should be adapted to the sustainable urban environment. For example, while transit oriented developments provide an alternative to automobile dependency by providing goods and services within walking distance of the entire neighborhood, these developments generally are not responsive to climate or other environmental factors. In contrast, much indigenous architecture evolved as a response to the local climate and available materials, and therefore provides many examples of energy efficient design that uses environmentally sensitive materials. No standard exists for determining if a material is 'green', but materials selected for use in the sustainable urban neighborhood should minimize the environmental impact of new construction over its entire life cycle and contribute to the overall energy efficiency of the structure. A better understanding of how these elements have been previously understood leads to a more complete understanding of the components within the sustainable urban neighborhood.

Transit Oriented Developments

Commuting to the city from the suburbs is not a recent phenomenon. For example in 1827, the omnibus transformed the residential make-up of larger cities in the United States. Those able to afford the omnibus were able to escape the crowded city and live in the outlying districts and thereby became the first commuters.[15] By the late nineteenth century, a series of technological advances in transportation and communication accelerated the process of urban population deconcentration. The advent of the trolley, rapid transit and the automobile extended the commuting distance between one's residence and place of employment.[16] This pattern of low-density growth greatly increased after World War II with the advent of federal legislation that provided low-cost builder and buyer programs, as well as a massive highway-construction program that made it easier for people of modest means to live away from their city jobs and activities. Unfortunately, the new suburban communities consisted almost exclusively of low-density single-family residences and did not provide pedestrian access to shopping or other basic services. The resulting sprawling developments are automobile-dependent and wasteful of natural resources.[17] A more sustainable development shall respect the environment and allow residents to access employment and shopping through less energy intensive methods of transportation. Transit-oriented development, or TOD, consists of a high-density, mixed-use, pedestrian-oriented environment within convenient walking distance of a transit station. While TOD's must be modified to maximize energy efficiency and reflect modern shopping habits, this concept can create an environment where one may socialize, work, and shop within short walking distance of home.[18]

The basic principle for all transit-oriented developments, regardless of location, is straightforward: they must be mixed-use, pedestrian-oriented and support all income levels. A

---

[15] Howard P. Chudacoff, and Judith E. Smith, The Evolution of American Urban Society (New Jersey: Prentice-Hall, Inc., 2000), 86-87.

[16] Edward S. Shihadeh and Graham C. Ousey, "Metropolitan Expansion and Black Social Dislocation: The Link between Surburbanization and Center-City Crime," Social Forces 75(2) (1996): 652.

[17] John J. Macionis, and Vince Parrillo, Cities and Urban Life (New Jersey: Prentice-Hall, Inc., 2000), 106.

[18] David Salvesen, "Promoting Transit-Oriented Development," Urban Land, July 1996, 31.

successful TOD minimizes private space in order to maximize public areas.[19] A TOD neighborhood has a central core consisting of a public transit station that is the focal point of the neighborhood. Within 1,200 feet of the station, which represents a reasonable walking distance, is a mix of shopping centers, office facilities, and multi-family housing.[20] Farther from the center but within a ten-minute walk of the transit station, the development is less dense and more residential, eventually becoming single-family housing.[21] Reinforcing the multimodal nature of these developments, TOD's are combined with multiple pedestrian and bicycle routes, increasing the resident's travel options. Aesthetically, buildings should address the street and sidewalk with entries, balconies, porches, architectural features, and activities that help create safe, pleasant pedestrian oriented environments. Building densities, orientation and massing should promote more active commercial centers, support transit, and reinforce public spaces. The architectural detail should also show a strong connection to human scale.[22]

In suburban areas, transit-oriented developments require both a private market for denser, less automobile dependent neighborhoods and governmental approval of higher density development near stations. Public policies that allow intensive building adjacent to stations and promote transit-friendly design can generate the most efficient use of travel opportunities afforded by transit service. Further, transportation and land use planning agencies must work together to develop locations for transit-oriented development. Both organizations benefit from

---

[19] Peter Calthorpe, The Next American Metropolis: Ecology, Community and the American Dream, (New York: Princeton Architectural Press, 1993), 53.

[20] Ibid., 55.

[21] Roxanne Warren, abstract of The Urban Oasis: Guideways and Greenways in the Human Environment [online] (New York: McGraw-Hill, [cited 22 January 01]); available from http://faculty.washington.edu/~jbs/itrans.

[22] Calthorpe, American Metropolis, 65.

this synergy, since a successful TOD offers transit agencies a means to increase ridership while providing cities a mechanism to generate less resource intensive development.[23]

Reducing Dependence Upon Natural Resources

Perhaps counterintuitively, compact urban regions provide better opportunities for healthy ecological systems than suburban development and rural density housing. By creating denser developments less dependent on the automobile for transportation, transit-oriented developments use fewer natural resources, are better able to recycle wastes, and allow for more natural biodiversity than conventional developments.[24] By locating new TODs in underutilized places near urban centers, consumers are closer to the areas of production and distribution. In addition, dense urban developments reduce the need to destroy rural greenspaces or agricultural land in order to create additional housing.

In the United States, the automobile and its supporting services and infrastructure, such as roads and highways, significantly contribute to the destruction of the natural environment and resources. If land use configurations support alternatives to the car, then many positive results are possible: people may choose to walk, bike and use transit more often; they can combine trips more easily; and because of these changes, slowly reduce their overdependence on the automobile.[25] According to one authority, properly planned transit-oriented developments may reduce automobile travel by 20-25% compared with conventional developments.[26]

---

[23] David Salvesen, "Promoting Transit-Oriented Development," 87.

[24] Urban Sustainability Learning Group, Staying in the Game: Exploring Options for Urban Sustainability (Chicago, IL: The Tides Center, 1996), 24.

[25] Calthorpe, American Metropolis, 46.

[26] "Transit Oriented Development" Online TDM Encyclopedia [online] (Victoria, British Columbia: Victoria Transport Policy Institute, 2001 [cited 22 January 2001]); available from http://www.vtpi.org/tdm.

Taking the Next Step

Transit-oriented development does create the possibility for significant automotive energy and air pollution reductions as well as an improved community fabric. However, TOD planners do not provide specific recommendations for adapting to the local climate.[27] In fact, some proponents of TOD's believe that planners can 'go too far' in bringing nature into human settlement. They state that 'urban vitality' should not be sacrificed for green space and the development should not be designed while considering the buildings' energy-efficiency.[28] This theory does not consider that a carefully designed development can be both environmentally responsible and meet the needs of the community.

When planning new developments also consider that store are generally increasing in size and thus require larger catchment areas.[29] The success of a transit-oriented development depends on the profitability of businesses located within the TOD. Unprofitable businesses relocate, reducing the TOD to a solely residential development. Today, commercial businesses prefer larger structures to take advantage of economies of scale and therefore require a large market area. Consumers who prefer to buy cheaply and have a large selection readily available reinforce this marketing strategy. Since most TOD's are designed for a maximum of 5,000 people, they cannot support large retail structures, which require population levels in excess of 10,000 people.[30] In addition, large stores do not easily fit within the dense scale of a TOD.[31] In order for

---

[27] Charles J. Kibert and G. Bradley Guy, "Abacoa: A Model for Sustainable Land Development," Land Development. Spring-Summer 1997, 25-29.

[28] Calthorpe, American Metropolis, 44.

[29] Randal O'Toole, The Vanishing Automobile and Other Urban Myths (Bandon, Oregon: Thoreau Institute, 2001), 136. Catchment area refers to number of people who can access the business. This number is dependent on the desired transportation method. In TOD's, where pedestrians generally access businesses, the catchment area is limited to a half-mile walking radius.

[30] Joseph de Chiara, Julius Panero, and Martin Zelnik, eds., Time-Saver Standards for Housing and Residential Development, 2nd ed. (New York: McGraw-Hill, Inc., 1995), 10. Supermarkets require a minimum of 10,000 people in the catchment area while department stores or shopping centers require 20,000 people.

TOD's to become a viable alternative to conventional developments, transit oriented developments must respect the reality of current shopping habits. Many people may be tempted to return to the automobile to do their shopping, unless TOD's can be adapted to provide sufficient population to support larger shopping centers.

Recommendations

While mass transit initiated sprawl, it now can contribute to the reversal of its damaging effects of sprawl not generated by automobile usage. People can become less dependent on the automobile when commercial and residential uses are clustered around transit stops, allowing other transportation options. Transit oriented developments require less land per person because of their density. Both of these factors improve air quality and minimize our dependence on non-renewable resources. However, transit-oriented developments should go further to minimize their impact on the environment. New developments should be more responsive to climatic and ecological influences. A more site-specific master plan improves the potential environmental benefits of the design. The designers of these developments must also consider the economic concerns of the commercial enterprises they wish to attract. The potential of transit-oriented developments to reduce automobile usage is unquestioned, but its guiding principles require refinement.

Passive Solar Design through Indigenous Prototypes

Until the advent of cheap fossil fuels in the middle to late 1800s, people typically oriented their homes and commercial buildings to maximize natural lighting and solar thermal gain. They used renewable resources such as hydropower, wind and biomass, for additional heating and

[31] John Niles and Dick Nelson, "Measuring the Success of Transit-Oriented Development: Retail Market Dynamics and Other Key Determinants," paper presented at the American Planning Association, National Planning Conference, Seattle, Washington, 24-28 April 1999, 6.

ventilation requirements.[32] In early American homes, architectural style was not as important as developing a response to the local site conditions and building with available materials. Indigenous architecture therefore provides many useful examples of passive solar design principles. A better understanding of indigenous responses to climate and the use of available materials suggests improvements to modern energy-efficient house design.

Cold Climate Design

Covering most of the Northern United States, above 40° latitude, the cold climate features cloudy, cold winters and bright, warm summers. During the winter, prevailing winds generally originate from the northwest while hot summer afternoons the wind is out of the south-southwest. While most of the precipitation is during the summer, structures must accommodate large amounts of winter snow.[33]

In the extreme northeast, early Americans had to work hard to stay warm. New England Colonial houses were constructed of local timbers and usually consisted of one main space with a centrally located fireplace – that doubled as both a space heater and a cook stove. Architectural strategies helped to warm the interior. Windows were oriented to the south or west to allow in solar warmth and light the indoor space, while the colder north elevation, was generally windowless. The saltbox form illustrates how early American architecture adapted to the reality of harsh winters. The distinctive long roof reached almost to the ground on the north side to deflect the strong winter wind while allowing a second story on the warmer south elevation.[34]

---

[32] Steven J. Strong, Reshaping the Built Environment: Ecology, Ethics and Economics, ed. Charles J. Kibert (Washington, D.C.: Island Press, 1999), 89.

[33] Victor Olgyay, Design with Climate: Bioclimatic Approach to Architectural Regionalism (Princeton: Princeton University Press, 1963), 153.

[34] Jim Kemp, American Vernacular: Regional Influences in Architecture and Interior Design (New York: Viking Penguin Inc., 1987), 17.

Figure 5: Saltbox Construction. Reprinted from Jim Kemp, American Vernacular: Regional Influences in Architecture and Interior Design (New York: Viking Penguin Inc., 1987), 38.

Modern structures built in cold climates should follow the energy efficient principles of saltbox construction. Ideally, the structure should emphasize retaining heat and radiant absorption, while minimizing conduction or evaporation loss. Due to the long winter season, conservation of heating is a higher priority than providing for summer comfort, although both needs should be met by the design. To maximize heat gain, orient structures along the east-west axis. In residential forms, two-story houses under one common roof are preferable for compactness. Locate the main living spaces along the warmer southern elevation and storage rooms and garages along the cold northern face of the building. In addition, evergreen windbreaks in the direction of winter winds shelters the structure while deciduous trees or a roof overhang along the southern elevation cool the building in the summer.[35] When adapted to modern technologies, the saltbox form remains an ideal response to cold climate requirements.

[35] Olgyay, Design with Climate, 155.

Temperate Climate Design

In most of the United States, the weather is balanced between hot summers and freezing winters. As with the cold climate, winter winds come from the northwest while summer winds originate from the south-southwest direction. Precipitation is also evenly distributed, with snow cover lasting only a few days during the winter. The summer tends to be rather humid with the west-facing exposures becoming overheated.

In the western United States, timber was not always available in sufficient quantities for house construction. While suitable clays existed for brick construction, the fuel to fire the bricks did not exist for early American settlers. Much of the best agricultural land of the plains was covered with thick soils that prevented access to the underlying rock for use as building stone. Therefore, pioneer settlers developed techniques of building with sod. Sod construction consisted of cutting the uppermost few inches of soil, along with the interlocking roots of the tough plains grasses, into rectangular sections with a special plow. These were then laid like bricks to make thick earthen walls that provided excellent insulation from both summer heat and winter cold.[36]

This region permits the most flexible structural forms. Because temperatures are within acceptable human comfort ranges throughout most of the year, provide a strong connection between interior and exterior spaces. Elongated buildings to encourage cross-ventilation should be provided. Locate bedrooms along the cooler east elevations and place outdoor living spaces on the south. Similar to cold climate construction, locate tree breaks against the northwest winter wind direction and provide deciduous shade trees along the south and west elevations.[37] While sod house construction is no longer appropriate to modern ventilation requirements, modern equivalents, such as earth berming and rammed-earth construction are effective means of

---

[36] Virginia McAlester and Lee McAlester, A Field Guide to American Houses (New York: Alfred A. Knopf, Inc., 1984), 86.

[37] Olgyay, Design with Climate, 161.

minimizing temperature swings as well as utilizing a locally available renewable material. Sod roofs, applied over modern roof systems, insulates the home while absorbing stormwater.

Figure 6: Sod Construction. Reprinted from Kemp, American Vernacular, 124.

Hot Arid Climate Design

This region is characterized by large daily temperature swings and intense sunlight with the hottest part of the building along the western face. Unlike the cold and temperate climates, the prevailing breeze follows the east-west axis. This part of the country receives minimal rainfall, and therefore water conservation is extremely important.

In the southwestern United States, early Spanish-American houses were constructed of adobe bricks. Adobe is a particularly durable material made by blending soil, water and straw and formed into bricks. The adobe brick walls were often two to three feet thick with small windows, forming a thermal mass that absorbed the heat during the day and released the heat into the home during the relatively cooler evenings. The exterior of the houses were coated with a protective layer of whitewash, which also reduced the heat load. Adobe houses typically began as a single space, rooms were later added to form an internal courtyard. The courtyard is partially covered to create a sheltered connection between rooms.[38] Each room was accessed through the courtyard, placing the house circulation on the exterior and allowing trapped heat to escape during the evening while providing outdoor sleeping spaces.

Figure 7: Adobe Construction. Reprinted from Virginia McAlester and Lee McAlester, A Field Guide to American Houses (New York: Alfred A. Knopf, Inc., 1984), 134.

The adobe house illustrates that encouraging heat loss is the guiding principle of design in hot and humid climates. Design the floor plan to require a minimum of movement. To minimize solar loads, locate non-inhabited spaces on the overheated west exposure. In addition, use light exterior colors to reduce heat absorption.[39] The massive walls of adobe construction continue to be utilized as a successful means of absorbing heat during the day while keeping the interior spaces cool, and releasing it during the cooler evenings.

Hot Humid Climate Design

Unlike the hot arid climate, this region is characterized by minimal daily temperature variations. Ocean breezes predominate along the Atlantic and Gulf coasts, while wind velocity is less than ten miles per hour for the remainder of the region. Summer breezes originate in the

[38] Virginia McAlester and Lee McAlester, Field Guide, 132.

[39] Olgyay, Design with Climate, 167.

south while winter wind comes from the north. Most of yearly rainfall comes principally during the summer months. The most significant design concern is the constant humidity. During the summer months, outdoor humidity rises well above the comfortable range.

In the southeast, air circulation provided the only means of cooling early American houses. The dogtrot house featured an open breezeway that extends through the center of the house, which separated the overheated kitchen from the rest of the house. In addition, these houses were located several feet above ground. With this design, cooling breezes flowed though the breezeway, under the floor and above the roof, allowing ventilation in several directions. Originally, the houses were constructed of locally available wood walls and tin roofs. The roof deflects the heat of the sun and its large overhang shaded the exterior walls and windows.[40]

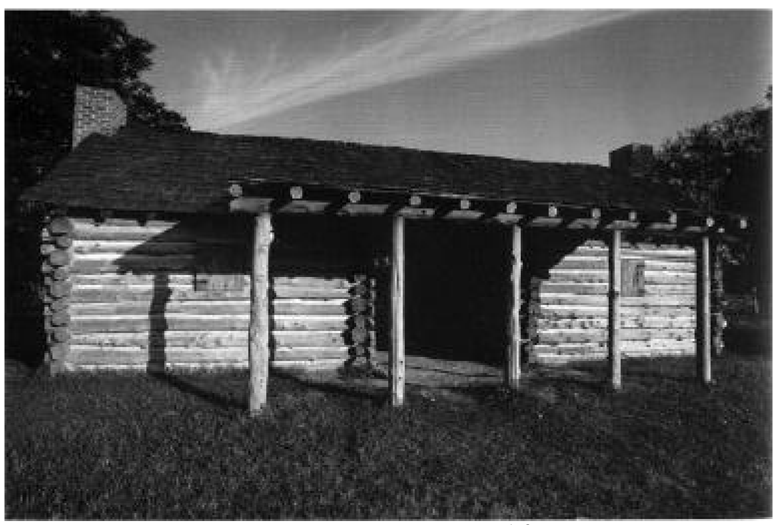

Figure 8: Dogtrot Construction Reprinted from Kemp, American Vernacular, 78.

As the dogtrot house illustrates, buildings in the hot humid climate should encourage air movement. Where possible, maximize surface area to encourage air circulation. Sun radiation builds up continuously during the day, requiring large shaded areas throughout the year. Heat

[40] Kemp, American Vernacular, 78.

and moisture-producing areas should be isolated from the remainder of the house.[41] In addition, any trees placed near the home should have high branches to allow breezes to pass below while providing some shade.

Recommendations

In the quest to create or emulate the latest style, many architects have abandoned the basic principles of passive solar design and relied on modern technologies to provide basic human comfort levels. However, this practice requires significant amounts of energy for heating, cooling and ventilation. A more sustainable structure works with the local climate and use local, renewable materials. Studying the indigenous structures of that area increases the understanding of how buildings should interpret these influences. Indigenous buildings are a direct manifestation of local environmental influences, the ultimate form of passive solar design principles. Adapting these principles to reflect modern technologies and program considerations improves the energy-efficiency of house design.

Selecting Green Materials

An energy-efficient architectural design begins by selecting environmentally sensitive materials. Truly green materials do not negatively impact the environment in their extraction or manufacture while minimizing the energy required to heat or cool the building. While manufactures extol the virtues of their green materials, their products are not always as 'green' as they claim. Without an accepted industry standard, anyone may claim that any particular product is green.[42] This claim is not without some basis in reality, because the environmental sensitivity of any product is subject to interpretation. For example, while wood is a renewable resource, if the wood is conventionally harvested or requires preservative treatment in its application, then wood may not be the best option for framing. On the other hand, steel stud

---

[41] Olgyay, Design with Climate, 173.

[42] Abby Bussel, "Eco-Evaluators: What Do They Do?" Progressive Architecture, March 1993, 90.

manufacturing releases various air and water pollutants, but used steel framing can be easily recycled back into new studs.[43] Both products can claim some level of environmental sensitivity, but the issue remains as to which is the greener product.

What is a Green Material?

To begin with, there is no one specific definition of a green material. Among commentators a general consensus exists that a green product should be biodegradable, low in embodied energy, low in toxins and in emissions of volatile organic compounds, contain recycled compounds and in themselves recyclable and are derived from renewable resources.[44] However, few products completely meet the stringent requirements for environmentally sensitive materials. The challenge consists of deciding which measures are the most critical. Emerging standards recommend selecting materials based on the environmental impact of their life cycle.

Using the Life Cycle Analysis for Material Selection

The life cycle analysis is based on the belief that all stages in the life of a product generate an environmental impact. A life cycle analysis considers how the material was extracted, manufactured and transported to the site, the performance of the material once installed, and whether the material can be reused or recycled. While an individual product may claim to be green based on one stage, it might not be 'green' in other life-cycle stages, which offsets the perceived benefits of the product.[45]

Currently several guidelines have been created to help in green material selection. The difference between them lies in determining the relative importance of each criterion. In the

---

[43] Nadav Malin, "Is Wood or Metal "Greener"?", Progressive Architecture, September 1995, 41.

[44] Stewart Mosberg, "What Do We Mean by "Green"?" Progressive Architecture, March 1991, 62.

[45] National Institute of Standards and Technology, Building for Environmental and Economic Sustainability Ver. 2.0 (BEES 2.0) (Washington D.C.: National Institute of Standards and Technology), 1.

wood/steel stud example, is the harvesting of the product more important, or how it's manufactured?

Green Material Guides

The editors of the Environmental Building News advocate the analysis of the entire life-cycle when selecting green materials. Their selection process is based on research into the qualities of the raw materials, energy consumed in its production and disposal and any by-products generated during its life-cycle.[46] They place the largest importance on the product's usage within the building because, of the relatively long lifetime that the building material is in use.[47] This standard does not consider that some products spend the most of their lifetime decomposing in a landfill or that some products are more easily recycled than others. Because wood studs are not commonly reused in construction while steel studs are relatively simple to recycle, steel may therefore be the better alternative, especially if the steel is derived from recycled sources. The editors of the Environmental Building News recommended wood studs only if they are available from sustainably managed forests; otherwise, they suggested specifying steel studs.[48]

Similar to EBN, the Environmental Resource Guide reviews the entire life cycle of a product to determine its environmental impact. Its main difference is that the ERG does not place a priority on any one stage; rather, it provides the basic research and leaves it to the user to determine the product's acceptability.[49] This approach places a larger burden on the user and may result in a harmful product being incorrectly specified. In keeping with the ERG's decision

---

[46] Nadav Malin and Alex Wilson, "Material Selection: Tools, Resources, and Techniques for Choosing Green", Environmental Building News, January 1997, 1.

[47] Ibid., 12.

[48] Malin, "Is Wood or Metal "Greener"?", 41.

[49] American Institute of Architects, Environmental Resource Guide, (Washington D.C.: American Institute of Architects, Inc., 1994), 2:xiii.

not to provide definitive suggestions for specific products or materials, the guide recommends neither wood nor steel.

The United States Department of Commerce has developed a separate set of guidelines for selecting green materials. The Building for Environmental and Economic Sustainability Standard has created a "systematic methodology for selecting building products that achieve the most appropriate balance between environmental and economic performance based on the decision maker's values".[50] Based on established standards for determining the life cycle 'cost' as well as considering the actual cost of each product, this standard determines an overall performance measure. This system has great potential for relatively inexperienced users to select green materials. However, few products have been analyzed to date, so other methods need to be used in the interim. The BEES guideline recommends wood studs overwhelmingly over steel studs.

Recommendations

Current research suggests that the selection of green materials should be dependent the environmental impact of their life cycle. Because products that excel in one criterion may be weak in another, one must balance the relative environmental strengths and weaknesses of various materials, considering, for example: energy efficiency, low toxicity and use of renewable resources. While several green guidelines exist to assist in product selection, their recommendations can be contradictory. Unfortunately, no single recognized standard exists for evaluating the relative merits between competing products. As in the metal/wood stud selection, the ultimate responsibility for green material selection rests on the user.

---

[50] BEES 2.0, 1-2.

CHAPTER 3
GUIDELINES FOR DESIGNING SUSTAINABLE URBAN NEIGHBORHOODS

The primary goal of this thesis is to develop guidelines for creating sustainable urban neighborhoods for any inner-city location. An ideal sustainable urban neighborhood functions analogously to a natural ecosystem while meeting the needs of the community. In order to achieve this goal, each element of the neighborhood must be designed interdependently. In addition, the waste products of each component of the neighborhood should be selected or designed to become the input of another component of the neighborhood, thus creating a closed-loop system. This thesis therefore recommends designing each scale within the system concurrently with the other scales to assure interdependency. As Figure 9 illustrates, the form of the sustainable urban neighborhood is dependent on the interaction between the various scales. For example, the development cannot be designed until the spatial needs of the buildings located within the neighborhood are addressed. In turn, the structures should not be designed without understanding how the selected materials impact their forms. The interconnected nature of the sustainable urban neighborhood should be considered while developing each component of the system.

Sustainable Development

Conceptually, the overall design of a sustainable neighborhood is similar to a transit oriented development, but with greater sensitivity to environmental issues and natural systems. Before designing a sustainable urban neighborhood, analyze the existing climate, infrastructure, and circulation patterns. The existing conditions must be understood before the neighborhood can be designed sustainably. The neighborhood should then be designed to encourage public transit, pedestrian and bicycle connections in order to minimize the need for automobiles.[51] Organizing the core of the neighborhood about a transit stop and locating all structures within the neighborhood within walking distance of the center encourages alternate forms of transit.

Figure 9: Components of a Sustainable Urban Neighborhood

Beyond transportation needs, the neighborhood is designed to minimize energy input and waste outflows. The lots are oriented to maximize passive solar design strategies for as many of the structures as possible. Also, land uses within the development are selected to meet the needs of the community while encouraging interdependency between the various structures.

Site Inventory

Before designing the development, begin by analyzing the potential of the existing site. Every site has its own unique climate and character; a sustainable urban neighborhood is

[51] Alex Wilson and Nadav Malin, "Establishing Priorities with Green Building," Environmental Building News, September/October 1995, 15.

designed to enhance those features. Often, these sites have existing homes and businesses. While the area may be underdeveloped or otherwise unusable, it is generally better to improve on what already exists than to ignore the lessons that the existing fabric has to offer.

A successful sustainable urban neighborhood also meets the needs of the community. This thesis recommends including the community's culture and character in the site analysis. This requires contacting those living and working near the proposed neighborhood to better understand their needs. From these contacts, analyze how people within the area live, work and play and determine how those activities should be accommodated within the neighborhood. In addition, many communities have developed master plans for the city. These plans indicates the city's vision for the neighborhood and should be incorporated within the design of the sustainable development.

In order to design an energy efficient neighborhood, the designer must identify the local climate and natural features of the site. This process requires determining the heating and cooling requirements of the area. Plotting the monthly temperature and humidity ranges on a bioclimatic chart shows what passive cooling and heating strategies are required in building design. Also, identifying the amount and form of precipitation recommends opportunities for stormwater retention and reuse. Diagramming topography and natural features determines appropriate land uses, their location, and areas where the natural landscape should be preserved. A soil analysis helps define the vegetation native to this region as well as groundwater absorption and land use suitability.

In places where an existing area is to be redeveloped, a sustainable urban neighborhood preserves existing structures that are structurally sound or important to the community. Generally, renovating an existing building requires far less energy and resources than building new.[52] Where the quality of the existing structures may not recommend reuse, determine if there

---

[52] Alex Wilson and Nadav Malin, "Establishing Priorities with Green Building," 14-15.

is any consistency in their original forms or adaptations. This may suggest a local response to passive heating and cooling requirements or a local preference of design features.

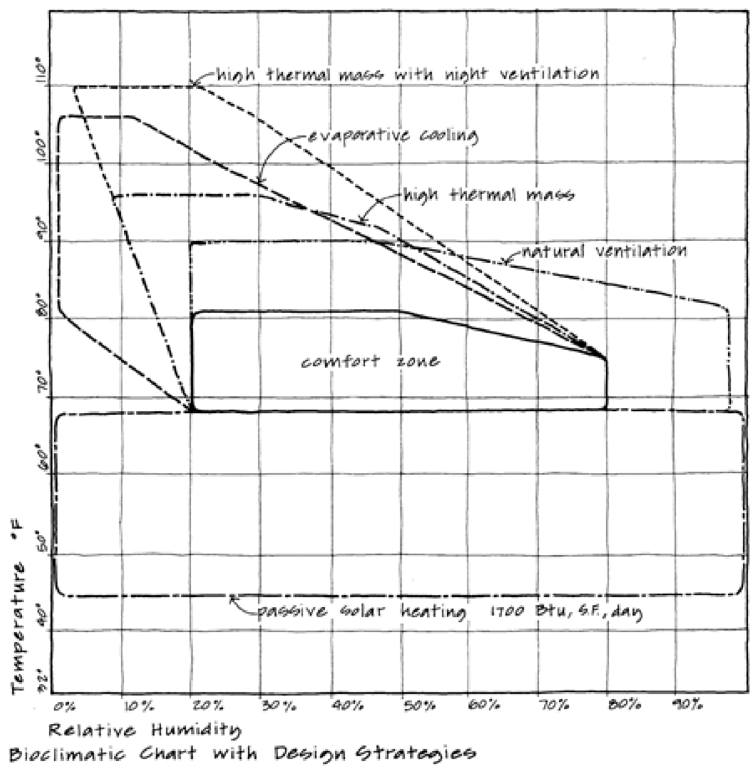

Figure 10: Bioclimatic Chart with Design Strategies. Reprinted from "Which Passive Cooling Strategy Is Right for You?" Energy Source Builder [online] (Lorane, OR: Iris Communications, Inc., June 1997 [cited 27 April 2001]); available from http://oikos.com/esb/51/passivecooling.html.

As part of the site analysis, determine the existing circulation routes within the neighborhood and the connections to adjacent communities. Routes connecting other neighborhoods suggest opportunities for retail areas as well as locations for bicycle routes. Streets that are used as high-speed thoroughfares should be rerouted away from the neighborhood. Existing public transit stops, especially those receiving heavy use should also be identified as potential locations for the center of the redeveloped neighborhood.

Once complete, represent the research graphically or verbally in order to begin developing a more environmentally sensitive design for the neighborhood. This information should also be presented to local residents and authorities to encourage feedback. This analysis can then be distilled into an overall site summary. While the site summary may not include all aspects of the site analysis, it should illustrate a deep understanding of the neighborhood.

Neighborhood Master Plan

As previously discussed, the sustainable urban neighborhood should be organized to allow structures to be designed as energy efficiently as possible. Ideally, begin by developing prototype structures, based on the green building guidelines, for the neighborhood, as these designs illustrate optimal lot sizes and orientation. Depending on the microclimate, this generally suggests maximizing southern exposures and avoiding structures with large openings due west or east.

