

CHAPTER SIX

PROOF OF CONCEPT: SITE ANALYSIS BY PROFESSIONALS

This part demonstrates how professionals can use the proposed framework in site analysis. This study also uses the results from the interviews to validate the SiteOne results. The procedures begin with the design of a scenario for the different parties involved in the site analysis process. The second step is to collect related maps and census data sets. Next, three professionals are interviewed; they represent different roles in site analysis: a developer, a feng shui master, and an ecologist. The fourth step is to transfer the interviews into different graphical results. Finally, the following summarizes the differences between the interview results and the SiteOne results and analyzes the possible causes of these differences.

6.1 Scenario Design

This study not only includes the implementation of the proposed framework through the use of a computer simulation program (Chapter 4), but also demonstrates how professionals can use the framework in site analysis. Three professionals participated in analyzing the alternative housing sites in the same study area, Reston, the study area used in SiteOne. These professionals¹ represent different roles in residential development: a developer, a feng shui master, and an ecologist. Each of them gets the same background information about Reston, including census data sets and maps (Appendix E). Table 6-1 shows the list of the census data tables and maps.

¹ The professionals interviewed in the study are scholars in the area, but not practitioners. They only represent the roles as the practitioners.



Reston, VA



Figure 6-1 Building and street maps

Since its development in the 1960s, Reston has a considerable percentage of land that has been zoned for residential uses. The housing demand is constantly increasing. The parcel and building maps show that only a limited amount of vacant land is available for future development (Figure 6-1). Therefore, the professionals determine if this vacant land can be used as the alternative housing sites or they can select build-up sites for redevelopment. This study records both their decision-making processes and the analysis results. The final output is the flowcharts for the decision-making processes and the maps for analysis results.

Table 6-1 List of census data tables and maps

<p>Maps of Reston, Virginia</p> <ul style="list-style-type: none"> Buildings Bodies of Water Zoning Public Facilities Historic Sites, Historic Area, and Schools Parcel Slope Soil Aerial Photo Urban Forestry <p>Census 2000 for Reston, Virginia</p> <ul style="list-style-type: none"> DP-1: Profile of General Demographic Characteristics: 2000 DP-2: Profile of Selected Social Characteristics: 2000 DP-3: Profile of Selected Economic Characteristics: 2000 DP-4: Profile of Selected Housing Characteristics: 2000 QT-H1: General Housing Characteristics: 2000 QT-H2: Tenure, Household Size, and Age of Householder: 2000 QT-H14: Value, Mortgage Status, and Selected Conditions: 2000 QT-H15: Mortgage Status and Selected Monthly Owner Costs: 2000 QT-H16: Selected Monthly Owner Costs as a Percentage of Household Income in 1999: 2000 QT-P19: School Enrollment: 2000 QT-P20: Educational Attainment by Sex: 2000
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6.2 Interviews

Three professionals were interviewed separately to demonstrate their site analysis processes, each of which took about an hour. Notes are taken during the interview. The interviews are also recorded for summaries after the interviews. The tasks performed in the interview are (1) identify the type of information that will be used, (2) identify the factors

that will be considered, (3) rank the selected factors in terms of the degree of importance, (4) identify the analysis method for each factor, (5) mark the results on the map, (6) describe if there are any conflicts for analyzing different factors and how they resolve the conflicts, and (7) describe if there are any tools they may want use in a site analysis process.

6.2.1 *With A Developer*

Developers play the most important role in real estate development projects. There are eight stages of development: idea inception, idea refinement, feasibility study, contract negotiation, formal commitment, construction, completion, and the final stage, property, asset, and portfolio management (Miles et al., 2000). Developers consider site analysis and evaluation in the first three stages. In the first stage, although generating prospective ideas is a creative process, it is necessary that developers have various background information to organize based on experiences. Useful information should include the history, current conditions, and forecasts. Obviously, information of alternative sites is among these basics. Developers and other participants should construct a market research. In a regional level, the market research includes analyzing the local economy, consumer surveys, population, employment, zoning regulations, and traffic patterns. In the property level, the market research compares unit size and quality, demand characteristics (preferences, income, and tenant types), and financial factors. It also includes future performance of the property, such as prospective rents, operating expenses, net operating income, and market value.

In the second stage, idea refinement, developers should locate the project site and check its physical features. Architects and engineers may also be involved in the project and propose a tentative design. At this stage, developers' concentrations move from location demand analysis to a site's physical and legal features. One technique is looking for binding constraints or reasons to exclude a site. For example, zoning requirements can be a binding constraint because rezoning could be difficult, costly, and time-consuming. The following list includes the most important factors that developers should consider when refining their ideas (Barrett and Blair, 1988):

- Zoning (legal use of the site, restrictions on density and layout, contiguous land uses, and likelihood of obtaining variances),
- Physical features (size, soils, topography, and hydrology),

- Utilities (sewage, water, and telecommunication lines),
- Transportation (transportation linkages, traffic, availability of public transportation, and site's accessibility and visibility),
- Parking (size and type),
- Environmental impact (impacts on air, water, and noise levels, waste project, historic districts, parks, open space, trees, and wildlife habitats),
- Government services (police and fire service, garbage collection, schools, health facilities, impact fees, property taxes, and permit fees),
- Local attributes (defensive, neutral, or offensive),
- Price of the land,
- Demand and supply (population growth, trends, projection, employment, income distribution and change, existing and planned supply, and competitive environment).

In the third stage, the feasibility study, developers initiate a formal documentation, including an executive summary, a market study, cost and value estimates, financial information, building permits, and other governmental considerations (Miles et al., 2000). Site-related information are inventory and quality of existing space, new and proposed constructions, and features, functions, and benefits of existing and proposed space. In addition, the feasibility study should contain maps, photographs, and preliminary drawings of the site. Drawings in this stage are much closer to the final designs than in the previous stages, because preliminary drawings show parking, landscaping, exterior elevations, and square footage of the project.

