

LANDSCAPE RESEARCH RECORD

No. 2 | 2014

Layers: Landscape, City, and, Community

Landscape Research Record

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LANDSCAPE RESEARCH RECORDS, which are published annually, consist of papers on landscape architecture subject areas. Each issue is a collection of papers presented at the Council of Educators in Landscape Architecture annual conference of that year. Conference theme is expressed as the subtitle of *Landscape Research Record*. The views expressed in papers published in *Landscape Research Record* are those of the authors and do not necessarily reflect the views of the conference planning committee, or the Council of Educators in Landscape Architecture.

PEER REVIEW OF PAPERS: All papers published in *Landscape Research Record* have been reviewed and accepted for publication through the Council of Educators in Landscape Architecture's peer review process established according to procedures approved by the Board of the Council of Educators in Landscape Architecture. Reviewers are recruited by track chairs from among conference attendees and other outside experts. The track chairs also serve as co-editors in the peer review process. The Council of Educators in Landscape Architecture requires a minimum of two reviews; a decision is based on reviewer comments and resultant author revision. For details about the peer review process and reviewers' names, see the information on the inside back cover.

IN THIS ISSUE: In 2014, the conference committee accepted 370 abstracts for presentation and rejected 39 abstracts. Authors of these abstracts were invited to submit a full paper. A total of 41 papers were received. 30 papers were selected for peer review. Finally, 21 papers were accepted for publication in this issue. The organization of this issue follows the standard conference tracks listed in the table of contents.

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No. 2 | 2014

Layers: Landscape, City, and Community

A Peer-Reviewed Publication

Council of Educators in Landscape Architecture

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FOREWORD

Welcome to the second issue of *Landscape Research Record*, published by the Council of Educators in Landscape Architecture (CELA). In 2013, the CELA Board approved and adopted a procedure to become fully responsible for publishing peer-reviewed conference papers annually and named the publication *Landscape Research Record* (LRR). LRR is a post-conference publication and published online only.

This second issue of LRR is a collection of peer-reviewed papers presented at CELA 2014 hosted by the Morgan State University and University of Maryland as co-host, with the theme “Layers: Landscape, City, and, Community.” The conference called to address the following questions:

How is landscape employed to shape or revitalize local and regional communities, and the complex layers of ecology, economy, technology, culture and politics, be employed towards the purpose?

What are the emerging discourses, movements, practices and technologies around the idea of park, plaza, greenway, urban agriculture, vacant-to-values, national park, and other aspects of urban, rural, suburban, exurban, and the in-between landscapes, and what are their roles in the natural process of communities and transformation of social groups?

How are best practices sustained in the midst of political and economic realities, and what are the essential ingredients to ensure eco-centric strategies with people and communities in mind?

How does landscape engage the community in the decision-making process, and how does landscape serve as a catalyst to activate local culture and community?

This issue contains of 21 top-quality, peer-reviewed papers resulting from the conference. As Mary Anne Alabanza Akers stated in her foreword for the CELA 2014 conference proceedings, “these papers represent diversity in thought and context, they all point to the essence of landscape architecture, that is, environmental stewardship, ecological integrity, design aesthetics, effective communication, and human/social responsibility.” This issue is once again a testament to the contribution of a CELA annual conference to the discipline and profession.

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DESIGN EDUCATION AND PEDAGOGY

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THE THREE P'S: PLANTS, PLANTING DESIGN, AND THE PROFESSIONAL

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1 ABSTRACT

Many of today's landscape architecture practitioners and students entered the profession because of their love of nature and plants. As universities address many changes in professional course content, some of the original hallmarks have been arguably marginalized. Are landscape architects slowly abandoning the very materials that separate them from other design professionals: plants and planting design? A CELA paper presented 22 years ago stated that "planting design has always been an essential component of landscape architecture as viewed by the public and those in the field" (Koepke and Myers, 1992). The paper investigated then-current planting design trends by identifying and interviewing eleven professionals who described the role of plants in practice. A 2012 study provided information about plant-based course requirements in 46 of 67 accredited landscape architecture degree programs in the United States (Brittenuum, 2013). A wide array of plant-related course requirements was revealed. Findings from both studies indicated additional plant-based information from practitioners can clarify new educational directions. This paper presents information about plant usage in professional practice gathered through interviews with twenty-two landscape architecture practitioners. These recorded interviews were transcribed and analyzed to apprise educators about the role of plant-based information in today's professional practice. It provides annotated opinions of landscape architects and relevant insights that may serve to enlighten academics and highlight future demands on the profession and thus on graduates entering practice.

1.1 Keywords

plants, curriculum, landscape architecture professionals

2 INTRODUCTION

Landscape architecture educators and practitioners are currently discussing the role of plants and planting design in their discipline. For a profession that was founded on plant usage, reports of such discussions seem banal, but knowledge and use of plants in the profession has changed from its original plant application focus to other venues, thus prompting such conversations.

How use of plant materials in design has changed is largely a product of the advancement of science and technology and the demands of professional practice. Determining the prominence and breadth of plant-usage in practice should pertain directly and ideally to the way plants are taught in education—but does it?

Educators are trying to meet academic expectations in a myriad of ways, but the same advancements in technology have caused the body of landscape architecture information to burgeon. Student credit hours threaten to soar, and university administrators hold caps on degree requirements. Deciding what knowledge or skills can be compressed or sacrificed in these situations is a daunting challenge. A larger issue is whether reduced information will limit new graduates as they begin their careers.

Schools certainly have not abandoned the inclusion of plant materials and planting design in courses. In a 2012 survey about plant identification and planting design curriculum requirements, representatives in 46 of 68 accredited landscape architecture degrees responded about their respective curriculums (Brittenuum, 2012). It was found that plant-based education is still a strong component in a professional degree but has diminished considerably from such course inclusions documented only forty years ago (Peters and Martin, 1974). While undergraduate schools still require traditional courses—albeit with reduced content/credit hours to comply with degree requirements today, graduate degrees have a new array of requirements and emphases—some with few or little plant coursework.

Because the schools surveyed did not report that their curriculum requirements paralleled practice demands, it is not clear why educators

have taken certain independent and divergent tracks concerning plant course requirements, their application and design. Would educators benefit by knowing more about current practice needs in order to guide plant-related course inclusions and tactics? Added information might also reveal particular challenges in the profession that would direct specialties suggested from any course changes.

2.1 2012 Survey

A pilot study entitled “The Current State of Teaching about Plants in Landscape Architecture Education and Its Relevance to the Needs of Today’s Practice,” determined the role plants and planting design had in professional landscape architecture education (Brittenuum, 2013). By soliciting all directors of accredited landscape architecture departments in the United States, it was found that the changing face of the discipline impacted classroom time spent on elementary knowledge and skills. The fine line between committing too much or too little time to discipline basics particularly impacted the two courses that had been historically central to landscape architecture education: plant identification and planting design.

The vital question for today’s landscape architecture schools is not only *what to teach* about plants, but *how to apply* broader precepts to contemporary concerns. Dual undergraduate and graduate curricula that serves the beginning undergraduate student who has little basic understanding about certain knowledge often must relate to those who come to graduate school as first professional degree candidates and share a common classroom.

The survey found that almost all undergraduate schools teach plant identification and have a planting design studio. However graduate schools lean toward teaching seminars and studios about plant ecology and larger planning issues rather than the nuances of plant culture, construction and design. Of the total reporting schools all but 12 have both plant identification and design requirements. Of those 12, 9 have plant identification required but not a separate planting design course.

The survey also revealed that Plant Identification courses ranged from those requiring 9 hours of credit to those only assigned 1.5 hours. The most common identification course prototype gave three hours of credit (in 25 schools). Planting Design courses in 31 schools ranged from requiring 6 hours to 1.5 hours-- with the most common credits being 3 or 4 credit hours. The schools in this mid-

range used the studio/lecture format. This format was also used by most schools, 38 of 59 reporting. A surprising finding showed that most Plant Identification classes were not outsourced to other departments, such as horticulture. Only 22 degree programs outsourced Plant Identification instruction. This information tends to imply that landscape architecture faculty still have *some expertise* with plants. It does not reveal how many faculty have a high level of plant expertise however.

Almost all respondent schools believed that landscape architects should be required to know botanical plant names as taught in Plant Identification course while not all believed that Planting Design was absolutely necessary as a separate course. Many of these schools reported that a planting design component was included in the general design studio at either one or all levels. How evaluations of the planting design component were qualified in a broader studio setting was not clear. Was it compromised when factored into the larger whole, thus diminishing the emphasis and assessment?

Some educators surveyed believed that professional landscape architects should be inextricably tied to their knowledge of plants and plant ecology. One open-ended survey response proclaimed: “LAs design within ecosystems. Knowledge of landscape ecology and its subset, plant ecology, is vital. Plant ecology, including plant identification and planting design, is the most distinctive and critical component within the discipline of Landscape Architecture, otherwise, we’re not much different than such disciplines as urban and regional design.” New technology taxes most landscape architecture course content. Plant-related courses could relieve that burden by including specialty content items such as roof gardens, green roofs, vertical walls, and bioswales.

2.2 2012 Survey: Syllabi

The 2012 survey data supplied only an initial view of today’s plant-based, curriculum requirements. Because each university has a variety of such required courses, the survey findings were strengthened by a second phase of information gathering. Syllabi for required plant-related courses were solicited from the same accredited schools in order to examine the contents of the respective courses. While the responses were considerably smaller than the first survey, it could be easily determined that graduate and undergraduate course contents were markedly different. Therefore it was important to establish what central plant knowledge provided the best means to prepare any degree candidate for

professional work. Both professional degrees — undergraduate and graduate — could strive for such inclusions. The question was — who, if not practitioners, could best provide that information?

2.3 Interviewing Professionals

The third phase of the original 2012 study focused on data-gathering from practitioners. Professionals could have been approached by using questionnaires, but the interview method has been shown to be more adaptable and flexible as a technique of data collection (Bell, 1993). Interviews also have been shown to allow researchers more entry to a broader array of comments due to its open approach. Two ways of interviewing, the formal structured interview and the informal unstructured, posed divergent methods (Burgess, 1984). The structured interview is closer to the questionnaire approach with questions and answers posed in a set way. However a pattern of questions administered by rote tends to be unnatural and thus not commonly used by researchers (Burgess, 1984). However, questions administered in an unstructured way are time consuming and difficult to organize for information commonalities (Bell, 1993). Ideally it is reported that research interviews are more successful when they bridge the two extremes, allowing the interviewee to talk freely but with a looser, semi-structured topics or questions, ensuring all issues are covered (Bell, 1993; Burgess, 1984; Oppenheim, 1992). This method of interviewing professionals appeared to be the best method to use for the third phase of the original study.

Common sense directed the selection of interviewees. Innovative professionals known for exemplary planting design expertise have a wide range of plant-based understanding and education. Rather than collecting data from a random array of landscape architects who may or may not have practices that use informed plant knowledge, it was determined that a sample of only those who had intimate, yet knowledgeable experience about plants and planting design would be petitioned. The chosen interviewees were well-regarded either for their award-winning designs, for plant expertise or for tandem practice and educational experience. Rational consideration about what plant knowledge was current information in practice would logically come from those who excelled at such. Under these conditions, comparisons between practice and existing planting design education would hopefully fuel new ideas about the basics of teaching planting design and of applying them to foundations of both undergraduate and graduate education.

3 METHODOLOGY

3.1 Semi-Structured Approach

A good relationship with respondents is important to semi-structured interviews, and interviewers who undertake this method benefit from an informal setting using a clear protocol for questions (Bell, 1993; Burgess, 1984). Personal contact in a setting of their choice tends to put respondents at ease, but distance and expenses could inhibit an interviewer's progress and number of possible interviewees. Because of the time-span allowed for the research to be collected, edited and analyzed (seven months), a combination of interpersonal settings was determined to be most productive and timely. Using on-site and technological visits through Skype, it was determined that practitioners could be more relaxed and conversational. The interviewee could also select the environment where most comfortable and private. Each was contacted personally by email or telephone, and after confirming their willingness to participate, a date and time was mutually selected for the interview. Interviewees signed an informed consent document developed mutually by the University of Arkansas and the researcher. They also completed a form that allowed them opportunity to record their opinion about plant and plant-based information, indicating a rank for items related to current practice and trends.

Aspects of good practice for semi-structured interviews identified by Bell (1993), Burgess (1994) and Oppenheim (1992) were used in these interviews. 1) Interview sessions were introduced by stating the aim and use of the information gathered; 2) interviews were recorded and timed according to a pre-prescribed range; 3) leading questions guiding interviews were used to instigate conversation; 4) topics for discussion were noted by interviewer for complete inclusion by all; and 5) interruption of responses was avoided if possible.

3.2 Practitioners Bring Relevance to Curriculum Requirements

The method of collecting data from professionals was framed to make connections to known plant course information from the 2012 survey and syllabi content submittals. To verify what landscape architecture practitioners considered necessary plant knowledge and skills, correlation between educational and professional needs could be more clearly addressed. This convergent information could direct the creation of relevant plant-based courses.

Practitioners representing varying parts of the United States were contacted in order to gather a range of information. During the interviews, each professional was asked predetermined, but open-ended, questions about their own education and practice and about their work experience with young professionals. Other questions sought opinions on current trends of plant use. All questions allowed participants to answer freely. Their interviews were later professionally transcribed and compared, developing a range of information sets and providing direction for final interpretation. To organize all interviews, answers were arranged by topic, allowing the research to follow a variety of findings, yet ultimately centralizing information into reliable categories.

Over the course of seven months, over twenty practitioners were interviewed and data collected. Interviews lasted from 45 minutes to 1 ½ hours. Some professionals encouraged the interviewer to visit their landscape architecture projects or read books and articles they had authored. Some escorted the interviewer personally to important career projects and provided an orientation about the basis of the plants and design. While a list of the interviewees can be found at the end of this article, no comments have been attributed to any one individual in this report.

4 RESULTS: PROFESSIONAL INTER-VIEWS

All responses provided by professionals are arranged into four general topics: 1) General Professional Comments, 2) Professional Expertise Needed in Practice, 3) Faculty Knowledge and 4) Class-Related Information. They are categorically included below with pertinent samples of quotations that identify comment direction. An additional sub-topic category, Classroom Emphasis, further defined particular information for inclusion in courses, but it is not contained in this paper.

4.1 General Professional Comments

General Professional Comments had the least number of relevant responses, but one of the most important. Participants believed there was a need to establish professional planting design leaders today. It was a disconcerting comment as these persons were the leaders in that regard. Respondents believed that exemplary role models in planting design could potentially inspire and thus impact recognition of the importance of plant expertise in landscape architecture practice and education.

“They (schools) need to get more practitioners in to give. . . talks and create some

planting design (interest). Getting different voices is one thing I’d like to encourage. I don’t feel that practitioners are being brought in to talk to students about it nearly enough.”

The second most prevalent comment observed that plants had been largely lost as central elements in landscape architecture today, and landscape architecture professionals are not deemed as planting design experts today. In a narrative comment, a noted designer reported that he has been introduced by others at social gatherings as a landscape architect who “really knows something about plants too!”

When asked if they thought landscape architects could eventually be replaced by allied professions like engineers, horticulturists, and architects, over one-third answered in the affirmative. After some discussion, many of those first comments were expanded.

“I say we just always have to be vigilant and watch that (being displaced by others). A recent example, . . . a potential market share, is with green roofs Everybody seems to know it doesn’t take much research to find out that sedums are the best thing (to use). . . . Why should somebody hire a landscape architect to design the plants when they can just go and find this information and basically call it out. So you always have to preach the value that you can bring to the project. I don’t see that we’re being misplaced or displaced, but I think we always have to be on guard.”

Conversely, the professionals who did not believe landscape architects were endangered by allied professionals commented on their reasons. One conversation held that the landscape architects today had challenges but due to their education and capabilities, could measure up to those challenges.

“I’ve encountered very few engineers that think they can do it all, but they just think what they do is what is (more) important--that the rest of the stuff doesn’t matter. . . .It really is mostly the architects . . . but I say we don’t need to focus on the other professions as enemies. We’ve just got to lead . . . to step forward and take our role and not worry about it so much. . . As long as we keep doing it and expanding it and doing it better and growing ourselves and growing people as leaders, we don’t have to worry about them trying to take some things away from us.”

The end result of these conversations was that landscape architects had so much information that encompassed so many parts of design, they did not need to believe they could only get a small part of design practice. One professional commented; “Let’s just make the pie bigger, let’s

not fight over a piece of pie. We're the ones who are going to make the world better. . . and a big part of that has to be equity, social equity, cultural equity, economic equity." She added that landscape architects "aren't talking enough about the economic and cultural stuff. . .but the fact that "green sustainability has been our message" and now that others have embraced it, "we should regard that as huge success."

Landscape architects now are engaged more often with other professionals about design's big picture. "The architects are still the quarterback if the client hired them. But, we're just called upon to manage and be involved with many more things. . . because we're allowed to do it with state laws and even local regulations." Laws are key elements in most states to landscape architecture's role in obtaining work and managing it.

4.2 Professional Expertise Needed in Practice

The second topic heading, Professional Expertise Needed in Practice, contained three reoccurring comment categories: using plants in technological applications, actively branding and marketing the professional's plant expertise; and recognizing that landscape architects are *the only professionals* that are educated to use plant materials in design. They recognized that different USDA plant zones played into every school and professional office situation, but students should know where they might find new information if they move from one growing zone to another. Keeping abreast of new cultivars should be emphasized.

Professionals believed that work in their practice indicated students need to be introduced to a bounty of plants that cover ordinary situations and yet apply to new technological situations. They mentioned that traditional woody plant identification courses might include more than woody plants: some woody, some perennials, some herbaceous, and some grasses for particular applications. This abundance of plant identification items begs to increase the course load to more than one plant identification course however. They also mentioned that new graduate hires should reveal a passion in an area of practice to place themselves in an office. Plants link to almost any specialty. For example, "soils and geology and hydrology are clues to us of a student's interest. So try to cram more in, (but don't) dilute to a point that it could be detrimental to them."

Another question asked practitioners referred to changes in the profession since the time they entered it. All agreed that it had changed. When one respondent compared required plant-

based courses today to those he was expected to complete as an undergraduate, he remarked that there twice as many identification and planting design semesters that made up a richer curriculum twenty years ago. Professionals were all disappointed when told there were less, required plant courses. Those who were connected to education noted that some universities appear to have introduced more than the required plant courses. It was reported that one school provides an array of plant courses that enhance a student's particular level of interest, such as historic, urban or small-scale planting design. Many students transfer into degree programs with room for extra professional electives. The additional plant-course opportunities allow these students to take more electives and perhaps develop minors in planting design. That change toward more plant courses is a major development from only two or four required courses offered in many schools.

Professionals remarked that they wished students would come into practice with a love for plants. They appeared to look back on their plant-related, university experiences with fond memories. They remember details about plant courses that rendered them as lyrical and experimental experiences. These early experiences tend to mirror those first days in practice as well, revealing that the love of plants and experiences with them in class, transferred directly into their professional lives.

"There was a temporal dimension to the plants that was special in its implication. It was rhythmic, it was musical, and there were crescendos. All aspects of the plant, whether it was texture, flower, color, volumetric, all the cycles, was a much richer medium to work with. The planting plan was almost a conceptual understanding of what we would do in the field, and we implemented (plans) based on the material as it actually existed." Their descriptions of basic plant courses might invigorate and challenge many of the more ordinary plant-related studios of today.

Interest in plants has heightened recently for professionals, especially in the past six years. An American Society of Landscape Architects (ASLA), Planting Design Professional Practice Network has formed and national conference sessions on plants have risen from one to six offerings in that time. Louisiana State University is presently developing a Planting Design faculty chair, which will be fully endowed. Plantsmanship among landscape architecture professionals is definitely on the rise.

According to an interviewee, "I suspect the better firms are now looking at the richness of

understanding of plants within the composition--and their performance in various ways and not just plants as a horticultural element. These hybrid plants that seek to clean up sites, plants that (acclimate to) the subsurface conditions, plants in response to very particular circumstances are part of the vocabulary of practice. . . .I suspect they (offices) are looking not so much for a specific talent with plants but a comprehensive of how plants are a part of an expanded design palette over all.”

4.3 Faculty Knowledge Necessary

The third topic, Faculty Knowledge Necessary, had two major, but explicit, directives for schools. First, faculty should be well-grounded in horticulture expertise as well as other specialties so that they are ready to make critical links to plant applications no matter what the course content situation. Second, schools should make a conscious effort to hire new faculty with horticulture capabilities as older faculty retire. All those interviewed alluded to the need for a wide range of faculty competencies, but believed horticulture knowledge was key to a robust faculty profile.

One noted landscape architect commented on the direction that teaching about plants needs to go. “Plants are being seen more as parts of dynamic and changing systems, not visual elements that you plug into a design. In the old school way of learning about plants and landscape design you looked up a tree (in a resource book) and you saw it has a 25 to 30 foot spread and 60 feet tall, and you put it in a landscape with that in mind. (But) what you put in the landscape had about an eight foot spread and was about 12 feet tall. . . . The idea of plants as growing, changing, dynamic things I think is a relatively recent trend. That landscapes are dynamic systems that change, that shade develops over time and so the sun-loving plants that you put in are no longer appropriate for the landscape.”

The same plantsman also framed another opinion against his educational experience. In his discussion about how to teach about plants, he offered an observation comparing horticulture knowledge and ecological concerns. “I think back then -- I was at Penn with Ian McHarg -- and so you had the horticultural camp and you had the ecological camp. The ecological designers understood landscape as a living, dynamic system that was very complex and the horticultural designers saw things a little more simplified and didn't really understand that (other) kind of thing. These two people didn't talk to each other for a long time.”

4.4 Class-Related Comments

Finally, the fourth topic, Class-Related Comments, directed the most discussion. Comments centered around eight educational headings: 1) Students should receive critical information about plant ecosystems; 2) plant classes should be taught very early in the educational sequence; 3) schools should require both plant identification and planting design courses, 4) more than the required classes should be offered and encouraged as electives; 5) course interaction between horticulture and design students should be sought for emphasizing mutual learning experiences; 6) students should experience horticulture in natural settings and in a variety of situations; and 7) students should understand how planting design is executed in a variety of conditions, like engineered soils and restoration situations. One recurring notation was that students should be allowed to explore a variety of planting design experiences and solutions in the same situation—practicing design in one place/situation as layering systems in the four seasons.

Practitioners are generally concerned that students are not experiencing plants first-hand. Several stated that outdoor field trips and observation is key to understanding plants and their habitats. Sketching plants in the wild or as existing conditions on-site would make connections that no student can receive from researching plant material on-line or in a textbook.

One practitioner commented that educators should reverse the role of landscape architects in plant-related practice. He said, “We are educating the future stewards, protectors, first responders, healers of the environment, built and natural landscape.” While others did not agree totally with him, they did respect his position, no matter how lofty. “We (landscape architects) can't be everything but should be aware of what we are. . .for example, we (need to) look at systems because plants are involved in it. . .and the clue is because we're looking at it in terms of how those systems can work with other elements of the environment. . .it needs to be worked into planting design.”

To garner more professional expertise, those interviewed believed that plants should be introduced as companions to growing technological knowledge. One respected professional observed that landscape architects should be more sensitive to water conservation issues and to regional appropriateness of plant selection therein, adding that water conservation measures are prime considerations and trends today. Parlaying plant

knowledge into systems management was key to a vital practice.

They also believed that working with other professionals was an important element for practice, saying that the breadth and depth of projects today require a broad platform containing many professionals. “We (have) worked with 20 scientists, everything from ornithologists to herbalists, . . . There was a tremendous interest in bees and pollination. . . . I do find (that) educating the public is (also) important. . . . I feel like I fight that battle (of educating the public) almost every day because the public and other professionals do not totally realize what landscape architects do.”

At times this practitioner had to charm the client into hiring the correct professional for each professional job. “I had to think about letting them (the client) know that I wanted to talk to her (as well as the architect) and then I made it awkward (purposely), saying it right in front of him (the architect). Finally, the way I did it was sideways. I said, ‘this part of the project is about engineers and that is about water engineers that are going to have to work this out. This is not about architects or landscape architects at this point.’ Ultimately, the client got the message.” The correct professional was hired for the job to be accomplished.

5 PLANT AND PLANTING TRENDS

Planting design trend predictions generally vary among professionals and the firms for which they work. Below is a list of trends, some mentioning larger and others more detailed trends. The list might include other items, but interviewees mentioned these most often:

- A. “The Native Movement has certainly mushroomed in the last five years. You have to kind of start with natives as your base—as your baseline—then know when to add exotics on top of that.”
- B. “Meadows and woodlands. . . . Whenever we’re working in those kinds of precarious environments or unique environments we usually will bring in a meadow specialist, (for a meadow) or a forester (for a woodland restoration). So know your limitations as a landscape architect. Meadows aren’t easy. They are inexpensive but to get them to look like that is really not easy. . . . There is nothing easy about a meadow.”
- C. More limited irrigation application: “Even natives need water. . . . My reaction to irrigation is -- we like to put it in as insurance. Our clients are making a huge investment and you can lose it all if it’s

planted . . . then you go into a huge drought. . . . So we like to wean the gardens off irrigation (then). To get LEED points you’re allowed to have irrigation if you’re reusing surface water and storm water or if it’s temporary and once the plants are established using a plant palette that isn’t so dependent on watering.”

- D. Sustainable design, water resource management, natural systems. “If you look at the topics of ASLA annual meetings for the last few years, there aren’t any sessions that don’t have sustainability in the title. It’s the big catch phrase (along with the sustainable SITES initiative). . . . and a sub-category would be water-wise xeriscaping. You know, you’ve got bruises on your forehead from hitting your head on the wall (with public water boards). . . but (finally) now you hear, ‘so I see that you do xeriscaping, that’s what we want!’ and that means natural systems. . . . (Doing that) is a better use of our resources as opposed to aesthetics—that’s just decorative arts or something.” Another comment detailed reduced use of lawn. “Lawn is becoming a difficult—it’s sort of becoming a no, no in some circles because it is such an energy user. . . . It requires a lot of watering. And you can’t put out the sheep any more.” She added, “There is more emphasis on green now. Every politician and every sort of two-bit marketing person goes, ‘Well, can we do something green?’ Well, yeah, we’ve been doing something green for 30 years.”
- E. Return to planting design applications and knowledge in practice. Since the public believes that landscape architects know a tremendous amount about gardens and plants, then this perception should be taken seriously. “We do ourselves a great injustice by not honoring the very thing that they (clients) believe we know so much about. It looks like we are missing knowledge about things (now). Being known for plant knowledge is the way to get into the door of many projects and then we can open up other avenues with the client. “ One practitioner remarked, “the general public is less engaged outdoors in everything. Gardens are declining, in statistics, and people have less time and their houses are still bigger generally. But we are *required and mandated* to be green these days, especially in public projects. I think planting design . . . the opportunity for

really interesting planting design— is much better in the public sector now.“

- F. Health, safety, welfare applications as it relates to planting design: A noted horticulturist/practitioner pointed to this triad. “it’s almost a richer time than ever from a plant point of view. Even absolutely related to health, safety and welfare. So it’s kind of surprising to me that schools back away from that.” Licensure issues are not linked directly to planting design now; questions related to plants are amalgamated into obtuse questions about law enforcement security. Only two states have plant-related additions to the national licensure examination. Because states with only title laws will be challenged on those grounds, tying planting design to health/safety/welfare is only a matter of time. Practitioners believe planting design expertise will be rewarded soon.
- G. International work. Until more international landscape architecture schools supply needed education opportunities, leaders in the professional realm will come from the United States. A US practitioner whose firm does much international work has recently “completed a series of guidelines for the US State Department called *Embassy Perimeter Improvement Concepts*. Planting applications were not done with species; it was done on the scale of massing and sustainability.“
- H. Use of specialists in practice. “Landscape architects need to be trained to call on specialists when we need them; I think we *need to know* when we need them and that means we have to be grounded in plants and soil and water and know how to use them effectively.” Landscape architects need to know when to sell themselves and do it actively.
- I. Urban ecology: All design professionals must muster the courage to broker ethical and practical means for healthy and socially acceptable environments. Ushering viable plant materials into cities is paramount in providing healthy living situations. On practioner remarked; “(An understanding of) urban ecology as the way to be more sensitive to water conservation issues and to regional appropriateness of plant selection is obvious. Cities in the West, the dry West, require that water and water conservation

measures be taken into account in terms of plant selection.”

- J. Natural planting design: “This kind of design (natural planting) is based on a mixing of plants and not worrying about over composing. This type of design will ultimately have a sense of order to it, that’s part of the evolution. It doesn’t have everything lined up in a certain, overly naturalized way.” Overall, professionals believed that landscape architects need to study how plants acclimatize and morph into natural patterns. Students could begin this kind of understanding early in their education and be able to apply it in studio settings.
- K. Use of plants as a value-added component in construction. Plants can be assessed as part of things like: fire mitigation, environmental restoration, brown field reclamation, wetland mitigation and restoration.

One practitioner/educator summed up the many faces of horticultural design education simply. He believed that trends in landscape architecture which are tied directly to planting design in practice are “some of the toughest and most elusive things to teach and to do-- to practice. It so often falls to a subjective sense of things and those are hard things to get past in teaching—teaching from a rational, objective point of view. Sure there’s intuition but there’s got to be some strategy, there’s got to be some logic as to how you choose plants.”

6 SUMMARY

Professionals working today witness new planting design and sustainability trends and have important ideas about their own needs as well as educational direction. Therefore developing any new course that is relevant in either plant identification or design can benefit from information about professional, innovative standards of planting design.

Professionals seem to agree that landscape architects are capable of leading a design team. Whether managing a project that is about plants, storm drainage, runoff, or other important issues, they can act as generalists and perform as an umbrella might, housing other professions on the design team. However landscape architects “should not be too focused on one and not the other”. Knowledge bits are all related and require common sense—but educated common sense.

Most interviewees believed that there is much work on the horizon for practicing landscape

architects. "With the emphasis on 'green' and what we are seeing in practice, it is a good time for landscape architects."

Both educators and practitioners expressed high aspirations for their students and the profession. If their passion for landscape architecture can be channeled and become convergent goals, the profession will more likely meet the challenges of a more dynamic design world in the future. The next step is for educators and practitioners to agree upon and plan what core elements should be found in such a robust set of plant-related objectives.

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MAKING MATERIALS MATTER IN LANDSCAPE ARCHITECTURE EDUCATION

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1 ABSTRACT

People live in a physical world surrounded by materials that are used to build what we need. Those that study landscape architecture attend accredited programs whose stated mission is to prepare them to enter a licensed design profession that addresses these needs. In this country, curricula are encouraged to have variations ensuring diversity and reflecting regional issues and institutional identities. Nevertheless, all students are required to take a class on “Site Design and Implementation: materials, methods, technologies, application” (LAAB, 2013, p.3.B), where competency means understanding the relationship between materials and methods of construction and design. This paper argues that a comprehensive approach to teaching building materials better serves design students. Rather than focusing on “how-to” guidelines or personal expositions, this approach incorporates the study of history and theory, and technology and practice – all referring to issues of sustainability. Thus connected, the materials class supplies the vocabulary for thinking about design, perception, and experience. This paper also reviews the research methods used to develop this approach, which is the subject of my recent book, The Innovative Use of Materials in Architecture and Landscape Architecture: History, Theory and Performance, (2014). Its fundamental premise is that innovation in design comes less from engineering extraordinary chemical compounds or complex assemblies, and more from asking questions pertinent to current concerns and responding in ways sympathetic to a material’s inherent character and capability. Using images of built details, this comprehensive approach helps students develop habits of observation, which lead to life-long learning in professional practice. Limited by a classroom delivery, a more robust student experience would also include activities in the field where the physicality of materials becomes increasingly apparent. In order to make materials matter in landscape architecture education, building materials must be linked to form as companions in design; not as an after-thought, but as a generator.

1.1 Keywords

building materials, sustainable construction, design education

2 INTRODUCTION

2.1 Materials and Design Education

Materials are physical and their distinct characteristics become known to people through their senses in perception. Seen and touched, sometimes heard, smelled and tasted, design education that leans toward framing the study of materials in terms of their abstract materiality risks forgetting about the physical properties of physical materials (Ingold, 2011, p.19-32). Landscape architecture programs often have fragmented approaches to the study of materials where students learn about them in design studios, construction technology classes, and history seminars that broadly consider the cultural conditions of various times. In many programs materials and methods of construction courses are taught by faculty with some experience in construction or by an adjunct with an active professional practice. The advantage is that their expertise provides students with practical information about building materials and methods used for durable construction, and sometimes with more advanced information on low-impact materials with capabilities of permeability, recyclability, and reflectivity, all important current issues for landscape architecture (www.asla.org/lowimpactmaterials.aspx).

However, landscape architecture is also an academic discipline where a deeper, more comprehensive understanding of any subject means learning its history and related design theories. In the case of building materials, the historic perspective investigates its evolving production and use, and the theoretical perspective explores links between design concepts and materials as they affect user perception and experience. In the United States, academic and professional organizations generally appreciate integrating history, theory, and practice in design education, although it is unclear how this appreciation is supported outside community

design studios. Research in Europe on landscape architecture education, such as the ECLAS Report, Version 26 (September, 2010), concludes that a comprehensive approach is required for students to understand *processes*, and not just acquire *facts*, in order to be well prepared for practice (www.eclas.org/accreditation-advice.php: 4.1). A subject such as building materials requires information about technical facts as well as facts about processes, and the productive inquiry questions “what,” “how,” and “why,” which are all grounded in thinking about cultural associations and historical contexts (Murphy, 2005, p.34). In the study of materials, a comprehensive approach supports more informed judgements about the suitable fit of a material choice to its intended application. For students, one lasting benefit of this approach is that they may develop habits of inquiry that continue during the subsequent practice of landscape architecture.

