

Visual Preference for Stormwater Pond Edge Treatments:

*design guidelines for enhanced stormwater ponds
in open space subdivisions*



Kimberly S. Heiss

Committee:

Lester L. Linscott, Chair, Department of Landscape Architecture
Gary E. Purdum, Department of Landscape Architecture

A THESIS PRESENTED TO THE GRADUATE SCHOOL OF THE UNIVERSITY OF FLORIDA
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF
LANDSCAPE ARCHITECTURE

UNIVERSITY OF FLORIDA

2007

Copyright 2007

by

Kimberly S. Heiss

To Richard and Carol.

ACKNOWLEDGMENTS

I am extremely grateful for the knowledge and guidance imparted by my thesis committee. Les Linscott, Chair: Associate Professor, Department of Landscape Architecture, was invaluable for his expertise on site analysis and landscape ecology; and, Gary Purdum: Assistant Professor, Department of Landscape Architecture, for his expertise on visual preference and statistical analysis. Additional thanks to; Glenn Acomb: Associate Professor, Department of Landscape Architecture for inspiring my early interest in stormwater management, and Mark Clark: Assistant Professor, Soil and Water Science Department for his educational stormwater wetland project at the University of Florida.

Thank you to the entire faculty of the Department of Landscape Architecture for the opportunity to be part of such a challenging and rewarding program.

Special thanks to Robert Walpole, Vice President – Engineering, Causseaux & Ellington, Inc., for discussing the site plans for the Sorrento project. Additionally, Gerry Dedenbach, AICP, CNU, Director of Planning and GIS Services, Causseaux & Ellington, Inc., for generously meeting with me to discuss the Turnberry Lake site plan.

Thank you to the many busy people from the regional planning offices at the City of Gainesville and Alachua County who assisted my efforts at tracking down information. From the Alachua County Government Offices; Michael Drummond, Stephen Hofstetter, and Stacie Greco, of the Alachua County Environmental Protection Department. From the City of Gainesville Planning & Zoning Department; Lawrence Calderon, and John Wachtel. Additionally, Sally Adkins, from the City of Gainesville, Public Works Department. Also, Fritz Olson of the Adopt-a-River, Current Problems Program.

Finally, I would like to thank my friend Carol Lewis for the many kayak

excursions that renewed my energy and focus. Additionally, thanks to Lars Andersen, of Adventure Outpost, for introducing paddlers in the community to the natural beauty of Florida's many springs, rivers, and coastal marshes.

Special thanks to my husband Richard for his support and encouragement throughout the entire project.

TABLE OF CONTENTS

	page
ACKNOWLEDGEMENTS	iv
LIST OF TABLES	vi
LIST OF FIGURES	viii
ABSTRACT	x
CHAPTER	
1 INTRODUCTION	11
2 BACKGROUND	14
Landscape Ecology	
Conservation/Open Space Subdivision Design	
Freshwater Wetlands: Basin Structure and Terrestrial Vegetation	
Environmental Psychology	
Rachel and Stephen Kaplan	
Joan Iverson Nassauer, FASLA	
Local Case Studies	
Case Study A - Stormwater Ecological Enhancement Project	
Case Study B - Turnberry Lake	
Case Study C - Sorrento	
3 MATERIALS AND METHODS	31
Scope of Research	
Survey Methodology	
Overview	
The Demographic Questions	
Twenty-Seven Visual Preference Scenes	

	- The Preference Parameters - Basin Structure - The Terrestrial Vegetation Parameter - Criteria Matrix - The Original Categories - Operational Definitions for Scene Criteria - Ranking Favorite View A, B, or C - The Interventions - Intervention A - Intervention B - Statistical Analysis Methods - Overview - The Rules Used for Belonging to Factor Groups - Sample Characteristics - The Survey Package - Survey Distribution - Response Rate	
4	RESULTS AND DISCUSSION - Results for Population Demographics - Results of the Principle Axis Factor Analysis - Factor Group 1 - Factor Group 2 - Factor Group 3 - Average Preference Rating for All Scenes - Average Ratings for the Original Nine Categories - Results of Favorite View Rankings - Group Comparisons - Importance of Access to Natural Area Comparisons - Favorite View Comparisons - The Intervention Results - Summary	45
5	RECOMMENDATIONS - The Stakeholders - The 3 Goals - Goal 1: Aesthetics - Goal 2: Profitability	84

Goal 3: Habitat Conservation	
Site Analysis	
Site Synthesis	
Conceptual Site Plan - Applying the Guidelines	
Conservation Subdivision Site Planning	
Design Development - Pond Level Enhancement	
Implementation	
Conclusion	

APPENDIX

A The Survey Package	120
B Open Space Ordinance, Alachua County, Florida	132

LIST OF REFERENCES	138
--------------------	-----

BIOGRAPHICAL SKETCH	142
---------------------	-----

LIST OF TABLES

Tables	page
3-1 Scene criteria matrix	34
4-1 Educational level results	46
4-2 Housing type results	46
4-3 Ownership results	46
4-4 Home price results	46
4-5 Context results	47
4-6 Importance of access to natural area result	47
4-7 Nature conservation group membership result	47
4-8 Average preference rating for the 3 factor groups	51
4-9 Significant preference for factor 2	52
4-10 Average preference rating for original 9 categories	58
4-11 Criteria matrix for original 9 categories	59
4-12 Home price category by Favorite View	64
4-13 Average home price in each home price category	65
4-14 Average price for favorite view by home price category	66
4-15 Importance of Access to Natural Area ratings breakdown	67
4-16 Average preference ratings for factor 1 (naturalized) by home price categories	68
4-17 Average preference ratings for factor 2 (moderate) by home price categories	68
4-18 Average preference ratings for factor 3 (manicured) by home price categories	69
4-19 Average access rating based on 6 home price categories	73
4-20 Favorite View by Access rating demographic result	75
4-21 Favorite View by Outdoor Activity demographic results	76
4-22 Intervention A results	77
4-23 Intervention B results	78
4-24 Expected change in preference vs. actual change in preference	79
4-25 Average 'after' intervention rating based on participant's Favorite View	80
5-1 Stakeholders and their probable objectives	85
5-2 Goals and Objectives of study	86

Table		page
5-3	Native Florida Freshwater Wetland Plants Source: CIR 912, revised July 2006, www.ifas.edu	97

LIST OF FIGURES

Figure	page
2-1 SEEP retention pond. Source: M. Clark and M. Otto, et al	22
2-2 Pre-development Turnberry Lake site. Source: G. Dedenbach, 2006	24
2-3 Turnberry Lake after development	25
2-4 Turnberry Place master plan. Source: G. Dedenbach. 2006	26
2-5 Jonesville Park master plan. Source: www.co.alachua.fl.us/government/depts/comm/pressreleases.aspx?pr_id=3791 . 8/21/2006	27
2-6 Sorrento post-development drainage plan. Source: R. Walpole, 2007. Color shading and legend added by K. Heiss	29
3-1 Favorite view scenes	38
3-2 The four intervention scenes	40
4-1 Overall preference for factor groups	52
4-2 Category F compared to Category A	53
4-3 Preference for Favorite View A by factor groups	62
4-4 Preference for Favorite View B by factor groups	62
4-5 Preference for Favorite View C by factor groups	63
4-6 Average home prices by price categories	65
4-7 Price for Favorite View based on home price category	67
4-8 Graph of Importance of Access to Natural Area by home price categories	69
4-9 Average factor preference rating by 11 home price categories	70
4-10 Original 9 categories by Importance of Access to Natural Area	70
4-11 Factor group results by Access rating	74
5-1 Nature trail bridge and boardwalk	87
5-2 Natural area site amenities that 'invite' exploration	88
5-3 Children's playground with perimeter path	89
5-4 Levels of complexity in landscapes	90
5-5 Zero lot line housing layout	92
5-6 At-grade garage under townhouse	93
5-7 Tucked away garages	94
5-8 Dry and Wet wildlife underpass	94
5-9 Effects of Shoreline Erosion	95

5-10	Rosemont subdivision post-development Source: Google Earth, 2006	101
5-11	Field Visit Sketch	102
5-12	Rosemont pre-development soil map Source: www.fgdl.org	104
5-13	Surface runoff in project area	105
5-14	Depth to seasonal high water table Source: www.fgdl.org	106
5-15	Critical wildlife linkages adjacent to site Source: www.fgdl.org	107
5-16	Areas of water accumulation Source: www.fgdl.org	108
5-17	1996 FEMA flood map Source: www.fgdl.org	109
5-18	Site synthesis	111
5-19	4-Step Conservation Subdivision Design Process Source: Arendt, R. (1996)	114
5-20	Conceptual site plan comparison - built vs. remodel	115
5-21	Section view of enhanced stormwater pond	116
5-22	Section view of sediment forebay	117

The figures listed above are the property of the author unless otherwise noted.

ABSTRACT

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 Landscape Architecture

VISUAL PREFERENCE FOR STORMWATER POND EDGE TREATMENTS: DESIGN GUIDELINES FOR ENHANCED STORMWATER PONDS IN OPEN SPACE SUBDIVISIONS

By

Kimberly S. Heiss

May, 2007

Chair: Lester L. Linscott

Member: Gary E. Purdum

Major Department: Landscape Architecture

Borrowing from Joan Iverson Nassauer's model of using cultural values and traditions to design a framework for an ecologically functional landscape; a visual preference survey was conducted to assess the sample population's opinions about different stormwater retention pond edge treatments. The two factors being assessed for visual preference that impact ecological functioning are; the marginal shoreline plants, and the emergent aquatic zone plants. The context of the study is aesthetics of stormwater retention ponds in new, suburban, single-family residential developments. This thesis presents the results of a visual preference survey of 204 participants from the Gainesville, Florida area. The participants were asked to rate 27 scenes of varying pond edge treatments to determine what degree of naturalization was preferred within the suburban residential setting. Demographic questions were designed to compare results with demographic groups to evaluate significant differences. Design guidelines and strategies from the survey and literature review are presented to assist in site planning and design of multifunctional stormwater retention ponds with an ecological base, yet attractive to potential home owners in new suburban residential settings.

Chapter 1 - Introduction



The purpose of this research is to answer questions about the aesthetics and ecological functioning of stormwater retention ponds. The ultimate goal of this study is to develop guidelines for designing attractive, ecologically functional, retention ponds that can be used for more than just flood control. The questions leading to the research are, why are retention ponds so often lacking in aesthetic and ecological character when they make up such a large portion of the landscape? Additional questions are; what issues politically, economically, and socially support this lack of cultural and ecological amenity in the public realm? Also, how does the public perceive this issue? Finally, does the general public understand the significance of stormwater retention's ecological and aesthetic potential? The answer is that they care a great deal – the participants who responded to the research survey have strong feelings about stormwater retention ponds and visual preference.

An article titled, “Messy Ecosystems, Orderly Frames” (Nassauer, 1995) provides a method that might determine if the general public will accept a more natural stormwater pond edge treatment than the typical mowed turf-to-waters edge. The methodology from Nassauer’s study was used to construct the visual preference research in this report. The context for this research is new, suburban residential subdivisions, because they are the result of Florida’s booming growth. The environmental as well as the aesthetic impacts of increasing suburban development will be significant. The parameters being evaluated for preference are various treatments of; 1) pond structure as it influences emergent aquatic plants, and 2) shoreline vegetation.

The results of the visual preference research evaluating participant’s preference for the two treatment parameters are discussed in this report. The answer to the question, “Would participants be willing to pay a premium to live with a view of a naturalized stormwater retention pond, and what would that pond look like?” is discussed in the results.

The stakeholders addressed by this study are; developers, land planning professionals, environmental agencies, and homeowner’s associations. This research developed goals of equal priority to meet the stakeholder’s objectives. These goals are: profitability, habitat conservation because it is key to water quality, and flood prevention.

Chapter 2 summarizes the literature constituting the theoretical perspective of this research. It addresses relevant topics that may not be well known by people interested in stormwater retention ponds.

Chapter 3 explains the formulation of the visual preference survey: pertinent variables and criteria used to evaluate the survey scenes.

Chapter 4 discusses the outcome of the survey and findings that should impact the viability of future development.

Finally, Chapter 5 provides design guidelines that combines survey results with the

goals of habitat conservation, profitability and flood prevention.

The results of this research have answered many questions and created new questions that will require further research and study.

Chapter 2 - Background



Landscape Ecology

Landscape Ecology is a field of inquiry that examines the impact of spatial arrangements of land uses on humans, wildlife, and ecosystems. The book, “Practical Ecology for Planners, Developers, and Citizens, details the fundamental concepts of landscape ecology and land use planning strategies for professionals and interested citizens (Perlman and Milder, 2005).

A few key landscape ecology principles apply to this study. For instance, ecosystems and biotic diversity are not well-suited to the imposition of development boundaries. Water flows from one property to the next, air flows from one place to the next, and animal species migrate with the seasons. Migratory bird flyways cover several states and hundreds of miles. To help illustrate another important principle in landscape

ecology - imagine a bird flying south for the winter along the Eastern coast of the United States. Instead of seeing relatively unbroken hardwood forests, pine flatwoods, tidal marshes, and coastal dunes, imagine large cities, towns and suburbs connected by highways and roads, with only patches of the original landscape showing through the development. It is a basic principle of landscape ecology to preserve large, natural “patches” and “corridor linkages” which are critical to wildlife forage and migration. Long term effects of increased development without planning for conservation of habitat, are a loss of free ecological services like water purification and plant and animal biodiversity.

Finally, if there is no site analysis and existing tree and vegetation inventory conducted, the site is generally cleared and graded without thought to the loss of native species and sense of place. Additionally, water quality deteriorates with the loss of vegetation and the increased soil erosion caused by clearing and grading.

Conservation/Open Space Subdivision Design

Randall Arendt’s book “Conservation Design for Subdivisions” argues that cities and counties create ordinances for open space design so that not all the land in a subdivision becomes houses, yards and streets (1996). Arendt proposes that a relatively higher proportion of a development should be dedicated to conservation easements. This concept poses a win-win situation as developers receive open space credit for the conservation easements, the municipal governments receive open space passive recreation areas for the residents, and wildlife and ecological functioning are taken into account, along with human needs.

Randall Arendt recommends that local ordinances *require* a site analysis that delineates opportunities and constraints to both development and conservation. A vegetation inventory should also be conducted for all development applications (2007).

Arendt feels strongly that there should never be any development where the planners and developers have not actually walked the property and made notes of its existing features.

Freshwater Wetlands - Basin Structure and Edge Parameter

The visual preference research in this report examines preference for two freshwater wetland parameters; the structural and the terrestrial edge. A good source for information on this topic within this context is “Creating Wildlife Habitat with Native Florida Freshwater Wetland Plants” by Martin Main, et al.

The Structural Parameter

The first parameter deals with site grading. Structure in this instance means the slope of the pond bank *under the water level*, which dictates *if* aquatic vegetation will be able to grow there. Hence, the structure parameter is also the aquatic plant parameter. For example, a steep underwater slope will not support aquatic vegetation because the water becomes too deep too quickly. The emergent zone aquatic plants can only grow in up to a foot of water. A moderate underwater slope will give emergent plants a short, shallow ledge in which to anchor their roots. A gradual slope will support the most aquatic vegetation because the shallow area is wider. Changing the structure or slope is a matter of changing the design before the pond gets built. Therefore, this parameter is of most importance to developers and planners who should design gradual slopes of less than 4:1 (Clark, 2006).

There are 3 categories of slope in the scenes. They are steep, moderate, and gradual. In the scenes, the slope is implied by the visibility of aquatic vegetation one sees in the picture.

The Terrestrial Vegetation Parameter

The second parameter deals with a vegetated buffer around the pond. The terrestrial vegetation is composed of plants on the landward side of the water's edge. Shoreline vegetation is more a matter of maintenance than structure and therefore can be changed as desired. This parameter is of most concern to the professional who will design the landscape plan, the landscape contractor who will install it, and perhaps the homeowner's association who may be involved in overseeing maintenance. County agencies will be concerned with both parameters because more vegetation on the bank and in the water means better water quality.

There are 3 categories of shoreline vegetation in the scenes. They are manicured, moderate, and naturalized. Manicured means mowed grass to the waters edge.

Environmental Psychology

Rachel and Stephen Kaplan

Rachel and Stephen Kaplan, have designed and conducted numerous studies about the natural environment, people, and the relationship between them. In their book, *The Experience of Nature: a psychological perspective*, they examine visual factors that create either preference for a natural scene or an aversion to it (1995). From the research results, they have created theoretical frameworks describing participant's preferences for various natural environments. One key finding is that participants frequently preferred natural scenes over developed scenes.

The Kaplan's also categorized human psychological needs in relation to the natural environment. Two key needs in relation to nature are *understanding* and *exploration*. Through their research, the Kaplan's found 4 factors which could explain participants visual preference for a scene: *coherence*, *complexity*, *legibility* and *mystery*. Some of the internal questions people seem to be asking when they look at a photograph of a natural

scene are:

Coherence – “Is there a focal point to this scene? Are the patterns somewhat organized or does it look like a chaotic jumble?”

Complexity – “What is the content of this scene? How much is going on?”

Legibility – “Could I find my way or would I get lost?”

Mystery – “Does this scene promise some exploration, or can I see everything within it already?”

Another important finding is that, “Preference is also consistently low in settings that are blocked [...] The sense of lurking danger, given the obstructed view, would also make the setting seem less safe and less comfortable (1995, 68-69).” The Kaplan’s studies suggest that participants equate heavy undergrowth with the threat of physical danger. This finding is of concern for those wanting to naturalize stormwater retention ponds in residential subdivisions. In relation to this study, the Kaplan’s research would seem to indicate that people might prefer naturalized edge treatments for stormwater retention ponds, as long as their views into it are not obstructed entirely and if there is a cleared path around it.

Also important to this study is the Kaplan’s findings regarding people and “nearby nature.” “People with access to nearby-natural settings have been found to be healthier than other individuals. The longer-term, indirect impacts also include increased levels of satisfaction with one’s home, one’s job, and with life in general (1995, 173).” By nearby nature they mean any kind of nature that might include yards, ballfields, and urban parks, as well as patches of wild areas that are easily accessible to residents.

Joan Iverson Nassauer, FASLA

Joan Iverson Nassauer’s research focuses on the intersection between landscape perception and landscape ecology. One focus is experimenting with urban landscape

designs that place unfamiliar ecosystems in a familiar cultural context. (Landscape Journal, 1995).

“Once we begin talking about the landscapes where we live everyday – about specific changes in the way the landscape will look even for the purposes of improving ecological quality – we encounter fear, anger, rejection (1995). “

Nassauer’s article presents the problem that many indigenous ecosystems and wildlife habitats violate expectations of *neatness* and *maintenance* in cultural settings. Nassauer’s theory maintains that landscape architects can use traditional landscape preferences as a frame to support the public’s acceptance of ecologically functional content. The implied assumption is that as people become familiar and comfortable with the “messy” look of a true, ecologically functional system, they will no longer need the traditional framework – or perhaps, not as much of it. Nassauer has constructed a cultural context called, ‘cues to care (1995, 167).’ ‘Cues to Care’ are basically visual signals to others that someone is tending the place. Examples of these ‘cues’ from Nassauer’s research are, mowed lawns, trimmed shrubs, flowering plants and trees, to name a few. The visual preference survey in this study has followed the technique that Nassauer used, which was to take a residential landscape setting and apply varying levels of naturalization to it through manipulation of representative photographs. The context in this report is suburban stormwater retention ponds, whereas in Nassauer’s it was a suburban front yard and a variety of agricultural settings. The context of the sites and vegetation are different as well, Nassauer’s was a Midwestern prairie ecosystem, whereas in this study, the context is within a north central Florida Upland Mesic Hardwood Forest and Cypress Domes.

Local Case Studies

The following case studies examine 3 local contemporary projects. Case Study

A is University of Florida pilot project and teaching lab for stormwater wetlands. Case Study B is an example of a central stormwater wetland emphasizing passive recreational activities and pedestrian linkage to an adjacent county park. Case Study C is an example of several smaller wetlands which are both natural and created, emphasizing wildlife corridors and linkages. Creating stormwater wetlands that function as natural wetlands and provide passive recreation for the residents is a change that coincides with the recent amendments to the Alachua County Unified Land Development Code. Chapter 407, Article 5, provides for Open Space Credit when stormwater facilities are, “designed to protect and enhance natural resources, promote pedestrian connectivity and enhance recreational opportunities (2005a).” (see Appendix B). Some of the key requirements as outlined in §407.56 are:

- Staged elevations within the treatment volume of a basin (forebay, islands, berms, channels – all to maximize the contact of stormwater with surfaces of basin)
- Irregular shorelines – to increase length and maximum surface contact.
- Perimeter trees - minimum one tree per every 35 linear feet.
- Basin bottom trees at an average of 35 feet on center.
- Perimeter pedestrian path of 12 foot width, maintained and linked to other pedestrian open space paths.
- Maintained to be kept free (no more than 5% cover) by nonnative invasive plants.

Case Study A – Stormwater Ecological Enhancement Project (SEEP)

SEEP is a pilot project by Professor Mark Clark and the Wetlands Club at the University of Florida. It is located just southeast of the parking garage at the Phillips Center for Performing Arts in the University of Florida Natural Area Teaching Lab (NATL). The following information comes directly from the SEEP brochure available at the kiosk on the east side entry to the Natural Area Teaching Lab: The objective of SEEP was to “develop a management plan to enhance species diversity of a stormwater

retention basin [...] while optimizing the basin's use for research and education. The 3-acre retention pond is at the low point of a 40-acre watershed. The majority of the basin was constructed in 1988 with additional storage created in 1990. Structures within this watershed contributing significant runoff to the basin include the Center for Performing Arts, the Entomology and Nematology buildings, the Park and Ride commuter lot and roadways between and around these buildings. The total storage of the basin to offset the increased runoff generated by these impervious surfaces is 478,000 cubic feet. As originally designed, the bottom of the basin was essentially flat, with uniform slopes on the north, south and east sides. To the west of the basin the slope is low and quickly grades into the preexisting depression of the area. *Because the basin was almost uniform in elevation, the vegetation was dominated by cattails* [emphasis mine]. [...] The primary goal of SEEP was to increase the diversity of flooding depths and frequency of flooding since these are the primary factors regulating vegetative composition in a wetland. To do this, two depressions, one 4-feet, the other 5-feet deep, were dug at the southeastern end of the pond providing a deep open-water habitat. At the north end a low berm was constructed to temporarily impound 80 percent of the entering stormwater. This forebay provides the first phase of treatment and has been planted with species known to take up heavy metals and remove nutrients. Water from the forebay is slowly released, first flowing through an area planted to resemble a bottomland hardwood swamp, then through a shallow freshwater marsh before entering the deep-water ponds. At the southeastern end of the pond another small berm was built to divert stormwater away from the ponds, increasing treatment time. At the end of this berm is a knoll planted with trees to provide

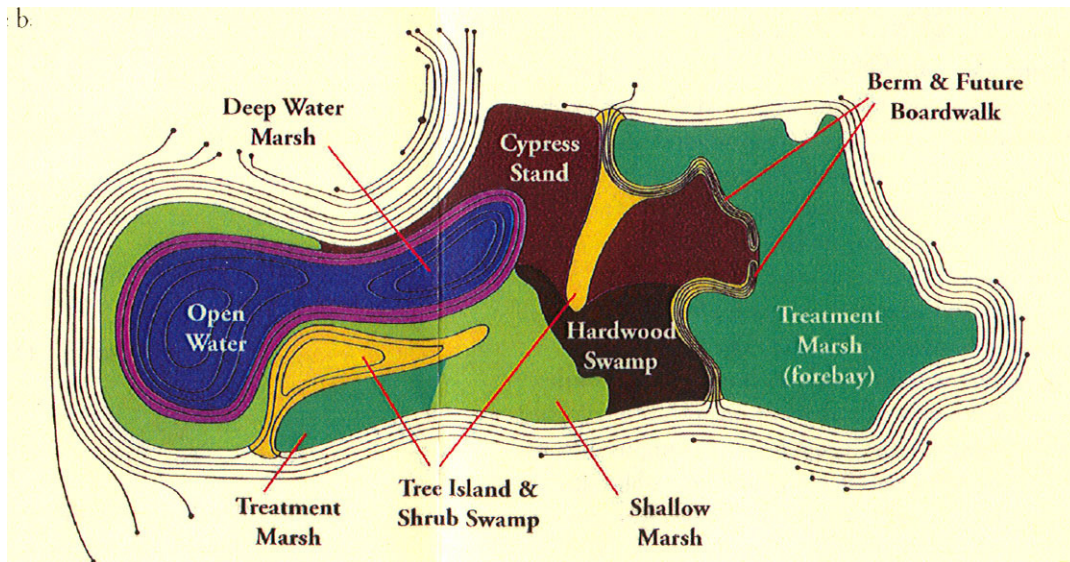


Figure 2-1 SEEP Retention Pond. Source: Wetlands Club Brochure (Clark and Otto, et al)

nesting or roosting for birds. The basin has been planted with species that are found in the natural wetlands of north central Florida. Boardwalks are planned to allow access by classes and the public to portions of the main wetland types (Clark and Otto, et al).”