The developer interviewed in this study rates the transportation analysis as the most important factor when he selects a site. He explains that urban and suburban land value relies more on the land's visibility and accessibility to customers and services than on its natural features. Based on the street map and background information about Reston, the developer selects the most desirable site for development. It is located on the south side of Baron Cameron Avenue, between Wiehle Avenue and Hunter Mill Road (Figure 6-2). The site is only 2000 ft. away from the intersection of Baron Cameron Avenue and Leesburg Pike, a major road connecting Reston to Washington DC. There are also exits to Dulles Airport Toll Road – a state highway that connects the Dulles International Airport to

Washington DC – from both Wiehle Avenue and Hunter Mill Road. Baron Cameron Avenue also connects to Reston Parkway, a major road running north and south through Reston. The transportation analysis from the street map shows the accessibility of the site both locally and regionally, although additional transportation information, such as traffic patterns and speed limits, can be helpful for detailed analysis.

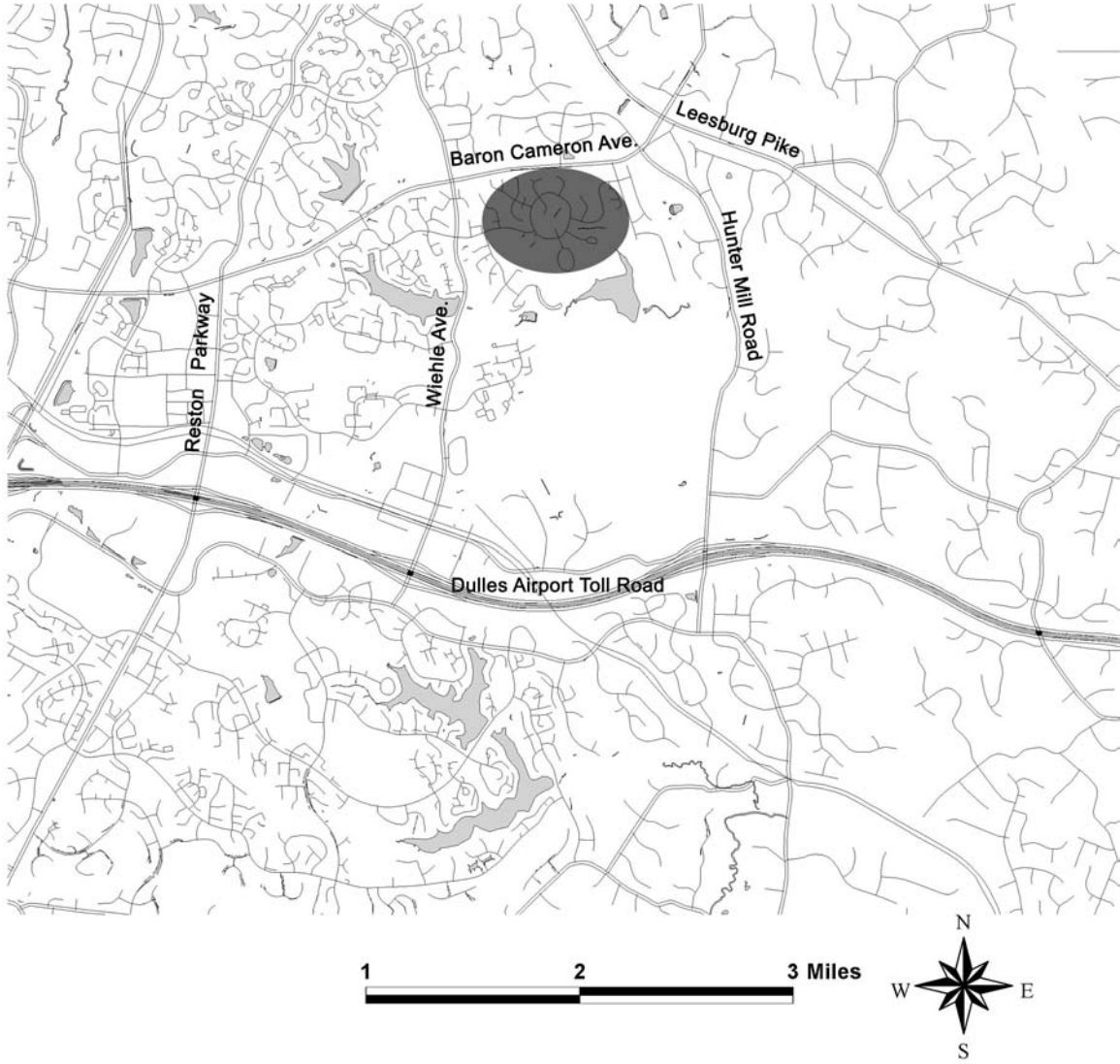


Figure 6-2 Developer's most preferred site

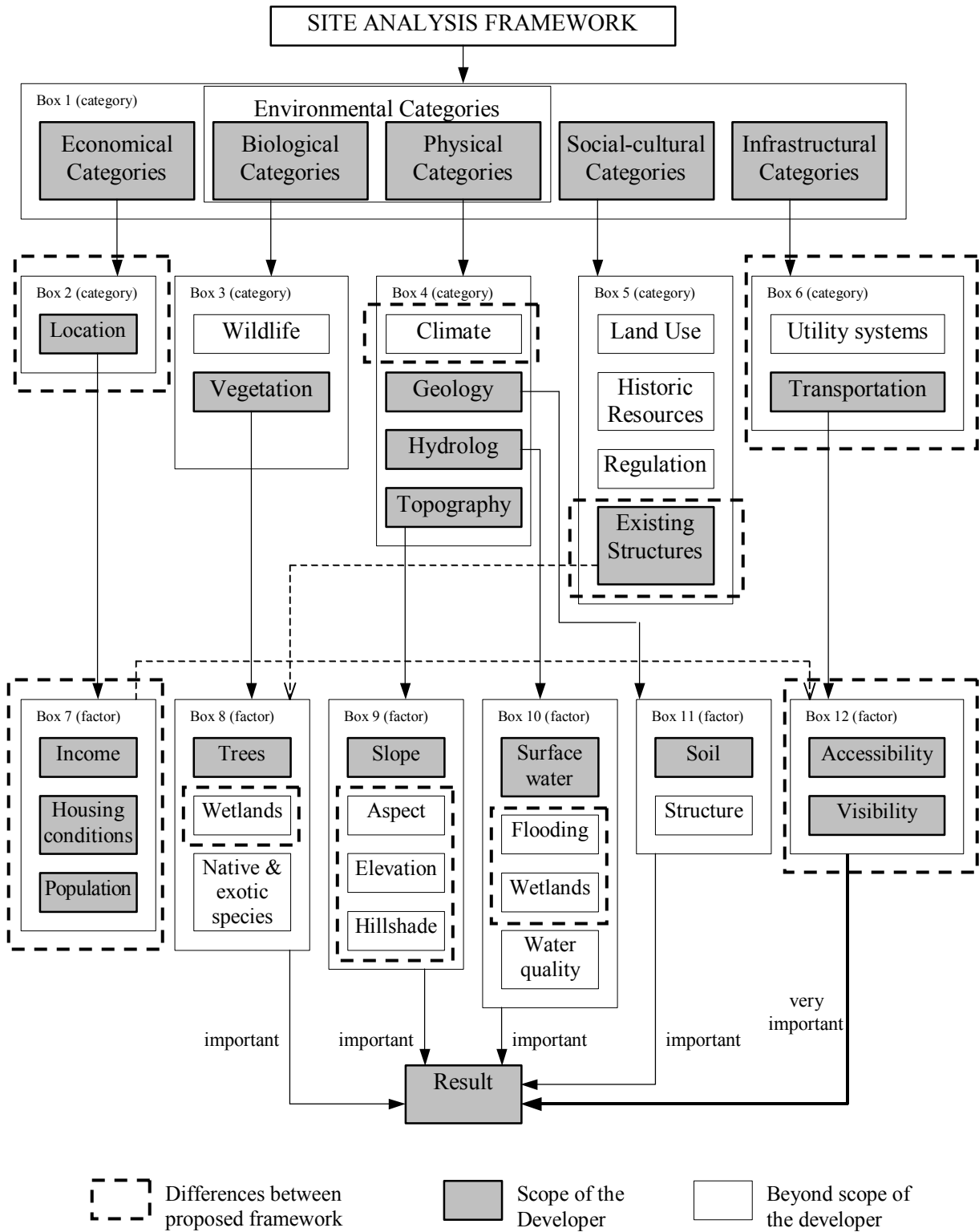


Figure 6-3 Developer's decision-making framework

The developer considers the project as a mixed-use complex, which includes an office building, retailers, and different density residential buildings. This decision is based upon the study of existing development patterns and census data in Reston. Reston's combination of apartments, townhouses, and single-family houses was a pioneer design concept when it was developed in 1962. The retailers in the selected site are also within walking distance of its residents, reducing air pollution and increasing livability through its pedestrian-oriented transit design.

In addition, the selected site should be well planned and organized. The developer emphasizes that the office building and the retailers should appear different than the residential spaces. The design should maximize open spaces in its arrangement of apartments, townhouses, and single-family houses. Based on the different functions of the buildings, the developer places the office building and the retailers on the north part of the site, near Baron Cameron Avenue and Wiehle Avenue. The apartments and townhouses can act as a buffer zone, separating the high-end single-family houses from the offices and the retailers. Residential buildings are on the south part of the site, near Lake Fairfax Park.