2.2 The Pedagogical Situation

CELA annual conferences have a dedicated track for research on design education and pedagogy. Searching the Abstracts in this track from the past five years, not a single title included the word “material.” Recent articles in *Landscape Journal* are also focused elsewhere, with the exception of “Form, Utility, and the Aesthetics of Thrift in Design Education” by Catherine Dee, where the “neglect of ‘form’ and material practice in teaching institutions” is noted and a case is made for teaching materials as craft (2010, p.21). Perhaps scholars consider this void filled in part by the publications on landscape materials and detailing by Niall Kirkwood (1999 and 2004) and more recently by Ryan, Allen and Rand’s *Detailing for Landscape Architects* (2011). The study of the physical landscape has not been neglected with many books including Dee’s work on aesthetic, spatial, and experiential concepts (2001), and on all issues of site sustainability by Meg Calkins (2009). Also, many books on building materials for architecture are helpful to landscape architecture students, such as Victoria Ballard Bell and Patrick Rand’s *Materials for Design* (2006 and 2014), and on design education, such as Marco Frascari’s *Eleven Exercises in the Art of Architectural Drawing* (2011). None of these books, however, address or propose approaches to teaching materials. This gap in landscape architecture education pedagogy may have the benefit of allowing great academic freedom for the subject instructor, but the comprehensive approach that is reviewed in this paper is intended to not only provide a more meaningful study of the subject for the student, but

also to allow this understanding to have a greater impact in their work on other subjects and especially in the design studio.

3 A COMPREHENSIVE APPROACH

3.1 The History of the Use of Materials

For designers, there is great value in knowing past situations before proposing future applications. Lasting techniques can be appreciated and potential errors avoided. While most materials weather and age, they do not have histories *per se* because history is a cultural construct of the human past. Nevertheless, there is a history to the use of every material. Research into the ways a particular material has evolved over time may refer to narrative accounts, which are evidence of then current practices (Deming and Swaffield, 2011, p.165). The treatises of natural philosophers, such as Pliny the Elder’s *Natural History*, written in the first century CE, and of material philosophers, such as Lucretius’s *On the Nature of Things*, written in the previous century, are examples appropriate to Western societies. Pliny’s work gives a thorough account of horticulture, agriculture, geology, and building materials and practices along with often vivid commentary on the ethical use of each material that reflected current social conditions. Lucretius’ poem, based on the scientific theories of Epicurus, considered the impact materials have on the thinking and sensations of people. Architectural treatises by architects from that time are a surviving source of information on garden design, plants, water management, city planning, and the design of the public realm. The most important treatise is Vitruvius’ *Ten Books on Architecture*, finished before 27 BCE, which is the oldest complete account on design from antiquity. Little survived between this book and Leon Battista Alberti’s *On the Art of Building in Ten Books*, written around 1450, a seminal book of the Renaissance. The second chapter on materials is particularly helpful because it not only describes physical materials including timber, stone, brick, lime, sand, metals and glass, but also explains methods professionals should employ in design and appropriate building techniques for durable construction. Essential writers in English from the nineteenth-century include landscape architects John Claudius Loudon in England and Andrew Jackson Downing in America, whose copious work covered the theory and practice of gardening and landscape architecture with many illustrations of assemblies and details, and examples of built projects.

The intention of these treatise writers was to record current building practices. Their aim was not necessarily objectivity, but rather the

epistemological status of their particular subject, which provides an insightful review that is helpful today (Ricoeur, 1984, p.204). Beyond this, another reason for studying these treatises is to help students broaden and refine the terminology they use to think and talk about their work. Things have names, and those words have etymological roots and linguistic patterns that reveal their unique and transcendent characteristics (Kripke, 1991). Good dictionaries include quotations from literature tracing the popular use of common words and their changing definitions. A valuable book that documents the evolution of landscape terms is Therese O'Malley's *Keywords of American Landscape Design* (2010), although its content is limited to the seventeenth to mid-nineteenth centuries. Students are not automatically literate regarding landscape elements and their accurate definitions, and a more precise understanding of what the words they use *mean* will help them understand and construct the *meaning* of their design proposals and its supporting elements.

3.2 Theories of Materials

Other philosophers, especially in the field of phenomenology, offer ways to consider the cultural significance and related symbolism societies have associated with particular materials. Martin Heidegger's essay "Building Dwelling Thinking" in *Poetry Language Thought* (1971) and Maurice Merleau-Ponty's *The Phenomenology of Perception* (1962) contribute to this investigation, and Gaston Bachelard's writings are particularly accessible to design students. In addition to his *The Poetics of Space* (1964), Bachelard wrote twenty-two books, of which five were on poetic images – material and dynamic – inspired by the transformative materials of earth, fire, water, and air (Jones, 1991, p.11). These base materials were first described by Empedocles in the fifth century BCE, as the doctrine of the four elements. Then, and for many centuries, the philosophical study of these elements was a way to understand the composition of the physical world and to understand the causes of change. Through literary references, Bachelard used these elements as an entree into understanding sensory experience because they are both materials and processes in themselves, and serve as vehicles that change matter into materials. The relationship between fire and metal, for instance, can lead to thinking of various metals as more than a choice between lamp post colors, or to considering air and stone as contrasting material objects in green roof design. Theories of materials studied by these philosophers examine cultural context, which cannot be

neglected in studios where students design for the intended experience of others. Fundamental questions of dwelling, especially needed in this Digital Age that is so full of abstraction and simulation, are particularly addressed in Bachelard's work.

Given that students are likely to focus on materials and methods of construction in a single class in a single semester, and yet they possess unlimited access to the full scope of human knowledge on their smart phones, a comprehensive approach that includes strategies to select and filter resources may develop lasting habits of research. Further, developing diagnostic strategies sharpens intuition, especially if students have the opportunity to evaluate built work (Deming and Swaffield, 2011, p.187-189). At a minimum, the study of every material should distinguish between its technical properties and its varying qualities for students to understand which aspects are basic and permanent, and which are open to change and innovation.

For example, methods of manufacturing brick have changed only slightly over centuries, gradually improving consistency, durability, and recycling potential. Nevertheless, any walk around a historic district will likely provide many examples of stable brick walls that are over a hundred years old and are likely to last another hundred years, and ten-year-old brick pavement that is cracked and needs replacing. Understanding the fundamental properties of brick, its technical production and conventional methods for durable construction, gives students the opportunity to question performative requirements and to discover opportunities for innovation. In the case of brick, this is not the bold but uninformed decision to use a stacking bond pattern that is prone to uneven settlement, especially in locations vulnerable to seismic activity, but perhaps of investigating the use of a microclimate created by the radiant heat from a south-facing brick wall, or the use of self-healing cement content in brick mortar that can flex with slight movement without failure. Beyond developing technical proficiency, a student might then wonder about *why* to use brick as opposed to another material. That theoretical question taps into the human dimension of a hand-placed brick and its cultural associations.

3.3 Sustainable Performance

Issues of sustainability – extraction methods, pre-consumer manufacturing, transportation distance, construction practices, use, and post-consumer recycling and repurposing – arise with each material differently (Calkins,

2009). Making design decisions about materials requires some information about each of these steps. Many students will not work in large offices where thorough research is done on every specified material and product, and even there, this work is sometimes not done thoroughly. Large or small, many firms rely on product representatives and suppliers who claim that certain sustainability standards have been met. The hasty professional depends on this information; the more thorough will know to ask for verification.

No class or book can remain current regarding the extensive research on sustainable materials and methods that is underway in this country and others. The U.S. government is continually publishing reports about materials used for construction, with information about supply sources and likely demand, alternatives, costs, building code compliance and performative quantitative data (see for instance, www.epa.gov). Students are familiar with seeking information online, but are often ill-equipped to search for pertinent resources regarding materials and data regarding consumption. Classes on materials can include resources such as online links to provide access to the most up-to-date information.

A comprehensive approach that studies the history of the production and use of building materials, theories that examine their significance, technological information and practical applications help students understand the opportunities and consequences of their design work. And the more they know about facts and processes, the more likely sustainable performance can be achieved. Talented students are anxious to “push the envelope” and a grateful society will appreciate this effort as long as it is not merely an exercise in egotistical vanity and a search for novelty, but rather questioning, and resolving, the true issues of design.

3.4 Limitations to This Approach

Teaching materials in a classroom has a predictable limitation. Even with well-prepared students, engaging lectures with informative images and lively discussions, the setting is interior and the topic is “out there.” Many students have never worked on a construction site or even been to one, and many programs do not have wood, glass, or metal shops, design/build courses, or collections of sample materials further diminishing student opportunities to work with materials physically. In their daily lives, many students do not know what they are seeing when they notice cracked brick pavers, rust on concrete surfaces, or splintered wood benches. Even if they instinctively

know that some material has failed, they lack the vocabulary to articulate and evaluate the design, construction, and maintenance issues, and to allow this observation to inform their design work. Teaching materials in a comprehensive manner acquaints students with technical vocabulary, inherent characteristics of materials, standard methods of construction, and issues of sustainability, and may give them experience designing and drawing details, but they remain removed from the physicality of actual materials. Field trips to projects under construction, to brick yards and stone quarries, to salvage yards for metal reclamation and re-purposing centers with stockpiles of heavy timber, stone block, and terra cotta ornament, and to building supply warehouses – especially those that supply “green” products – provides an extremely valuable added dimension to the study of materials. Seeing excavators in operation, concrete crushers turning demolished slabs into aggregate, or even discussing soil boring reports with structural engineers is beneficial and deepens the understanding of materials. If these field activities cannot be part of the course, then case study analysis assignments of local built projects that are either superior or disastrous examples of the use of materials can support the deeper learning experience for the student.

4 THE METHOD BEHIND A COMPREHENSIVE APPROACH

4.1 Writing about Materials

This comprehensive approach to teaching materials developed over many years. Classes varied in size and level with undergraduate and graduate students together studying architecture, landscape architecture, and urban design, and sometimes had an additional expectation of incorporating the preparation of construction documents. No single book was found that could be used as a class text. In an effort to fill this gap, my research in this field was recently published as *The Innovative Use of Materials in Architecture and Landscape Architecture: History, Theory and Performance*, (2014). Some familiar research methods were used in its preparation. A thorough literature review was conducted of relevant books on building materials that ranged from technical encyclopedias (Brady et al., 2002) and architectural guides (McMorrough, 2006) to books on material philosophy, treatises on design theory, and cultural studies. Clearly, there are favorite topics in books on building materials – concrete, wood, masonry, metals, and plastics – while other materials such as glass, ceramics, and vegetation are generally ignored because they are considered more

specialized. Some materials are so deeply connected with the fundamental tools of landscape architecture, such as shaping earth and managing water, that they are not thought of as distinct materials. Information from these books was organized in a spreadsheet and sorted by material.

4.2 Images of Materials

There are choices about what kind of images to use when teaching about materials. Typically, books on materials include photographs of significant built projects or profile professional firms who experiment with materials. These types of books may familiarize students with projects and firms, but do not necessarily provide information about materials and their strategic use. A student can imitate without understanding what they see. Images of built project details, on the other hand, show the formed material surface and often joinery methods, giving students illustrations of practical applications while avoiding distracting judgments about the overall design. In the mid-nineteenth century, the term “details” was “usually applied to the drawings on a larger scale for the use of builders, and generally called *working drawings*” (Gwilt, 1982, p.1187). For a drawing to “work,” the image had to be of a sufficient scale with dimensions, material representation, and technical information for the design to be constructed. For the student, looking at built details allows examination of particular materials free from programmatic issues. The student can consider the material first, and then the application in context. Looking at photographs of built details also helps students develop habits of critical observation by looking at images that are free of rendered illusion and not distorted by distance. John Locke’s evaluation of the camera obscura described one benefit of looking in this manner because it “allows the subject to guarantee and police the correspondence between exterior world and interior representation and to exclude anything disorderly or unruly” (Crary, 1998, p.42-43).

As part of this book project research, librarians at ASLA headquarters made available winning national award competition submissions kept on file. Each entry contains written descriptions and up to fifteen photographs as part of the submission package. Many of these projects have photographs and site plan drawings published when *Landscape Architecture Magazine* does a feature piece, but frequently the photographs of details are not included. For this book research, a second spreadsheet was prepared organizing hundreds of projects and thousands of photographs of all awarded projects

since 2005. The spreadsheet recorded the designer, project name and location, and completion date, and was sorted by material with added comments. The intent was to focus primarily on American landscape architects and built projects in the United States, because students are more likely to visit these places, and some day to work for these firms.

Additional images were added to the file following personal interviews at many small, mid-size, and large landscape architecture firms who generously opened their project files and shared their work. Sometimes innovative uses of materials were found on projects not submitted for an award, or on a small job that was the initial place of experimentation. Other firms were approached at professional conferences and academic symposia, and many later contributed photographs of their work for consideration. Also, professionals suggested interesting investigations being conducted by others. Using photographs of built work substantiates an insistence that materials are physical, and that when they are well-used, are evidence that the construction is durable.

5 A SAMPLE INVESTIGATION

5.1 Wood

If wood as a building material is studied following this comprehensive approach, then the subject begins with thinking about the general properties of trees. Trees are about half earth (carbon) and half air (oxygen and hydrogen), which accounts for their solid and liquid materiality, and makes some wood species better suited for certain purposes than others (Brady et al., 2002, p.1042). Of the estimated 10,000 species worldwide, about 50 hardwoods and 30 softwoods are commercially viable in the United States. Because a materials and methods of construction class is not a tree identification course, students do not need to be familiar with 80 species, only the ones that are well-adapted to the local climate and weather, and to know which produce extractives making them naturally resistant to pests, rot, and decay for more sustainable construction. They also need to know which joining techniques, treatments, and finishes suit the situation and anticipated maintenance procedures.

Using wood as a material must consider the “vital actions” of a tree that are part of the living activities of growth and sap production. Knowing the inherent characteristics of various species assists in the proper selection of wood types for the intended application. For example, there are four tree species that are sustainable choices in the temperate mid-Atlantic region: Bald cypress

(*Taxodium distichum*), Black locust (*Robinia pseudoacacia*), Eastern red cedar (*Juniperus virginiana*), and Eastern white oak (*Quercus alba*). They all have decay- and rot-resistance capabilities, but cannot be used interchangeably. Frank Lloyd Wright called cypress the “eternal wood” and used Louisiana “tidewater” cypress for cladding many house exteriors which have survived for decades, but the wood may be difficult to procure. Cedars are fast growing trees making their weaker lumber limited to short spans, which is ideal for furniture, but not wide, plant-bearing arbors or pergolas. Black locust is very durable and available in three grades, but is slightly poisonous if ingested, and must be carefully used in public places. White oak is less common than red oak and more expensive, but longer-lasting.

Students also need to know something of the structural properties of wood. Different species have different proportions of lignin that gives wood compressive strength, and cellulose structure that gives tensile strength. Few materials have as many practical applications as wood, which can be used vertically as posts, horizontally as beams, and as a surface with boards or planks. The spanning capability of wood has limits and requires structural calculations. Wood constructions deflect with weight, wind, and other forces, and this barely perceptible “give” makes it a good choice for a more comfortable walking experience when compared to concrete, for instance.

As a natural resource, wood is generally considered to be renewable, but there are many reservations about sustainably harvesting old-growth and second-growth forests and the consequent ecological disruption to forest habitats. The quality of wood from single species tree plantations is diminished because there is less competition for light and nutrients, which changes the structural strength of wood. Guidelines for sustainable design encourage repurposing timber from demolished structures, but that practice must take into account the transportation distance and erection difficulties of long elements. Also, recovering “sinker” logs can adversely affect wetlands because of the heavy equipment required to retrieve them (Calkins, 2009, p.294-299).

Thus introduced, students can now consider the evolving use of wood as a building material. Wood has been used by many cultures because it was readily available and could be worked with few tools by relatively unskilled labor. Traditionally, the lessons of wood-working depended on time-tested traditions. Architects (who were the general designers then) were responsible for knowing when to harvest trees, how long to

allow cut lumber to air-dry and in what conditions, how to test for structural integrity, and what wood species were best for specific purposes. For example, Vitruvius wrote about nine tree species noting, for instance, that straight fir was used for framing, dense oak for underground construction, alder for underwater pilings, and larch for paneling near fireplaces (II.IX.1). Pliny the Elder summarized a general appreciation saying that “trees and forests were thought of as her [the Earth’s] ultimate gift to mankind” (XII.1).

When considering a theory of wood as a material, different societies developed cultural associations related to the properties of wood, methods of joining, and the degree of finishing. For example, rustic structures made of minimally treated wood and retains its bark are still used in National Parks, and even some areas in New York’s Central Park (Eastern red cedar and Black locust are used in the Ramble and North Woods for benches, bridges, and railings; in the Shakespeare Garden for fencing and benches; and in Strawberry Fields for the entrance pergolas) because using wood in a more rustic state conveys a heightened sense of being close to nature (Miller, 2003, p.167 and www.centralparknyc.org). Highly crafted and finished wood surfaces, on the other hand, suggest refinement. At either extreme, design details showing how to connect wood elements need to minimize exposing cut ends to the weather and to slightly slope horizontal surfaces where exposed to rain; and that finishing products are needed to protect wood from damaging ultraviolet light (Fiest, 1983: 185-186).

5.2 Santa Fe Railyard Park and Plaza Utility Poles

One example of an innovative use of wood in landscape architecture is Ken Smith’s design for utility poles at the Santa Fe Railyard Park and Plaza. The site’s desert ecology called for the minimal visual presence of technology and mechanical equipment, but park programming required artificial light for public use after dark. The question was how to conceal the power line and conduit to utility pole light fixtures. The innovative use of the material came from understanding that wood scraps are processed and assembled into glued-laminated structural elements – typically beams – and that the beam could be turned vertically and used as a post. Then the conduit could run inside a cavity or raceway void in the assembly. This response was only possible because the designer understood the technical capability of reconstituted wood waste, and appreciated the role this seemingly insignificant detail

would have on the entire aesthetic perception of the park experience. Even unseen requirements of utility pole construction – they extend seven feet into the ground – supports associations to the way trees are rooted and are reminiscent of the way people can become grounded to place, especially in this design whose intent was to also restore degraded ecological processes (Smith, 2010). Knowing this, a different material could have been used for the poles, such as hollow metal tubes, but there would be a noticeable difference. This innovative use linked technical capability to tangible and intangible associations of wood as a material, with a more satisfying result.

6 CONCLUSION

A comprehensive approach to teaching building materials that includes the history of its use and theories based on inherent characteristics, along with technical facts and practical applications, better prepares students to understand the relationship between design and materials. Seeing images of how materials have been used effectively, strategically, and creatively is also important because their design work can take inspiration and develop from thinking about materials that are well-suited to particular applications. This approach cultivates their instincts for what is naturally appropriate versus what is artificially forced, and is therefore less likely to last. Professionals contend with clients, costs, and schedules, which are subjects most academic programs cannot cover extensively, but there is a great disadvantage to marginalizing the study of building materials and their sustainable applications. All landscape architecture must withstand the forces of nature and the rigors of public use, especially in urban settings, and the material elements that become the visual and tactile vocabulary of design not only make places, but also engage the user's imagination – consciously or not. Making materials matter in landscape architecture education is important because materials are inescapably linked to form as companions in design.

7 ACKNOWLEDGEMENTS

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LANDSCAPE AND LONGEVITY: PURSUING INTEGRATED AESTHETICS AND FUNCTION AT MULTIPLE SCALES IN NEW ORLEANS

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1 ABSTRACT

It is important to educate students that landscapes need to be beautiful as well as useful. These are attributes that should be considered integrally and holistically in the design of contemporary urban landscapes. Contemporary landscape architecture is appropriately concerned with the degradation of our urban environments, yet within the current economic climate the discipline is often relegated to a discussion of functional ecosystem services. But the true value of landscape architecture extends beyond performance criteria in the engagement of the unique conditions and specificity of a place. Unless urban landscape design projects are seen and experienced as cultural amenities, they won't be valued, loved, or taken care of by the citizens they are meant to serve. For landscapes in the city to last through inevitable change, they must adapt and evolve to meet the needs of their local community, ensuring ongoing involvement and appreciation. In addition to providing larger scale environmental value, they must integrally engage people in their everyday experiences. The collaborative Gutter to Gulf research/design studio exemplifies this approach of mobilizing technical performance to create engaging experiences. Student work in New Orleans over the past six years illustrates resilient landscape strategies that operate at multiple scales and demonstrate the holistic integration of aesthetics and function. Landscape projects function simultaneously at the scales of regional ecology, urban morphology and individual experience.

1.1 Keywords

aesthetics, utility, stormwater, resilience

2 DEFINING VALUE

In the world of design, aesthetics should not be seen as superfluous or superficial. Students need to learn the necessary value of both beauty and utility in the landscape. These attributes should be considered integrally and holistically in the design of contemporary urban landscapes in order for them to be sustained in the public realm. This is not a new concept, but one that needs to be remembered and reinforced in our landscape architecture design programs. In her 1995 essay, *Messy Ecosystems, Orderly Frames*, Joan Nassauer posits, "Novel landscape designs that improve ecological quality may not be appreciated or maintained if recognizable landscape language that communicates human intention is not part of the landscape. Similarly, ecologically valuable remnant landscapes may not be protected or maintained if the human intention to care for the landscape is not apparent." The role of care and intention in the landscape is clear, however twenty years later this concept needs to be expanded to include aesthetics and beauty as defining characteristics of the "recognizable landscape language" in contemporary culture.

Discourse in landscape architecture programs often focuses on issues of ecology and the environment. Students of landscape architecture rightfully need to be prepared as experts in these technical issues and the functional requirements necessary to design and build in urban contexts. But it has long been discussed in the academic context that "...design creativity has all too frequently been reduced to dimensions of environmental problem solving..." as stated by James Corner in his 1997 essay, *Ecology and Landscape as Agents of Creativity*. Landscape architectural education must ensure that "...the landscape architectural project becomes more about the invention of new forms and programs than the merely corrective measures of restoration." (Corner, 1997).

Landscape Architects are in a unique position to ensure that practical concerns can also

be the means to incredible design ends. Contemporary landscape architecture is appropriately concerned with the degradation of our urban environments, yet within the current economic climate the discipline is often relegated to a discussion of functional ecosystem services. But the true value of landscape architecture extends beyond performance criteria in the celebration of the unique conditions and specificity of a place. It is imperative that contemporary landscape architecture engages the community and fosters stewardship in addition to providing measurable functionality. Landscape architects must use their technical expertise and visualization skills to enact projects that operate on many scales, ranging from regional systems, civic infrastructure, neighborhood amenity, and citizen engagement. Landscape value needs to be legible to a wide variety of audiences. The historic role of aesthetics in the discipline can reinforce, enhance and transcend meaning derived from utilitarian performance.

Unless urban landscape design projects are seen and experienced as cultural amenities, they won't be valued, loved, or taken care of by the citizens they are meant to serve. For landscapes in the city to last through inevitable change, they must adapt and evolve to meet the needs of their local community, ensuring ongoing involvement and appreciation. In addition to providing larger scale environmental value, they must integrally engage people in their everyday experiences. Local advocacy and support are important in the initiation of a project, but even more critical in maintaining long-term success. For contemporary landscapes to flourish over time, they must engage multiple audiences and provide value across a multitude of scales. Functionality is not enough to engender value and ensure longevity. For urban landscapes to succeed and thrive, they need to be legible as beautiful amenities enriching everyday civic life. "For new forms of ecologically rich landscapes to be sustained, the forms must be recognized and perpetuated by people in everyday situations, maintaining the landscape and creating their own landscapes." (Nassauer, 1995).

3 SYNTHESIZING PERFORMANCE AND EXPERIENCE

In her manifesto titled, "Sustaining Beauty: The Performance of Appearance", Elizabeth Meyer asks, "Can landscape architects insert aesthetics into our discussions of sustainability?" The collaborative *Gutter to Gulf* research/design studio exemplifies this approach of mobilizing technical performance to create engaging experiences. A

teaching and research initiative begun in 2008 by Elise Shelley and Jane Wolff at the Daniels Faculty of Architecture, Landscape, and Design at the University of Toronto and Derek Hoferlin at the Sam Fox School of Design and Visual Arts at Washington University in St. Louis, the project began as a means to address the urgency that persisted in the region's landscape, infrastructure and urban circumstances post-Hurricane Katrina.

From the outset, the interest with *Gutter to Gulf* was to work with local designers and institutions to engage in cross-discipline discussions of long-term landscape resiliency in this context that was primarily focused on emergency response. It became quickly apparent that the stormwater challenges in New Orleans predated the storm. The issue was not only catastrophic events, but also everyday rain activity that posed a problem for this watery landscape in the Mississippi River Delta. The circumstances after catastrophic events often evoke the urgent desire to instigate beneficial change through design. Extreme conditions also provide rich grounds for innovative thinking and creative discourse. But the challenge in enacting any of these proposals comes in gaining local support and mobilizing community resources. Projects promoting landscape resiliency require quantifiable and meaningful measures of performance, but they also must communicate vision, beauty and amenity, enabling citizens to understand their value in both environmental and experiential terms.

For the last six years, the *Gutter to Gulf* initiative has been undertaken as the fourth and last core studio in the Masters of Landscape Architecture sequence at the University of Toronto, and it deals with cities as compendia of landscape systems. The studio has used water as a catalyst for the design of urban landscapes. Water raises design issues that are rhetorical—what, for instance, should the image of water be in urban environments, and how can that image help citizens understand the ecological conditions they inhabit?—and practical—how does rainwater hit the ground, travel through the city, and make its way to an open body of water? These issues cross disciplines and arenas: they engage planning, urban and landscape design, architecture, engineering, economics, and politics. They involve landscape types from public infrastructure to civic space to private gardens. They demand reckoning with ecological systems from regional to residential scales.

In New Orleans, hydrological dilemmas are both extreme and apparent. The issues of sea level rise, climate change and aging infrastructure in the

city provide a datum and point of departure for design challenges present in cities all over North America. However the vulnerability of these urban systems may not be apparent until they are illuminated by extreme events like Hurricane Katrina along the Gulf Coast, Super Storm Sandy along the Atlantic Seaboard, and even in Toronto, with 2013 rainstorms of record-setting intensity, which dramatically disrupted everyday life and surprised a city known for sixty years of thoughtful watershed management and planning.

The *Gutter to Gulf* studio has continued and evolved due to the effective design strategies that have emerged and proved useful in the local New Orleans context, and as powerful precedents for work throughout the United States and Canada.

4 IMAGINING ALTERNATIVE FUTURES

As a design/research studio initiative, *Gutter to Gulf* involves students in real-world design, that has the potential to be instrumental and useful beyond the student's individual portfolio, and through this attempts to facilitate the realization of projects and efforts that have little or no traction in a fractured, reactionary, post-disaster design climate. Helping students learn how their work can be a tool for advocacy and education was facilitated through local partnerships with sympathetic designers and organizations.

The studio work has ambitious goals: That the projects be able to demonstrate what landscape-scale stormwater management really looks like and why it is a desirable alternative to dependence on closed-system engineering; that functional performance and operation of these landscapes can be calculated and quantified with a level of accuracy that demonstrates a meaningful and legitimate strategy for landscape resilience; and lastly, that these spaces designed to address water management can also have inherent aesthetic value, serving greater community needs and fostering unique experiences.

In our initial efforts, students worked to help illuminate the critical issues by first establishing accurate base data that clarified the existing situation. Only in knowing how the systems operated, could realistic changes be proposed. The design proposals that emerged served to clarify what resilient landscape strategies might look like in the New Orleans context. Site research, field work, lectures by expert consultants, policy-makers, practitioners and community members all served to influence the knowledge of the place and the design strategies. These student designs describe a new, ecologically resilient vocabulary for

architectural, landscape, infrastructure, and urban conditions that enable communities to understand how spaces designed to help combat water issues, can also become powerful and meaningful places in everyday life. This material became the basis of an instructor-authored advocacy website that helped explain the reality of the situation to all interested parties: residents, designers and policy-makers from all disciplines. The website is a dissemination tool for the students' designs, making alternative futures visible and accessible to the citizens of New Orleans.

The *Gutter to Gulf* website, designed, written, and curated by Shelley, Wolff, and Hoeflerlin from their studio teaching work was launched in 2011. It includes documentation of the region's historical evolution and present circumstances; a taxonomy of water infrastructure; interactive tools to allow the comparison of physical and policy structures; field guides and reports; and design proposals that offer visions for future New Orleans. This website was used as education and outreach material for the recent Water Management Strategy for metropolitan New Orleans, demonstrating that design research undertaken by students can act as a tool for critical agency.

The website is a venue for viewing the extensive work produced by the students. It emphasizes the need to fully understand the conditions of a place, in order to make considered proposals. It links historic relationships, technical operations, and cultural meaning to future visions for the city. It makes student work accessible and gives it legitimacy in a larger discussion about the evolution of a place, the performance of landscape, and the role of beauty in engaging everyday experience.

5 PROPOSING CHANGE

The projects to be discussed are grouped according to the scale of the issues they raise: individual lots and blocks; neighborhoods; districts; and the city as a whole. Each project (and each scale) asks a unique set of questions about the definition of infrastructure in twenty-first century New Orleans and the role these functional systems play in the identity and aesthetics of a place. From the smallest elements of building — the individual lot and garden — to the largest — canals, levees, and waterways — the projects propose constructed and organic systems to manage water. They address regional systems at an incremental scale. Together these proposals begin to define a new vocabulary for urban water infrastructure. Each deals with a familiar landscape problem or type and

transforms it according to the specifics of the place and the dilemmas of the moment. These projects become tools to visualize of a new future for the inhabitants of this city. They offer alternative strategies for resilience, and illustrate what these types of landscapes could actually look like and the role they could play in civic life. They propose landscapes of performance and beauty.

has the power to effect significant change in the city's drainage regime in aggregation. Individual citizens or small groups can execute projects at the scale of the block (or its smaller components). They provide a means to remake the city's drainage system incrementally: every house and garden that retains its own runoff sends less water into the storm sewer system.

5.1 Block/Lot

Water management in small quantities — house by house, lot by lot, and block by block —

At this scale it is critical to illustrate to the individual homeowner that methods undertaken to reduce risk for their property, can also create aesthetic value and engaging experiences.

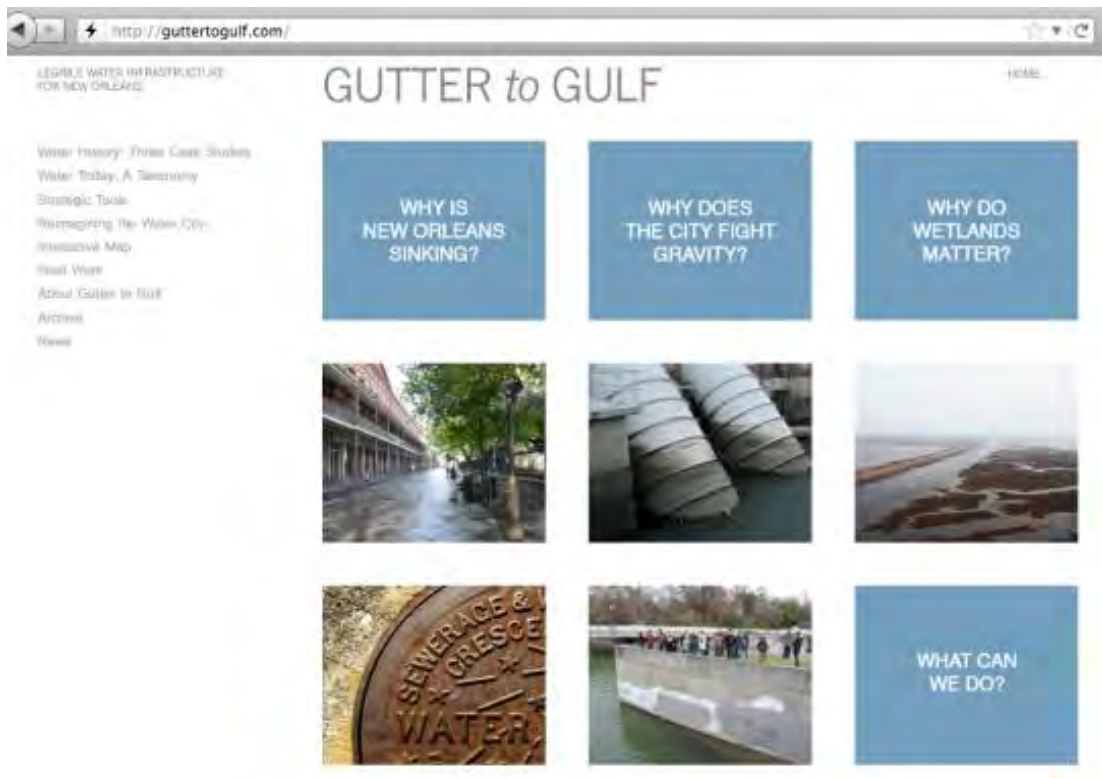


Figure 1. Gutter to Gulf Website (2012). www.guttertogulf.com

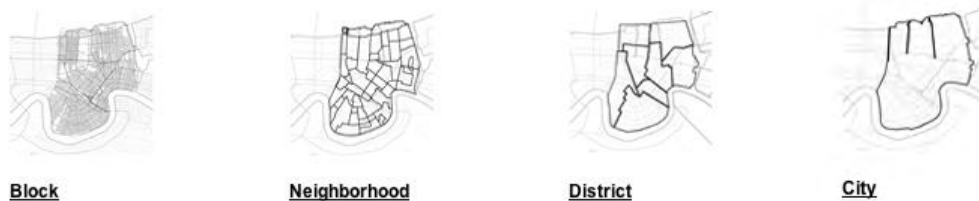


Figure 2. Scales of Project Influence (2012). www.guttertogulf.com

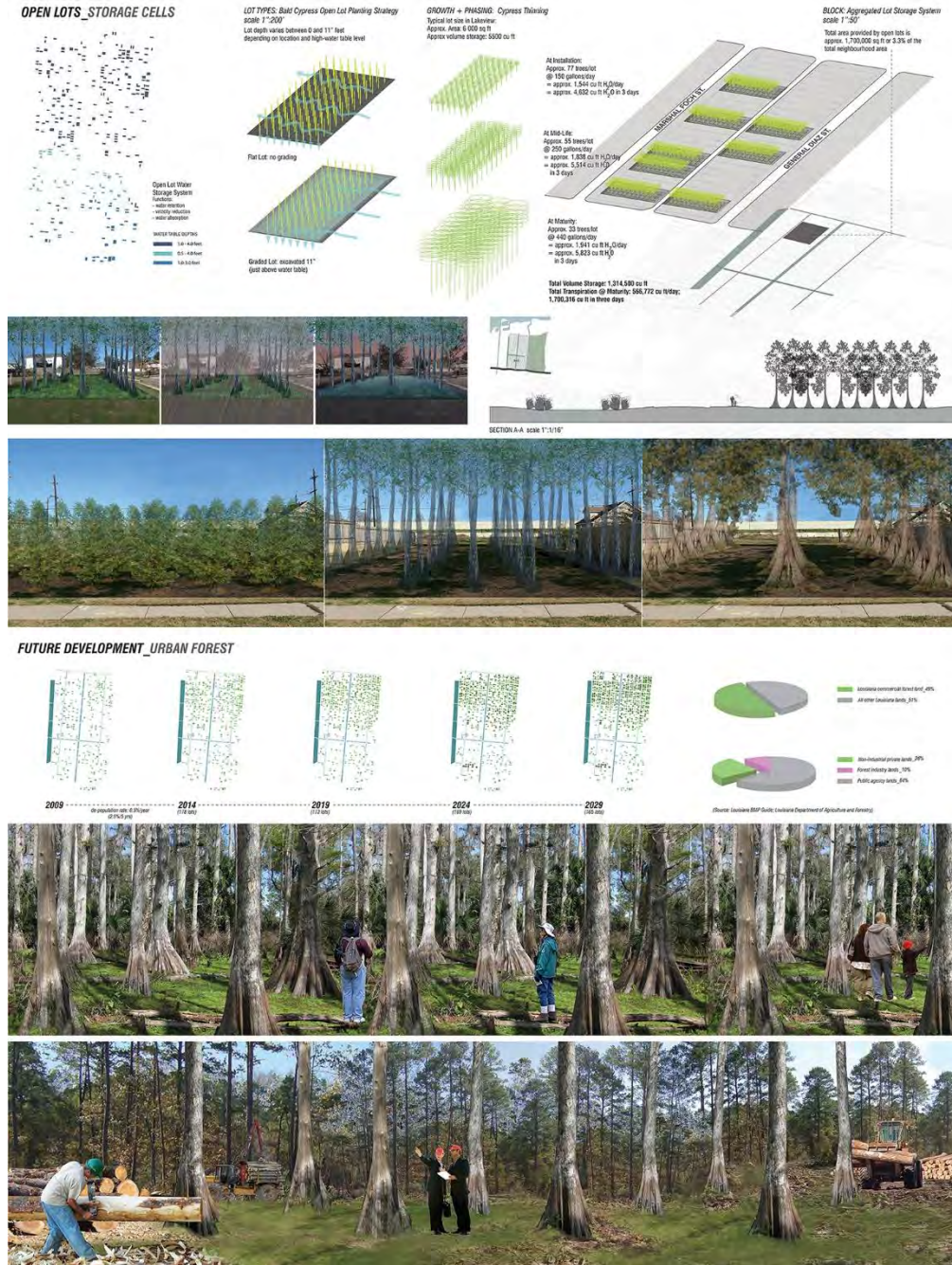


Figure 3. Tree Farm. Lara Semeniuk, University of Toronto, (2009). www.guttertogulf.com

In *Tree Farm* (Figure 3), an urban forestry project is proposed to fill vacant lots in the Lakeview neighborhood. Like many of the residential areas located near Lake Pontchartrain, Lakeview suffers from low elevations (as low as eight feet below sea level), unstable organic soils, and a high water table that restricts infiltration. As a result, the area is subject to significant flooding and vacancy remains high.