The neighborhood should include places for a variety of green spaces. Providing urban forests within the neighborhood absorbs carbon dioxide and other air pollutants as well as reducing its 'heat envelope'.[53] The connection of urban forests with continuous green corridors,[54] forming an interconnected matrix of built and natural forms, benefits the neighborhood in several ways. First, the matrix of restored native forests restores the natural ecosystem and reintroduces native wildlife to the neighborhood.[55] Second, the continuous greenspaces creates pedestrian access to play spaces and gathering areas for various age levels. These green routes can also function as a natural means of stormwater drainage for the entire neighborhood. Naturally retaining and draining rainwater is generally less expensive than conventional stormwater systems.[56] Where the existing soil structure and precipitation rates allow, these routes can then

---

[53] Ibid., 15.

[54] Green corridors, which can consist of hedgerows, drainage ditches and other protective vegetation, allow species to travel between natural areas. Paul Selman, Environmental Planning: The Conservation and Development of Biophysical Resources, 2d ed. (London: SAGE Publications Ltd, 2000), 162-3.

[55] Cynthia Girling et al., Green Neighborhoods: Planning and Design Guidelines for Air, Water and Urban Water Quality (Eugene: University of Oregon, 2000), 23.

[56] Alex Wilson, "Stormwater Management," Environmental Building News, September/October 1999, 8.

connect to constructed wetlands, an aesthetically pleasing and natural method for wastewater reclamation.[57]

Minimizing the width of vehicular routes and adding landscape features limits automobile traffic speeds and reduce the amount of impervious surfaces within the neighborhood.[58] Streets should also be limited to connecting adjacent communities and gathering places within the neighborhood. Create separate lanes for bicycle routes and sidewalks adjacent to vehicular routes. Where vehicular parking is required, provide bicycle parking as well. Parking structures with commercial uses at street level encourages pedestrian activity and are more attractive than surface parking lots.

Center the sustainable urban neighborhood on a public transit stop with the remainder of the neighborhood within walking distance, approximately one-half mile, of the stop. Adjacent to the transit stop, locate the basic needs of the neighborhood. These structures should be oriented for ease of pedestrian access. A local elementary school, library or community center provides a gathering place for the neighborhood. Also within short walking distance of the neighborhood center, locate businesses that serve the basic needs of the neighborhood, such as theatres, child care centers, markets, hardware stores, stationery stores, clothing stores and other businesses recommended from discussions with the local community. While the population of most sustainable urban neighborhoods cannot support modern superstores, the diverse range and convenient access of neighborhood shops limits their need. In larger neighborhoods, with areas farther than one-quarter mile from downtown, secondary nodes should be organized around bus stops with corner shops or similar general stores.

Locating places for a sufficient amount of businesses to employ the residents of the neighborhood keeps the area active throughout the day. Ideally these structures should be

---

[57] Craig S. Campbell and Michael H. Ogden, Constructed Wetlands in the Sustainable Landscape (New York: John Wiley and Sons, Inc., 1995), v.

[58] Girling et al., Green Neighborhoods, 89.

located within walking distance of the transit stop and with minimal automobile parking and maximum bicycle parking to allow those commuting into the neighborhood other transportation alternatives. A diverse range of businesses helps to maintain steady employment throughout various economic cycles. For manufacturing and light industry, a sustainable urban neighborhood provides opportunities for businesses that create products required by the neighborhood or utilize waste products generated within the neighborhood. Places that resell used building materials, recycle materials, compost food products can help to reduce the approximately 80% of rubbish that currently is sent to landfills.[59]

Table 1: Population Levels Required to Support Selected Urban Activities.

Activity	Population
Post Office	100
Corner Store	500
Daycare Center	500
Elementary School	1,800
Market	2,000
Restaurant	2,000
Beauty Parlor	3,000
Drug Store	3,000
Bank Office	5,000
Library	5,000
Supermarket	10,000

Source: Adapted from Joseph de Chiara, Julius Panero, and Martin Zelnik, eds., Time-Saver Standards for Housing and Residential Development, 2nd ed. (New York: McGraw-Hill, Inc., 1995), 10.

Residences should be spread throughout the neighborhood. Homeownership, as opposed to rental properties, fosters community stability and safety by encouraging families to maintain their properties and become involved with the community.[60] Ideally land parcels should be built

[59] David Pearson, The Natural House Book (New York: Simon & Schuster Inc./Fireside, 1989), 268.

[60] U.S. Department of Housing and Urban Development, The State of the Cities 1999 [electronic journal] (Washington, D.C., June 1999 [cited 17 April 2001]); available from http://huduser.org/publications/polleg/tsoc99/contents.html.

in a variety of densities and scales to encourage a diverse mixture of incomes and ages within the neighborhood.[61] The individual lots themselves should be as dense as practical, allowing more community spaces. Within the center, apartments or condominia can be located above offices while, if space permits, single family homes can be located on the outskirts of the neighborhoods. The lots should be of various sizes to encourage mixed income housing.

Implementing the Sustainable Urban Neighborhood

The construction of a project of this magnitude takes time. The impact of the development on the current residents, businesses and other elements of the existing neighborhood requires careful consideration. This thesis recommends redeveloping the neighborhood so that it impacts minimally those who live and work within the existing one. The order of construction is therefore extremely important. The initial structure built for the new neighborhood should symbolize the concepts of the sustainable urban neighborhood. If possible, the new neighborhood begins with the construction of a transit stop and a community building. Both buildings introduce sustainable design principles to those visiting the area during construction. After the community buildings are constructed, the neighborhood should be developed as an equal mixture of housing and commercial spaces. In this manner, the population of the neighborhood grows as more employment opportunities and services become available. In areas where the neighborhood is a redevelopment, consider how people and businesses within the existing neighborhood should transition to the new plan. Ideally, those currently living and working in the neighborhood should not be displaced; rather, they should have the option of relocating within the neighborhood to similarly valued structures. This concept requires a carefully considered phasing plan to ensure that the transition to the sustainable urban neighborhood is relatively painless for all concerned.

---

[61] Local Government Commission, Ahwahnee Principles [online] (Sacramento, CA: Center for Livable Communities [cited 1 Sep 00]); available from http://www.lgc.org/clc/library/ahwahnee/principles.html.

Second, materials currently in use in the existing neighborhood should be either reused or recycled into part of the new design. Native trees should be relocated, not destroyed, and exotic vegetation should be composted and reused within the neighborhood. Buildings that are not a part of the new neighborhood plan should be deconstructed, so that their materials can be reused in new buildings. As with its operation, the construction of a sustainable urban neighborhood should generate as little waste as possible.

Guidelines for Green Buildings

Conventional architectural design infrequently considers adapting the building design for its location in order to minimize its energy requirements. Using this method, building systems are designed independently to meet industry standards without concern for the unique qualities of the structure or other systems within the building. On the other hand, a green building is designed to fit within its ecosystem and climate. The building's shell filters out the extreme climatic factors while allowing the natural sunlight and wind to heat, cool and ventilate the building. Replicating natural systems, all of the components contained within a green building function interdependently to reduce its external energy requirements and waste generated during construction and operation.[62] Ideally, this process begins by selecting the major building components during the design of the structure, which allows the building's form to complement the characteristics of the selected systems.

Spatially Efficient

Within the sustainable urban neighborhood, structures should be designed to meet, but not exceed, the needs of the users. Sustainable development practices recommend minimizing private spaces in order to increase community areas.[63] The adaptability of a green home allows for future additions and renovations (see Design for the Future). A well-designed and efficient

[62] Wilson and Malin, "Establishing Priorities with Green Building," 14.

[63] Calthorpe, American Metropolis, 55.

structure inherently requires fewer materials to construct and less energy to maintain than a larger one.[64] The money saved from designing a spatially efficient structure can be redeployed to upgrade other systems and finishes within the building.

Design with the Climate

Several principles must be considered in order to reduce the amount of energy required to operate a building. The building must be designed for its climate and site conditions. For cooling alone, an energy-efficient design can reduce cooling loads by 50% of conventional construction.[65] Use the site inventory to orient the building, optimizing the site's natural heating and cooling effects. When placed and specified appropriately, vegetation minimizes the effects of summer sun or winter winds.[66] The building should then be designed with overhangs calculated to allow sunshine in the winter while blocking it in the summer. Sunlight can then be used as the primary lighting source of buildings; artificial lighting should only be necessary in the evening. Light shelves can assist these daylighting strategies, by bouncing daylight further into the interior spaces.[67] To meet the building's power requirements, consider using systems that use natural systems to generate energy. For example, in commercial structures, photovoltaics work well to offset the energy needed to power the building since most power is required during daylight hours. While residential structures are most affected by climatic loads on the building, commercial energy requirements can be reduced if the building uses natural systems for heating and ventilation.

---

[64] Alex Wilson, "Small is Beautiful: House Size, Resource Use, and the Environment," Environmental Building News, January 1999, 10.

[65] Alex Wilson, "Keeping the Heat Out: Cooling Load Avoidance Strategies," Environmental Building News, May/June 94, 14.

[66] Donald Watson and Kenneth Labs, Climatic Building Design: Energy-Efficient Building Principles and Practice, (New York: McGraw-Hill Book Company, 1983), 85.

[67] Dianna L. Barnett and William D. Browning, A Primer on Sustainable Building, (Colorado: Rocky Mountain Institute Green Development Series, 1995), 44.

Energy Efficient Systems

The energy requirements of any building can be significantly reduced simply by providing a well insulated, airtight and geometrically simple structure.[68] In commercial structures, energy loads generated within the building generally exceed those created by local climate. The support systems within the building should therefore be designed to minimize the overall energy requirements of the structure. In order to have the most efficient structure, all of the systems should be designed and sized for the actual needs of the entire structure, as opposed to using 'rules of thumb'. For example, the mechanical system should be designed for the actual building envelope (which is designed for the climate), lighting load (which should be minimized as a result of daylighting techniques), and the specified appliances (which are energy-efficient). A mechanical system designed for the actual needs of the building is typically much smaller than one designed for a conventional building. A smaller mechanical system requires less structure to support and less space for ductwork.

The plumbing and electrical systems should be designed to require minimal energy inputs. For the plumbing system, use low-volume, high-pressure fixtures. If current codes permit, reuse greywater for toilets and rainwater and other non-potable uses. Otherwise, the building should be designed to allow the conversion in the future. For lighting systems, design the fixtures to take advantage of natural daylight within the building. For example in commercial structures, place sensors in the light fixture dimmers to augment the current amount of daylight. These sensors should also dim the lights if the space is unoccupied. In addition, select lighting fixtures for their minimal energy requirements and heat generated.

Design for the Future

Unfortunately, the future needs of the building's occupants cannot always be anticipated. Thus structures should be designed to be as flexible and adaptable as possible. This

---

[68] Wilson, "Small is Beautiful," 7.

concept suggests carefully locating shear walls and other structural elements so as to not interfere with future renovations. The location of mechanical, electrical and plumbing systems should be easily accessible and upgradeable. If the past is any indication, provide sufficient space and connections for future technologies, such as for photovoltaics or greywater recycling. In addition, potential locations for future expansion should be identified so that the structural system accommodates the addition.

No matter how carefully designed, some buildings eventually need to be replaced. Buildings within the sustainable urban neighborhood are designed for ease of dismantlement. A building designed for deconstruction allows the materials contained within the building to be reused, or at least recycled, into other building components and helps to 'close the loop' within the sustainable urban neighborhood.[69] A deconstructable building should have bolted, instead of fused, connections and a minimum of composite materials.

Selecting and Assembling Green Materials

Currently, the selection of green materials is rather limited. Therefore, it is difficult to find and specify materials that meet all of the criteria for environmental sensitivity.[70] In the sustainable urban neighborhood, provide recommendations for materials that are as 'green' as possible. Primarily, the selection of materials and assemblies should reinforce the energy-efficient strategies of the structure.[71] Buildings are generally designed to last a minimum of fifty years, therefore the materials that are selected either need last the lifetime of the building or should be easy to access and replace. Selected materials should also be locally produced in order to minimize transportation requirements. In addition, the materials should be assembled so that

---

[69] Kibert, Sendzimir and Guy, "Construction Ecology," 914.

[70] An ideal green product should be "biodegradable… low in toxins and in emissions of volatile organic compounds, contain recycled constituents or are in themselves… derived from renewable resources". Mosberg, "What do We Mean By "Green"?" 62.

[71] Wilson and Malin, "Establishing Priorities with Green Building," 14.

they generate a minimum of construction waste and that the assembled components can be disassembled for future reuse. When more than one material meets these criteria, select materials with minimal environmental impact over its life cycle, materials that do not impact the indoor air quality of the structure and materials that have the greatest potential for reuse or recycling. As with any other element of the sustainable urban neighborhood, green materials are also part of the closed-loop system.

Preferred Materials

Green materials should originate from renewable sources and be sustainably harvested.[72] As discussed in Chapter 2, while wood framing is an excellent example of a material originating from a renewable resource, if the wood was removed from a clear-cut forest, then the environmental impact is similar to the mining of iron for steel studs.[73] Therefore the extraction of the basic components of the product must be considered.

In order for materials to be part of a closed-loop system, they must be recyclable or biodegradable. Generally speaking, recyclable products are minimally processed so that it is easier for it to be broken down and reformed into a new material.[74] However, for some composite materials such as concrete, carpet and plastics, technologies exist for the products to be reduced to their original components, which may then be reused. Whenever possible, select products that contain recycled components. While post-industrial recycled content is a good start, post-consumer recycled content is stronger indication that materials have been removed from the waste stream.[75]

---

72 Pearson, The Natural House Book, 130.

73 Malin, "Is Wood or Metal "Greener"?" 39.

74 Nadav Malin, "What It Means to Be Green," Architectural Record, August 1999, 140.

75 Alex Wilson, "Building Materials: What Makes a Product Green?" Environmental Building News, October 2000, 2-3. Post-industrial recycled content refers to waste generated within the factory that is used in the manufacture of another product.

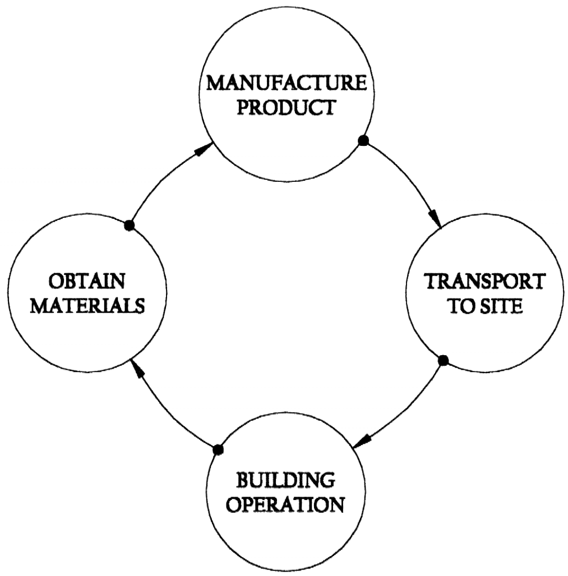

Figure 11: Materials as Part of a Closed Loop System

Selecting materials that are manufactured locally supports the local economy while reducing the distance that the materials need to be transported to the site. As discussed in Chapter 1, transportation vehicles generally require harmful chemicals for fuel and release toxins into the environment as waste. The selection of products manufactured within 500 miles of the neighborhood follows the LEED standard.[76]

Materials to Avoid

In an energy-efficient structure, buildings are airtight in order to reduce the heating and air-conditioning loads. Therefore, select materials that do not negatively impact air quality. Many modern materials contain volatile organic compounds (VOC), which are toxic to the building's

---

[76] U.S. Green Building Council, LEED Green Building Rating System Version 2.0 (Washington D.C.: U.S. Green Building Council, 2000), 16. The LEED Green Building System promotes the improvement of the environmental performance of commercial buildings.

inhabitants and can cause irritation, headaches, nausea, and damage to some internal organs.[77] VOC are commonly located in paint, carpets, vinyl flooring and furniture. Selected products should not contain volatile organic compounds or materials that are harmful to the environment. These materials include arsenic (currently used in pressure treated wood), mercury (used in some lighting systems) and hydrochlorofluorocarbons (in insulation).[78]

As previously mentioned, products should be selected that are easily recycled. Unfortunately, as more dissimilar materials are combined to form a product, it becomes more difficult to separate the materials in order to reuse or recycle them. Some obvious examples of currently non-recyclable products include: plastic lumber, laminated countertops and plywood. The use of composite materials should be limited to applications where they greatly increase the energy-efficiency of the structure.

Using Green Materials

Energy-efficient buildings should be designed to use materials whole, as opposed to cutting them to custom sizes. Using whole materials reduces construction waste as well as maximizing the potential reuse of the material. To meet this requirement, energy-efficient buildings are designed to a standard two or four feet module.[79] Selecting adhesives that are of the same or inferior strength as the materials they connect increases the opportunity for the reuse of the material, since it avoids destroying materials in the process of removing strong adhesives. The final color of green materials is also an important factor. In northern climates, darker colors help to trap heat within the building, while lighter colors should be used in the south to reflect it.

[77] St. John, A., ed., The Sourcebook for Sustainable Design: A Guide to Environmentally Responsible Building Materials and Processes (Boston: Boston Society of Architects, 1992), 9.2. Technically, a VOC is any organic compound that evaporates at room temperature.

[78] Wilson, "Building Materials," 3.

[79] Wilson and Malin, "Establishing Priorities with Green Building," 15.

The Greenest Material

When properly located, vegetation can greatly moderate natural temperature swings, absorb urban noise and other pollutants. Selecting native plants minimizes the water and fertilizers required to maintain the vegetation as well as strengthening the natural ecosystems as well as encouraging wildlife.[80] With this in mind, limit the use of high-maintenance grasses to areas where it is required for the proposed activity. In those locations, potable water requirements can be minimized with the use of drip irrigation, preferably in conjunction with reclaimed water. Throughout the neighborhood, selecting native vegetation reduces the overall energy needs of the neighborhood.

Conclusion

The pace of change in technology and industry is faster than natural systems can adapt to moderate their effects. Therefore Americans must begin to alter their lifestyles in order to consume fewer resources and generate less waste. In the built environment, there are have several opportunities to reduce our non-renewable energy needs. A sustainable urban neighborhood is more analogous to a natural system than conventional development. All components of the neighborhood are interconnected and energy-efficient. In order to achieve a sustainable urban neighborhood, begin by creating specific recommendations for the redevelopment of the urban district. These recommendations are dependent on the neighborhood's climate, natural and manmade features, and the needs of the community. These guidelines can create a sustainable urban neighborhood that benefits not only its residents but also begins to repair the damage man has generated in our natural environment.

---

[80] Mary Duryea, Eliana Kampf Binelli and Henry L. Gholz. Restoring the Urban Forest Ecosystem, ed. Mary Duryea, Eliana Kampf Binelli and Henry L. Gholz (Gainesville, FL: School of Forest Resources and Conservation, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, 2000), 2-1.

CHAPTER 4
SITE INVENTORY

In order to determine the effectiveness of this thesis, a site was selected and redesigned according to the sustainable urban neighborhood guidelines. Jacksonville, Florida meets the criteria for a city experiencing suburban sprawl with substantial underutilized land in the inner city. Over sixteen thousand acres of the city lies available for development,[81] while most recent development is concentrated far from the inner city. In a ten-year span, daily vehicle miles traveled increased 74% while the aggregated length of roadways increased less than ten percent.[82] The suburban sprawl in Jacksonville has generated urban blight and wasted historic resources,[83] while the resulting commuting on limited roadways has led to traffic congestion, increasing fossil fuel emissions. The city hopes to reverse this trend by redeveloping downtown Jacksonville, and therefore Brooklyn, in order to encourage resettlement of the inner city.

Interstate 95 and the St. John's River form the boundaries of the Brooklyn district. The location of the interstate, together with McCoy's Creek, isolates Brooklyn from the remainder of downtown Jacksonville. Once a thriving residential community, most of this 285-acre site is currently in a state of disrepair and neglect. Over half of its land is vacant and many of the existing structures require substantial repair. However, Brooklyn has the potential to be redeveloped into an asset to the city and its residents. Not only is the neighborhood adjacent to the river, but it also has a small creek running along its northern boundary. These natural

---

[81] Pagano and Bowman, "Vacant Land," 4.

[82] Texas Transportation Institute, The Mobility Data for Jacksonville, FL [online] (College Station, TX: Information & Technology Exchange Center/Publications [citied 27 April 2001]); available from http://mobility.tamu.edu/2001/study/cities/tables/jacksonville.pdf, 2.

[83] Jason Thiel, Program Manager for Jacksonville Economic Development Commission, email to author, 22 May 2001.

features, combined with its close proximity to downtown Jacksonville, suggest that the new Brooklyn neighborhood can support a thriving community.

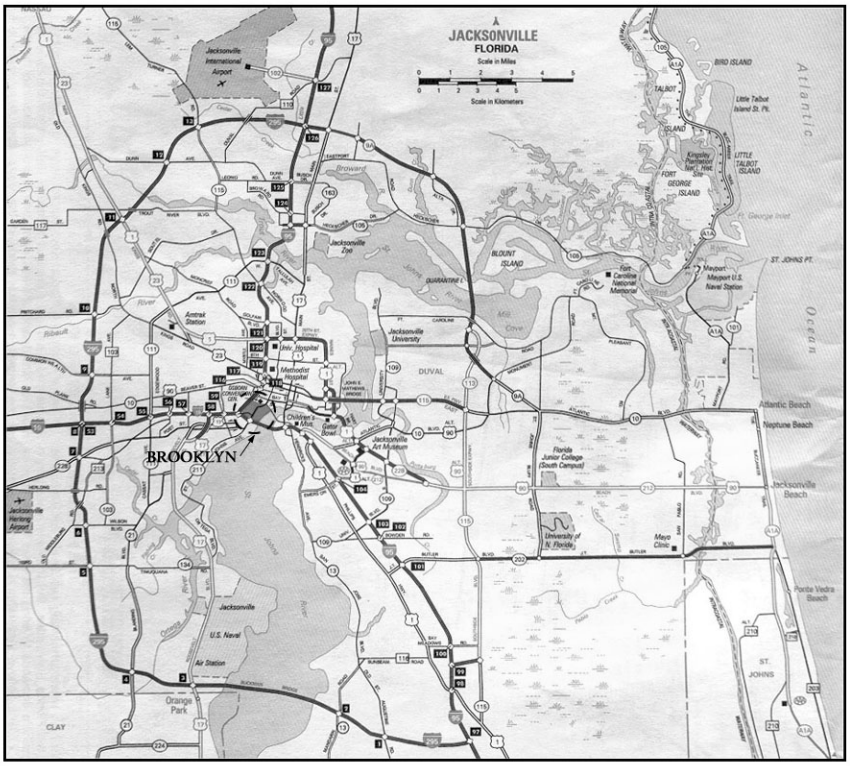

Figure 12: Location of the Brooklyn District in Jacksonville, Florida. Adapted from American Automobile Association, AAA North American Road Atlas 1996: United States, Canada, Mexico, MCMXCV ed. (American Automobile Association, 1995), 26.

Local Vision

> Jacksonville is the celebration of a great, international river and extensive public green space, where city parks and attractive water features are essential components of busy, sustainable urban neighborhoods.[84]

Between 1998 and 1999, the City of Jacksonville held a series of public workshops in order to develop a downtown master plan. Early in the process, these workshops discussed perceived assets and liabilities of the existing downtown. The participants believed that the St.

[84] Statement presented as the design theme for downtown Jacksonville. City of Jacksonville Planning Development Department, Public Participation Summary (Jacksonville, FL: City of Jacksonville, 1999), Section 8.

John's River and the downtown skyline are community assets. On the other hand, most participants believed that the city lacks evening and weekend activities, sufficient public transportation and public greenspaces.[85] Over time, these issues evolved into specific concerns with the downtown area. Basically, most participants believed that the downtown did not support those living within the urban center because basic services, such as restaurants and day care centers, are not available. They also felt that Jacksonville might become a more dynamic city if activities were more diverse and evenly distributed throughout the downtown. In addition, the number of greenspaces should be increased and linked and additional pedestrian access points to St. John's River should be provided. They also felt that streets should become less oriented towards for automobiles by widening sidewalks, adding bicycle lanes and slowing automobile traffic.[86]

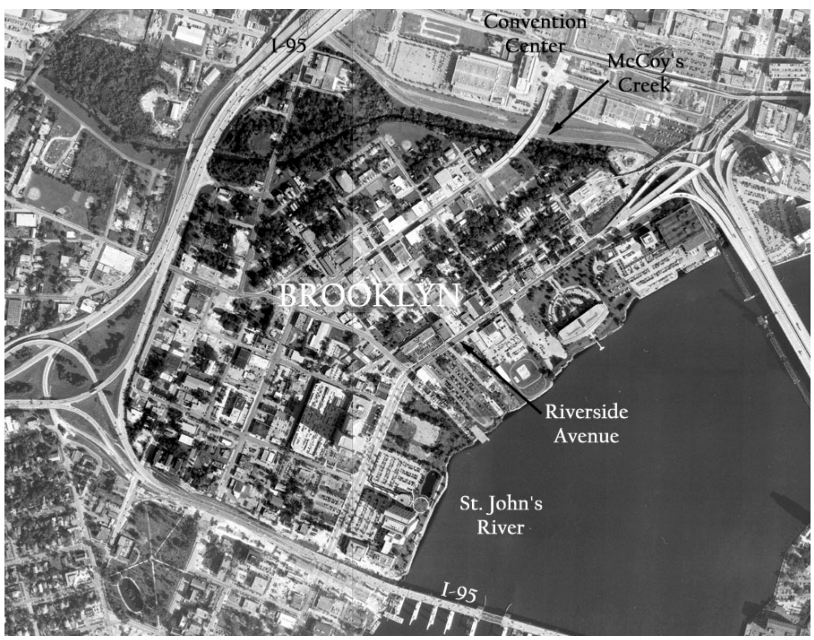

Figure 13: Aerial view of the Brooklyn Neighborhood in Jacksonville, Florida

---

[85] Planning Development Department, Public Participation Summary, Section 1.

[86] Summarized from the Planning Development Department, Public Participation Summary, Section 3.

1. We will improve access to our river banks, creating a greenway of substantial amenity to our citizens.
2. We will develop clearly defined downtown districts with distinct identities and a mix of uses and identify which district would be an appropriate location for major public capital investment projects.
3. We will develop interconnected, attractive and safe pedestrian links among neighborhoods, activities and open space.
4. We will encourage adequate, well-designed and strategically placed parking throughout downtown.
5. We will recognize open space as a valuable development asset.
6. We will provide a sustainable system of connected public open spaces that encourages variety, both in terms of size and function. Water and natural features will be important elements.
7. We will establish downtown as a 24-hour city and as a new location for residential development, a regional destination for tourists, conventioneers, and local residents.
8. We will enhance the perception of downtown as a safe place.
9. We will pursue short-term actions that help us achieve our long-term vision.

Figure 14: City of Jacksonville's Vision for their Downtown Redevelopment. Reprinted from City of Jacksonville Planning Development Department, Celebrating the River: A Plan for Downtown Jacksonville (Jacksonville, FL: City of Jacksonville, 2000), 9.

These diverse ideas were eventually combined into a master plan for downtown Jacksonville. The guiding principles, as defined by the City of Jacksonville, became the basis for a series of plans illustrating this vision for the new downtown. Most of these principles are similar to those indicated in the sustainable urban development guidelines. Unfortunately, environmental sensitivity was not indicated to be part of the vision for downtown. This lack of vision suggests that the community, and the residents of Brooklyn, needs to be educated as to the benefits of sustainability. This education needs to include recommendations for healthier, less wasteful living and how to maintain green buildings. For example, in Florida a cupola can be used to naturally ventilate a house. In order for the ventilation to occur, the homeowner needs to open the window on the leeward side of the house. While this is a relatively simple operation, it does require a different set of skills than merely turning on the air conditioning and an interest in using passive solar design techniques. Also, the community and its businesses needs to learn the benefits of water conservation, material recycling and composting.

> Our vision for Brooklyn is to regenerate is as a vibrant mixed-use neighborhood and to link it to the river via as many routes as possible. A key redevelopment strategy will be to attract creative businesses and individuals, such as graphic artists, architects, sculptors and designers, to this area.[87]

The City intends to redevelop the neighborhood as a transit-oriented development by extending the automated skyway express (ASE) along Riverside Avenue. As a catalyst, the city intends to provide substantial improvements to McCoy's Creek, converting the area into a 'primary open space' with pedestrian and bicycle trails. The Creek renovation connects to a planned series of parks within the city. Park Street then becomes a pedestrian-oriented mixed-use street connecting McCoy's Creek to the remainder of the neighborhood. While the remainder of Brooklyn becomes single and multi-family housing, the City intends to preserve Riverside Avenue as a high volume connection to downtown Jacksonville, lined by office towers with pedestrian connections to St. John's River.[88]

The City's plan for Brooklyn has many parallels to the goals of a sustainable urban neighborhood. The redevelopment of McCoy's Creek into an urban park provides local residents with much needed green space and should help to retain stormwater within the city. This scheme also suggests developing Park Street as a commercial corridor, providing goods and services to the neighborhood. Unfortunately, the neighborhood master plan does not mention providing bicycle paths throughout the neighborhood, or providing a continuous bicycle route through the city. Another area of concern is the proposed plan for Riverside Avenue. If Riverside Avenue remains a high-speed thoroughfare with office towers to either side, pedestrian crossings to the river need to be carefully considered. In addition, future structures should be located so maintain existing views of the River.

---

[87] City of Jacksonville Planning Development Department, Celebrating the River: A Plan for Downtown Jacksonville (Jacksonville, FL: City of Jacksonville, 2000), 20.

[88] Paragraph summarized from Planning Development Department, Celebrating the River, 20-21.