The developer also takes the visibility of the site and its development into account, especially that of the office building. In his vision, the office building is a ten-story construction and should be visible from the nearby major streets. Therefore, it is necessary to conduct a thorough site survey, using site visits to collect topographic information, consider surrounding constructions, and note tree coverage.

In addition to the site's accessibility and visibility, the developer also considers its physical features, and wants to "maximize the natural characteristics of the land". Among them, soil, slope, bodies of water, and vegetation are important factors for his selection of the particular site in Reston. The site's elevation is higher than the park and the Lake Fairfax on its south. Its south facing gentle slope allows a continuous view of these vistas. In addition, vegetation is also a concern. The tree coverage map shows that the south part of the selected site faces Lake Fairfax Park, a highly forested area. The existing forestry is very desirable, because it provides a high quality living environment and can increase the values of nearby properties. Re-designing existing landscapes can further enhance these natural features. Therefore, the developer wants to build the single-family houses in this area.

In summary, the developer's site selection criteria highlight the land's visibility and accessibility. He also considers its natural characteristics, including soil, slope, bodies of water, and vegetation. Additionally, the developer hopes that a computer tool can allow him to analyze the entire Reston area at the beginning and zoom into alternative sites for detailed analysis later. He wants more information about the site than he receives in the interview, such as the heights of surrounding buildings and trees, so that he can have a comprehensive picture of the site. He also suggests that using computers to create 3D simulations of future development could help him make a better decision.