Benefits from the SEEP project:

- Plant diversity through topographic diversity.
- Wildlife habitat diversity through plant diversity.
- Aesthetics – not a simple rectangular basin with lawn grass to pond edge.
- Improved water quality through use of a forebay, plants known to have high treatment potential, creation of a longer flow design to maximize water contact with soil and vegetation.
- Research – optimizing performance.
- Education – a public education service into the benefits of wetlands.

Case Study B – Turnberry Lake: stormwater wetland as a recreational site

In the preliminary steps of my research, I inquired at the Alachua County Growth Management office if there were any examples of new residential projects where the developer was creating a stormwater wetland as a site amenity and was also selling the adjacent lots for a premium. I was directed to the County Environmental Protection Department to speak with senior environmental planners Michael Drummond and Stephen Hofstetter. To their knowledge there was only one example that fit the criteria. This case is Turnberry Lake in Jonesville, Alachua County.

The site for the subdivision was approximately 169 acres in Alachua County located at the 2700 block of NW 143rd Street, just northwest of Gainesville in a previously rural area called Jonesville. Initially the property was owned by the Institute of Food and Agricultural Sciences (IFAS) as part of its agricultural complex who then sold it to Hawley Realty. Hawley Realty approached Causseaux & Ellington, Inc. for the site planning of a single-family residential subdivision to be developed in three phases. At the time of the development review the existing zoning was R-1a (single family residential; 1 to 4 units/acre and R-1aa (single family residential; 1 to 3 units/acre). The proposed number of units/lots was 171, making it a low density residential application. Following is a pre-development aerial of the site.



Figure 2-2 - Pre-development Turnberry Lake site. Source: Dedenbach, G. 2006.

The actual site is mainly the light colored central area and the wood and field area bordering the long right side of the sandy area. The property was basically flat and virtually featureless with the exception of two sinkholes within the central wooded rectangle. The road that follows the curve of the sandy area on the lower left border of the sandy field is the future NW 32nd Avenue which will lead to the future Jonesville County Park. Below is a photo of the central stormwater ‘lake’ area when I visited on July 11, 2006.



Figure 2-3 Turnberry Lake, July, 2006. Source: K. Heiss

The houses frame the central stormwater detention pond whose edges are landscaped much like a natural wetland. The mature stand of trees on the right side of the picture is a manmade peninsula that contains the two sinkholes. Gerry Dedenbach, AICP, Causseaux & Ellington, Inc., Director of Planning and GIS Services, was the site designer for the project. He is also a University of Florida, Landscape Architecture graduate. I met with him on July 12, 2006, regarding the Turnberry project, of which I had done a site visit the day before. Mr. Dedenbach showed me the illustrative master plan (Figure 2-4) and described some of the key design constraints and opportunities at the site.

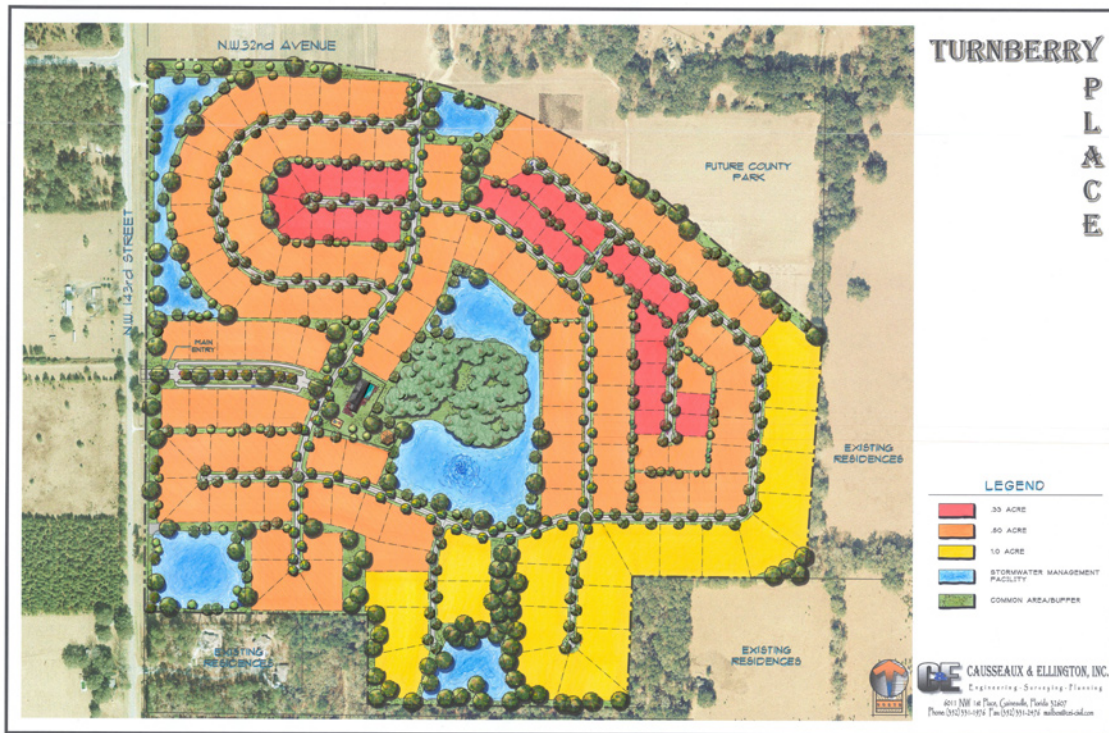


Figure 2-4 - Turnberry Place Master Plan. Source: Dedenbach, G. 2006.

Mr. Dedenbach stated that the decision to make a large central water feature came from the constraint that the site was flat and virtually devoid of intrinsic landscape features. Additionally, because water is such a visually preferred amenity it was decided to have one large central stormwater basin containing water rather than many smaller dry basins scattered throughout the development. The size and shape of the basin was first a function of flood control and detention requirements to offset the new impervious surface created by the development. The basin size requirement for flood control was the local Water Management District (WMD) design storm of 10 and 100 year events. The ultimate basin size was 10-acres, located in the very center of the development. The central area was already the low spot on the site with the exception of one other area toward the southwest corner. The basin you see pictured as wet in the south-central portion of the development serves as the outlet for the central ‘lake.’ While the southwest basin was designed as a dry basin, it occasionally retains water which is one of the

problems with dry basins. The earth was graded around the wooded sinkholes which creates a picturesque peninsula that juts into the lake. Mr. Dedenbach laid out the roads to either terminate with a view of the lake or to pass by the north and south borders. The lots along the stormwater wetland have been sold at premiums compared to many of the homes without a direct view of the water feature. The future Jonesville Park will be built on the adjacent northeastern corner of the map where the map is labeled Alachua County Park. Below is a Master Plan of the proposed park.



Figure 2-5 - Jonesville Park Master Plan. Source: Alachua County, www.co.alachua.fl.us/government/depts/comm/pressreleases.aspx?pr_id=3791. 8/21/2006.

The newly planned adjacent Jonesville Park is an illustration of the trend toward multi-use stormwater park and linking recreation areas. Now it will be possible for residents of Turnberry Lake to paddle a boat in the lake, which they can take out from the

clubhouse on the western shore. They can also walk or jog the mowed grass path around the 'lake' and continue to jog from their lake to the county park.

Case Study C – Sorrento: wetland linkages and wildlife corridors

Sorrento is a single-family residential subdivision created under the Planned Development (PD) District which is a zoning district in the City of Gainesville that, “provides a method for landowners or developers to submit unique proposals which are not provided for or allowed in the zoning districts otherwise established by this chapter (2006a).” The engineer and site planner for the project was Robert Walpole, P.E., Vice President of Engineering, at Causseaux & Ellington, Inc. The allowable density was 4 units/acre. In this case the PD was used to allow flexibility in the lot sizes and shapes to preserve open space. The flexibility of a PD means that the lots can be smaller while retaining the same overall density. This compact development design reduces the need for pavement and roadways which in turn decreases the amount of stormwater runoff. The existing site had several natural but degraded wetlands and a wetland along the western boundary that was part of a pre-existing conservation easement. The lowest elevation is on the southeast corner of the site and is the headwaters of the Hogtown Creek. The design had to allow for the number of dwelling units while respecting the on-site wetlands. Historically, the on-site wetlands had been connected, but over the years had become hydraulically isolated through ditching and draining. Tammy Garcia, Senior Biologist at Creative Environmental Solutions (CES), worked in cooperation with Robert Walpole on meeting the code requirements for stormwater wetland planting and wildlife habitat. She stated that “the development was designed so that the wetlands, buffers, and stormwater areas were contiguous, with the hopes of keeping/providing wildlife habitat connectivity on the site post development (2007).” Additionally, her team planted portions of the buffers which were disturbed by grading. Mr. Walpole’s design goal was

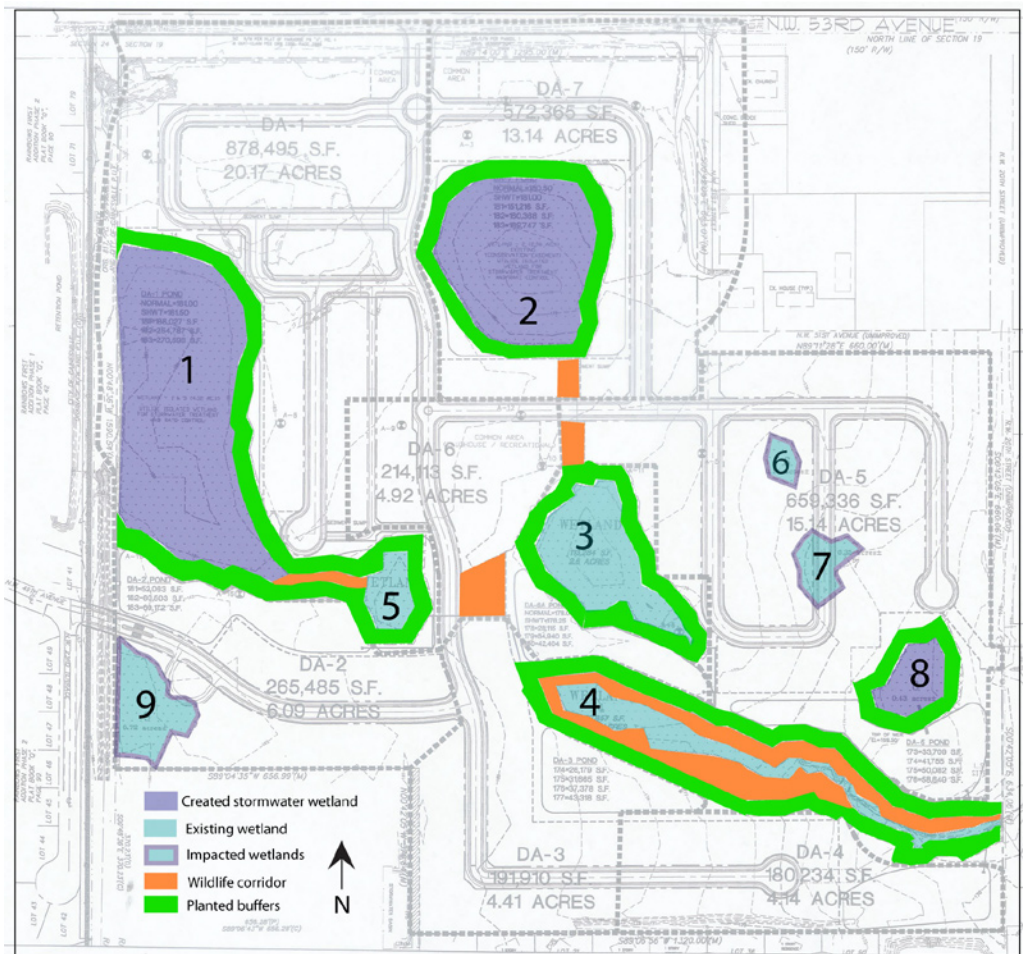


Figure 2-6 - Post Development Drainage Plan. Source: Walpole, R. 2007. Color Shading and Legend: Heiss, K.

to reconnect the wetland system. To do this he designed and excavated a hydrologic connection between wetlands 1 and 5 which equalized the water levels. For wetland 4 he designed a series of check dams to slow the runoff coming off the relatively steep side slopes and to create mini-habitats in the storage pools below. Stormwater wetland 1, which was historically a natural wetland along the western property line, has undergone restoration by the removal of a long ditch that drained it. The upland pine forest that had grown there over the years gradually died and has been replanted with native wetland species. The wetlands on Figure 2.6 above labeled 1, 2, and 8 are created stormwater

wetlands, the others are the existing natural wetlands. The Water Management District permit in this case was the “wetlands to stormwater permit” which requires the design to control the level of stormwater on top of the wetland hydroperiod. Weirs control the seasonal low and seasonal high points in the stormwater wetlands which then flow to the natural wetlands. Stormwater wetland 2 has sediment traps in all 4 corners to trap oil and trash from the first flush of each storm. The created stormwater wetlands of Sorrento are not only functioning well from an ecological standpoint but are designed as site amenities as well. The houses that abut these facilities are sold as premium lots.

Chapter 3 - Materials and Methods



Scope of Research

The survey seeks to discover participant's visual preference for a range of stormwater pond edge treatments from the most conventional, manicured retention pond to the most naturalized stormwater wetland. Patterns of preference will be examined among the different demographic groups as well. The context within which the study is set is primarily middle class, suburban, single-family residential. Two research parameters were chosen for scene selection; 1) structure, and 2) terrestrial vegetation.

Survey Methodology

Overview

The Visual Preference Survey is the research instrument chosen to answer the

question, “what are people’s preferences for various stormwater pond edge treatments?”

And, “what percentage of their homes price would they be willing to pay for their favorite view?”

Briefly, the parts of the survey are as follows:

- 1 page of demographic questions
- 27 scenes for rating
- 3 Views for ranking; and 2 demographic questions regarding home price and percent of home price participant would be willing to pay for favorite view.
- 1 Intervention regarding the benefits of aquatic and terrestrial vegetation to; either A) wading birds, or B) wildlife.

Following is a discussion of each part of the survey as listed above, what questions were hoped to be answered and their relevance to the larger research question.

The Initial Demographic Questions

The purpose of the first page of demographic questions was to determine participant groups for use later in the analysis. The distinctions that were sought were; occupation, educational level, housing type, ownership, setting (urban, suburban or rural), outdoor activities both passive and active, importance of access to natural area (on a scale of 1 – 5), and membership in a conservation organization.

The Twenty Seven Visual Preference Scenes

The purpose of having the participants rate 27 scenes was to determine what characteristics of edge treatment they preferred as opposed to those edge treatments which they did not like. Some rules had to be established for selecting scenes so that they were similar enough that participants wouldn’t be rating scenes based on irrelevant characteristics like favorite architectural styles or specimen trees. For instance, all scenes had to contain a few, middle class, single-family homes with a view of a retention pond. The same three houses were used over and over again through manipulation using

Adobe Photoshop. Secondly, the weather was similar on each day that the photographs were taken, sunny with perhaps a few clouds at most. Varied distances of homes to the waters edge were allowed since this could be a relevant factor influencing preference. Additionally, only five different ponds were used. The differences in pond edge treatment were created using Adobe Photoshop.

The following text describes in detail how the criteria for the scenes were developed.

The Structural Parameter

The first parameter deals with site grading. Structure in this instance means the slope of the pond bank *under the water level*, which dictates *if* aquatic vegetation will be able to grow there. This parameter was discussed in detail in Chapter 2.

There are 3 categories of slope in the scenes. They are steep, moderate, and gradual. In the scenes, the slope is implied by the visibility of aquatic vegetation one sees in the picture.

The Terrestrial Vegetation Parameter

The second parameter deals with a vegetated buffer around the pond. The terrestrial vegetation is composed of plants on the landward side of the water's edge. This parameter was addressed in detail in Chapter 2.

There are 3 categories of shoreline vegetation in the scenes. They are manicured, moderate, and naturalized. Manicured means mowed turf grass to the waters edge.

Criteria Matrix

Table 3-1 is a matrix of scene selection criteria as relates to the structure parameter and the terrestrial vegetation parameter.

Table 3-1 Scene Criteria Matrix

Pond Slope	Terrestrial Vegetation Treatment at Pond's Edge		
	Manicured	Moderate	Naturalized
Steep (no aquatic plants)	Category A mowed turf to waters edge	Category B some terrestrial fringe	Category C naturalized bank, no turf
Moderate (some aquatic plants)	Category D some aquatic plants, no shoreline fringe just mowed turf	Category E some aquatic plants & shoreline fringe, then mowed turf	Category F some aquatic plants then a totally naturalized bank, no turf
Gradual (most aquatic plants, aka emergent zone)	Category G a few floating leaved aquatics, wide emergent zone, mowed turf	Category H more floating leaved aquatics, wide emergent zone, some shoreline fringe	Category I most floating leaved aquatics, wide emergent zone, totally naturalized bank, no turf

The following are the actual scenes selected for use in their representative categories.

The Original Categories

There are three examples of each category in the survey. The nine categories (A – I) are as follows:

Category A represents a deeply dug, steeply sloped pond with no floating leaved aquatic plants, no emergent zone aquatic plants, and mowed turf to the ponds edge. It is the most manicured of all 9 categories.



Category B represents a deeply dug, steeply sloped pond with some shoreline plants and some turf. It is considered a moderate type treatment – in-between manicured and natural.



Category C represents a deeply dug, steeply sloped pond that has no floating leaved aquatics, no emergent zone, and a highly naturalized bank. No turf grass is visible.



Category D represents a moderately sloped pond with no floating leaved aquatic plants, some emergent zone aquatic plants and a manicured bank – it is considered on the manicured side of the moderate category.



Category E represents a moderately sloped pond with no floating leaved aquatic

plants, some emergent aquatic plants and some shoreline planting. Mowed turf is still visible in each of the 3 scenes. Category E is right in the middle of the moderate category.



Category F represents a moderately sloped pond with no floating leaved aquatic plants, some emergent zone aquatic plants and completely naturalized banks.



Category G represents a gradual sloping pond that has a wide and shallow perimeter ledge. Category G has a few floating leaved aquatic plants, a wide emergent zone and a manicured terrestrial edge.



Category H represents a gradual pond slope with more floating leaved aquatic plants, a wide emergent zone and some shoreline plantings. Some mowed turf grass is

still visible.



Category I represents a gradual pond slope that contains the most floating-leaved aquatics, a wide emergent zone, naturalized banks and no mowed turf grass. It is the most naturalized of all 9 categories.



Operational Definitions for Scene Criteria

Manicured – regularly mowed, fertilized, and irrigated turf grass.

Naturalized bank or shoreline fringe – the buffer of terrestrial plants between the maintained turf grass and the littoral zone. Composed of native plants that can take occasional flooding.

Emergent zone or littoral zone – the shallow depth aquatic plants that grow in water no deeper than a foot. Composed of plants that can survive constant inundation at a water level of no more than one foot.

Pond Edge – where land meets permanent water level.

Floating Leaved Aquatic Plants – composed of native, freshwater aquatic plants that thrive in water depths of approximately 2 feet, such as water lilies, or even greater

depths such as Spatterdock.

Moderate width: for the purposes here approximately 10 feet.

Finally, the 27 scenes from the 9 categories were randomly ordered in the survey with no indication of category or criteria for selection and participants were asked to rate each scene on a scale of 1 – 5, where 1 = they do “not [like it] at all” to 5 = they “like it very much.”

Ranking Favorite View A, B, or C

After the 27 scenes, there were 3 views selected for ranking in order of most favorite (1) to least favorite (3). This was the only battery of questions where participants were asked to *rank* rather than rate. It is important to note the difference between these procedures. In ranking you are forcing people to make choices based on what is offered. In rating, participants don’t have to like any of the scenes, they could easily give them all a rating of 1, for instance. The purpose of ranking the following three scenes was to have another way of comparing the response data.

View A is from Category C or a naturalized category. View B is from Category B or a moderate category. View C is from Category A or the most manicured category.



Figure 3-1 Favorite View Scenes (from left: View A, B, and C)

Following the 3 views were two demographic questions. One asked the participants the price of their current home, and the second asked what percentage of their

homes price they would be willing to pay for their favorite view (from choice A, B, or C above). The purpose of these questions was to determine how important they considered their favorite view based on their willingness to pay for it.

The Intervention

The purpose of this portion of the survey was to determine if the participant's ratings would be influenced by reading a half-page narrative whose purpose was to persuade them of the benefits of: 1) Aquatic habitat for wading birds, and 2) Terrestrial vegetation for wildlife.

Intervention A

Approximately half of the sample received Intervention A. The participants were asked to read the following text before rating 4 scenes:

Why shallow-sloping retention ponds are important for wading birds:

Florida is known for its many beautiful wading birds such as egrets, herons, ibises, and cranes. Our wading birds forage for food in water that is no deeper than a foot or two, for snails, frogs or small fish. Some of the plants that grow in the shallow water are; Pickerel Weed, Cardinal Flower, Duck Potato, and Crinum Lily. These plants all have attractive flowers and foliage and do not grow high enough to block views. The scarlet flowers of the Cardinal Flower plant provide nectar for butterflies and hummingbirds as well.

Unfortunately, most retention ponds are dug so that their banks drop steeply to a great depth to provide the largest amount of water storage for the least amount of land use. Sadly, this approach deprives wading birds of a place to forage for food, and water-loving plants a place to grow. Shallower edges teeming with plant life are more like natural ponds and lakes.