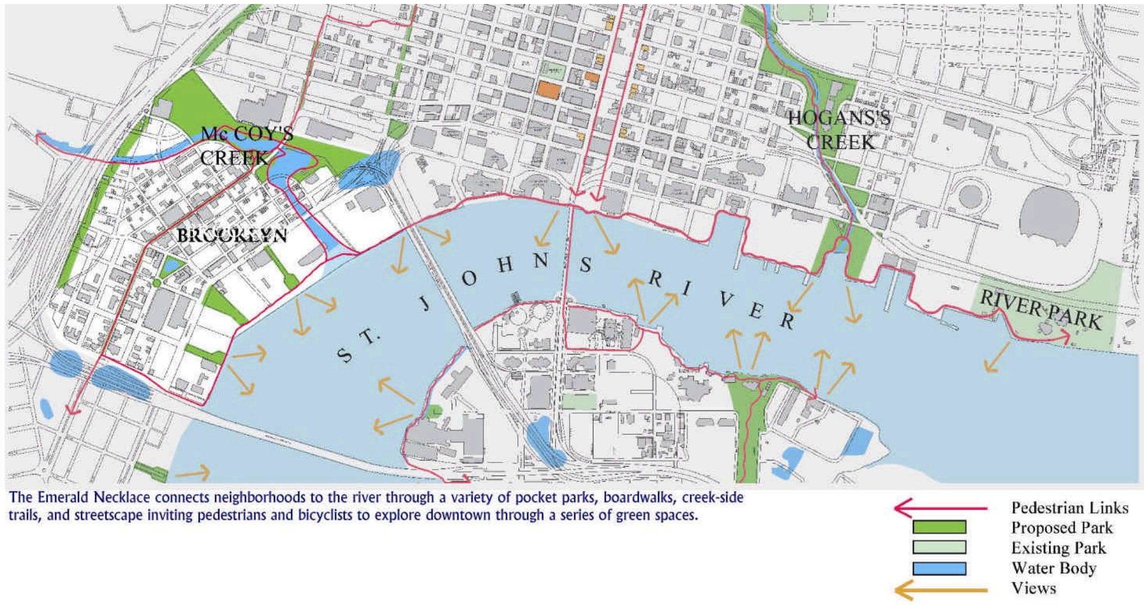

Figure 15: Open Space and Pedestrian Plan. Reprinted from Planning Development Department, Celebrating the River, 10.

Figure 16: Partial Plan of Brooklyn. Reprinted from Planning Development Department, Celebrating the River, 40.

Climate

The Brooklyn neighborhood is located on the St. Johns River, approximately sixteen miles from the Atlantic Ocean. Its location along the thirtieth parallel and close proximity of the Atlantic Ocean and the Gulf of Mexico brings humidity and ample precipitation to the area, allowing the growth of subtropical vegetation.[89] The site therefore possesses hot humid climate characteristics.

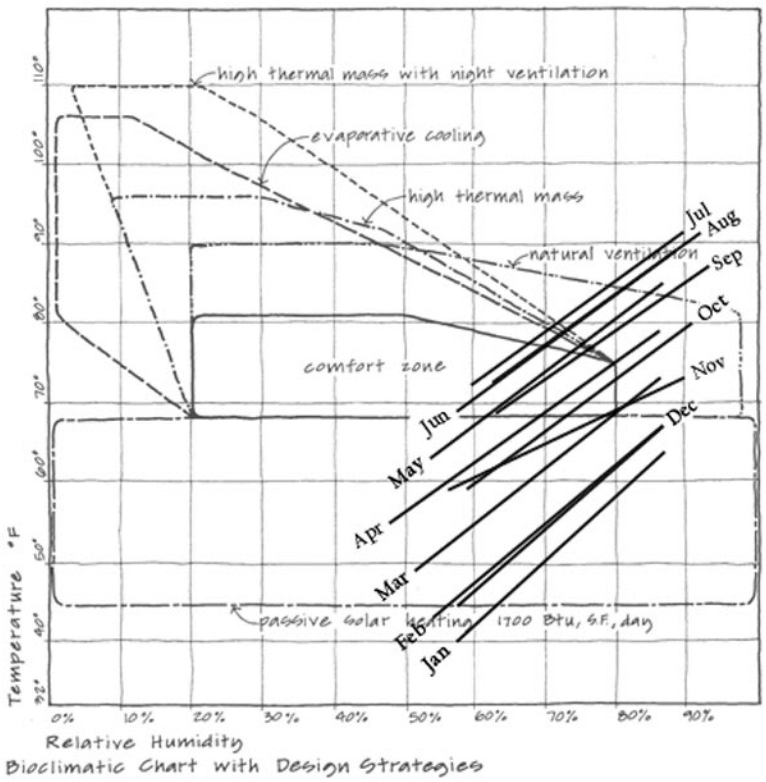

Figure 17: Bioclimatic Chart for Jacksonville. Adapted from "Passive Cooling Strategy".

Most of the year, temperatures range fairly uniformly each day from the 70s to the 90s. More variability is experienced in the winter, when temperature ranges from the 60s to 80s on most days and 20s to 40s on a few days. An average of fifteen overnight freezes occur annually,

[89] Jacksonville Community Council, Inc., Quality of Life in Jacksonville: Indicators for Progress [online] (Jacksonville: Jacksonville Community Council, Inc., 2000 [cited 27 April 2001]); available from http://www.jcci.org/qol/qol.pdf, 4.

but on almost all winter days temperatures rise above freezing.[90] On average, Jacksonville requires approximately 1434 heating degree days per year.[91] However as Figure 17 indicates, passive solar heating can be utilized for most of the heating season with mechanical heating only necessary during cold spells in January and February. Due to the hot humid climate, cooling is the primary design consideration. Although Jacksonville experience approximately 2551 cooling degree days per year,[92] with passive design features such as natural ventilation, mechanical cooling may be limited to activation during the heat waves that occur from May to September.

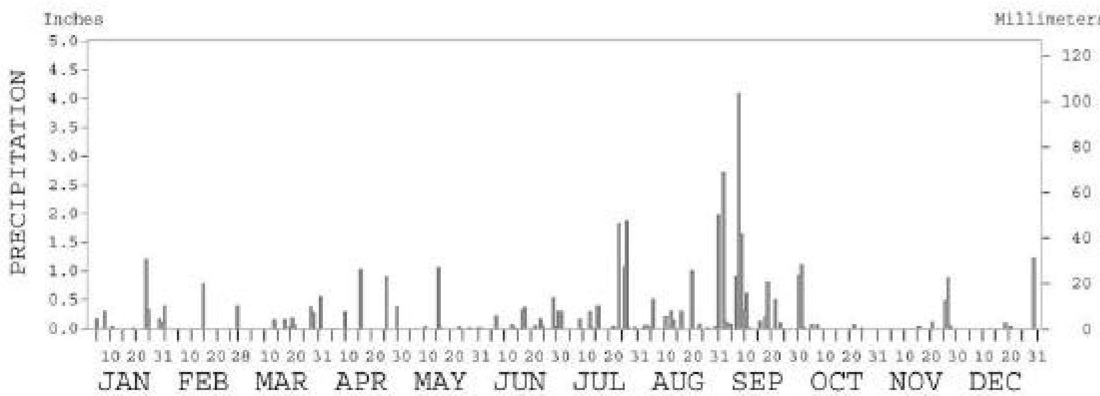

Figure 18: Yearly Precipitation for Jacksonville. Reprinted from National Climatic Data Center, Local Climatological Data: Annual Summary with Comparative Data: Jacksonville, Florida (JAX) (Asheville, N.C.: National Climate Data Center, 2001), 1.

The precipitation for Jacksonville is almost entirely in the form of rain. As Figure 18 indicates, the majority of rainfall occurs from late July through September, for a total of fifty-three inches per year. The unevenness of rainfall distribution complicates its on-site collection for landscape irrigation. Since bacteria collects in water stored more than thirty days, rainwater collection for this area should either be sized for an average month of rainfall (approximately

---

[90] Ibid.

[91] National Climatic Data Center, Local Climatological Data: Annual Summary with Comparative Data: Jacksonville, Florida (JAX) (Asheville, N.C.: National Climate Data Center, 2001), 3.

[92] Ibid., 3.

which is less an inch), releasing the overflow during the summer, or chlorine needs to be added monthly to the stored water.

Prevailing winds are northeasterly in the fall and winter months, and southwesterly in the spring and summer. This suggests locating an urban forest in the southwest corner of the neighborhood cools the neighborhood in the summer while the trees filter pollutants originating from the highway. Wind movement, which averages slightly less than 9 mph, is higher in the early afternoon hours.[93] Although Jacksonville lies within the hurricane belt, hurricanes have only rarely been a concern. Nevertheless, all structures within the sustainable urban neighborhood needs to meet existing hurricane resistant construction requirements. The average wind speeds are, however, inadequate for current wind power technologies.

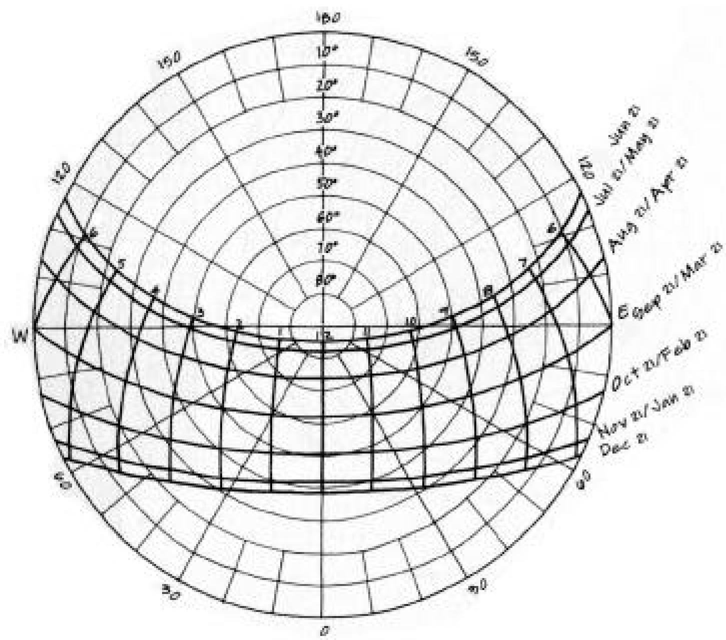

Figure 19: Sun Path Diagram for Jacksonville. Adapted from G. Z. Brown and Mark DeKay, Sun, Wind & Light: Architectural Design Strategies, 2d ed. (New York: John Wiley & Sons, Inc., 2001), 301.

---

93 National Climatic Data Center, Local Climatological Data, 7.

Natural Features

The Brooklyn site sits within the Leon-Boulogne-Evergreen soil unit.[94] These soils are in flatwoods interspersed with depressions. The Leon soils are poorly drained sandy soils approximately eight inches thick. The Boulogne soils are also poorly drained soils, but they consist of dark gray fine sand approximately six inches thick. The Evergreen soils are located within depressions and consist of black loamy sand. This soil unit extends approximately eighty inches below grade, where it meets sediments from the Hawthorne group, for approximately four hundred feet, eventually resting on Ocala Limestone.

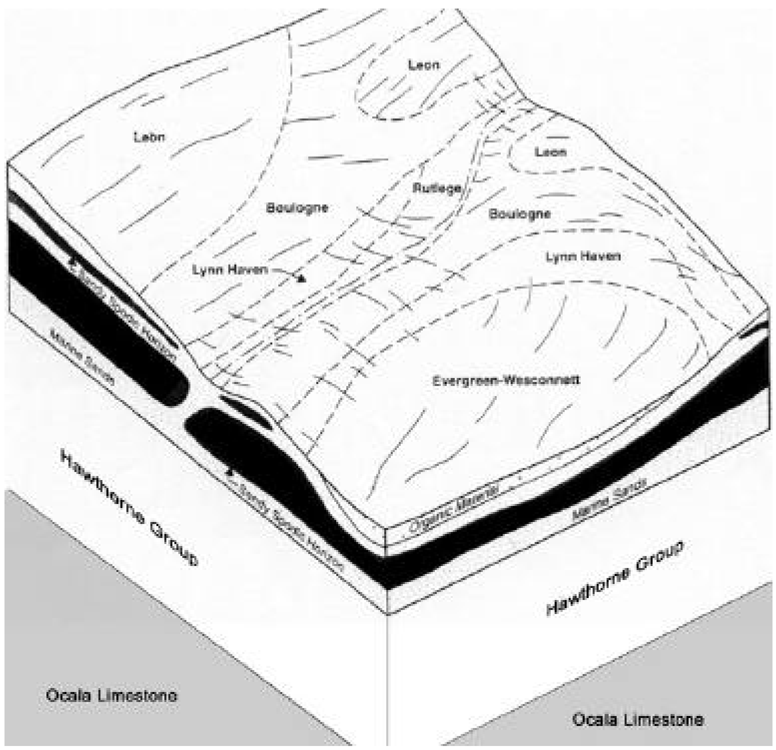

Figure 20: Soil Pattern Present in Leon-Boulogne-Evergreen. Adapted from Frank C. Watts, Soil Survey of City of Jacksonville, Duval County, Florida (Washington D.C.: The Service, 1998), 24.

[94] Frank C. Watts, Soil Survey of City of Jacksonville, Duval County, Florida (Washington D.C.: The Service, 1998), 23-24.

While the natural ecosystem for the Leon-Boulogne-Evergreen soil unit is Scrub and High Pine, this particular ecosystem is maintained by fire,[95] which is inappropriate for urban locations. Therefore the Mesic Hardwood Forest ecosystem, the climax ecosystem for pine forests, is introduced into the Brooklyn neighborhood. Specifically this area is part of the temperate broad-leaved evergreen forest zone.[96] Vegetation in this area consists of an overstory of Southern Magnolia, various oaks and Sweet Gum, and an understory of American Holly and Devilwood.[97] These plants should constitute the dominant vegetation in the Brooklyn neighborhood.

Potable water in Duval County is obtained primarily from the surficial aquifer system and the Floridan aquifer system. The surficial aquifer below the Brooklyn neighborhood begins approximately seventy-five feet below grade, with the upper surface extending to the water table. The water table is less than ten feet below grade, minimizing the opportunity for subsurface structures. This aquifer is recharged through direct infiltration of precipitation, with some minor upward leakage from the deeper aquifer system. The Floridan aquifer is the dominant source of ground water for irrigation, public supplies, and industrial uses in Duval County. The slowly permeable sediments of the Hawthorn soils confine the aquifer to the Ocala Limestone below. While the Floridan aquifer is primarily recharged in areas west and southwest of Jacksonville, the surficial aquifer can be maintained by precipitation.[98] This suggests using the surficial aquifer as a cistern for the neighborhood. If stormwater was contained within the neighborhood until it is absorbed into the aquifer, then the aquifer could be used for irrigation.

---

[95] Ronald L. Myers, Ecosystems of Florida, ed. Ronald L. Myers and John J. Ewel (Orlando, FL: University of Central Florida Presses, 1990), 151.

[96] Ibid., 200.

[97] Ibid., 199.

[98] Paragraph summarized from Watts, Soil Survey, 117.

Since the soil group drains poorly, stormwater retention requires a large land area, perhaps incorporating part of the natural drainage system itself.

As suggested by the soil unit, the Brooklyn neighborhood is relatively flat. The steepest slope is less than two percent, with most of the remaining site sloping less than one percent. The average elevation is approximately fifteen feet above sea level, rising to twenty-five feet in a few locations. While the land south and east of Riverside Avenue drains into the St. John's River, most of the site drains towards McCoy Creek The stormwater retention area, therefore, should be placed near the Creek. The retention area allows rainwater to recharge the surficial aquifer, as opposed to the rainwater draining into the Creek.

Several natural features should be preserved and improved within the Brooklyn neighborhood. The most dominating feature is St. John's River. Unfortunately, office towers along Riverside Avenue generally block the view of the River. This suggests that some existing view corridors should be preserved and pedestrian access to the River should be created. A linear park along the river allows residents to enjoy the view and connects this part of Brooklyn to the remainder of the neighborhood. This linear park should be extended to follow McCoy's Creek. The Creek area could then be developed as a more active neighborhood park. The form of the park should follow the flood plain, which is approximately eight feet above sea level.

Land Uses

The existing Brooklyn Neighborhood is in a state of decline. Excluding the Riverside Avenue corridor, approximately one-half of the land is undeveloped (see Figure 27) and many of the remaining buildings are in need of repair. However, a few structures should be preserved as part of the redeveloped neighborhood. Renovating the former schoolhouse on the southwest corner of the site could be a symbolic start to the new Brooklyn neighborhood. The active churches and other well-constructed buildings should be preserved as a link for the current residents and to minimize energy-intensive new construction. Since the population of the area has been steadily decreasing, few homes are owner occupied[99] and most housing is in poor condition. Generally, the occupied structures within Brooklyn consist of light industrial or similar service-type uses. Other than convenience stores, Brooklyn does not contain businesses to serve the basic needs of the community.

Along Riverside Avenue, the current land usage is quite different from the remainder of Brooklyn. Several high-rise office towers line this Avenue, taking advantage of the views of downtown Jacksonville and the River. These structures do not support or connect to Brooklyn and it is difficult to access them, without a car, from the neighborhood. Current marketing analysis, completed for the City, suggests that the available land in this area be developed as high-rise structures.[100] While this approach may increase revenues for the city, a more balanced approach provides structures that transition and connect the existing office towers with the proposed residential neighborhood.

Neighborhood Circulation

Interstate 95 currently isolates the Brooklyn neighborhood by forming a loud, unsightly barrier between the neighborhood and the remainder of Jacksonville. To slow traffic in this area, the City of Jacksonville recommends reducing highway access in this area.[101] The highway access ramp from Gilmore Street should therefore be closed. All development along the edges of the neighborhood need to consider the impact of the highway, suggesting that a buffer should be created between the highway and residential or commercial use. This buffer should transition into gateways where local streets pass under the highway and connect to adjacent neighborhoods. Another area of concern is Riverside Avenue. Currently, this Avenue is for high-

---

[99] Urbanomics, Inc. and Development Strategies, Inc., Jacksonville Downtown Mater Plan: Residential and Commercial Market Analyses (Jacksonville, FL: Urbanomics, Inc. and Development Strategies, Inc., June 1999) 2-4.

[100] Cambridge Systematics, Inc., Jacksonville Downtown Mater Plan: Transportation Element (Jacksonville, FL: Cambridge Systematics, Inc., 1999) 3-4.

[101] Urbanomics and Development Strategies, Market Analyses, 2-4.

speed vehicular traffic traveling to and from downtown. The width of Riverside Avenue, combined with the traffic speeds, greatly limits pedestrian access to the buildings on the west side of the Avenue and St. John's River. In order to connect the river with the rest of the neighborhood, either the pace of Riverside needs to be reduced or pedestrian crossings should occur above the street. Within the Brooklyn neighborhood, the only four lane streets are Park Street and Forest Street, the remaining streets are two lane. Most of these side streets lack sidewalks and all streets are without bicycle lanes.

Public transportation is available throughout the Brooklyn neighborhood. The current system of buses connects Brooklyn to downtown Jacksonville and to western neighborhoods. Although the bus system also connects Brooklyn to the nearest skyway[102] stop, at the convention center, the planned skyway extension to Brooklyn improves the neighborhood's transportation alternatives.

Recommendations

The Brooklyn neighborhood contains all of the elements of an area that could become a sustainable urban neighborhood. The existing neighborhood is experiencing decline while new suburbs are being constructed on the periphery. The city government supports the idea of redeveloping Brooklyn into a transit-oriented development. A market appears to exist for mixed-use housing development in the city.[103] This thesis therefore recommends redeveloping Brooklyn into a sustainable urban neighborhood.

Local Vision

Brooklyn is organized around the proposed automated skyway express stop. While the city intends to locate the skyway along Riverside, this may be inappropriate if the Avenue continues to be utilized as a high-speed thoroughfare, which deters pedestrians from crossing up

---

[102] In Jacksonville, the skyway is also referred to as the Automatic Skyway Express, or ASE.

[103] Urbanomics and Development Strategies, Market Analyses, 5-4.

to six lanes of traffic. In addition, a series of connected greenspaces can link the St. Johns River to a redeveloped McCoy's Creek. All streets should be redesigned to reduce vehicular speeds and promote pedestrian and bicycle usage. As part of a sustainable urban neighborhood, the commercial areas within Brooklyn should provide basic services, such as restaurants and day care centers. Most of these businesses should be located along Park Street, in order to expand on the existing commercial corridor.

Climate

Due to the hot humid climate, cooling is the primary design consideration for this neighborhood. Passive design features, such as natural ventilation, helps to limit mechanical cooling activation on the hottest days of the summer. Since summer winds originate from the southwest, locating an urban forest in this area (see Figure 29) helps to cool the neighborhood and the trees filter any pollutants from the highway.

Natural Features

This neighborhood can be restored as part of a Mesic Hardwood Forest ecosystem. Therefore, the vegetation selected for the neighborhood should be native to that ecosystem. Restoring the ecosystem requires the creation of pockets of hardwood forests connected by linear greenspaces, to allow wildlife to move from one pocket to another. These linear parks can also serve as part of a natural stormwater drainage system and provide pedestrian access to the commercial core. The retention area itself should be located at the lowest part of the site, near McCoy's Creek. The Creek can also be redesigned to allow active and diverse play areas. The redesigned park should follow the natural flood plain.

Land Uses

While most of Brooklyn is converted into a sustainable urban neighborhood, a few structures should be preserved as a link for its current residents. Preserved structures include those that are important to the neighborhood or appropriate to the proposed neighborhood design. For example, the existing churches are integrated into the design of the new Brooklyn neighborhood.

Riverside Avenue needs to be woven back into the fabric of the Brooklyn neighborhood. This approach suggests locating uses along the Avenue that transitions and connects the existing office towers with the proposed residential neighborhood. New structures should have a strong connection to street edges and provide services that support the neighborhood. If office towers are part of the revised scheme, parking for those uses should be above the street with commercial uses along the first floor.

Circulation

In order to reduce automobile congestion and speeds, alternative forms of transportation are emphasized. The planned ASE extension to Brooklyn greatly improves the public transit connection to downtown. Bicycle lanes, linear parks and wider sidewalks encourages alternate forms of transportation. Traffic speeds can be reduced by providing narrow streets lined with trees. These trees also help to cool the neighborhood, reduce traffic noise and filter vehicular pollutants. Adding trees along Gilmore Street also helps to reduce the highway impacting that area of the neighborhood. In addition, the highway access from Gilmore Street should be closed to further reduce automobile traffic in that area. Another alternative for this area is to transform Gilmore Street into an eco-industrial corridor. Carefully selected business could serve as a buffer from the highway as well as providing employment opportunities to the community.

Figure 21: McCoy's Creek

Figure 22: Tree along Gilmore Street

Figure 23: View of Riverside Avenue near Forest Street

Figure 24: Demolition along Riverside Avenue for Street Widening Project

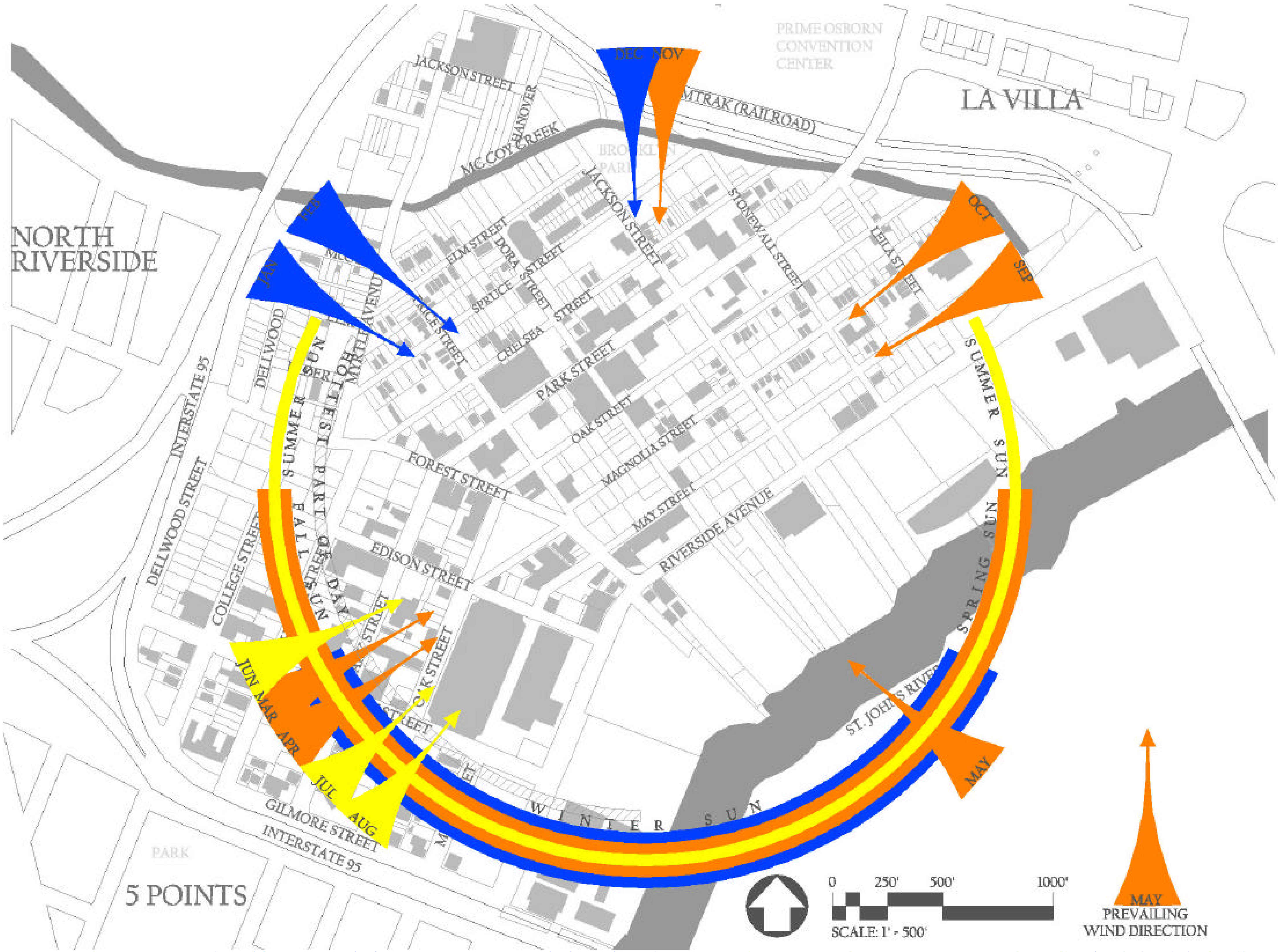

Figure 25: Climatic Forces. Adapted from National Climatic Data Center, Local Climatological Data: Annual Summary with Comparative Data: Jacksonville, Florida (JAX) (Asheville, N.C.: National Climate Data Center, 2001) 3 and G. Z. Brown and Mark DeKay, Sun, Wind & Light: Architectural Design Strategies, 2d ed. (New York: John Wiley & Sons, Inc., 2001), 301.

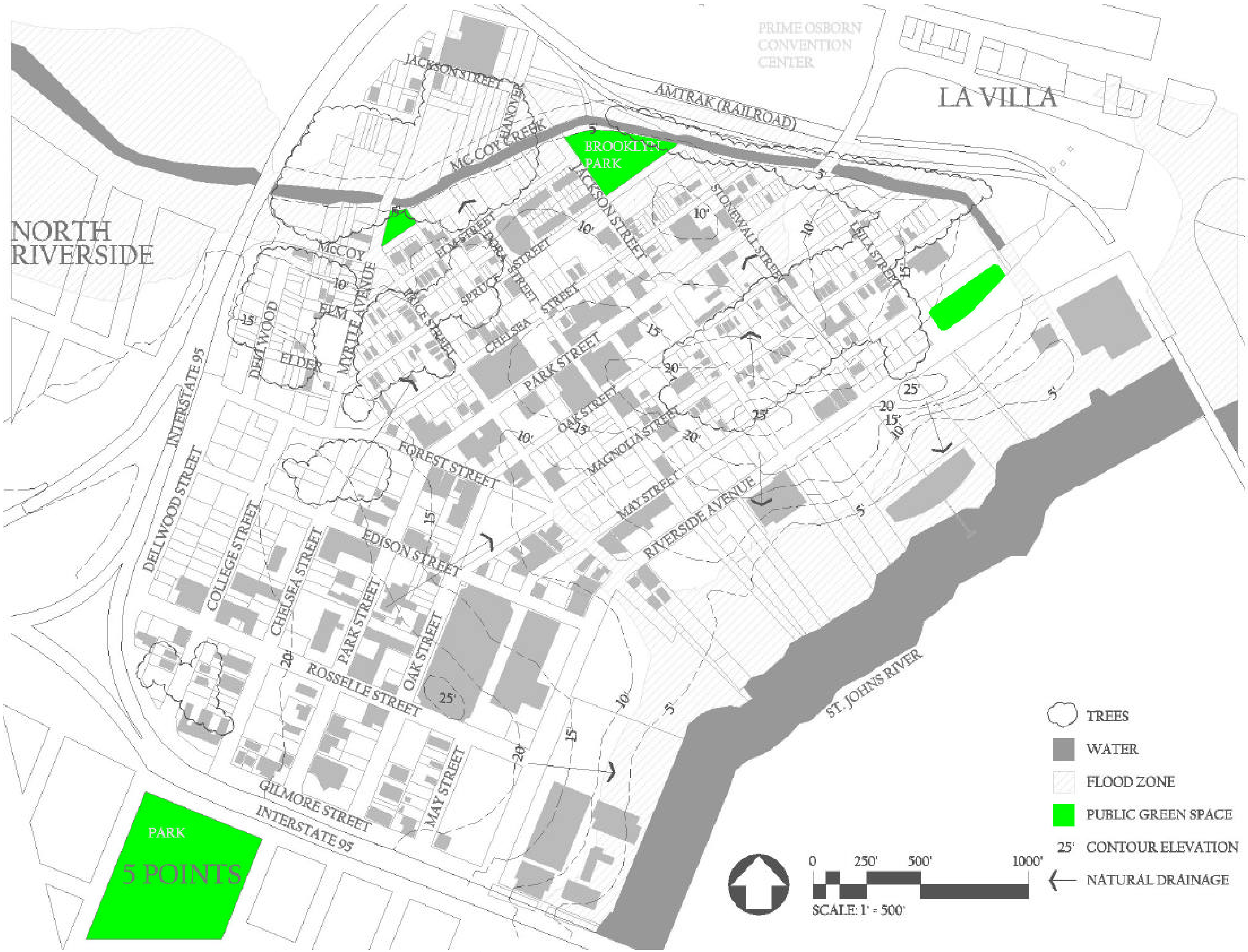

Figure 26: Existing Natural Systems. Information provided by Jason Thiel, 5 February 2001.