6.2.2 *With A Ecologist*

In general, ecologists pay special attention to air, water, earth, and fire in our living environment. Obviously, changes in the composition of air could dramatically influence all life. By increasing the surface temperature of the Earth, for example, the use of fossil fuels, deforestation, chlorofluorocarbons (CFC), and agriculture sources could double the carbon dioxide in the atmosphere and cause global warming. Because buildings, refrigeration, air conditioning, and fire extinguishing systems use about half of the CFCs produced in the world, and the maintenance of buildings needs another half of the world's fossil fuel consumption, architects and engineers can contribute to reduce global warming by carefully designing these systems and specifying environmentally-friendly alternatives. Water is another important element. However, acid rain, manufacturer waste, and ocean dumping have already caused severe problems in the environment. In terms of domestic usage, the major concern is the amount and quality of available drinking water. In residential and commercial buildings, the toilet uses one-third of the domestic water supply, and laundry, gardening, and general house cleaning uses one-quarter. Less than half of the domestic uses require drinking-quality water. However, drinking water is supplied for all functions. Therefore, professionals can change the structures of water systems based on different water consumptions in the buildings. Ecologically-conscious strategies include graywater systems and on-site water purification, which can recycle water for gardening, car washing, and heating (Zeihner, 1996).

In terms of ecological site design, the goal is to enhance and protect the natural resources and biodiversity of the land. The process may begin with assessment and inventory, then initial concept, detailed design, and, finally, specific construction processes.

Because a thorough understanding of the site is the first step, the ecologist interviewed in this study points out the important information needed for site analysis at the very beginning of the conversation. His list covers comprehensive climatic data sets, topographic and hydrologic information, vegetation, water supply, wastewater treatment, transportation, and utility information. The format of presenting the information may vary: some of it may be presented in tables and writings, some in maps, still others in radar imaging or aerial photos, using modern technologies.

The ecologist picks his most preferred site based on the given information (Figure 6-4). It is at the southeast corner of the intersection of Baron Cameron Avenue and Wiehle Avenue. The following descriptions show his concerns in detail.

The important climatic factors mentioned by the ecologist are sun, temperature, and wind. Solar radiation contributes to outdoor comfort and indoor solar heating. Temperature variations, sometimes only 3 to 4 °F, could influence energy use patterns. Information about wind, including prevailing direction, seasonal variations, intensity of wind, speed, and frequency of wind, is also important. The combination condition of sun and wind can determine the site microclimates. The ecologist recommends a grid cell system to analyze microclimates on a building site. Four matrix conditions in this system are: avoiding sun (shade), admitting sun, blocking wind, and admitting wind. The analysis process includes converting hourly data sets into separate grid layers, overlaying the sun layer with the wind layer, assigning values to the combination conditions in each cell, and overlaying the hourly layers for seasonal and annual layers².

Topographic features, such as slope, aspect, and surface conditions, are also important. Maintaining site character and protecting the vegetation and soil are the primary concerns. The development should also avoid agriculture land, floodplain, and wetland. Additionally, surface color and reflectivity could retain or reject heat and light from the sun, modifying prevailing climatic conditions and impacting the heating, cooling, and lighting loads of buildings. Moreover, topography, solar radiation, and wind have a combined impact

² For more information, check Brown and DeKay's *Sun, Wind & Light* (2001).

on microclimate. One example that the ecologist gives is how wind blows in different areas in a valley. During the day, the wind blows uphill because air warms up by the sun. At night, the air flows down the valley because it is cooled by the cold ground surface. In steep sloped areas, aspect should also be a concern, especially when facing the prevailing wind direction. The ecologist also considers the existing constructions and open spaces, including parks and greenbelts. The reflectivity of the roof and elevation materials of large buildings can influence the energy uses and lighting systems of themselves and nearby buildings. In urban and suburban settings, organized buildings and streets can also form wind corridors to introduce the prevailing breeze into densely built-up areas.