If retention ponds were designed to be shallow near their edges they would be great places for our wading birds to find food and for butterflies and hummingbirds to find nectar. The current home building boom in our State makes habitat loss the number one threat to wildlife. This small change in the design of retention ponds would improve water quality because plants absorb pollutants and prevent soil

erosion.

Intervention B

Approximately half of the sample received Intervention B. The participants were asked to read the following text before rating 4 scenes:

Where will the wildlife live?

We all need food, shelter, clean air, and clean water to survive, and so do our fellow creatures. Acres of suburban lawns do not provide shelter or food for most wildlife. Mowed turf grass simply isn't tall enough to provide shelter and is typically cut before it produces seeds. Songbirds need shrubby trees and bushes that provide lots of hiding places and produce berries, such as holly trees, wax myrtles, and beautyberry. The many beautiful butterflies and hummingbirds you see rely on the flowers of plants that are typically 2 to 3 feet tall for nectar.

Besides creating large, wildlife-unfriendly lawns, we send precious rain water that runs off streets and rooftops underground into drains where wildlife can't get to it. Often, rain water runoff is held in retention ponds near our homes. Imagine if the fringes and shallow depths of retention ponds were planted with flowering, water-loving plants instead of mowed grass right to the waters edge. Imagine the food, water and shelter you would be creating for wildlife in your community. Water-loving plants also absorb many of the pollutants in the water.

Plants that stick out of the water a few feet also make great places for snails to feed. Once wading birds know that there are snails to eat, they will come to eat too. Imagine seeing a limpkin or egret foraging in a nearby pond. Having a variety of plants of different heights creates shelter and range of food sources for our wildlife.

Here are the four scenes that they then rated on a scale of 1 – 5, where 1 = they do “not [like it] at all” and 5 = they “like it very much”.

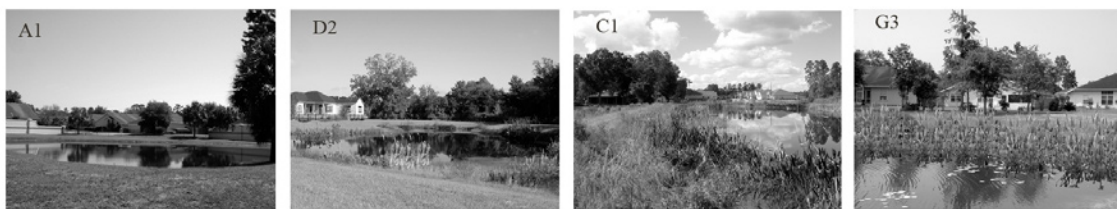


Figure 3-2 - The Four Intervention A and B Scenes

As you can see from Figure 3-2 reading left to right, the first scene is from Category A which is a highly manicured treatment, with neither shoreline fringe nor aquatic plants. Scene two is from Category D which is a moderate treatment that has some aquatic plants. Scene three is from Category C which is similar to Category F and I which are highly naturalized shoreline treatments with emergent zones. Scene four is from Category G which is also a naturalized treatment and includes an aquatic plant emergent zone.

This portion of the survey was quasi-experimental because the sample was tested “before” and “after” a treatment. The independent variable was the reading and the dependent variable was their reaction or preference rating. Participants had already rated these four scenes as part of the 27 scene ratings. The success of the Interventions was determined using *T*-tests comparing ratings for each of the four scenes to the mean ratings for their categories. For example, Scene 1 was compared to the mean ratings for Category A. Scene 2 was compared to the mean ratings for Category D. Scene 3 was compared to the mean ratings for Categories C. Scene 4 was compared to the mean ratings of Category G.

Statistical Analysis Methods

Overview

Principle Axis Factor Analysis with Varimax rotation was used to condense and structure the 27 scenes into factor groups based on the participant’s ratings. Cronbach’s alpha was used to measure the reliability of the factor analysis to determine if the scenes really belonged to the factor group. An alpha of $>.70$ is considered a good reliability result. As you will see in the next chapter, the alpha measures for the factor groups in this study were all $>.80$. ANOVA was used to compare subsets of people to see if they had different preferences for categories. Two types of ANOVA tests were used; 1) the

Repeated Measure of Analysis of Variance and, 2) the One-Way Analysis of Variance.

T-tests were used to determine significance when there were only 2 comparison groups.

Tukey HSD was the type of Post Hoc test of significance when there were 3 or more groups being compared. The measure of significance for the data is $p < .05$.

Rules Used for Belonging to Factor Groups

1) In order for a scene to belong to a factor group it had to have a factor loading of .40 or higher.

2) If a scene had a factor loading of .40 or greater on a primary factor and a loading of .45 or greater on any other factor it was discarded because it was a double loader.

3) In order for a factor group to exist it had to have a minimum of 2 scenes.

Rules Used for Number of Factor Groups

1) Eigen values greater than 1

2) Scree plot analysis

3) Parallel analysis

Sample Characteristics

The population of interest was local residents of Gainesville, Florida - particularly homeowners in newer, middle class, single-family home subdivisions. Because Gainesville is home to University of Florida, this is not a typical cross-section of America being that it is a university town and therefore may be somewhat more progressive than other areas. The results could however, be generalized to similar contexts. In order to ensure the accuracy of the data, the largest possible number of participants was desired.

The Survey Package

The ten-page survey package (see Appendix A) included the following items in the order listed:

- 1-page cover letter
- 1-page informed consent to survey (UF IRB Protocol #: 2006-U-0823)
- 1-page of demographic questions
- 5-pages of scenes to be rated (a total of 27 scenes)
- 1-page of 3 separate scenes to be ranked along with 2 demographic questions
- 1-page intervention ($\frac{1}{2}$ the sample got Intervention A; $\frac{1}{2}$ the sample got Intervention B).
- A self-addressed, stamped envelope for the participant to return the survey.

Survey Distribution

The survey was distributed in 3 residential contexts; urban, suburban, and rural, in and around the city of Gainesville, Florida which is home to the University of Florida. The method of distribution was to anonymously place the survey package on the porch near the door, with the cover letter facing up.

Response Rate

Between November 10, 2006 and January 21, 2007 a total of 513 surveys were hand distributed. The total received by the due date of January 30, 2007 was 204. $204 \text{ surveys received} / 513 \text{ distributed} = .397$ or approximately a 40% response rate.

The next chapter will examine the results of the statistical analysis and discuss significant results among demographic groups.

Chapter 4 - Results and Discussion



The goal of this chapter is to formulate planning guidelines for Chapter 5, based on the survey results. In order to achieve this goal the results of the statistical analysis will be presented and discussed. In order to discuss the responses it is best to know something about the participants. Therefore, the first part of this chapter will look at the results of the demographic questions.

Results for Population Demographics

Frequency tables were used to analyze the demographic questions. Table 4.1 illustrates that while participants exhibited a range of educational levels, the category with the most participants was the *Masters Degree*.

Table 4-1 Educational Level Results

Educational Level	Frequency	Percent
High school	28	13.7
Associate	15	7.4
Bachelor	57	27.9
Master	60	29.4
Doctorate	37	18.1

The following table shows that the majority of participants *live in single family homes*.

Table 4-2 Housing Type Results

Housing Type	Frequency	Percent
Single family	156	76.5
Apartment	16	7.8
Condominium	14	6.9
Townhouse	16	7.8

The majority of the participants *are homeowners*.

Table 4-3 Ownership Results

Ownership	Frequency	Percent
Rent	34	16.7
Own	168	82.4

The price range for homes was very large, so it was grouped into thirds for easier comparison:

Table 4-4 Home Price Results

Home Price Results	No. of Participants in that Range
\$25,000 - \$143,000	44
\$147,000 - \$200,000	48
\$204,000 - \$845,000	43

The majority of participants *live in the suburbs*.

Table 4-5 Context Results

Setting	Frequency	Percent
Urban	72	35.3
Suburban	119	58.3
Rural	9	4.4

The majority of participants rated ‘importance of access to natural areas’ as *important to very important*.

Table 4-6 Importance of Access to Natural Areas Results

Importance of access to a natural area	Frequency	Percent
Not at all	9	4.4
A little	15	7.4
Somewhat	47	23.0
Important	56	27.5
Very important	76	37.3

The majority of participants *were not members* of any nature conservation organizations.

Table 4-7 Nature Conservation Group Membership Results

Nature conservation membership	Frequency	Percent
No	147	72.1
Yes	57	27.9

Results of the Principal Axis Factor Analysis

Factor 1: Natural - Wide Shoreline Fringe and Littoral Zone

This factor group is characterized by scenes where the vegetation is most abundant both at the shoreline fringe and within the littoral zone. Many of the scenes also have deep water aquatic plants such as Water Lilies and Spatterdock.

Scene	Factor Loading	Alpha	Mean
7	.901	.94	2.51
1	.813		
21	.755		
27	.755		
24	.737		
4	.713		
26	.697		
22	.670		
20	.655		
3	.592		



Scene 7; Category E1



Scene 1; Category F1



Scene 21; Category C3



Scene 27; Category I1



Scene 24; Category I2



Scene 4; Category F2



Scene 26; Category C2



Scene 22; Category G3



Scene 20; Category H2



Scene 3; Category C1

Factor 2: Moderate Width Shoreline Fringe and Littoral Zone

This factor group is characterized by a less profusely vegetated shoreline fringe and a moderately wide emergent zone. When all participant ratings were averaged together, this was the most preferred factor group with Scene 6 being the most preferred scene in the survey.

Scene	Factor Loading	Alpha	Mean
9	.768	.86	3.46
14	.764		
18	.714		
19	.602		
6	.580		
12	.516		
17	.443		



Scene 9; Category D3



Scene 14; Category H3



Scene 18; Category B3



Scene 19; Category D2



Scene 6; Category F3



Scene 12; Category G2



Scene 17; Category E2

Factor 3: Manicured Lawn - Little to No Shoreline Fringe or Littoral Zone

This factor group is characterized by scenes that are predominately manicured lawn to pond edge. There is little to no shoreline fringe or littoral zone.

Scene	Factor Loading	Alpha	Mean
11	.857	.90	2.77
16	.823		
10	.745		
2	.730		
23	.630		



Scene 11; Category A2



Scene 16; Category A3



Scene 10; Category D1



Scene 2; Category A1



Scene 23; Category B1

All of the scenes contain sky, terrain, water, trees, and houses. The main distinction is how both the terrestrial edge and the aquatic edge of the pond are vegetated. The factor groups resulting from the analysis are telling us how the participants group or identify

the categories. Specifically, the participant's preference ratings created three distinct categories. Of these three groups, it was determined that Factor 1 represents scenes that are the most naturalized, Factor 2 represents scenes that are in-between naturalized and manicured or what will be called moderate in this study. Factor 3 represents scenes that are highly manicured. This information is important because it shows that the participants classify scenes based on experience and feelings, about a range of landscape treatments.

The factor group reliability test results are surprisingly high for such a small number of test items. The resulting alpha measures are well above .70, which indicates that the participant's are clear or *internally consistent* about how they feel about each group.

Overall, Factor 2 (moderate) is the most preferred group, with an average rating of 3.43. Scene 6; Category F3 is the most frequently preferred scene in the survey, and also belongs to the moderate factor group.

Table 4-8 Average Preference Rating for the 3 Factor Groups

Factor Group	Mean Pref.
1 - naturalized	2.51
2 - moderate	3.46
3 - manicured	2.77

Test results indicate that participants have *significantly more* preference for Factor 2 (moderate) than for Factors 1 (naturalized) and 3 (manicured). However, the difference in preference between naturalized and manicured is *not* significant.

Table 4-9 Significant Preference for Factor Group 2

Factor Group	Compared to	Mean difference	Std. Error	Significance level
1 - naturalized	2 - moderate	-.9544*	.126	.000
	3 - manicured	-.2510	.140	.199
2 - moderate	1 - naturalized	.9544*	.126	.000
	3 - manicured	.7034	.150	.000
3 - manicured	1 - naturalized	.2510	.140	.199
	2 - moderate	-.7034	.150	.000

The graph below illustrates that Factor 2 (moderate) is significantly preferred over the other two types. Factor 3 (manicured) is significantly less preferred than moderate, but not significantly more than Factor 1 (naturalized). Naturalized is significantly less preferred than moderate, but not significantly less preferred than manicured.

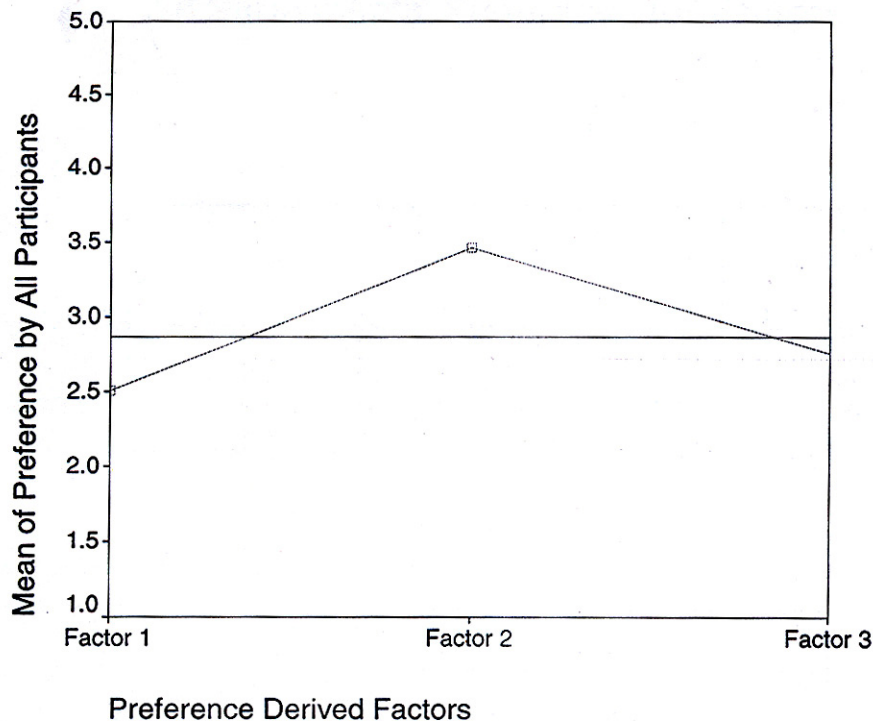


Figure 4-1 - Overall Preference for Factor Groups

What distinctive features are there in the moderate (Factor 2) scenes, particularly

Scene 6 (Category F3)? (see figure 4-2). The distance across the wetland may be a characteristic that influences preference. The scene is framed by mature trees and a residence in the distance. Based on their research, the Kaplan's stated that, "In terms of preferences, the spatial configuration that consistently generates favorable response involves areas that are open, yet defined (1995, 48)." Compare Scene F3 with Scene A1 from the manicured category. It too has background trees and a residence in the distance, but the foreground has nothing but mowed turf grass. This manicured scene was not as highly favored possibly due to the lack of mystery about the scene. This result may be explained by the Kaplan's statement that, "If the need to explore is a pervasive human need, it is also reasonable that preferences would be greater where exploration is facilitated (1995, 52)." The scene on the right does not invite exploration because everything is out in the open. Another characteristic that may influence preference is the shape of the pond, Scene F3 has more edge – it moves in and out and is highly vegetated, whereas, in Scene A1 the pond edge is completely regular in shape and has no aquatic plants or shoreline fringe.



Figure 4-2 Category F (left) compared to Category A (right) Source: K. Heiss

Average Preference Rating for all Scenes

The following pages show in order, left to right, the favorite to least favorite scenes of the survey when all the participants ratings are averaged together.

The variables being studied are shoreline terrestrial vegetation and the emergent aquatic plant zone. The result of interest in this study, are what pond edge treatments will the participant's prefer.

The first four favorite scenes show moderate toward naturalized pond edge treatments as defined by the criteria in Chapter 3. The vegetation around the pond is quite natural in that it does not look manicured or trimmed. Additionally, it is not so dense and tall that preference ratings drop substantially as in the least 3 preferred scenes. The most preferred scene in the survey, has a completely naturalized bank with some emergent aquatic zone (Category F3). In the second favorite scene, there is some emergent aquatic zone, and a naturalized shoreline (Category D3). In the third favorite there is a considerable emergent aquatic zone, some floating-leaved aquatic plants, and a completely naturalized terrestrial edge (Category H3). Interestingly, the first 3 favorite scenes all have a naturalized shoreline treatment. All three also have an emergent aquatic plant zone, however the preference goes up as the emergent zone becomes narrower.

Other variables that may be influencing preference, but that were not the focus of this survey are; pond shape, distance of view across pond, presence of mature tree canopy, and distance of houses to pond. These variables in this context, would make for interesting future research.

Most Preferred to Least Preferred Scenes: The First Nine Favorites

Avg rating: 3.83



1 - Scene 6; Category F3

Avg rating: 3.74



2 - Scene 9; Category D3

Avg rating: 3.70



3 - Scene 14; Category H3

Avg rating: 3.58



4 - Scene 18; Category B3

Avg rating: 3.51



5 - Scene 5; Category H1

Avg rating: 3.15



6 - Scene 12; Category G2

Avg rating: 3.13



7 - Scene 17; Category E2

Avg rating: 3.12



8 - Scene 8; Category B2

Avg rating: 3.10



9 - Scene 19; Category D2

Most Preferred to Least Preferred Scenes: Ten through Eighteen

Avg rating: 3.04



10 - Scene 15; Category E3

Avg rating: 2.98



11 - Scene 13; Category I3

Avg rating: 2.98



12 - Scene 23; Category B1

Avg rating: 2.91



13 - Scene 10; Category D1

Avg rating: 2.88



14 - Scene 3; Category C1

Avg rating: 2.79



15 - Scene 25; Category G1

Avg rating: 2.71



16 - Scene 11; Category A2

Avg rating: 2.69



17 - Scene 2; Category A1

Avg rating: 2.64



18 - Scene 4; Category F2

Most Preferred to Least Preferred Scenes: Nineteen through Twenty-Seven

Avg rating: 2.62



19 - Scene 27; Category I1

Avg rating: 2.56



20 - Scene 24; Category I2

Avg rating: 2.55



21 - Scene 22; Category G3

Avg rating: 2.54



22 - Scene 20; Category H2

Avg rating: 2.54



23 - Scene 7; Category E1

Avg rating: 2.50



24 - Scene 16; Category A3

Avg rating: 2.49



25 - Scene 1; Category F1

Avg rating: 2.18



26 - Scene 21; Category C3

Avg rating: 2.07



27 - Scene 26; Category C2

What elements are specific to the least favorite group of scenes? The shoreline vegetation is tall and dense enough to constrict or block views of the water. These three scenes impart a feeling that one could not navigate the scene without difficulty or danger. Particularly in the last scene, one might feel disoriented and be unable to quickly find

ones way out because the vegetation is so dense. The Kaplan's found similar results in a visual preference survey, and stated that, "Heavy undergrowth was associated with the threat of physical danger (1995, 102)." Finally, the houses appear closer to the ponds in the least favorite scenes.

Shoreline plants low enough to be seen over are preferred. Turf, however, is not the most preferred shoreline treatment. A moderate, planted emergent aquatic zone is preferred as long as the pond is not so shallow or over-planted that it appears choked with vegetation.

Average Ratings for the Original Nine Categories in Order of Preference

In this section the original categories of A – I are shown in order of how participant's preferred them, from most preferred to least preferred. The following table illustrates again that the moderate treatment is the most preferred; followed by a moderate treatment (Category D) that leans toward naturalized (Category H), and then a moderate treatment that leans toward manicured (Category B).

Table 4-10 Average Preference Rating for Original 9 Categories

Category	Mean Preference Rating	Category	Mean Preference Rating
D	3.25	G	2.83
H	3.25	I	2.72
B	3.23	A	2.62
F	2.98	C	2.39
E	2.97		

For ease of cross-referencing, Table 4-11 below lists the original criteria matrix from Chapter 3:

Table 4-11 Criteria Matrix for Original 9 Categories

Pond slope as it influences aquatic vegetation in the emergent zone	Terrestrial shoreline vegetation (also called marginal plants)		
	Manicured	Moderate	Naturalized
Steep	A - no emergent zone, mowed turf to waters edge	B - no emergent zone, some marginal fringe	C - no emergent zone, completely naturalized bank.
Moderate	D - some emergent zone, no marginal plants just mowed turf.	E - some emergent zone, some marginal plant fringe, some mowed turf	F - some emergent zone and a totally naturalized bank, no turf.
Gradual	G - some floating-leaved aquatics, wide emergent zone, no shoreline fringe	H - more floating-leaved aquatics, wide emergent zone, some marginal fringe, some turf.	I - most floating-leaved aquatics, wide emergent zone, totally naturalized bank, no turf.

Table 4-11, shows that none of the top 3 preferred categories have mowed turf to waters edge. Category A is second to last. From these results it seems that many people prefer a moderate shoreline buffer that doesn't block views into or over the pond, and a moderate emergent aquatic plant zone, followed by a large open water area.

Results of Favorite View Rankings

The three views in this portion of the survey are View A (C1), View B (B1), and View C (A3). View A represents the naturalized category – there is no mowed turf grass in sight. View B represents a moderate category with some mowed turf grass followed by a moderate shoreline fringe. View C is the manicured view, it has no shoreline fringe only mowed turf grass to pond edge.

Views A-C were ranked rather than rated. It is important to note the difference between *ratings* and *rankings*. The twenty-seven scenes previously discussed were rated on a scale of 1 – 5. The results of *ratings* give a better idea of the *differences* in preference. In other words, rating creates a more nuanced measure for evaluation. Whereas, the Favorite Views, discussed below are *ranked*. Ranking *imposes* a decision on the participant and hence relative difference in preferences are not measured.

View from House A: 77 participants or 38% of the sample prefer this view.



View from House B: 75 participants or 37% of the sample prefer this view.



View from House C: 45 participants or 22% of the sample prefer this view. What is important to note here is that *slightly over half of this group still prefers the moderate*

shoreline fringe of View B.



The results show that there is almost an equal market for all three categories, natural, moderate, and manicured; with slightly more for the natural and moderate pond edge treatments. This finding coincides with the research conducted by the Kaplan's as supported by the following statement, "For some, nature is favored if it is groomed, orderly, and with indication of human-sign. For others, nature that appears unmanaged and wild is the most preferred. To label only one end of such a suggested continuum as "nature" would undermine the strong positive feelings common to most of these groups with respect to the natural environment (1995, 105)."

Next Analysis of Variance (One-way ANOVA) was used to examine patterns between Favorite View and preference for each of the three factor groups. The graph below illustrates the results for those who ranked View A as their favorite.

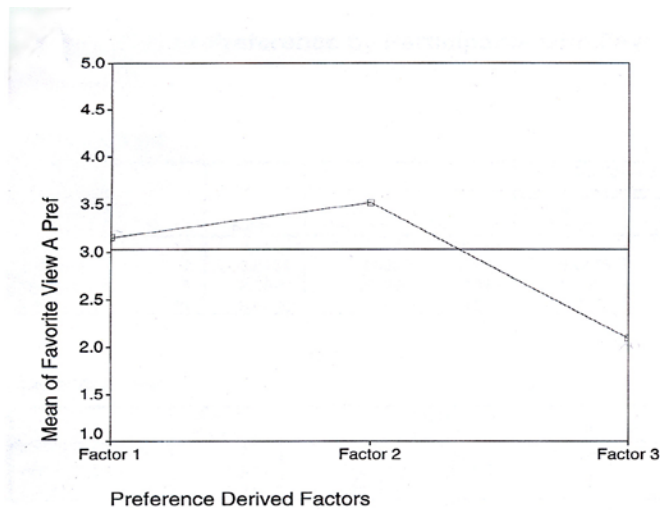


Figure 4-3 - Preference for Favorite View A by Factor Groups

Participants who prefer View A also have the highest preference for Factor Group 2 (moderate). They have significantly less (-1.42) preference for Factor 3 (manicured) compared to Factor 2 (moderate). They also have significantly less (-1.06) preference for Factor 3 (manicured) compared to Factor 1 (natural). These participants dislike the manicured scenes.