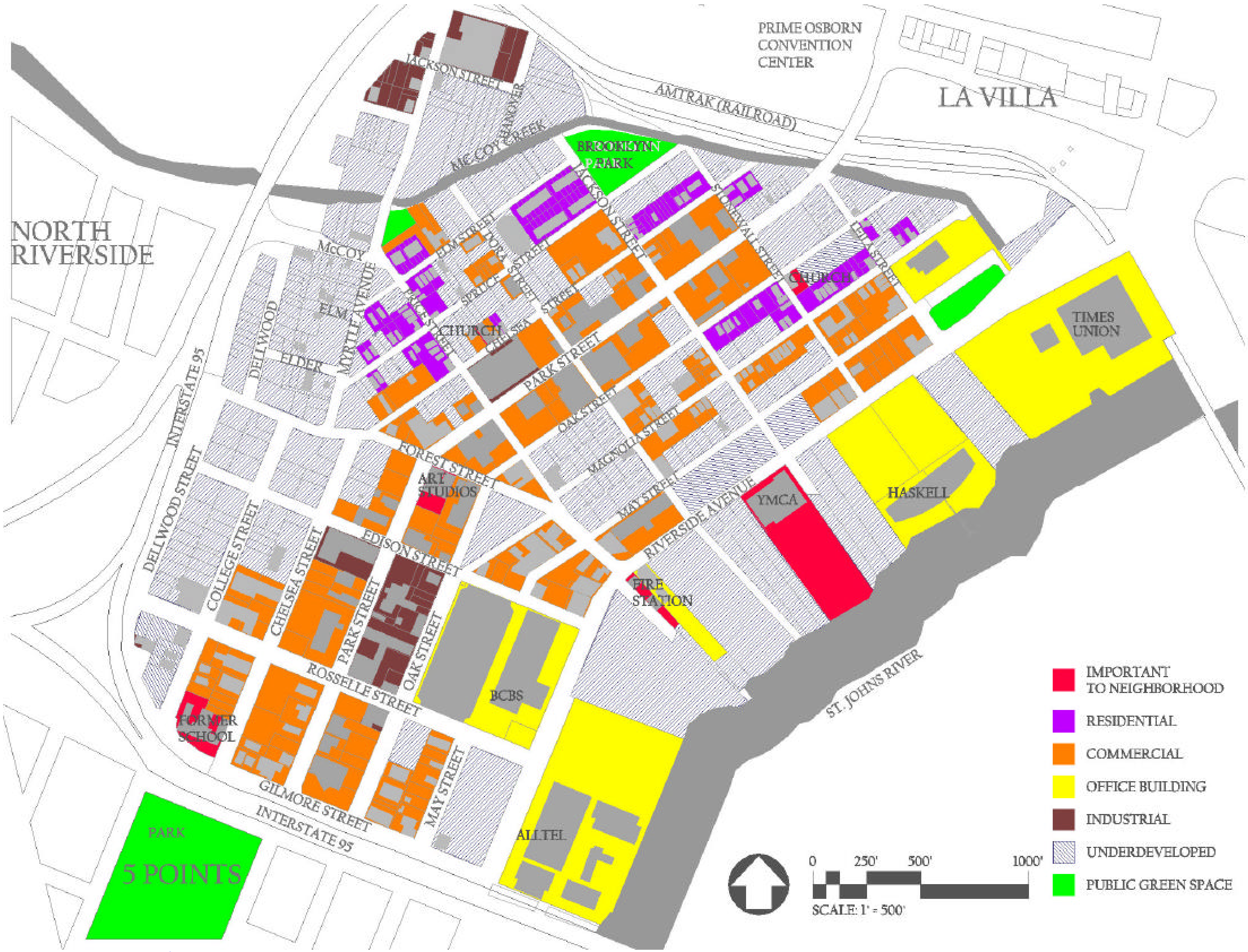

Figure 27: Existing Land Uses

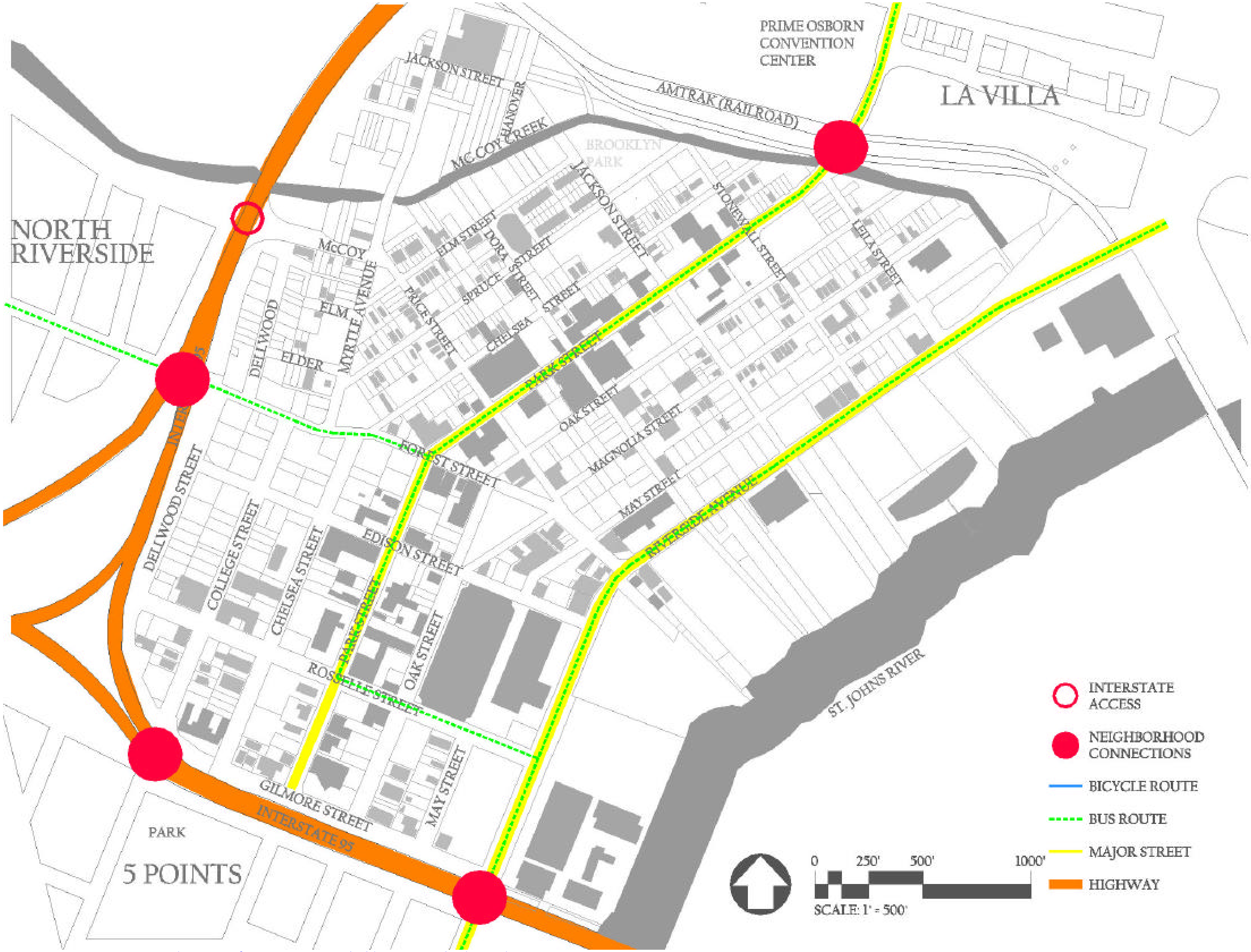

Figure 28: Existing Circulation. Information provided by Jason Thiel, 5 February 2001.

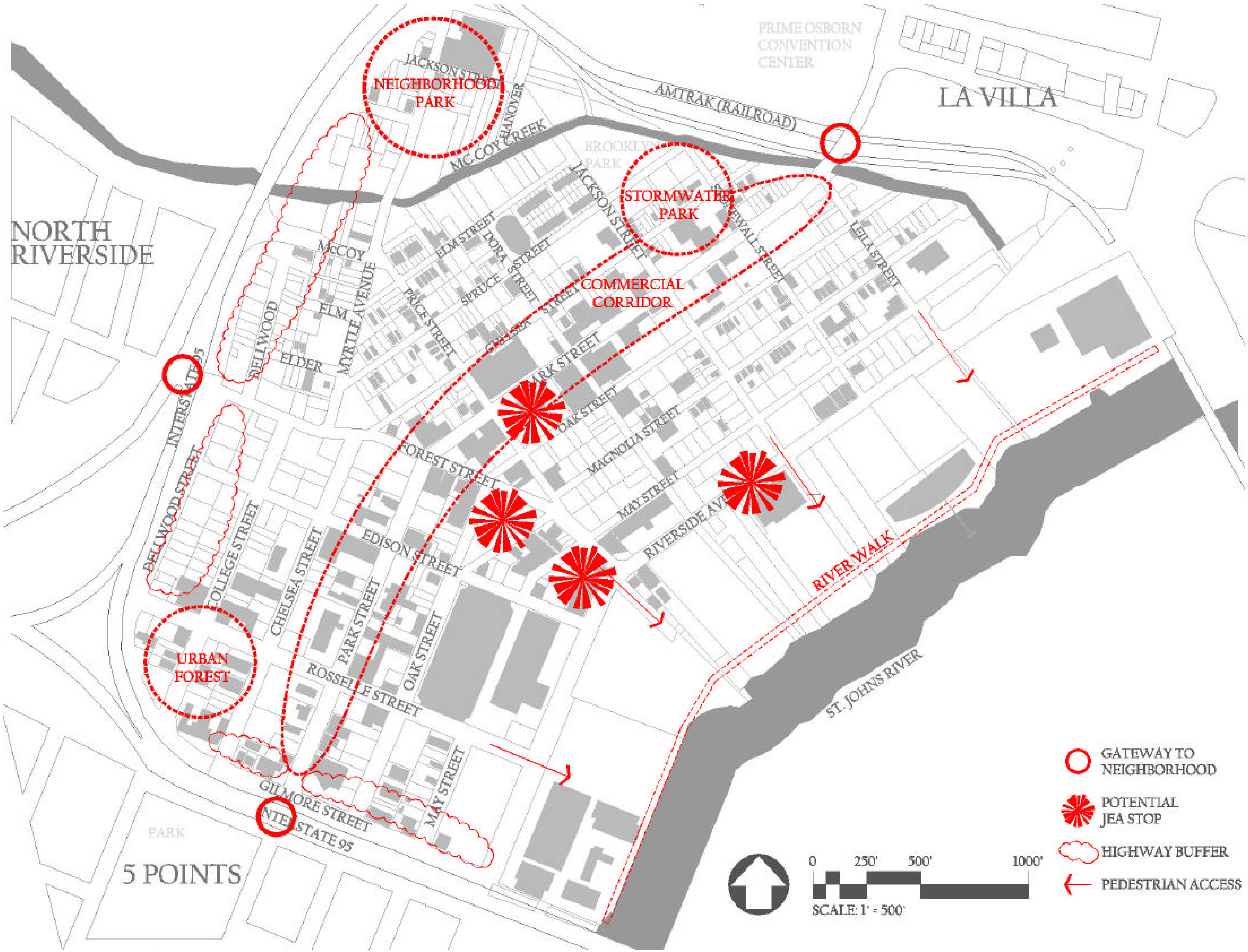

Figure 29: Summary of Existing Site Recommendations

CHAPTER 5
DESIGN RECOMMENDATIONS FOR BROOKLYN

Neighborhood Master Plan

The proposed conversion of Brooklyn into a sustainable development attempts to fulfill several goals. Primarily, the neighborhood should require minimal external energy and generate minimal waste. Existing structures are therefore preserved whenever possible. Streets are narrower to minimize vehicular traffic while maximizing alternate, less energy-intensive, forms of transportation. Second, the neighborhood design encourages a variety mixed-use and mixed-income structures in order to establish a stable community. The increased density of these structures maximizes the opportunity for public areas. Public green spaces surround the neighborhood, providing many types of gathering spaces as well as a natural buffer to the highway. The proposed design of Brooklyn illustrates how an existing development can be transformed into a sustainable urban neighborhood.

The general pattern of the development is organized around the preserved elements of the existing neighborhood. For Brooklyn, most structures that should remain part of the new neighborhood are located along Park Street and Riverside Avenue. The existing street layout is therefore be maintained with Park Street as a shopping district and Riverside Avenue as primarily business-oriented corridor. Forest Street has been realigned with a gracious curve. This arrangement divides Brooklyn into four quadrants. Three of the quadrants consist of various types and scales of residential housing and are immediately adjacent to public green spaces that surround the neighborhood. The housing blocks were then reoriented to maximize passive cooling benefits. The remaining area is converted into an eco-industrial zone, since the southwest quadrant consists mainly of the BlueCross Blue Shield office building and parking structure. The largest parcel was developed as an eco-enterprise center. Pioneered in Minneapolis as a means of creating urban employment while encouraging green business practices, an eco-enterprise center leases office and warehouse space for environmentally sustainable businesses.[104] A common structure maximizes the potential for waste reduction through exchanges between the tenants.

Figure 30: Parti of Brooklyn Redevelopment.

Natural Systems

Within the neighborhood, parcels and streets are minimized in order to increase opportunities for public green spaces. The variety of public green spaces surrounding the development allows different levels of activity. An urban forest along the western edge creates opportunities for nature walks. Play fields to the north allow organized team sports for all age levels. Adolescents preferring less organized sports can use the skate park to the west of the site. East of the skate park, public garden space can be used as a backdrop for evening strolls along McCoy Creek. A riverwalk completes the circuit through the neighborhood and can be

[104] National Housing Institute, "Minneapolis Goes Green," Shelter Force Online [online] (Orange, NJ: National Housing Institute, January/February 1999 [cited 19 June 2001]); available from

connected to the riverwalk to the east of Brooklyn. Tree-lined streets and linear parks connect the public green spaces along Brooklyn's perimeter. Trees along the streets remove particulates from local traffic while helping to reduce automobile speeds. The use of native vegetation encourages wildlife, requires minimal maintenance and helps to restore the native ecosystem.

Table 2: Recommended Native Plants for Brooklyn's Natural Drainage Areas.

	Scientific Name	Common Name	Height	Planting Locations
Swale planting	*Acer rubrum*	Red maple	35'	street, parks
	Fraxinus caroliniana	White ash	50'	parks
	Ilex cassine	Dahoon holly	20'	street, hedge
	Illicium floridanum	Florida anise	10'	border, hedge
	Myrica cerifera	Southern wax myrtle	15'	screen, highway

Source: Adapted from Michael Jameson and Richard Moyroud, ed., Xeric Landscaping with Florida Native Plants (Hollyrood, FL: Betrock Information Systems, Inc., 1991), 65-66. and Bijan Dehgan, Landscape Plants for Subtropical Climates (Gainesville, FL: University Press of Florida, 1998).

Beyond plant selection, the neighborhood design also contributes to restoring the natural ecosystem. The urban forest located along the western and northern boundaries of the site serves to filter noise and air pollution from the highway. Smaller naturalized areas are created within the residential blocks. Connecting the naturalized areas via linear parks and swales forms an ecosystem matrix. The matrix also assists in natural stormwater drainage.

Stormwater is held within the neighborhood and absorbed directly into the aquifer. Stormwater runoff from streets is transferred to natural swales that line every street. The vegetation within the swale absorbs particulates and decreases the runoff speed, allowing the water to be absorbed into the aquifer below. Swales are also used within public green spaces and the residential blocks to channel water flow. All remaining stormwater is eventually directed to a constructed wetland, which slowly filters and releases water into the aquifer.

---

http://www.nhi.org/online/issues/103/minneapo.html.

General Concepts for Proposed Land Uses

The Brooklyn neighborhood was organized to meet the needs of the community, encourage alternate forms of transportation, and maximize energy efficiency while minimizing waste. This was accomplished by creating an interconnected mix of existing and new structures, which allows resources to be used more efficiently as well as creating an active neighborhood. By providing three-dimensional mixed-use zoning throughout the neighborhood allows residents to work, shop and play within Brooklyn, without requiring them to drive.

Primarily, pedestrian and bicycle access was promoted over vehicular transportation requirements by locating main building entrances on the street. Narrow lots with structures located on the street lot line minimize travel distances between structures thus encouraging walking. Bicycle parking is required for all non-residential areas, while parking lots are obscured from the street or not provided. In residential areas, garage doors cannot face the street and driveways must be narrow, reinforcing the pedestrian scale of the neighborhood.

Beyond transportation needs, the neighborhood was designed to minimize energy input and waste outflows. Whenever possible, existing non-residential structures were integrated into the proposed neighborhood plan, since less energy is generally required to renovate them then to build new. New structures are designed using the energy-efficient practices discussed later in the chapter and use green materials. New lots were oriented to maximize passive solar design strategies for as many of the structures as possible. In addition, structures are located to allow solar and wind access to adjacent buildings as well.

While a large portion of the neighborhood is devoted to public green space, additional green spaces are required within private lots. These green spaces use native vegetation, in order to restore the native mesic hammock ecosystem. Lawns are used only where required for play areas. Providing green spaces, both public and private, throughout the neighborhood help reduce urban heat islands as well as providing additional space for stormwater retention. In fact, large lots are required to collect stormwater runoff and allow it to be absorbed into the aquifer. To avoid flooding while allowing stormwater to drainage naturally, the first floor of all buildings are held above the flood plain.

Based on the proposed site plan, zoning requirements were developed to assist designers in developing proposals for individual parcels. These requirements do not require a specific building form; rather, it is hoped that a dynamic range of design solutions can be generated using the zoning requirements as a point of departure.

Primarily nonresidential uses

Since they provide opportunities for public gatherings that strengthen the fabric of the community, civic structures, such as public theatres, galleries, community centers and houses of worship are permitted throughout the neighborhood. Civic structures should fit within their surrounding context and follow the scale of the adjacent structures.

Table 3: Retail Uses that Encourage Pedestrian Activity.

Preferred Uses
Cinemas, theatres and auditoriums
Eating Places, cafes and restaurants
Food stores and food markets
General Merchandise retail, including electronics, variety shops, and hardware stores
Health clubs and gymnasiums
Miscellaneous retail trade, such as florists, camera supplies, art & hobby supplies
Personal services, such as barber & beauty shops, shoe repair
Excluded Uses
Drive-thru facilities
Parking garage
Gasoline stations

Within the retail corridor along Park Street, mixed-use structures ensure constant street activity. Locating retail stores on the first floor should encourage residents to shop within Brooklyn. Covered walkways and bike racks along Park Street are also recommended. The main entrance to the stores must be along either Park or Forest Street to encourage pedestrian access between buildings. The upper floors should be retail, commercial or residential uses. When existing buildings along Park Street are renovated, the structures must be extended to meet either Park or Forest Street.

New construction in lots south of Riverside Avenue match the scale of the existing, high-rise, neighboring lots. The new structures, however, cannot create shadows on structures located north of Riverside Avenue. In order to encourage pedestrian travel along Riverside Avenue, part of the new construction must be along that street and contain the main entrance to the structure. A pedestrian route must also be provided through each lot to connect Riverside Avenue with the riverwalk. Any vehicular parking must be accessed from a side street and should not be visible from Riverside or the riverwalk. To encourage employees to utilize alternative forms of transportation, covered bicycle parking must equal to the number of parking spaces provided and be located adjacent to the main entrance. The structures themselves should be a mix of retail, commercial and residential uses. When existing structures in this area are renovated, new structures must be added along Riverside Avenue.

For commercial structures located north of Riverside Avenue, mixed use is also encouraged. The first floor is ideally retail, to encourage public access along Riverside Avenue, with professional offices on the upper floors. These structures must be approximately four stories tall to maximize solar access to adjacent buildings.

The eco-industrial area in the southwest portion of the neighborhood are for businesses that either generate green materials for the neighborhood, and the city, or reuses waste materials generated by the neighborhood. Preferred uses include environmentally sustainable businesses, such as recycling centers, resale stores and the manufacture of energy-efficient materials. Multi-story structures with multiple businesses within each structure are encouraged in this area in order to promote the sharing of resources. As with the other non-residential uses, the building must be located along the front property line. The main building entrance must face the street and bicycle parking must also be provided. If provided, the loading docks cannot be viewed from Riverside Avenue.

Primarily residential uses

Multi-family structures should provide a range of unit sizes and prices in order to create a mixed-income neighborhood. Lots located along Forest Street may have retail stores at street level. As with non-residential uses, the main entrance should be facing the street. Bicycle parking should be provided. On larger lots, public green space must be provided that connects to existing pedestrian paths. In general, structures may not exceed four stories, but taller structures are permitted if no shadow is cast on adjacent structures.

Attached residential buildings, such as townhouses, apartments buildings or condominiums can be single or multiple units, to also provide a range of unit sizes and prices. While the main entrance must face the street, a second entrance should also be provided to access the pedestrian path along the rear of the lot. Given the narrow lot dimensions, three story structures are permitted.

Residential lots may be for either one or two families. In addition, owner-occupied home businesses are also encouraged to reinforce the mixed-use nature of the neighborhood. To avoid casting shadows on neighboring houses, structures should not exceed 2 ½ stories. Front and rear porches should be provided to foster interaction between neighbors as well as to encourage outdoor, non-conditioned, activities.

Proposed Circulation

Circulation within the Brooklyn neighborhood attempts to minimize automobile traffic while encouraging alternate forms of transportation. Primarily, circulation within Brooklyn is designed as a pedestrian-oriented neighborhood. All streets are lined with sidewalks that are generously proportioned according to the intended traffic flows. Separate greenways provide automobile-free routes that connect the residential areas to Park Street as well as the green spaces surrounding Brooklyn.

Public transportation routes have been designed for convenient access throughout Brooklyn. According to the city plan, the skyway is located along Riverside Avenue. The skyway stop is proposed to occur at the Forest Street intersection. This placement allows commuters convenient access, via a pedestrian bridge over Riverside, to the offices along the River. The skyway stop is also within a 10-minute walk of the entire neighborhood. The busses generally follow their existing routes, with the exception that busses continue along Park Street into the Five Points neighborhood, instead of switching over to Riverside Avenue.

Bicycle lanes are isolated from potential conflicts between busses, automobiles and pedestrians. Conventionally, bicycle lanes are often located at the edge of city streets. This design often requires people, leaving their parked car or exiting a bus, to cross the bicycle lane. Also, cars must cross the bicycle lane when turning, which is in conflict of bicyclists continuing along the street. In Brooklyn, bicycle lanes are located within the wide street median. By creating a fairly continuous median, opportunities for conflict between bikes and cars are minimized.[105] Appropriate signage along the left hand lane of major streets within the neighborhood alerts drivers to oncoming traffic. Pedestrian and bicycle conflict along the River and perimeter green spaces is avoided by providing a separate bicycle lane that parallels the pedestrian path.

Vehicular access in the neighborhood is greatly limited. While the entire neighborhood is accessible by car, the streets are arranged to make walking or bicycling more convenient. Most streets are one-way and two-way streets contain fairly continuous medians. Streets are also limited in width, which tends to reduce traffic speeds as well as minimizing the amount of impervious surfaces within the neighborhood.

---

[105] Michelle M. DeRobertis and Rhonda Rae, "Buses and bicycles: Design alternatives for sharing the road," ITE Journal, 71 (May 2001): 43.