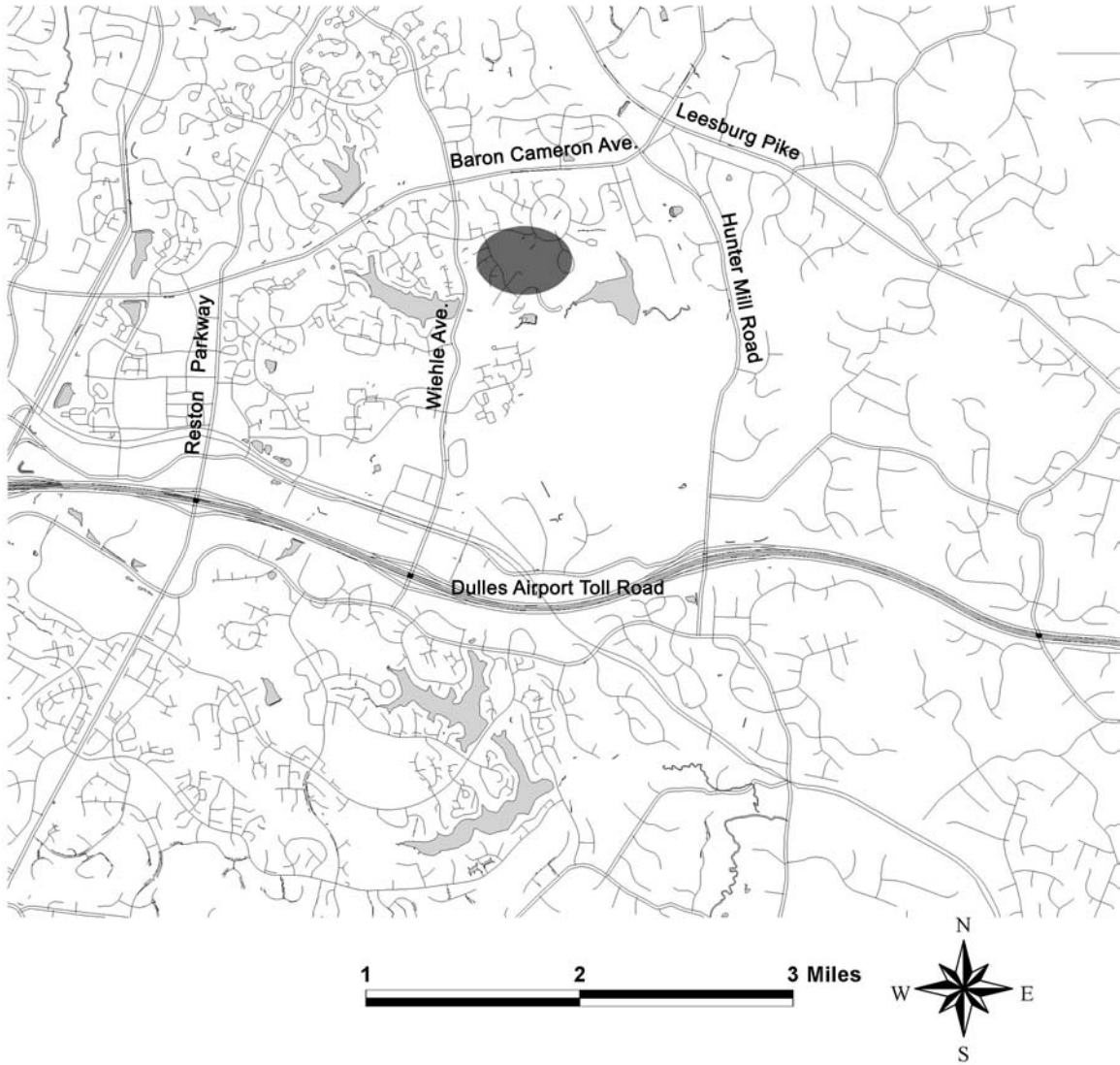


Figure 6-4 Ecologist's most preferred site

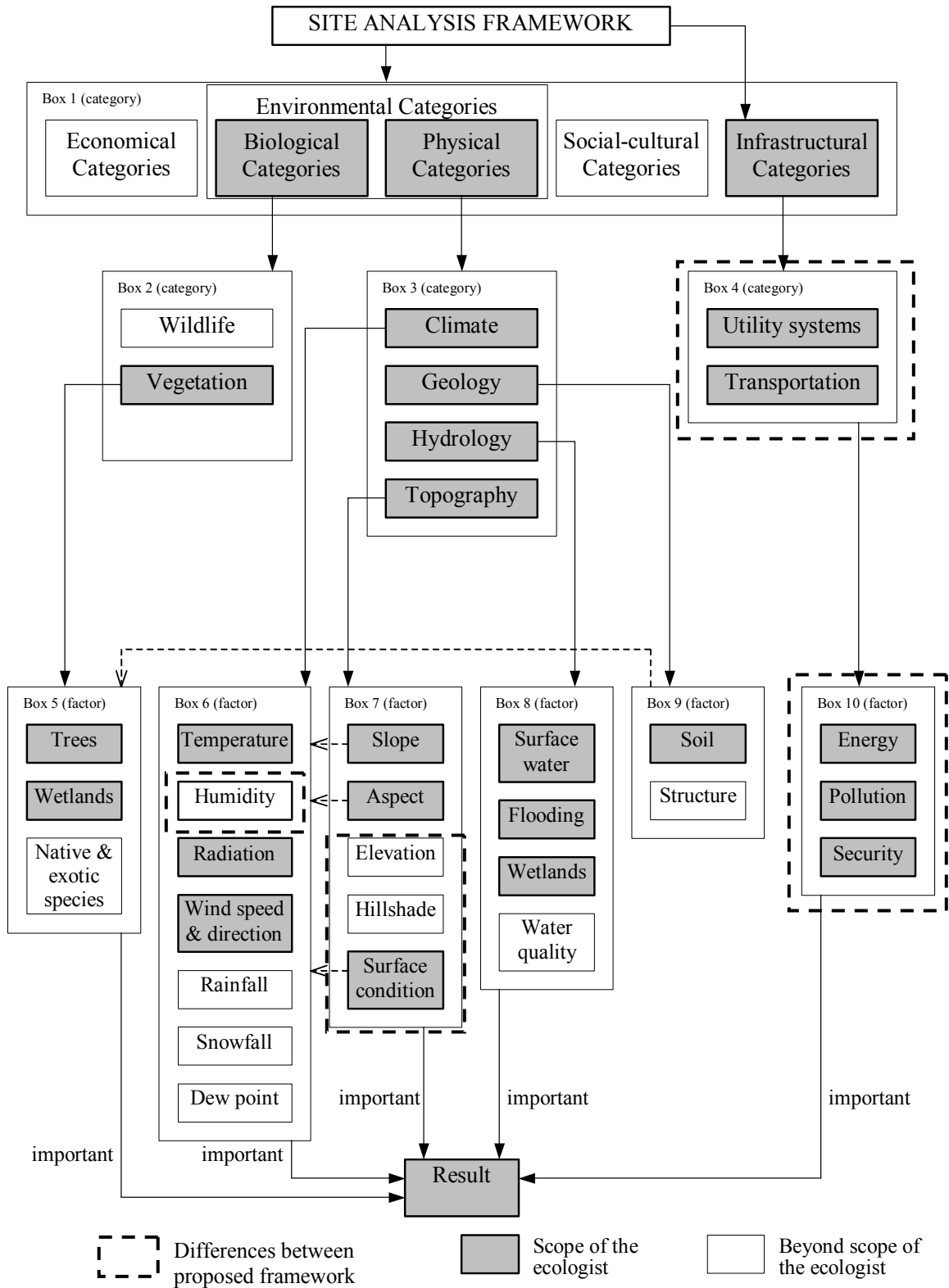


Figure 6-5 Ecologist's decision-making framework

The ecologist considers the maturity and coverage of vegetation for several reasons. He mentions that vegetation can protect nutrients and soils, enhance visual quality, and provide shade. In addition, vegetation as a carbon sink – where more carbon was taken in than was given out – helps offset our greenhouse gas emissions. Carbon sinks normally include plantations, plantings on farms, remnant vegetation areas and possibly grazing lands where production has been drastically reduced or increases in tree density. Carbon stored in woody vegetation (forests and woodlands) can be altered directly through land use change, or indirectly through climate change.