The same conditions that make Lakeview less than ideal for rebuilding provide an excellent environment for cypress farming. These hydrophilic trees absorb large quantities of water, and they also tolerate flooding, so the forest lots could serve as a water storage basin for the rest of the neighborhood. Keeping the forested lots wet would ameliorate the forces that cause ground elevations

to drop, and tree harvesting would provide new economic resources for the city.

Reintroducing cypress trees to the area is appropriate, as the site previously existed as a cypress swamp. In addition to integrated stormwater management, and the financial benefits of cypress farming, these lush woodlands, proposed to infill the many derelict lots, would provide a new image, aesthetic and habitat value to individual sites, the streetscapes and the overall neighborhood.

5.2 Neighborhood

New Orleans culture is strongly defined by neighborhoods, and since Hurricane Katrina, neighborhood groups have had tremendous success at mobilizing resources for rehabilitation. Projects at the neighborhood scale expand beyond the efforts of individual citizens to involve community groups and public entities. Collaboration and coordination among these groups can be complex, but it enables comprehensive action. *Rice Farm* (Figures 4 and 5)

combines water conveyance and storage with small-scale cooperative agriculture. Channels along the neutral grounds transport storm water to rice paddies cultivated on adjudicated properties. The paddies are built on concrete slabs to avoid soil contaminants, and the cultivation cycle is calibrated to seasonal rainfall patterns. The crop is not labor-intensive, and even small areas can produce enough rice to generate profit.

The project creates an opportunity for economic growth, community activity, education and employment through an agricultural process that introduces dramatic seasonal registration. The plant material itself provides an image of regrowth and regeneration for the area.

The challenge of this type of project is mobilizing neighborhood interest, creating sustainable maintenance practices and engaging the community with ongoing operations and events. The success of projects like “Grow Dat Youth Farm”, an initiative instigated by the Tulane City Center, provide inspiration for the future opportunities *Rice Farm* could enable.

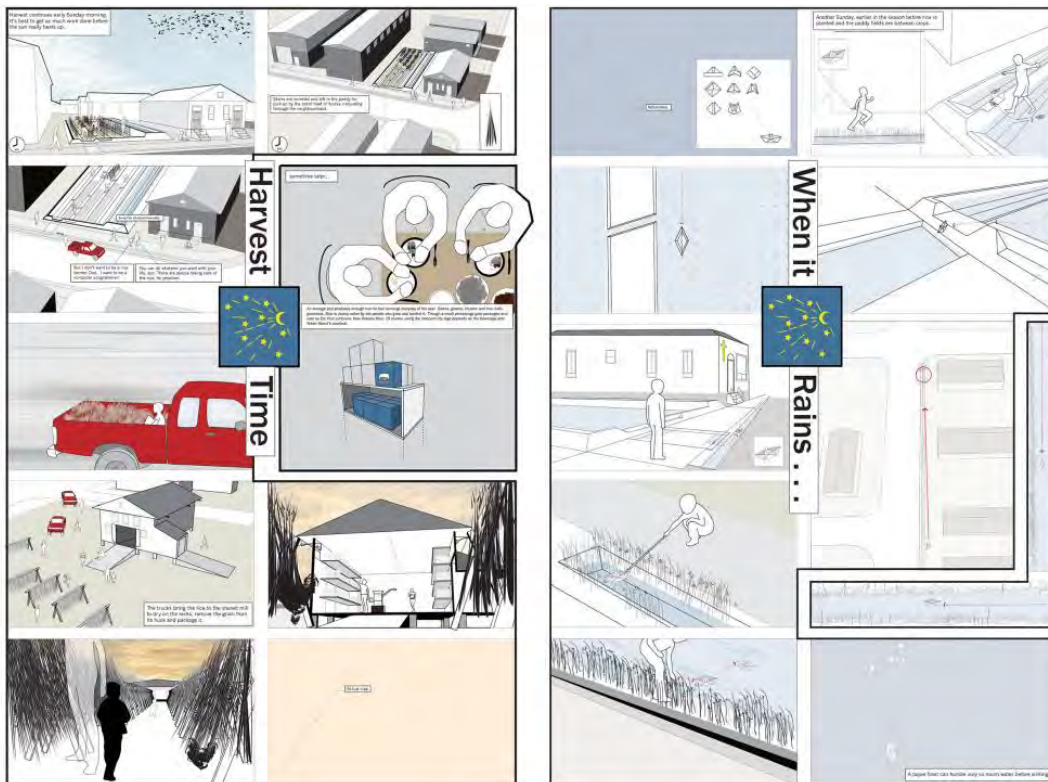


Figure 4. Rice Farm. Adam Bobbette and Karen May, University of Toronto, (2010).
www.guttertorgulf.com

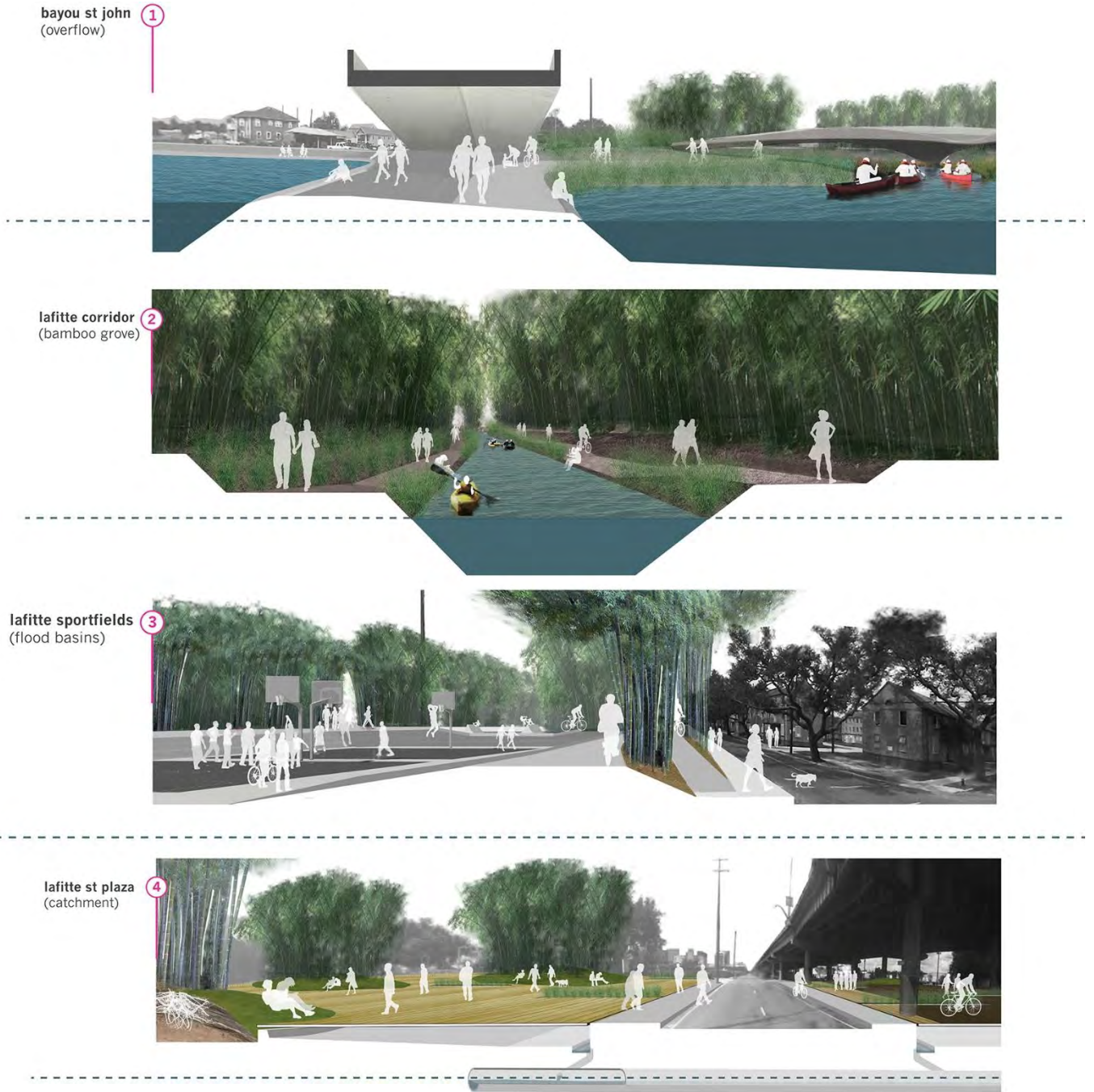


Figure 6. Corridor. Juan Robles, University of Toronto, (2010). www.guttertogulf.com

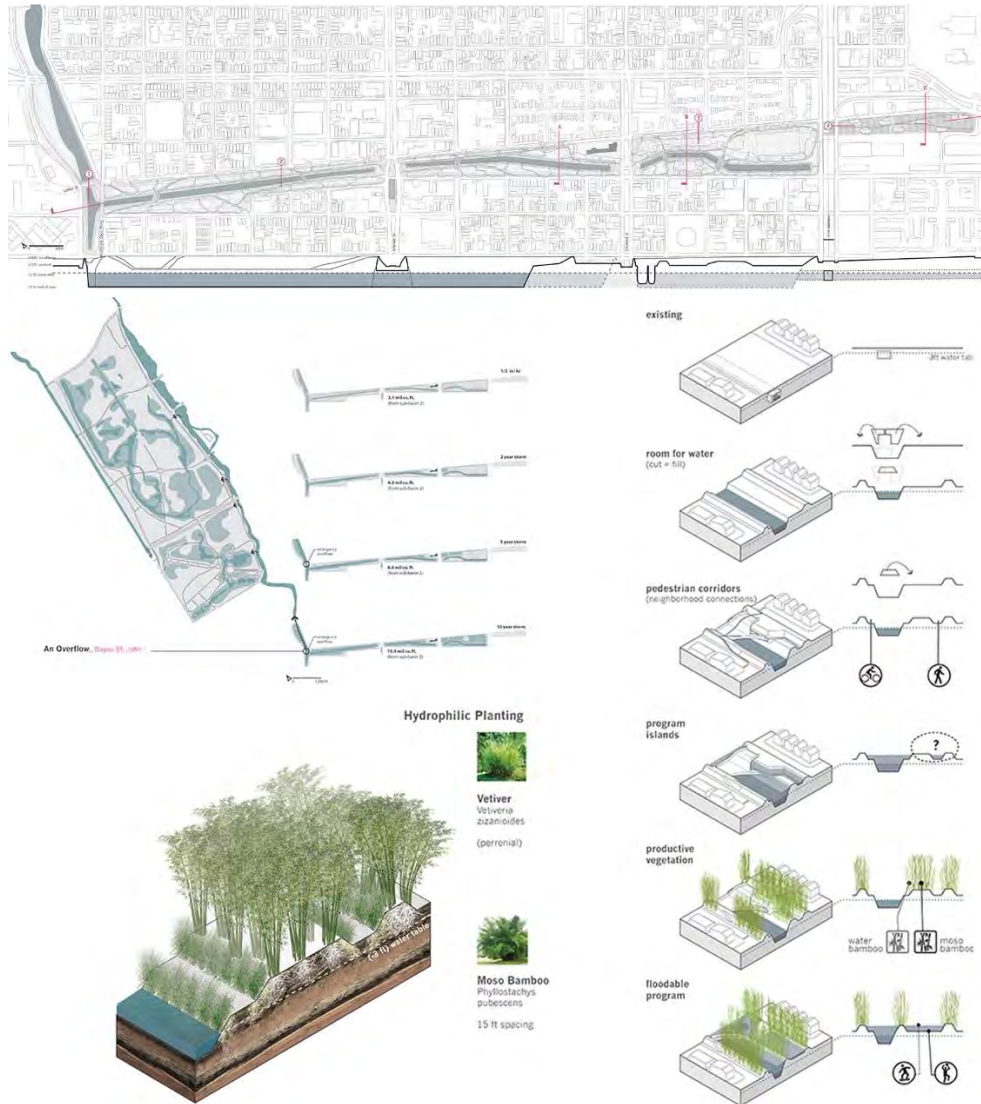


Figure 7. Corridor. Juan Robles, University of Toronto, (2010). www.guttertogulf.com

5.4 City

City systems can be singular entities that serve all of New Orleans's citizens (for example, City Park) or they can be repetitive systems that extend throughout town (for example, the highway system). They are administered by municipal agencies, and their scale is expansive enough to address drainage in substantial volumes.

Fish Farm (Figure 7) fills in a defunct industrial channel and reconfigures it for aquaculture. Many of New Orleans's industrial waterways have lost their economic value as the city's port moved downstream, out of the city's center. These industrial channels are polluted and hazardous, and their large scale makes them

dangerous sites for destructive wave action during storm surges.

Closing the channel and filling it with aquaculture eliminates the threat of storm surges. The dimensions of the new landscape are scaled to optimize production of catfish, crawfish, and rice. A wetland at the downstream end of the system absorbs the nutrients produced by fish farming and releases clean water into the main channel of the Mississippi River.

The immense size of this post-industrial landscape is reimagined with sublime beauty, power and presence. The scale of proposed activity and productivity on the site imbue the place with new meaning and function, in terms of economics, ecology, opportunity and aesthetics.

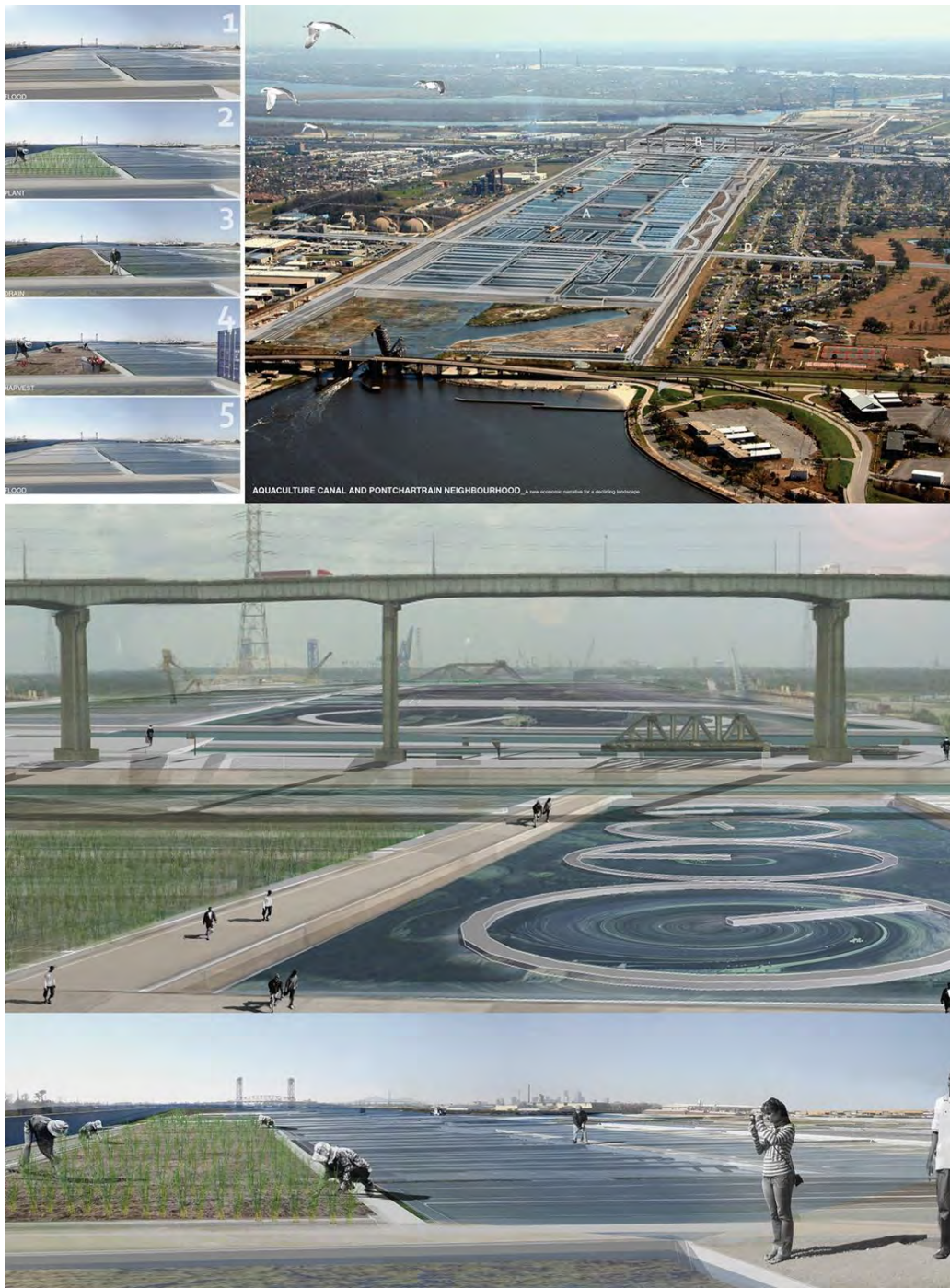


Figure 8. Fish Farm. Fadi Masoud, University of Toronto, (2009). www.guttertogulf.com



Figure 9. Fish Farm. Fadi Masoud, University of Toronto, (2009). www.guttertogulf.com

6 ENSURING LONGEVITY

These projects all introduce measurable and quantifiable function to the sites they serve. They go beyond utility, however, by engaging the medium of the discipline to its best effect. Topography, hydrology, vegetation, and seasonality are employed to enrich the landscape spaces and enhance experience.

While this work is focused on New Orleans, the intent is to help students discern the issues that make the work relevant to its specific context, and the fundamentals that have more universal application. New Orleans is a unique environment, and in-depth research, analysis, site visits, field work, interviews, expert consultations, work with practitioners and community groups all served to assist the students' understanding of how designs operate in their specific contexts – how they come to be, how they are funded, how they are built, how they operate within site circumstances, and how they are sustained through community life.

Stormwater management is an issue facing all contemporary urban environments, but how it is integrated into the unique circumstances of each location is the key to how successful it will be in the long-term. Operating in the rich aesthetic and cultural history of a place is critical for design projects – for their initiation, execution and for their evolution in changing urban circumstances. The “recognizable landscape language” (Nassauer, 1995) of New Orleans is defined by rich cultural

references and solutions for everyday and catastrophic stormwater management must embrace this unique context. While these projects are obviously conceptual, and the notion of resilience and longevity is speculative, the studio mandated the visualization and projection of design futures as a critical component of the studio design process. These projects pose alternatives to infrastructural water management solutions by embracing the New Orleans landscape, and endeavor to illustrate that utilitarian function can be used as a means to celebrate the inherent beauty and wonder of landscape in the civic realm, now and in New Orleans's future.

Aesthetics in landscape architecture is not simply decoration or a superficial veneer to civil engineering. Resilient landscapes, by definition, address functional performance within the rich aesthetic history of our discipline.

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QUANTIFYING SCHOLARLY PRODUCTION AMONG RECENTLY TENURED LANDSCAPE ARCHITECTURE FACULTY

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1 ABSTRACT

The career development and success of landscape architecture faculty hinges increasingly on their scholarship. Research performance is emphasized by academic institutions, whose assessments of faculty productivity are based on quantifiable research behaviors. Landscape architecture does not easily fit the traditional academic department model. As a result, it often becomes necessary for landscape architecture faculty to describe the academic context in which they engage in scholarship and may place them at a disadvantage when evaluated. The purpose of this study was to establish a current understanding of landscape architecture faculty scholarly productivity.

The study employed direct content analysis of the curriculum vitas of 18 landscape architecture faculty members who were awarded tenure at nine similar public universities in the 2008-09 academic year or thereafter. Common scholarly outputs, such as refereed journal articles, juried competition participation, reports, etc., were operationalized by the research team. Two researchers independently analyzed each vita, thereafter comparing the individual results, and negotiating any discrepancies with a third researcher.

The results describe the mean scholarly productivity of landscape architecture faculty during the tenure evaluation period and after the awarding of tenure. The findings suggest landscape architecture faculty members' scholarly productivity continues to be relatively low in comparison with other academic disciplines. An emphasis on traditional academic refereed products is pronounced. The findings also suggest that a minority of landscape architecture faculty are responsible for a majority of the scholarly productivity. Landscape architecture as an academic field is in need of greater training in conceptualizing, acquiring support for, conducting, and reporting research to be successful in an

academic environment and provide a much needed foundation for current practice.

1.1 Keywords

scholarship, faculty, tenure, academia, productivity

2 INTRODUCTION

The career development and success of landscape architecture faculty hinges increasingly on their scholarship (Deming and Swaffield, 2011). In particular, research performance is emphasized by academic institutions, whose assessments of faculty productivity are based on quantifiable research behaviors (Milburn and Brown, 2003). Faculty in the process of demonstrating their scholarly productivity and its value to secure academic promotion and tenure balance the compatible yet distinct demands of scholarship and the preparation of future practitioners. Landscape architecture does not easily fit the traditional academic department model (Milburn et al., 2003). Prior studies of landscape architecture scholarship indicate that faculty productivity is hindered by relatively high instructional loads and student contact time (Milburn et al., 2001; Chen et al., 2011). As a result, it often becomes necessary for landscape architecture faculty to describe the academic context in which they engage in scholarship (Gobster et al., 2010), and may place them at a disadvantage when evaluated with faculty in other fields.

However, there is little recent investigation of the type, quality, and quantity of scholarship on which faculty may be appropriately evaluated in the diverse context of landscape architecture (Chenoweth, 1992; LaGro, 1999; Milburn et al., 2001; Milburn and Brown, 2003). Therefore, the purpose of this study was to establish a current understanding of landscape architecture faculty scholarship.

3 METHODS

The study employed direct content analysis, specifically systematic intuitive interpretive analyses to classify and quantify the curriculum vitas of landscape architecture faculty members who were awarded tenure within the last five years. Participant selection was framed by the specific need to communicate expectations for landscape architecture faculty productivity within Utah State University. As a result, participant selection involved first identifying similar public land-grant university programs with accredited bachelors and masters degrees in landscape architecture. Twenty one of 66 accredited academic programs, all within the United States, were identified as peer institutions to Utah State University.

Early in 2013, the administrators for each of these 21 academic programs were contacted and asked to identify their faculty who had been awarded tenure in the 2008-09 academic year or thereafter. Three program administrators were unresponsive after repeated requests and were excluded from the study. The remaining 18 administrators identified 24 faculty who were awarded tenure during the defined period. According to the purpose of the study, faculty members who were not successful in garnering tenure were excluded from the study. Interestingly, seven academic programs reported no faculty awarded tenure since the 2008-09 academic year.

Participation of the 24 identified individuals was solicited by an email request wherein they

were asked to provide their current full curriculum vita. Participants were assured anonymity in the reported results. Six faculty were unresponsive after repeated requests. In total, 18 faculty members representing nine academic programs participated in the study, a 75% response rate.

3.1 Measures

Scholarship in landscape architecture may be defined as creative intellectual work that is validated by peers and communicated. Accordingly, scholarly productivity is primarily assessed by peer review as a measure of the quality of a faculty member's contribution, and the number of publications, presentations, and secured external funding as measures of communication productivity or quantity (Rudd, 1988 in Milburn et al., 2003). Although these generalities cannot fully elucidate the complexity of scholarship in landscape architecture, an important step toward a more coherent academy is the acceptance of increasingly precise terminology regarding scholarly outputs (LaGro, 1999). This is still the case. Accordingly, to establish a coherent metric for this study the authors identified categories of scholarly output felt to be generally recognized, as shown in Table 1, the definitions for which were taken from established definitions/specifications such as the 2012 Higher Education Research Data Collection (HERDC) specifications and Australia Research Council (HERDC, 2012; ERA, 2012; Deakin, 2012).

Table 1. Scholarly output categories and definitions

Category	Review	Definition
Journal Article	Peer ¹ -	A written work published in an academic/professional journal. The journal is published by a recognized publisher and possesses an ISBN ³ .
Conference Proceedings	Peer -	A fully written work published in the collection of papers of an academic/professional conference.
Abstract	Peer -	A written abstract, extract, extended abstract, or synopsis published in an academic/professional journal or conference proceedings.
Presentation – Invited	-	Presentation at an academic/professional conference where the organizers independently approach the author.
Presentation – Contributed	-	Presentation at an academic/professional conference where the author approaches the organizers.
Presentation – Poster	-	Presentation of a display at an academic/professional conference.
Book	-	A major written work bound and published. Preferably by a recognized commercial press or publisher, and possessing an ISBN.
Book Chapter	-	A written work contributing to a compilation subject to editorial scrutiny.
Article – Working Paper	-	A written work distributed independently or in an unrecognized journal.
Article – Popular Press	-	Newspaper or magazine articles, media interviews, internal newsletters and the like.
Report	-	A written work completed in behalf of an independent entity.
Website	-	An online work.
Illustration	-	A graphic work distributed independently or in a recognized outlet.
Exhibit	Refereed ² -	Curated exhibition of original creative work in an independent public venue.
Design Competition	Refereed	A competition sponsored by an independent organization inviting the submission of proposals.
Creative Work, Design/Planning Project	-	Original work for which copyright law could conceivably apply.
Built Work	-	The manifestation of original work/design common to landscape architecture and its allied disciplines.
Award	-	An award offered by an independent organization according to a publicly understood process. The independent organization is at least an academic institution or equivalent.
Grant Award	Refereed	Funding allocated through competitive granting schemes.
Contract Award		Funding allocated in response to an independent organization's request.

¹ Peer Reviewed work involved a formal, impartial, and independent assessment or review of the work in its entirety before publication/presentation, conducted by qualified experts independent of the author.

² Refereed exhibits involved a publicly understood refereeing process conducted by an independent review panel formed from qualified peers.

³ International Standard Book Number.

3.2 Procedures

Content analysis of the curriculum vita was conducted during April 2013. The textual content was individually coded and quantified for the year

tenure was awarded and the prior five years. Post-tenure was the year following through the 2012-13 academic year. In consideration of publication lags, all works reported as accepted or in-press were counted as published in the year indicated. Single

and multi-authored publications or creative works were not assessed differently.

Two researchers independently coded the textual content of each vita according to the pre-defined operational terms/categories and their subjective perspective. The categories under which individual faculty presented their scholarly output were not strictly adhered to, but rather the textual information was coded according to the previously agreed upon operational definitions for this study. The individual results were then compared to identify any discrepancies, whereupon consensus agreement concerning alternative interpretations was reached through dialogue with a third researcher (Graneheim and Lundman, 2004). The agreed upon findings were then interpreted to address the purpose of the study. Initial agreement was over 90% with the exception of one category.

4 RESULTS

The study results are reported descriptively as the total mean productivity by category during the tenure evaluation period and after the awarding of tenure in Table 2. The information in Table 2 is not presented for comparison between the pre- and post-tenure award periods as the post-tenure period varies in length between participants. Two participants are outliers with significantly higher scholarly productivity in numerous categories. The total mean productivity is also reported with these two participants excluded from the sample for clarity. Participants' curriculum vita were very unclear regarding the distinction between grants and contracts. As the researchers were unable to code the information appropriately, it was necessary to aggregate all funding as external funding, although this category does include internal academic institution awards as well. For the remaining categories, initial independent researcher agreement was over 90% with the exception of peer reviewed conference proceedings. Across the participants it was difficult to assess the accuracy of conference proceedings designated as peer-reviewed. This category required substantial investigation of the proceedings by the researchers and consensus agreement to establish.

The mean yearly scholarly productivity is reported in Table 3. To calculate the yearly productivity for participants after the awarding of tenure, the overall scholarly productivity was divided by the mean post tenure period for participants.

5 DISCUSSION

A major criticism of the academic field in supporting the profession (Milburn et al., 2001), scholarly productivity in landscape architecture is low relative to that of collegiate scholars, where yearly publication rates range between 0.74 in the fine arts, 1.46 in the physical sciences, 2.54 in health sciences, and 3.38 in engineering for example (Dundar and Lewis, 1998; Fairweather, 2002; Fox, 2005; Prpić, 2009). Prior study indicates landscape architecture faculty publish 0.48 refereed articles per year (Milburn et al., 2001; Milburn and Brown, 2003) and give 0.87 conference presentations per year (Milburn and Brown, 2003). With a publication rate already considered low, more recent study of landscape architecture faculty suggests that publication in the discipline is trending away from refereed articles toward conference proceedings (Chen et al., 2011).

This study indicates that during the evaluation period for tenure landscape architecture faculty publish between 0.4 and 0.6 peer reviewed journal articles per year, 0.3 to 0.5 peer reviewed articles in conference proceedings per year, give between 1.1 and 1.31 invited conference presentations, and delivered between 0.86 and 2.68 contributed conference presentations per year. In regard to external funding, landscape architecture faculty secure between \$57,485 and \$101,670 per year of their pre-tenure evaluation period.

After being awarded tenure, landscape architecture faculty publish between 0.35 and 1.19 peer reviewed journal articles per year, 0.29 to 0.71 articles in peer reviewed conference proceedings per year, give between 1.97 and 2.07 invited presentations, and delivered 1.52 to 1.58 contributed conference presentations per year. Post tenure, landscape architecture faculty secure between \$26,260 and \$86,299 in external funding each year.

These results support earlier findings regarding publication rates, but show significantly higher conference presentation rates. While low overall, the results suggest that landscape architecture faculty are emphasizing traditional academic refereed products. Further, scholarly products historically associated with landscape architecture, but less so with other academic disciplines, such as exhibits, design competitions, and creative work, are being largely ignored likely in favor of the more institutionally accepted outlets needed to garner support in the academic environment.

Table 2. Total mean productivity by scholarly output category (not for pre- post- comparison)

Category	Tenure Timing	Mean Productivity	Mean Productivity excluding Outliers
Journal Article	Pre	3.6	2.4
Peer Reviewed	Post	3.7	1.1
Journal Article	Pre	1.7	1.9
	Post	1.5	1.8
Conference Proceedings	Pre	3.0	1.8
Peer Reviewed	Post	2.2	0.9
Conference Proceedings	Pre	1.2	0.9
	Post	1.2	0.6
Abstract	Pre	2.6	0.4
Peer Reviewed	Post	3.9	0
Abstract	Pre	0.1	0.1
	Post	0	0
Presentation – Invited	Pre	7.9	6.6
	Post	6.4	6.1
Presentation – Contributed	Pre	16.1	5.2
	Post	4.9	4.7
Presentation – Poster	Pre	0.8	0.3
	Post	1.0	0.3
Book	Pre	0.4	0.5
	Post	0.2	0.2
Book Chapter	Pre	0.5	0.4
	Post	1.0	0.8
Article – Working Paper	Pre	0	0
	Post	0	0
Article – Popular Press	Pre	8.3	9.4
	Post	4.6	5.7
Report	Pre	3.4	2.9
	Post	1.6	0.6
Website	Pre	0.2	0.3
	Post	1.1	1.3
Illustration	Pre	0	0
	Post	0	0
Exhibit	Pre	0	0
Refereed	Post	0	0
Exhibit	Pre	0.9	1.0
	Post	0.5	0.7
Design Competition	Pre	0.3	0.3
Refereed	Post	0.1	0.1
Creative Work, Design/Planning Project	Pre	1.3	1.2
	Post	0.5	0.6
Built Work	Pre	0.1	0.1
	Post	0	0
Award	Pre	2.9	3.0
	Post	2.4	2.1
External Funding	Pre	\$610,024	\$344,915
	Post	\$266,665	\$81,146

Table 3. Mean yearly productivity by scholarly output category

Category	Tenure Timing	Mean Yearly Productivity	Mean Yearly Productivity excluding Outliers
Journal Article	Pre	0.6	0.4
Peer Reviewed	Post	1.19	0.35
Journal Article	Pre	0.28	0.31
	Post	0.48	0.58
Conference Proceedings	Pre	0.5	0.3
Peer Reviewed	Post	0.71	0.29
Conference Proceedings	Pre	0.2	0.15
	Post	0.38	0.19
Abstract	Pre	0.43	0.06
Peer Reviewed	Post	1.26	0
Abstract	Pre	0.01	0.01
	Post	0	0
Presentation – Invited	Pre	1.31	1.1
	Post	2.07	1.97
Presentation – Contributed	Pre	2.68	0.86
	Post	1.58	1.52
Presentation – Poster	Pre	0.13	0.05
	Post	0.32	0.09
Book	Pre	0.06	0.08
	Post	0.06	0.06
Book Chapter	Pre	0.08	0.06
	Post	0.32	0.25
Article – Working Paper	Pre	0	0
	Post	0	0
Article – Popular Press	Pre	1.38	1.56
	Post	1.48	1.84
Report	Pre	0.56	0.48
	Post	0.51	0.19
Website	Pre	0.03	0.05
	Post	0.35	0.42
Illustration	Pre	0	0
	Post	0	0
Exhibit	Pre	0	0
Refereed	Post	0	0
Exhibit	Pre	0.15	0.16
	Post	0.16	0.22
Design Competition	Pre	0.05	0.05
Refereed	Post	0.03	0.03
Creative Work, Design/Planning Project	Pre	0.21	0.2
	Post	0.16	0.19
Built Work	Pre	0.01	0.01
	Post	0	0
Award	Pre	0.48	0.5
	Post	0.77	0.67
External Funding	Pre	\$101,670	\$57,485
	Post	\$86,299	\$26,260

This emphasis is reflected in the way faculty scholarship is presented in vita, which can appear highly variable without widely understood and adhered to definitions of scholarly products. In lieu of establishing specifications for scholarly products in the field of landscape architecture, it would be beneficial if landscape architecture faculty adhered more closely to commonly accepted definitions of scholarly products.