Next, a look at Favorite View B.

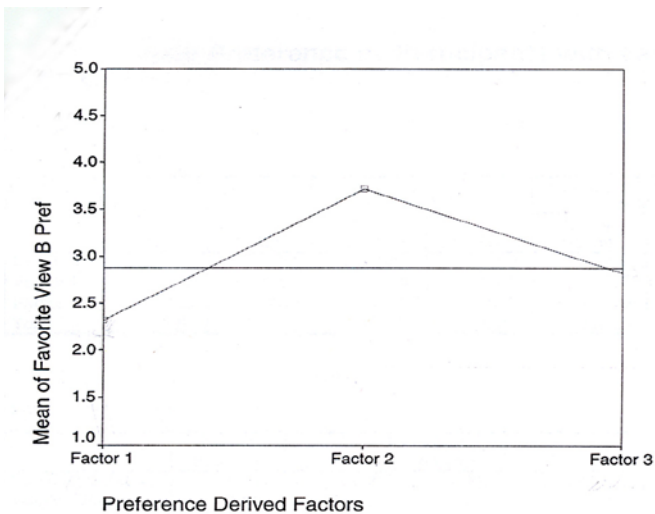


Figure 4-4 Preference for Favorite View B by Factor Groups

Participants who prefer View B also prefer Factor 2 (moderate) but followed by Factor 3 (manicured) this time. Participants who chose View B prefer Factor 1 (natural) significantly less (-1.40) than Factor 2 (moderate). They also prefer Factor 2 (moderate) significantly more (.89) than Factor 3 (manicured).

Next, a look at Favorite View C.

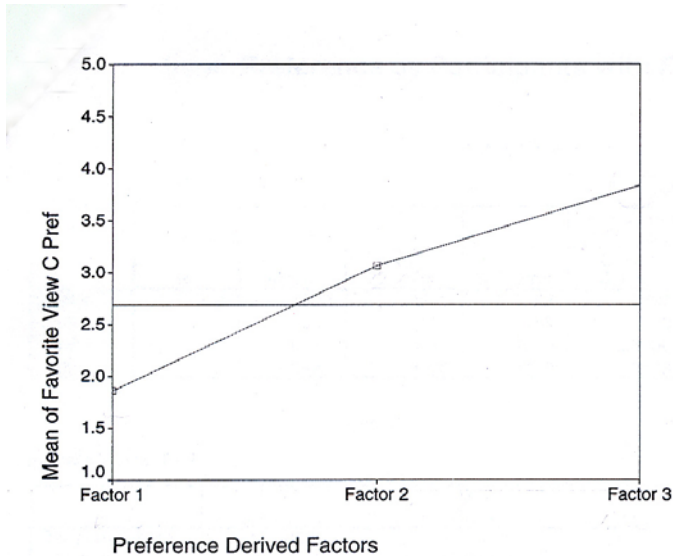


Figure 4-5 Preference for Favorite View C by Factor Groups

Those participants who chose View C have the highest preference for Factor 3 (manicured). They prefer Factor 3 (manicured) significantly more (.77 and 1.98) than either Factor 2 (moderate) or Factor 1 (natural). These results indicate, that the more naturalized, the less this group tolerates it. The people who prefer View A (natural) still prefer the moderate Factor, indicating their preference levels are slightly more flexible. A design guideline could be to place homes with manicured surroundings near the access road and to the front of the development. Similarly, frame the manicured area as a central grassy common space surrounded by moderate plantings on the development edges. The people who prefer naturalized views will probably want houses adjacent to the conservation areas.

Favorite View by Home Price Range

After having ranked the three views in order of their favorite to least favorite the participants were then asked how much they paid for their house, and what percentage of their home's price they would be willing to pay for their favorite view, such as the one they chose. The main finding was that those whose homes are \$100,000 or less are more likely to prefer View A (naturalized), as are those whose homes are in the highest price range, of \$325,000 to 845,000. However, the participants in the mid to upper middle range, especially \$250,000 to \$300,00 are most likely to prefer View B or C (moderate and manicured). Interestingly, the upper middle range participants (\$250,000 - \$300,000) are the one group who rated 'access to natural area' as 'low importance.' The most important point stemming from these results is to know your clients and the market.

Following is a table that lists these findings and the amount of respondents in each price range.

Table 4-12 Home Price Category by Favorite View

Home Price Categories (US\$)	Favorite View (Number of participants)			
	View A	View B	View C	Total
up to 100,000	16	8	3	27
110,000-150,000	11	12	5	28
151,000-200,000	12	14	10	36
204,000-250,000	4	9	7	20
251,000-300,000	1	6	5	12
325,000-845,000	8	3	0	11
Total participants preferring view	52	52	30	134

Average Price Participant is Willing to Pay for View based on Home Price Category

The average home price in the study is approximately \$200,000. The range of home prices are grouped into 11 categories as illustrated on the following graph.

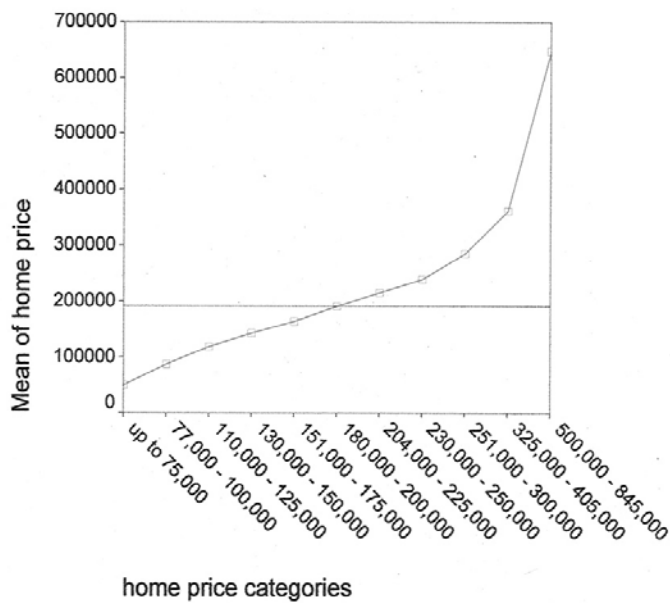


Figure 4-6 Average Home Prices by Price Categories

The following table indicates how many participants were in each of the 11 categories and what the average home price is within that category.

Table 4-13 Average Home Price in Each Home Price Category

Home Price Category (US\$)	Number of Respondents	Avg. Price in Category (US\$)
up to 75,000	13	50,223.15
77,000 to 100,000	14	87,071.43
110,000 to 125,000	7	118,571.43
130,000 to 150,000	22	143,450.00
151,000 to 175,000	18	164,055.56
180,000 to 200,000	19	191,105.26
204,000 to 225,000	12	215,458.33
230,000 to 250,000	8	239,625.00
251,000 to 300,000	12	285,333.33
325,000 to 405,000	5	361,000.00
500,000 to 845,000	6	647,500.00
Total	136	191,605.15

The average home price for the respondents is \$191,605.15.

The next table details the price respondents in each home price category are willing to pay for their favorite view on average.

Table 4-14 Average Price for Favorite View by Home Price Category

Home Price Category (US \$)	Number of Respondents	Avg. Price for Favorite View
up to 75,000	11	7,585.91
77,000 to 100,000	12	26,725.00
110,000 to 125,000	7	15,642.86
130,000 to 150,000	20	15,722.45
151,000 to 175,000	18	32,061.11
180,000 to 200,000	18	15,323.89
204,000 to 225,000	8	51,349.36
230,000 to 250,000	8	81,012.50
251,000 to 300,000	12	91,770.83
325,000 to 405,000	5	38,650.00
500,000 to 845,000	5	86,410.00

The following graph clearly illustrates that the participant's whose home prices are approximately \$230,000 to \$300,000 are willing to pay the most for their favorite view. Also, the group whose homes are \$500,000 and up are willing to pay substantial amounts for their favorite view.

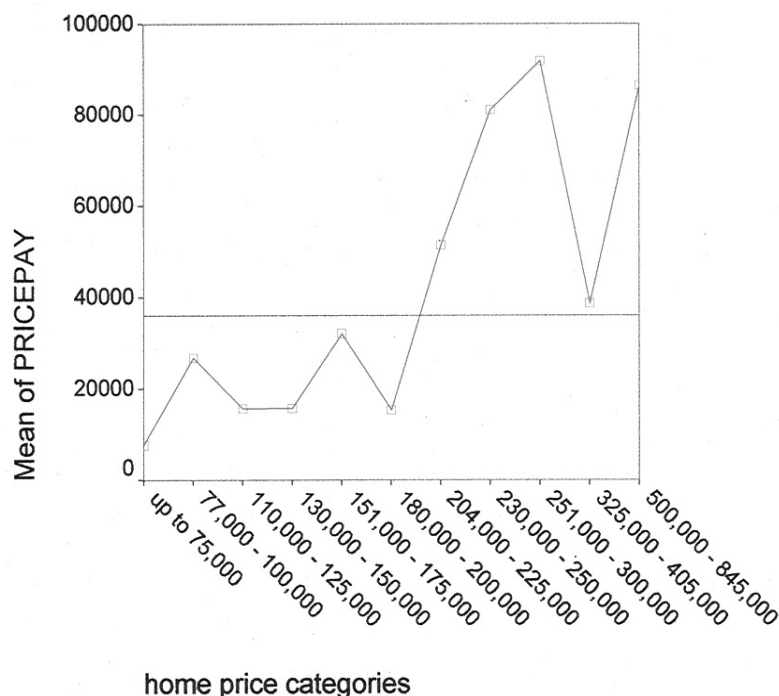


Figure 4-7 Graph of Price for Favorite View Based on Home Price Category

Group Comparisons

Importance of Access to Natural Area Results

The 'Importance of Access to Natural Area' rating question yielded three almost equally divided demographic groups: 124 people responded to this question; 46 participants rated it as a 5 or 'very high importance'; 36 rated it a 4 or 'moderately high' importance; 42 rated it with a 1, 2, or 3 which is 'neutral to low importance'.

Table 4-15 Importance of Access to Natural Area Ratings Breakdown

Importance of access to a natural area	Rating	No. of Participants
Very high importance	5	46 (37%)
Moderately high	4	36 (29%)
Neutral to low	1, 2, or 3	42 (34%)

Home Price by Factor Preference

To determine how participant's in various home price categories felt about each of the three factor groups a multivariate test was run on the data. The following table illustrates the average preference rating for Factor 1 (naturalized) by the 11 home price categories.

Table 4-16 Average Preference Ratings for Factor 1 (naturalized) by Home Price Categories

Home Price Category	Mean	No. of Participants
up to 75,000	2.68	13
77,000 to 100,000	2.77	14
110,000 to 125,000	2.34	7
130,000 to 150,000	2.53	22
151,000 to 175,000	2.68	18
180,000 to 200,000	2.12	19
204,000 to 225,000	2.83	12
230,000 to 250,000	2.02	8
251,000 to 300,000	1.90	12
325,000 to 405,000	3.08	5
500,000 to 845,000	3.32	6
Total	2.51	136

Table 4-17 Average Preference Ratings for Factor 2 (moderate) by Home Price Categories

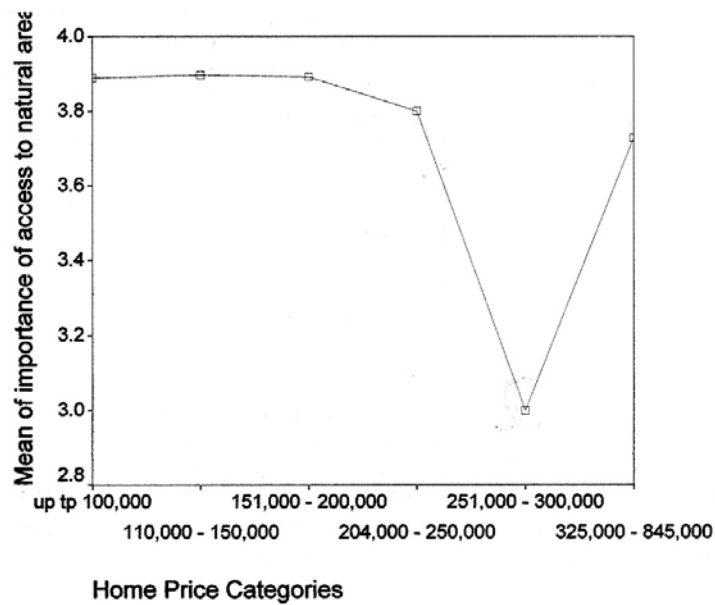
Home Price Category	Mean	No. of Participants
up to 75,000	3.57	13
77,000 to 100,000	3.43	14
110,000 to 125,000	3.24	7
130,000 to 150,000	3.55	22
151,000 to 175,000	3.75	18
180,000 to 200,000	3.55	19
204,000 to 225,000	3.49	12
230,000 to 250,000	3.57	8
251,000 to 300,000	3.01	12
325,000 to 405,000	4.11	5

500,000 to 845,000	3.48	6
Total	3.52	136

Table 4-18 Average Preference Ratings for Factor 3 (manicured) by Home Price Categories

Home Price Category	Mean	No. of Participants
up to 75,000	2.52	13
77,000 to 100,000	2.11	14
110,000 to 125,000	2.66	7
130,000 to 150,000	2.86	22
151,000 to 175,000	2.93	18
180,000 to 200,000	3.16	19
204,000 to 225,000	2.87	12
230,000 to 250,000	2.93	8
251,000 to 300,000	3.22	12
325,000 to 405,000	2.72	5
500,000 to 845,000	1.77	6
Total	2.77	136

The following graphic illustrates the information from the above Table.



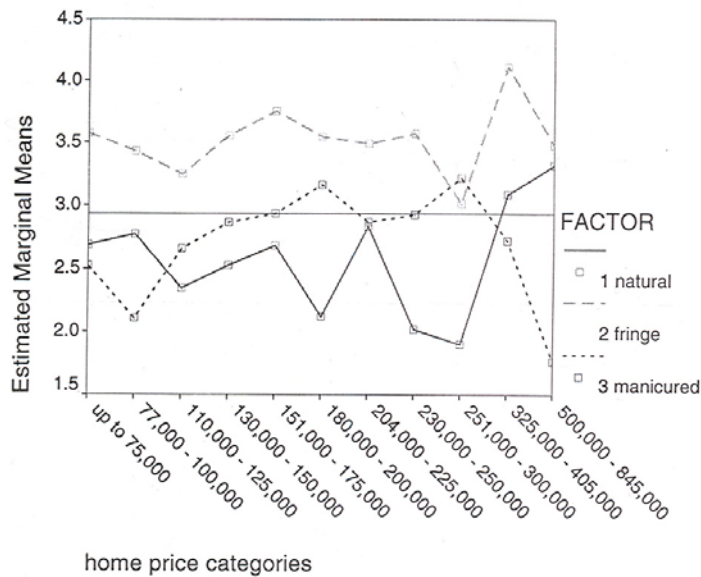


Figure 4-9 Average Factor Preference Rating by 11 Home Price Categories

Significant Results between Category Preference and Importance of Access to Natural Area Preference

Interesting and significant results were found for the original 9 Categories when compared to Importance of Access to Natural Area responses.

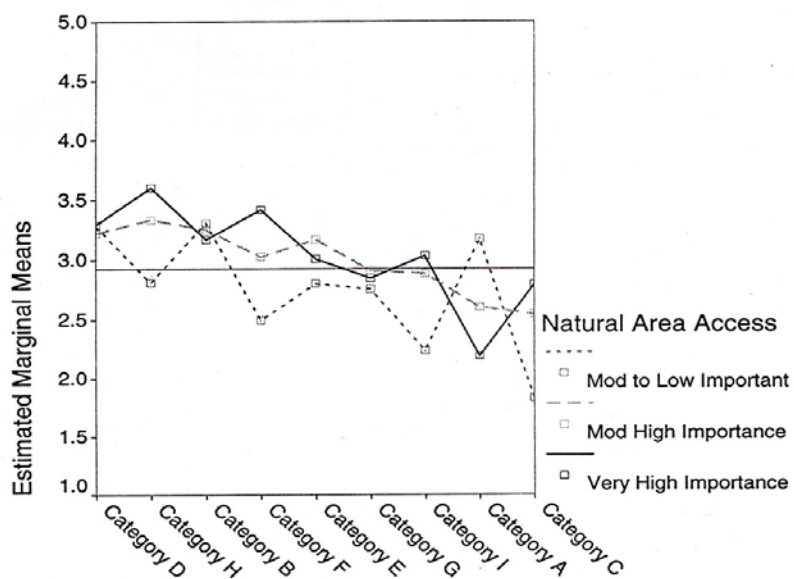


Figure 4-10 Original 9 Categories by Importance of Access to Natural Area

The Categories with significant results are listed below.

Category A (very manicured all around)

Participants who gave a 'low' rating for 'importance of access to natural area' (access) have significantly more preference (.57) for Category A than participants who rate access as 'moderately high importance'. Participants who rate access as 'very high importance' have, significantly less (-.98) preference for Category A than those participants who rate access as 'low importance'.

Category C (very wild shoreline)

Participants who rate access as 'low importance' have significantly less (-.71) preference for Category C than those who rate access as 'moderately high importance'. Participants who rate access as 'very high importance' have significantly more (.97) preference for Category C than those who rate access as 'low importance'.

Category F (moderately naturalized shoreline)

Participants who rate access as 'low importance' have significantly less (-.53) preference for Category F than those who rate access as 'moderately high importance'. Participants who rate access as 'very high importance' have significantly more (.92) preference for Category F than those who rate access 'low importance'.

Category H (moderately naturalized shoreline)

Participants who rate access as 'low importance' have significantly less (-.52) preference for Category H than those who rate access as 'moderately high importance'. Participants who rate access as 'very high importance' have significantly more (.79)

preference for Category H than those who rate access as ‘low importance’.

Category I (very naturalized shoreline)

Participants who rate access as ‘low importance’ have significantly less (-.65) preference for Category I than those who rate access as ‘moderately high importance.’ Participants who rate access as ‘very high importance’ have significantly more (.79) preference for Category I than those who rate access as ‘low importance’.

The greatest differences in preference were found between those for whom access is ‘highly important’ and those for whom it is of ‘low importance’. The scenes over which their preference differed varied in their being more naturalized or very manicured.

The results of participant’s preferences for the relatively moderate Categories of B, D, E, and G are not that different when compared to their ratings of importance of access to natural areas. In other words, people seem to feel more comfortable with the moderate categories – but, the results show that there are much stronger emotions and attitudes on either extreme from the middle whether the treatment is naturalized or manicured. Since this study shows that the three treatments; natural, moderate and manicured have almost the same amounts of people who prefer them and that even the moderate category is evenly divided in thirds for each type, a potential planning and design guideline is to cater to each constituency either through creating a specialty market niche or through a development that meets all three preferences in various parts of the layout.

Comparisons between Importance of Access to Natural Area Rating and Home Price

The following graph illustrates the relationship between the participants average rating of ‘importance of access to natural area’ by home price category.

The access rating drops substantially for the homeowners whose houses cost in the range of \$251,000 to \$300,000. Then the access rating goes up almost equally for the next price range of \$325,000-\$845,000. This result would make interesting future research. There is something unique about the attitudes toward nature of the group that is very nearly the wealthiest based on home prices, but not quite in the absolute wealthiest group. This is the only group of participants who rate access to a natural area as ‘low importance.’

Table 4-19 Average Access Rating based on 6 Home Price Categories

Home price range (US\$)	Number of participants	Mean rating of access
up to 100,000	27	3.89
110,000 - 150,000	29	3.90
151,000 - 200,000	37	3.89
204,000 - 250,000	20	3.80
251,000 - 300,000	12	3.00
325,000 - 845,000	11	3.79
Total respondents	136	3.79

Next, a Repeated Measure of Analysis of Variance was used to test for differences between ratings of Importance of Access to Natural Area and the 3 different factor groups.

Comparisons between Access Rating and Factor Groups

Significant differences were found in the relationship between rating for Importance of Access to Natural Area (access) and the three Factor Groups. For instance, the participants who rate access as ‘very high importance’ have significantly more (.81) preference for Factor 1 (natural) and significantly less (-.77) for Factor 3 (manicured) than those who rate access as ‘low importance.’

Participants who rate access as ‘low importance’ have significantly less (-.62)

preference for Factor 1 (natural) than those who rate access as ‘moderately high importance’. The ‘low importance’ group also have significantly less (-.42) preference for Factor 2 (moderate) than those who rate access as ‘very high importance’.

The results show that the participants who prefer the manicured treatment are less likely to feel that access to a natural area is important. This suggests that in designing a development for all three constituent groups – the manicured constituent group does not need to be near a conservation area. The people who prefer natural settings should be located near the conservation area. Plan so that the people who prefer manicured landscapes will be able to select houses in the more manicured settings within the development, away from the enhanced stormwater retention ponds.

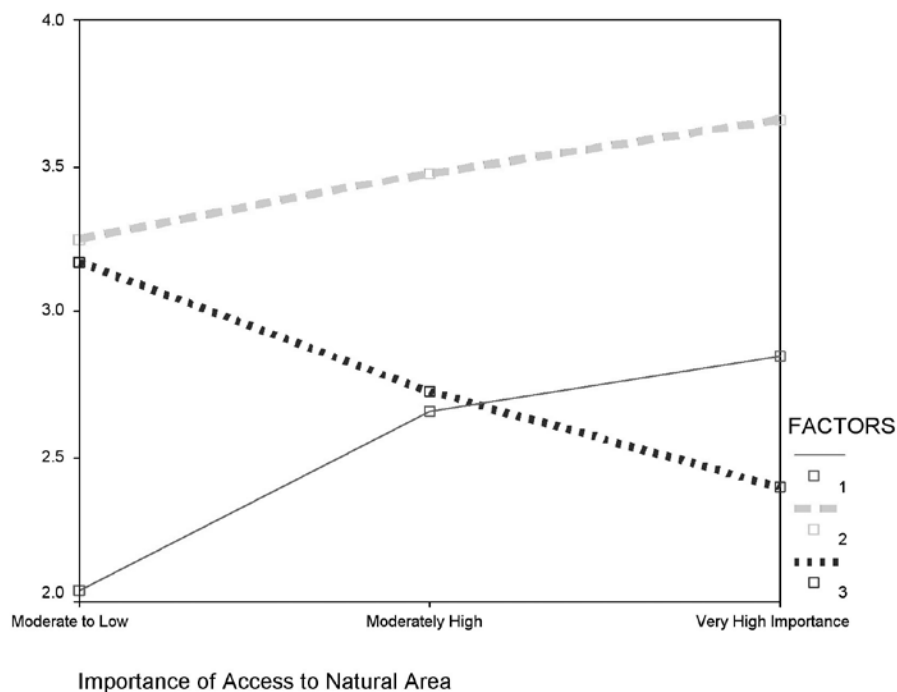


Figure 4-11 Factor Group Results by Access Rating

Favorite View Results

Pearson Chi-Square revealed significant results (.002) for differences between groups who rank View A, B, or C as a favorite based on their access ratings. Favorite

View A, or the naturalized view, is the preferred view for participants who rate ‘access to a natural area’ as ‘very high’ in importance, and moderate View B was their second favorite. For participants who rate ‘access to a natural area’ as ‘moderately high’ in importance, their preferred view was View B or the moderate scene, and their second favorite is the naturalized scene. For the participants who rate ‘access to a natural area’ as ‘low to moderate in importance’ their preference is for moderate View B, with their second favorite being the manicured View C.