The ecologist also pays attention to infrastructure, including transportation, water supply, power, and sanitary waste systems. Based on transportation conditions and population density, properly locating public transportation services can offset the use of individual cars. This can both save energy and control pollution. He also mentions the importance of knowing the artery locations of the utility systems for security and safety related issues.

After collecting the information, the ecologist also suggests several possible ways to use renewable energy in the new development. If the stream and river waterfalls are large enough, a hydroelectric generator can provide power. Identifying south-facing slopes and solar radiation areas can also help to install hot water or photovoltaic solar panels.

In addition to collect information about climate, topography, hydrology, vegetation, and infrastructure, the ecologist considers the impacts of current development in a larger scale and in the future. Regional impacts should also be a concern when analyzing the microclimate or other local influences. The information compiled for the analysis process can use different scales. For example, a twenty-foot grid may be used to analyze microclimates on a building site, and a 200-foot grid may be used to consider the entire Reston area. The ecologist recommends using computer technology, such as GIS, to compile information for these different tasks. Additionally, computer technology can also help to predict future impacts by simulating certain scenarios and generating consequent results.

6.2.3 *With A Feng Shui Master*

Feng shui is a comprehensive environmental evaluation system that examines issues related to astronomy, climate, geology, topography, ecology, and landscape. In addition,

people who live and use the land and buildings are also important to feng shui because its ultimate goal is to find places in which there is harmony between humans and the natural environment.

The feng shui master uses the form school principles, which are based on visual survey of land forms. He has visited the region before and is familiar with its general development. For this particular analysis, he relies on the maps that he receives for the primary information on the area.

The feng shui master points out his favorite site at the beginning of the interview. Then, he articulates and explains the features of the selected site. First of all, he considers the bodies of water and major roads as the most important factors for the site selection. Because the elevation and slope maps of Reston show that most areas in the region do not have greater than 20% slopes, while mountains and water are the two most important features in feng shui. In urban and suburban settings, major roads are considered substitutes for mountain ridges in feng shui. Therefore, the areas that surround the lakes, especially, the north banks of these lakes become alternative sites. The selected site is surrounded by Lake Anne and two roads: Wiehle and Baron Cameron Avenues (Figure 6-3). They are major roads in Reston, having enough flows to bring chi to the site, and avoiding too much traffic, like other highways in the region. The size of these two roads is desirable; they are not busy thoroughfares but are within easy access of two highways: Dulles Airport Toll Road and Leesburg Pike.

Slopes and their orientation should also be considered. The site is on a gentle south-facing slope, which feng shui considers very desirable. The site also has an open area in the front towards the lake, so that chi can accumulate and pass onto the site. The northeast, north, and northwest sides of the site are higher than the site, forming a horseshoe shape and protecting the site from the winter wind.

In addition to the natural features of the site, the feng shui master also considers the profiles of the residents who live in the area. He assumes that most of the residents who live there will be older people. Therefore, accessibility to services, especially hospitals, cultural landmarks, and recreation services, become a crucial factor. The selected site is less than two miles from the Reston hospital and the post office. It is also within walking distance of the Lake Anne community center.

Moreover, the feng shui master reviews the information about the soil and the vegetation. Desirable soil should not contain high levels of radon or other harmful minerals. It should also be suitable for construction and gardening. The selected site is near Lake Fairfax Park and North Reston National Golf course. Green trees and prosperous vegetation indicate good soil conditions in the vicinity.