For example, the results for invited presentations are questionable. It was difficult to evaluate whether the presentations indicated as 'invited' met the definition of an invited presentation. Often the researchers defaulted to the descriptor reported by the participants which resulted in high initial researcher agreement. However, anecdotally it appears that the term is being misused and the number of invited presentations is grossly overestimated. No participants reported the independent distribution of working papers. It is very probable that this is the result of confusion with non-peer reviewed journal articles. The vast majority of the peer reviewed abstracts are associated with the annual conference of the Council of Educators in Landscape Architecture (CELA). There are very few other outlets which employ a similar dissemination strategy of peer reviewed abstracts. Landscape architecture faculty members are endeavoring to maximize this outlet during the tenure review period.

Similarly, the results for exhibited work, and other creative work, as a category of scholarly productivity are limited. This study focused solely on whether exhibited work was subject to a recognizable peer-review process as a measure of the scholarly significance of the work. However, there are a number of measures of the significance of creative works which are not well articulated in the field of landscape architecture. While only two participants documented exhibited work, perhaps reflecting institutional scholarly priorities, it was difficult to assess whether the exhibited work underwent a peer-review process, and more difficult to identify alternative measures of significance. Landscape architecture scholars engage in creative works may wish to be more articulate regarding the significance of their work, and the field may wish to establish credible standards for evaluating the significance of creative works.

The results of this study are similar to those reported by Milburn and Brown (2003) in suggesting that a minority of landscape architecture faculty are responsible for a majority of the scholarly productivity. A comparison of scholarly productivity between the two outlying participants

and the remainder of the sample indicates that the two outlying participants are responsible for over 22% of the scholarly productivity during the tenure evaluation period. When considering all of the participants, the results suggest that faculty productivity increases somewhat post tenure, and significantly so for peer reviewed journal articles. However, it appears that mean faculty productivity in fact falls post tenure when the two outlying participants are excluded from the results. The two outlying participants are responsible for over 39% of the scholarly productivity post tenure award. In addition, the 55% reduction pre to post tenure in external funding is surprising if one assumes that an experienced faculty member is better positioned to garner funding. The findings thus suggest that faculty productivity decreases immediately post tenure, as well as reiterating that a minority of landscape architecture faculty members are responsible for a majority of the scholarly productivity.

The reasons behind these findings should be examined in the future, but are likely due to a minority of landscape architecture faculty being academically trained for the scholarly demands of the academic environment. A careful examination of the results supports this assertion in that productivity measured for scholarly categories that are often less valued in the academic environment, such as exhibits, popular press articles, and contributed presentations, actually rises when the outlying participants are excluded. While the scholarly categories typically most valued in the academic environment, such as peer reviewed publication, are lower. When the outlying participants are included, the opposite is true.

However, some caution should be exercised as the data are reported for the six years of the tenure period, while productivity post tenure is reported for individual periods that together averaged just over three years. Interestingly, very few participants (n=2) were awarded tenure in the last two years.

5.1 Limitations

This study has a number of limitations. We were unable to evaluate the level of responsibility individual participants had for externally funded research as few faculty members reported whether they were the principal or co-principal investigator. We were unable to assess the level of responsibility for multiple author publications as few respondents reported their role in the publication. Nor were we able to assess the role played in individual faculty member's professional practice experience or whether their experience was academic or

professional practice experience. Guest or invited jury participation was not measured in this study given the variability of reporting.

Most unfortunately, there are a host of well-studied factors which influence scholarly productivity, such as age, gender, subfield specialization, collaboration, etc., which the authors did not assess [see Helsi and Lee (2011) for a more complete presentation of these factors]. Specifically, we were unable to accurately assess faculty instructional loads. Teaching in landscape architecture is time intensive. With studio-based curricula and faculty/student ratios being accreditation requirements, landscape architecture faculty typically have high student contact time overall as well as per credit hour, and labor intensive teaching loads (Milburn et al., 2001). The high instructional load is often offered as justification for the low scholarly productivity among landscape architecture faculty. However, we were unable to accurately assess instructional load as very few respondent's curriculum vita indicated the number of credits or contact time for the listings of courses taught. In addition, the difference between academic institutions' credit equivalents, such as the difference between semester and quarter credits, was not known.

Lastly, there were a number of non-responsive programs and faculty members. Is the failure of faculty to respond associated with lower confidence in their scholarly productivity and thus a wish to not self-report? If so, we can expect that the actual scholarly productivity rates of landscape architecture faculty are lower than reported here. Conversely, could non-respondents have been less apt to respond due to high engagement in scholarship? The answer to these questions, while important to ask, may offer minimal statistical change given the number of non-respondents.

6 IMPLICATIONS

The purpose of this study was to establish a current understanding of landscape architecture faculty scholarship. The findings indicate that scholarly productivity in landscape architecture is low overall and falls somewhat after the awarding of tenure. During the evaluation period for tenure faculty members focus on more commonly valued categories of scholarly output and then on less commonly valued categories of scholarly output following the awarding of tenure. In addition to establishing the scholarly productivity rates of landscape architecture faculty, the most significant finding of this study suggests that a minority of landscape architecture faculty are responsible for a majority of the scholarly productivity. Considered

together, the overall low scholarly productivity and a minority of faculty accounting for the majority of the scholarly productivity points toward a critical need for greater preparation of the landscape architecture academy in conceptualizing, acquiring support for, conducting, and reporting meaningful research. Doing so will lead to greater success in the academic environment, support for evidence-based professional practice, and provide a much needed theoretical foundation for the future of landscape architecture.

Despite national discussions regarding the future of the tenure model in higher education, the majority of new and emerging landscape architecture faculty positions employ this system. Consequently, success for the emerging faculty nationally will rely upon effective performance within the tenure track system. In a climate of increasing demands for transparency and accountability by the public and legislators, emerging academics can expect to face calls for performance at or above national standards. Doing so within the realm of scholarship requires clarity in benchmarks among peers at peer institutions. This study established a first such baseline for one program, and offers a rare look into metrics for various forms of scholarship. To augment existing bases for defining national standards (e.g., external expert reviewers' opinions, peer perceptions by voting faculty peers), quantified standards represent a gap in the process that this study begins to address. Future efforts to reduce the gap could improve data through a consistent, annual survey that analyzes faculty productivity from a larger and more diverse cohort of landscape architecture programs. Despite means to improve future iterations of this study, the current findings offer a foundation for understanding productivity among successful early career scholars in the discipline.

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TRANSFORMATIVE LEARNING IMPACTS OF STUDY ABROAD

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1 ABSTRACT

As Michigan State University sends nearly 2600 students to study abroad each year, including 18-24 Landscape Architecture students, the questions remain: What are the students learning? Will this develop them professionally as well as personally? Using data from a survey of the School of Planning, Design and Construction's alum, this article explores the impact of study abroad. Transformative growth is measured utilizing the Association of American Colleges and Universities learning outcomes rubrics for Civic Engagement, Ethical Reasoning, Global Learning, and Intercultural Knowledge and Competence. Comparative analysis shows those alum who participated in a formal study abroad program measured higher in the learning outcome rubrics than those who did not participate. The article provides insight to ways in which students abroad may transform during study abroad and how the University may help a student to "unpack" their experience.

1.1 Keywords

study abroad, transformative learning, impacts

2 INTRODUCTION

Why do we invest in Study Abroad? The benefit claims include expanding professional and intellectual knowledge, changing how a young person sees themselves in the world and fostering personal growth (Brewer, 2009). As University faculty, we invest hundreds of personal hours in creating programs each year. As administrators and parents, we invest thousands of dollars annually to offer programs. We do this because we believe Study Abroad is one of the transformative experiences of a college education.

The Association of American Colleges and Universities (AAC&U) has released rubrics to assess 16 core learning goals of higher education. The AAC&U VALUE (Valid Assessment of Learning in Undergraduate Education) (2010) includes four rubrics which are recommended to be studied together and this research team believes can be enhanced through study abroad in ways in which a traditional classroom cannot. These four rubrics are: Civic Engagement, Ethical Reasoning, Global Learning, and Intercultural Knowledge and Competency. The alum of Michigan State University's majors of Construction Management, Interior Design, Landscape Architecture, and Urban Planning, who now comprise the School of Planning, Design and Construction are used as the study group. While this study group represents more than Landscape Architecture students, study abroad research demonstrates that built environment students studying in a multi-disciplinary setting emerge with similar outcomes (Kotval et al., 2013; Myers et al., 2005).

3 MICHIGAN STATE UNIVERSITY'S SCHOOL OF PLANNING, DESIGN AND CONSTRUCTION STUDY ABROAD PROGRAM

Michigan State University's (MSU) Landscape Architecture program offered its first study abroad experience in 1975 to Toronto, Canada. In 1977, study abroad became a formal

part of the curriculum. Though not mandatory, it is an 8 week intensive travel integrated into the spring semester and typically attended by 95-100% of the cohort. In the 35 years of LA study abroad programming, students have traveled to Australia, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Italy, Mexico, Morocco, Netherlands, New Zealand, Norway, Spain, Turkey, Taiwan, and the United Kingdom. The first half of the semester (January-February) is spent expanding student knowledge of international design, urban design, field sketching, and foreign cultures. "We sketch in the classroom in winter," explains an alum "but not until we go into the field on our study abroad do our sketches improve. Not only technically with our perspective, but the sketches begin to show the full scene and feel of the urban environment."

Student experiences vary slightly each year depending on the faculty leading the program, but typically include design studies in business districts such as La Defense and Canary Wharf, naturally designed settings such as Stourhead, office visits with international firms such as Zaha Hadid Architects and University partnerships in France, Germany, Portugal, and Spain. University partnerships offer students the opportunity to expand their understanding of the built environment beyond the confines of Landscape Architecture and work collaboratively with related disciplines. These meetings and projects with local experts, students, and faculty help the students to effectively adapt to their new setting and thus expand their technical skills, disciplinary knowledge, and cultural knowledge (Vande Berg et al., 2012).

In 2008, Landscape Architecture joined the School of Planning, Design and Construction (SPDC) with Construction Management, Interior Design, and Urban Planning majors. Each major offers discipline specific study abroad programs that integrate international experiences into the learning process. The related disciplines regularly study in China, Cuba, Germany, Japan, Korea, Netherlands, Romania, Turkey, and the United Arab Emirates. These programs are summer offerings and can be taken to fulfill core program course requirements or electives. The second longest running program in SPDC is the Urban Planning partnership with Dortmund University which began in 1984.

4 ROLE AND VALUE OF STUDY ABROAD

Study abroad grew in popularity in the 1920s as American students traveled to other countries and universities to study foreign

languages (Brown, 1983). Study abroad today demonstrates improvement in self-reported student efficacy of foreign language skill attainment. The multifaceted motivation of students choosing to study abroad, however, creates difficulty in measuring how a student has improved (Cubillos and Ilvento, 2013). A multifaceted pedagogy, inclusive of experiential learning, has shown to enhance the student learning during the experience abroad (Vance et al., 2013). The learning attributed to language during study abroad includes not only the technical skills but also cultural adaptability and sensitivity (Williams, 2005).

Today, Michigan State University's ~275 Study Abroad programs service thousands of students annually, span seven continents, and 60 countries (Office of Study Abroad, Michigan State University, 2014). MSU is rated in the top 50 Study Abroad comprehensive programs in the United States (US News, 2013). As MSU was formed as a Land Grant University, the Office of Study Abroad supports the transformation of MSU into a "world-grant" university (Office of Study Abroad, Michigan State University, 2014), utilizing students and faculty skills and talent to improve the global community. In 2010-2011, this included the participation of 2,577 MSU students in study abroad.

Studying in a foreign country is considered a high-impact practice as students achieve deep learning gains, personal gains, and develop through collaborative learning environments and interaction with their faculty (Kuh, 2008). Those in hiring positions report differences in the importance of specific study abroad programs (such as a study abroad in relevant major, foreign language involvement) than those in senior management levels; those who have studied abroad place more importance on their new hires having also having done so. In an ever-increasingly urbanized, global community, the firms who work internationally place more importance on study abroad and language acquisition (Trooboff, 2008). If those who have studied abroad value the experience, while employers without study abroad experience do not value it as much, what is it that alum are not conveying in their interviews to explain its impact?

While alum, employers, faculty, and students consider international experience for the personal development and transformation of college students, study abroad is ranked behind other experiences which are more closely aligned to 'job training,' such as internships, teamwork, community engagement and leadership (Crawford et al., 2011). At the 2011 APLU (Association of Public and Land-grant Universities) Summit in Indianapolis, Indiana, the discussion on study

abroad among employers and University administrators revolved around the perceptions that study abroad helps students develop personally, but not necessarily in their technical knowledge. The question lingers among employers, if a student is not traveling to enhance their language skills, what is the benefit of study abroad?

Many of the soft skills valued by the employers, such as the ability to properly communicate, self-manage, and work on teams (Crawford, et al., 2011) can be developed during study abroad. Students, however, often have trouble depicting their growth during the interview process (Gardner et al., 2008) but instead focus on describing the places they traveled and what they saw. Brewer and Solberg (2009) suggest that for study abroad to be a truly transformative and integrated into the learning curriculum, the experience must begin with classroom preparation followed by an experience that alters personally held perceptions and a reintegration of the newly realized self and skill into society (Mezirow, 1975).

The 'preflight' and 'unpacking' of study abroad are essential components of moving study abroad from an excursion to a transformative learning experience. The majority of students attending a study abroad at MSU are either juniors or seniors (Office of Study Abroad, MSU, 2014) and thus may not be able to 'unpack' and utilize the new skills in academia (Gardner et al., 2008). Landscape Architecture students at MSU have a full year to unpack their experience and utilize both their growing technical and interpersonal skills in the classroom.

While studying abroad may help a student experience a perspective shift, it can also foster a deeper understanding of professional technical skills. A design-based education is not complete until one has achieved a "cross-cultural" educational experience (Myers et al., 2005). These cross-cultural experiences include not only working in a foreign country but also working with students who have a different educative and skill background than oneself. Technical skills develop during a built environment study abroad, such as field sketching, understanding of good and bad design, and understanding of urban interaction. While past education experiences will provide each student with a different skill set, the skills gained for built environment students on study abroad transcend siloes in the different disciplines (Myers et al., 2005). For example, while on study abroad, urban planning and landscape architecture students can both develop the communication skills to work in a community previously unknown to the student (regardless of this community being in a different

state or country) and to learn that built environment needs differ from community to community (Kotval et al., 2013). This community, service oriented approach is fundamental to a holistic understanding of the design process (Sherk, 2013)

The Association of American Colleges and Universities detail a VALUE rubric (2010) one should gain through the use of high-impact practices, such as study abroad. Each rubric has 4-6 characteristics to describe elements of possible growth and four measurable changes from benchmark (1) to Milestones (2-3) and capstone (4). Four rubrics may be developed through study abroad in ways a classroom cannot: Civic Engagement, Ethical Reasoning, Global Learning, and Intercultural Knowledge and Competence. The AAC&U defines them as follows:

Civic Engagement: "working to make a difference in the civic life of our communities and developing the combination of knowledge, skills, values and motivation to make that difference. It means promoting the quality of life in a community, through both political and non-political processes." (Excerpted from *Civic Responsibility and Higher Education*, edited by Thomas Ehrlich, published by Oryx Press, 2000, Preface, page vi.) In addition, civic engagement encompasses actions wherein individuals participate in activities of personal and public concern that are both individually life enriching and socially beneficial to the community" (AAC&U, 2010, Civic Engagement Rubric p 1).

Ethical Reasoning: "right and wrong human conduct. It requires students to be able to assess their own ethical values and the social context of problems, recognize ethical issues in a variety of settings, think about how different ethical perspectives might be applied to ethical dilemmas and consider the ramifications of alternative actions. Students' ethical self identity (sic) evolves as they practice ethical decision-making skills and learn how to describe and analyze positions on ethical issues." (AAC&U, 2010, Ethical Reasoning Rubric p 1).

Global Learning: "a critical analysis of and an engagement with complex, interdependent global systems and legacies (such as natural, physical, social, cultural, economic, and political) and their implications for people's lives and the earth's sustainability. Through global learning, students should 1) become informed, open-minded, and responsible people who are attentive to diversity across the spectrum of differences, 2) seek to understand how their actions affect both local and global communities, and 3) address the world's most pressing and enduring issues

collaboratively and equitably.” (AAC&U, 2010, Global Learning Rubric p 1).

Intercultural knowledge and Competency: “a set of cognitive, affective, and behavioral skills and characteristics that support effective and appropriate interaction in a variety of cultural contexts.” (Bennett J. M., 2008. Transformative training: Designing programs for culture learning. In *Contemporary leadership and intercultural competence: Understanding and utilizing cultural diversity to build successful organizations*, ed. M. A. Moodian, 95-110. Thousand Oaks, CA: Sage.)” (AAC&U, 2010, Intercultural Knowledge and Competency Rubric p 1).

5 METHODOLOGY

This study is part of a comprehensive analysis of Michigan State University’s School of Planning, Design, and Construction study abroad programs. The mixed method survey explored the potential of alum growth during study abroad. The online survey link was sent to alum of the Michigan State University Construction Management, Interior Design, Landscape Architecture, and Urban Planning programs.

The survey began with basic demographic data. All respondents were asked to answer their definition of the aforementioned four rubrics from the AAC&U, to define their discipline, and to explain where they have traveled or lived previously. Those who had not participated in one of the four majors’ study abroad programs were then allowed to exit the survey. This paper explores the qualitative aspects of the survey – the explanation of both the four rubrics and the definition of the discipline. The research team coded each of the responses according to the four measurable change levels described in each rubric, with a 1 (Benchmark), 2 (First Milestone), 3 (Second Milestone), or 4 (Capstone). Each respondent’s 1 through 4 values were totaled and divided by the number of provided responses to obtain a mean (dividing by three for those who only answered three rubric question, dividing by four for those who answered all four rubric questions).

The two authors coded separately and then compared and discussed the results to minimize coder bias. Coding was consistent, as the AAC&U rubrics provide descriptive characteristics that indicate whether a student is a benchmark, capstone, or somewhere in between. Until the final data was assembled into SPSS for statistical analysis, the coders did not know the demographics (having studied abroad, having traveled, age, major) of the respondents. As each study abroad is

an elected option of the student, a limitation in the methodology is that a student choosing to study abroad may inherently possess an open mind to global learning or other liberal learning and intercultural aspects of the VALUE rubric. Further limitations are explored and explained in the conclusion.

Utilizing crosstabs in the Statistical Package for Social Sciences (SPSS), the research team looked for differences and correlations depending on the alum’s age, possible participation in study abroad, number of places traveled, and undergraduate major. Crosstabs further analyzed correlations among the individual responses for each rubric.

6 RESULTS AND DISCUSSION

6.1 Response Rate

The survey was electronically sent to 2,932 alum. While these emails are the most up to date within the university alum system, many of these domain emails are no longer regularly read or have gone dormant. Thirty-one emails were returned as ‘non-deliverable.’ The total response rate was 7.2% (208 of 2,901). This article is based upon the five, open-ended responses. The total survey included responses from 33 Construction Management alum, 43 Interior Design, 84 Landscape Architecture, and 42 Urban Planning. A total of 70 have studied abroad while 135 did not. No significant differences were found between the groups and the data is presented as frequency and mean scores for discussion.

6.2 Civic Engagement

Those who participated in study abroad resulted in a higher mean rubric score (3.3478) for Civic Engagement than those who did not (2.9737) (Table 6 in Summary and Conclusion). More respondents were coded to a 2 (First Milestone) that did not attend study abroad while those who did study abroad had more respondents code to a 4 (capstone) than those who did not attend, as shown in Table 2.

Those coding to the lower end of the rubric were able to recognize the importance of engaging but failed to acknowledge how to be involved in their community. Typical problems related to civic engagement in the built environment include failing to see the full picture (such as one respondent writing only “landscaping” as their response) or identifying engagement as problem imposed upon the designer by the government.

Table 1. Response rate based on participation in each question and participation in study abroad

Participated in Study Abroad?	Civic Engagement	Ethical Reasoning	Global Learning	Intercultural Knowledge and Competence
Yes	46	45	45	41
No	38	37	37	37
Total	84	82	82	78

Table 2. Civic engagement coding based on those who did or did not participate in study abroad

	Benchmark (1)	Milestone (2)	Milestone (3)	Capstone (4)
Participate	1	5	17	23
Did not Participate	2	8	17	11
Total	3	13	34	34

Table 3. Ethical reasoning coding based on those who did or did not participate in study abroad

	Benchmark (1)	Milestone (2)	Milestone (3)	Capstone (4)
Participate	1	9	20	15
Did Not Participate	0	12	18	7
Total	1	21	38	22

The fundamental difference between those coded to the upper level of the rubric (3 and 4) is the ability to not only recognize when civic engagement occurs but also demonstrate ways in which one engages themselves and their discipline for the public good. “The world beyond you deserves respect and contribution” indicates that study abroad is helping American students to not only see themselves as engaged citizens, but as ones who are willing to participate in the public good of global society. However, this response fails to extend into how respect may be shown or what areas need contribution. The responses at the capstone level, though not necessarily longer in text, describe experiences of civic engagement rather than how another might do so. One example is how one may utilize their discipline to help a community realize their own voice on a project rather than simply working on the community or local master plan. Civic engagement responses may also include non-discipline specific participation in things such as a PTA, organizing service through secular or religious organizations, and school boards.

6.3 Ethical Reasoning

As with Civic Engagement, those who participated in study abroad have a higher Ethical Reasoning mean coding score (3.0889) than those who did not study abroad (2.8649) (Table 6 in Summary and Conclusion). The greatest number of responses for those who participated were in the Second Milestone followed by Capstone. For those who did not study abroad, most of their responses were coded in within the Milestone levels (Table 3).

Responses coded to lower values in the rubric mentioned “the golden rule” or “doing the right thing” but failed to acknowledge the complexity of an ethical decision, such as the multidimensional decision making discussed by the AAC&U to understand the gray context, differing outcomes, and the perspectives of the various stakeholders in the situation. A designer specifically mentioned “form follows function,” which like the golden rule, is a technique taught early in one’s learning and is simply an expected behavior later in life.

Those coded to higher levels recognize the gray area, and that the gray area is different for each problem and circumstance. “We are not perfect beings but we try to be the best suitors that we can.” Others indicate using previous experiences and knowledge to help them make informed decisions in their professional lives today. Additionally, a typical Second Milestone code indicates a desire not to hurt others – be it a specific client or the community.

The top ranking respondents move beyond the previous levels by identifying “those without a loud voice” and ways in which underrepresented, silent, or minority voice groups are supported through Ethical Reasoning. Respondents at the capstone level discussed working with their professional organizations to encourage universal participation and relying on these organizations to ask the tough questions of the professionals. One of the most common characteristics of a top ranked individual is the ability to recognize that each situation is unique and the individual must work further to understand the complexities before moving forward with a decision.

Table 4. Global learning coding based on those who did or did not participate in study abroad

	Benchmark (1)	Milestone (2)	Milestone (3)	Capstone (4)
Participate	0	6	23	16
Did Not Participate	1	11	16	9
Total	1	17	39	25

Table 5. Intercultural knowledge and competence coding based on those who did or did not participate in study abroad

	Benchmark (1)	Milestone (2)	Milestone (3)	Capstone (4)
Participate	0	3	18	24
Did Not Participate	1	7	14	11
Total	1	10	32	35

6.4 Global Learning

As with Ethical Reasoning, in Global Learning, the greatest number of respondents were coded to a Second Milestone (value of 3). A higher percentage of those who attended study abroad fell into the upper codes than those who did not participate (Table 4). Those who did participate in study broad have a mean ranking of 3.2222 while those who did not have a mean of 2.8919 (Table 6 in Summary and Conclusion).

Those ranking lower in Global Learning focus on fixing problems for the children at home and do not see the world as a global community. While working to support the community needs is a valuable asset, one respondent specifically discussed helping his or her own children before being willing to help others'. The First Milestone respondents recognized that learning can come from leaving one's traditional community confines and leaving the university itself, but failed to acknowledge what this learning entails or connect how it may change one's perspective.

Global learners of a higher aptitude demonstrate a recognition of learning from other cultures. "We cannot be isolated and must take a global view when learning about any subject" notes one respondent, indicating that different cultures and nations provide different viewpoints. This may be achieved through "having a conversation with people of a variety of cultures," "keeping an open mind," and "media and travel." These Second Milestone respondents still, however, did not describe how these experiences changed their behaviors or outlook upon return to their home culture. One response, discussing the media, does not specify whether this is meant by social media, English speaking media with international perspectives (BBC, Al Jazeera), or American news broadcasts about foreign nations. Will an American watching American news learn as much as an American traveling to those nations?

Those with a Capstone rank recognize information such as "how things are interconnected and how actions take in on area may have lasting effects on other areas." These respondents understand that they will not master how to work with all communities in the world with one study abroad, but the skills learned to adapt themselves in new settings and to always "to further knowledge to be a better citizen of the world." Without necessarily understanding the language of Mezirow, the respondents have described immersing themselves into an unknown setting and thus appreciating "life in a new way" upon their return.

6.5 Intercultural Knowledge and Competence (IKC)

Continuing the trend, the mean for Intercultural Knowledge and Competence (IKC) of those who studied abroad (3.5122) is higher than those who did not (3.0541), but this was the first VALUE rubric in which those who did not study abroad breached a 3.0 mean (Table 6 in Summary and Conclusion). For the first time in this study, the majority of respondents were ranked as Capstone, and it was not until Capstone that those who did participate in study abroad outranked those who did not study abroad in a single stage of the rubric (Table 5).

The lower level respondents openly acknowledged their inability to understand how this value differed from Global Learning. The others discussed that there are cultures different than their own, but did not discuss a way in which they grew through meeting a new culture, or if they did meet a new culture at all. A key goal of IKC is that the respondent should be able to transition their Global Learning and other skills into a new setting to create an impact in their community. In fact, one respondent coded to a Capstone indicates "This represents an appreciation for (Global Learning)

and an open mind to consider what may be learned from that.”

Those ranking in the Second Milestone manage to recognize differences, but fail to depict how they learned from these differences and how they continue to change. One respondent notes, “You cannot get (it) from a book. You have to live in other cultures.” However, the respondent fails to identify the X-Factor that makes study abroad, working in a previously unknown community, and IKC important in general.

Those ranking at a Capstone level have discussed the skills learned through working in unknown communities (whether abroad or not) and how they apply them in their professional careers. One need not study abroad to develop a higher order of IKC as the United States has minority communities within many municipalities, but studying internationally will nearly guarantee that the student has not previously worked or studied in that cultural setting. A Caucasian student may work with an ethnic minority in the United States, but will rarely have worked in a French speaking community in the United States. Barriers to communication in foreign communities include “(language), body language,” and “social hierarchy.”

7 SUMMARY AND CONCLUSION

Overall, the impact of study abroad is apparent: alum who participated in study abroad demonstrate higher means than those who do not (Table 6). In fact, those who did not attend study abroad only met a mean ranking above 3.0 for one of the four rubrics, while those who did attend surpassed 3.0 with each rubric. Additionally, for three of the four characteristics, those who attended study abroad have a lower standard deviation, describing a higher consistency of higher scores.

The data is presented and discussed at the frequency and mean level because none of the findings were significantly different for those who did or did not attend study abroad. While this makes our major finding a rejection of the hypothesis – that study abroad significantly transforms our students – the analysis process can help inform how we can improve study abroad. The data does show that people who participated in study abroad achieve higher levels of the VALUES rubric, just not at a significantly higher level than those who did not study abroad. This mirrors the finding for age. While one may expect the age of the respondents to skew the study as general life experience and professional development will move a person

further along the rubric, age did not emerge as a statistical indicator of change. The number of places traveled outside of formal education and the location of these experiences have not yielded statistical results. While we are headed in the right direction, with study abroad participants attaining higher levels on the rubrics, can we do better? Can we go from ‘better’ to significant?

This leads to the question of what can we do, as educators, to enhance student learning and reach the full transformative potential of study abroad. The literature suggests that to be transformative, the main components are ‘preflight’ preparation, a disorienting experience (often experiencing something new) and ‘unpacking’ upon return (Gardner et al, 2008; Brewer and Solberg, 2009). Are we preparing enough? Are we asking the tough questions, about values and ethics? Are we pushing our students to take the time to reflect on their experiences and foster deep learning? Are we challenging assumptions and stereotypes? Are we helping students make connections across time, cultures and disciplines? This is where the VALUES rubric can provide guide posts.

Before the study abroad experience, educators can assist students through classroom activities, discussions, and lectures to open their mind to experiences and thought processes different than their previously held assumptions. During study abroad, educators must continually help student to connect the classroom preparation to the real-world application in their now foreign context. By crafting reflection exercises upon return, discussions and experiences that strategically move students from Benchmark to Milestone to Capstone may be unearthed, and bring voice to, the transformative value of study abroad. Then we will have made a significant difference, statistically, as well as in human lives. Understanding the impact of a past event, such as study abroad, may take years for an alum to absorb, understand and value. Additional life experiences will influence one’s ability to move across the rubrics. This study is a preliminary step to identify and measure the knowledge and personal growth stemming from study abroad specifically connected to liberal learning in a professional degree.

The breadth of Landscape Architecture allows for multiple pedagogies in the reflection process, including discussions, drawings, project development, essay writing, and real-world site visits. Indeed, enhancing the development of students will require formal and intensive education while studying abroad and not allowing the experience to be one simply for travel or seeing the highlights abroad.

Table 6. Rubric means, sample size, and standard deviation based on those who did or did not participate in study abroad

	Civic Engagement	Ethical Reasoning	Global Learning	Intercultural Knowledge and Competence
<i>Participate</i>				
Mean	3.3478	3.0889	3.2222	3.5122
N	46	45	45	41
Std. Dev.	0.76645	0.79264	0.67044	0.63726
<i>Did Not Participate</i>				
Mean	2.9737	2.8649	2.8919	3.0541
N	38	37	37	37
Std. Dev.	.85383	.71345	0.80911	0.77981
<i>Total</i>				
Mean	3.1786	2.9878	3.0732	3.2949
N	84	82	82	78
Std. Dev.	0.82375	0.76164	0.74999	0.74046

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DESIGN IMPLEMENTATION

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A BLUEPRINT FOR STORMWATER INFRASTRUCTURE DESIGN: IMPLEMENTATION AND EFFICACY OF LID

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1 ABSTRACT

This study introduces a preliminary approach to integrating design framework with Low Impact Development (LID) technologies which promote education and awareness, and evaluates the impact of LID. The proposed framework, called a "BLUEprint" for Stormwater Infrastructure Design, serves as a three-tiered design performance measurement structure. To verify the proposed framework, three water conservation-based design projects in Texas were selected. The framework was applied to determine types of appropriate LID facilities in each project and to simulate their hypothetical performance with quantitative measurements utilizing same variables to compare efficacy of LID applications in each site.

First, to develop the framework, after reviewing existing LID facilities applied in previous projects, 17 LID facilities including the green roof, bio-swale, and bio-detention pond were selected and categorized into three typologies based on hydrological functionality: capture, convey, and clean. Runoff amounts and collectable rainwater were measured according to these typologies. Second, to promote public's awareness, each LID facility was suggested to be integrated with an innovative hierarchical way-finding system which illustrates the ratio of infiltrated water to total rainfall. Expanded social space and number of signage were correspondingly assessed to measure social benefits of LID. Finally, the vegetation palette effectiveness was evaluated based on drought tolerance and water treatment capacity relative to site conditions. In a comparison among the three projects, the hypothetical results showed that the LID facilities examined reduced runoff volume by up to 45% and could annually save about \$10,000 by

planting xeriscape vegetation with less water demand and reusing harvested rainwater for irrigation.

This result emphasizes the significance of the integrated LID design framework and efficacy-evaluating model. The proposed framework would be an effective tool in the decision making process for holistic LID design and planning with more objective design strategies using quantitative measurements.

1.1 Keywords

BLUEprint, stormwater runoff management, LID, education, efficacy

2 INTRODUCTION

Land planning strategies which emphasize stormwater runoff management, such as Low Impact Development (LID), have become increasingly utilized in design projects to minimize the impact of impervious land cover (Huber, 2010). Several design guidelines exist which expose the potentialities of utilizing LID applications and differentiate the distinctive features of LID facilities (Wynkoop, 1999; City of San Francisco, 2009; City of Houston, 2006). They have documented several suggestions including promoting the implementation of residential rain gardens and retention planters with curb cuts for bio-infiltration, vegetated roofs and permeable paving in mixed use zone (specifically in pedestrian/parking areas). However, only a few integrated approaches have attempted to investigate the actual effectiveness of LID based designs. Although the Texas Department of Transportation has shown efforts to develop engineering techniques in reducing urban

runoff under the Clean Water Act (1972) (TxDOT, 2013), on-site infiltration water management systems such as bio-swales and detention ponds have not yet been examined. The first step in alleviating this quandary is begin to provide an integrated LID design framework and test the efficacy of its implementation.