The moderately vegetated pond edge treatment was the favorite view 2 out of 3 times. The naturalized view was the favorite 1 out of 3 times, and the manicured view was never the favorite in this comparison.

Table 4-20 Favorite View by Access Rating Demographic Result

Importance of access to natural area	Percent of group who chose as Favorite View		
	View A - natural	View B - moderate	View C - manicured
low to moderate	8.2	14.8	11.7
moderately high	10.7	11.7	6.1
very high	20.4	11.2	5.1

Outdoor Activity Results

Pearson Chi-Square was used to test the results of a comparison between Favorite View and Outdoor Activity. The survey question asked participants to circle the following outdoor activities that they do: jogging, biking, walking, gardening, hiking, birdwatching, kayaking/canoeing (i.e, paddling), fishing, camping, and hunting. Two of the test results are significant. The significant findings are that the bicyclists and paddlers preferred View A or the naturalized view more often than participants who engage in the other activities. Especially note the dislike the paddlers have for View C or the highly manicured pond. One could speculate that paddlers have gained a greater appreciation for aquatic plants because they have more experience of them. The Kaplan’s

state, “Understanding the environment, like anything else, is at least partially dependent on prior experience [...] the environmental patterns associated with the different forest practices may be interpreted very differently depending upon one’s ability to understand them (1995, 51).” In this case the Kaplan’s were conducting a visual preference study on different forest management practices, but the result is that preference increases with understanding of the scene being viewed. Great site amenities could be planned by creating bicycle trails around the conservation areas and designing a retention pond that would be interesting enough to paddle. To make a retention pond interesting enough to paddle will probably require designing an irregular border and interesting planting plan for aquatic and shoreline plantings.

Table 4-21 Favorite View by Outdoor Activity Demographic Results

Favorite View: A, B, or C	Percent of Bicyclists	Percent of Paddlers
View A - naturalized	20.4	15.3
View B - moderate	14.3	8.7
View C - manicured	5.6	1.0

The Interventions

The 4 scenes (A1, D2, C1, and G3) were each used earlier in the survey, and thus reflect “before” and “after” ratings measuring the effectiveness of the intervention text on influencing preference. Both Intervention A and B had the same four scenes, only the intervention text was different. *T*-tests were run on the collected data because there were only two groups for comparison.



Figure 4-12 The Intervention Scenes 1-4, from left to right

Intervention A Results

The hypothesis was that after reading a ½-page text about the benefits of aquatic plants as habitat for wading birds, the participant's preference ratings would go up for the more naturalized scenes. The results for Intervention A *“Why shallow-sloping retention ponds are important for wading birds”* are as follows:

Table 4-22 Intervention A Results

Intervention scene no. & category	Mean rating “before” reading intervention	Mean rating “after” reading intervention	Significance level	Mean difference (before/after)
Scene 1 - A1 manicured	2.89	2.57	.041	-.32
Scene 2 - D2 moderate	3.20	3.48	.004	.28
Scene 3 - C1 naturalized	2.61	2.70	not significant	
Scene 4 - G3 moderate	2.46	3.42	.000	.96

As a result of the text, preference ratings for the manicured scene went down significantly (-.32) and preference increased significantly (.28 and .96) for the two moderate scenes. Additionally, Scene 4, one of the moderate scenes, increased in preference by almost a full point. Preference for the natural scene did increase, but

not significantly. Intervention A was moderately successful in influencing people's preferences.

For Intervention B, the hypothesis was that after reading a ½-page text about the benefits of terrestrial vegetation for wildlife, the participant's preference ratings would go up for the more naturalized scenes.

Following are the results for Intervention B *"Where will the wildlife live?"*

Table 4-23 Intervention B Results:

Intervention scene no. & category	Mean rating "before" reading intervention	Mean rating "after" reading intervention	Significance level	Mean difference (before/after)
Scene 1 - A1 manicured	2.49	1.95	.000	-.54
Scene 2 - D2 moderate	3.00	3.18	not significant	
Scene 3 - C1 naturalized	3.18	3.40	not significant	
Scene 4 - G3 moderate	2.63	3.65	.000	1.02

As a result of the wildlife intervention, participant's preference for the manicured scene (A1) decreased significantly (-.54). Additionally, their preference for one of the moderate scenes (G3) increased by more than a point (1.02). Therefore, both of the interventions were successful in influencing people's preferences.

From the Intervention results we can extrapolate the following: environmental interpretation that raises empathic environmental awareness is somewhat effective in influencing people's preferences. Overall, the preference ratings did change in the expected direction, however not significantly for the naturalized scene in either intervention. The next section examines possible reasons for incomplete effectiveness by the interventions.

Strongly Held Views of Nature and Intervention Effectiveness

Another test was run on the Intervention Scenes, but this time it was used to determine if participants who came to the test with a strong preference for either wild or manicured scenes, would be influenced by the interventions. This result was achieved by cross-comparing participants who ranked either View A (wild) or View C (manicured) as their favorite view with their ratings ‘after’ reading the interventions to see if they changed.

Table 4-24 Expected Change in Preference Based on Participant’s Favorite View

Favorite View	Intervention for	Scenes			
		1 (manicured)	2 (moderate - manicured)	3 (wild)	4 (moderate-wild)
A (wild)	wildlife	decrease	decrease	increase	increase
A (wild)	wading birds	decrease		increase	increase
B (moderate)	wildlife	decrease	increase		increase
B (moderate)	wading birds	decrease	increase		increase
C (manicured)	wildlife		increase		increase
C (manicured)	wading birds				increase
Expected Change		decrease	increase	decrease	increase

The following table lists the before and after the intervention change in average preference rating of scenes 1 - 4 based on the participant's favorite view.

Table 4-25 Actual Change in Preference Based on Participant's Favorite View

Intervention Scene 1-4	Intervention Type	Participant's Favorite View	Avg. Before Rating	Avg. After Rating
1 (manicured)	wildlife	A (wild)	1.69	1.17
1	wildlife	B (mod)	2.63	2.06
1	wildlife	C (manicured)	4.2	3.86
1	wading birds	A	2.24	1.68
1	wading birds	B	2.67	2.11
1	wading birds	C	4.03	4.30
2 (moderate - manicured)	wildlife	A	2.93	2.60
2	wildlife	B	3.37	3.75
2	wildlife	C	2.53	3.64
2	wading birds	A	3.00	3.12
2	wading birds	B	3.53	3.92
2	wading birds	C	3.13	3.47
3 (wild)	wildlife	A	3.66	4.36
3	wildlife	B	2.92	2.78
3	wildlife	C	2.67	2.47
3	wading birds	A	3.64	4.09
3	wading birds	B	2.22	2.03
3	Wading Birds	C	4.03	4.30
4 (moderate - wild)	Wildlife	A	2.95	3.71
4	Wildlife	B	2.58	3.78
4	Wildlife	C	2.13	3.29
4	WadingBirds	A	2.73	3.82
4	Wading Birds	B	2.74	3.69
4	Wading Birds	C	1.97	2.73

The results appear to indicate that that the values people held prior to the intervention did influence the effectiveness of the intervention. The participants who

had previously chosen View B (moderate) as their favorite category were most likely to increase their preference for the highly naturalized scene after reading the intervention than participants who had previously chosen View C (manicured). For the participants who ranked View A (highly naturalized) as their favorite view, they liked that category even more after reading the intervention text. The participants who chose View C (manicured) as their favorite view were not inclined to raise their preference for highly naturalized even after reading the interventions. This suggests that people are more likely to be influenced if the intervention already agrees with their beliefs. Also, if a persons beliefs and preferences about nature are moderate, then it is more likely that an intervention will increase their preference for a naturalized scene.

Summary

Following are the key findings of the visual preference survey.

Moderate edge treatments are preferred by the majority of participants

Factor 2 (moderate) is significantly preferred over the other two types. Structurally, this would be a basin that is neither very deeply dug, nor so shallow and gradual that it would be choked with dense aquatic vegetation. It would be a basin design that had a moderate sloping bank with a low-growing shoreline fringe, and an aquatic bench of approximately 10' - 12.' The shallow aquatic bench would be planted with low-growing emergent aquatics such as Pontederia or Golden Canna.

The least preferred shoreline treatment is very dense, tall vegetation, such that it almost blocks the view of the pond. Or a pond so shallow that it is choked with aquatic plants throughout.

People prefer open yet defined spaces, as the Kaplan's found in their research. In this case, the open is the water and the definition is provided by the shoreline fringe, as

long as it is not too chaotic and overgrown. That said, there is a look for everyone, which was another key finding.

Each treatment type has nearly equal numbers of constituents

While Factor 2 (moderate), is clearly the most preferred treatment type; when looked at separately, there are almost equal numbers of participants who prefer each of the three treatments. Clearly, what constitutes ‘nature’ means different things to different people.

Participants are willing to pay substantial amounts for their favorite view type

Responses to the question, “What percentage of your home’s price would you be willing to pay for a favorite view, such as the one above [Views A, B, or C]?” lead to impressive results. The average amount for favorite view was \$36,019.91.

The more strongly the participant held a preference for an extreme treatment (wild or manicured) the less likely it was that the Interventions would change their preference bias.

The top 3 favorite scenes have a naturalized shoreline treatment where the terrestrial plants are tall, but not tall enough to block views.

Even those participants who chose View A (manicured) as a Favorite View, still have higher average preference ratings for Factor 2 (moderate).

Observations not Related to the Original Test Parameters

The following observations were not purposefully tested for, but appear to influence preference, and as such, would make good future research.

Pond Shape

The most preferred scenes have irregular pond shapes, not simple geometric ovals, circles, or rectangles. Preference may be due to the fact that when the natural edge is increased there is more complexity to a scene. Again, this supports the idea that people prefer an environment that invites exploration.

Pond Size

The most preferred scenes are of a rather large pond with lots of naturalized edge.

In Chapter 5, there will be a look at the key stakeholders and their primary objectives. The objectives will be condensed into 3 main issues, that if addressed, should meet all of their needs. Finally, a conceptual remodel of the Rosemont development in Gainesville, Florida, using guidelines extracted from the survey.

Chapter 5 - Recommendations



The Stakeholders

A goal of this study is to discern the stakeholders and their concerns regarding stormwater retention ponds. The stakeholders are defined and potential concerns are grouped into categories. (Table 5-1 illustrates their probable objectives). Environmental agencies include such organizations as US EPA, State Conservation and

Table 5-1 Stakeholders and their Probable Objectives

	Environmental Agencies	Developers	Physical Planners	Residents
Objectives:				
1. Water quality	X		X	X
2. Habitat conservation	X			
3. Flood prevention		X	X	X
4. Profitability		X	X	
5. Aesthetics			X	X
6. Nearby nature	X			X
7. Ease of maintenance		X	X	X
8. Cost efficient	X	X	X	X
9. Educative	X			X

Wildlife Protection Agencies, Non-Governmental Organizations (NGOs), Water Management Districts (WMDs), County and/or Municipal Environmental Protection and Public Works Departments. Planners include County Planners, Landscape Architects, and Civil Engineers, Residents include the important category of children who need nearby nature areas to explore as part of their growth and development.

Evaluation of the stakeholders and their probable objectives lead to formulation of three goals that if addressed will meet the needs of each group.

The 3 Goals

Following is a table that illustrates a way to meet all the objectives by addressing 3 key issues. Planning with these 3 issues in mind will create a triple-win situation.

Table 5-2 Goals and Objectives of Study

Goals:	Objectives
Habitat conservation	Water quality improvement - preserves organic topsoil and vegetative cover. Flood prevention - soil and plants absorb runoff, whereas buildings and roads increase it. Wildlife - provides food, shelter, migration, and accessible clean water. Ease of maintenance - low maintenance conservation areas. Educative - nature is a great teacher.
Aesthetics	Enhanced stormwater ponds are a flood prevention model that also provides an aesthetic amenity that is usable for passive recreation (multifunctional).
Profitability	Aesthetics - nature trails, cypress domes, enhanced stormwater ponds. Less excavation and fill when work with site hydrology. Know your market - conventional turf-to-pond edge was not the preferred treatment. Less maintenance Conservation easement tax benefits Free water quality improvement provided by ecosystem

All of the objectives can be met by keeping three goals in mind; 1) Profitability, 2) Habitat Conservation, and 3) Flood Prevention. The next section will cover results from the visual preference survey and how they can be applied to meet these three goals.

Provide Aesthetic and Recreational Amenity for Profitability

Aesthetics enhances recreational experiences and increases use - both attract

potential buyers.

Creating a Natural Aesthetic through Site Amenities

Recreational amenities for conservation areas

Providing access to natural areas was considered ‘important to very important’ by 132 of 203 respondents, or 65% of the sample. With that in mind, planning trails through the conservation areas of the subdivision would be a wise choice to improve profitability. The photographs below are examples of trail amenities for heavily-wooded conservation areas.



Figure 5-1 Nature trail bridge (left) and boardwalk with seating areas (right)
Source: K. Heiss

Creating access to conservation areas could be beneficial on many levels. For example, this trail might inspire new residents to learn more about the native plants of the area. For people whose families have been here for generations, it would be a chance to reconnect with ‘the old Florida’. For all residents, it would be an opportunity to decompress after work in the quiet beauty of nature. It would be a place of community pride and bonding for the residents.

Some ideas for creating places for the constituents who prefer highly naturalized areas are; provide home sites surrounded or adjacent to uncleared areas or with extensive views of natural areas, and provide trails that access the conservation areas. Trails should

be well-marked and provide interpretation either at the trail head or at significant site features.

Recreational amenities for areas combining natural and manicured settings

Next are three trail amenities for natural areas closer to the homes. These photographs portray amenities that have high levels of interest in the form of mystery - that is they 'invite' exploration.



The top scene is an asphalt paved trail that leads to a beautiful red bridge set over a small artificial stream which hides a stormwater outlet beneath it. The outlet underneath the created water feature leads to a dry detention basin that has an overlook platform enclosed by a matching red fence. The plantings on the 'stream' bank are irises (both purple and white), duck potatoes, and native ferns. These low-growing plants will not block views, nor will they require trimming. The middle picture is a narrow, mulch trail that meanders through a shady live oak canopy. The bottom picture is an unpainted wooden bridge set over a small freshwater marsh that connects to on-site nature trails. Some ideas for creating sites for people who prefer moderate natural areas are to; provide more of Nassauer's 'cues to care' such as attractive fencing, trimming of hedges, park seating, and built water features, such as fountains.

Figure 5-2 Natural area site amenities that 'invite' exploration. Source: K. Heiss

Recreational amenities for the manicured settings

Participants who rated ‘importance of access to a natural area’ as ‘low importance can also be provided recreational amenity. Trails for exercise, getting from point A to point B within the neighborhood, for biking, or getting to school, etc. give access to edge treatments and create a pleasant journey. Provide mowed grassy commons adjacent to neatly maintained perennial borders.



Figure 5-3 Children’s playground with a perimeter path and border plantings under a shady oak canopy. Source: K. Heiss

Creating a Natural Aesthetic with a Preferable Level of Complexity

The previous photographs all represent ‘invitations to explore’ or mystery, as the Kaplan’s would categorize it. However, *complexity* and *coherence* are two other issues that affect preference for a scene. The middle scene in the next group of photographs is fairly high in complexity, but also highly coherent, a combination likely to be visually

preferred. The scene on the left is high in complexity and low in coherence, which is generally an undesirable condition. The scene on the right is low in complexity and very highly coherent which is typically seen as unstimulating.



Figure 5-4 Examples of various combinations of complexity and coherence
Source: K. Heiss

With careful attention to these visual details, an enhanced stormwater retention pond becomes quite an asset.

Profitability

Profitability can be achieved by marketing to the desires of potential homeowners. Following are ways to increase profitability by addressing these desires using the results of the survey.

Increasing Profitability through Increasing Development Edge

One more method of increasing desired natural views in the subdivision is to increase the development edge through siting houses on meandering lines. Increasing development edge not only creates more natural views, it also increases the filtration of sediment and pollutants from runoff.

Pond Size

Although pond size is not directly studied in this research, it does seem to influence preference. The favorite scene was the largest retention pond in the study.

The results of a 1995 study conducted by the US EPA, “*Economic Benefits of Stormwater Controls*”, reveals that people are willing to pay a premium for a lot with a view of an enhanced stormwater pond. The report states that of several factors influencing pond premium – size was the foremost. “In most of the case studies, ponds had a surface area of several acres or more. (Schueler and Holland, 2002, 461).” Similar to this study, they found that residential lots in the price range of \$130,000 to \$375,000 could be sold at estimated premiums of \$7,500 - \$ 37,500 for homes adjacent to retention ponds or created wetlands (i.e., enhanced stormwater retention ponds). In this visual preference survey the average was \$36,020 for a preferred view. Their report states that, “Two of the case studies tracked the resale value of homes near ponds for up to two decades, and found the premium held up or increased as time went by [...] While the study primarily examined the waterfront effect associated with wet ponds, it did include two case study examples involving stormwater wetlands. In this limited sample, stormwater wetlands were also found to have a strong waterfront effect. This appears to reflect a recent trend among many housing consumers to prefer a more natural appearance of their community (Schueler and Holland, 2002, 462). “

Habitat Conservation

This section addresses water quality improvement and flood prevention. Soil and vegetation absorb rainfall preventing large volumes of surface runoff. Soil and vegetation decrease the need for flood volume storage in retention ponds. Whereas, impervious surfaces increases runoff, the need for conveyance, and storage of runoff volume. The next section will look at ways to increase conservation, therefore inhibiting stormwater runoff.

Increasing Residential Density to Increase the Conservation Area

The following photographs show housing module design strategies for increasing density so that more of the site may be preserved.

One of the strategies to create a more compact building footprint is zero-lot line modules, where the houses are aligned to one side of the lot. This strategy emphasizes a spacious lawn/patio area on one side of the house rather than the conventional method of centering homes on narrow lots, thus creating a fairly useless, fenced-in grass strip between each house.



Figure 5-5 Zero Lot Line Housing Layout, Town of Tioga. Source: K. Heiss

Garages take up a lot of space, why not tuck them under the house instead of beside it? Below is an example of a local, upscale residence with a garage at grade, under the front of the house.



Figure 5-6 At Grade Garage under Townhouse, Downtown Gainesville, Source: K. Heiss

Another alternative is to have the garages at grade behind the house in a central courtyard or in an alley. Figure 5-7 shows the garage at the back of the house which is an aesthetic improvement – but in this method the garage still takes up valuable terrain. Additionally, with this method, another street is needed for the alley which adds to the impervious surface and expense. This doesn't necessarily have to be bad if the overall density is high enough, and if the on-site conservation area is still half of the site. Either way, all three methods serve to free up street-parking which is a valuable amenity for residents who have big families or like to entertain.



Figure 5-7 Tucked Away Garages for Using Less Space (left); and aesthetics (right).
Source: K. Heiss

Tie in Existing Natural Areas and Features

Link existing wetlands and their buffers to habitat corridors throughout the site.

Use opportunities to link on-site corridors to off-site corridors.

Linking On-Site Habitat when Intersected by a Road

When a road must intersect a habitat corridor provide a culvert with dry and wet tunnels or a bridge so wildlife can pass underneath safely.

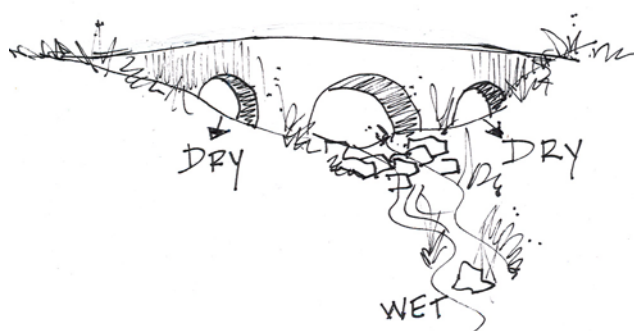


Figure 5-8 Dry and Wet Wildlife Underpass. Sketch: K. Heiss

Improving Water Quality - Prevent soil erosion and sedimentation

The photograph on the left shows what happens to even a moderately sloped pond bank when it is not planted, or worse, sprayed to kill the shoreline vegetation.



Figure 5-9 Effects of Shoreline & Aquatic Vegetation on Pond Bank Soil Stabilization.
Source: K. Heiss

The slope has completely eroded right up to the ridge. Soil erosion causes water quality to diminish through increased sedimentation. The retention pond on the right has a moderate and healthy shoreline fringe that holds the soil in place when it rains. Other water quality problems that will be created by the pond on the left are lack of nutrient uptake by aquatic plants, since there are none. Additionally, aquatic plants absorb excess fertilizers and pesticides coming from the adjacent lawn areas.

Soil Erosion & Sedimentation Prevention Strategies:

- 1) Effective site preparation
 - a) maintain and protect buffers to existing water features.
 - b) thin and prune forest strands - especially edges.
 - c) protect sensitive areas and species
 - d) get rid of noxious plants
 - e) minimize grading
- 2) Phase larger developments - disturb as you go, not all at once.
- 3) Spoil top soil and bank excess cut at bottom of slopes to prevent sediment from leav-

ing site or entering streams.

4) Stabilize slopes as soon as possible.

Design Shallow Pond Slopes for an Aquatic Bench and Plant It

Design perimeter slopes of less than 4:1 (Clark, 2006) so that the soil is less likely to erode because of steep slopes, and then ‘button up’ the terrestrial slope by planting the shoreline marginal plants. Plant the emergent aquatic zone until the depth of the permanent water level reaches 1 foot. A registered landscape architect can design the subdivision site plan, site drainage, enhanced retention ponds, and an attractive landscape plan.

Use On-Site Wetlands for Storing and Filtering Runoff

Which aquatic plants are known for their high capacity to filter nutrients from water? Pond Cypress is such an example and these ecosystems exist frequently in as yet undeveloped areas of Florida. Cypress domes are a type of low-nutrient, still water system – meaning the standing water is mainly from precipitation and surface runoff. The underlying geological formation is an isolated depression therefore, the water does not exit the pond. Because the pond is an isolated system, cycling only through precipitation and evapotranspiration, nutrients in the system come mainly from leaf litter (Mitsch and Gosselink, 1986).

If you have a site with cypress domes on it, for example, they can be used to collect and filter stormwater runoff. Studies have been done on the effectiveness of cypress domes in absorbing nitrogen and phosphorus. “Boyt, Bayley, and Zoltek (1977) described nutrient uptake that occurred in a mixed hardwood swamp that had received domestic sewage effluent for 20 years. They found that total phosphorus and total nitrogen in the outflow were reduced by 98% and 90%, respectively, compared with the inflow (Mitsch

and Gosselink, 1986, 117).”