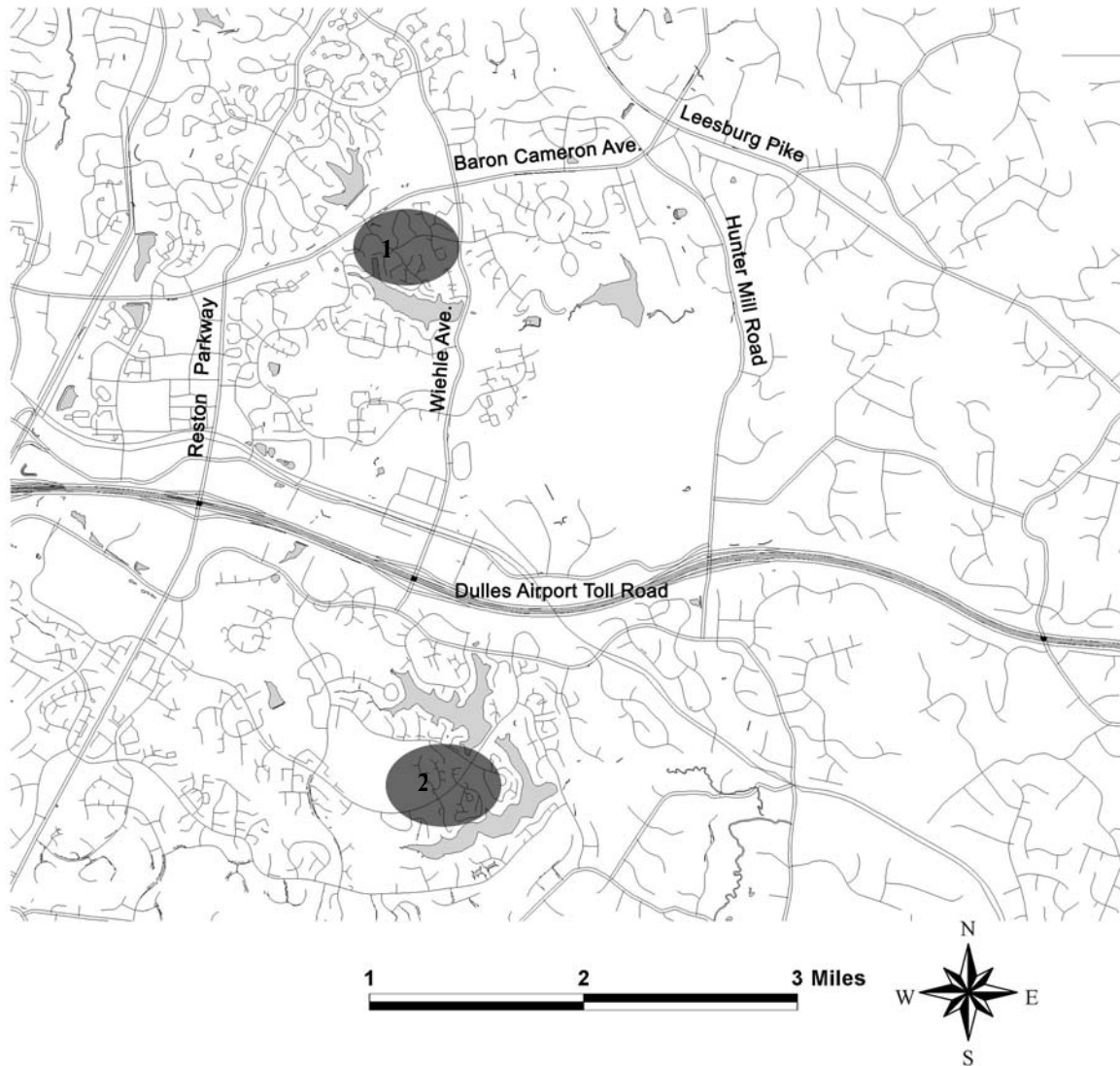


Figure 6-6 Feng shui master's preferred sites

The other concern of the feng shui master is the electromagnetic field (EMF). He says that feng shui practitioners should avoid selecting sites with power lines or other strong sources of EMFs nearby, and this inclusion of modern science has been in practice for a long time. At the present time, cancer fears may impact property values, although there is a lack

of definitive scientific evidence about the possible health effects of EMF exposure. For example, a home's value can be reduced by as much as 20% if its location is near a transmission line. In some cases, buyers are refusing to even consider houses located near utility lines³. Because the selected site in this case has already been developed, the feng shui master assumes that its EMF is under a safe level.

The feng shui master also selects an alternative site based on the same criteria. Because the potential users of this site are young professionals and couples with young children, accessible to schools is desired. The site is surrounded by Lake Thoreau and Lake Audubon. Three schools are within walking distance to this site. This site is less favorable because it is closer to the Dulles Airport Toll Road.

In summary, the feng shui master takes into consideration the relationship between the site and bodies of water or major roads, slope, aspect, and EMF. Because people who live and use the land are also important, the feng shui analysis shows different results for different users in the same region.

6.3 Comparison

The developer emphasizes the accessibility and visibility of a site. The transportation analysis is the most important factor, which influences the site's external accessibility and its internal layout for buildings with different functions. He also considers natural characteristics of the site, including soil, slope, bodies of water, and vegetation. A thorough survey of soil and slope conditions can help to identify suitable sites for development and reduce construction costs. Favorable vegetation and bodies of water also helps increase livability and enhance visual quality. Figure 6-7 shows a flowchart of the developer's decision-making process.

The comparison shows similar site analysis processes used by the developer and in the proposed framework. In addition, the criteria used for soil and slope analyses are similar for the developer and in SiteOne. The developer mentions that he should consult engineers and architects for soil and slope analyses. SiteOne adapts the same standards and criteria that these professionals use in their practices. However, SiteOne demonstrates the concepts and

³ From the Philadelphia Inquirer, 3 June 1994, <http://infoventures.com/emf/topics/bu42ni06.html>.

ideas of using environmental models in the analysis procedures. Although the proposed site analysis framework considers the infrastructure and economic models, these models are not included in SiteOne. The items highlighted by the dashed lines in Figure 6-3 show these differences. Additionally, the criteria for vegetation and hydrologic analyses in SiteOne are also different from those used by the developer.

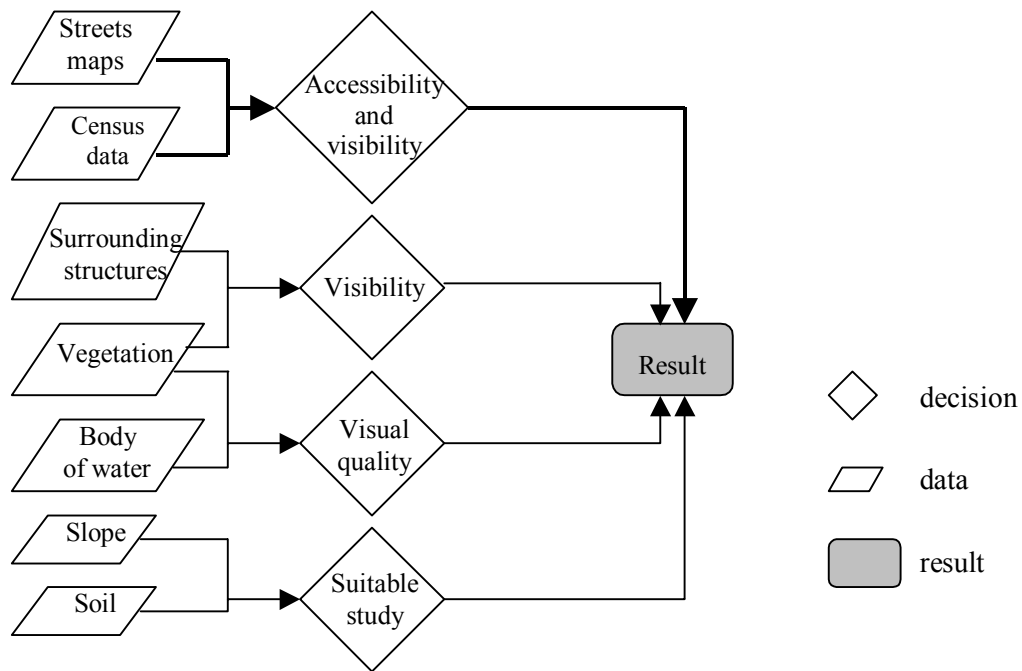


Figure 6-7 Flowchart of the developer's decision-making process

The ecologist considers information about climate, topography, hydrology, vegetation, and infrastructure. He also mentions important factors within these categories. For example, he needs detailed topographic information, such as slope, aspect, and surface conditions for his analysis. Figure 6-8 describes the ecologist's decision-making process.