Figure 31: Proposed Natural Systems

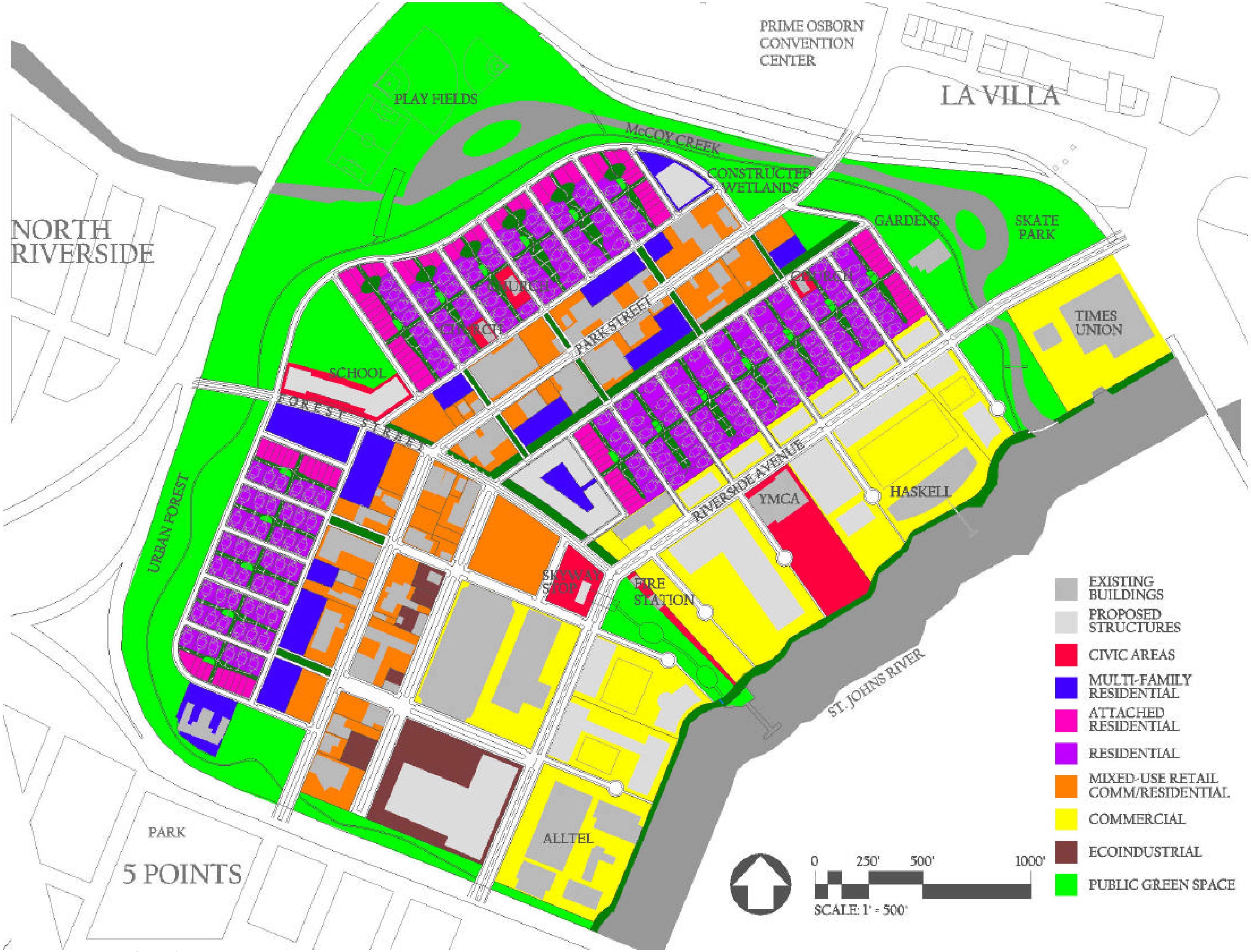

Figure 32: Proposed Land Uses

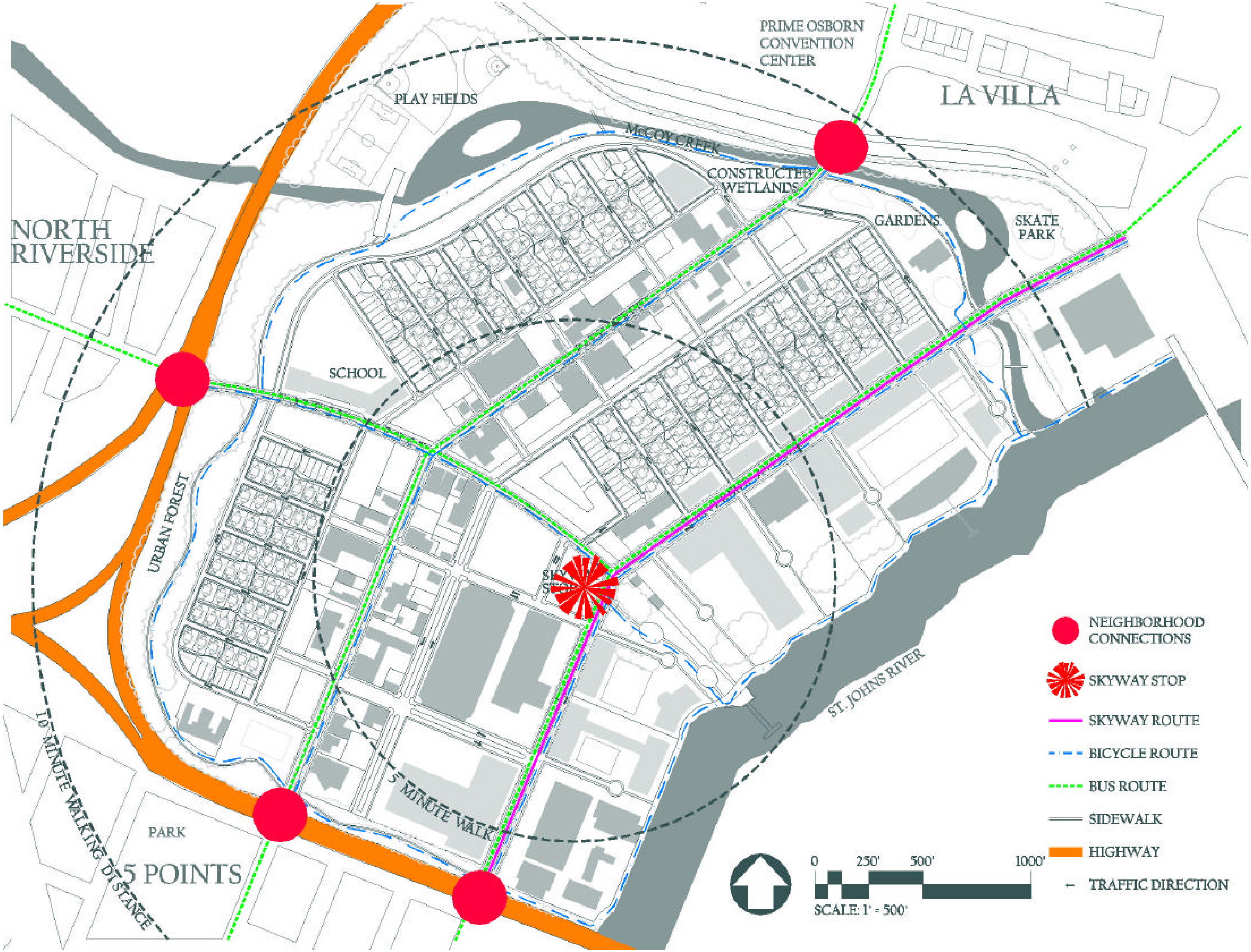

Figure 33: Proposed Site Circulation

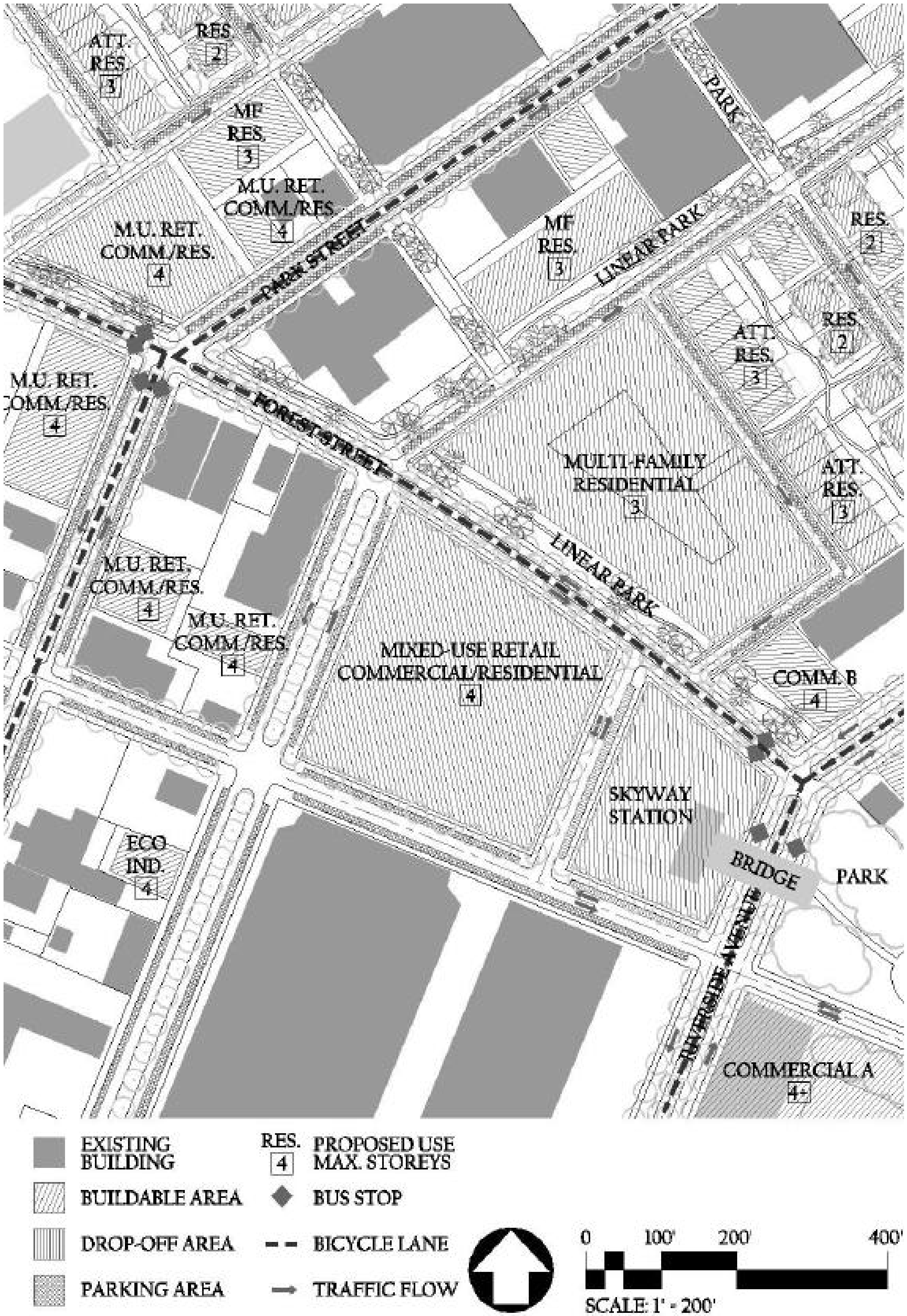

Figure 34: Detail Plan of Brooklyn Center

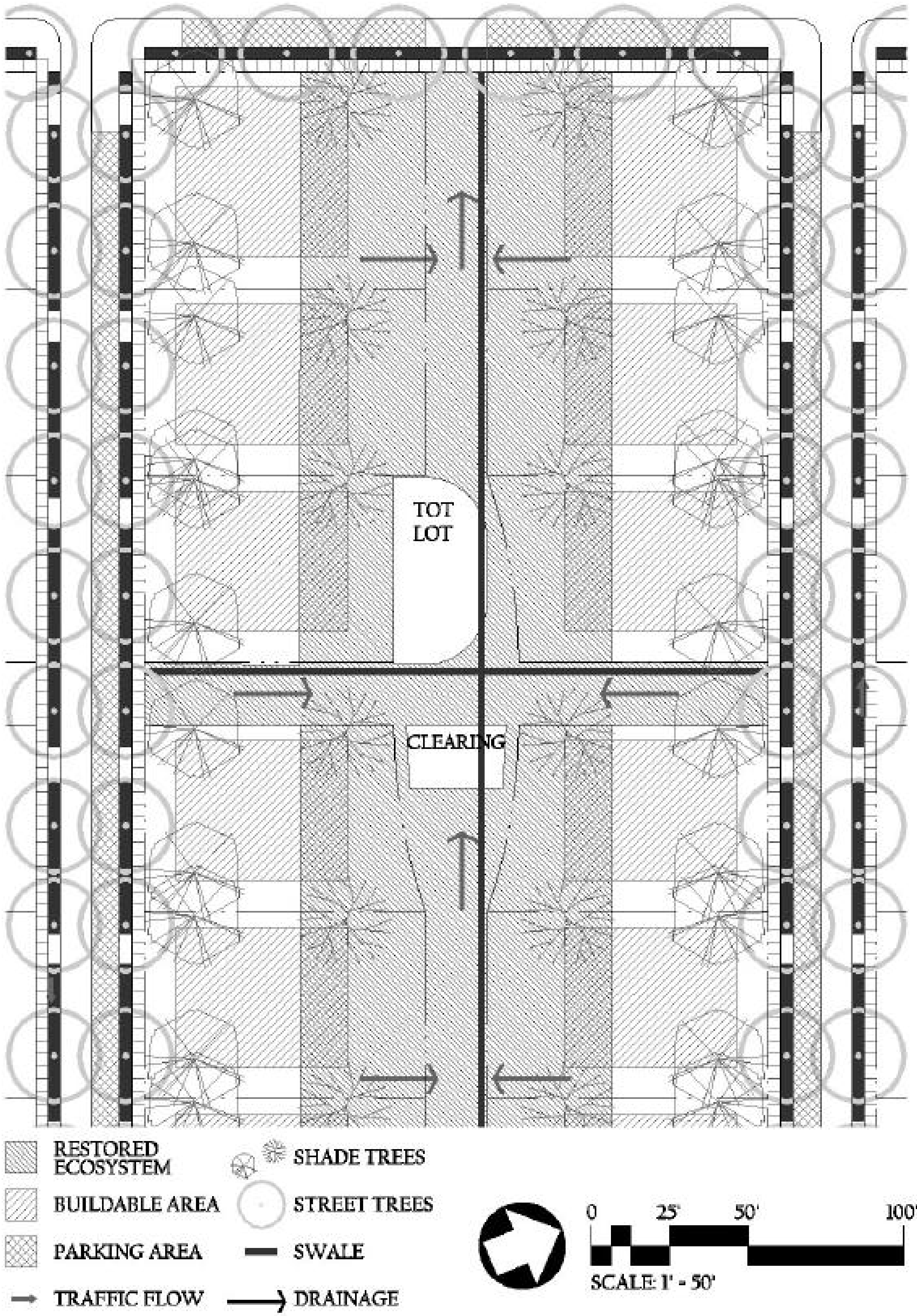

Figure 35: Typical Residential Block

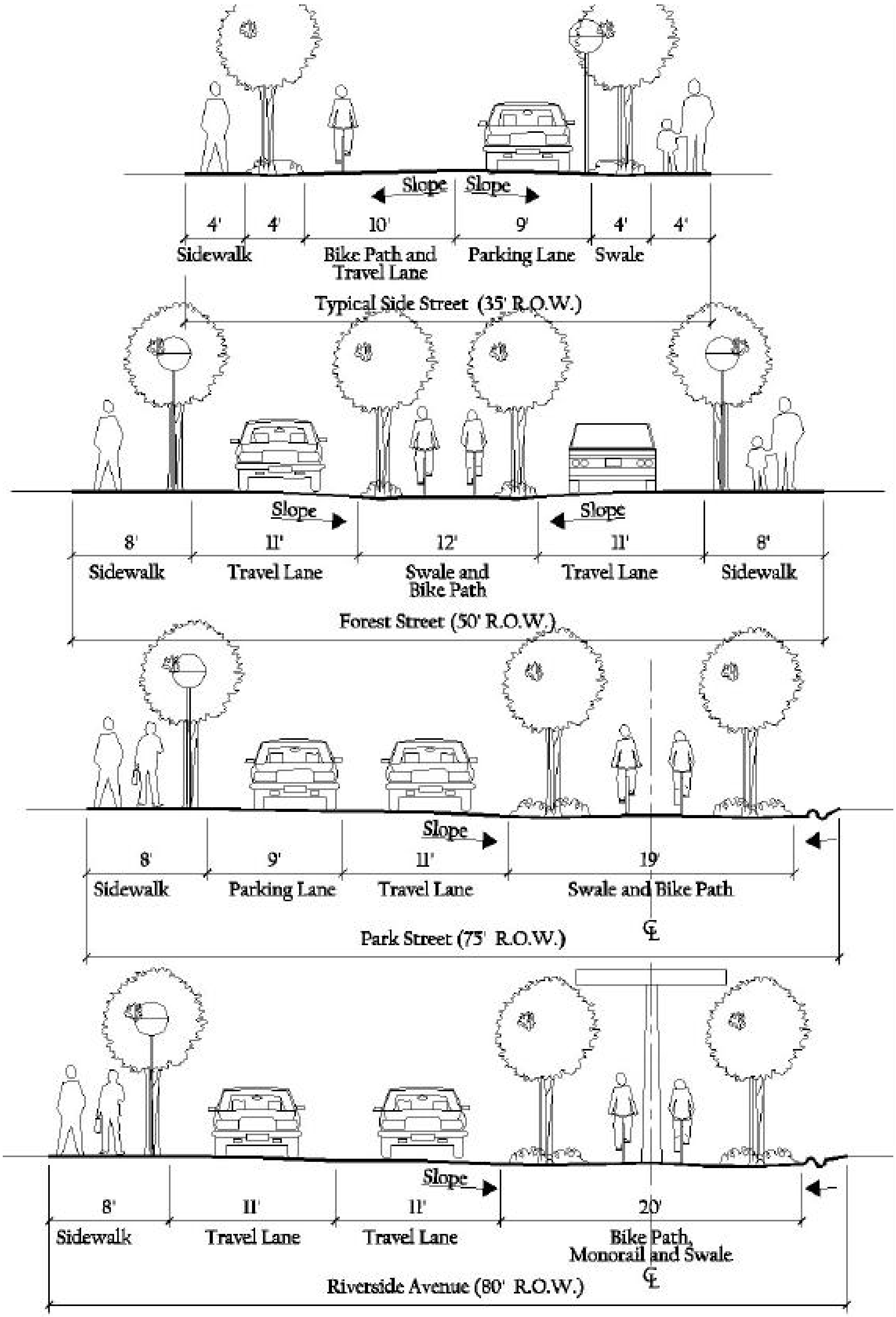

Figure 36: Typical Street Sections

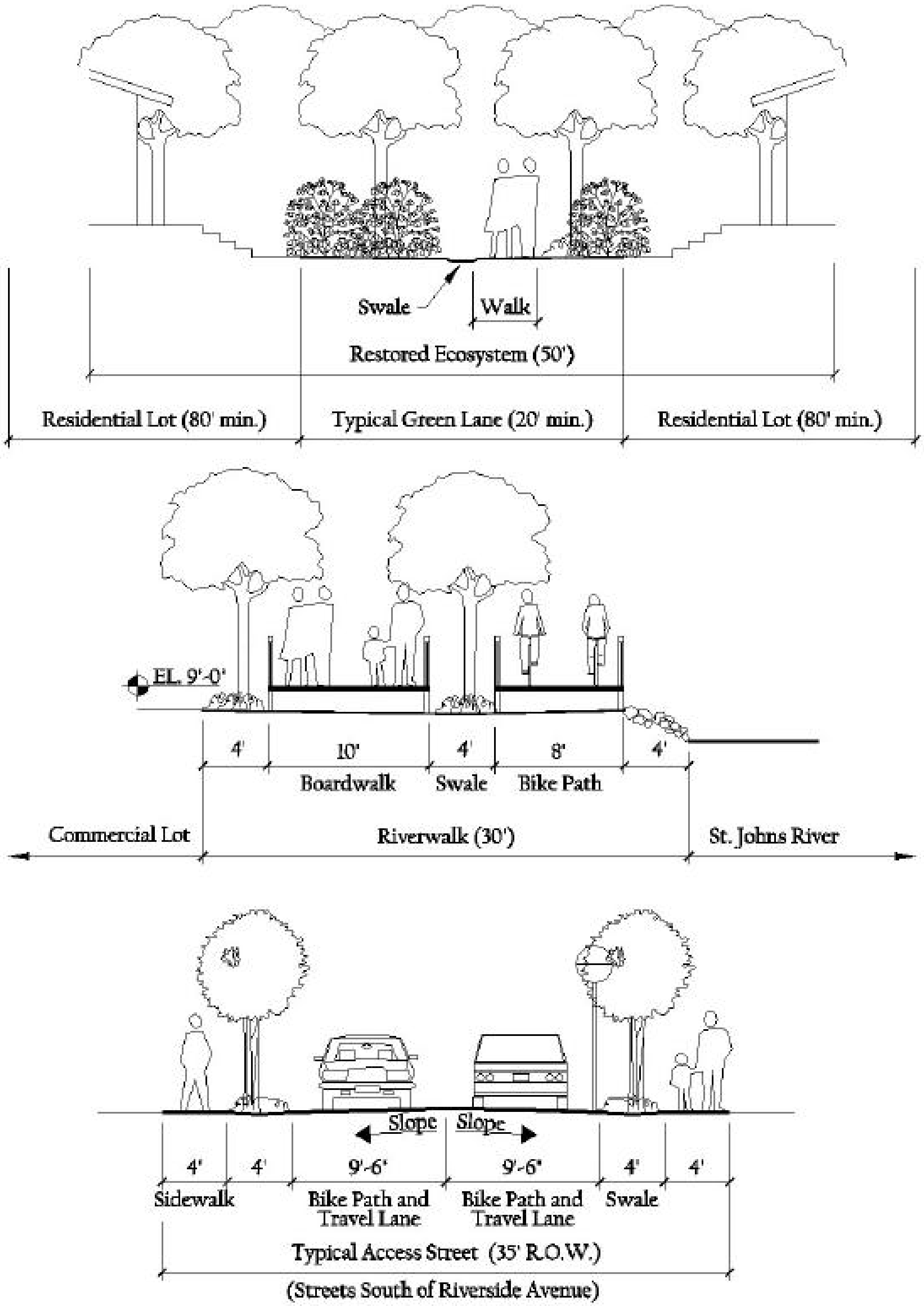

Figure 37: Typical Street and Pedestrian Path Sections

Prototype Green Buildings

As discussed in Chapter 4, the climate in Florida is hot and humid. Throughout northern Florida, the summers are warm (reaching into the 90s) and rather humid (averaging 75%) with prevailing winds from the southwest. The winter is much milder (in the 50s) with periodic invasions of cold air from the northwest. Most of the precipitation occurs during summer, when thunderstorms occur several times a week.[106]

Structures within Brooklyn should, therefore, be designed to minimize their cooling load. Reducing the cooling load of structures located in hot climates has many benefits. The most immediate improvement is the energy cost reduction due to the cost of air conditioning being roughly proportional to its conditioning capacity. In addition, because the duct size is directly related to the cooling load, energy efficiency structures in Florida requires significantly smaller ducts than standard construction practices.[107]

Commercial Structures

Within Brooklyn, many existing commercial structures can be renovated into new uses. In fact the neighborhood was designed in order to preserve the existing infrastructure to the greatest extent possible. Before deciding to build new, designers should carefully consider the benefits of reusing the existing structure. Renovated structures generate less waste and embodied energy than demolition and new construction. When the building program requires a new structure, the existing materials must be either reused or recycled as current technology permits.

Commercial structures, either in this neighborhood should be designed or renovated in order to reduce their internal heating loads. In Florida, thirty percent of the cooling load of a typical office building is attributable to heat produced from lighting, twenty percent to solar heat

---

[106] National Climatic Data Center, Local Climatological Data, 8.

[107] Wilson, "Keeping the Heat Out," 13.

gain through the windows, fifteen percent to heat gain through the roof and thirteen percent is generated by internal equipment.[108]

All commercial structures within the Brooklyn neighborhood meet, or exceed, the requirements for the latest version of LEED Green Building Certification. LEED[109] is a self-assessing system designed for rating new and existing commercial, institutional, and high-rise residential buildings. The rating system is based on existing proven technology. It evaluates environmental performance from a "whole building" perspective over a building's life cycle, providing a definitive standard for what constitutes a "green building". It is a feature-oriented system where credits are earned for satisfying each criterion. Different levels of green building certification are awarded based on the total credits earned. For Brooklyn, only the minimum certified level is required.

Spatial arrangement

To maximize the potential for daylighting strategies, buildings should be oriented along a generally east-west axis. Daylighting strategies can reduce lighting requirements up to fifty percent.[110] The daylight provided must be of an acceptable quality to the building's occupants, which suggests providing diffuse, cool sunlight; uncontrolled glare and localized overheating cause users to resort to blinds, defeating the benefits of the daylighting design.[111]

Open spaces should be provided along the windows, allowing natural light and ventilation to penetrate throughout the entire floor. The east-west orientation also minimizes

---

[108] Danny S. Parker, Philip W. Fairey and Janet E.R. McIlvaine, Energy Efficient Office Building Design for a Hot and Humid Climate: Florida's new Energy Center [online] (Cape Canaveral, FL: Florida Solar Energy Center, 1994 [cited 28 May 2001]); available from http://www.fsec.ucf.edu/~bdac/pubs/PF291/pf-291.htm.

[109] Leadership in Energy and Environmental Design as developed by the U.S. Green Building Council, LEED Green Building Rating System Version 2.0 (Washington D.C.: U.S. Green Building Council, 2000).

[110] Adrian Tuluca and Steven Winter Associates, Inc., Energy Efficient Design and Construction for Commercial Buildings (New York: McGraw-Hill, Companies, Inc., 1997), 82.

[111] Parker,. Fairey and McIlvaine, Florida's new Energy Center.

solar heat gain along the overheated west façade. Minimizing the width of structures allows for greater cross-ventilation.

Appropriate systems

Lighting uses much energy in commercial structures; in typical office buildings, for example, it accounts for up to fifty-percent of the electricity consumption.[112] Additionally, the cooling equipment must remove the heat generated by the light fixtures. In order to reduce cooling loads, lighting fixtures should contain electric ballasts that can be automatically dimmed in according to the amount of daylight available. Occupancy sensors should also be used to minimize lighting waste. In keeping with LEED requirements, minimal exterior lighting should be provided and lighting should not be directed at the sky in order to minimize light pollution.[113]

Commercial structures within Brooklyn should be designed using low-flow plumbing fixtures. Toilets and sinks should contain automatic controls to minimize water waste. Where permitted by code, designers should also consider using waterless urinals and composting toilets.

Maintaining proper humidity levels within buildings in Florida is a constant concern. In energy-efficient structures, mechanical systems are generally used under part-load conditions. Therefore, the mechanical equipment must be carefully sized for the actual operating conditions, especially if operable windows are provided. The mechanical system should produce a positive pressure, with respect to the exterior, and dehumidify all ventilated air. Exterior air should be dehumidified prior to being mixed with any return air. By directly conditioning the moist outside air first, the thermodynamic effectiveness of moisture removal is improved, a smaller dehumidifier is required, and a centralized location for air filtration or other enhancements is provided.[114]

---

[112] Tuluca and Steven Winter Associates, Inc., Commercial Buildings, 81.

[113] U.S. Green Building Council, LEED, 7.

[114] Parker, Fairey and McIlvaine, Florida's new Energy Center.

Residential Structures

Unlike commercial structures, cooling loads generally originate from climatic factors. Therefore the shape and openings of the house has the greatest impact on its energy-efficiency. Primarily, houses designed for Brooklyn should encourage summer ventilation. Constant airflow reduces the need for mechanical ventilation during the early and late summer months.

Similar to the LEED standard, the Florida Green Building Coalition has developed a standard for Florida Green Homes.[115] The standard has minimum requirements in various categories, some specific to the unique Florida climate. The standards provide an excellent checklist for designing and detailing energy-efficient homes within Florida. All new residences within Brooklyn require Florida Green Home certification.

Spatial arrangement

Residential structures should be designed to maximize climatic benefits. Lots within Brooklyn have been arranged to provide for a generally east-west orientation. This configuration allows for high-occupancy areas, such as the living and dining rooms to face south. Placing the porches on the east and west facades minimizes glare in the morning and afternoon. The kitchen and other heat-producing spaces should be isolated from the remainder of the occupied spaces, minimizing overheating during the summer.

An open floor plan, with a raised slab, assists in the natural ventilation of the home. Openings should be located to encourage cross-ventilation. Casement windows can capture summer and fall breezes while transom windows can allow hot air to escape along the ceiling.

Another consideration in Florida house design is the height of the interior spaces. Sufficient vertical space should be provided to provide for convective ventilation. Once the heat rises above the occupants, it can then be channeled out of the building.

---

[115] Florida Green Building Coalition, Inc., Florida Green Home Designation Standard of the Florida Green Building Coalition, [online] (Naples, FL: Florida Green Building Coalition, Inc. [cited 31 October 2001]); available from http://floridagreenbuilding.org/Standards/HomeStd_071001.pdf.

Appropriate Systems

Residential design in Florida should take advantage of the large number of sunny days. Daylighting techniques should be used for rooms along the southern façade, while avoiding glare during the summer months. In addition, all houses within Brooklyn should be equipped with compact fluorescent lamps, rather than incandescent fixtures. Compact lamps save use sixty percent less electricity than traditional incandescent lighting.[116]

As with commercial structures, homes should be designed using low-flow plumbing fixtures. In addition, technologically advanced clothes and dishwashers greatly reduce the water requirements of the home. In addition, eliminating in-sink garbage disposals reduces the load on sewage treatment plants as well as reducing water usage.[117] Designers should also consider providing a solar water heater as well as a cistern for rainwater collection.

The mechanical system of residences should be integrated with the building's systems. For most of the cooling season, ceiling fans in high-occupancy areas should reduce the need for mechanical ventilation. An energy-efficient home should require conditioning on only the hottest days. To minimize heat loss, ductwork should be located within the conditioned spaces.

Design for the Future

Plumbing systems with within Brooklyn should be designed for future greywater recycling. When permitted by code, greywater can be used for landscape irrigation or toilet flushing. In addition, the flat roofs should be engineered for the addition of future photovoltaic panels. For sloping roofs, provide wiring for future building-integrated photovoltaic roof assemblies.

---

[116] Tuluca and Steven Winter Associates, Inc., Commercial Buildings, 82.

[117] "Water Conservation Checklist," Environmental Building News. September 1997, 13.

Prototype Residential Structure for Brooklyn

A prototype house was designed in order to illustrate the design principles for energy-efficient housing in Brooklyn. The first floor consists of an open plan that encourages natural ventilation between spaces as well as allowing heated air to escape through the roof monitor. The main living areas are located where they receive the most daylight while the porches are located to minimize glare in the morning and afternoon. The kitchen and mechanical room were isolated from the rest of the house, minimizing internal heat gain during the summer.

For a house to reduce its energy requirements, the house was oriented on the site to maximize its energy efficiency. Deciduous trees located southwest of the building shade the house in the summer; yet allow sunlight through in winter.[118] Sunlight cannot be easily controlled on west elevation, so those openings are heavily shaded with deep overhangs. These overhangs cover screened porches, providing additional living spaces throughout most of the year, without requiring additional conditioned space. The main living spaces are located along the southern elevation to take advantage of the better sunlight for daytime activities. The kitchen helps to heat the northern part of the house during the winter and is separated, by means of the roof monitor, from the living spaces to avoid overheating the house in the summer.

The house design also encourages natural ventilation. The casement windows used on the on the main level maximizes cross-ventilation in both the north-south and east-west directions. In fact, the length of the house is oriented to allow airflow during the hottest months of the year. To maximize the house surface area and increase airflow, the floor is raised above the ground. The overhangs over the windows not only block direct sunlight, but they also assist in trapping air under the eaves, funneling the breezes into the house.[119] The roof monitor assists in ventilating the house by releasing any heat generated from within the house. Heat continuously rise up the staircase and be vented through the roof monitor. The process of the hot air being

---

[118] Watson and Labs, Climatic Building Design, 89.

[119] Ibid., 195.

replaced with cooler air, known as the stack effect, naturally generates positive air circulation and cools the interior spaces.[120]

Green materials, as discussed in the next section, were used throughout the house, maximizing the energy-efficiency of the structure. Sustainably harvested cedar shingles are used for the exterior finish since they provide a natural deterrent to termites. Using low-e double glazed windows minimize heat gain during the summer. To minimize solar gain through the roof, a light colored metal roof was used and the entire roof assembly is vented. Sustainably harvested 2x6 wood studs, spaced 24" on center, packed with cellulose generates a better-insulated wall than conventional 2x4 wood studs, 16" on center, with batt insulation. Using these assemblies, in fact, allows the house to exceed accepted energy-efficient standards for Florida.[121]

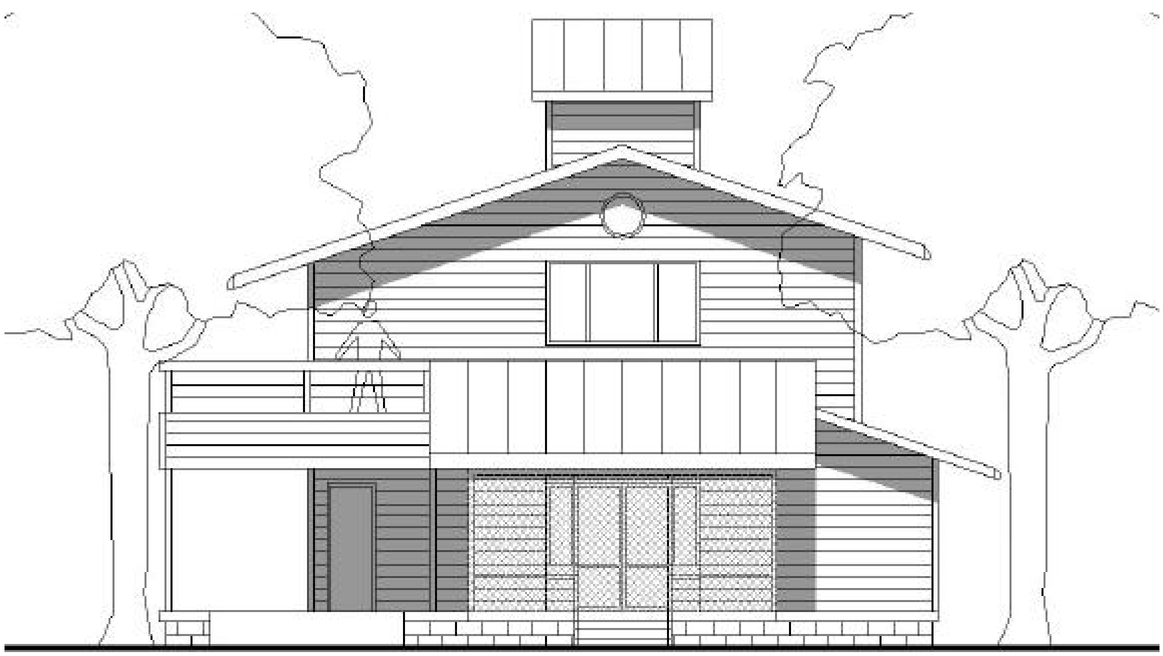

Figure 38: Street Elevation of the Prototype House.

[120] Ibid., 201.

[121] The prototype house will have a roof R-value of 30, a wall R-value of 20 and a floor R-value of 15, values of 26, 19, and 13 respectively are considered energy-efficient. Ibid., 146.

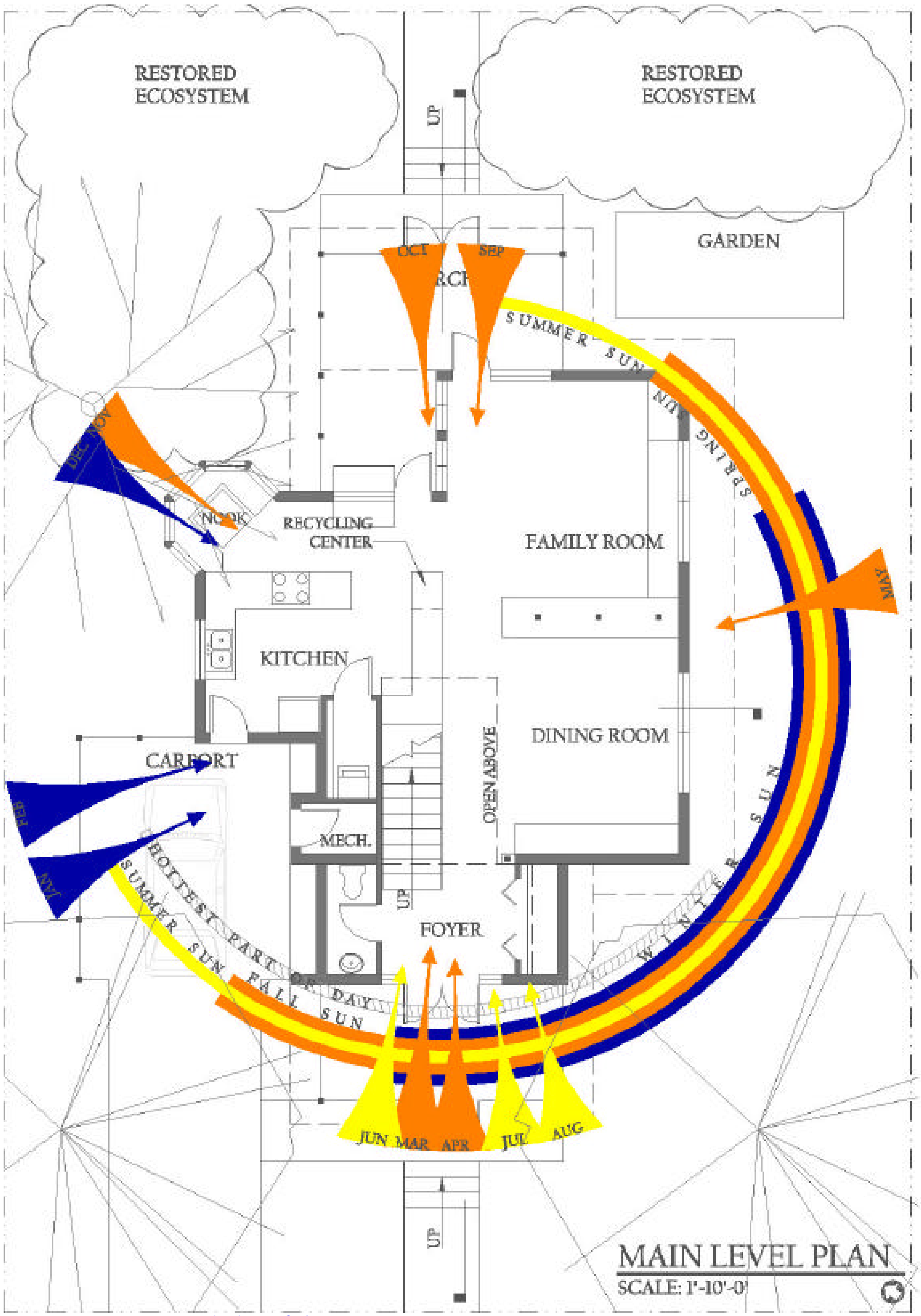

Figure 39: Main Level Plan of the Prototype House.