Create a Site that Encourages Desired Fauna

Hardly anyone wants to encourage snakes or alligators in a residential subdivision – although, if we were realistic we would know that they pose much less of a threat to us than driving does – which we do everyday. While most of us don’t want to encounter these two species – it would be equally undesirable if our development was not conducive to songbirds, butterflies, herons, turtles, frogs, geckos, deer, fox, ducks, and other native wildlife.

Which local plants grow low enough so as to not block views, have attractive foliage or flowers, and will grow in these conditions? There is a University of Florida, IFAS Extention document (CIR 912) “Creating Wildlife Habitat with Native Florida Freshwater Wetland Plants” (Main, Allen, and Langeland, 1991) which is available on-line and lists plants that would thrive in retention pond conditions (www.ifas.ufl.edu). Following are excerpts of some of the beautiful wetland plants that meet these criteria:

Table 5-3 - Native Florida Freshwater Wetland Plants. Source: www.ifas.ufl.edu. CIR 912. Revised July 2006.

Emergent Aquatic Plants:	Comments:
Yellow Canna <i>Canna flaccida</i>	Yellow flowers year-round, grows to 4 feet. Preferred conditions are sun to partial shade, intermittent flooding, at a planting density of 18 inches. Plants spread quickly, add color and attract butterflies.
Caric Sedges <i>Carex spp.</i>	Numerous (16 wetland species) clump-forming emergent or marginal sedges. Nutlets are eaten by birds and mammals.
String Lily <i>Crinum americanum</i>	Fragrant flowering perennial that grows to 3 feet. Plant 2 feet apart in sun to partial shade, from water’s edge to water 3 feet deep. Ducks and mammals feed on seeds.

Iris <i>Iris spp.</i>	Attractive flowers grow in clumps and attract butterflies. Plant 2 feet apart in full sun to partial shade in areas of intermittent flooding. Dormant in winter. Five native wetland species.
Pickernelweed <i>Pontederia</i>	Purple flowering colonial reaching a height of 4 feet. Plant 2-3 feet apart in medium to high light, in 16-18 inches of water. Ducks and mammals feed on seed; Apple snails lay eggs on stems; and butterflies are attracted to this plant.
Marginal plants: grasses and grass-like (shoreline fringe)	Comments:
Muhly Grass <i>Muhlenbergia capillaris</i>	Attractive perennial bunch grass with striking purple inflorescence. Grows 3-5 feet in full sun and tolerates a wide range of soil moisture. Excellent landscaping plant. Seeds eaten by birds and wildlife.
Marginal plants: Flowers	Comments:
Swamp Sunflower <i>Helianthus augustifolius</i>	Spreading, flowering perennial herb growing 2-6 feet in full sun to partial shade. Prefers usually wet soils as do 5 other <i>Helianthus</i> species found in Florida. Seed heads eaten by birds.
Lobelia <i>Lobelia spp.</i>	These beautiful flowering herbs grow 2-4 feet and should be planted on foot apart. There are 12 native species which grow in specific areas of Florida. <i>L. cardinalis</i> red flowers attract hummingbirds, and it, along with <i>L. floridana</i> , prefer very wet soils. The other <i>Lobelia</i> species occur in moderately wet soils.

This table represents just a few of the choices of emergent aquatic plants and marginal terrestrial plants that could beautify a residential retention pond, preserve wildlife habitat, and improve water quality.

Flood Prevention Strategies

The conventional engineered method of stormwater retention facilities for flood control is not within of the scope of this study. What is within the scope of this study in relation to flood control, is the structure or slope of the designed basin. The relationship

is such that, to meet the same design storm, typically the 10 and 100-year event (rainstorm), a pond with a shallower perimeter will need to be larger to hold the same volume of water. This study and others, reveal that large enhanced stormwater ponds create premium lots that retain their value over the years, so what at first looks like a terrible constraint is actually an opportunity to increase amenity and hence profitability.

That said, there are plenty of strategies for decreasing impervious surface so that there isn't so much demand for storage volume in the first place.

Design to Collect and Filter Runoff as Close to the Source as Possible

- Homes can come with rain barrels attached to the downspouts.
- Areas between houses can have planted depressions called bioretention gardens.
- Driveways can be shared access creating one less impervious driveway per two residences.
- Driveways don't have to be paved. Invisible Structures makes a high-density plastic grid that can be planted with soil and grass. The structure keeps the roots from being compacted and hence you could have a completely pervious drive made of turf grass.
- Curb and gutters don't have to be used – paved paths surrounded on both side by a vegetated swale can collect runoff from street and paved pedestrian paths.
- Streets can be narrower, reducing impervious surface.
- Compact lot design can greatly reduce impervious surfaces.
- A terrific source to look at for illustrated methods of reducing impervious surface in subdivisions is, *Low Impact Development: technical guidance manual for Puget Sound*, January 2005, by the Puget Sound Action Team, available through www.psat.wa.gov.

Applying the Guidelines

As noted previously, there are three categories that if addressed, will achieve all the objectives, and they are; 1) habitat conservation, 2) aesthetics, and 3) profitability. Conservation Subdivision Design (CSD) can be used as a site planning method that meets all three. CSD will be used in this case study to 'conceptually remodel' an existing, conventional subdivision.

Rosemont is part of the Mile Run Subdivision in Gainesville, Florida. It is located just north of 53rd Avenue, at Northwest 37th Street. The subdivision was built between the early to late 1990s. A residential subdivision adjacent to Rosemont's northern boundary line will be included as part of the project area for this case study to demonstrate thinking beyond the site boundaries.

The first step in meeting the goals of habitat conservation and profitability are in the research and site analysis phase.

Site Analysis

The site analysis planning phase consists of gathering data through; field visits, collecting pertinent geographical data, and inventorying existing vegetation and infrastructure. The purpose of the research and site analysis phase is to become clear about what unique opportunities and constraints are at work on the site.

Following is an aerial of the developed site as it looks today. The northern border (top of photo) shows an as yet undeveloped upland hardwood hammock which probably contains cypress domes in the low areas.



Figure 5-10 Rosemont Subdivision Post-Development. Source: Google Earth, 2006.

Phase One: Field Visit

Field visits are made to take photographs, and make notes about the place. Figure 5-11 is an example of a field sketch with notes regarding the underwater slope, inlet and outlet, of the large, central retention pond at Rosemont.

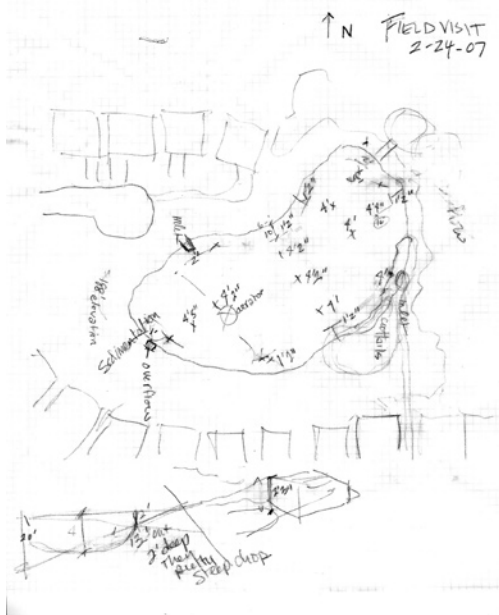


Figure 5-11 Field Visit to Assess Retention Pond Slopes.
Source: K. Heiss

Phase Two: Collecting Geographical Data

Digital files of soils, hydrology, topography, wildlife data and flood zones used for mapping are available from the Florida Geographic Data Library (FGDL) at www.fgdl.org.

The soil map is probably the most important map because it contains so much pertinent information about the site. For instance, the soil types indicate natural plant communities when cross-referenced with *26 Ecological Communities of Florida*, originally published by the Soil Conservation Society, Gainesville, Florida Chapter (1985). The FGDL soil dataset SSOILS also provides important information to site planners such as soil drainage type and depth to seasonal high water table.

The soil map indicates that the best-drained soils are Millhopper and Tavares located on the southern half of the site. They are listed as moderately well drained. The northern half of the site is composed of poorly drained soils and wetlands, as is the entire

development north of Rosemont.

It is possible to tell the pre-development vegetation based on the soil map. This site was primarily Upland Hardwood Hammock with areas of isolated cypress domes. Cypress Domes grow in the Montechoa and Pompano soils listed on the map. According to Mitsch and Gosselink, “Cypress domes (sometimes called cypress ponds or cypress heads) are poorly drained to permanently wet depressions dominated by pond cypress. They are generally small in size, usually 1 to 10 hectares, and are numerous in the upland pine flatwoods of Florida and Southern Georgia [...] These wetlands are called “domes” because of their appearance when viewed from the side – the larger trees are in the middle with the smaller trees toward the edge (1986, 321).”

Cypress domes mainly experience standing water during the rainy season which is in the summer in north-central Florida. Most of the standing water is from rainfall and sheet flow with little to no subsurface flow. In the dry season, during the spring and fall, the standing water may mostly dry up due to evapotranspiration (Mitsch & Gosselink, 1986).

Wauchula soil which dominates most of the northern half of the project area indicates a slough. A slough is defined as “broad shallow channels of flowing water corresponding to linear depressions in underlying limestone (Purdum, 2002, 70).” On this site, sheet flow is moving west off of the Alachua Slough Drainage divide; and north west off the Unnamed Stream Drainage divide. These poorly drained soils should not be the first choice for building on. The conventional treatment to ‘improve’ them for building, is to dig a perimeter ditch around the site to drain the project area. “When deepwater swamps have been drained, or when their dry period is extended dramatically, they can be invaded by pine (*Pinus* spp.) or hardwoods (Mitsch and Gosselink, 1986).” In north-central Florida, a cypress-pine association indicates a drained cypress dome (Mitsch and Ewel, 1979).”

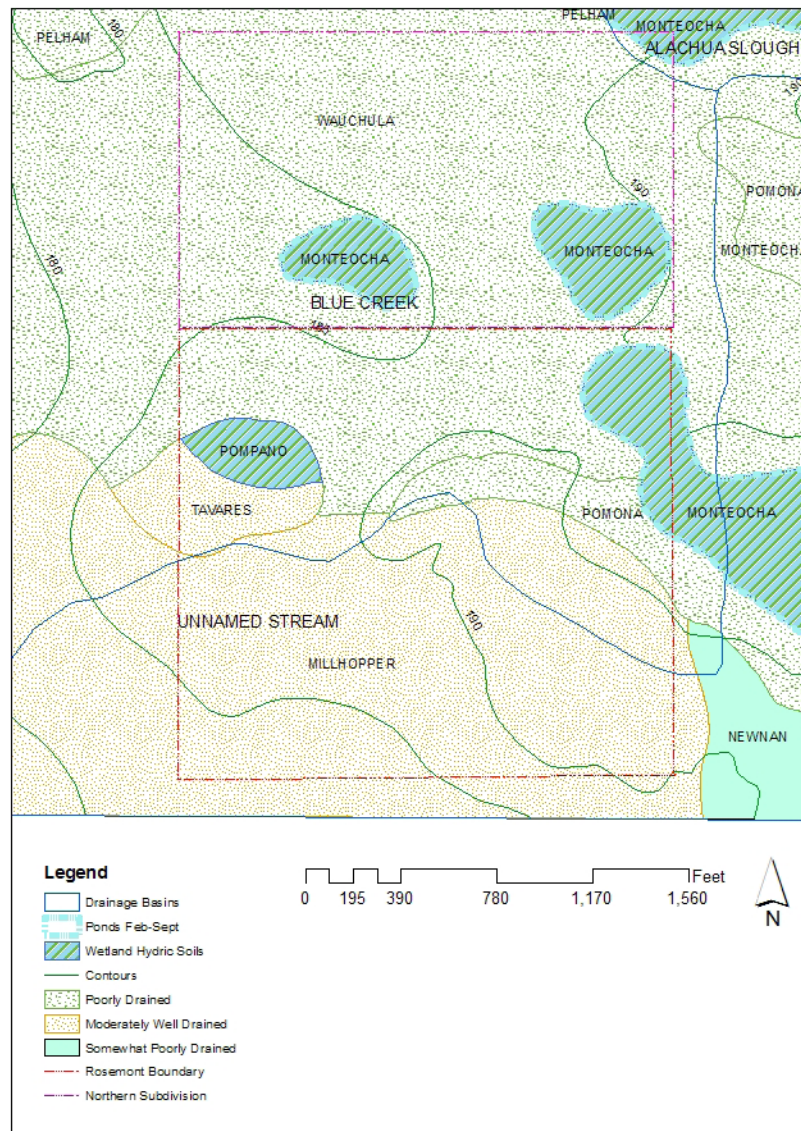


Figure 5-12 Soils Map with Topo and Drainage Basins
Source: www.fgdl.org

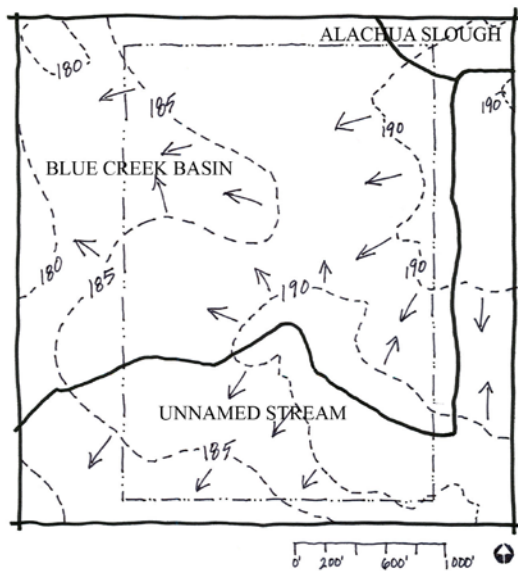


Figure 5-13 Surface Runoff in Project Area. Graphic: K. Heiss

Cypress domes contribute to a ‘sense of place’ in Florida, they are a unique landscape feature of the southeastern United States, an essential landscape element that tells you where you are. Cypress domes will be considered primary conservation areas in the new conceptual plan.

Another factor in choosing sites suitable for building is to consider depth to the seasonal high water table. In Figure 5-14, the northern half of the site, where the Wauchula soils are located, has a depth of only $\frac{1}{2}$ foot. Such a high water table along with heavy summer rains means that a lot of expensive excavation and fill will need to take place to make this portion buildable. The southern half of the site containing the Millhopper soils has a depth to seasonal high water table of 3.5 feet which is acceptable. The Montechoa soils typically have 2 feet of standing water during the summer rainy season and the Pompano soil has 0 feet to the water table which means it could be ponded during times of heavy rain.

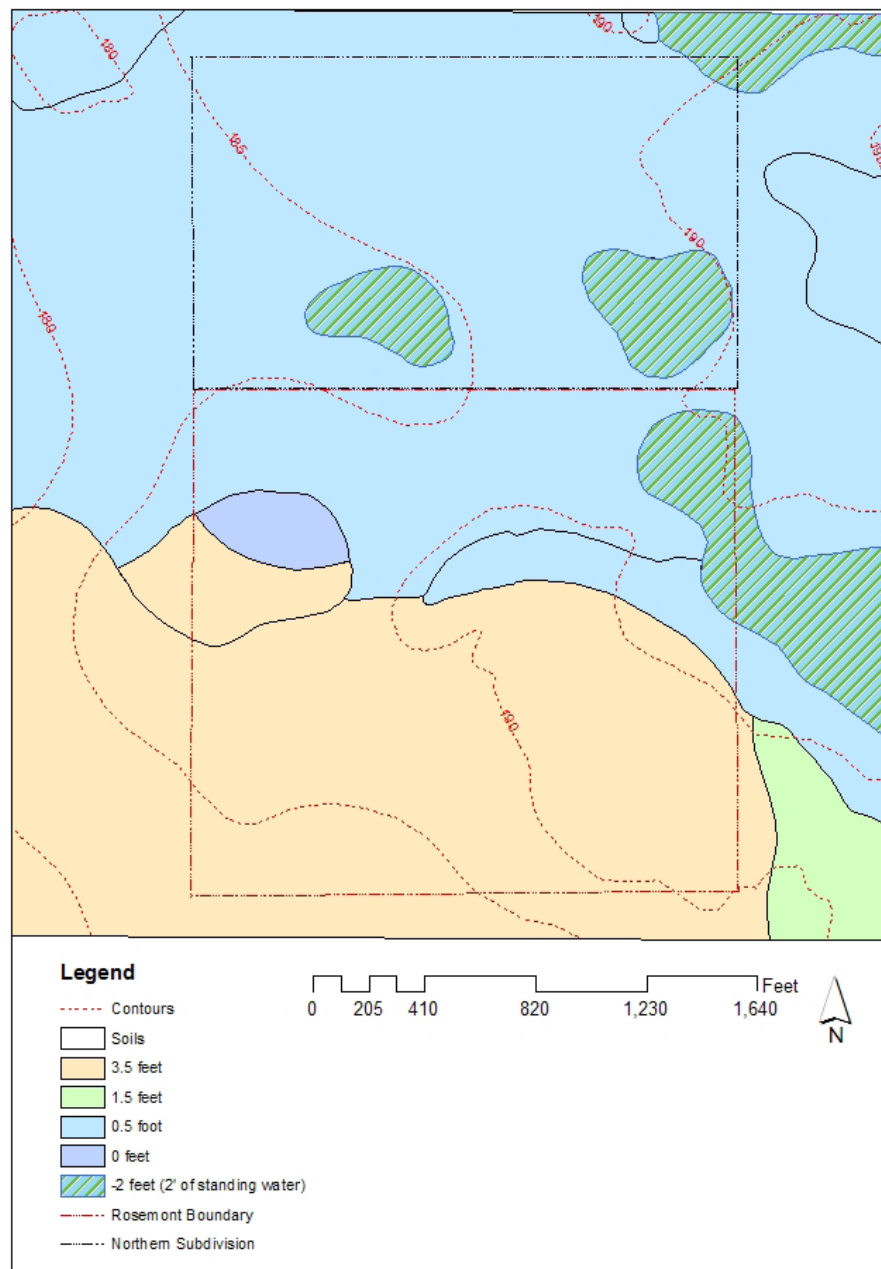


Figure 5-14 Depth to Seasonal High Water Table.
Source: www.fgdl.org.

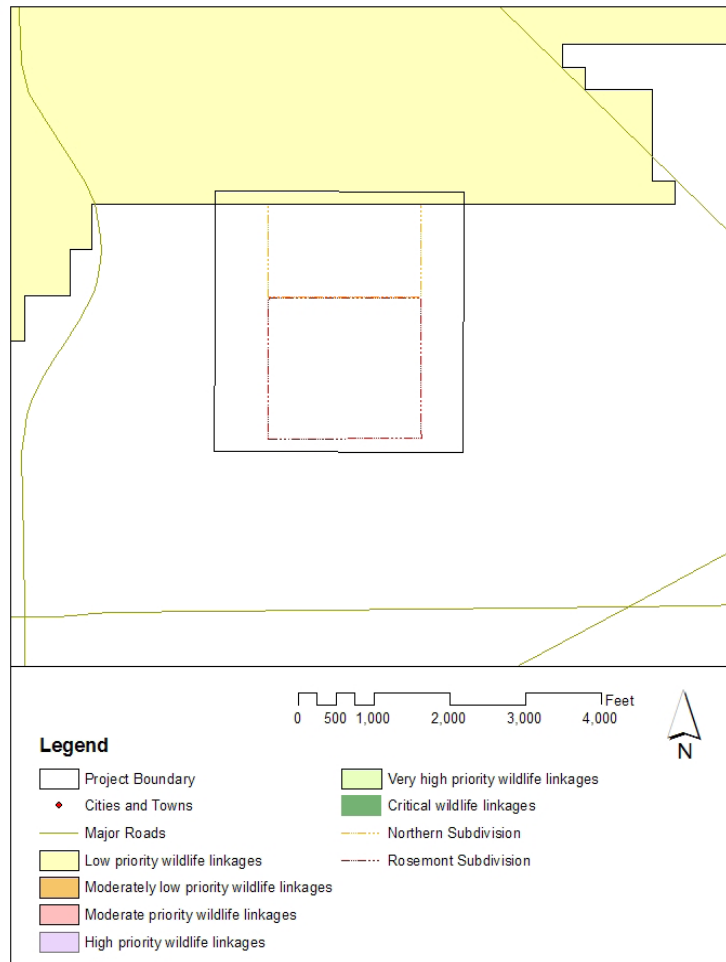


Figure 5-15 Critical Wildlife Linkages Adjacent to Site
Source: www.fgdl.org

Figure 5-15 illustrates data from the Florida Ecological Greenways Network Critical Linkages and Prioritization Results (FGDL geodataset name: gweco_prio_2005). There are no “critical” linkages left adjacent to the property as of 2005, however the aerial indicates that there is still a mature forest north of the project area which is labeled a ‘low priority wildlife linkage, on the map. Use opportunities to link on-site conservation areas to off-site undeveloped areas for use as wildlife corridors.

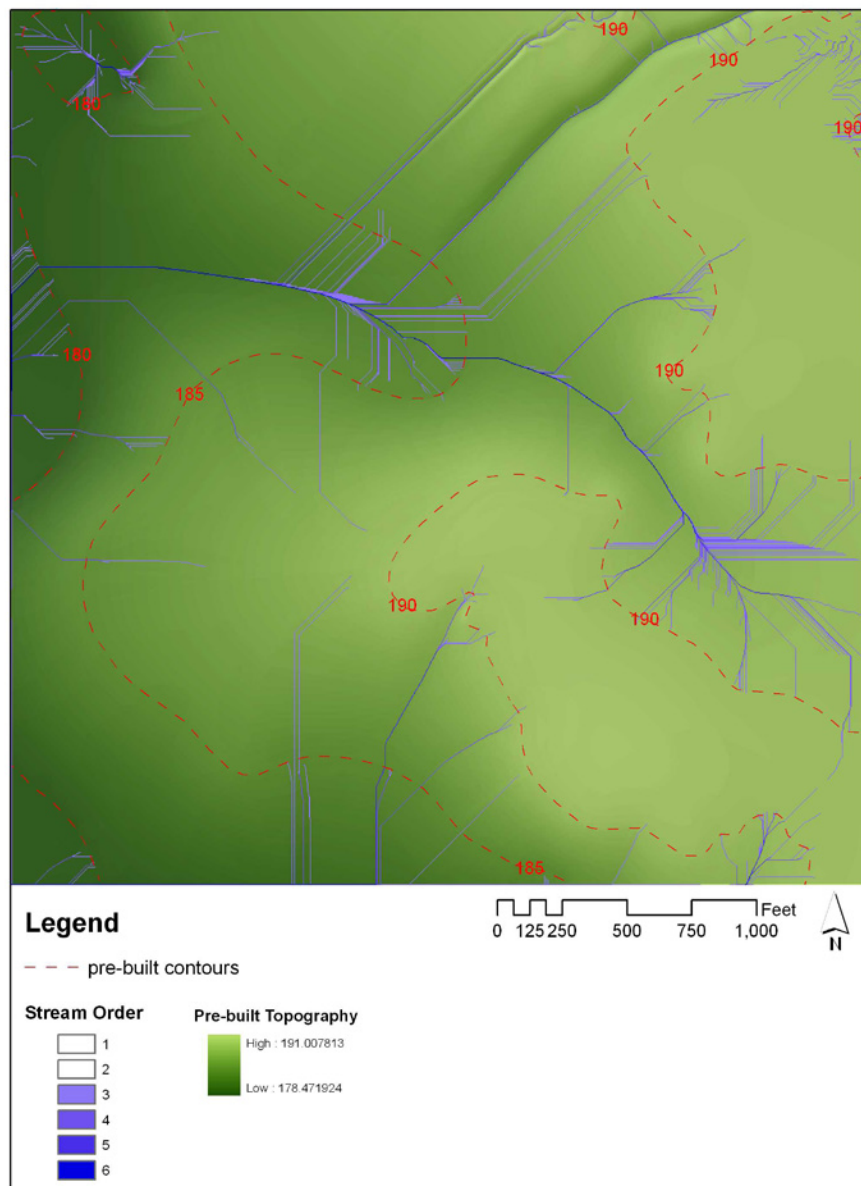


Figure 5-16 Areas of Water Accumulation
Source: www.fgdl.org

Figure 5-16 is a digital elevation model created from a topographical map in ArcView that shows areas of water accumulation on the site. These areas of water accumulation should be used as the natural areas for vegetated swales and buffered stormwater retention ponds. This is an example of working *with* rather than against the site hydrology. Figure 5-17 indicates flood hazard zones within the project area.