The ecologist and SiteOne use the similar data collection and analysis process, although the ecologist needs more information, such as the heights of buildings and trees, surface conditions, and information about water and utility systems. The ecologist's analyses for environmental factors, especially their impacts on microclimate, are similar to those SiteOne uses. For example, the grid system recommended by the ecologist overlays the different layers and assigns values to the combination conditions. SiteOne uses a similar overlaying method to generate result maps. The ecologist also takes into consideration the combined impact of topography, solar radiation, and wind. His concern is similar to the

SiteOne’s climatic analysis using feng shui, which uses wind speed and direction, elevation, and aspect data sets. However, data type and format used by the ecologist are broader than those used in SiteOne. His concern about microclimate is also in a larger scale. For example, vegetation can act as a carbon sink in addition to its protection of nutrients and soils. Properly located public transportation services can save energy and control pollution. The items highlighted by the dashed lines in Figure 6-5 show these differences between the framework of the ecologist and the proposed framework.

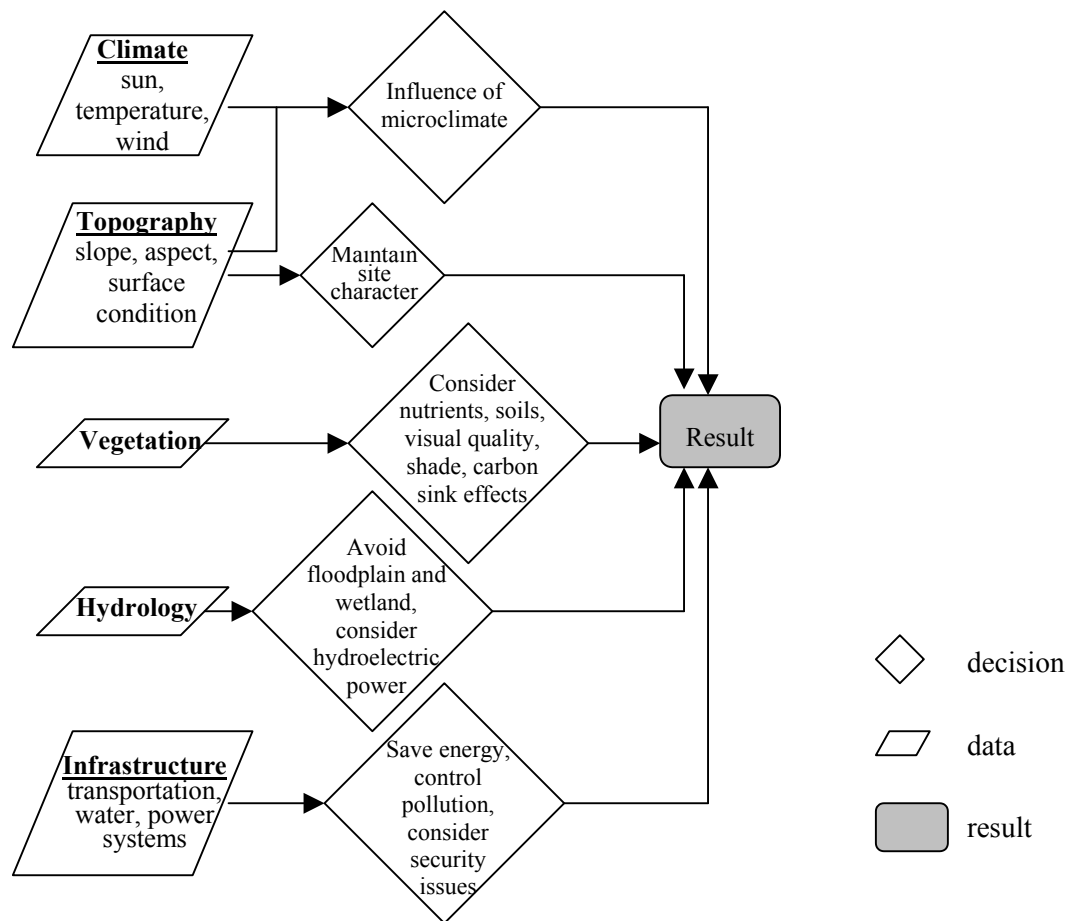


Figure 6-8 Flowchart of the ecologist’s decision-making process

The feng shui master analyzes sites based on visual survey of land forms. The bodies of water and major roads are the most important factors for his site selection. He also considers other natural features (slope, orientation, soil, vegetation, and EMF) and the profiles of the residents.

Although the information used by the feng shui master is similar to that used in SiteOne, his criteria is more abstract. He uses mostly combined information instead of single factor. His decision-making process is also hard to transform to a descriptive flowchart.

In short, the comparisons show the similar components and structures among the decision-making processes of the interviewers and SiteOne. The similarity is more obvious between the factors and framework used by the ecologist and in SiteOne, although the ecologist's concerns are normally in a larger scale. In addition, the discrepancies suggest that more categories and factors need to be added to the framework in order to perform a thorough site analysis, which can become a future research direction for the proposed framework and SiteOne. Moreover, the interviewers were asked to select the most suitable sites for development. The results are different from those generated by SiteOne, because the major objective in the case study is site analysis, to analyze an area with considerations of several factors in the selected models. However, the results of site analysis can provide useful information for site selections.