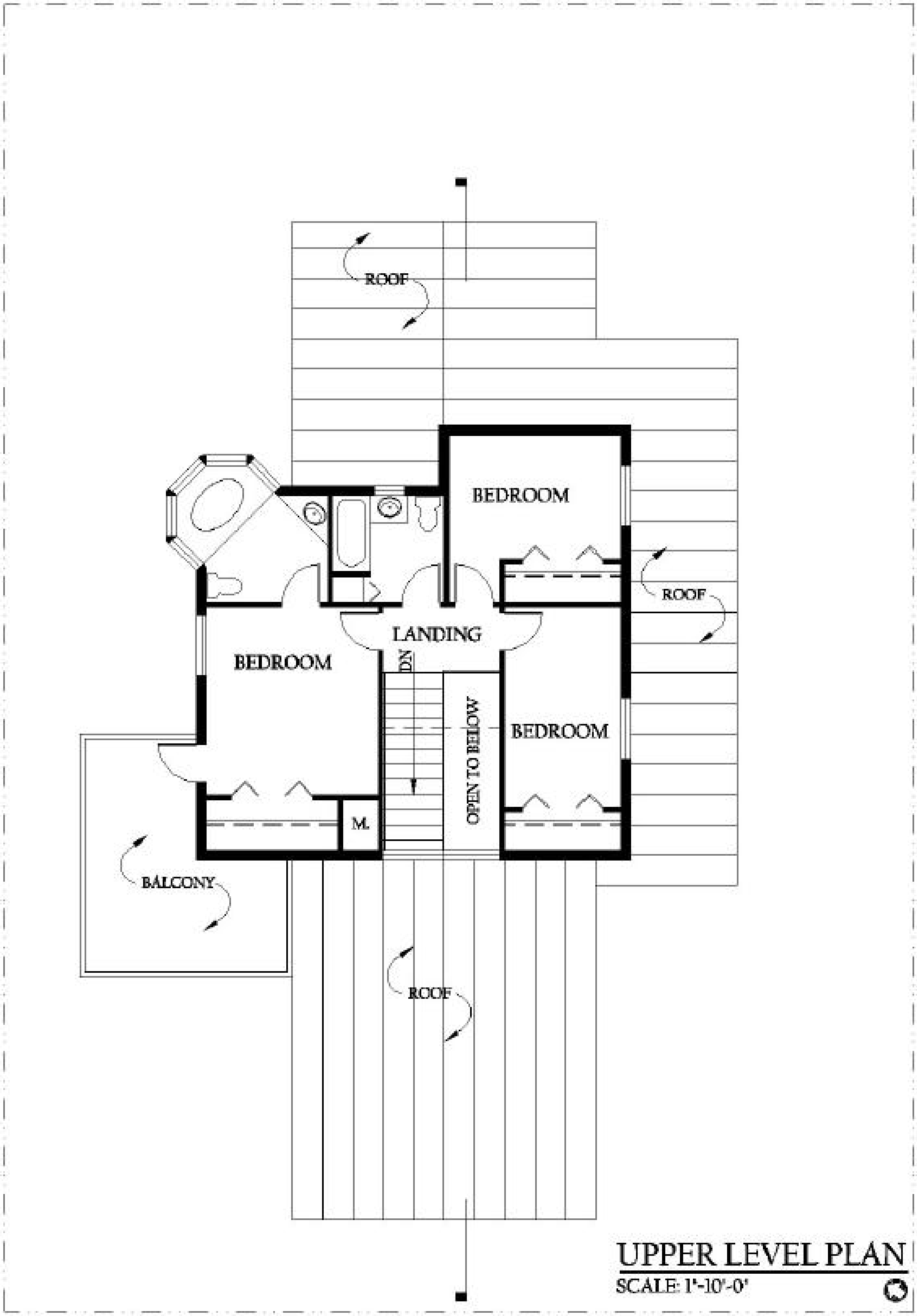

Figure 40: Upper Level Plan of the Prototype House.

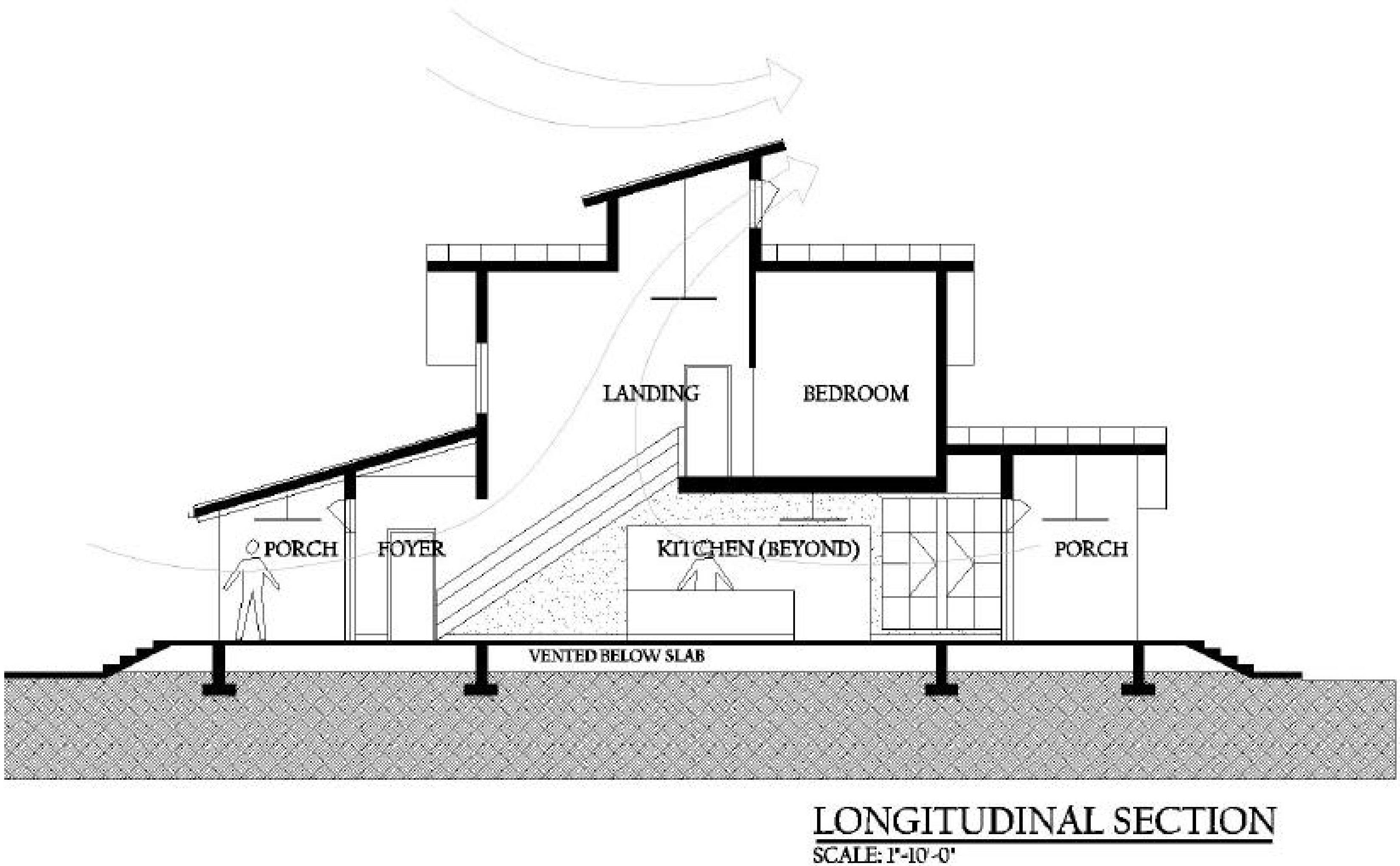

Figure 41: Longitudinal Section through the Prototype House.

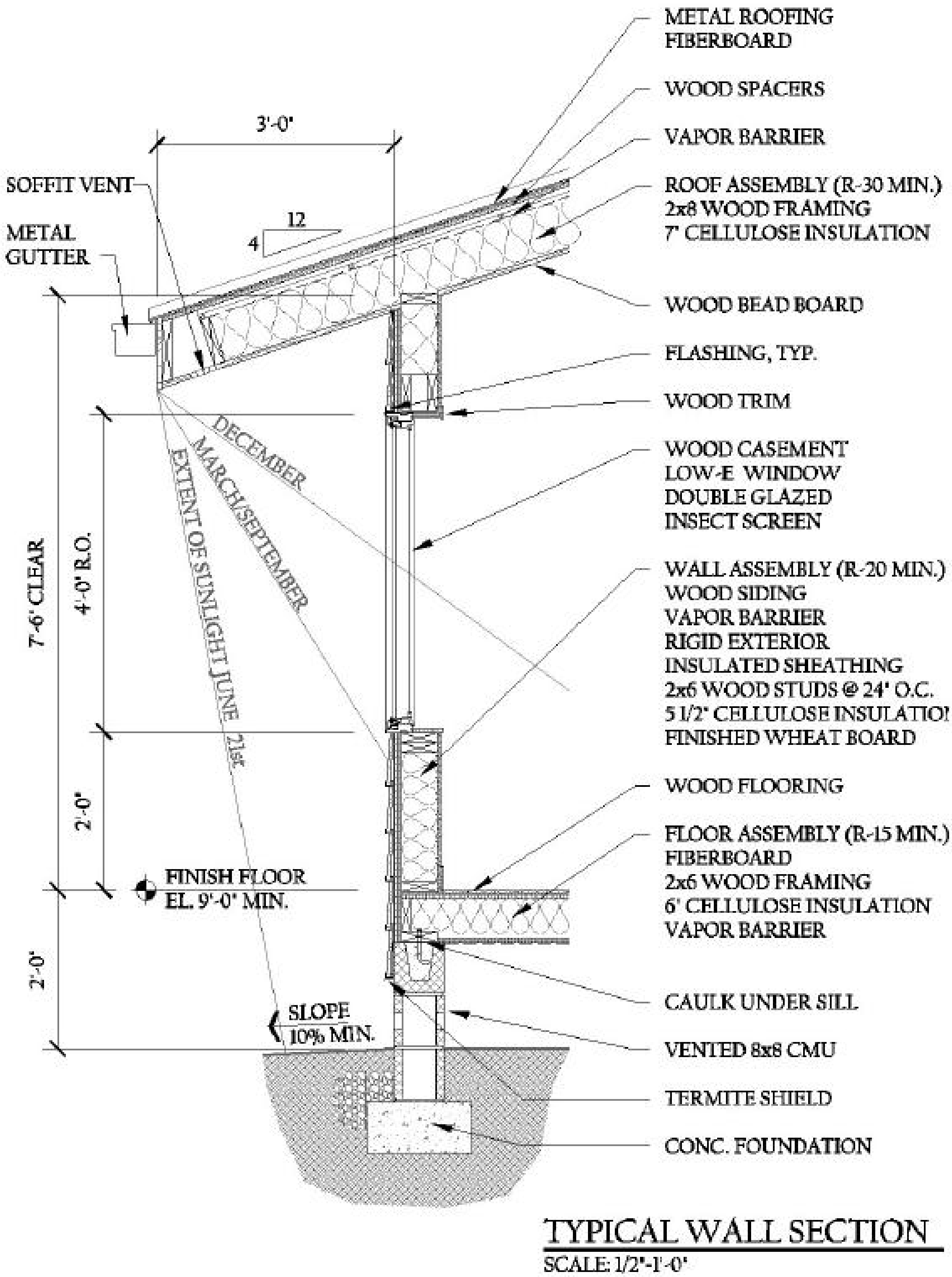

Figure 42: Typical Wall Section through the Prototype House.

Green Material Recommendations

Primarily, materials were selected that reinforce the energy-efficient strategies of the structure. For this project, preference was given to exterior materials that are lightly colored or maximize ventilation. Some materials were selected due to their close proximity to the neighborhood. Materials manufactured within the region support the local economy while reducing the distance that the materials need to be transported to the site. Other suggested materials were selected for what they do not contain. Where the standard manufacture of materials involves components that are harmful to the environment, such as volatile organic compounds (in paint, fiberboard and carpet) arsenic (currently used in pressure treated wood), mercury (used in some lighting systems) and hydrochlorofluorocarbons (in insulation), alternative materials were recommended.

Table 4: Recommended Green Materials for Brooklyn.

	Company	Environmental Benefits	Recycled/ Renewable	Regional Product
Site Work				
Porous pavement	Geoblock Grasspave	Stabilizes green space for pedestrian traffic, water to penetrate the system	yes	no
Concrete				
Concrete	CSR Rinker, various	Locally produced, Brick absorbs VOC's	no	yes
Masonry				
Cement Blocks	Faswall	Recycled wood fibers mixed with cement Non-toxic	yes	yes
Brick	Cherokee Brick & Tile Boral Bricks	Locally produced Components are from renewable resources	yes	yes

Table 4––continued.

	Company	Environmental Benefits	Recycled/ Renewable	Regional Product
Metals				
Steel	Birmingham Steel Corp. US Steel	Easily recyclable	yes	yes
Steel Beam	SMI Steel	Utilizes Smart Beam technology to reduce total steel	no	no
Wood & Plastics				
Wood	Red Hills Lumber Co.	Sustainably harvested Renewable resource	yes	yes
Cedar Shingles	ABC Forest Products, various	Sustainably harvested, Natural pest deterrent	yes	no
Pressure Treated Lumber	Sunbelt Forest Products	Arsenic and chromium free	yes	yes
Thermal & Moisture Protection				
Garden Roof	American Hydrotech ZinCo	Carbon and Heat sink Absorbs Stormwater	partially	partially
Membrane Roof	Carlisle Syntec Systems Stevens Roofing	No plasticizers, chlorine or other halogens White color is solar-reflective (83% of UV rays)	yes	yes
Cellulose Insulation	Appelgate Insulation Cell Pak Inc.	25% greater energy efficiency, 75% recycled content Non-carcinogenic, no CFC's	yes	yes
Doors & Windows				
Wood Door	Sylvania Certified	Sustainably harvested wood door	yes	no
Aluminum Window	Various	Maintenance free, thermally broken	no	yes
Aluminum Window	Visionwall	High energy efficiency (R-7)	no	no
Glazing	Viracon	Desiccant-filled spacer using an organic sealant – energy efficient	no	yes
Skylight	Tubular Skylight, Inc.	Energy-efficient (R-22)	no	yes

Table 4--continued.

	Company	Environmental Benefits	Recycled/ Renewable	Regional Product
Finishes				
Gypsum Wallboard	Temple	99% recycled content	yes	yes
	Georgia Pacific	40% recycled content		
Fiberboard	Homasote	100% recycled newsprint non-formaldehyde	yes	no
Particleboard	Acadia Board Co.	Waste sugar cane, non-formaldehyde	yes	no
Particleboard	Wheat Lumber Eco-Const.	wheat straw mixed with MDI resin non-formaldehyde	yes	no
Carpet	Collins & Aikman	Fully recyclable carpet and backing, low VOC	yes	yes
Carpet	Earth Weave Carpet	Carpet and backing from renewable sorces, no VOC	yes	yes
Linoleum	Domco, Inc.	All natural product, biodegradeable	yes	yes
Rubber Flooring	Tuflex Rubber Products	made from 100% recycled rubber	yes	yes
Ceramic Tile	Florida Ceramic	Durable material, locally manufactured	no	yes
Acoustic Ceiling	Celotex	Recycled content, locally manufactured, absorbs VOC's	yes	yes
Paint	Safecoat	No VOC's, seals in off-gassing from base material	no	no
Equipment				
Refrigerator	Conserv	Energy-efficient, no CFC's	yes	no
Elevator	Various	Gearless, no oils or lubricant	no	no
Mechanical				
Solar water heater	Pacemaker	no electricity required	no	yes
Electrical				
Photovoltaics	Uni-Solar, Kyocera	Building integrated photovoltaic system	no	no
Ceiling Fan	Hampton Bay	aerodynamic fans blades allow 40% increase in airflow	no	yes

Table 5: Recommended Native Plants for Brooklyn.

	Scientific Name	Common Name	Height	Planting Locations
Canopy Trees	*Carya glabra*	Pignut Hickory	40'	shade, street
	Celtis laevigata	Sugarberry	80'	shade tree
	Fraxinus americana	White Ash	50'	parks
	Magnolia grandiflora	Southern Magnolia	100'	shade, street
	Pinus taeda	Loblolly Pine	70'	screen, windbreak
	Quercus laurifolia	Laurel Oak	60'	parks, street
	Quercus michauxii	Basket Oak	100'	shade tree
	Quercus shumardii	Shumard Oak	75'	shade, street
	Quercus virginiana	Live Oak	80'	shade, parks
	Sabal palmetto	Cabbage Palm	40'	specimen, street
	Tilia caroliniana	Basswood	80'	shade tree
	Ulmus alata	Winged Elm	40'	shade, street
Understory Trees	*Acer saccharu*	Florida maple	30'	street, parks
	Carpinus caroliniana	Hornbeam	35'	specimen tree
	Cercis canadensis	Redbud	30'	street, specimen
	Chionanthus virginicus	Fringe Tree	25'	specimen tree
	Ilex opaca	American Holly	25'	street, barrier
	Juniperus silicicola	Southern Red Cedar	40'	specimen, windbreaks
	Morus rubra	Red mulberry	15'	woodland mass
	Prunus caroliniana	Cherry Laurel	40'	border, screen
	Prunus umbellata	Flatwoods Plum	20'	specimen tree
Shrubs	*Callicarpa americana*	Beautyberry	8'	mass planting
	Erythrina herbaceae	Coralbean	4'	specimen plant
	Hamamelis virginiana	Witchhazel	15'	border, hedge
	Ilex vomitoria	Yaupon Holly	25'	screen, hedge
	Rhapidophyllum hystrix	Needle Palm	8'	specimen plant
	Rhododendron canescens	Wild Azalea	15'	specimen plant
	Sabal minor	Bluestem palmetto	3'	parking areas
Groundcovers	*Thelypteris kunthii*	Wood fern	3'	woodland mass
	Zamia floridana	Coontie	2'	hedge, low mass
Vines	*Bignonia capreolata*	Cross-vine		screen
	Gelsemium sempervirens	Yellow jessamine		cover walls
	Lonicera sempervirens	Coral honeysuckle		cover fences
Wildflowers	*Ruellia caroliniensis*	Wild petunia	1'	borders
	Salvia lyrata	Lyre-leaf sage	1'	borders

Source: Adapted from U.S. Soil Conservation Service, 26 Ecological Communities of Florida (Washington D.C.: Soil Conservation Service, 1980), 63-64 and Bijan Dehgan, Landscape Plants for Subtropical Climates (Gainesville, FL: University Press of Florida, 1998).

As Table 4 indicates, green materials are available for use in construction within the sustainable urban neighborhood. However, selecting the actual material often requires choosing either energy-efficiency or a regionally manufactured material. For example, the most efficient window, Visionwall, is manufactured in Canada. Since windows typically last the life of the building, Visionwall may be the better selection over a regionally produced window. For carpet, designers must choose a carpet from recycled sources or one from renewable sources. Since indoor air quality is a primary concern for green materials, Earth Weave Carpet may be the better selection. Other products, such as refrigerators and elevators, were listed in order to illustrate greener alternatives to conventional products. As the construction continues adapting to consumer preferences for green materials, more options should become available. Therefore, this list should be used as a point of departure and modified to include additional green materials when they are identified.

CHAPTER 6
COMPARATIVE ANALYSIS

From the Brooklyn case-study, several analyses were preformed to determine the energy-efficiency of each scale to conventional design. The overall development was compared the current zoning and Jacksonville's proposed master plan using several criteria, such as land usage, public green space allocation and transportation alternatives. The energy-efficiency of the prototype house design was then compared to a more conventional design using Energy 10. The results of both of these analyses illustrate the environmental benefits of the sustainable urban neighborhood.

Sustainable Development

The proposed sustainable urban design was compared to both the current zoning and Jacksonville's master plan. The current zoning plan was modified to reflect The Better Jacksonville Plan approved by the city last year. According to the Better Jacksonville Website, the indicated improvements in the Brooklyn neighborhood are limited to the addition of green space along McCoy's Creek.[122] As discussed in Chapter 4, the city's master plan for Brooklyn also transforms the creek into a public green space. Unfortunately, a complete master plan covering the entire neighborhood was not available. For the comparison study, the land uses follow the current zoning guidelines when not otherwise indicated.

Once the neighborhood plans were generated, they were compared to the proposed sustainable urban neighborhood using an adaptation of the Place^{3}s model.[123] While the Place^{3}s

---

[122] "Overview," The Better Jacksonville Plan [online] (Jacksonville, FL: City of Jacksonville, September 2000 [cited 28 October 2001]); available from http://www.betterjax.com/Overview/default.htm.

[123] Eliot Allen, Michael McKeever, and Jeff Mitchum, The Energy Yardstick: Using Place^{3}s to Create more Sustainable Communities [online] (Sacramento, CA: California Energy Commission, State Energy Office in

approach to urban planning uses energy accounting to evaluate the efficiency with which land is used, their analysis was beyond the scope of this study. The Brooklyn neighborhood analysis provides similar comparisons in land usage, design and circulation without calculating the resulting energy usage.

Table 6: Comparison of Brooklyn Neighborhood Design Alternatives.

	Current Zoning	Master Plan	Proposed Design
Land Use Distribution (not including roadways)			
Public Buildings	3.7%	3.4%	3.7%
Residential	29.4%	36.5%	26.2%
Retail	20.2%	19.8%	6.3%
Commercial	19.9%	16.3%	20.5%
Industrial/EcoIndustrial	9.8%	9.9%	3.5%
Public Green Space	17.0%	14.0%	37.3%
Mixed-Use	19.9%	16.3%	26.8%
Green Space Allocation			
Ratio of Public Green Space to Residential	1:1.7	1:2.6	1:0.7
Residences within 1/4 mile of park	68.7%	98.0%	100.0%
Roadway swales (s.f.)	0	0	248,879
Stormwater Mitigation	city system	city system	natural
Transportation Alternatives			
Roadways (including sidewalks & bike paths (s.f.))	3,107,012	3,246,439	2,247,185
Average Street width (vehicular pavement)	35'	35'	20'
Residences within 1/4 mile of rail stop	not available	not available	65%
Linear feet of dedicated Bike Paths	0	8,668	15,669
Percentage of Streets with Sidewalks	15%	not available	100.0%

Oregon, and the Washington Dept. of Energy, 1996 [cited 31 October 2001]); available from http://www.sustainable.doe.gov/pdf/places.pdf.

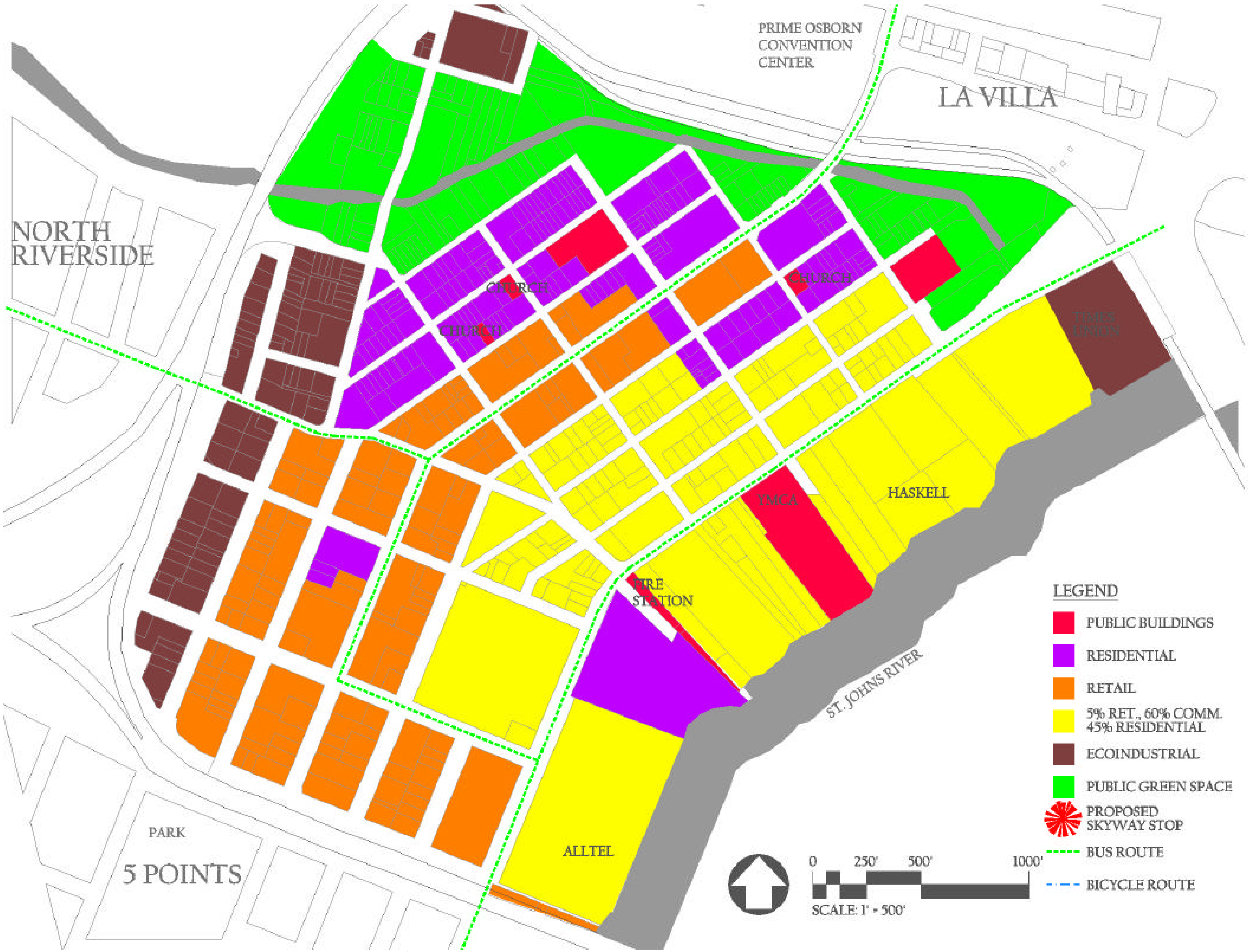

Figure 43: Brooklyn's Current Zoning Land Use Plan. Information provided by Jason Thiel, 5 February 2001.

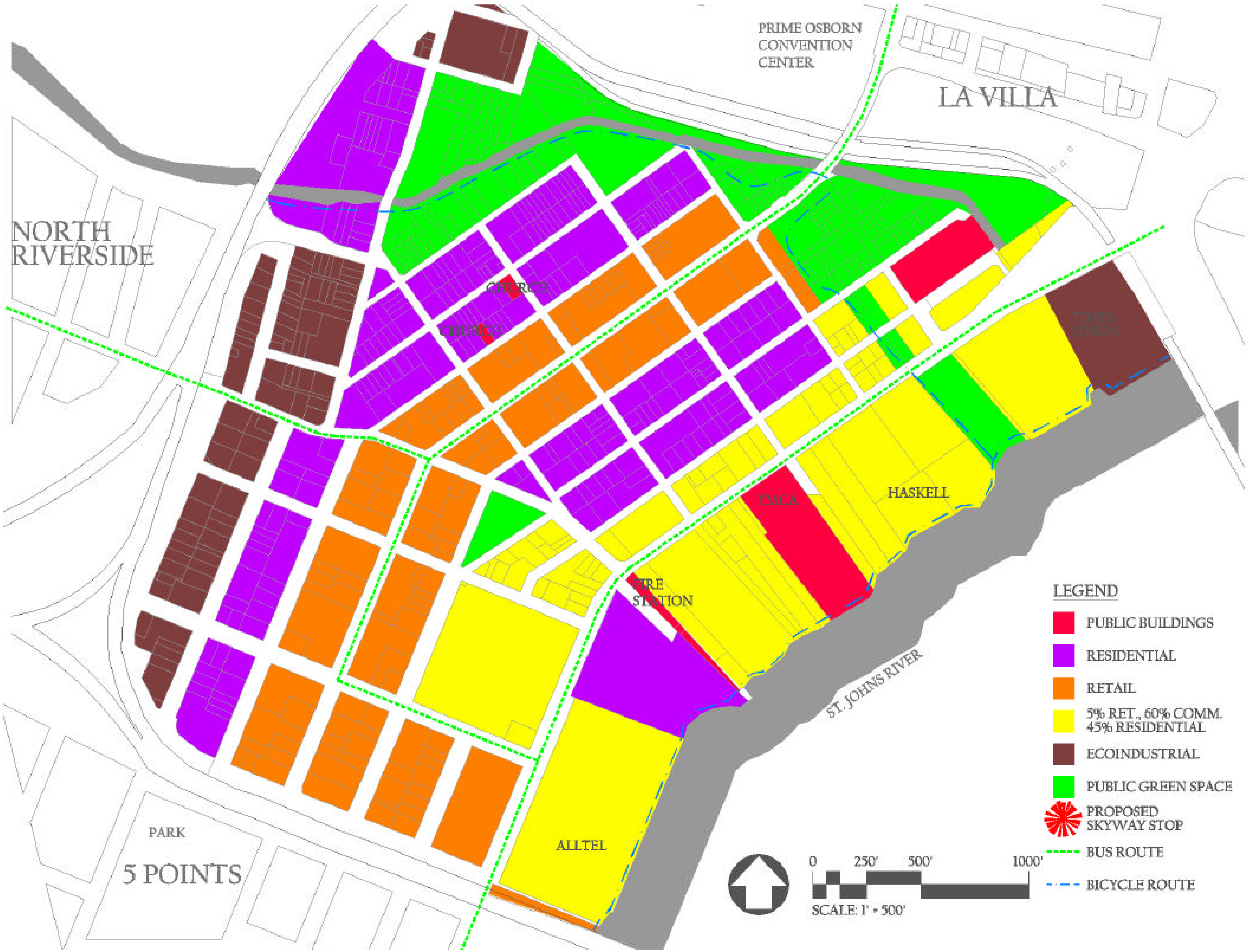

Figure 44: Jacksonville's Future Master Plan for Brooklyn Land Use Plan. Adapted from Planning Development Department, Celebrating the River, 40.