Accordingly, this study proposes a framework, called “BLUEprint,” as an applicable design implementation and measurement approach which guides hydrologically sensitive design and assesses its impact using quantitative methods. Simultaneously, the framework aims to increase public education and awareness about the benefits of LID applications. To substantiate its validity, the framework was applied to three water conservation-based design projects in Texas. The master plan of each project was utilized to assess the environmental, social and economic benefits of LID applications. The first site was the 26-acre Texas A&M Sediment and Erosion Control Laboratory (SEC) located in the Riverside Campus of Texas A&M University. It was formerly used as a runaway, but renovated into the secondary campus supporting various research activities. By applying LID techniques, SEC could serve as a real-world model for LID practices for students and professional to emulate. The second site was the 5-acre Lone Star Groundwater Conservation District (LSGCD) office in Conroe, Texas. Since the city had experienced water challenge due to the excessive groundwater withdrawal from the Gulf Coast aquifer, the design approaches emphasized on-site infiltration and groundwater recharge by applying LID practices. The final site was the 1.94-acre TAES Annex Building located in the main campus of Texas A&M University. The site was exposed to several drainage problems such as standing water and heavy runoff and LID practices were applied to solve those issues and to increase public awareness about LID.

3 DESIGN FRAMEWORK

The proposed design framework developed for this research is shown in Figure 1. The major objectives of the framework were to promote sustainable stormwater management and increase educational literacy about LID. Three phases of a design process – facility construction, planting, and way-finding system installation – were organized according to the frame of implementation units and performance measures. *LID facilities*, *the vegetation palette*, and *the informative signage* served as major design elements. Seventeen *LID facilities* were categorized into three typologies depending on their hydrological functionality:

capture, convey, and clean. To increase the effectiveness of water conservation using both mechanical and biological facilities, the selected LID facilities were divided into two groups based on composing materials. While the first group (mechanical facilities) is mainly comprised of concrete requiring engineering skills, the second group (biological facilities) is reliant upon phytoremediation processes since they maximize the use of vegetation in mitigating pollutants and dissipating the energy of water flow.

Based on drought tolerance and water treatment capacity, xeriscape and phytoremediation plants were suggested as *the vegetation palette* of the proposed framework. While xeriscape plants function to reduce water demand of irrigation, phytoremediation plants serve as natural filters in cleansing contaminated runoff. Two types of phytoremediation plants are specifically suggested: phytoextraction and rhizofiltration. Phytoextraction plants mainly play a significant role in heavy metal uptake. Similarly, rhizofiltration plants are capable of taking in metals and hydrophobic organics from soil water or from water flowing through the root zone (Schnoor, 1997). Table 1 demonstrates the recommended plant lists of each vegetation palette for effective stormwater management in Texas. While xeriscape can work in conjunction with LID facilities such as green roofs and turf pavement, phytoremediation plants are able to be incorporated with filter strips, riparian buffers, rain gardens and detention/retention ponds. They are recommended to be placed upstream of treatment facilities (near pollutant sources) or downstream of all LID facilities (before or in water bodies).

The informative signage was proposed to develop an innovative hierarchical way-finding system in the framework to improve social benefits by understanding LID applications. Three different scales of signage – standing board, embedded signage within paving elements, and large informative kiosks – were proposed to convey the information of how much water could be infiltrated into the soil out of total rainfall (the water-infiltration footprint). Monthly rainfall data, monthly evapotranspiration data, and post-design runoff coefficients of surface materials would be integrated to measure infiltration ratios for each LID facility. For instance, a typical rain garden in College Station, TX revealed a 0.54 infiltration rate assuming a 70% water loss through evapotranspiration supplemented by outdoor irrigation. The calculation process is as following: in October when the highest precipitation of 4.9 inches is reported, the water loss through

evapotranspiration is 4.3 inches. Under the assumption of 70% of water supplement through irrigation, the actual water loss rate through atmosphere turns out 26%. Therefore, rain gardens, where 20% of runoff is removed from total rainfall (runoff coefficient = 0.2) consequently promote 54%

of rainwater to be infiltrated into the soil (100% - 26% - 20% = 54%). This number is relevantly higher than the infiltration rate of impervious pavement, which is 18%. The infiltration rates also vary depending on surface materials and regional climate conditions.

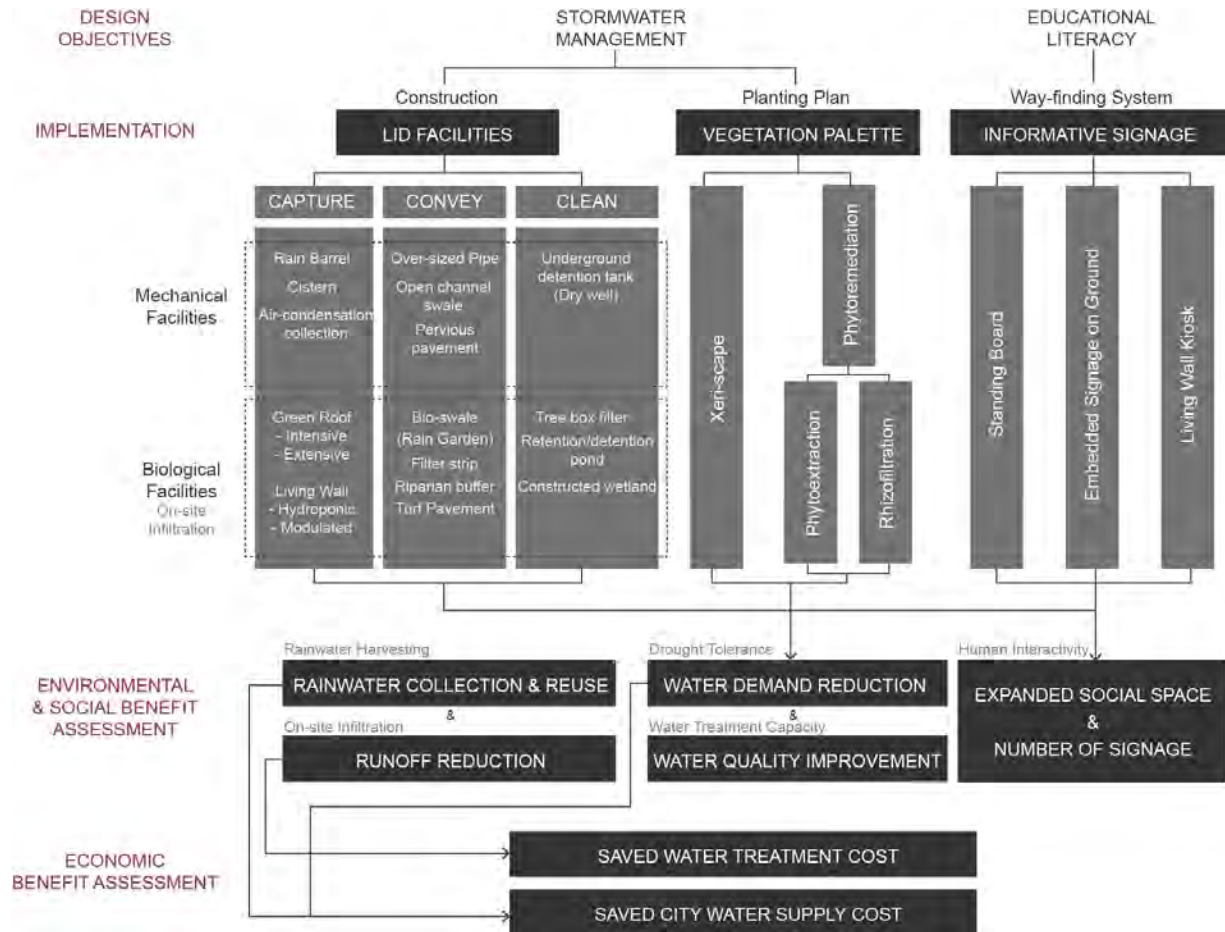


Figure 1. Proposed Framework (BLUEprint) for Stormwater Infrastructure Design

Table 1. Plant lists of vegetation palette for stormwater management

Vegetation Palette	Reference	Recommended Plants
Xeriscape	Texas Water Development Board (TWDB), 2013	Agave, Yucca, Palo Verde, Cactus, Desert Willow, Bulbine, Gayfeather, Texas Mountain Laurel, Agarita, Flame Acanthus, Blackfoot Daisy, Mesquite, Lantana, Buckeye, Rosemary, Western Redbud, most Oaks, Cypress, Sages, Acacia, Gaura, Lavender, Mexican Feathergrass, Muhly grass, Buffalo grass
Phytoremediation		
<i>Phytoextraction</i>	Schnoor, 1997	Sunflowers, Indian Mustard, Rape seed plants, Barley, Hops, Crucifers, Serpentine plants, Nettles, Dandelions
<i>Rhizofiltration</i>		Aquatic Plants - Emergents: Bullrush, Cattail, Coontail, Pondweed, Arrowroot, Duckweed - Submergents: Algae, Stonewort, Parrot Feather, Eurasian Water Milfoil, Hydrilla

4 METHODS

4.1 Framework Application

To test the applicability of the proposed framework, three water conservation-based design projects in Texas were examined through assessment of their master plans (See Figure 2). Three proposed master plans were approved by the

corresponding agencies and the design construction of each site is under progress. In each plan, LID facilities were implemented in three hydrological functionality (capture, convey and clean) according to the framework and the location was determined based on existing site conditions. Table 2 elucidates a listing of LID facilities designed on each site and their specific locations.



Figure 2. Master Plans of Three LID-based Design Projects in Texas (2013). Graphics by the Authors (2a: SEC, 2b: Conroe LSGCD, 2c: TAES Annex Building.)

Table 2. LID facilities designed on each site and their specific locations

Site	Hydrological Functionality	LID facilities	Location
SEC	Capture	Cistern, green roof, living wall	Existing buildings
	Convey	Pervious pavement, open channel swale, bio-swale, filter strip, riparian buffer	Proposed parking lot, upstream of major treatment systems
	Clean	Retention pond	Upstream from off-site stormwater management system
Conroe LSGCD	Capture	Rain barrel, cistern, air-condensation collection	Existing buildings
	Convey	Over-sized pipe, pervious pavement, bio-swale, filter strip	Existing/proposed parking lot, upstream of major treatment system
	Clean	Tree box filter, detention pond	Near pollutant sources, downstream of all LID systems (at the lowest point of the site)
TAES Annex Building	Capture	Cistern, living wall	Existing buildings
	Convey	Pervious pavement, bio-swale, filter strip, turf pavement	Existing parking lot, upstream of major treatment systems
	Clean	Dry well, constructed wetland	Near capturing systems and off-site stormwater management system

Table 3. Data used for the environmental benefit measurement

Implementation	Environmental Benefits	Needed Data for Measurement	Units	
LID facilities	Rainwater collection & reuse	Monthly rainfall	inch/month	
		Roof size	square feet	
		Roof coefficient	-	
	Runoff reduction	Annual rainfall	inch/year	
		Property size	acre	
		Conventional design / LID design's composite runoff coefficient	-	
Vegetation palette	Water demand reduction	Xeriscape plant cover	acre	
		Annual reference evapotranspiration	inch/month	
		Crop coefficient (K _L)	-	
		Irrigation efficiency	%	
	Water improvement	quality	Pollutant concentration in soil	ppm
			Phytoextraction coefficient	-
			Plant density	kg DW*/acre
		Phytoremediation plant cover	acre	

* DW = Dry weight

4.2 Data Collection

After applying the framework to the three selected projects to determining locations and characteristics of LID practices (facilities, vegetation palettes, and informative signage), primary data were collected to quantify environmental, social and economic benefits of each design. Then the quantitative metrics were used to measure each benefit. For each metric, comparisons were made across three cases.

Environmental & Social Benefits: To measure environmental benefits of LID, this research focused on rainwater collection and reuse, runoff and water demand reduction, and stormwater quality improvement. Table 3 summarizes data utilized in assessing environmental benefits. To calculate the volume of rainwater collection and reuse, monthly rainfall, roof size, and roof coefficient data were used, while annual rainfall, property size, and composite runoff coefficient values comparing conventional design and LID design were computed the rate of runoff reduction. To measure the environmental benefits of xeriscaping compared to the conventional landscaping, xeriscape plant cover, annual reference evapotranspiration, crop coefficient, and irrigation efficiency were employed to estimate the volume of reduced water demand. Finally, pollutant concentration in soil, phytoextraction coefficient, plant density, phytoremediation plant cover determined the extent of water quality improvement. With regard to social benefits, digital maps of three master plans were utilized to measure expanded

social space after construction and number of signage.

Economic Benefits: The measured results of the environmental benefits were then utilized to evaluate economic benefits. Table 4 illustrates data employed to assess saved water treatment cost and saved city water supply cost. Annually reduced runoff volume and water treatment cost unit determined total saved water treatment cost. Similarly, annually collectable rainwater, reduced water demand by xeriscaping and city water rate were used to estimate saved city water supply cost. Inflation rates in US were ultimately applied to the final output to be agreed in dollar value of 2013.

4.3 Benefit Measurement

Rainwater Collection & Reuse: For the comparison among the three water conservation-based design projects in Texas, collectable rainwater of each project was measured by using a simple calculation method introduced by Texas Water Development Board (TWDB, 2005). For example, Table 5 shows the consequential process of calculation for the SEC Lab project. Derived from the rainfall data in College Station and the roof size of buildings on the site, the estimated annual collectable rainwater volumes were indicated on the last column in table 5. The same methodology was applied in evaluating rainwater supply for the other two projects. In the case of the SEC Lab, 0.5 million gallons of rainwater could be annually captured and reused for outdoor irrigation.

Table 4. Data used for the economic benefit measurement

Economic Benefits	Needed Data for Measurement	Units
Saved water treatment cost	Annually reduced runoff volume	gallon
	Water treatment cost unit	\$/gallon
Saved city water supply cost	Annually collectable rainwater	gallon
	Reduced water demand by xeriscaping	gallon
	City water rate	\$/1000 gallons

Table 5. Collectable rainwater in the SEC Lab project

(A) Average annual rainfall [in.]*	(B) = (A) × 0.62 Average annual rainfall [gal. per sq.ft.]	(C) = (B) × 21182.10sf** Potential volume of water from collection area [gal.]	(D) = (C) × 0.9*** Estimated annual supply to collection tank [gal.]
38.47	23.85	505,223	454,701

* Average annual precipitation recorded from 2000 to 2013 at College Station, Easterwood Field Station

** Roof size *** Coefficient of asphalt shingle roof (TWDB, 2005)

Table 6. Comparison between conventional design and LID design runoff coefficients of the SEC Lab project

	Type	Facilities	Size [ac]	Runoff Coeff.*
Conventional Design	Light Industrial Area	Concrete pavement / conveyance pipes / open channel swale	26.04	0.65
LID Design	Grassland <7% (clay)	Turf pavement, filter strip	10.19	0.2
	Grassland >7% (clay)	Reparian buffer, filter strip	0.34	0.3
	Retention pond	Constructed wetland, retention/detention pond	4.9	1
	Bush/Tree area	Bio-swale (rain garden), green roof	4.98	0.2
	Roof	Asphalt shingle/ membrane roof	0.49	0.85
	Paved Area	Vehicle road, sidewalk	4.43	0.82
	Porous pavement	Sidewalk, parking lot	0.71	0.45
				0.48**

* *Design and construction of sanitary and storm sewers* (1969), p.332. Copyright 1969 by the Joint Committee of the ASCE and the Water Pollution Control Federation

** Composite runoff coefficient of LID design

Runoff Reduction: After the application of LID techniques, the reduction in total runoff volume compared to the conventional design approach was measured for each project by using one of the benefit toolkits introduced by Center for Neighborhood Technology (CNT, 2010). Changes of runoff coefficients (C) from conventional design to LID design were used to represent retention rates of each LID facilities as C values imply a variety of surface conditions. Table 6 demonstrates calculation of composite runoff coefficients for the SEC Lab project. With an assumption that the typical runoff coefficient of conventional design is 0.65, the number was lowered to 0.48 after LID application in this case. Based on changes in surface material and runoff coefficients, the annually reduced runoff volume was then calculated using average annual rainfall data.

Water Demand Reduction: Xeriscape is one of the strong strategies to conserve water by reducing its consumption by plants. The following equation illustrates how to calculate the irrigation requirement (IR) of xeriscape (Smeal, 2007).

$$IR = 0.623 \times ET_0 \times K_L \times CA \div IE \quad (1)$$

Where; IR is irrigation requirement [gallons]; 0.623 is a constant to convert inches to gallons; ET_0 is reference evapotranspiration [inches]; K_L is plant coefficient; CA is canopy area [square feet]; and IE is irrigation efficiency

The reference evapotranspiration (ET_0) refers to the “regionally specific estimate of the amount of water lost from a medium-height, cool season grass growing in an open field” (U.S. Green Building Council, 2010). Additionally, plant coefficients (K_L) which vary by plant species are utilized with ET_0 to estimate the actual evapotranspiration rate of specific plants. While plant coefficients of xeriscape plants normally range from 0.1 to 0.3, most wildflowers and grasses have the medium value (0.6) (TWDB, 2013). Therefore, to compare LID projects to conventional landscape designs and calculate water demand reduction by xeriscaping, we presume that conventional landscaping would have the medium value of plant coefficients. Also, another assumption is made: the irrigation efficiency of xeriscape garden is 95%. Based on these suppositions, Eq. (1) was applied in assessing reduced amounts of outdoor irrigation water.

Water Quality Improvement: Phytoremediation plants play a pivotal role in purifying contaminated soil or runoff (EPA, 2000). To estimate how much metals are removed from soil, *Brassica juncea* (Indian Mustard), one of the most effective phytoextraction plants found in previous studies (Kumar, 1995; Schnoor, 1997; EPA, 2000), were widely planted in three projects. For estimating water quality improvement, laboratory-measured phytoextraction coefficients found by Kumar (1995) were significantly used. The last column in Table 7 demonstrates the amount of metal uptake within the shoot of *Brassica juncea* in

an acre when they were planted by 3 tons dry weight per acre. We assumed that the pollutant concentration in soil is below the EPA standard (EPA, 1995). Based on the calculation in Table 7, the total amounts of metal uptake by *Brassica juncea* at three different sites were assessed.

Human Interactivity Increase: Two indirect measures were utilized to evaluate the increase of human interactivity in the three selected projects: expanded social space and number of the water-infiltration footprint signage. These indicators are frequently addressed by the Landscape Architecture Foundation (LAF) in measuring social values of constructed designs (*Landscape Architecture Foundation*: <https://lafoundation.org/research/landscape-performance-series/case-studies/>). To promote public awareness of LID application, this research

proposed an innovative hierarchical way-finding system integrated with each LID facility, called water-infiltration footprint. While the increased social space was calculated on the digital map, the number of three different types of outdoor signs was counted on the final master plans.

Cost Saving: Rainwater harvesting, drought tolerance of plant specimen, and on-site infiltration resulted in direct water use and treatment cost savings. One of the benefit toolkits introduced by Center for Neighborhood Technology (CNT, 2010) was used to estimate saved water treatment cost. First, the sum of collected rainwater and reduced water demand multiplied by city water rates represented the avoided cost in city water supply. Second, reduced runoff volume multiplied by water treatment rates indicated the saved cost in water filtration process.

Table 7. Measurement of metal uptake amounts by *Brassica juncea*

Pollutant	Pollutant Concentration (Clean Water Act Section 503.) [mg/kg DW][ppm]	Phytoextraction coefficient* (<i>Brassica juncea</i>)	Metal Uptake [Metal mg/kg DW (shoot)]	Metal Uptake within the surface biomass of the plant in an acre [kg]**
Cr	3000	58	174000	415.78
Cd	39	52	2028	4.85
Ni	420	31	13020	31.11
Cu	1500	7	10500	25.09
Pb	300	1.7	510	1.22
Zn	2800	17	47600	113.74
Total				591.78

* The ratio of metal concentration in the surface biomass of plant (g metal/g dry weight tissue) to the initial soil concentration of the metal (g metal/g dry weight soil) (Kumar *et al.*, 1995).

**Individual dry mass of *Brassica juncea* is 0.426g for shoot and 0.485g for whole plant (Shoot accounts for 87.8% of the whole plant) (Boucher, 2013).

5 RESULTS

5.1 Rainwater Collection & Reuse

In the cross-case comparisons among the three projects (Table 8), the SEC lab gathered the largest volume of rainwater through harvesting systems but the reuse rate was the lowest since large volume of rainwater in SEC was directly flowing into retention ponds for the purpose of storing water and reusing it for laboratory experiments. On the other hand, the TEAS Annex Building project efficiently saved outdoor irrigation water by reusing captured rainwater.

5.2 Runoff Reduction

The SEC lab relatively reduced the largest runoff volume compared to the other two projects, yet the actual reduction rate was the lowest (see Table 9). On the other hand, the Conroe LSGCD

project and the TAES Annex Building project reported higher runoff reduction rates although the project sites were smaller. The two projects not only successfully minimized total impervious area but also modified drainage flow paths to increase travel time of runoff.

5.3 Water Demand Reduction

Table 10 exhibits how much water was annually conserved by xeriscaping in the three projects. Xeriscaping saved a range of 50-85% of irrigated water in all projects, resulting in a lessening on the city water supply. In the comparison between the LSGCD project and the TAES Annex Building project, the higher water loss through evapotranspiration for the same acreages, more irrigation water saved.

Table 8. Cross-case comparisons of annually collectable rainwater

	SEC	Conroe LSGCD	TAES Annex Bldg
Annual rainfall [in]*	38.47	50.44	38.47
Roof size [sf]	21,182.10	11,620.87	11,266.87
Annually collectable rainwater [gal]	454,701	327,075	241,858
Reuse rate [%]**	1.7	5.1	12.0

* Average annual precipitation recorded from 2000 to 2013 at the nearest weather station to the sites

** (Collectable rainwater volume on roof / total rainfall volume on site) x 100

Table 9. Cross-case comparisons of runoff reduction

	SEC	Conroe LSGCD	TAES Annex Bldg
Annual precipitation [in]	38.47	50.44	38.47
Size [ac]	26.04	4.75	1.94
Runoff coefficient (conventional design)	0.65	0.65	0.65
Runoff coefficient (LID design)	0.48	0.36	0.44
Total annual runoff reduction [gal]	4,625,411.19	1,887,143.58	425,678.26
Reduction rate [%]*	26.2	44.6	32.3

* $[p1 - (\text{Runoff volume in LID design} / \text{runoff volume in conventional design})] \times 100$

Table 10. Cross-case comparisons of plant's water demand reduction by xeriscaping

	SEC	Conroe LSGCD	TAES Annex Bldg
Xeriscape plant cover [ac]	2.24	0.2	0.2
Annual ET ₀ [in]*	56.32	54.9	56.32
K _L **	0.1-0.3	0.1-0.3	0.1-0.3
Irrigation requirement of xeriscape garden [gal/year]	360,381.91 - 1,081,145.72	31,365.68 - 94,097.03	32,176.96 - 96,530.87
Irrigation requirement of conventional garden [gal/year]	2,162,291.43	188,194.06	193,061.73
Reduced water demand [gal/year]	1,081,145.72 - 1,801,909.53	94,097.03 - 156,828.38	96,530.87 - 160,884.78
Reduction rate [%]	50-83	50-83	50-83

* Averages computed using climate data from the National Weather Service (Texas A&M AgriLife Extension, 2013).

** Data from Texas Water Development Board (TWDB, 2013).

5.4 Water Quality Improvement

The total amounts of metal uptake by *Brassica juncea* at three different sites were represented in Table 11. As long as the pollutant in soil was within a safe level, a maximum of 2,000 kg of metals could be taken up in the SEC lab project. Since the SEC lab was previously a brownfield abandoned as an old airport, the function of phytoremediation plants would be more effective than other two sites. In addition, as shown in table 10 lead (Pb) was much more difficult to be removed than Cadmium (Cd).

5.5 Human Interactivity Increase

Table 12 shows that the TAES Annex Building project had the largest increase in social space (27%). The proposed LID plaza and living wall library areas in the TAES project helped create this increase. Also, 23 to 49 outdoor water-infiltration footprint signs for education were

stationed in projects. Overall, the TAES Annex Building project represented the largest achievement in fostering public education about LID as the density of signs per one acre of social space was the highest in this project (43/acre).

5.6 Cost Saving

Economic benefits of LID were assessed in Table 13. As a result, three LID projects generated an annual profit of \$1,100 to \$7,300 in saving city water supply and water treatment cost. Since the city of Conroe exposed higher water rate for non-residential land than other cities due to the emerging issue of groundwater depletion, the LSGCD project could have avoided the largest cost by stormwater management strategies. Furthermore, the saved water supply cost by rainwater harvesting and xeriscaping far overweighed the saved water treatment cost by on-site infiltration in all three projects.

Table 11. Cross-case comparisons of metal uptake amounts by *Brassica juncea*

	SEC	Conroe LSGCD	TAES Annex Bldg
Phytoremediation plant cover [ac]	3.32	0.26	0.19
Metal uptake within the surface biomass of the plan [kg]			
Cr	1,380.38	109.35	78.17
Cd	16.09	1.27	0.91
Ni	103.29	8.18	5.85
Cu	83.30	6.60	4.72
Pb	4.05	0.32	0.23
Zn	377.62	29.91	21.38
Total	1964.72	155.64	111.26

Table 12. Cross-case comparisons of social benefits

		SEC	Conroe LSGCD	TAES Annex Bldg
Size [ac]		26.04	4.75	1.94
Expanded social space [ac] (Rate of increase [%])		5.28 (20)	1.12 (24)	0.53 (27)
Number of signage	Standing board	14	10	9
	Embedded signage	31	15	13
	Living wall kiosk	4	2	1
Total		49 (9/ac)	27 (24/ac)	23 (43/ac)

Table 13. Cross-case comparisons of cost saving by LID application

	SEC	Conroe LSGCD	TAES Annex Bldg
Annually saved water supply cost	\$6,048	\$7,113	\$1,079
Annually saved water treatment cost*	\$461	\$188	\$43
Total saving (2013 price)	\$6,509	\$7,302	\$1,122

* Apply US inflation rate to covert dollar value of 2009 to 2013. Cumulative rate of inflation from 2009 to 2013 is 8.6%. (US Inflation Calculator, 2013)

6 CONCLUSION & DISCUSSION

This study emphasized the significance of LID based-design and evaluated its efficacy of post-implementation. The proposed three-tiered framework and performance measurement structure (the "BLUEprint") served as a framework in guiding overall design plans of the three LID projects. The projected results of environmental, social and economic benefits implied significant contributions of LID techniques to water conservation and groundwater recharge; in total, all projects annually saved 3 million gallons of water supply and reduced 6 million gallons of runoff, generating an annual profit of \$15,000. However, the small pool of design projects lowers the external validity of this study. Larger design samples of LID application would aid in establishing more applicable framework. In addition, indirect factors such as reduced flooding risk need to be quantified in dollar value to assess the avoided environmental damage cost to prevent underestimation of economic impact. The elaborate process of benefit measurements accompanied by cost analysis would also build up the proposed framework and help determine design impacts. Above all, field assessment after the current construction of the sites will be needed to rectify errors between observed data and projected data.

Overall, the proposed framework would be an effective tool in the decision making process for holistic LID design and planning with more objective design strategies using quantitative measurements.

Since the framework could be variously applied not only to micro scaled projects such as parking lot design but also to macro scaled plan and environmental policy, it would bring a wide range of benefits to property owners, developers, and municipal governments. By further developing the measuring structure into detail indicators with varied weights, the system of LID would be strengthened and the framework would serve to be applied to multiple case studies and design practices in the future.

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MORPHOGENESIS IN THE LANDSCAPE: ALGAEIC INFRASTRUCTURE AND RECYCLED CARDBOARD

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1 ABSTRACT

Among the many emerging discourses and technologies potentially adhering to landscapes, morphogenesis, conceived as an architectural theory, derives materiality, functionality, and form from the biotic world. As part of a discussion of “data driven” or “bottom up” design, Leach’s morphogenesis recognizes that “nature itself can teach us about the efficiency of certain structural organizations.” (Leach, 2009) This case study experiments with morphogenesis in the landscape. The study method is to document a morphogenetically derived installation’s form in the landscape. The team developed a morphogenetic module, built 330 copies of it, and created an emergent intervention (Algaeic Infrastructure) for a specific site in an example of Clement’s Third Landscape.

Built from recycled cardboard, Algaeic Infrastructure proposes an emergent pattern derived from the module’s form, the landscape, and the process of building. The structure is created by interactive rules similar to the development of computer programs that “think” (Johnson, 2011) and thus physically models a version of “learning.” The interlocking system was deployed along an arroyo as an event space for High Desert Test Site (HDTs) in October 2013. The project site is Montessa Park, Albuquerque, NM, where the city’s edge intersects the military base and the airport. A past dairy, deep downcutting of the arroyo, a prison farm, and current “sacrifice” uses, such as ATVs, shooting ranges, and garbage collection layer this in-between (Third) landscape. The ecological implications of this study lie in the proposal of a flexible, modular, morphogenetic system allowing building/designing to accommodate ecological flows rather than impede them.

1.1 Keywords

morphogenesis, topological connections, emergence, third landscape, grasshopper, parametric landscape

2 THEORY

2.1 Morphogenesis in the Landscape:

On the one hand, the derivation of design form and function from biota as applied to landscape seems painfully obvious. Landscape architecture is posited, after all, as the design discipline of natural spaces and functions either within or outside of the urban form. Landscape architecture might be seen as the crucible in which the discredited divisions of nature and culture, man and animal, were melted down in the past twenty years. In 2011, Mirko Zardini opens *Seemingly Seamless*, an essay from *Landform Building* (Stan Allen, ed.), with a strawman opposition between landscape and architecture: “Landscape is irresistible. It is soft, neutral, and continuous, unanimously understood as good, reliable, and therefore not open to criticism” (Zardini, 2011), and architecture is the opposite. He suggests *Landform Building* (based on Landscape Urbanism) is a new theoretical direction for architecture and landscape in that “it seeks a path around distinctions between the natural and the artificial...the city is no longer understood as figure and ground, but as a complete environment.” (Zardini, 2011)

As a physical prototype for understanding a non-oppositional relationship of landscape and architecture, *Algaeic Infrastructure* uses the principle of modular organization with an open and flexible outcome to connect with a “third landscape” (Clement, 2006) site. The third landscape “interstitial space” (Clement, 2006) forms a matrix interlocking human intervention -- flood channels, aggressive grazing, erosive farming, and upstream development -- with untended plantings of

renegade, vestigial windbreaks and a persistent seedbank. The modules exhibit radial symmetry (reminiscent of algal forms) and topological interlocking connections. (Estrina et al., 2011) The functional equivalent can be found in the interconnections of colonial algae as they form interlocking matrices across water bodies. The structural requirements of the topological interconnections create a ninety degree orientation to the modules and thus a three dimensional connected fabric. As Leach, indicates, *“nature itself can teach us important lessons about the efficiency of certain structural organizations.”* (Leach, 2009)

“It (morphogenetic design) is not a question of what a cultural object might ‘symbolise’ – the dominant concern in the Postmodernist quest for interpretation and meaning – but rather what it ‘expresses’. The concern, then, is to understand culture in terms of material processes – in terms of the actual ‘architecture’ of culture itself.” (Leach, 2009)

Leach’s call to abandon a metaphoric understanding of design language and enter into a material and “actual” language, echoes De Landa’s Neo Materialism “... neo-materialism is based on the idea that matter has morphogenetic capacities of its own and does not need to be commanded into generating form.” (De Landa, 2012) In De Landa’s 2012 interview with *New Materialism: Interviews & Cartographies*, he defines a trajectory which seeks, as does Leach’s morphogenesis, to posit an engineering or mechanically based order to the world, allowing for a logic that emerges from material existence. The freedom from one-to-one correspondence of meaning and object opens a breath of fresh air into the discipline of landscape architecture. Not beholden to culturally mandated equations -- the signs, symbols, and signifiers of a semiotic era -- we are allowed to investigate material language. While morphogenesis may derive forms and borrow structural memes, a morphogenetic language is not then bound to the equation of algae, streambeds, and fertilizer blooms. A material language can obviate the opacity of a metaphor’s reliance on shared cultural texts and experiences, and thus, potentially disrupt a hegemonic order.

2.2 Theory: Scale

“Designers must take action and modify our stance at all scales and morphologies to have a positive effect on the global community. Our reflections on their possible role is first and

foremost based on one succinct predicate: the end of scale.” (Mitchell, 2012)

One of the implications of the *Algaeic Infrastructure* prototype is scale. Using a modular building method allows a large structure to be derived from a small scale module. At first glance, there are two scales to be considered -- the scale of the module and the scale of the overall structure. In modular construction those scales continue to multiply, as the emergent structure is allowed to grow and intersect with the surrounding site. The module has an internal logic and formal structure based on its material nature and the topological interlocking requirements. Thus, the structure has an ever-variable and responsive form. Twenty modules create a self-supporting sphere, but forty modules interlocked do not form two self-supporting spheres, rather they create an emergent form dependent on the surrounding context.

As Mitchell predicts the end of scale, *Algaeic Infrastructure* posits a scalar logic reaching both forward into a world of custom printed airplane parts, (Lipson et al., 2013) and back to the limitations of human scale technologies, such as hand laid masonry and post and beam wooden construction. Mitchell’s scale is perhaps the dominance of the Fordian globalization of manufacture and building. At this technological moment in Western culture, interventions replicate and iterate without interference or resistance from either land or material reality.

2.3 Theory: Ecological

Algaeic Infrastructure proposes design and construction interaction with a site as a process rather than an imposition of form. This offers a potential answer to Zardini’s observation that *“...a deeper acknowledgement of multiplicity may provide such strategies with the full potential to negotiate between the soft and the hard, the neutral and the opinionated, the continuous and the fragmented -- offering a conscious distancing from previous spatial agreements based on ‘pure force.’”* (Zardini, 2011)

Algaeic Infrastructure prototypes a building process engaged with scale and site to model flexibility. Working with a module and allowing the site conditions to determine overall formal structure perhaps frees construction, not only from the cultural pitfalls of metaphor, but also from the blindness to ecological conditions which can accompany conventional grading and construction. This prototype offers a rearrangement of the priorities of design. Rather than privileging an

overall form and forcing the site to support that form, this process allows the site and the module's capabilities to determine an overall intervention. Modular scalar building is not proved by this prototypical presentation, given that *Algaeic Infrastructure* is an art piece rather than a habitable space, but the proposition offers potentials to be explored in section 3.1 Implications.