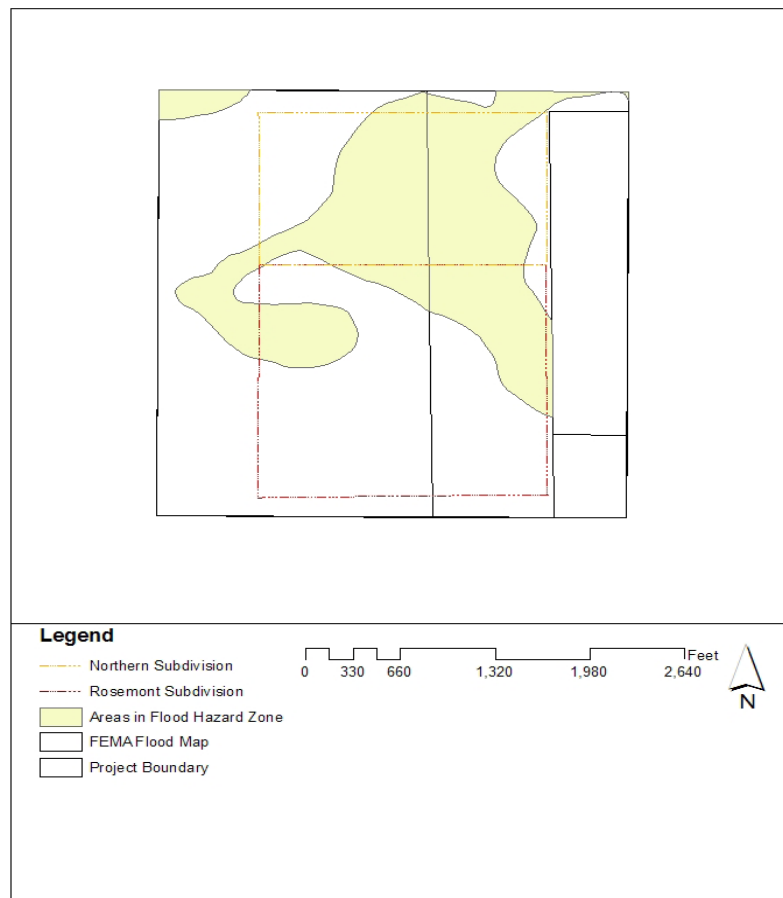


Figure 5-17 FEMA Flood Map Source: www.fgdl.org

Phase 3: Putting it All Together: Opportunities and Constraints

From an analysis of the site conditions, a conceptual site plan can be created that works *with* the existing natural features (opportunities and constraints) of the site. Working *with* the natural hydrology is important in meeting several of the stakeholder objectives. First, it reduces cost to the developer because excavation and fill is the most expensive part of the development process. Second, it improves water quality by reducing clearing and grading which cause soil erosion and sedimentation during the construction phase.

Site Analysis Synthesis

After visiting the site, making field notes, talking to owners, and compiling and assessing GIS data, the next step is to put it all together in a site synthesis. The site synthesis is a graphic of the opportunities and constraints of the site. It identifies in zones, where houses might best be built and zones of opportunity for conservation. It also looks at views for enhancing or screening, vehicular access points based on exiting infrastructure, and vegetative buffers, etc.

Following is a graphic of the site synthesis for the Rosemont remodel.

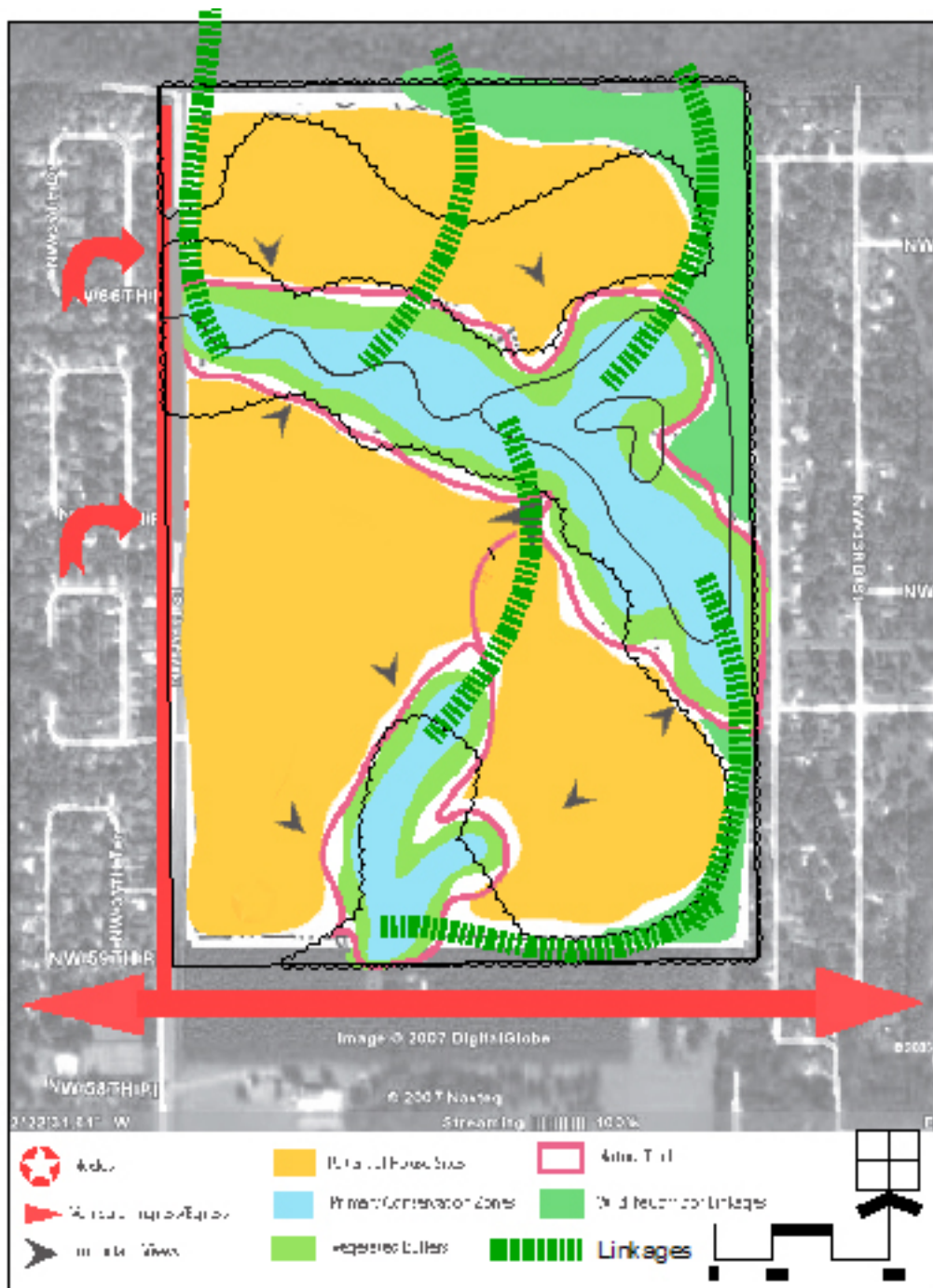


Figure 5-18 Site Synthesis of Project Area

Conservation Subdivision Site Planning

Site planning is designing the armature of the site. The subdivision can only be as conservation oriented as the site plan – after that everything else is a detail. Fortunately, the majority of the stakeholder objectives can be met at the site planning level if sensitive site planning methods are used. Conservation Subdivision Design (CSD) is an example of sensitive site planning. The steps below are taken from Conservation Design for Subdivisions (Arendt, 1996).

Step One: Identify the Primary and Secondary Conservation Areas

Arendt argues in his book for a total conservation area of $\frac{1}{2}$ the site. No less than a $\frac{1}{4}$ of this can be primary conservation (1996). In this case, the primary conservation areas will be the cypress and mixed hardwood swamps, and a broad vegetated buffer around them. The secondary conservation area will be preserving a forested corridor along some of the northern border to create a wildlife link to the offsite forest. In the remodel, wildlife will have access on and off-site via the buffer area around the retention ponds, and the entire eastern and northern borders.

Step Two: Locate Potential House Sites

In this step it is important to layout neighborhoods first - then houses. The housing module or neighborhood is the building block for the development layout. Houses should be located a comfortable distance from the enhanced stormwater retention ponds for two reasons: 1) because they are the areas of water accumulation, water quality improvement necessitates vegetated buffers between impervious surface, like roads and rooftops and open water bodies; and, 2) a comfortable distance between homes and ponds was the

preferred aesthetic in the survey. The favorite scene has a distance of approximately 50 – 60' from the house to the pond. A strategy for applying the Kaplan's visual preference matrix criteria of coherence and legibility can be done by repeating design elements (coherence) such as architectural styles; and, by creating neighborhood landmarks (legibility) such as the shopping center, fountains, parks, monuments, etc. Designing in landmarks assists people in wayfinding – or making a mental map of their neighborhood or town.

Step Three: Draw in Roads and Trail Alignments

For water quality purposes and cost it is best if trails are permeable and paved streets *are the absolute minimum possible width*. Not using curbs and gutters is a great idea, instead direct road runoff to vegetated swales parallel to the road. If curbs are a must, use curb cuts to allow sheet flow to escape the street and direct it to a vegetated channel or bioretention depression.

Vegetated swales collecting water from the roofs and roads should lead to on-site wetlands. The swales should have native rock check dams to collect sediment and slow velocity of runoff. In this case, limerock boulders will be used to create an attractive check dam and the swale could be planted with native grasses such as Muhly Grass which has a beautiful purple/pink inflorescence.

Step 4: Draw in Lot Lines

Finally, the lot lines can be drawn. At this stage, check dams should be located as well as bioretention areas and vegetated swales. Pedestrian nature trails should already have been laid out in Step 3.

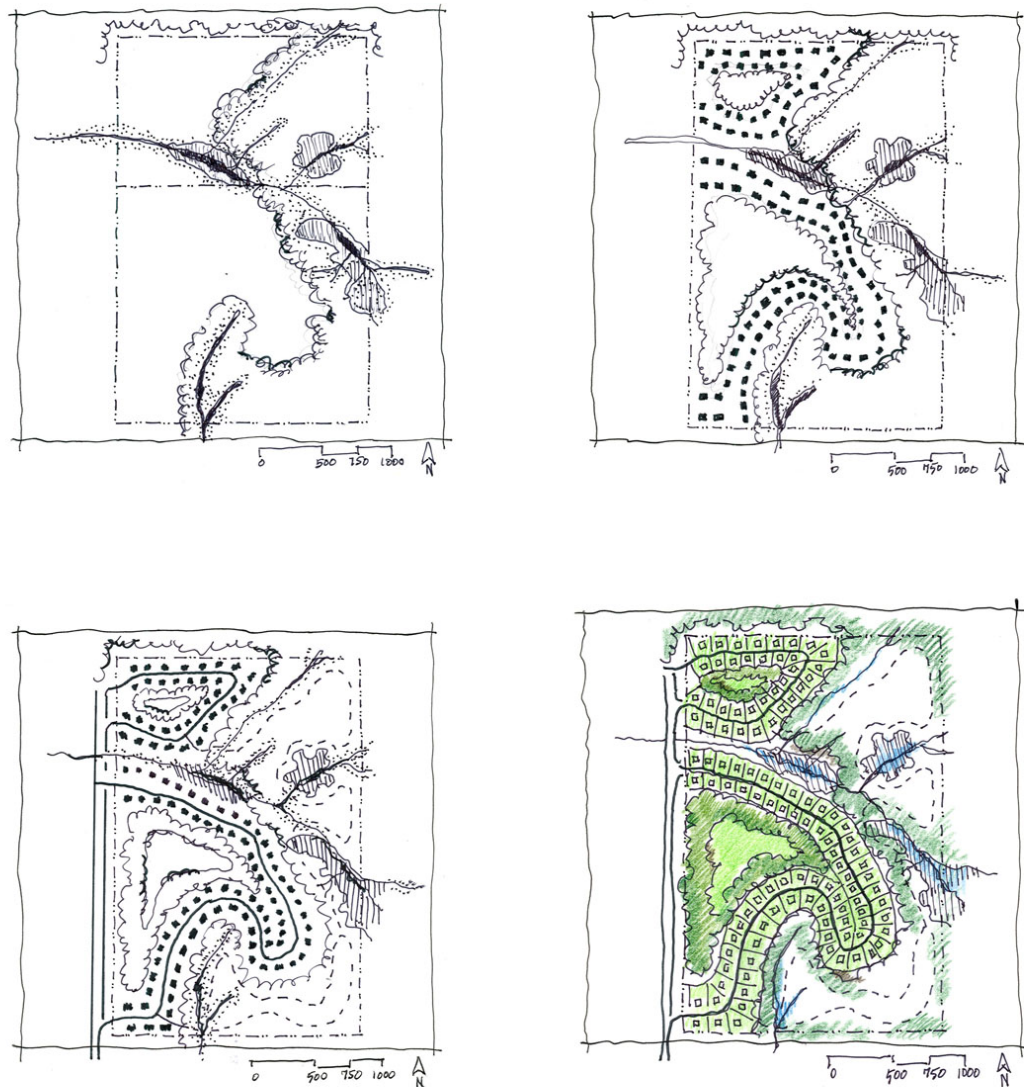


Figure 5-19 4-Step Conservation Subdivision Design Process Drawing: K. Heiss

Many more concepts should be run through and tested with clients - but the 4-step process is always the same. As sketchy as the above plan is, it is sensitive to the site hydrology, preserves the cypress stands and mixed hardwood swamp, builds primarily on the best drained soils on the site, and includes lots of conservation easement area, buffers and trails.

Comparing Site Plans

An actual site plan process requires many revisions and communication back and forth between the client and often several types of land planners. Below are the graphic results for the difference between the actual Rosemont on the left and the final conceptual plan, on the right.



Figure 5-20 Conceptual Site Plan Comparison (Rosemont, left; CSD concept, right)

Notice that the original Rosemont plan does not have unbroken wildlife corridors or make much connection to the off-site undeveloped forest to the north. The CSD plan does provide a large, linked wildlife corridor that also connects to existing forests off-site. The CSD has a large central staged retention pond (11 -1/2 acres) with meandering perimeter for enhanced visual interest. In the new conceptual plan there are trails and boardwalks to make the conservation area accessible. Additionally, there is room for a

beautiful park in the triangular bit of ground between housing modules, in the central area.

The layout for the CSD is more urban and could easily contain a neighborhood shopping center and some multifamily townhouses. Additionally, more residents will have views of the conservation area and access to nature through the trails. Moreover, each of the CSD housing block modules have a central cul-de-sac that is depressed to act as a bioretention area and as a grassy park for the residents whose homes encircle it.

There is area between the housing modules that is planned for vegetated swales to collect runoff from the roofs, streets, and drives. The vegetated swales are attractively landscaped and provide welcome natural views as well as improving water quality.

Design Development - Pond Level Concept Generation

Following, is a section view of a moderate shoreline fringe and a moderate emergent aquatic zone. No plants are so high that they block views, and the trails provide safe access around the pond.



Figure 5-21 Section view of an enhanced stormwater retention pond edge

Below is a section of a sediment forebay. The inlet has limerock around it to

prevent erosion. The first shallow pool or the forebay, is planted with Pickerelweed (*pontederia*) to filter out excess nutrients and remaining sediments. A weir controls the water level into the next stage.

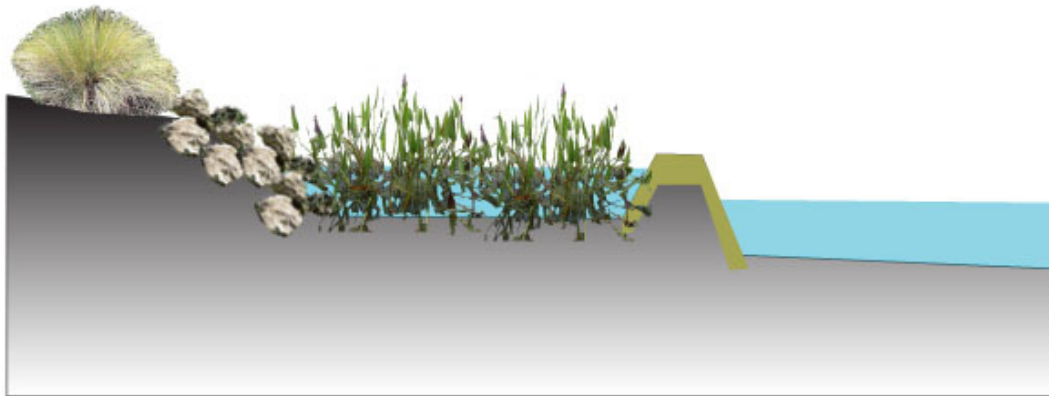


Figure 5-22 Section View of Sediment Forebay Graphic: K. Heiss

Implementation

Construction

Phasing of construction is important for two reasons; 1) less overall compaction of soil by heavy equipment, and, 2) less erosion caused by the entire site being cleared at once.

Top soil should be spoiled (saved) in the form of berms to prevent runoff escaping and area and to infiltrate the sediments the runoff is carrying – which is using the top soil as a temporary check dam.

During site clearing, in preparation for construction, is the time to thin the wooded areas so that the finer trees will be healthier.

Operations and Maintenance

Nassuaer's 'Cues to Care' discussed in Chapter 2, really comes into play in the landscaping, and the general grounds maintenance. What are signs of human intent after all but maintenance and care for a place? Below, are cues that would relate specifically to an enhanced, stormwater retention pond that is a site amenity.

Architectural cues

Boardwalk with railing.

Covered overlook areas – ex. an overlook gazebo that could be used for picnics.

Conservation area biking and walking trails.

Wildlife feeders and houses.

Planting Cues

Planting patterns – beds that border pond edge and trail edge.

Flowering trees and plants.

Mowing – mowed grass adjacent to naturalized beds.

Thinning or trimming understory or any low branches that block important views.

Conclusion

Registered landscape architects are trained in aesthetics, site planning, and amenity. Enhanced stormwater retention ponds in Conservation Subdivisions are a triple-win situation. Everyone will benefit from the improved natural views, water quality, and profitability of this method. Stormwater retention ponds that are designed for flood control and planted with turf grass to the waters edge are *not* the preferred aesthetic. This study proves that people want stormwater retention ponds that double as site amenities

and natural open spaces for exploration and relaxation.

APPENDIX A - THE SURVEY PACKAGE

January, 2007

Dear Neighbor,

I am a University of Florida Graduate student in the Department of Landscape Architecture. I am writing you because I am conducting a survey for my thesis regarding people's preferences for various retention pond edge treatments. This survey has been approved by the University of Florida, Institutional Review Board (see attached). I'd greatly appreciate your taking a few minutes to fill this survey out and then put the survey in the self-addressed, stamped envelope that I've provided to mail it back to me. The survey is completely anonymous; please do not write your name on it or the envelope. Your timely response is greatly appreciated. The more people who respond to this survey, the more meaningful it will be.

If you have any questions regarding the survey you will find my phone number as well as my thesis advisors contact information on the attached Informed Consent to Survey document.

Thank you for your help.

Sincerely,

Kim Heiss
Graduate Student
University of Florida
Department of Landscape Architecture

Informed Consent to Survey Document

My name is Kim Heiss and I am a graduate student in the Department of Landscape Architecture at the University of Florida. I am interested in researching visual preferences for varying degrees of naturalization surrounding stormwater detention ponds and what these preferences mean in terms of management and maintenance to the property owner.

This survey has no anticipated benefits or risks and should take 15 minutes to complete. You will be asked to answer a few demographic questions and then to rate some photographs based on how much you like the scene portrayed in the photograph. Although there is no direct compensation, your participation is important and very much appreciated. Thank you for your willingness to participate in this study.

Before beginning this survey, I would like to reassure you that as a participant of this study you have several very definite rights:

- There are no direct benefits, risks, or compensation to you for participating in this study.
- Your participation in this survey is entirely voluntary.
- You are free to refuse to answer any question at any time.
- You are free to withdraw from the survey at any time.
- Your identity will be kept confidential to the extent provided by law.
- This survey will be kept strictly confidential and will be available only to members of the research team.
- Excerpts of this survey may be made part of the final report, but under no circumstances will your name or any personally identifying characteristics, other than a subject number (for example 1, 2, or 3), be included in this report.
- Survey forms will not bear your name or any personally identifying characteristics other than a subject number (for example 1, 2, or 3).

If you have any questions regarding this survey please feel free to ask me at any point in time or to contact me at (352) 381-8554. You may also contact my faculty supervisor, Les Linscott at (352) 392-6098 (ext. 325) [University of Florida, College of Design Construction, and Planning, Department of Landscape Architecture, PO Box 115704, Gainesville, FL, 32611-5704]. You may also contact my supervisor, Gary Purdum at (352) 392-6098 (ext. 329). For questions about your rights as a research participant, please contact the University of Florida Institutional Review Board at (352) 392-0433 [University of Florida, Psychology Building, Room 98A, Gainesville, FL].

I have read the above description. I voluntarily agree to participate in this study and have received a copy of this document.

Approved by
University of Florida
Institutional Review Board 02
Protocol # 2006-U-0823

Survey Questionnaire

Thank you for taking part in this survey which may help to improve water quality, wildlife habitat, and the aesthetics of stormwater detention ponds. *Please do not write your name on the survey.*

Occupation: _____

Education (highest level and/or field of study): _____

Please circle one of the following as relates to your current type of housing:

Single family home Apartment Condominium Townhouse

Do you rent _____ or own _____ your current housing? (please check one)

Is the setting you live in now (please check one):

urban _____; suburban _____; or rural: _____

Do you do any of the following outdoor leisure and fitness activities (**circle** all that apply):

Jogging Biking Walking Gardening

Do you do any of the following outdoor activities (**circle** all that apply):

Hiking Birdwatching Kayaking/Canoeing Fishing

Camping Hunting

How important is it for you to live near or have access to a natural area?