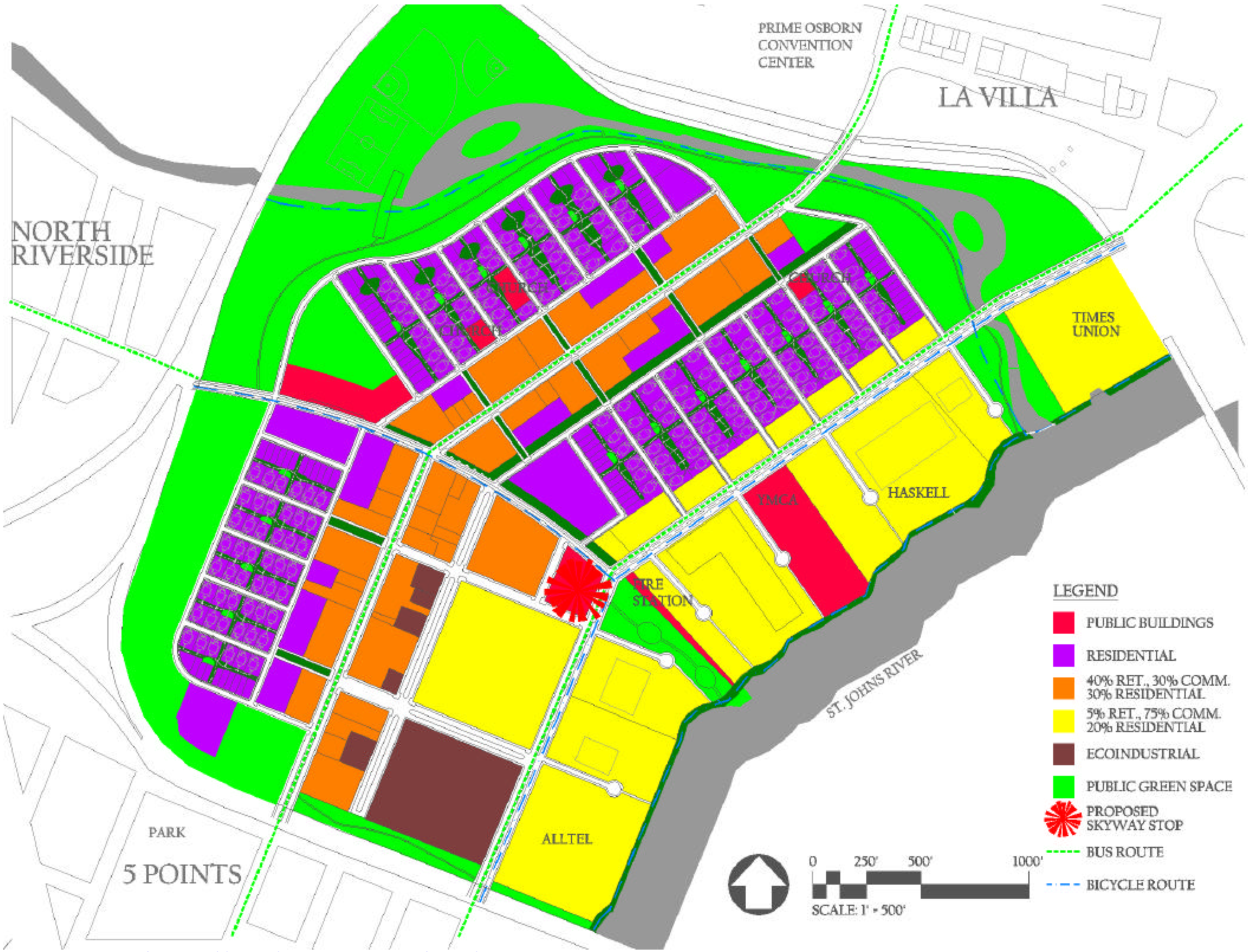

Figure 45: Proposed Sustainable Development Design Land Use Plan

The neighborhood analysis illustrates the key differences between the plans. In the proposed plan, over one-third of the neighborhood is dedicated to public green space distributed throughout the community, while the alternative plans contain significantly less green space most of which is located along McCoy's Creek (the master plan's proximity to parks ratio is deceptively high to due a small, 1 ¼ acre park located in the center of Brooklyn). The larger percentage of green space in the proposed plan required reducing the amount of square footage devoted to residential, retail, and industrial uses. However, most of the reduction only occurs at the ground level, since taller developments are generally allowed in the proposed plan. For example, while retail uses appear to be dramatically reduced, the number does not reflect that buildings along the major streets have other uses on the floors above street level. The other dramatic difference between the plans is the reduced quantity of paved surfaces in the proposed plan. In the proposed plan, significantly less space is devoted to roadways, reducing the amount of impervious surfaces that in turn reduces the amount of stormwater runoff. In addition, the use of natural systems for stormwater mitigation significantly reduces installation and operating costs, as opposed to connecting to the city stormwater system. A similar system used in the Village Homes development of Davis, California saved approximately $800 per household.[124]

Energy-Efficient Buildings

The prototype house design was then analyzed using Energy-10 software.[125] The software was developed as a collaborative project between the National Renewable Energy Laboratory's Center for Buildings and Thermal Systems, the Sustainable Buildings Industry Council, Lawrence Berkeley National Laboratory, and the Berkeley Solar Group. The resulting program

---

[124] Bill Browning and Kim Hamilton, "Village Homes: A model solar community proves its worth," In Context: A Quarterly of Humane Sustainable Culture (Spring 1993 [cited 11 November 2001]); available from http://www.context.org/ICLIB/IC35/Browning.htm.

[125] National Renewable Energy Laboratory/Lawrence Berkeley National Laboratory, Energy-10: A Tool for Designing Low Energy Buildings Ver. 1.2 (Energy-10 V1.2). National Renewable Energy Laboratory/Lawrence Berkeley National Laboratory, Washington D.C.

compares the energy usage of any two proposed buildings. The energy simulations quantify the benefits of various design strategies as well as recommend additional modifications to optimize the building's design and selected systems.

For this project, the prototype house was compared to a similarly designed structure, located in the existing Brooklyn street grid – instead of the proposed neighborhood – and using conventional construction techniques. In order to narrow the analysis to energy-efficiency, the standard construction house was of the same size and volume as the prototype house. Additional high-efficiency windows were provided on the prototype house to allow for daylighting. As the Table 7 indicates, the standard construction house was constructed of 2x4 wood studs, sitting on a concrete slab-on-grade with an insulated attic. The prototype house used 2x6 studs over a raised slab and cathedral ceilings. In addition, the prototype house utilized additional energy-efficiency techniques such as tighter seals on all wall and roof penetrations, higher energy efficient rated (EER) heat pump and lighting dimmers that adjust to sunlight conditions.

The computer simulation indicates that the prototype house utilizes approximately 22% less energy than the standard construction house, which in turn reduces a homeowner's annual utility cost by nearly $400 per year. Due to the increased insulation in the prototype design, the most significant energy reduction was in winter heating, while using daylighting techniques reduced internal lighting requirements. The limitations of the software did not allow for energy reductions for natural ventilation or solar water heaters. Using a solar water heater system saves approximately $250 per year for a family of four.[126] Because the software did not account for natural ventilation, raising the floor slab actually reduced the computed energy savings. In addition, using natural ventilation instead of air-conditioning during the early and late summer months also reduces the total energy requirements of the house.

---

[126] "JEA Fact Sheet #147: Solar Water Heating," Power for Pennies [online] (Jacksonville, FL: Jacksonville Electric Authority, April 2000 [cited 31 October 2001]); available from http://www.jea.com/safety/downloads/f-147.pdf.

Table 7: Comparison of Prototype House and Construction House using Energy-10.

Prototype Design Evaluation	Oct 26, 2001	
Energy-10 Summary Page	Weather file: jcksnvll.et1	
Variant: Thesis	Saved as C:\PROGRA~1\ENERGY10\TH-HOUSE, Var. 2	
Description:	**Standard Construction**	**Prototype Design**
Floor Area, ft^2	1734.0	1734.0
Surface Area, ft^2	5477.4	5477.4
Volume, ft^3	21632.0	21632.0
Surface Area Ratio	1.18	1.18
Total Conduction UA, Btu/h-F	592.5	665.0
Average U-value, Btu/hr-ft^2-F	0.108	0.121
Wall Construction	2 x 4 frame, R=12.6	2 x 6 frame poly, R=23.1
Roof Construction	attic, r-30, R=29.4	cathedral, 2x10, R=30.8
Floor type, insulation	Slab on Grade, Reff=8.0	Exposed to Outside, Reff=4.4
Window Construction	4060 double, wood, U=0.47	4060 low-e al/b, U=0.31
Window Shading	None	28 deg latitude
Wall total gross area, ft^2	3373	3373
Roof total gross area, ft^2	1052	1052
Ground total gross area, ft^2	1052	1052
Window total gross area, ft^2	360	888
Windows (N/E/S/W:Roof)	4/2/6/3:0	10/8/10/8:1
Glazing name	double, U=0.49	double low-e, U=0.26
Operating parameters for zone 1		
HVAC system	Heat Pump/ER Backup	Heat Pump/ER Backup
Rated Output kBtuh	52/37/49	41/50/67
Rated Air Flow/MOOA,cfm	2641/0	2454/0
Heating thermostat	70.0 °F, no setback	70.0 °F, setback to 65.0 °F
Cooling thermostat	78.0 °F, no setup	78.0 °F, setup to 83.0 °F
Heat/cool performance	COP=2.9,EER=8.9	COP=4.3,EER=13.0
Economizer?/type	no/NA	yes/fixed dry bulb, 60.0 °F
Peak Gains; IL,EL,HW,OT; W/ft^2	0.20/0.04/0.66/0.36	0.11/0.02/0.66/0.36
Daylighting?	no	yes, continuous dimming
Infiltration, in^2	ELA=448.7	ELA=121.4
Results:	(Energy cost: 0.400 $/Therm, 0.069 $/kWh, 0.069 $/kW)	
Simulation dates	01-Jan to 31-Dec	01-Jan to 31-Dec
Simulation status, Thermal/DL	valid/NA	valid/valid
Energy use, kBtu	84280	65956
Energy cost, $	1711	1339
Saved by daylighting, kWh	NA	314
Total Electric, kWh	24699	19329
Internal/External lights, kWh	1363/149	452/84
Heating/Cooling/Fan, kWh	4078/7571/2438	1661/6895/1136
Elec. Res./Heat Pump, kWh	3734/344	1517/144
Hot water/Other, kWh	4971/4130	4971/4130
Emissions, CO2/SO2/NOx, lbs	33195/195/101	25978/153/79

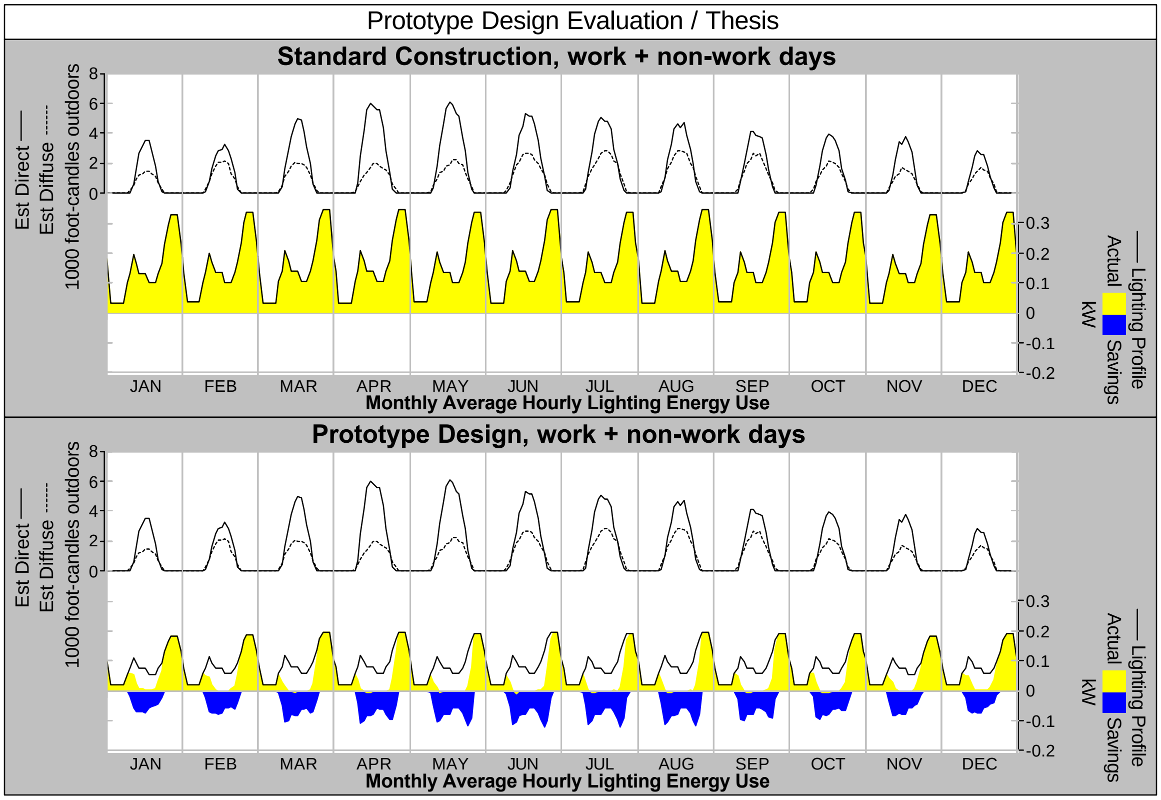

Figure 46: Monthly Lighting Energy Use.

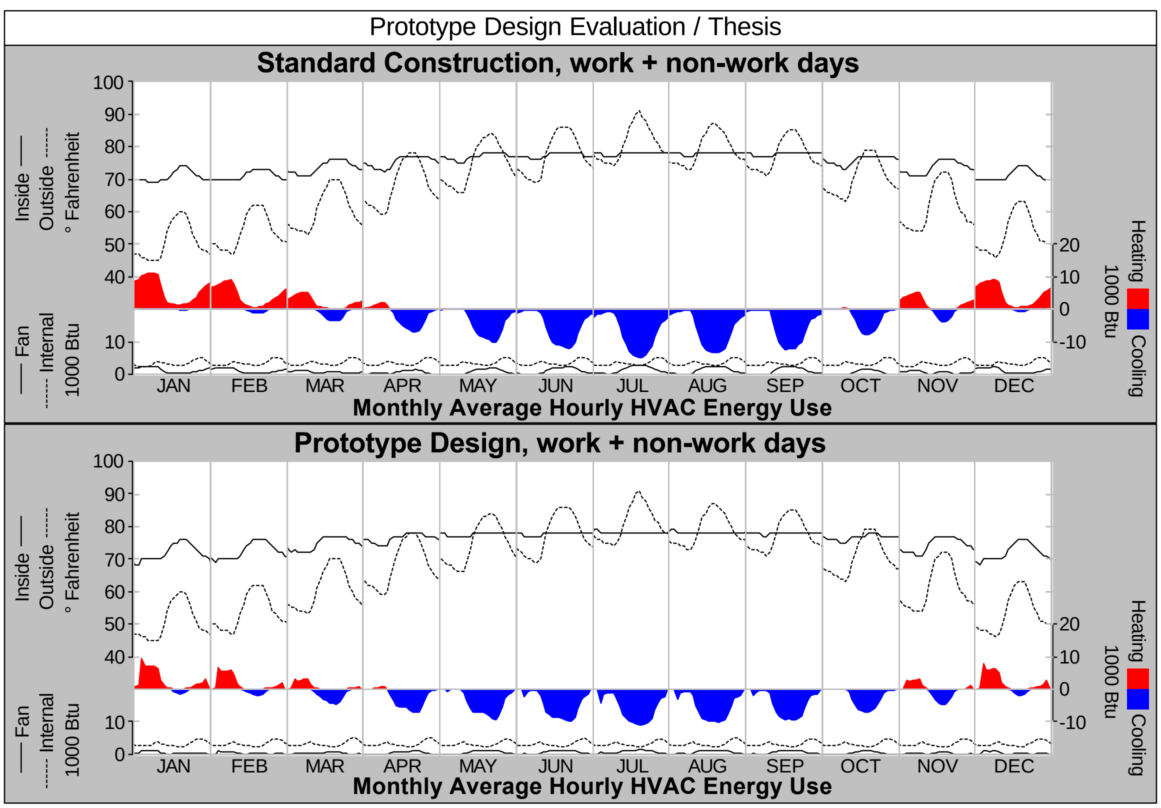

Figure 47: Monthly HVAC Energy Use.

Conclusion

The redevelopment of Brooklyn as a Sustainable Urban Neighborhood has a smaller impact on the environment then either maintaining the existing zoning or implementing the vision described in Jacksonville's master plan. By reducing roadway widths and the industrial area, the proposed plan is able to devote over one-third of the neighborhood to public green space distributed throughout Brooklyn. The addition of sidewalks, bike routes and a skyway stop, while reducing automobile lanes encourages Brooklyn residents and workers to use alternative means of travel. Allocating over one-quarter of the neighborhood to mixed uses ensures that resources are used more efficiently as well as keeping the neighborhood active.

The analysis of the energy-efficiency of the prototype illustrates the economic and environmental benefits of the design. The increased insulation used in the prototype design reduced the reduction the winter heating costs, while adding windows allows residents to rely on the abundant Florida sunshine for internal lighting. Additional energy savings are generated through the use of solar water heaters, natural ventilation and increased overhead vegetation. By implementing house designs based on the energy-efficient principals of the prototype house on a neighborhood-wide basis reduces the carbon dioxide by approximately 850,000 pounds and well as saving the neighborhood $44,000 in energy costs per year.

CHAPTER 7
CONCLUSION AND RECOMMENDATIONS

This study investigated the potential of redeveloping neglected inner cities into sustainable urban neighborhoods. Constructing new mixed-use neighborhoods in underdeveloped urban areas reuses existing infrastructure while preserving existing rural land. By returning to city living and using alternative forms of transportation, the nation begins to reduce its dependency on the automobile, thus reducing its contribution to the greenhouse effect. Not only do these new developments promote energy efficiency by reducing automobile dependency, but also through the materials selected, buildings designed and the overall development layout reduces the neighborhood's external energy requirements and wastes.

In order to design an energy-efficient community in any urban environment, this thesis generated guidelines for developing sustainable urban neighborhoods. Primarily, the neighborhood should be designed while considering the requirements of energy-efficient structures and green materials. Thus materials should be selected that are locally produced, reducing transportation requirements, and from renewable resources. Buildings should be designed to optimize use of these green materials while minimizing its future energy requirements. The development should then be oriented to maximize the energy-efficiency of the individual structures while enhancing the climate and character of the location.

The guidelines for designing sustainable urban neighborhoods were then utilized in the proposed redevelopment of an existing underdeveloped urban community. Jacksonville, Florida is an example of a largely underdeveloped central city surrounded by sprawling suburbs. The Brooklyn neighborhood in particular currently suffers from economic neglect and may soon be redeveloped by the City. While the city's vision recommends a transit-oriented development in order to minimize transportation requirements, the sustainable urban neighborhood alternative proposes a design that encourages energy efficiency throughout the development.

The proposed Brooklyn design illustrates that a sustainable urban neighborhood is more sensitive to natural systems and requires less energy to maintain. When compared to the current zoning or approved master plan, the proposed sustainable urban neighborhood has a greater variety of transportation alternatives while decreasing the amount of paved surfaces. Stormwater is retained naturally within the site and requires minimal cost to install and maintain as well as recharging the aquifer. The increased percentage of mixed-use development generates an active neighborhood as well as enabling resources to be used efficiently. The efficiency of the design is reinforced through the analysis of the prototype house. When compared to conventional construction and design, the prototype generates approximately seven thousand pounds less carbon dioxide per year and requires 22% less energy to operate than conventional construction. The analysis suggests that using the proposed guidelines for designing sustainable urban neighborhoods creates energy-efficient communities.

Lessons Learned

The challenge of this thesis was in defining its limits. Developing guidelines for sustainable urban neighborhoods that encompass every aspect of green design could be the work of a lifetime. Within the constraints of a master's thesis, my research was unfortunately limited to the discussion of the basic components of a sustainable urban neighborhood. Ideally, the neighborhood analysis should have included calculations of approximate stormwater runoff. This document should also provide the design and analysis of a prototype commercial building. In addition, several additional building wall sections, illustrating different green material options, should have been developed and analyzed as well as a cost-benefit analysis of those options. While I believe that these elements was not required in order to analyze the design, their inclusion may have presented a more complete document.

Areas of Future Research

Sustainable design is an emerging specialty within the architecture profession. Therefore, few accepted standards exist to accurately analyze the energy efficiency of a proposed design or selected materials. Without an accepted standard, the value of this thesis, whether a sustainable urban neighborhood can be developed within the urban environment sustainable urban neighborhoods can be developed using a specific set of guidelines, cannot be objectively analyzed. With the recent adoption of Practice E2129-01: Standard Practice for Data Collection for Sustainability Assessment of Building Products by the American Society for Testing and Materials (ASTM), the construction industry is moving closer to simplifying green material selection. Upon acceptance of a green material standard, the design of the prototype energy-efficient house should be reevaluated. In turn, the recommended materials for the Brooklyn neighborhood should be updated.

But most importantly, a truly sustainable urban neighborhood requires more than an energy-efficient design. As discussed in Chapter 1, the neighborhood must also be economically feasible and socially acceptable to its future inhabitants. A more complete analysis of the potential advantages of the sustainable urban neighborhood includes presenting the guidelines and proposed designs to the Jacksonville Economic Development Commission and the Brooklyn neighborhood as well as performing a market analysis. Conceptually, I believe that this proposed sustainable urban neighborhood, while a departure from the current design alternatives, it should be acceptable to both the citizens of Jacksonville and future developers. However additional research in these areas improves the quality of the guidelines and increases the potential success of the design.

APPENDIX A
LEED RATING SYSTEM PROJECT CHECKLIST[127]

[127] U.S. Green Building Council, LEED, v-vi.

Project Checklist

LEED

Sustainable Sites

14 Possible Points

Y	Prereq 1	**Erosion & Sedimentation Control**	Required
Y ? N	Credit 1	**Site Selection**	1
Y ? N	Credit 2	**Urban Redevelopment**	1
Y ? N	Credit 3	**Brownfield Redevelopment**	1
Y ? N	Credit 4.1	**Alternative Transportation**, Public Transportation Access	1
Y ? N	Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms	1
Y ? N	Credit 4.3	**Alternative Transportation**, Alternative Fuel Refueling Stations	1
Y ? N	Credit 4.4	**Alternative Transportation**, Parking Capacity	1
Y ? N	Credit 5.1	**Reduced Site Disturbance**, Protect or Restore Open Space	1
Y ? N	Credit 5.2	**Reduced Site Disturbance**, Development Footprint	1
Y ? N	Credit 6.1	**Stormwater Management**, Rate or Quantity	1
Y ? N	Credit 6.2	**Stormwater Management**, Treatment	1
Y ? N	Credit 7.1	**Landscape & Exterior Design to Reduce Heat Islands**, NonRoof	1
Y ? N	Credit 7.2	**Landscape & Exterior Design to Reduce Heat Islands**, Roof	1
Y ? N	Credit 8	**Light Pollution Reduction**	1

Water Efficiency

5 Possible Points

Y ? N	Credit 1.1	**Water Efficient Landscaping**, Reduce by 50%	1
Y ? N	Credit 1.2	**Water Efficient Landscaping**, No Potable Use or No Irrigation	1
Y ? N	Credit 2	**Innovative Wastewater Technologies**	1
Y ? N	Credit 3.1	**Water Use Reduction**, 20% Reduction	1
Y ? N	Credit 3.2	**Water Use Reduction**, 30% Reduction	1

Energy & Atmosphere

17 Possible Points

Y	Prereq 1	**Fundamental Building Systems Commissioning**	Required
Y	Prereq 2	**Minimum Energy Performance**	Required
Y	Prereq 3	**CFC Reduction in HVAC&R Equipment**	Required
Y ? N	Credit 1.1	**Optimize Energy Performance**, 20% New / 10% Existing	2
Y ? N	Credit 1.2	**Optimize Energy Performance**, 30% New / 20% Existing	2
Y ? N	Credit 1.3	**Optimize Energy Performance**, 40% New / 30% Existing	2
Y ? N	Credit 1.4	**Optimize Energy Performance**, 50% New / 40% Existing	2
Y ? N	Credit 1.5	**Optimize Energy Performance**, 60% New / 50% Existing	2
Y ? N	Credit 2.1	**Renewable Energy**, 5%	1
Y ? N	Credit 2.2	**Renewable Energy**, 10%	1
Y ? N	Credit 2.3	**Renewable Energy**, 20%	1
Y ? N	Credit 3	**Additional Commissioning**	1
Y ? N	Credit 4	**Ozone Depletion**	1
Y ? N	Credit 5	**Measurement & Verification**	1
Y ? N	Credit 6	**Green Power**	1

LEED

Materials & Resources

13 Possible Points

Y	Prereq 1	**Storage & Collection of Recyclables**	Required
Y ? N	Credit 1.1	**Building Reuse**, Maintain 75% of Existing Shell	1
Y ? N	Credit 1.2	**Building Reuse**, Maintain 100% of Shell	1
Y ? N	Credit 1.3	**Building Reuse**, Maintain 100% Shell & 50% Non-Shell	1
Y ? N	Credit 2.1	**Construction Waste Management**, Divert 50%	1
Y ? N	Credit 2.2	**Construction Waste Management**, Divert 75%	1
Y ? N	Credit 3.1	**Resource Reuse**, Specify 5%	1
Y ? N	Credit 3.2	**Resource Reuse**, Specify 10%	1
Y ? N	Credit 4.1	**Recycled Content**, Specify 25%	1
Y ? N	Credit 4.2	**Recycled Content**, Specify 50%	1
Y ? N	Credit 5.1	**Local/Regional Materials**, 20% Manufactured Locally	1
Y ? N	Credit 5.2	**Local/Regional Materials**, of 20% Above, 50% Harvested Locally	1
Y ? N	Credit 6	**Rapidly Renewable Materials**	1
Y ? N	Credit 7	**Certified Wood**	1

Indoor Environmental Quality

15 Possible Points

Y	Prereq 1	**Minimum IAQ Performance**	Required
Y	Prereq 2	**Environmental Tobacco Smoke** (ETS) **Control**	Required
Y ? N	Credit 1	**Carbon Dioxide** (CO_2) **Monitoring**	1
Y ? N	Credit 2	**Increase Ventilation Effectiveness**	1
Y ? N	Credit 3.1	**Construction IAQ Management Plan**, During Construction	1
Y ? N	Credit 3.2	**Construction IAQ Management Plan**, Before Occupancy	1
Y ? N	Credit 4.1	**Low-Emitting Materials**, Adhesives & Sealants	1
Y ? N	Credit 4.2	**Low-Emitting Materials**, Paints	1
Y ? N	Credit 4.3	**Low-Emitting Materials**, Carpet	1
Y ? N	Credit 4.4	**Low-Emitting Materials**, Composite Wood	1
Y ? N	Credit 5	**Indoor Chemical & Pollutant Source Control**	1
Y ? N	Credit 6.1	**Controllability of Systems**, Perimeter	1
Y ? N	Credit 6.2	**Controllability of Systems**, Non-Perimeter	1
Y ? N	Credit 7.1	**Thermal Comfort**, Comply with ASHRAE 55-1992	1
Y ? N	Credit 7.2	**Thermal Comfort**, Permanent Monitoring System	1
Y ? N	Credit 8.1	**Daylight & Views**, Daylight 75% of Spaces	1
Y ? N	Credit 8.2	**Daylight & Views**, Views for 90% of Spaces	1

Innovation & Design Process

5 Possible Points

Y ? N	Credit 1.1	**Innovation in Design**: Specific Title	1
Y ? N	Credit 1.2	**Innovation in Design**: Specific Title	1
Y ? N	Credit 1.3	**Innovation in Design**: Specific Title	1
Y ? N	Credit 1.4	**Innovation in Design**: Specific Title	1
Y ? N	Credit 2	**LEED™ Accredited Professional**	1

Project Totals

69 Possible Points

Certified 26-32 points **Silver** 33-38 points **Gold** 39-51 points **Platinum** 52-69 points

APPENDIX B
FLORIDA GREEN HOME STANDARD CHECKLIST[128]

[128] Florida Green Building Coalition, Inc., Florida Green Home Designation, A1-A4.

Schedule A, Version 1.0

NEW HOME REQUIREMENTS : Select measures to obtain the minimum number of points listed for each category. The sum of the minimums totals 160 points. Accumulate at least an additional 40 points of your choice to qualify for the program. If any category minimums cannot be achieved, point deficiencies may be made up by adding the deficiency to the total minimum score of 200. (Example: Applicant elects to achieve only 10 points from a category with a minimum of 15. Applicant may still qualify if total points equal or exceed 200 + [15-10] = 205.) Note that category maximums cannot be exceeded at any time.

EXISTING HOME REQUIREMENTS : Same as for NEW HOME except no minimum point requirement in the Materials and Site categories.