3 PROCESS

3.0 Morphogenetic process -- limits and materials

"Morphogenesis... More recently it has been appropriated within architectural circles to designate an approach to design that seeks to challenge the hegemony of top-down processes of form-making, and replace it with a bottom-up logic of form-finding." (Leach, 2009)

Leach, in this articulation of morphogenesis, describes a process that could be applied to *Algaeic Infrastructure's* growth. Is this an absence of design? It surely is an absence of the parti, the grand sketch, the overall gesture, that claims to synthesize a site and a program into an expression through the magic hand of the author. (Booth, 2011) It is perhaps a re-definition of the role of designer(s). We claim the result is emergent, as defined in Steven Johnson's 2001 explorations.

3.1 Process: Form-Finding Parameters

(Johnson, 2001) This does not mean it is undesigned, rather a form-finding process with simple rules has been enacted. Our criteria were replication, structural integrity, and a scalar flexibility.

We sought replication to create a flexible form which could be arranged in a variety of ways in the variable arroyo channel. In Albuquerque, an arroyo changes morphology with each year's rain. A replicating form would allow for response to the variable conditions of the arroyo. It would also allow us to build in response to the site conditions of a particular day, both phenomenological and formal.

Structural integrity was required to allow the piece to build to the extent we were intending. The arroyo channel measured approximately 35' at its base and about 130' at the widest top of bank-to-bank measurements. The 35' broken roadway/dam where we located the piece was fifteen feet above the floor of the arroyo. We needed to create a system which could span some of these distances yet create a dense intervention.

Scalar flexibility was necessary to allow a spatial element to come into play. We ended up with two scales of modules to allow a structure to emerge from the replication. The play with scaled modules could continue as we indicate in our potential outcomes of this experiment.

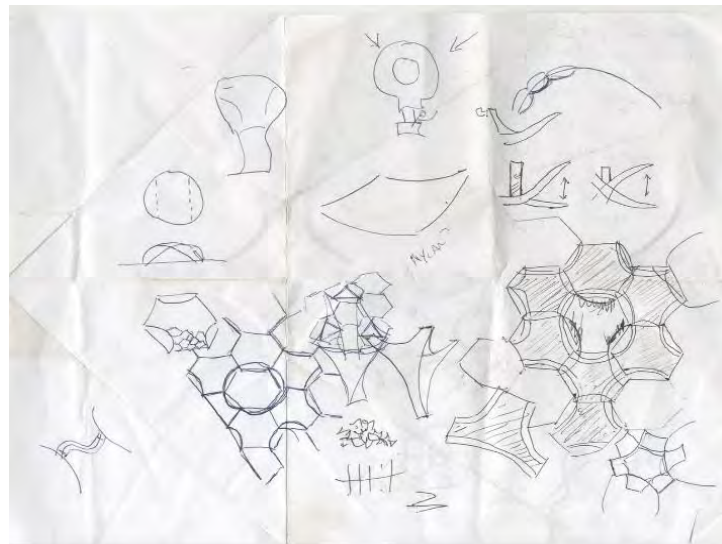


Figure 1. Form Finding Sketches (2013). Diagrams by the Authors

This sketch derived from early explorations of using inflatable modules to generate a thermodynamic structure. In the bottom right hand section, the formal antecedent to the final cardboard module emerges. The parameters for this form were to find a flat module which would generate a three dimensional fabric with an inherent geometry.

3.2 Process: Simulation

Once a basic formal intent is determined, formal responses to pressure and elasticity are determined through digital simulation. The platform for this investigation is Grasshopper, a visual scripting plugin for Rhinoceros 3D. The simulation itself is conducted through Kangaroo, a physics engine for Grasshopper. Kangaroo

facilitates the simulation of material properties and form relative to dynamic forces such as pressure and gravity.

A basic footprint of the module is created within the Grasshopper environment, framing two mesh planes. Kangaroo simulates an increase of air pressure within the planes to enable inflation. The Grasshopper plugin Weaverbird optimizes the meshes, restructuring their internal organizations based off of the curvature necessary to represent the curvature of the surface.

Using the mesh framework optimized by Weaverbird, the surfaces can then be flattened into a two-dimensional plane that would inflate and approximate the dimensions of the digital model. This two-dimensional plane serves as the template for fabricating the modules.



Figure 2. Grasshopper Model (2013). Diagram by the Authors



Figure 3. Cardboard Collection (2013). Photo by the Authors

3.3 Process: Cardboard as Morphogenetic Material

Cardboard became the final material for the structure. We experimented with inflated modules which would have a photo-responsive function. Our team requirement to use a sustainable plastic required compostable bio-plastic, yet bioplastic's sealing limitations made it not feasible. We explored photo-degradable plastic but discovered that the modules did not retain air in the 1 mil plastic our computer models predicted would best inflate.

Cardboard is not only a commonly recycled material, -- the EPA estimates in 2011 66% of the paper stream was recycled (EPA, 2011) -- but is also made from recycled content. The paper stream accounts for 70 million tons of waste. Recycled cardboard is valued at between \$55 and \$100 per ton (Metcalf, 2012).

Our process transformed cardboard from heaps in a recycling yard into a structural and aesthetically viable product. We bought 900 pounds (just under half a ton) of cardboard from recycling services in Albuquerque. The usual waste stream for cardboard collected in Albuquerque is shipment to Mexico, where it is pulped and reconstituted as paper products. Our criteria was to look for boxes which would cover a substantial portion of a 4'x8' sheet. We hand-picked refrigerator and large appliance boxes from mountains of material.

We then flattened, cut, and laminated five or six layers of recycled cardboard between two sheets of clean 4'x8' double-ply cardboard. The lamination was a hand (and foot) process with gallons of wood glue and scrapers.

The final result was a board 1 5/8" thick and 4'x8' in dimension. Boards were marked with a template and rough-cut with a hand jig saw to rough module dimensions. Final shaping was done with a band saw, and each piece took six minutes to cut. The team processed 900 pounds of recycled

cardboard into thirty 4'x8' laminated sheets and cut from them 330 individual modules in two sizes.

Cardboard is not a permanent outdoor installation material. It requires quick assembly and disassembly based on precipitation and wind conditions.

We initially imagined cardboard as a sketch model material. We needed multiple modules to model the emergent patterning available with the form derived from our sketches and algal research. Cardboard is plentiful and cheap in our culture. As we worked with it, the cardboard's durability, formal character and conversion from scrap to material replaced our earlier theories on photo-reactivity and inflatable architecture.

3.4 Process: Scale

The team began building with the module at a five-inch inscribed diameter scale in order to understand the formal implications of its replication. This exploration was a purely visual scalar model. Our next step was to build 240 one-foot inscribed modules made from the 1 5/8" laminated cardboard sheets. This module created a piece which could be assembled into a 10' x 10' x 20' installation. The scale was not habitable, but certainly more haptic than solely visual. The next version was 90 modules at a scale inscribed within a two and a half foot diameter. Those pieces shifted the perceptual scale to a habitable sphere. The two and a half foot scale responded to the 15 feet of rise between the arroyo floor and the top of the road. The final installation used both one foot and two and a half foot modules to respond to the site's variations.

The site scale in section has a ratio of 1:2, height to width of the arroyo floor, and 1:8 for the height of the roadway to the width of the arroyo's widest bank-to-bank distance. The form seems steeper on site.

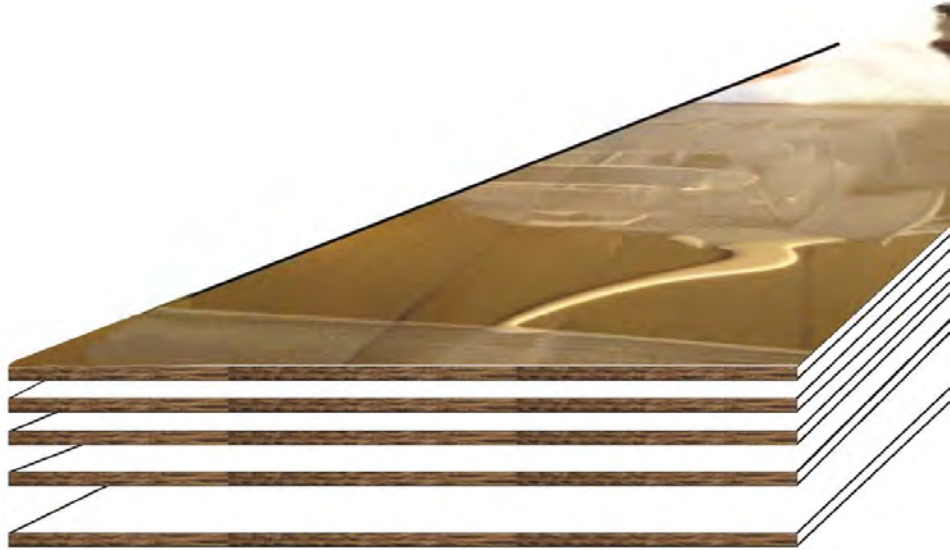


Figure 4. Cardboard Lamination (2013). Composite: Harris



Figure 5. Algaeic Infrastructure (2013). Photo by the Authors



Figure 6. Montessa Park Arroyo Site (2013). Photo by the Authors

3.5 Process: Site Installation

The process of installation became an exploration of the site conditions. The arroyo is a constantly changing field. Larger and later than usual fall rains filled one side of our chosen site at the old ford down into the fifteen foot head cut. The Tijeras arroyo, which runs through Montessa Park, was, according to aerial photos from the 1940's, a surface intermittent stream. It has down-cut due to development and engineering, such that the surrounding lands, once farms, are now dewatered scrub. The site is in the Frisbee golf course at the eastern end of Montessa Park.

We installed the cardboard, testing and feeling out the modules' movements beginning on

Thursday afternoon. By Friday at 3pm we were done. We collected some camping gear and spent the night on the levee above the structure. The night was cold with a low of 26 F by the car thermometer. We slept, but woke with the booming of airplane engines, the sounds of late night target practice, and an anomalous weather radio driving by at high decibels. High winds rearranged our piece, so before dawn by the full moon's light, we rebuilt the structure.

The sun rose with the piece in place and us roasting marshmallows. Our loved ones came and brought breakfast. People began to arrive around ten, slowly at first. The piece was hidden in the arroyo. People parked at the road side and walked into the site without our guidance.



Figure 7. Visitors at Algaeic Infrastructure (2013). Photo by the Authors

4 SITE

4.1 Montessa Park - The Third Landscape/Sacrifice Zone -- or Why is a Modular and Temporary Intervention Appropriate for the Third Landscape?

The Third Landscape refers to Gilles Clement's essay about interstitial landscapes that harbor biological diversity and ecological resilience. Third Landscapes are reservoirs for the possibilities of regeneration, and inherently revolutionary. Montessa Park, situated between the Albuquerque International Airport and a growing new urbanist vision to the south, could be seen as such a teeming and possible landscape. "*The term Third Landscape does not allude to the Third World, but to the Third Estate. It is a referral to Abbé Siéyès' question: « What is the Third Estate? Everything-What role has it played to date? -None-What does it aspire to? -Something »* (Clement, 2006) In such a landscape, efforts at a temporally fixed architecture and landscape have largely deteriorated. The park is seen as a sacrifice zone to uses such as garbage collection, ATV use, and shooting ranges. Past tree plantations, farming, and prisons all exist in palimpsest demarcations on the ground surface. The space is public, yet access is virtually secret. The park entrance begins across the interstate, and while it appears to connect with the major artery from the University of New Mexico to the slowly growing new urbanist development, the road beds are actually separated by twenty feet of drop. Google Earth's directions do not lead to the park.

Javier Mozas comments in his a+t "Strategy Series" introductory essay of 2008, "*These spaces are ideal spaces to take in diversity without attributes, not just biological diversity, but also cultural diversity, the diversity which leads to dreams....the diversity which is expelled from other landscapes*"(Mozas, 2008). There is an inherent flexibility in Montessa Park. Not only is it an ecologically shifting ground of erosion, flooding, and wind, but it is also a shifting ground of political allegiances and possibilities. Open Space administration rejected our first site proposal as too risky. The end of the park with heavy ATV presence is often home to random bullet holes, such as those perforating a sewer line the month before our installation.

5 IMPLICATIONS

Borrowing from Feyerabend's anti-positivism, we refrain from conclusion and suggest implications. The strongest implications are for the scalar shifts from module to structure. The scalar shifts in Algaic Infrastructure drive the interest we have in working with this module at different scales. The team imagines possibilities for this system to form an interlocking emergent module as erosion control or as a structural architectural intervention. If this formal language proceeds from landscape control to architectural form, then the Landform Building morphogenetic process could be fully articulated, fulfilling the promise of modular structures.

The morphogenetic implications of the structure may unfold with further material exploration. The cardboard has a temporary quality, depriving it of a determined function or structural demonstration. While morphogenesis and neo-materialism free us from the requirements of a metaphoric structure, further research into materials is required to articulate this module. From our original principles of replication, structural stability, and flexibility, we can derive a palette of materials to test further, perhaps largely cast, or printed.

Process implications link physical parametric computer modeling. Rather than a predictive computer model, we worked with a model analyzing an analog proposal. The gaps and resistances – ie: failure of the inflatable modeling and predicted gaps in the spherical form -- offer space for this process to be iterative and conversational, rather than a monolithic digital conclusion. The process of emergence comes from both ends of the project workflow.

During the installation we observed the expected deterioration of the cardboard and a less expected loosening of joints as the material shrank. This leads us to conclude that a relatively stable material would be required to maintain structural integrity. Likewise, were this structure to be applied to erosion control, the material would need to be inert to encourage siltation and allow for plant growth.

The emergent nature of the design, the unfolding neo-materialism, and the adaptation of scale offer implications for working with site design from a morphogenetic --"form finding"-- process.



Figure 7. Visitors at Algaeic Infrastructure (2013). Photo by the Authors

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HISTORY AND THEORY

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ROBERTO BURLE MARX AND THE BOTANICAL GARDEN

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1 ABSTRACT

Rio de Janeiro's colonial and imperial gardens played an influential role on the work of modernist Latin American landscape architect Roberto Burle Marx (1909-1994). Burle Marx mythologizes the influence of his visit as a young man to the Berlin-Dahlem Botanical Garden's greenhouses, which displayed the tropical plants of his native Brazil in the ecological tableaux developed by the botanist Adolf Engler (1844-1930). Engler had collaborated with Carl Friedrich Philipp von Martius (1794-1868) on his monumental work Flora Brasiliensis, and developed the field of phytogeography, emphasizing the importance of geology on biodiversity. Burle Marx, credited as a pioneer in the use of native Brazilian flora in his designs, often cites his rejection of a significant preference for the use of imported European species in Brazilian parks. Yet many of the historic parks of his hometown of Rio de Janeiro incorporated native tropical flora, including most importantly the nineteenth century projects by Auguste François Marie Glaziou (1828-1906). Influenced by the work of von Martius and Engler, Burle Marx often worked with botanists to catalog ecological plant associations at his project sites. Two of Burle Marx's lesser known projects from 1961 are discussed in the context of these precedents: the Jardim Botânico, São Paulo, and the Parque Zoobotânico, Brasília. From 1967 until 1971, Burle Marx insisted on the protection and conservation of the Jardim Botânico of Rio de Janeiro. Fittingly, Burle Marx's own experimental botanical garden of Brazilian flora at Sítio Santo Antônio da Bica is now a national historic and artistic monument.

1.1 Keywords

Roberto Burle Marx, Brazil, native plants, public parks, botanical gardens, ecology

2 A BRAZILIAN GARDEN FROM A BERLIN GLASSHOUSE

2.1 The Berlin-Dahlem Botanical Gardens: Myths and Lessons

At the age of nineteen, while studying music and painting in Berlin, Roberto Burle Marx (1909-1994) visited a beautiful glasshouse filled with plants from his native Brazil at the Berlin-Dahlem Botanical Gardens. He describes being astounded by the richness of this tropical flora, which included collections of plants that he had not seen in the gardens and parks of Rio de Janeiro.

"When, in 1928, I lived for two years in Germany, brought there by my father, one of my fascinations was, in the Botanical Garden of Berlin, to see the Brazilian flora growing and flourishing in the greenhouses of that institution. It was astonishing to me because of the fact that I had never seen these plants in the gardens and parks of Rio—yet they evoked so much emotion in me."

(Burle Marx, *Paisagismo Brasileiro*, 1967, p.14)

The Berlin-Dahlem gardens did indeed have a rich collection of Brazilian flora, enriched by the Brazilian specimens of Carl Friedrich Philipp von Martius (1794-1868) and developed carefully into ecological groupings by the German botanist Heinrich Gustav Adolf Engler (1844-1930), the founding director of Berlin-Dahlem. Yet Brazil had a long history of the use of native plants in its public gardens, particularly in Rio de Janeiro's nineteenth-century Imperial gardens designed by the French hydraulic engineer and botanist François-Marie Glaziou (1833-1906).

This paper attempts to dispel the myth propagated by Roberto Burle Marx of a Brazilian garden culture that excluded all native plants. There was indeed a well-established practice of the incorporation and valorization of native flora in nineteenth and early twentieth century public parks in both Rio de Janeiro and São Paulo. Yet it is also critical to expand the understanding of what Burle Marx *did* learn in Dahlem, and to highlight the importance of the lesson of the greenhouse "phytogeographies" developed by Engler and von Martius. The significant ideas of these German

botanists influenced Burle Marx's public parks throughout his career as a landscape architect.

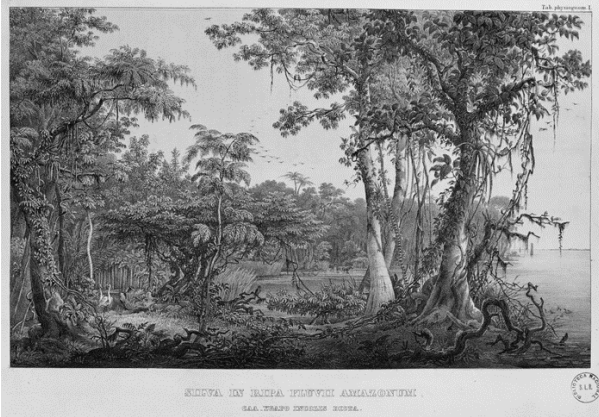


Figure 1. Forests along the Amazon, Karl Friedrich Philippe von Martius (1840-1906)
Image courtesy Fundação Biblioteca Nacional, Rio de Janeiro

2.2 The Phytogeography of Brazil

Exploration into the vast interior of Brazil began only in the seventeenth century, in the era of the Portuguese *bandeirantes*, adventurers who sought gold, gemstones, and Indian slaves. And it was not until the beginning of the nineteenth century, when the Portuguese crown opened the interior to European scientific expeditions, that Brazil's floral wealth was collected and classified. Brazilian tropical plants—orchids, philodendrons, bromeliads—were brought back and cultivated in European greenhouses, structures that displayed to the public both the emergent technologies of iron and glass as well as the tropical exoticism of the New World.

One of the many expeditions was the *Missão Científica Austríaca*, led by the Austrian botanist Karl Friedrich Philippe von Martius and the zoologist Johann Baptist von Spix. Sent by the Emperor of Austria, Francisco I (whose daughter had recently married the Portuguese Principe Real Dom Pedro), the team arrived in Brazil in 1817 and traveled throughout the country until 1820, collecting, observing, and recording specimens of flora and fauna. *Flora Brasiliensis*, initiated in 1840 and only completed in 1902, was the expedition's monumental publication, documenting over 8000 species of native flora with thousands of lithographic prints. In addition, the work included a map dividing the country into five ecological regions, as well as over fifty plates illustrating the landscapes and plant life of various geographic regions throughout the country (Martius, 1840).

This study of phytogeography developed by both von Martius and Engler was manifest in the tableaux of the Berlin-Dahlem gardens. Burle Marx became fascinated by the work of von Martius, stating:

“How one sees a difference in this spirit, that of a von Martius, a man of humanistic culture, who, upon arriving in Brazil, fell in love with its exuberant nature, and, in a mixture of science and poetry, divided Brazil into phyto-geographic regions, distinguishing each with names of Greek divinities—the Naiads (water nymphs), the Oreads (mountain nymphs), the Hamadryads (wood nymphs). He was a man of a refined sensibility, who combined the finest ecological concepts of his time with a deeply artistic sense of perception. This may be seen in his descriptions of sunrise over the lakes of Pará or of a tropical storm in the heart of the Amazon forest.” (Burle Marx, *Projectos de Paisagismo*, 1962, p.24)

3 PUBLIC PARKS OF COLONIAL RIO DE JANEIRO

3.1 Passeio Público, Mestre Valentim, 1783

The Passeio Público, an asymmetrical public promenade in the historic center of Rio de Janeiro that still exists today, is considered the city's first public park. Executed from 1779 through 1783, the Passeio Público was the vision of Mestre Valentim da Fonseca e Silva (c. 1745-1814), a sculptor and urbanist from the interior region of Minas Gerais. Commissioned by the Viceroy of the colonial State of Brazil, Dom Luís de Vasconcelos e Sousa, and inspired by Lisbon's own Passeio Público, the enclosed park featured large shade trees, a pond with islands, and ornamental sculptural elements including bronze alligators. Located along the Bay of Guanabara to its east, the park, an irregular hexagonal form with strong geometrical axes, was bounded by the hills of São Bento to the north, Santo Antonio to the south, and Rua da Vala to the west. (Carvalho, 1999) A wide terraced promenade extended the length of the park's frontage on the Bay of Guanabara, open to the view and breeze.

Flora of the park was selected for its ability to provide broad expanses of shade in this particularly hot and sunny tropical climate—tall trees included tropical natives such as mango, tamarind, and palm trees, as well as cedars and pines. (Mariano Filho, 1943)



Figure 2. William Bell, *Jardim Botânico*, Rio de Janeiro (1882)
US Navy / Public domain

3.2 Jardim Botânico da Lagoa Rodrigo de Freitas, 1808

The Jardim Botânico of Rio de Janeiro was founded in 1808 by King João VI of Portugal. It was originally intended as a garden for the local acclimatisation of spices brought from the East Indies to Brazil (“an Acclimatisation Garden meant to introduce the growing of East Indies spices to Brazil”), such as nutmeg, pepper, and cinnamon. (Rodrigues, 1908) After the transfer of the royal court of Portugal to Brazil during the Napoleonic Wars, the garden was opened to the public in 1822. A stunning 750-meter long allée of 134 Royal palms (*Roystonea regia*) are all descended from one single tree, the *palma mater*, a gift to King João VI from the Isle de Mauritius in 1809. The *palma mater* was destroyed by lightning in 1972. This tree, imported from the West Indies, is not a native Brazilian tree, but it shares the characteristics of trees in the equatorial belt. Vitória Régia (*Victoria amazonica*) water lilies are also found at the garden in the Lago Frei Leandro Pond.

Located along the perimeter of the Lagoa Rodrigo de Freitas in Rio de Janeiro, the Jardim Botânico may have been established as an “acclimatisation garden,” but it quickly became an important research institute for the study of native Brazilian flora. Many exploratory expeditions were dispatched from the Botanical Garden, a transformation of the garden’s mission begun during the directorship of João Barbosa Rodrigues between 1890 and 1892, and again from 1903 until 1909. Barbosa Rodrigues augmented the garden’s collection of live plants and addressed the necessity of conservation, particularly that of native Brazilian species. A specialist in Brazilian palms, he founded a herbarium, museum, and library at the garden, and published a monumental reference work on the palm species, entitled *Sertum*

Palmarum Brasiliensium, which is still considered a classic botanical text.

Naturalists from the botanical garden joined Cândido Rondon, a Brazilian military officer, in the early twentieth century as part of the Missão Rondon, an expedition that sought to integrate the country of Brazil through an investigative exploration of the western Amazon region. In 1922, a group of Belgian botanists led by Jean Massart arrived at the garden; the Missão Massart excursion was established, recording flora discovered on voyages throughout the states of Rio de Janeiro, São Paulo, Minas Gerais, Bahia, and Amazônia in the reference work *Une mission biologique belge au Brésil 1922-1923*. Over 1500 photographs were included with this report. The Jardim Botânico continues to be well-known globally as an important research institute, particularly for the identification and conservation of neotropical flora. Yet its beautiful gardens are also a popular leisure destination for locals and tourists alike. (Bediaga, 2007)

4 PUBLIC PARKS OF IMPERIAL RIO DE JANEIRO

4.1 Glaziou’s Passeio Público and the Imperial Gardens

Auguste François-Marie Glaziou came to Rio de Janeiro in 1858 after having worked in Paris with Adolphe Alphand, the designer of Parc des Buttes-Chamont and Parc Monceau. In 1860, Glaziou was commissioned to renovate Mestre Valentim’s Passeio Público; he transformed its formal design with the romantic sensibility of an English garden, with sinuous planting beds and curving paths. “This plan represents a garden known as ‘English’ or ‘landscape,’ of the style adopted by the most forward-looking civilizations,

for its natural and gracious singularity...enlarging the horizon to its very limits." (Laemmert, 1862)

Glaziou was appointed the first Director of Imperial Gardens in 1869, and completed the designs of several plazas and streetscapes using the local tropical flora that he himself had collected on numerous expeditions. The beautification program of the Avenida do Mangue and the Largo do Machado from 1869 through 1875 included the planting of fig and palm species. Many other urban streetscapes and plazas were redesigned under his direction. (Martins, 2011)

In 1869, Glaziou began the renovation of the imperial gardens of the Palácio de São Cristóvão, the Quinta da Boa Vista. The palace had been the residence of Dom João VI, Dom Pedro I, and Dom Pedro II. Glaziou created a romantic landscape around the palace with a strong central allée of sapucaias, a native Brazilian tree. The allée bisected the grounds into two sinuous gardens, with lakes and grottos.

In 1874, Glaziou began the transformation of the Campo de Santana, a former marshland, creating a public park called Parque do Aclamação. The construction of the park, which was overseen by Glaziou himself, was completed in 1880 and inaugurated by the emperor Dom Pedro II. The form of this large park was modeled on the great parks of Paris: Parc Monceau, Parc des Buttes-Chaumont, and the Bois de Boulogne. Sinuous lines guided the design, and again, "natural" elements were constructed within the park: large rocks, tunnels, grottos, lakes, and waterfalls. Both native and European species were used in the planting palette. (Dourado, 2011)

4.2 Glaziou in the Highlands of Brazil

In 1883, the mystical Italian priest Dom Bosco spoke of a dream of a promised land in the interior of Brazil, between the fifteenth and twentieth latitudes, where "milk and honey will flow and there will be an unimaginable wealth." In 1892, an expedition to the central highlands of Brazil was established by the *Comissão de Estudos do Planalto Central do Brasil*. Led by the Belgian astronomer Dr. Louis Cruls, the director of the National Observatory, the team's goal was to mark an area for the future capital city, the "Distrito Federal," or Federal District. Glaziou joined the expedition team as the field botanist. This mission, nicknamed "Missão Cruls," predated the competition for the city of Brasília by over fifty years, and until the commencement of the construction of the new capital in 1956, a dashed rectangle was indicated on all national maps—the "retângulo Cruls." In 1894, through written correspondence with Dr. Cruls, Glaziou suggested the creation of an artificial lake to ease the dryness of the place. This was indeed realized years later during the construction of Brasília as Lago Paranoá. (Glaziou, 1894)

Almost seventy-five years later, Roberto Burle Marx would similarly arrange "coletas" into the Amazon and other regions of Brazil, his own version of the "missão," in search of plants for both his garden designs and his own collection of live plants. Two of Burle Marx's unbuilt public projects, both from 1961, for a botanical garden in São Paulo and a zoobotanical garden in Brasília, exemplify his attempts to merge the notions of Engler's ecological plant associations, Glaziou's use of native plants, and the provision of a cultural education through the design of the public landscape.



Figure 3. Auguste Glaziou, Quinta da Boa Vista, Rio de Janeiro (1869).
Image Courtesy: Arquivo Geral da Cidade do Rio de Janeiro

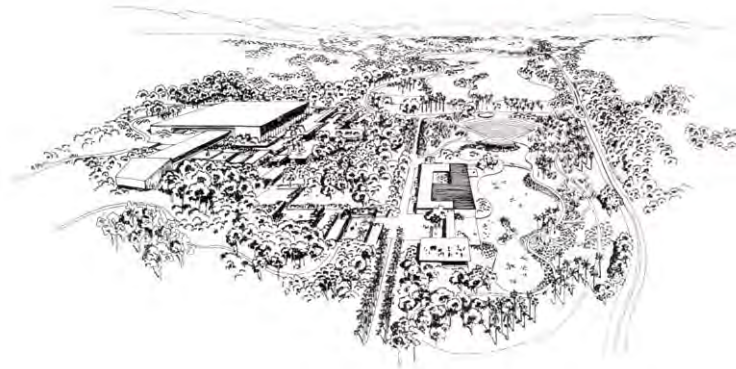


Figure 4. Roberto Burle Marx, Perspective of Jardim Botânico de São Paulo (1961).
Image Courtesy: Burle Marx & Cia. Ltda

5 ROBERTO BURLE MARX AND THE BOTANICAL / ZOOBOTANICAL GARDEN

5.1 Roberto Burle Marx and the Jardim Botânico, São Paulo

“The characteristics of the Jardim Botânico of São Paulo are, at the same time, a scientific garden, a reserve for the conservation of flora and fauna, and a place of recreation for the people of this immense and hardworking metropolis.”

(Burle Marx, *Projectos de Paisagismo*, 1962, p.21)

Burle Marx’s unbuilt project for a transformation of the Jardim Botânico of São Paulo was begun in 1961 at the request of the director of the existing garden, Alcide Teixeira, and a group of botanists and ecologists. The Jardim Botânico of São Paulo, which still exists today within the state park known as Parque Estadual das Fontes do Ipiranga, encompasses an area of over two square miles within the city’s urban footprint. The park and botanical garden incorporate a large area of conserved Atlantic rainforest.

The project by Burle Marx was to include a botanical garden, a separate zoological garden, an astronomical observatory, an experimental animal farm, and several other programmatic elements, organized by a series of lakes created through the damming of the Pirarungáua Creek. Burle Marx’s new programming emphasized the three elements of his vision of an ideal botanical garden: the public areas and collections, consisting of gardens, playgrounds, and picnic areas; the ecological gardens, representing the flora of São Paulo State; and an area for the Botanical Institute, with greenhouses and collections for scientific work. Internal roads were pushed to the perimeter of the park, with “educational” pedestrian pathways and a

small train on a looped path creating public connections within the Jardim Botânico and the larger Parque Estadual. (Bardi, 1964)

5.2 Roberto Burle Marx and the Parque Zoobotânico, Brasília

“...With the zoological garden, the basic idea is, unlike that which we see in many museums, to create scenes not of dead animals and wax plants, but of live animals, among live plants.”

(Burle Marx, *Projectos de Paisagismo*, 1962, p.24)

In 1961, immediately after the end of the Kubitschek regime, Burle Marx was invited by Dr. João Moojen de Oliveira, director of the Zoobotanical Foundation of Brasília, to design a zoobotanical park for the new capital city at a site crossed by the Riacho Fundo stream. (Bardi, 1964) The Parque Zoobotânico of Brasília, although never realized, remains one of Burle Marx’s most important proposals for a public garden.

The Parque Zoobotânico of Brasília is unique in many ways; first, in its development by Burle Marx as an intentional series of *tableaux vivants* of both flora and fauna. It was imagined as both a botanical and zoological garden, presenting living “paintings” of plants and animals within their proper ecological and zoo-geographic habitats. Like von Martius’ “phytogeographies,” Burle Marx was compelled by the interdependency of plant and animal life and in the belief that this should be understood in the context of a natural environment. *“I want to insist that nature is a complete symphony, in which the elements are all intimately related—size, form, color, perfume, movement, etc. Within this understanding, the plant or animal is no longer only an isolated entity, something to be collected. It is much more: nature is an organization endowed*

with an immense dose of spontaneous activity, possessing its own 'modus vivendi' with the world around it."

(Burle Marx, *Projectos de Paisagismo*, 1962, p.23)

The plan of the Parque Zoobotânico is separated into two parts: one is the structured Zoarium, with the animal exhibits along with the educational, research, and administrative aspects of the park. The second is a much larger area containing the Ecological Zones, cut diagonally by a stream, the Riacho Fundo, and dammed to fill various small lakes. Sixteen ecological regions of Brazil are represented here, each with their particular flora and fauna, as well as an area devoted to a representation of the Amazon forest. In addition, there are areas representative of the equatorial zones of North America, Europe, Africa, Asia, and Australia. Every continent within the tropical belt, therefore, is present. Because of its vast size, a small train again was envisioned, one that would encircle the park and convey visitors to its furthest regions. This train, in essence, takes the visitor on a compressed temporal voyage around the world.

5.3 Roberto Burle Marx and the Federal Council of Culture

With the military coup of 1964, ambitious projects such as the Jardim Botânico and the Parque Zoobotânico disappeared. With Burle Marx's appointment to the Conselho Federal de Cultura in 1966, the military dictatorship provided him with a highly effective new forum for the continuation of his cultural project—this one constructed through rhetoric and words. Burle Marx's consular statements of this period, often arguing for the protection of Brazilian landscapes from development and neglect, were perhaps as important and influential in the construction of Brazilian culture as his earlier public park projects.

"And today, when I embark on excursions in search of botanical material that I might use in the creation of my gardens, I note with sorrow the discouraging fact that no matter where one goes, destruction [of nature] is being felt. It is a misfortune that seems incurable, a misfortune that one accepts melancholically, as if there were no possibility of changing this. If we continue to accept that which we see happening, soon little will remain of this Brazilian flora that is considered to be one of the richest in the world."