1 = not at all 2 = a little 3 = somewhat 4 = important 5 = very important

Do you belong to any of the following environmental organizations (circle all that apply):

Audubon Sierra Club The Nature Conservancy

Other: _____

Please rate the scenes on the following pages by how much you would like to see the scene.

For each of the photographs, please indicate how much you like the scene. *The higher the number you circle, the greater your preference for the scene.*

On a scale where: 1 = not at all 2 = a little 3 = some 4 = quite a bit 5 = like it very much



1 2 3 4 5



1 2 3 4 5



1 2 3 4 5



1 2 3 4 5



1 2 3 4 5



1 2 3 4 5

For each of the photographs, please indicate how much you like the scene. The higher the number you circle, the greater your preference for the scene.

On a scale where: 1 = not at all 2 = a little 3 = some 4 = quite a bit 5 = like it very much



1 2 3 4 5



1 2 3 4 5



1 2 3 4 5



1 2 3 4 5



1 2 3 4 5



1 2 3 4 5

For each of the photographs, please indicate how much you like the scene. *The higher the number you circle, the greater your preference for the scene.*

On a scale where: 1 = not at all 2 = a little 3 = some 4 = quite a bit 5 = like it very much



1 2 3 4 5



1 2 3 4 5



1 2 3 4 5



1 2 3 4 5



1 2 3 4 5



1 2 3 4 5

For each of the photographs, please indicate how much you like the scene. *The higher the number you circle, the greater your preference for the scene.*

On a scale where: 1 = not at all 2 = a little 3 = some 4 = quite a bit 5 = like it very much



1 2 3 4 5



1 2 3 4 5



1 2 3 4 5



1 2 3 4 5



1 2 3 4 5



1 2 3 4 5

For each of the photographs, please indicate how much you like the scene. *The higher the number you circle, the greater your preference for the scene.*

On a scale where: 1 = not at all 2 = a little 3 = some 4 = quite a bit 5 = like it very much



1 2 3 4 5



1 2 3 4 5



1 2 3 4 5

Please rank the scenes from 1-3, with 1 being your favorite and 3 being your least favorite.

View from House A: Rank: _____



View from House B: Rank: _____



View from House C: Rank: _____



What was the purchase price for your current house? _____

What percentage of your homes price would you be willing to pay for a view such as the one you ranked as a favorite in the scenes above?: _____

Please read this first and then rate each picture...

Why shallow-sloping retention ponds are important for wading birds:

Florida is known for its many beautiful wading birds such as egrets, herons, ibises, and cranes. Our wading birds forage for food in water that is no deeper than a foot or two, for snails, frogs, or small fish. Some of the plants that grow in the shallow water are; Pickerel Weed, Cardinal Flower, Duck Potato, and Crinum Lily. These plants all have attractive flowers and foliage and do not grow high enough to block views. The scarlet flowers of the Cardinal Flower plant provide nectar for butterflies and hummingbirds as well.

Unfortunately, most retention ponds are dug so that their banks drop steeply to a great depth to provide the largest amount of water storage for the least amount of land use. Sadly, this approach deprives wading birds of a place to forage for food, and water-loving plants a place to grow. Shallower edges teaming with plant life are more like natural ponds and lakes.

If retention ponds were designed to be shallow near their edges they would be great places for our wading birds to find food and for butterflies and hummingbirds to find nectar. The current home building boom in our State makes habitat loss the number one threat to wildlife. This small change in the design of retention ponds would improve water quality because plants absorb pollutants and prevent soil erosion.

Please rate each of the pictures of *different edge treatments* for retention ponds, according to how much you like each one.

On a scale where: 1 = not at all 2 = a little 3 = some 4 = quite a bit 5 = like it very much

All manicured lawn.



1 2 3 4 5

Lawn then water plants.



1 2 3 4 5

Naturalized.



1 2 3 4 5

Lawn then water plants then water lilies.



1 2 3 4 5

Please return your completed questionnaire and photo survey, as soon as possible, in the stamped, self-addressed envelope provided with the survey.

Please don't return the Informed Consent Document or my cover letter.

Thank you very much for your participation and timely response!

Please read this first and then rate each picture ...

Where will the wildlife live?

We all need food, shelter, clean air, and clean water to survive, and so do our fellow creatures. Acres of suburban lawns do not provide shelter or food for most wildlife. Mowed turf grass simply isn't tall enough to provide shelter and is typically cut before it produces seeds. Songbirds need shrubby trees and bushes that provide lots of hiding places and produce berries, such as holly trees, wax myrtles, and beautyberry. The many beautiful butterflies and hummingbirds you see rely on the flowers of plants that are typically 2 to 3 feet tall for nectar.

Besides creating large, wildlife-unfriendly lawns, we send precious rain water that runs off streets and rooftops underground into drains where wildlife can't get to it. Often, rain water runoff is held in retention ponds near our homes. Imagine if the fringes and shallow depths of retention ponds were planted with flowering, water-loving plants instead of mowed grass right to the waters edge. Imagine the food, water and shelter you would be creating for wildlife in your community. Water-loving plants also absorb many of the pollutants in the water.

Plants that stick out of the water a few feet also make a great place for snails to feed. Once wading birds know that there are snails to eat, they will come to eat too. Imagine seeing a limpkin or an egret foraging in a nearby pond. Having a variety of plants of different heights creates shelter and range of food sources for our wildlife.

Please rate each of the pictures of *different edge treatments* for retention ponds, according to how much you like each one.

On a scale where: 1 = not at all 2 = a little 3 = some 4 = quite a bit 5 = like it very much

All manicured lawn.



1 2 3 4 5

Lawn then water plants.



1 2 3 4 5

Naturalized.



1 2 3 4 5

Lawn then water plants then water lilies.



1 2 3 4 5

Please return your completed questionnaire and photo survey, as soon as possible in the stamped, self-addressed envelope provided with the survey.

Please don't return the Informed Consent Document or my cover letter.

Thank you very much for your participation and timely response!

APPENDIX B - OPEN SPACE ORDINANCE

Alachua County , Florida

Source: Unified Land Development Code, adopted as ordinance 05-10, 12/08/2005

Chapter 407. General Development Standards
Article 5. Open Space

Article 5 Open Space

407.51 Purpose

This Article implements the open space policies contained in the Future Land Use, Stormwater and the Conservation and Open Space Elements of the Alachua County Comprehensive Plan and provides for open space areas designed to protect and enhance natural resources, promote pedestrian connectivity and enhance recreational opportunities.

407.52 Minimum Open Space Requirement

Open space shall be provided on at least 20 percent of a development and shall be delineated on all development plans and plats. Within rural clustered subdivisions, as described in §407.77(b) of this Chapter, open space shall be provided on at least 50 percent of a development.

407.53 Primary Open Space Areas

When land development involves a parcel that contains any of the conservation areas listed in subsection (a), the open space requirements shall first be fulfilled with these areas and the required buffers. When the minimum requirement is not fulfilled with conservation areas, the requirements shall then be fulfilled with Natural Areas as listed in subsection (b).

(a) Conservation Areas and Associated Buffers

1. Wetlands;
2. Surface waters within private ownership;
3. 100 year floodplains;
4. Listed species habitat;
5. Strategic ecosystems; and
6. Significant geologic features.

(b) Natural Areas

Significant habitat or other natural features such as steep slopes, ridges, sinkhole areas, or areas that potentially could be utilized to enhance or restore natural features on or adjacent to the development site. This open space shall be useable to the extent consistent with the character and protection of the resource.

407.54 Secondary Open Space Areas

After conservation areas and associated buffers and other natural areas have been set aside as open space, any remaining required open space may then be fulfilled with the qualifying areas listed in this Section, based upon the type of development.

(a) Residential Developments

Within residential developments, the following areas shall be credited toward open space requirements:

1. Community Green Spaces

Pervious open spaces designed as active or passive recreation areas intended primarily for recreational or pedestrian use, such as community fields, greens, and pervious areas of plazas or squares. Pedestrian amenities and other minor structures that enhance the open space may be permitted within these qualifying open space areas.

Chapter 407. General Development Standards

Article 5. Open Space

2. Pedestrian Trails

Paved or mulched pedestrian trails located within a qualifying open space may be counted towards the required open space area.

3. Stormwater Management Areas

Stormwater management areas that are designed consistent with §407.56 and §407.57 may be considered as credit for up to one half of the required open space.

(b) Non-Residential Developments

Within non-residential developments, the following areas shall be credited toward open space requirements:

1. Community Green Spaces

Pervious open spaces designed as active or passive recreation areas intended primarily for recreational or pedestrian use, such as community fields, greens, and pervious areas of plazas or squares. Pedestrian amenities and other minor structures that enhance the open space may be permitted within these qualifying open space areas.

2. Landscaped areas

Landscaped areas with a minimum area of 500 square feet and a minimum width of 20 feet containing native species canopy and understory trees, shrubs, and groundcovers consistent with xeriscape principles.

3. Stormwater Management Areas

All portions of stormwater management areas that are designed consistent with §407.56 and §407.57 may be considered as credit for the required open space.

(c) Quality Mixed-Use Developments

All Community Green Spaces, Pedestrian Trails, Landscaped Areas as described above, as well as buffers, squares, parks, plazas, and all portions of stormwater management areas that are designed consistent with §407.56 and §407.57 shall be credited toward the required open space, for mixed-use developments that meet all of the following standards:

1. Achieve a gross residential density of at least six dwelling units per acre or a minimum of 90% of the maximum density allowed in the urban residential land use category designated on the Future Land Use Map.
2. Contain non-residential uses at a ratio of at least 150 square feet per each residential unit within the development.
3. Establish a vertical mixture of uses with a minimum of 10% of the non-residential square footage having residential uses above.
4. Meet all of the design and development standards for Traditional Neighborhood Developments outlined in Article 7, Chapter 407.

(d) Other Mixed-Use Developments

Within mixed-use developments that do not meet the standards in subsection (c) above, all Community Green Spaces and Pedestrian Trails as described above shall be credited toward the required open space. The proportion of residential to non-

Chapter 407. General Development Standards**Article 5. Open Space**

residential development will determine the portion of stormwater management areas that shall be credited, in accordance with subsections (a) and (b) above.

407.55 Designation of Open Space Areas

- (a) Prior to submitting a development plan or as part of the Pre-application conference, when applicable, an applicant shall consult with staff to identify the most appropriate portion of the development site to be designated as open space.
- (b) In addition to the specific standards and priorities set forth in this Article, the following goals shall guide the designation of open space:
 - 1. Open space areas shall be useable and contiguous to the extent consistent with the character and protection of the resource.
 - 2. Open spaces should be contiguous to greenways, trails, public parks, or other open spaces on adjoining parcels in order to promote the creation of larger open spaces with greater usability, resource protection, and connectivity.

407.56 Requirements for Stormwater Management Areas used as Open Space

Stormwater management systems shall be designed in accordance with Article 9 of this Chapter and must complement and be integrated with the other required open space areas. In addition to the design requirements of Article 9 for stormwater management areas, the following criteria shall apply in order to be considered as credit toward the open space requirement:

- (a) Stormwater management facilities shall be designed to provide a greater biological diversity, enhanced stormwater treatment, and a variety of hydrologic conditions by incorporating the following design features:
 - 1. Provide staged elevations within the treatment volume of the basin. The initial tier, or forbay, should be designed to capture the majority of the sediments. Additionally, baffles, islands, berms, channels and other similar measures may be incorporated to maximize the contact of the stormwater with the surfaces of the basin.
 - 2. At a minimum, one tree shall be planted for every 35 linear feet, or part thereof, of basin perimeter. Within the basin bottom, a variety of native trees shall be provided at an average of one tree every 35 feet on center. Spacing of trees may be closer when trees are planted in groups. Certified apparently weed free sod shall be used.
- (b) Retention/detention basins shall be designed with irregular shorelines to increase the overall length of shoreline.
- (c) A 12-foot-wide maintained pedestrian path shall be provided around the perimeter of the basin and be connected to pedestrian paths in other open spaces. No clearing, mowing or removal of native, non-invasive vegetation shall take place interior to this path. As an alternative, a designed landscape plan may be approved by the Development Review Committee that would provide greater or equal biological diversity and enhanced stormwater treatment.
- (d) Stormwater facilities designated as open space shall be managed to maintain no more than 5% cover of invasive nonnative plants.

407.57 Access to Open Space

- (a) Required open space shall be accessible from the development. Access to the open space areas shall be provided in the form of pedestrian paths that connect the open

Chapter 407. General Development Standards

Article 5. Open Space

space to the transportation network, the mowed path around stormwater facilities, and open spaces on adjacent developments. These pedestrian paths shall be shown clearly on the development plan, maintained, and marked formally at entrances with explanatory signs describing their function and purpose. When agricultural activities comprise part or all of the open space within a Rural/Agriculture Clustered Subdivision, accessibility to these areas is not required.

- (b) For purposes of this Section, the following factors shall be considered in determining whether the open space is useable and accessible:
 1. Areas useable for passive recreation such as walking, picnicking, wildlife viewing and similar activities shall be considered accessible for purposes of this requirement;
 2. Wet and natural areas that are not directly or easily accessible may be considered to meet the requirements of this Section if they can be viewed easily from adjacent land areas that are also part of the stormwater or open space system;
 3. A periodic lack of public access due to significant rainfall shall not disqualify such areas from counting toward the required open space percentage.
- (c) Basins that require fencing, as defined in §407.92(c), shall not be counted toward the required open space for a development. For basins that do not require fencing, decorative fencing may be added as an aesthetic feature, provided that it does not preclude access to the open space.

407.58 Protection and Maintenance of Open Space Areas

- (a) All open space areas shall be maintained and remain undeveloped.
- (b) All open space areas shall be defined in detail on the development plan and delineated on plats. It shall be a condition of all development approval that such open spaces shall remain as shown on the development plan or plat, shall remain useable and accessible as required by this Article, and shall be maintained accordingly. Any failure to abide by this condition shall be deemed a violation of the development plan or plat.
- (c) All conservation areas including those that contribute towards the required open space shall be identified and protected in accordance with Chapter 406 of this ULDC.
- (d) Where deemed necessary to ensure the protection or accessibility of the required open space, the approval of the development may be conditioned on the open space being protected by easements, restrictive covenants, or other legally enforceable instruments that run with the land. All such restrictions shall be recorded in the public records of Alachua County.
- (e) A responsible entity, which may include the owner, a property owner's association, the County, another public agency or a non-profit organization, shall be designated to be responsible for maintaining the open space in a manner that is consistent with all applicable County requirements and the purpose for which it was created.
- (f) Any conditions necessary for stormwater facilities to meet open space requirements shall be incorporated into the stormwater maintenance plan. The responsible entity is required to inform the acting maintenance contractors of these conditions.

Chapter 407. General Development Standards

Article 5. Open Space

407.59 Alternative Compliance

- (a) The provisions of this Article shall be liberally construed to effectively carry out the purpose and the intent of the Comprehensive Plan and of this Article in the interest of the health, safety and welfare of the residents of the County.
- (b) An applicant may submit an open space plan which varies from the strict application of the requirements of this Article in order to accommodate unique site features or characteristics, to provide specialized open space amenities, or to take advantage of innovative design. In no event, however, shall there be variation from the requirement to provide a minimum of 20% of the development site as open space area.
- (c) An alternative compliance open space plan may be approved only upon a finding that it fulfills the purpose and intent of the Comprehensive Plan and of this Article as well as or more effectively than would adherence to the strict requirements.
- (d) In evaluating proposed alternative compliance landscape or planting plans, considerations shall be given to proposals which preserve native vegetation and use xeriscape and other low water use landscape design principles and where the design ensures preservation of the maximum existing vegetation on the site.

REFERENCES

- Agresti, A., B. Finlay. 1986. *Statistical Methods for the Social Sciences*. Second Edition. Dellen Publishing Company. San Francisco, CA.
- Alachua County, FL. 2005a. *Unified Land Development Code. Chapter 407. Article 5 – Open Space*. Gainesville, FL. Adopted December 8, 2005.
- Alachua County, FL. 2005b. *Unified Land Development Code. Chapter 407. Article 9 – Stormwater Management*. Gainesville, FL. Adopted December 8, 2005.
- American Society of Civil Engineers (ASCE) and Environmental and Water Resources Institute of the ASCE (EWRI). 2006. *Standard Guidelines for the Design of Urban Stormwater Systems*. ASCE/EWRI 45-05., *Standard Guidelines for Installation of Urban Stormwater Systems*. ASCE/EWRI 46-05., *Standard Guidelines for the Operation and Maintenance of Urban Stormwater Systems*. ASCE/EWRI 47-05. Reston, VA.
- Arendt, R.G. 1996. *Conservation Design for Subdivisions: A Practical Guide to Creating Open Space Networks*. Island Press. Washington, DC.
- Arendt, R.G. 2007. “Conservation Subdivision Design” PowerPoint presentation. *Sustainable Growth Symposium, Lake County, Florida*. Florida Green Building Coalition, Inc., Naples, FL, February 16, 2007.
- Atlanta Regional Commission (ARC). 2001. *Georgia Stormwater Management Manual, Volume 2: technical handbook*. First Edition. Atlanta, GA. www.georgiastormwater.com
- Bay Area Stormwater Management Agencies Association (BASMAA). 1999. *Start at the Source: design guidance for stormwater quality protection*. PDF available online at <http://basmaa.org/documents/index.cfm?fuseaction=documentdetails&documentID=23>
- Boyt, F.L., S.E. Bayley, and J. Zoltek, Jr. 1977. Removal of nutrients from treated municipal wastewater by wetland vegetation. *J. Water Pollut. Control Fed.* 49:789-799.
- City of Gainesville, FL. 2006. *Code of Ordinances. Chapter 30, Article VII, Division 4 - Planned Development District*. Gainesville, FL. Adopted September 25, 2006.
- Clark, M. 2006. “Stormwater Pond Workshop for The Building Community” PowerPoint presentation. Millhopper Branch Library, Gainesville, FL, March 1, 2006.
-

-
- Clark, M., M. Otto. <?>. *Stormwater Ecological Enhancement Project*. Brochure available at the University of Florida, Natural Area Teaching Lab. Or from the Wetlands Club, PO Box 116350, University of Florida, Gainesville, FL 32611.
- Cox, D. 2002. *A Naturalist's Guide to Wetland Plants: An Ecology for Eastern North America*. Syracuse University Press. Syracuse, NY.
- Creswell, J. 2003. *Research Design: Qualitative, Quantitative and Mixed Methods Approaches*. Sage Publications, Thousand Oaks, CA.
- Debo, T.N., A.J. Reese. 1995. *Municipal Storm Water Management*. Lewis Publishers. Boca Raton, FL.
- Fader, S. 2000. *Density by Design: new directions in residential development*. 2nd ed. Washington, D.C. Urban Land Institute.
- Ferguson, B.K. 1998. *Introduction to Stormwater: Concept, Purpose, Design*. John Wiley & Sons, Inc. New York, NY.
- France, R.L. 2003. *Wetland Design: Principles and Practices for Landscape Architects and Land-Use Planners*. W.W. Norton, New York, NY.
- Garcia, T. 2007. email dated Friday, January 26, 2007.
- Herzog, T.R, Kaplan, S., & Kaplan, R. 1982. The prediction of preference for unfamiliar urban places. *Population and Environment*, 5, 43-59.
- Hinman, C. 2005. *Low Impact Development: technical guidance manual for Puget Sound*. Publication No. PSAT 05-03. Puget Sound Action Team, Washington State University. Copies available by request at www.psat.wa.gov
- Kaplan, R., S. Kaplan. 1995. *The Experience of Nature: A Psychological Perspective*. Ulrich's. Ann Arbor, MI.
- Main, M, G. Allen, K. Langeland. 1991. *Creating Wildlife Habitat with Native Florida Freshwater Wetland Plants*. IFAS Extension. CIR 912. University of Florida, Gainesville, FL.
- Martin, R. 1993. *Suburban Resident's Perception of Wildlife Habitat Patches and Corridors in Their Neighborhoods*. Unpublished thesis. University of Minnesota.
- Mays, L. (ed.) 2001. *Stormwater Collection Systems Design Handbook*. McGraw-Hill. New York, NY.
- Mitsch, W.J., K.C. Ewel. 1979. Comparative biomass and growth of cypress in Florida wetlands, *Am. Midl. Nat.* 101:417-426.
-

-
- Mitsch, W.J., J.G. Gosselink. 2000. *Wetlands*. Third Edition. John Wiley & Sons, Inc. New York, NY.
- Moore, D.S., G.P. McCabe. 1998. *Introduction to the Practice of Statistics*. Third Edition. W.H. Freeman and Company, New York, NY.
- Nassauer, J. 1993. "Ecological Function and the Perception of Suburban Residential Landscapes." In P.H. Gobster, ed. 55-60.
- Nassauer, J. 1995. "Messy Ecosystems, Orderly Frames." *Landscape Journal*. Vol. 14, No. 2, pp. 161-170.
- Perlman, D.L., J.C. Milder. 2005. *Practical Ecology for Planners, Developers, and Citizens*. Lincoln Institute of Land Policy. Island Press, WA.
- Purdum, E.D., 2002. *Florida Waters*. A water resources manual from Florida's Water Management Districts. www.sjrwmd.com.
- Schueler, T. R., H. K. Holland. 2000. *The Practice of Watershed Protection*. Center for Watershed Protection. Ellicott City, MD.
- Soil Conservation Service, 1985. *26 Ecological Communities of Florida*. Originally published by the Soil Conservation Society, Gainesville, Florida Chapter.
- St. Johns River Water Management District (SJRWMD). February 1, 2005. *Applicant's Handbook: Regulation of Stormwater Management Systems Chapter 40C-42*, F.A.C. Palatka, FL.
- Vileisis, A. 1997. *Discovering the Unknown Landscape: A History of America's Wetlands*. Island Press. Washington, DC.
- United States Department of Agriculture (USDA), Soil Conservation Service (SCS). <198->. *26 Ecological Communities of Florida*. <Washington, DC.??>
- United States Environmental Protection Agency (US EPA). 1999. *Preliminary Data Summary of Urban Storm Water Best Management Practices*. EPA-821-R-99-012. Office of Water. Washington, DC.
- US EPA. 1995. *Economic Benefits of Runoff Controls*. EPA/841/S-95/002. Office of Wetlands, Oceans, and Watersheds. Washington DC
- US EPA. 2004. *The Use of Best Management Practices (BMPs) in Urban Watersheds*. EPA/600/R-04/184. Office of Research and Development. Washington, DC.
-

Water Environment Federation (WEF) and American Society of Civil Engineers (ASCE).
1992. *Design and Construction of Urban Stormwater Management Systems*. WEF
Manual of Practice No. FD-20. ASCE Manual and Reports of Engineering Practice
No. 77. Alexandria, VA and Reston, VA.

BIOGRAPHICAL SKETCH

Kimberly S. Heiss was born and raised in Pennsylvania. She received a Bachelor of Fine Arts in Illustration in 1986, from the Philadelphia College of Art now called University of the Arts. After graduation she worked as an administrative coordinator for a non-profit cultural alliance in Philadelphia. She and her husband Richard have also traveled extensively including living in Paris for six months in 1997 – 1998 where they studied the French language at Alliance Francaise.

Ms. Heiss's continued interests in art, landscape, and conservation led to her decision to pursue a Master of Landscape Architecture degree from the University of Florida in the spring of 2003.