PREREQUISITES : At least one measure from the following Waterfront Considerations and Swimming Pool/Spa Prerequisite lists must be incorporated:

Prerequisite 1: Swimming Pool/Spa

- ☐ Sanitation system that reduces/eliminates chlorine use (salt water, ionization, etc.)
- ☐ Pool cover
- ☐ Solar pool heating system
- ☐ Efficient pool pumping
- ☐ Swimming pool/spa free house

Prerequisite 2: Waterfront Considerations

- ☐ Use of native aquatic vegetation in shoreline area
- ☐ Low maintenance plants placed between lawn and shoreline; no turf adjacent to water
- ☐ Use of terraces, swales, or berms to slow storm water movement into water body
- ☐ Home site does not border natural water body

Category 1: Energy (Building Envelope/Systems)

Points Achieved	Points Possible	Criteria
		Code/Ratings
______	100	Meet Florida Energy Code (HERS=80)
______	5-50	Confirmed Florida HERS Rating (attach) 5 pts for every HERS pt above 80

HERS rated homes are given credit for features including:

- Efficient a/c and heat
- Proper orientation
- Efficient windows
- Radiant barrier
- Solar or efficient water heating
- Ducts sealed or in conditioned space
- Insulation quantity and type
- Envelope sealing

For complete explanation of HERS Rating, see Ref. Guide

Points Achieved	Points Possible	Criteria
		Design
______	1	Document proper sizing of HVAC system
______	1	Adequate return air transfer paths
______	1	Cross vent and ceiling fans code credits
______	1	Min 100ft² roofed porch min 3 sides open
______	1	Passive solar space heat system
______	1	Passive solar day-lighting
______	1-4	House shaded on east and west by trees
______	1	Washer and dryer outside of cond space
______	1	Light colored roof
______	1	Light colored exterior walls
______	1	South roof area for future solar use
______	1	Pre-plumb for solar hot water
______	1	Centrally locate hot water heater
______	1	Insulate all hot water pipes
______	1	Efficient envelope volume
______	1	Dwelling unit attached, zero lot-line, row house
______		***Total points for Category 1 (100 min/150 max)***

Category 2: Energy (Appliances, Lights, Amenities)

Points Achieved	Points Possible	Criteria
		Energy-efficient appliances/amenities
______	2	Energy Star® refrigerator
______	2	Energy Star® clothes washer
______	1	Energy Star® dishwasher
______	1	Energy-efficient clothes dryer
______	1	Energy-efficient oven/range
______	1	Buyer given info if none installed
______	1	Efficient or no well pumping
		Energy-efficient lighting
______	10	Indoor lights are fluorescent
______	2	Recessed, sealed IC fixtures
______	2	Max installed lighting wattage < 0.5 W/ft²
______	2	Light colored interior walls, ceilings, carpet/floors
______	1	Single bulb fixtures in bathrooms
______	2	Outdoor lights are fluorescent/elec ballast, pv, low voltage, or have motion detector
______		***Total points for Category 2 (10 min/25 max)***

"To provide a Florida green building designation resulting in environmental and economic benefits."

Category 3: Water

Points Achieved	Points Possible	Criteria
		Appliances
______	2	Hot water recirculation system
______	1	Low-flow fixtures
______	1	Faucet aerators
______	1	Faucets do not drip upon occupancy
______	2	No garbage disposal
______	1	Low-flow toilets
______	4	Waterless toilet
		Greywater reuse
______	3	System installed
______	1	System rough in
		Rainwater harvesting
______	3	System installed
______	1	System rough in
		Installed landscape
______	2	Drought tolerant turf in sunny areas only, no turf in densely shaded areas
______	1	50% of plants/trees from local drought tolerant list
______	2	80% of plants/trees from local drought tolerant list
______	3	100% of plants/trees from local drought tolerant list
______	3	Turf less than 50% of landscape
______	2	Evenly shaped turf areas, no turf on berms
______	2	No invasive exotic species
______	2	Plan for edible landscape/food garden
______	2	Plants with similar maintenance requirements grouped together
______	2	Mulch applied 3-4 inches deep around plants
______	2	Use of alternative mulches
______	2	Soil amendment where necessary
		Installed irrigation
______	1	Separate irrigation zones for turf/plants/drought tolerant species (sprayers and rotors separate)
______	1	Calibrate irrigation system for less than ¾" of water per application
______	1	Use of micro-irrigation in landscape beds
______	2	Use of micro-irrigation in lawns
______	1	Rain shut-off device properly installed
______	1	Irrigation system efficiency checked by qualified technician
______	7	Landscape exists primarily on rainfall; no permanent irrigation system
______		***Total points for Category 3 (15 min/40 max)***

Category 4: Site

Points Achieved	Points Possible	Criteria
		Native tree and plant preservation
______	2	Develop a tree/plant preservation plan
______	2	Maximize tree survivability
______	2	Replant or donate removed vegetation
______	1-9	Preserve or create wildlife habitat/shelter
		On-site use of cleared materials
______	1	Mill cleared trees or grind for mulch
______	1	Reuse stumps and limbs for mulch/landscape
		Erosion control/topsoil preservation
______	2	Develop an erosion control site plan
______	1	Stabilize disturbed soil
______	1	Stage disturbance
______	1	Save and reuse any removed topsoil
		Drainage/retention
______	2	Onsite designated retention area
______	2	Control sediment runoff during construction
______	2	Direct filtered rooftop runoff to planted area(s)
______	1-4	Maintain pervious surface area
______		***Total points for Category 4 (10 min/30 max)***

Category 5: Health

Points Achieved	Points Possible	Criteria
		Combustion
______	3	Detached garage, carport, or no garage
______	2	Attached garage with air barrier between garage and living space (including attic)
______	1	Attached garage – exhaust fan on motion sensor and timer
______	1	Direct vent, sealed combustion fireplace w/ electronic ignition
______	1	Sealed combustion furnace or furnace isolated from conditioned area
______	1	Sealed water heater combustion or isolated from conditioned area and power vented
______	1	Carbon monoxide detector
		Moisture Control
______	1	Drainage tile on and around top of footing
______	1	Drainage board for below grade walls
______	1	Gravel bed beneath slab on grade floors
______	1	Seal slab penetrations
______	1	Capillary break between foundation and framing
______	2	Central dehumidification system

Category 5: Health, cont.

Points Achieved	Points Possible	Criteria
		Ventilation
______	3	House under positive pressure with respect to the outdoors
______	1	Radon/soil gas vent system installed
______	1	Floor drains sealed
______	1	Radon test of home prior to occupancy
______	1	High efficiency, low noise bathroom exhaust fans with timer or humidistat
______	1	Kitchen range hood vented to exterior
______	1	Laundry room exhaust fan vented to exterior
______	1	All applicable exhausts have backdraft damper
______	1	Laundry rooms inside conditioned spaces must have window or other make-up air source
______	1	Whole house fan with insulated cover
______	1	No power roof vents
______	1	Dampered fresh air intake
______	1	Efficient HVAC filter
______	2	Heat recovery ventilator or air to air heat exchanger
______	1	Ventilation system rough-in
______	1	Install screens on all windows and doors
______	1	Written plan for the location of exhaust and intake vents
		Source Control (materials)
______	1	No exposed particleboard
______	1	No flex vinyl wall covering or flooring
______	1	Zero VOC paints, stains, and finishes
______	1	Low VOC sealants and adhesives
______	1	Minimize carpet use
______	1	Protect ducts during construction
______	3	Integrated pest management
		Cleanability
______	1	Central vacuum system
______	1	Narrow grout lines
______	1	Useable entry area
______	1	Low dust collecting window coverings
		Universal Design
______	1	Barrier free entrance
______	1-3	Universally designed living area
______		***Total points for Category 5 (10 min/30 max)***

Category 6: Materials

Points Achieved	Points Possible	Criteria
		Structure
______	3	Autoclaved aerated concrete block
______	2	Insulated Concrete Forms (I.C.F.)
______	2	Structurally insulated panels
______	1-2	Engineered wood products for roof and/or floor
______	1	Recycled content roof material
______	1	Certified sustainable lumber
______	1	Engineered/alternative material for outdoor living
______	1	Concrete with fly ash
______	1	Recycled content siding or soffit material
		Sub-Assembly
______	1-2	Locally produced doors and/or windows
______	1	Recycled/natural content insulation
______	1	Recycled content drywall
______	1-2	Recycled content sheathing/subfloor
______	1	Recycled content exterior sheathing
		Partitions/Trim
______	1	Finger jointed or laminated products
______	1	Finger jointed trim
______	1	Steel interior studs
______	1	ACQ bottom plate
		Finishes
______	1	Eco-friendly flooring materials
______	1	Eco-friendly ceiling materials
______	1	Recycled content paint
______	1	Recycled content air conditioner condenser pad
		Durability
______	1	3 in 12 $\leq$ roof slope $\leq$ 6 in 12
______	1	Large overhangs (eave and gable)
______	1	Wood frame uses house wrap and vented rain screen
______	1	Siding and exterior trim primed all sides
______	1	Window and door flashing
______	1	Plants/turf minimum of 3 ft. from foundation
		Waste management
______	2	Develop construction and demolition waste management plan
______	2-4	Implement job site waste management
______	1-5	Plan and implement design related mechanisms
______	1	Compost bin/built in collection of recyclables
______		***Total points for Category 6 (10 min/45 max)***

Category 7: Disaster mitigation

Points Achieved	Points Possible	Criteria
		Hurricane (wind, rain, storm surge)
______	2	Safe room
______	1-2	Inland site (sliding scale w/ distance from coast)
______	2	Window and skylight protection or impact resistant type
______	2	Garage and exterior door protection or impact resistant type
______	2	Secondary water protection installed on roof
______	2	Adhesive applied to roof sheathing
______	2	Gable end braced and vent protection installed
______	2	Hip roof design
______	2	Roof covering above and below flashing
______	2	Exterior structures properly anchored
______		***Flood (check all to receive 5 points)***
	☐	Finished floor level at least 12" above 100 yr. flood plain
	☐	Bottom of slab at least 8" above the top of backfilled dirt, graded for proper drainage
	☐	Grade slopes away from building on all sides
	☐	Garage floor and driveway properly sloped to drain out. Garage floor at least 4" lower than living floor.
______		***Wild fire (check all to receive 5 points)***
	☐	Fire resistant exterior wall cladding
	☐	Fire resistant roof covering or sub-roof
	☐	Fire resistant soffit material
______		***Termites (check all to receive 10 points)***
The following co-requisites from other sections must be done:		
	☐	Seal slab penetrations (Health/Moisture Control)
	☐	Plants/turf minimum of 3 ft. from foundation (Materials/Durability)
	☐	Grade slopes away from building on all sides (Flood)
The following additional criteria must also be done:		
	☐	Notice of termite protection in place on site
	☐	Monolithic poured slab
	☐	No foam insulation extends below grade
	☐	8" or more clearance between building exterior cladding and final earth grade
	☐	Rain gutters installed with leaf screens or meet "Large Overhangs" co-requisite under Durability
	☐	If present, downspouts must discharge 3 or more feet from building

Category 7: Disaster mitigation *(cont.)*

Points Achieved	Points Possible	Criteria
	☐	If installed, irrigation/sprinkler system located 2 or more feet from building, water shown not to hit building while operating
	☐	Condensate line(s) discharge 2 or more feet from building and are located 5 or more feet from dryer vent
	☐	Damage replacement warranty issued and available for annual renewal
______		***Total points for Category 7 (5 min/30 max)***

Category 8: General

Points Achieved	Points Possible	Criteria
		Small house credit
______	0-50	Conditioned house size
		Renewable power generation
______	0-20	Photovoltaics
		Reconfigurability
______	2	Roof trusses designed for addition
______	2	Unfinished rooms
______	2	Pre-wired for security, sound, automation
		Lot choice
______	2	Build on an infill site
______	2	House built within designated FGBC green development
______	2	Site located within ¼ mile walk to mass transit
______	2	Site located in TND or small lot cluster development
______	2	Brownfield site
		Other
______	10	Remodeling of an existing structure
______	2	Home builder/designer/architect/landscape architect member of FGBC
______	2	Homeowner's manual given to homeowner
______		***Total points for Category 8 (0 min/50 max)***

_______ Total points to qualify for Florida Green Home Designation (200 min/400 max)

Please provide contact information for the homebuilder and/or homeowner using the following section. Please note that certain measures selected to qualify the home for the program must be verified by a Certifying Agent that has been accredited by FGBC, Inc., while others require that verification be submitted. A list of Certifying Agents is available at floridagreenbuilding.org or by contacting FGBC, Inc. After completing the Florida Green Home Standard Checklist in its entirety, it must be submitted by a Certifying Agent to FGBC, Inc. c/o Florida Solar Energy Center, 1679 Clearlake Rd., Cocoa, FL 32922. The completed checklist must be accompanied by all required submittals, and a check for the Green Home processing fee payable to the Florida Green Building Coalition, Inc. Processing fee per home is $50 for members of FGBC and $75 for non-members. Please visit floridagreenbuilding.org for membership information. An FGBC representative may be contacted by sending email to info@floridagreenbuilding.org or by calling 321-638-1450.

Home Builder Information	and/or Home Owner Information
Name: ____________	Name: ____________
Company: ____________	Address 1: ____________
Address: ____________	Address 2: ____________
Phone: ____________	Phone: ____________
Fax: ____________	Fax: ____________
E-mail: ____________	E-mail: ____________

Certifying Agent Information

Name: ____________

Company: ____________

Address: ____________

Phone: ____________

Fax: ____________

E-mail: ____________

Third Party Inspectors (if applicable)

Name of HERS Rater: ____________
(if HERS points included)

Name of FY&N Inspector:

____
(if Florida Yards & Neighborhoods points included)

By signing below we acknowledge that each of the measures intended to qualify the home for the Florida Green Home Standard Designation have been incorporated into the home's construction/renovation.

Home Builder Signature: ____________
and/or
Home Owner Signature: ____________

Certifying Agent Signature:

____

LIST OF REFERENCES

Albritton, Daniel L., Myles R. Allen, Alfons P. M. Baede, John A. Church, Ulrich Cubasch, Dai Xiaosu, Ding Yihui, Dieter H. Ehhalt, Christopher K. Folland, Filippo Giorgi, Jonathan M. Gregory, David J. Griggs, Jim M. Haywood, Bruce Hewitson, John T. Houghton, Joanna I. House, Michael Hulme, Ivar Isaksen, Victor J. Jaramillo, Achuthan Jayaraman, Catherine A. Johnson, Fortunat Joos, Sylvie Joussaume, Thomas Karl, David J. Karoly, Haroon S. Kheshgi, Corrine Le Quéré, Kathy Maskell, Luis J. Mata, Bryant J. McAvaney, Mack McFarland, Linda O. Mearns, Gerald A. Meehl, L. Gylvan Meira-Filho, Valentin P. Meleshko, John F. B. Mitchell, Berrien Moore, Richard K. Mugara, Maria Noguer, Buruhani S. Nyenzi, Michael Oppenheimer, Joyce E. Penner, Steven Pollonais, Michael Prather, I. Colin Prentice, Venkatchala Ramaswamy, Armando Ramirez-Rojas, Sarah C. B. Raper, M. Jim Salinger, Robert J. Scholes, Susan Solomon, Thomas F. Stocker, John M. R. Stone, Ronald J. Stouffer, Kevin E. Trenberth, Ming-Xing Wang, Robert T. Watson, Kok S. Yap, and John Zillman. Summary for Policymakers: A Report of Working Group 1 of the Intergovernmental Panel on Climate Change. Geneva, Switzerland: Intergovernmental Panel on Climate Change, 2000 [cited 13 April 2001]. Available from http://www.ipcc.ch/pub/spm22-01.pdf.

Allen, Eliot , Michael McKeever, and Jeff Mitchum. The Energy Yardstick: Using Place^{3}s to Create more Sustainable Communities. Sacramento, CA: California Energy Commission, State Energy Office in Oregon, and the Washington Dept. of Energy, 1996 [cited 31 October 2001]. Available from http://www.sustainable.doe.gov/pdf/places.pdf.

American Automobile Association. AAA North American Road Atlas 1996: United States, Canada, Mexico. MCMXCV ed. American Automobile Association, 1995.

American Institute of Architects. Environmental Resource Guide. 2 vols. Washington D.C.: American Institute of Architects, Inc., 1994.

Barnett, Dianna L. and William D. Browning. A Primer on Sustainable Building. Colorado: Rocky Mountain Institute Green Development Series, 1995.

Brown, G. Z. and Mark DeKay. Sun, Wind & Light: Architectural Design Strategies. 2d ed. New York: John Wiley & Sons, Inc., 2001.

Browning, Bill and Kim Hamilton. "Village Homes: A model solar community proves its worth." In Context: A Quarterly of Humane Sustainable Culture, Spring 1993 [cited 11 November 2001]. Available from http://www.context.org/ICLIB/IC35/Browning.htm.

Bussel, Abby. "Eco-Evaluators: What Do They Do?" Progressive Architecture, March 1993, 90-91.

Calthorpe, Peter. The Next American Metropolis: Ecology, Community and the American Dream. New York: Princeton Architectural Press, 1993.

Cambridge Systematics, Inc. Jacksonville Downtown Mater Plan: Transportation Element. Jacksonville, FL: Cambridge Systematics, Inc., 1999.

Campbell, C. Lee and Walter W. Heck. Principles of Sustainable Development. Edited by F. Douglas Muschett. Delray Beach, FL: St. Lucie Press, 1997.

Campbell, Craig S. and Michael H .Ogden. Constructed Wetlands in the Sustainable Landscape. New York: John Wiley and Sons, Inc., 1995.

Chudacoff, Howard P. and Judith E. Smith. The Evolution of American Urban Society. New Jersey: Prentice-Hall, Inc., 2000.

City of Jacksonville Planning Development Department. Celebrating the River: A Plan for Downtown Jacksonville. Jacksonville, FL: City of Jacksonville, 2000.

City of Jacksonville Planning Development Department. Public Participation Summary. Jacksonville, FL: City of Jacksonville, 1999.

de Chiara, Joseph, Julius Panero, and Martin Zelnik, eds. Time-Saver Standards for Housing and Residential Development. 2d ed. New York: McGraw-Hill, Inc., 1995.

Dehgan, Bijan. Landscape Plants for Subtropical Climates. Gainesville, FL: University Press of Florida, 1998.

DeRobertis, Michelle M. and Rhonda Rae. "Buses and bicycles: Design alternatives for sharing the road." ITE Journal. 71 (May 2001): 36-44.

Duryea, Mary, Eliana Kampf Binelli, and Henry L. Gholz. Restoring the Urban Forest Ecosystem. Edited by Mary Duryea, Eliana Kampf Binelli and Henry L. Gholz. Gainesville, FL: School of Forest Resources and Conservation, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, 2000.

Florida Green Building Coalition, Inc. Florida Green Home Designation Standard of the Florida Green Building Coalition. Naples, FL: Florida Green Building Coalition, Inc., July 2001 [cited 31 August 2001]. Available from http://floridagreenbuilding.org/Standards/HomeStd_071001.pdf.

Girling, Cynthia, Ronald Kellett, Jacqueline Rochefort, and Christine Roe. Green Neighborhoods: Planning and Design Guidelines for Air, Water and Urban Water Quality. Eugene, OR: University of Oregon, 2000 [cited 13 April 2001]. Available from http://www.aaa.uoregon.edu/-nee/guidelines.html.

Grillot, Michael J., Patricia A. Smith, Joel E. Lou, Karen F. Griffin, H. Vicky McLaine, and Lowell Feld. International Energy Annual 1999. Washington D.C.: Energy Information Administration, Office of Energy Markets and End Use, U.S. Department of Energy [cited 13 April 2001]. File no. DOE/EIA-0219(99). Available from http://www.eia.doe.gov/pub/pdf/international/021999.pdf.

Hu, Patricia S. and Jennifer R. Young. Summary of Travel Trends: 1995 Nationwide Personal Transportation Survey. Prepared for the U.S. Department of Transportation, Federal Highway Administration. Washington D.C.: U.S. Department of Transportation [cited 27 May 2001]. Available from http://wwwcta.ornl.gov/npts/1995/DOC/trends_report.pdf.

Jacksonville Community Council, Inc. Quality of Life in Jacksonville: Indicators for Progress. Jacksonville: Jacksonville Community Council, Inc., 2000 [cited 27 April 2001]. Available from http://www.jcci.org/qol/qol.pdf.

Jameson, Michael and Richard Moyroud, ed. Xeric Landscaping with Florida Native Plants. Hollyrood, FL: Betrock Information Systems, Inc., 1991.

"JEA Fact Sheet #147: Solar Water Heating." Power for Pennies. Jacksonville, FL: Jacksonville Electric Authority, April 2000 [cited 31 October 2001]. Available from http://www.jea.com/safety/downloads/f-147.pdf.

Kemp, Jim. American Vernacular: Regional Influences in Architecture and Interior Design. New York: Viking Penguin Inc., 1987.

Kibert, Charles J., Jan Sendzimir and Brad Guy. "Construction ecology and metabolism: natural system analogues for a sustainable built environment." Construction Management and Economics. 18 (2000): 903-916.

Kibert, Charles J. and G. Bradley Guy. "Abacoa: A Model for Sustainable Land Development." Land Development, Spring-Summer 1997, 25-29.

Local Government Commission. Ahwahnee Principles. Sacramento, CA: Center for Livable Communities [cited 1 Sep 00]. Available from http://www.lgc.org/clc/library/ahwahnee/principles.html.

Macionis, John J. and Vince Parrillo. Cities and Urban Life. New Jersey: Prentice-Hall, Inc., 2000.

Malin, Nadav. "Is Wood or Metal "Greener"?" Progressive Architecture, September 1995, 39-41.

Malin, Nadav. "What It Means to Be Green." Architectural Record. August 1999, 137-140.

Malin, Nadav and Alex Wilson. "Material Selection: Tools, Resources, and Techniques for Choosing Green." Environmental Building News, January 1997, 1,10-14.

McAlester, Virginia and Lee McAlester. A Field Guide to American Houses. New York: Alfred A. Knopf, Inc., 1984.

McArdle, Paul, Perry Lindstrom, Michael Mondshine, Stephen Calopedis, Chris Minnucci, and Sarah Billups. Emissions of Greenhouse Gases in the United States 1999. Washington D.C.: Energy Information Administration, Office of Integrated Analysis and Forecasting, U.S. Department of Energy, 2000 [cited 13 April 2001]. File no. DOE/EIA-0573(99). Available from ftp://ftp.eia.doe.gov/pub/oiaf/1605/cdrom/pdf/ggrpt/057399.pdf.

Mosberg, Stewart. "What Do We Mean by "Green"?" Progressive Architecture, March 1991, 62-63.

Myers, Ronald L. Ecosystems of Florida, Edited by Ronald L. Myers and John J. Ewel. Orlando, FL: University of Central Florida Presses, 1990.

National Climatic Data Center. Local Climatological Data: Annual Summary with Comparative Data: Jacksonville, Florida (JAX). Asheville, N.C.: National Climate Data Center, 2001.

National Housing Institute. "Minneapolis Goes Green." Shelter Force Online [electronic journal]. Orange, NJ: National Housing Institute, January/February 1999 [cited 19 June 2001]. Available from http://www.nhi.org/online/issues/103/minneapo.html.

National Institute of Standards and Technology. Building for Environmental and Economic Sustainability Ver. 2.0 (BEES 2.0). National Institute of Standards and Technology, Washington D.C.

National Renewable Energy Laboratory/Lawrence Berkeley National Laboratory. Energy-10: A Tool for Designing Low Energy Buildings Ver. 1.2 (Energy-10 V1.2). National Renewable Energy Laboratory/Lawrence Berkeley National Laboratory, Washington D.C.

Niles, John and Dick Nelson. "Measuring the Success of Transit-Oriented Development: Retail Market Dynamics and Other Key Determinants." Paper presented at the American Planning Association, National Planning Conference, Seattle, Washington, April 1999.

Odum, Howard T., Elisabeth C. Odum and Mark T. Brown. Environment and Society in Florida. Boca Raton, FL: Lewis Publishers, 1998.

Olgyay, Victor. Design with Climate: Bioclimatic Approach to Architectural Regionalism. Princeton: Princeton University Press, 1963.

O'Toole, Randal. The Vanishing Automobile and Other Urban Myths. Bandon, Oregon: Thoreau Institute, 2001.

"Overview." The Better Jacksonville Plan. Jacksonville, FL: City of Jacksonville, September 2000 [cited 28 October 2001]. Available from http://www.betterjax.com/Overview/default.htm.

Pagano, Michael A. and Ann O'M. Bowman. "Vacant Land in Cities: An Urban Resource." The Brookings Institution. Washington D.C.: The Brookings Institution, December 2000 [cited April 27, 2001]. Available from http://brook.edu/es/urban/pagano/paganofinal.pdf.

Parker, Danny S., Philip W. Fairey, and Janet E.R. McIlvaine. Energy Efficient Office Building Design for a Hot and Humid Climate: Florida's new Energy Center Cape Canaveral, FL: Florida Solar Energy Center, 1994 [cited 28 May 2001]. Available from http://www.fsec.ucf.edu/-bdac/pubs/PF291/pf-291.htm.

Pearson, David. The Natural House Book. New York: Simon & Schuster Inc./Fireside, 1989.

St. John, Andrew, ed. The Sourcebook for Sustainable Design: A Guide to Environmentally Responsible Building Materials and Processes. Boston: Boston Society of Architects, 1992.

Salvesen, David. "Promoting Transit-Oriented Development." Urban Land, July 1996, 31-35, 87.

Selman, Paul. Environmental Planning: The Conservation and Development of Biophysical Resources. 2d ed. London: SAGE Publications Ltd, 2000.

Shihadeh, Edward S. and Graham C. Ousey. "Metropolitan Expansion and Black Social Dislocation: The Link between Surburbanization and Center-City Crime," Social Forces 75(2) (1996): 649-666.

Strong, Steven J. Reshaping the Built Environment: Ecology, Ethics and Economics, edited by Charles J. Kibert. Washington, D.C.: Island Press, 1999.

Texas Transportation Institute, The Mobility Data for Jacksonville, FL. College Station, TX: Information & Technology Exchange Center/Publications [cited 27 April 2001]. Available from http://mobility.tamu.edu/study/PDFs/jacksonville.pdf.

"Transit Oriented Development." Online TDM Encyclopedia. Victoria, British Columbia: Victoria Transport Policy Institute, 2001[cited 22 January 2001]. Available from http://www.vtpi.org/tdm.

Tuluca, Adrian and Steven Winter Associates, Inc. Energy Efficient Design and Construction for Commercial Buildings. New York: McGraw-Hill, Companies, Inc., 1997.

Urbanomics, Inc. and Development Strategies, Inc. Jacksonville Downtown Mater Plan: Residential and Commercial Market Analyses. Jacksonville, FL: Urbanomics, Inc. and Development Strategies, Inc., 1999.

Urban Sustainability Learning Group. Staying in the Game: Exploring Options for Urban Sustainability. Chicago, IL: The Tides Center, 1996.

U.S. Census Bureau. POPClocks. Washington D.C.: Census Bureau, 2001 [cited 13 April 2001]. Available from http://www.census.gov/main/www/popclock.html.

U.S. Department of Housing and Urban Development, The State of the Cities 1999. Washington, D.C.: Department of Housing and Urban Development, 1999 [cited 17 April 2001]. Available from http://www.huduser.org/publications/polleg/tsoc99/contents.html.

U.S. Department of Transportation, Bureau of Transportation Statistics. Transportation Indicators. Washington D.C.: Department of Transportation, 2001 [cited 13 April 2001]. Available from http://bts.gov/transtu/indicators/Environment.pdf.

U.S. Green Building Council. LEED Green Building Rating System Version 2.0. Washington D.C.: U.S. Green Building Council, 2000.

U.S. Soil Conservation Service. 26 Ecological Communities of Florida. Washington D.C.: Soil Conservation Service, 1980.

Warren, Roxanne. Abstract of The Urban Oasis: Guideways and Greenways in the Human Environment. Seattle: University of Washington, [cited 22 January 01]. Available from http://faculty.washington.edu/~jbs/itrans.

"Water Conservation Checklist." Environmental Building News. September 1997, 13.

Watson, Donald and Kenneth Labs. Climatic Building Design: Energy-Efficient Building Principles and Practice. New York: McGraw-Hill Book Company, 1983.

Watts, Frank C. Soil Survey of City of Jacksonville, Duval County, Florida. Washington D.C.: The Service, 1998.

"Which Passive Cooling Strategy Is Right for You?" Energy Source Builder [electronic journal]. Lorane, OR: Iris Communications, Inc., June 1997 [cited 27 April 2001]. Available from http://oikos.com/esb/51/passivecooling.html.

Wilson, Alex. "Building Materials: What Makes a Product Green?" Environmental Building News. October 2000, 1-5.

Wilson, Alex. "Keeping the Heat Out: Cooling Load Avoidance Strategies." Environmental Building News. May/June 1994, 1,13-17.

Wilson, Alex. "Small is Beautiful: House Size, Resource Use, and the Environment." Environmental Building News. January 1999, 1,7-10.

Wilson, Alex. "Stormwater Management." Environmental Building News. September/October 1994, 1,8-13.

Wilson, Alex and Nadav Malin. "Establishing Priorities with Green Building." Environmental Building News. September/October 1995, 1,14-17.

BIOGRAPHICAL SKETCH

Kara S. Strong was born and raised in northwest Indiana. Upon graduation from high school, she left for the Army Reserves and college. After completing two years of the architecture program at Oklahoma State University, she transferred to the Boston Architectural Center where she received her Bachelor of Architecture degree. While in Boston, Kara spent eight years working in various architectural firms, eventually as a job captain responsible for the technical and consultant coordination of various projects.

While obtaining her master's degree at the University of Florida, Kara was a research associate for the Center for Construction and Environment, where her expertise was in the areas of sustainable urban planning, architectural design and materials. She assisted the director in completing the USEPA SDCG Depot Avenue Eco-Development Project. In order to better understand the economic value of deconstructed commercial buildings, she also analyzed the outflows of a recently demolished residential hall at the University of Florida. She also designed a prototype sustainable affordable house for the Alachua County Housing Authority. The approximately nine hundred square-feet house plan will be used by ACHA when they replace substandard housing.

In her spare time, Kara is striving toward completing the Architectural Registration Exam. Kara is an Associate Member of the American Institute of Architects and Phi Kappa Phi. Her interests include traveling to exotic places, reading, and caring for her cat, Tigger.