(Burle Marx, *Paisagismo Brasileiro*, 1967, p.16)

Burle Marx's position and ambition as counselor was clearly stated: to prevent the deforestation, personally observed over the course of his career, which had led to the extinction of hardwood species and an increase in erosion and mudslides. He notes the observable change in the climate—the increase in torrential rains—that deforestation seems to have provoked. For Burle Marx, the definition of national culture needed to include the Brazilian forest and its diversity of flora. And that "culture" needed to be understood as part of the Brazilian national heritage, deserving of both definition and protection. (Burle Marx, *Sugestões para Preservação dos Parques Nacionais*, 1967; Burle Marx, *Defesa das Reservas Naturais*, 1969)

In several of Burle Marx's speeches to the Council's plenary sessions, he insists on the immediate protection and preservation of the Jardim Botânico in Rio de Janeiro as a cultural heritage site. (Burle Marx, *Jardim Botânico*, 1968; Burle Marx, *Jardim Botânico e Hôrto Florestal*, 1969) The notion of cultural preservation had been addressed by the Ministry of Education through the establishment of the *Livros do Tombo*—the registration of cultural treasures, usually buildings, into the record of national patrimony. But this was mainly focused on the built environment—the protection of buildings. Burle Marx argued strongly for a shift to create a meaningful protective status for landscapes as well, inclusive of historic, contemporary, and natural landscapes. He saw all three of these landscape types as vulnerable to neglect, development, and devastation. (Burle Marx, *Parques, Jardins, e Praças Públicas*, 1968)

5.4 Roberto Burle Marx and the Sítio Santo Antônio da Bica

Appropriately, one of Burle Marx's many legacies is his personal continuation of the tradition of ecological study and cultural preservation, perhaps equally inspired by Karl Friedrich Philippe von Martius' *Flora Brasiliensis*, Dom João VI's Jardim Botânico, and Adolf Engler's Berlin-Dahlem Botanical Gardens. In addition, he developed a pedagogical approach to public park design that would allow every citizen to gain a greater cultural understanding of Brazil's own ecological tableaux, much as he was inspired by his own visit to the Berlin-Dahlem Botanical Gardens as a youth. In 1949, Burle Marx purchased the former plantation Sítio Santo Antônio da Bica in Barra de Guaratiba, a village west of Rio de Janeiro. This 150-acre site consists of a collection of over 3500 species of live plants, many of which Roberto Burle Marx collected and even discovered himself during his *viagens de coleta*, his travels throughout the various

geographic regions of Brazil. In 1985, the site was donated to the Brazilian government and renamed Sítio Roberto Burle Marx, and it is fully protected by the *Instituto do Patrimônio Histórico e Artístico Nacional*.

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NOTE: All translations from the Portuguese are by the author.

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PERSONALIZING A PARKWAY: WOMEN'S MEMORIAL PLANTINGS ALONG THE MOUNT VERNON MEMORIAL HIGHWAY

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1 ABSTRACT

This paper documents and analyzes a set of memorial groves sponsored by patriotic women's groups and planted along the Mount Vernon Memorial Highway on the Virginia side of the Potomac River. Like the groves themselves, this story is part of a larger story about women planting trees along the Potomac, and this paper begins an investigation into the motivations and impacts of those efforts. Specifically it looks at documentary and material evidence – the original planting plans and the present day landscape – to understand what was originally planted and the current status of the memorials. By placing this physical evidence within the planning history and design of the parkway, it begins to identify the role the memorials would have played were they more intact than they are. More specifically, it argues that the memorial plantings add a more individual and personal layer to the commemorative role of the parkway, and this augments other aspects of the design that encourage social use and inhabitation of the landscape.

1.1 Keywords

women's memorial groves, parkways, cultural landscape, commemorative landscapes

2 INTRODUCTION

Towering over the George Washington Memorial Parkway, not far from Washington's home at Mount Vernon, two enormous willow oaks mark a view across the Potomac River to Fort Washington, an historic battlement sited by Washington himself (Figures 1 and 2). Although there are other large oaks along the route of the parkway, these two have special status, in part because they stand prominently atop a small knoll at a bend in the roadway, but also because placed at their feet and affixed to a granite stone is a bronze plaque that reads,

These willow oaks are planted in honor of the bicentennial of George Washington by the National Society of the Colonial Dames of America in the District of Columbia 1732 – 1932.)

These trees are one of a set of eleven memorial plantings sponsored by patriotic women's groups along the length of the original Mount Vernon Memorial Highway, and like the roadway itself, they commemorate Washington's two-hundredth birthday while creating a suitably dignified route to Mount Vernon from Washington DC. At the time, the Memorial Highway was so popular that even before it was finished and dedicated, Congress authorized its expansion and transformation into the George Washington Memorial Parkway that today lines thirty miles of the Potomac River including Washington DC and numerous other places important in the life and legacy of the first president. But it is the original segment, the Mount Vernon Memorial Highway, that is home to this set of memorial plantings. They were planted to augment the commemorative role of the parkway, and they represent a significant contribution by patriotic women's groups such as the Daughters of the American Revolution and the Mount Vernon Ladies Association, groups that had vested interest in the stewardship and preservation of Washington's legacy and that wanted to be part



Figure 1. Willow Oaks (2013).
Photo by Author



Figure 2. Willow Oaks (2013).
Photo by Author

of the design and planning process. Along with other aspects of the design, the memorials contribute to an overall richness of social use and personalized meaning of the parkway.

Due to various circumstances, none of the other plantings has the stature of the Colonial Dames' willow oaks, and the groves have little presence along the parkway today. Some have been relocated or replanted and are still too young to have much stature; several are surrounded by other trees and don't read as memorial groves at all, and others are missing altogether and their stones have been removed. Even if fully present, they would still be minor individual notes along the parkway, but as a set they comprised a collective and noteworthy contribution to the commemorative purpose of the Memorial Highway.

This paper tells a nascent story of those memorials, looking at the planning process, earlier proposals, the actual plantings, and their current condition. It then speculates about the impact of the groves were they fully extant today. Like the memorials themselves, it is a small story, the first step in a larger story about a series of plantings along the Potomac River in the twentieth century, each sponsored or originated with powerful women or patriotic women's groups and each having some commemorative purpose. This paper examines the documentary and material evidence of the groves – the original planting plans and the existing landscape – to understand their placement in the landscape at the time of planting and their role in the current landscape as a first step toward exploring and interpreting their contribution to the landscape of the Potomac River.

3 PLANNING AND DESIGNING THE MOUNT VERNON MEMORIAL HIGHWAY

The Mount Vernon Memorial Highway was dedicated in 1932 to commemorate the two-hundredth anniversary of George Washington's birth and provide a direct route between Washington, DC and Mount Vernon. (Swanson-Moore Act 1928) Designed by Gilmore Clarke and Jay Downer, the lead landscape architect and civil engineer of the newly built Westchester County Parkways in New York, the Memorial Highway was a state-of-the-art parkway that included the first federally-built cloverleaf interchange, several other grade-separated intersections, sweeping spiral curves, naturalistic grading, and other hallmarks of the Westchester County parkways (Clarke, 1932).

Though it seems a bit surprising to dedicate a modern highway to an eighteenth century president, even one who had been an engineer in his day, the Memorial Highway was widely regarded as the most fitting of the tributes to Washington in honor of his bicentennial (Davis, 2001). This is particularly surprising given some of the other gestures, which included the newly minted and ubiquitous Washington quarter, the impressive engineering feat of the George Washington Bridge in New York, and the more traditional George Washington National Masonic Memorial built by his former Mason's lodge in Alexandria, Virginia and in view of the Memorial Highway. Yet it was the Memorial Highway that captured people's imagination due to its combination of history, modernity and nature, seemingly odd bedfellows in a highway landscape but a trio of attributes that resonated at the time with motorists and visitors to

Mount Vernon (Davis, 2001). The parkway followed the edge of the river closely, crossing inlets and tributaries on stone-faced bridges and newly built causeways, and it afforded an entirely new experience of the river as a continuous landscape (Clarke, 1932). With carefully framed views to the monuments of the capital city and places important in Washington's life, the modern highway undulated through beautifully composed picturesque landscape, leading motorists through an idealized version of the Virginia coastal plain to the hallowed ground of Mount Vernon (Simonson, 1936; Simonson, unpublished; Kelsch, 2011).

Crucial to this blend of history, modernity and nature was Wilbur Simonson's planting design for the Memorial Highway (Bureau of Public Roads, 1932). Simonson was the field landscape architect for the project and with his assistant, plantsman Henry Nye, he designed a decidedly traditional landscape in marked contrast to the modern engineering of the roadway. Their scheme adhered closely to Beaux Arts design conventions of the time, almost literally applying the principles laid out in Henry Vincent Hubbard and Theodora Kimball's *Introduction to Landscape Design*.

In any case the best design will probably be to seize upon the particular character of each landscape unity through which the road passes, and develop it to its best expression, as far as this is possible in a narrow strip along the road, for itself alone or as a foreground to a more distant view. Thus a sequence of different effects will be presented to any one passing along the road. It should be remembered that the scenes presented should be such that they may be grasped and enjoyed by a spectator moving at some speed (Hubbard and Kimball, 1917, p.223).

Conforming to Hubbard and Kimball's principles and using species found in the adjoining landscape, Simonson and Nye created a sequence of distinct naturalistic rooms, each inspired by the immediate conditions of the site and each typically punctuated by carefully framed views of the Potomac River, monuments of Washington, DC, and Mount Vernon itself. And within this site-based landscape plan, the women's plantings were situated to reinforce special views, thresholds, and historic places along the route (Bureau of Public Roads, 1932).

Driving along the river today, all of this seems rather inevitable, but the style and even the location of the Memorial Highway was radically different from a much earlier proposal for a Mount Vernon Avenue put forth by a group of Alexandria

businessmen and civic boosters in 1888, forty years before the Memorial Highway and at about the same time when automobiles were first invented (Reavis, 1888; Davis, 2001). Mount Vernon Avenue was to have been a grand, formal roadway running inland along ridges parallel to the river and was to be lined with statues of prominent statesmen and other historical figures, an American version of Rome's Appian Way complete with tombs of past presidents and other commemorative monuments (Reavis, 1888; Davis, 2001). Notably, each state would be allocated a quarter mile of the route along which they could erect statuary commemorating historical figures from their own state (Reavis, 1888; Davis, 1997). In stark contrast to the grandness of that plan, the Senate Park Commission (more commonly known as the McMillan Commission) proposed a naturalistic road to Mount Vernon in 1901 as part of its overall plan for Washington DC (Senate Park Commission, 1902). The naturalistic imagery of that proposal was intended to evoke a different set of associations with George Washington than the grandness of Mount Vernon Avenue, and this shows up clearly in the Commission's emphasis on the terminus at Mount Vernon.

The terminus of such a great national road at Mount Vernon ought to have the most careful and sympathetic study, for with all its tremendous historical associations Mount Vernon is not designed on the scale of a great public monument, but on the more delicate domestic scale of a gentleman's country place, a character which has been most skillfully preserved by the Mount Vernon [Ladies] Association, and does far more to bring to the visitor a feeling of the personal presence of Washington than the bald historical fact of his residence there. It will be no easy problem to design a terminus dignified and adequate for a broad national road of pilgrimage some 15 miles in length and to relate this terminus frankly to the Mount Vernon mansion as the main object of the pilgrimage without intruding a discordant public note into that place which should speak not of the statesman, but of the private gentleman of Virginia who there made his home (Senate Park Commission, 1902, p.122).

It is clear from this passage, that the planners of Washington had a very different vision of a road to Mount Vernon than the early promoters did, one that was related to Washington's own sense of his life as a gentleman farmer, whose estate and garden were a domestic expression of his revolutionary patriotism (Wulf, 2011).

By the time of Washington's bicentennial, the naturalistic ideals of the Senate Park Commission plan had more momentum than the earlier grand boulevard and seemed more in keeping with the parkways and roadways that were being developed in other cities (Davis, 2001). Still, many people, including some powerful women and women's organizations, held on to the idea that the individual states should have an opportunity to commemorate Washington along the route. During the planning process, various individuals and groups sent letters to the Bureau of Public Roads advocating alternate schemes for the roadway, and newspaper articles and editorials kept several of these schemes in the public eye (Davis, 1997). Typical of these was a proposal by Marie Moore Forrest, a pageant designer, who proposed a parade of state-themed floats each with a predetermined and compatibly landscaped pullout along the roadway, so that the Memorial Highway would be transformed into a fifteen-mile long pageant on the day of its dedication. Other proposals carried forth the earlier notion of having each state landscape a segment of the highway with a botanical representation of its own flora (Davis, 1997). For its part, the Bureau of Public Roads offered a counter proposal, a single grove of oaks, one from each state, which they argued would have greater symbolic presence and not interfere with the overall style of the parkway (Davis, 1997).

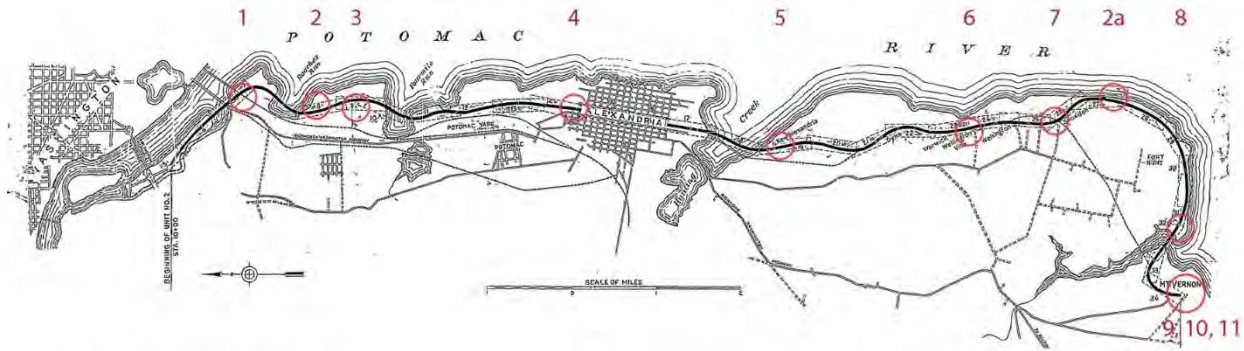
As condensed and interpreted by Parkway historian Timothy Davis from correspondence files of the Bureau of Public Roads, the designers of the Memorial Highway and the Bureau of Public Roads were not actually interested in public input, however, and held strongly to the idea that the landscape should be stylistically unified and representative of the regional landscape, not the individual states (Davis, 1997). As Davis describes it, the Bureau employed a series of stall tactics followed by last-minute approval that left the states with too little time to act and have any input on the design. Somehow in this process, the eleven memorials were approved and designed, though there is no evidence of this in the BPR's correspondence files, nor has a preliminary search of records from the women's groups yielded any insight. (Bureau of Public Roads 1912-50) It is still unclear when this idea was raised, by whom, and what degree of agency the women had in the decision-making. It is also unclear if they were seen as a 'consolation prize' for the earlier ideas, or a compromise solution, or perhaps just, a successful idea that fit within the designers' own ideology for the parkway.

4 THE ELEVEN MEMORIALS

In whatever way the women's plantings came to be accepted as part of the parkway landscape, they were different from the botanical diversity that would have characterized the individual states' contributions. Each of the sponsoring groups was committed to the preservation of American heritage through such activities as historical preservation and honoring American soldiers, and therefore commemorating George Washington as the first President of the United States and the commander of the Continental Army was in keeping with their core missions. Planting trees was a common symbolic gesture at the time, and these plantings were tangible expressions of the groups' commitment to heritage preservation (Borah, 1932).

The memorials themselves range from one to thirteen trees (Figure 3). Occasionally the number of them is symbolic, such as thirteen American elms to represent the thirteen original colonies, but more often it is the gesture of planting that is significant. At the terminus, all the trees planted had direct association with George Washington, most notably an American elm (*Ulmus americana*) that was a literal grandchild of the Cambridge Elm, the tree under which Washington assumed command of the Continental Army. Many, but not all, of the memorials were marked with a bronze, neo-colonial plaque identifying the sponsoring group and its commemorative purpose, each affixed to a stone from "the historic Washington Canal" that had run between the Potomac and Anacostia Rivers in front of the White House and at the base of Capitol Hill (Bureau of Public Roads, 1932).

Overall, four memorials were planted along the northern, more urbanized half of the parkway between Washington and Alexandria, and four more were planted along the more rural portion south of Alexandria and closer to Mount Vernon. Three memorials with direct ties to George Washington were planted at the Mount Vernon terminus. Typically they mark important thresholds in the landscape, or significant views, or are located at places important in Washington's life. It is unclear if the women or Simonson chose the location and number of trees, but frequently there is a resonance between the chosen location and the group involved. For example, the Alexandria Chapter of the American War Mothers planted their grove at the entrance to Alexandria; the Society for the Preservation of Virginia Antiquities planted theirs at the ruins of Abingdon (Washington's step-granddaughter's home); and the Mount Vernon



- | | | |
|---|------------------------|-------------------------|
| 1 Garden Club of America | 4 American elms | Cloverleaf interchange |
| 2 DC Chapter, Colonial Dames | 2 Willow oaks | Capital Overlook |
| 3 Assoc. for Preserv. of VA Antiquities | 4 Red oaks | Abingdon |
| 4 Alex. Chapter, Amer. War Mothers | 3 Oriental plane trees | Entry to Alexandria |
| 5 Mt. Vernon Chapter, D.A.R. | 8 Honeylocusts | Belle Haven medians |
| 6 Fairfax County Chapter, D.A.R. | 2 Oriental plane trees | Dyke overlook |
| 7 DC Chapter, United Daughters of Conf | 1 Red oak | Collingwood median |
| 2a* DC Chapter, Colonial Dames (*relocated) | 2 Willow oaks | Ft. Washington Overlook |
| 8 Women Descendents of Anc. & Hon. Art. | 13 American elms | Riverside Park |
| 9 National Society, Colonial Dames | 13 Virginia cedars | Mt. Vernon terminus |
| 10 Maryland Chapter, D.A.R. | 1 American elm | Mt. Vernon terminus |
| 11 Mt. Vernon Ladies Association | 1 Flowering dogwood | Mt. Vernon entry gate |

Figure 3. Overall Plan of Memorial Highway indicating Location and Sponsors of Each of the Groves. Image by Author based on Plan Detail from *Plan and Profile of Proposed Mt. Vernon Memorial Highway*, (Bureau of Public Roads, 1929)

Chapter of the Daughters of the American Revolution planted their grove just south of Alexandria at the beginning of the stretch that more clearly was focused on journeying to Washington’s home. The detailed placement of the actual memorials, shown sequentially from north to south, reads as a sort of storyboard of the parkway and gives a sense of the places along the Memorial Highway that were deemed important enough to be marked with a memorial (Bureau of Public Roads, 1932).

The National Capital Committee of the Garden Club of America planted the northernmost memorial, four American elms (*Ulmus americana*) forming a gateway at the western edge of the cloverleaf interchange and marking entry into Washington, DC (Figure 4). It is atypical of the other memorials in that it is oriented to the traffic crossing the Memorial Highway rather than driving along it, and it is also the only one that designates groundcover beds – English ivy (*Hedera helix*) and Japanese honeysuckle (*Lonicera japonica*) – as part of the memorial, perhaps to give the elms more presence for moving traffic. The Garden Club’s mission is environmental preservation and beautification rather than historic preservation, and this probably accounts for their emphasis on the

arrival to Washington, DC instead of the commemoration of George Washington. (Information on each of the groups was attained from their respective webpages, January 2014.) The memorial also included two boundary markers of locust posts and chains, one on either side of the roadway.

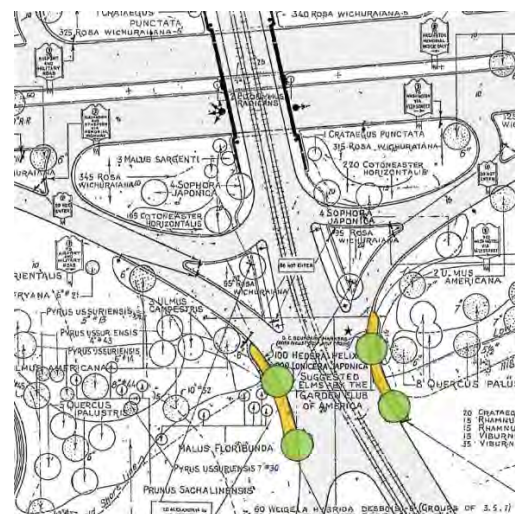


Figure 4. Garden Club of America, Four American Elms. Planting Plan Detail Colorized by Author. (Bureau of Public Roads, 1932, sheet 9/45)

The District of Columbia chapter of the National Society of the Colonial Dames of America planted the second memorial heading south, two large specimen willow oaks (*Quercus phellos*) in the traffic island at Capital Overlook (Figures 5 and 6). Capital Overlook, the most lushly planted place along the entire parkway, may have appealed to the chapter because it afforded a sweeping panorama of the Potomac River and the monuments of the capital city. The trees were planted in the traffic island, standing out from the surrounding vegetation, with a bronze plaque oriented toward people as they got out of their cars. Due to construction of National Airport, the overlook was removed less than eight years after planting, and the memorial was replanted at the Fort Washington overlook (Mackintosh, 1985). These two trees are the pair of grand willow oaks that today stand so prominently over the southern stretch of the parkway. The Association for the Preservation of Virginia Antiquities sponsored the third memorial, four red oaks (*Quercus rubra*) near the ruins of Abingdon, the former home of Washington's step-granddaughter Nellie Custis. The Association was the nation's first statewide preservation organization, and as noted on the planting plan, they were cooperating with other organizations to preserve the ruins (Bureau of Public Roads, 1932, Sheet 11). A grove of six trees is indicated on the plan, but curiously only four are identified as being memorial plantings (Figure 7).

The Alexandria, Virginia chapter of the American War Mothers, women whose sons had served in the Armed Forces, planted three oriental plane trees (*Platanus orientalis*) at the intersection of Montgomery Street and Washington Street, the northern edge of Alexandria (Figure 8). The three trees were the fourth memorial encountered and would have marked the point where the Memorial Highway entered the historic city, passing places like Christ Church where Washington had formerly worshipped.

After passing through Alexandria and continuing south, the parkway crossed the mouth of Hunting Creek on a newly constructed bridge and causeway. From this point to Mount Vernon the adjacent lands took on a more rural character, and the newly planted landscape seemed more convincingly naturalistic.

Perhaps because of this or because of the sense of being closer to the destination, there were more memorial plantings south of Alexandria than to the north, including three by different chapters of the National Society of the Daughters of the American Revolution (DAR). The DAR is an organization of women descended from soldiers under Washington's command and is committed to the preservation of American heritage and patriotism, so it is not surprising that three different chapters would have sponsored memorials.

The Mount Vernon Chapter of the DAR, its most local chapter, planted the first grove encountered by southbound motorists after leaving Alexandria (Figures 9-11). In the two teardrop medians at the intersection of Belle Haven Road, the chapter planted eight honeylocusts (*Gleditsia triacanthos*) in honor of the eight Virginia-born presidents. The new trees surrounded an existing cherry tree (perhaps a fortuitous additional reference to Washington) and were marked by a bronze plaque at the intersection, identifying the eight presidents and visible to motorists waiting to turn onto the parkway.

The Fairfax County Chapter of the DAR planted the sixth memorial, two oriental plane trees (*Platanus orientalis*) in the traffic island at Dyke Overlook. This pullout gives access to the largest marsh along the river and was a popular destination even before the construction of the Memorial Highway (Figures 12 and 13). As with Capital Overlook, a bronze plaque faced people as they got out of their cars and approached the river.

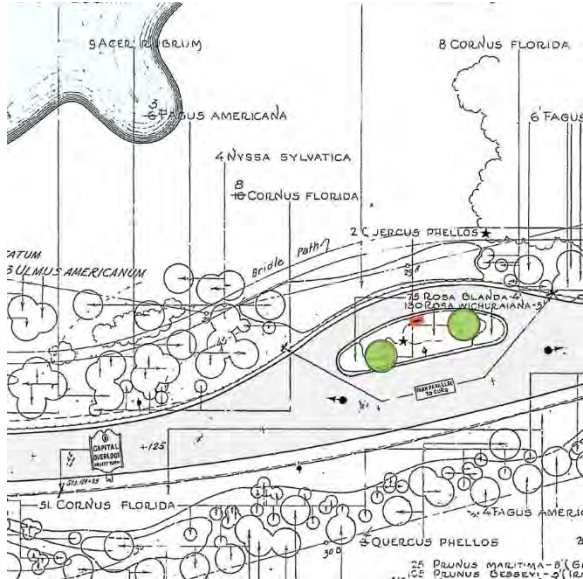


Figure 5. District of Columbia Chapter, Colonial Dames Two willow oaks. Planting plan Detail Colorized by Author. (Bureau of Public Roads, 1932, sheet 6/45)



Figure 6. Willow Oaks in 1932. (National Archives Photo No. 30N-32-572)

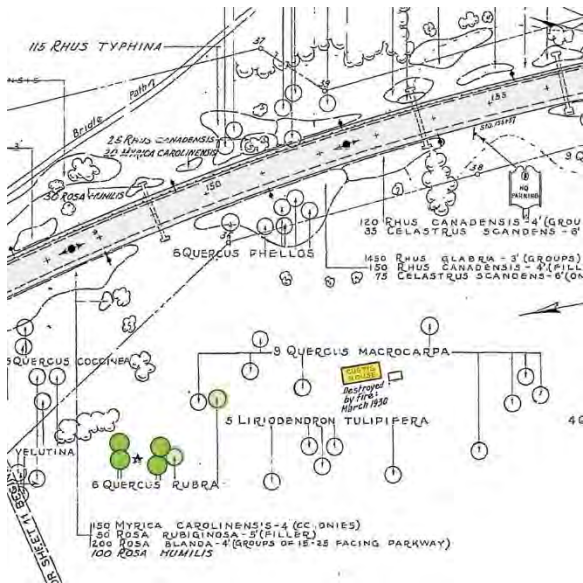


Figure 7. Association for Preservation of Virginia, Antiquities Four Red Oaks. Planting Plan Detail Colorized by Author. (Bureau of Public Roads, 1932, sheet 11/45)



Figure 8. American War Mothers, Alexandria VA, Three Oriental Plane Trees. Planting Plan Detail Colorized by Author (Bureau of Public Roads, 1932, sheets 17-18/45)

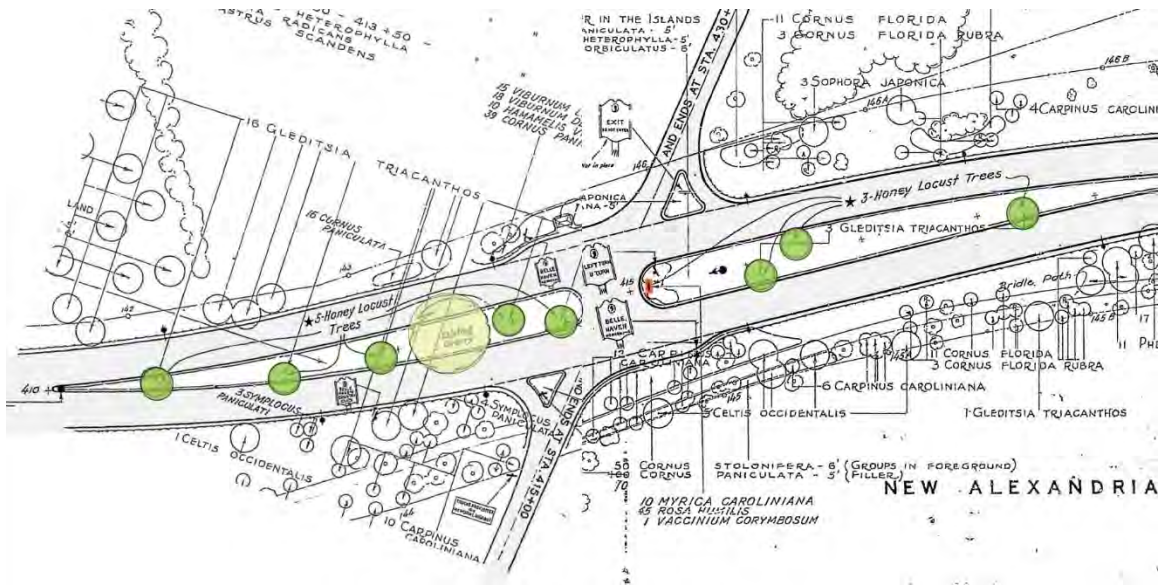


Figure 9. Mount Vernon Chapter, Daughters of the American Revolution, Eight Honeylocusts. Planting Plan Detail Colorized by Author. (Bureau of Public Roads, 1932, sheets 23-24/45)



Figure 10. Honeylocusts in Belle Haven Medians, 1946 (National Archives Photo No. 30N-46-2060-A)



Figure 11. Plaque of Eight Virginia-born Presidents, 1945 (National Archives Photo No. 30N-45-1574)

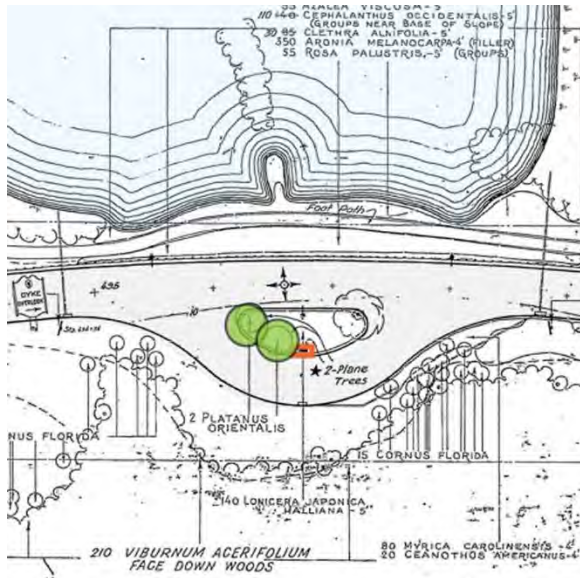


Figure 12. Fairfax County Chapter, DAR, Two Oriental Plane Trees, Planting Plan Detail Colorized by author. (Bureau of Public Roads, 1932, sheet 29/45)



Figure 13. Two Oriental Plane Trees, 1932. (National Archives Photo No. 30N-32-574)

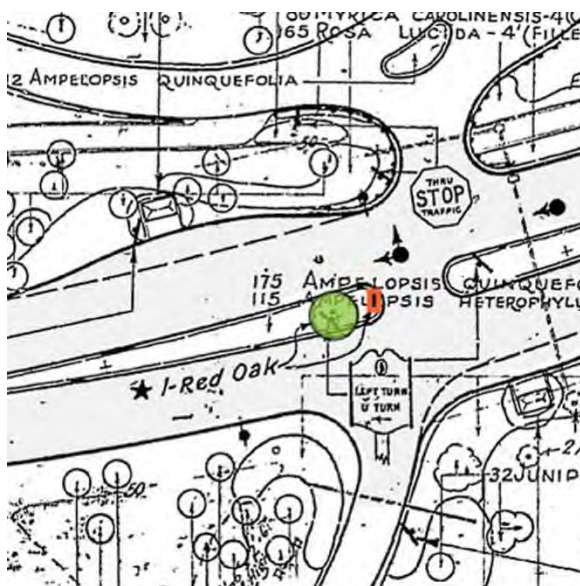


Figure 14. District Chapter, United Daughters of the Confederacy, One Red Oak, plan detail colorized by author. (Bureau of Public Roads, 1932, sheet 29/45)



Figure 15. One Red Oak in Median (National Archives Photo No. 30N-45-1522)

The District Chapter of the United Daughters of the Confederacy, an organization comprised of descendants of Confederate soldiers and committed, somewhat ironically, to the preservation of Confederate heritage, planted a solitary red oak (*Quercus rubra*) at the teardrop intersection at Collingwood, the most residential segment of the parkway (Figures 14 and 15). As at

the Belle Haven intersection, a bronze plaque was placed right at the intersection, once again visible from cars waiting to make the turn. This was the seventh memorial encountered by southbound motorists.

After the relocated willow oaks, the last grove before Mount Vernon was sponsored by the Women Descendents of the Ancient and Honorable

Artillery Company, the oldest in the U.S. Planted on high ground of Riverside Park overlooking the Memorial Highway, it may have a different history since it has its own plan and was dedicated on Armistice Day, four days before the dedication of the Memorial Highway (Figures 16 and 17). It also has a larger plaque, mounted on a substantially larger stone, that reads,

commemoration of the bicentennial celebration of George Washington's birth and to revere The Ancient and Honorable Artillery Company of Massachusetts, organized 1637.

Dedicated by The National Society, Women Descendants of the Ancient and Honorable Artillery Company, November 11, 1932.

The thirteen adjacent American elms representing the thirteen original colonies were planted in

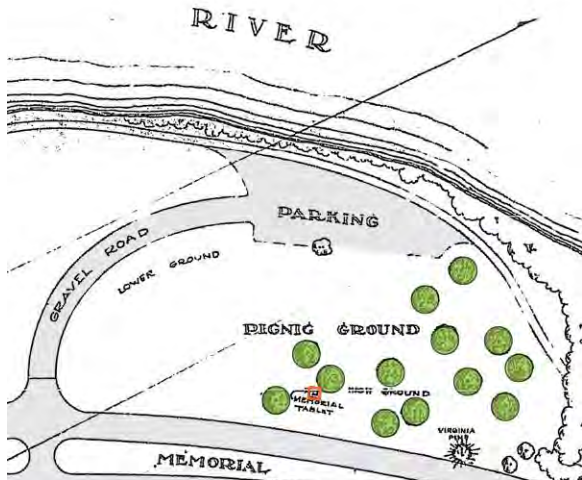


Figure 16. Women Descendants, Ancient & Honorable Artillery Company. Plan Detail Colorized by Author. (Office of Public Buildings and Public Parks, 1932)



Figure 17. Mrs. Charles Neil Jewett with Plaque, 1932 (Women Descendants, Ancient & Honorable Artillery Co., Used with Permission)

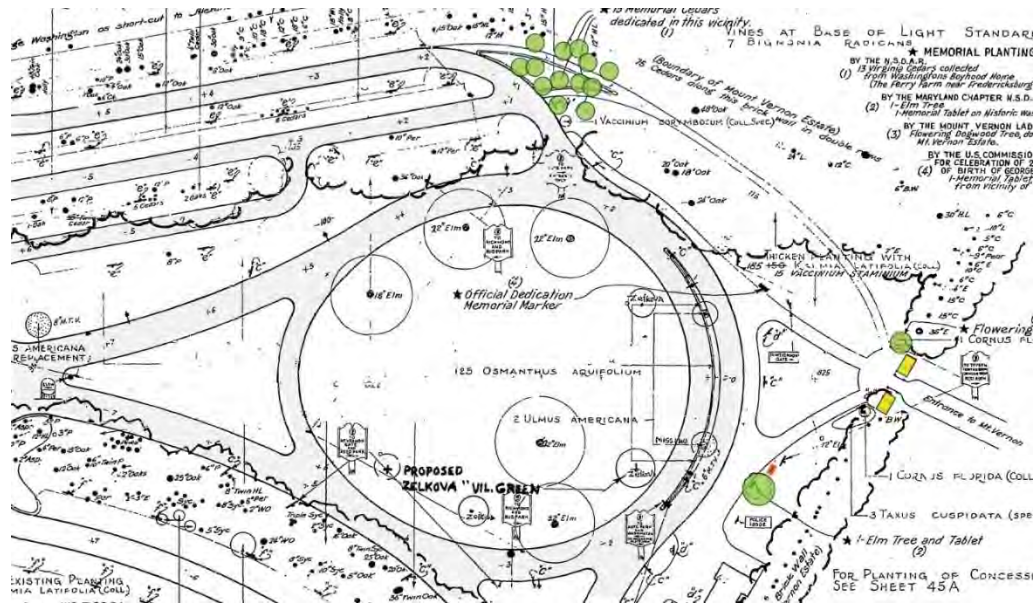


Figure 18. Three memorials at the Mount Vernon Terminus, one American elm, One Flowering Dogwood, Thirteen Virginia Cedars. Planting Plan Detail Colorized by Author. (Bureau of Public Roads, 1932, sheet 45/45)



Figure 19. Memorial Elm at Mt. Vernon Gate, with Temporary Marker, 1932. (National Archives Photo No. 30N-32-209)

Three memorials were planted at the Mount Vernon terminus (Figure 18), each having literal associations with George Washington, and each placed along sidewalks between the parking and the entry gate so that visitors would likely pass at least two if not all three of them before entering the estate.

The National Society of Colonial Dames, with its emphasis on historic preservation and interpretation of historic sites, planted thirteen Virginia cedars (*Juniperus virginiana*) from Ferry Farm, Washington's boyhood home, thereby uniting his birthplace and his gravesite and also referencing the original thirteen states. They were planted adjacent to the largest parking area, right where people would leave their cars and join the paths leading to the entry gate. Along a different path, the Maryland Chapter of the DAR donated and planted an American elm (*Ulmus americana*), the aforementioned grandchild of the Cambridge Elm, and marked it with a bronze plaque along the sidewalk between the visitor center and the entry gate (Figure 19). And finally, the Mount Vernon Ladies Association, the oldest preservation group in America, donated a flowering dogwood from inside the estate, planting it just outside the gate to welcome visitors.

5 THE MEMORIALS IN THE CURRENT LANDSCAPE

A mere eight years after the dedication of the Memorial Highway, Washington National Airport was constructed on parkway lands north of Alexandria, including the site of Abingdon and

Capital Overlook. The George Washington Memorial Parkway, as it was now called, was relocated away from the river, and the memorial plantings were removed (National Park Service 1994, p.178-9). The actual willow oaks from Capital Overlook may have been transplanted to the Fort Washington overlook or new ones planted, but the four red oaks were probably just cut down, since there is no indication of what happened to them. This likely was the first loss of one of the memorials, but none of them has remained intact. Five other memorials are missing entirely, including the Garden Club's four elms at the cloverleaf interchange, the Alexandria War Mothers' plane trees at the entrance to Alexandria, and all three of the plantings at the terminus. The remaining memorials each differ from their original plantings.

Eight honeylocusts exist today at Belle Haven, six having been recently replanted, but many other trees also occupy the teardrop medians now, and the plaque has been moved to the side of the roadway where it has no evident association with the trees. There is no way to read this group of trees as a memorial and associate them with the plaque or with the eight Virginia presidents. The same is true of the thirteen elms at Riverside Park, where today six zelkovas (*Zelkova serrata*) stand amidst a larger grove of huge oaks and other trees but no elms. It seems likely that six of the elms died of Dutch elm disease and were replaced with zelkovas, and the remaining elms died later, leaving only the six zelkovas. As with the honeylocusts, the plaque refers to nothing identifiable in the current landscape to a casual

observer. Slightly more convincing are two plane trees at Dyke Overlook, however they are of different ages, neither seems old enough to be original, and the plaque only refers to one, so they are ambiguous.

The only memorial other than the Colonial Dames' pair of willow oaks that has any real correspondence to the original planting is the solitary red oak planted by the United Daughters of the Confederacy. The original plaque and a new red oak were relocated to the side of the road, near the original location and alongside the Mount Vernon trail where walkers, joggers and cyclists pass it daily (Figure 20). The tree is beginning to have some degree of presence commensurate with its memorial purpose, and hopefully in time many people will notice it as they stroll, jog or ride by.

The quiet but growing presence of the Daughters of the Confederacy's red oak gives a hint to the potential role these memorials might have had along the parkway. The Mount Vernon Memorial Highway, especially the southern section, differed from many later and more modern parkways, even the northern stretch of the George Washington Memorial Parkway built thirty years later. That section is strikingly beautiful with divided roadways tracing different arcs through a forested landscape with grassy verges and spectacular overlooks into the Potomac River gorge. It is classic parkway scenery and was even used as an example of good roadway design in highway design textbooks (Davis, 2001, p.178). The Mount Vernon

Memorial Highway, especially the southern section between Alexandria and Mount Vernon is quite different from this later segment, more intimate in scale and more domestic in character. Houses intentionally front the parkway on bordering roads designed to carry local traffic, and there are bus stops along the route to allow local residents to travel to and from Alexandria. A wide swath of landscape filled with mature cedars and pines extends for about a mile between the homes and the roadway, creating a long linear park in the foreground of the neighboring houses. Furthermore, the Mount Vernon Trail was completed in 1974, fulfilling a goal of the original design to have a foot trail and a bridle trail along the whole length of the parkway (Bureau of Public Roads, 1932, National Park Service, 1994, p.186). On any given day, the trail is well used by walkers, cyclists and joggers, some just out to walk their dog, others making a two-wheeled pilgrimage to Mount Vernon (Figure 21). In the adjoining parks and at the various parking turnouts, people picnic, fish, and just enjoy the scenery of the river so that the overall landscape seems saturated with people, especially in good weather. A photo taken on a weekday morning in July 2013, for example, shows five different people fishing, walking, exercising and bike riding, all in close proximity to one another. All this activity, set within Simonson and Nye's spatial rooms, makes the parkway feel quite personal and domestic compared to other parkways.



Figure 20. Red Oak (2013). Photo by Author



Figure 21. Trail Users, 7.26.13. Photo by Author

The United Daughters of the Confederacy's single red oak quietly adds to this richness of social use and gives the parkway's commemorative gestures a slightly more personal and individual meaning. The parkway is not an abstract commemoration of George Washington since its commemoration is manifested in specific places like Mount Vernon and Abingdon and with deliberate views to places like the Washington Monument and Fort Washington. The women's memorial plantings, were they all intact, would personify the act of commemoration. They would remind modern day visitors to Mount Vernon and local inhabitants that Washington's presence in the landscape was not just a fact of the eighteenth century, but is carried down through generations of women, some of them descended from the very soldiers he led into battle and others caring about the heritage of Virginia and the nation. Spaced about a mile and a half apart on average, they would not have had large presence in the landscape, but placed in key locations along the Memorial Highway, they would have acted as exclamation points to the larger story of the commemoration of Washington's bicentennial.

That the memorials do not still exist is perhaps in part because their story is not recognized and because few of the remaining trees have much presence along the roadway due to such factors as the addition of other trees among them, the loss of some identifiable locations like Capital Overlook and Abingdon, and even the higher speeds of traffic today. For these and other reasons, the individual memorials could be seen as not being important enough to warrant concern when the trees died or the roadway was relocated. However, these plantings are part of a longer tradition of planting commemorative trees along the Potomac River in the twentieth century. That tradition includes First Lady Nellie Taft's efforts early in the century to plant Japanese cherry trees around the Tidal Basin to express harmonious relations between the U.S. and Japan; a planting of thirty-nine trees commemorating the signers of the U.S. Constitution for its sesquicentennial; and Lady Bird Johnson's capital beautification program in the 1960s that included Governor's Grove, fifty-four dogwoods sponsored by the First Ladies of the states and territories, and the transformation of Columbia Island into today's Lady Bird Johnson Park. Seen in this light, the commemorative plantings along the Mount Vernon Memorial Highway take on a broader significance than their present stature would suggest.

It is tempting to conclude that these eleven memorials should be restored and replanted,

however, the changes in the parkway landscape make such a proposal unfeasible and unlikely to carry the intended meaning in the same places. Perhaps a more successful strategy would be to reexamine the current landscape, and working with the women's groups, initiate a new set of memorials that, like Daughters of the Confederacy's red oak, reorient to places where people are more likely to see them and where the trees are likely to grow with the stature and presence of the Colonial Dames' willow oaks. The new groves might serve to reinvigorate the commemorative role of the parkway in an era when George Washington seems more a distant, historical icon than an actual person who once lived in this landscape and left a significant legacy both to the nation and in this specific place. Most of the original memorials were located in places where people stopped and got out of their cars, but today many of those places no longer exist or are no longer significant pedestrian areas. Examining how people currently inhabit and use the landscape would suggest new places that both honor Washington's legacy and appeal to existing users. These newer memorials would still need careful cultivation to survive the effects of age and competition, but the renewed interest in them would give the women's groups another chance to personify the legacy of George Washington.

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A CASE STUDY IN HYDROLOGY AND CULTURAL IDENTITY: 2,500 YEARS OF LANDSCAPE-MAKING IN MENDOZA, ARGENTINA

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1 ABSTRACT

Through an analysis of the Parque General San Martin in Mendoza, Argentina, this paper examines the work of 19th century landscape designer Carlos Thays alongside the material contributions of the indigenous Huarpes people to consider the discipline of landscape architecture as part of a long line of landscape practice in the challenging environment of western Argentina. Mendoza, Argentina is a modern city of nearly one million inhabitants situated on the border between the great agricultural plains of Argentina and the desert foothills of the Andes Mountains. Historically it has been a frontier settlement of utmost strategic importance, existing variously at the southern edge of the Incan Empire, the eastern edge of colonial Chile, and now the western border of Argentina. In addition to its location at the political and geographic margins, it leads a perilous existence at the edge of environmental sustainability- the region receives less than seven inches of rainfall a year, is located in a highly active seismic zone, and is susceptible to flash flood events. In the late 19th century a large public was projected on Mendoza's western edge. Parque San Martin was intended to mediate environmental extremes for the growing urban population and offer a new form of public cultural expression. In this context landscape architecture developed to mediate challenging environmental conditions and help form and reflect shifting cultural identities. This paper presents this landscape as both an early example of modern landscape design in western Argentina and as part of a long lineage of cultural landscape transformation intimately bound up with hydrological manipulation and shifting cultural values.

1.1 Keywords

urbanism, indigenous landscape, hydrology, cultural landscape, Argentina

2 INTRODUCTION

On the western edge of the city of Mendoza, Argentina there is a large park whose origins date to the late 19th century. In the park a sinuous lake and verdant forests and lawns combine with tennis courts, soccer fields and cultural monuments, all set against the sheer wall of the Andean Cordillera rising just to the west. From the interior of this landscape a visitor can see the great, jagged heights of the mountains and sense the expanse of the arid semi-desert that surrounds the city in all other directions. While dramatic, from inside Parque General San Martin these feel far enough removed to impress without overwhelming.

In this paper I explore a simple hypothesis: that the Parque General San Martin, and the modern practice of landscape architecture in this place, is part of a long, complex history of landscape-making in the American borderlands that mediates exaggerated and difficult environmental conditions while also actively forming cultural values amid shifting political alliances. My methods include historical and theoretical research in Spanish and English in landscape architecture and related fields, including planning, archaeology and anthropology, as well as site visits and discussions with current administrators. By decentering the European tradition of park-making and considering the landscape in a broader cultural and ethnographic context, I reveal the role of hydrology and landscape design in shaping cultural identity and position the Parque General San Martin in Mendoza, Argentina as a project that figures indigenous intellectual and material contributions alongside those of colonial and post-colonial societies, and the ideas imported from Europe.

2.1 Historical Context

For over five hundred years the city of Mendoza has been a frontier settlement of utmost strategic importance. This history extends beyond the modern, republican, and colonial periods back to the Huarpes society of the 15th century. Before Spanish contact the area existed at the southern limit of the Incan Empire and was inhabited by the Huarpes (Michieli, 1983). The Huarpes constructed

a sophisticated network of irrigation canals enabling agricultural production and habitation in an arid, seismically active environment subject to flash floods and far from traditional centers of power (Echagüe, 1945; Michieli, 1983). Later, in the colonial period, travelers and soldiers moving through the Southern Cone of South America between the capital of Santiago and the port city of Buenos Aires would stop in Mendoza to rest and resupply right after, or just before, beginning the difficult journey over the Andes Mountains through the Libertadores Pass, located at ten thousand feet above sea level (Gobierno de Chile).

Mendoza is situated on the border of two of the major geographic regions of South America. To the east lie the great Argentine plains, known as *the pampas*, which stretch over seven hundred miles to the Atlantic edge of the country and become progressively more humid. To the west are the Andes, the South American portion of what geologists know as the American Cordillera, the mountainous spine running throughout the Western portion of North and South America. The Argentine historian Juan Pablo Echagüe described the province of Mendoza as a dry and rugged land tucked roughly against the highest portion of the Andean Cordillera. Seventy miles to the west of the city is Aconcagua, at 22,841 feet the highest peak in the Americas (Peakware). The difficult crossing here is mandated by its position directly between Buenos Aires and Santiago and the presence of the Libertadores Pass; if one drew a straight line between the capitals of Santiago and Buenos Aires, Mendoza would be on it. It is here where the great Inca Road network reached its southeastern limit (Hardoy, 1968), here where General San Martín's *Ejército de Los Andes* (Army of the Andes) began its journey through the Libertadores Pass and into Chile as part of the South American War of Independence (Ponte, 1987), and here where the great railroads of the Argentinean agricultural heartland had their terminus during the post-colonial, republican period (Mignone, 2012). And today it serves as the critical land link between Chile and the MERCOSUR trading block (similar to NAFTA); annually over one and half million people and four million metric tons of cargo move through the Libertadores Pass (CIE, 2014).

2.2 The Edges of Feasibility

Mendoza typically receives a little under eight inches of rainfall per year, about half of what the parched city of Los Angeles, California enjoys (NOAA). Like many Andean cities, Mendoza relies on melting snows and glaciers carried by fluctuating

and temperamental rivers for much of its water. Infrequent floods produced by the breaking of ice dams deep in the Andes have historically been the cause of massive flooding on the Mendoza River, and occasional rain events in the region produce more frequent and smaller events (Ponte, 1987). The climate is arid like many places throughout the American Cordillera. However, when irrigated the soils are incredibly productive and Mendoza has long been home to agricultural societies (Michieli, 1983). This region is not marked by scarcity but rather by a complex, syncopated interplay between *scarcity* and *excess* (Figure 1). Living here requires the construction of a landscape that both “speeds up and slows down processes of nature” (Jackson, 1984).

The alliance between the city and its river is a powerful and delicate one. Describing this relationship Echagüe (1938) informs us that:

Without a doubt, the area would be a wasteland without its always timid and always ferocious rivers... Wherever there is irrigation, the land produces a magnificent bounty. The Mendocino, therefore, loves their river, even though at times they fear it... Truly! How sweetly the domesticated waters of the ditches and irrigation canals murmur. To them the Mendocino owes the sweet-smelling marvel of the gardens, yards, and vineyards and all the places that generate life in the whole province; that is, work, industry, economy, customs, well-being, domestic life, and public life in the province are all conditioned by the desires of the crops and the demands of the water system. (p.17)

In this passage Echagüe develops an interesting strand. He suggests the idea that this situation demands more than mere cultural response or adaptation. Instead, together with the desires and expectations of its inhabitants it seems to *conjure forth* culture- political life, domestic habits, processes of production, labor and consumption are all generated from the rhythms of the regional hydrological systems, and the need to modulate its extremes. The regional landscape of Mendoza throws into relief the fact that landscapes are historically produced rather than simply offering a background or screen upon which culture and society are projected, or the raw material from which they are carved. This sentiment is something between the environmental determinism of Frederick Jackson Turner and the idea that universal knowledge and practices must be adapted and applied locally as a “hybrid or pale copy” (Raj, 2007). This third way suggests an

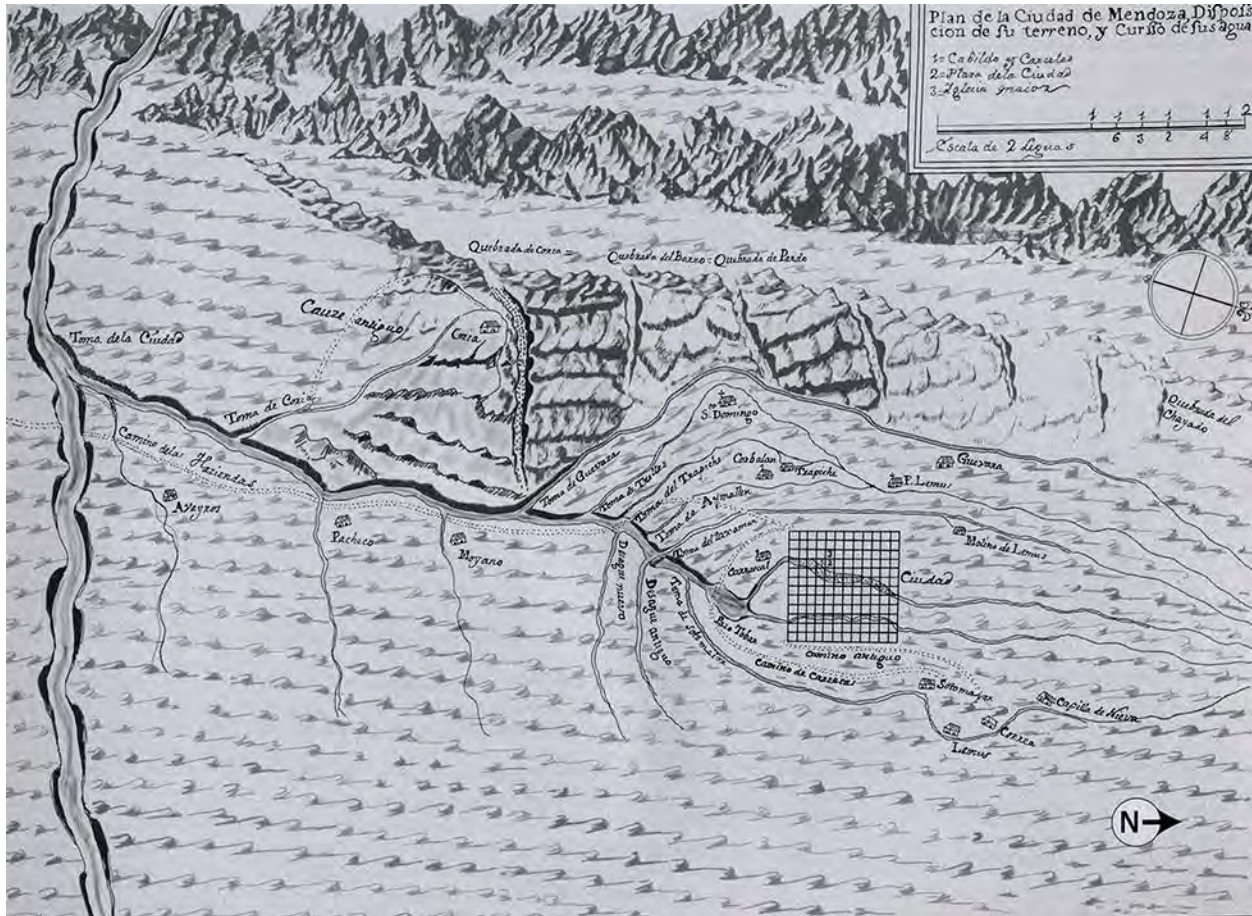


Figure 1. Map of Mendoza in 1761. The River Moving Across the Map (south-north) is the Primary Source of Irrigation; the Pluvial Arroyos Running West-east Can Also Be Seen. (Ponte, 1987, p.71)

alternative framework for conceiving of landscapes, one that “cannot be confused either with the causal chain of ‘historical’ events, or with a sequence... of customs and law, ideals and ideology, and socio-economic structures or institutions” (Lefebvre, 1991).

Cultural landscape theorists such as Setha Low have shown that these places are best understood as syncretic products (Low, 2000). In the case of Mendoza, the landscape both results from and creates the asymmetrical and dynamic relationships of exchange, conflict, and collaboration between local elites, distant cultural powers, quotidian concerns of everyday people through time, as well the material demands of local hydrological systems, soils, and vegetation.

2.2 Life on the Political Margins

The Huarpes people and their progenitors were an agricultural society that had inhabited and irrigated the valley of Mendoza for over 2,500 years (Michieli, 1983). Estimates put their population at

about 20,000 (Pyle, 1976) in the 16th century when they were encountered by Spanish settlers, a number that would quickly fall to 2,500 through forced deportations to work camps in Chile. Historian Fernando Morales Guíñazú (1938) noted that “when Francisco de Villagra in 1552 and Pedro de Castillo in 1561 arrived in the Valley of Huentota, they encountered a region irrigated by three canals diverted from the Cuyo River (today Mendoza), that according to tradition had been laid out by the Incan engineers, who had improved the rudimentary cultivation systems of the Huarpes. Those canals carried the names of the three principal chiefs of the region.” This evidence suggests that the process of linking landscape construction with local political life, which Echagüe (1945) identified in 1945, was not specific to any one era but instead stretched back at least two millennia. Through naming, the Huarpes practiced a tradition of symbolically uniting the hydraulic infrastructure with local political leaders, suggesting a process of synthetic cultural production (Michieli, 1983).

The conclusion that the canals were an Incan import is often drawn because the Inca came from a long tradition of hydraulic engineers, and archaeological and ethnographic evidence suggest that Mendoza served as an outpost to the Incan Empire as it was located on the southeast frontier of the empire and connected by the Inca highway network. However, the Argentinean archaeologist Catalina Michieli shows that this history was more intricate and subtle than the typical story of technological innovation being implanted by a distant colonizing power:

It is possible that the Incan culture had exercised its influence in the construction of the irrigation works, but in no way should they be understood as solely and uniquely derived from and developed by the colonizers, as on one hand the historical-cultural progenitors of the Huarpes had utilized artificial irrigation for at least 2500 years, and on another the ditches and fields in the area that pertained to the Inca were already abandoned by the time the Spanish arrived to the valley. (Michieli, 1983, p.23).

The reference to an Incan settlement that was exterior to established centers of power suggests that Mendoza was something like a *tambo*, a construction along the Inca Road that occurred at regular intervals. Here the *chusquis*, or runners who carried information, could stop and rest and soldiers would occasionally pass through to ensure that tributes from the local elites were properly accounted for (Protzen, 2006). This archaeological interpretation suggests that rather than wholesale importation, the irrigation network resulted from a more syncretic process in which foreign ideas and techniques that coincided with already-established technologies and beliefs were understood and then recreated in ways that satisfied local elites.

Combined with the symbolic relationship between the hydraulic infrastructure and the local politicians, this process is revealed to be an early example of a common phenomenon: the adoption and simultaneous renovation of a foreign technology considered to be innovative and prestigious by local elites. This schematic reinforces calls for a reconstruction of earlier narratives of European contact and settlement in the area currently issuing from post-colonial studies (Chanady, 1994). Huarpes society was traditionally understood to be a static, ahistorical group and Europeans are then both blamed and attributed with touching off the dynamism, destruction, and importation of modern technologies and ideas (the Laws of the Indies offer a primary example) that has

marked the Americas for the last five hundred years (Emerson, 2010). However, rather than a difference in *kind* in which something fundamentally new was occurring, the history of Mendoza suggests that the encounters after 1492 created a difference in *degree*. Dynamics of cultural violence, exchange, and growth that had been operative in the Americas for thousands of years began to undergo a *scalar jump*, rapidly expanding the rate at which technology, ideas, and wealth were being exchanged, and increasing the amount of violence and landscape change that was occurring.

2.3 From Chilean to Argentinean Borderland

The City of Mendoza was established in 1561 as part of Chile, which was at the time a *General Captaincy* of the Viceroyalty of Peru. When Pedro de Castillo founded the City of Mendoza from Santiago in 1561, his band was given the land along the largest canal that was unused and considered undesirable by the Huarpes because it sat at a low point and was subject to floods and enjoyed less air circulation (Ponte, 1987, p.25). The founding acts of the city make no mention of the pre-existing hydraulic infrastructure or other constructed topographic features of the valley (Ponte, 1987, p.25). Historian Jorge Ricardo Ponte notes that this “was not merely an omission, but rather was indicative of the cultural attitude of the colonizers. The hydraulic system of the *Huarpes*, which predated the arrival of the conquistadors, was an expression of the indigenous culture, whose omission in the founding acts of the city can be attributed to the fact that the European worldview discounted the cultural production of indigenous Americans.” (Ponte, 1987, p.25).

For the next two hundred and seventeen years the small settlement served as an eastern outpost of the Chilean government (Arana, 1902). The colonial city remained almost completely within the original footprint. The western border of the settlement was formed by the *Paseo Publico*, a main street built alongside the Tajamar Canal. To the west of the *Paseo Publico* were agricultural fields. This spatial organization served to help buffer the city from diluvial floods and dusty winds coming off the cordillera further to the west. The town was difficult to manage, being cut off from the Pacific-oriented nerve centers in Santiago and Lima by the difficult Andes Mountains. Yet it remained an important settlement serving as a strategic logistics platform where travelers and soldiers could rest and refuel. It was of utmost importance in the efforts of the colonial Chilean government to maintain a presence in northern Patagonia, which

at that time remained a contested territory largely beyond colonial control.

In 1776 all of that changed with the creation of the Viceroyalty of La Plata, with Buenos Aires as its capital (Arana, 1902). While commerce and cultural exchange between Buenos Aires and Santiago had long flowed through Mendoza, suddenly the city was an Andean outpost to an agricultural export economy based on the Atlantic seaboard. During this period population growth began to outstrip the existing urban footprint and the city expanded to the north and the south along the pre-existing canals (Ponte, 1987, p.166). These canals would become particularly important in the social life of the city. In 1858 the traveler León Pallière estimated the population of the city to be between ten and fourteen thousand, and noted that "a large, long avenue of poplars which are very tall and quite old form a veritable wall of green between the mountains and the city." (Ponte, 1987, p.164)

This tree-lined avenue on the Tajarar canal, now known as the *Alameda*, formed the primary social space of the city. Earlier in 1825 the Scottish mining engineer Francis Bond Head had described an incredible scene at length:

As soon as the sun rises the Alameda fills with people, and it takes on a singular and interesting

aspect. The men sit around tables and smoke and eat sweets; the women sit on the adobe benches on each side of the walk. It is hard to believe, but when the Alameda is absolutely full of people, women of all ages come out without a single stitch of clothing on and bathe themselves in the canal that delineates either side of the Alameda... of all the scenes I've seen in my life, I've never seen anything to match that... the walkways are illuminated in a very simple way with star-shaped paper lanterns lit with a small candle. There's usually a band playing, and at the end of the walk there is a small pavilion of adobe... (Ponte, 1987, p.127)

Through the coupling of three linear landscape types- the street, the allée, and the canal- the *Paseo Publico*, or *Alameda*, functioned as both defensive and domestic infrastructure on the western edge of the city (Ponte, 1987, p.164), (See Figures 2 and 3). It protected the population from floodwaters coming down off the hills to the west, and helped to filter the dusty dry air coming from the same direction. Additionally, it acted as an armature of social life, offering an elongated stage that was one of the primary social spaces in the everyday life of the city.



Figure 2. Mendoza in 1846. (J.M. Gutierrez, 1846)



Figure 3. (Ponte, 1987, p.240)

Urban historian Jorge Ricardo Ponte (1987, p.240) noted that the conversion of the *Paseo Public* to the now-tree-line *Alameda* landscape (Figure 3) was the local instance of the general tendency in South America to create promenades with alleés of trees, a trend that was started by Carlos III in 1768 with the *Paseo del Prado* in Madrid. This seems to be a simple case of the importation and local materialization of a European ideal. Yet the Tajamar canal, originally constructed by the Huarpes, was a unique and critical element of this landscape, both creating the conditions for the verdant poplars to flourish in the otherwise xeric conditions as well as enabling the bathing rituals to take place which so astonished visitors and gave the scene much of its life. In addition, its location at the western edge of the city allowed the poplars to serve as a filter, mediating the effects of the dry, dusty winds from the west and creating a dramatic juxtaposition. From this landscape one could see the town spreading to the east along this spine, and to the west the great mountains of the Andes loomed. These facts, as well as the scene described by Head suggests that this landscape was not merely a local example of a universal ideal, but the syncretic result of a historical process that both enabled habitation in this difficult environment, and gave expression to newly forming cultural attitudes.

3 PARQUE GENERAL SAN MARTIN

In 1861 the city was leveled by an earthquake (Romano, 2010). The difficulty in rebuilding amongst the ruins combined with the fact

that the original site offered to the colonists by the Huarpes had been the least desirable, due to its being lower and more prone to flooding, led Mendocinos to rebuild the city from scratch in an adjacent area just to the west of the Alameda. During the rebuilding process provisions were made for additional plazas within the urban grid. However, as the population continued to grow in subsequent decades new pressures were exerted on the hydrological infrastructure of the city—contamination of the drinking water from using the canals as both water source and domestic sewer intensified to the point that yellow fever and diphtheria became endemic among the population (Ponte, 1999). In addition, the air quality in the city continued to be an issue due to the dust from the streets and surrounding desert (Ponte, 1999).

As in many growing cities throughout the Americas at this time, these issues gave rise to a new public health and sanitation imperative (Ponte, 1999). As part of this, in 1896 the Provincial Governor and his Treasury Minister, Emilio Civit, made a list of recommendations to guide the future growth of the city (Ponte, 1987). Two points in particular stand out; Mendoza was to 1) begin a forestation project to the west of the city that would (ostensibly) clean and humidify the air coming from the west, and 2) extend plumbing service for potable water throughout the city, allowing drinking water to be taken upstream from the city itself. The form this was influenced by the aspirations of local and national elites, the influential urban design concepts emanating from Europe (especially France), and the existing hydraulic infrastructure of the city (Ponte, 1987, p.278).



Figure 4. Plan of Mendoza Showing the Proposed Park Designed by Carlos Thays. (Quiroga, Cesár, 1903)

In the same year as Civit made his recommendations, a law was passed for the purchase of 813 acres to the west of Mendoza

(Ponte, 1987, 291). The land was to become a municipal park and real estate venture, as provision was made for eighty lots around its edges (Figure

4) (Ponte, 1987, p.296). The original designer for the park, contracted in 1896, was Carlos Thays (Ponte, 1987, p.297). Thays was a French landscape designer who worked for Jean-Charles Alphand in Paris. In 1889 he came to Argentina to work on a new public park for the city of Cordoba. He soon settled in Buenos Aires and in 1891 he was named the Director of Parks and Promenades for the capital city (Berjman, 1998). Carlos Thays was part of a cadre of second-generation French *paysagistes*, including Jean Claude Nicholas Forestier in Buenos Aires, and Havanna and Edouard André in Montevideo, that fanned out across South America in the late 19th century, working in the burgeoning capitals of the young republics of the continent (Berjman, 1998).

At the behest of local and provincial elites Thays was contracted to create the design for the park (Ponte, 1987, p.296) as well as the adjacent grounds of the penitentiary and military barracks, as shown in my analysis of the original plan (similar to Figure 4). The plan was inspired in part by the popular French style, with sinuous pathways spiraling out from a central lake. The lake was to act as recreational space for regattas and strolling, as well as a reservoir for the irrigation of the botanic garden located near the entrance. The entire park was to be densely vegetated and heavily forested, with rolling lawns between bosques of trees, and the straight axis of the Avenue de los Andes lined with an alleé of trees and pointing directly west toward the Andes Mountains. However, this was something completely different from an exaggeration and domestication of existing vegetation, geologic features, or hydrologic processes, such as was created in New York City's Central Park. It was an oasis in the middle of the desert! And yet like those great landscapes it was to be the cultivation of radical aesthetic and performative juxtapositions at the scale of a major urban landscape. The park was intended as the manifestation of the aspirations of local and national elites, as evidenced by their choice of designer and the programming of the forestation project as a new public park. While they attempted to provoke widespread support for the park by employing narratives from the public health and sanitation discourse of the day, there was resistance to such an exorbitant and ostentatious undertaking. The tone of local papers at the time preserved dissenting opinions as to the construction and design of the park, calling it the "aristocratic landscape *par excellence*" (Ponte, 1987, p.295).

3.1 Borderlands of Intentionality: From Botanic Garden to Productive Landscape

In this design there was no pretense of it being anything natural. Similar to Central Park in New York City, the verdant landscape would offer a stark aesthetic juxtaposition relative to its surroundings, in this case contrasting both the city to the east, and the desert and jagged mountains to the west. It would be the great gathering space in the city, offering a wide range of sensuous pleasures, edifying experiences, and social interactions. And yet an analysis of the project plan (see Figure 4) reveals its situation to the west of the city, with an elongated form and north-south orientation. These facts suggests that, following the recommendations of Civit, it was also intended to function as a buffer or screen against the dry, dusty winds and stormwater floods from the west (Ponte, 1987, p.295). Even as it materialized aspirational and ostentatious desires of local politicians, the park was an outgrowth of the existing hydraulic infrastructure, functioning as a larger, thickened version of the earlier *Alameda*. The park was an apparatus, "having a concrete strategic function and always being located in power relations," (Agamben, 2009) but one that was complex and contradictory. In this case the landscape design was not reduced to *either* cultural meaning and expression *or* hydraulic infrastructure. Rather, the Parque San Martin project exhibited a *both/and* capacity, drawing from the ability of landscape to negotiate multiple competing agendas simultaneously.

As the park slowly took shape in subsequent years a number of major adjustments and reconceptualizations occurred; the real estate venture was redrawn from a perimeter band encircling the Parque San Martin (then named the *Parque del Oeste*) to a cluster of development on the southern end of the parcel (Ponte, 1987, p.431). This was perhaps because at the time the urban street grid still didn't extend to the south and so there was little immediate benefit from having a forested area to protect that tract. In addition to many programmatic changes such as concessions to local sports teams or the construction of tennis courts intended to provide for active recreation, in the twentieth century the park more than doubled in size through westward expansion in order to include the Monument to the Army of the Andes, and through the relocation of the barracks and penitentiary (Parque General San Martín). The former presence of the barracks, and the later construction of the monument, are a result of the military legacy of Mendoza- this is the place where

General San Martin trained his army and marched over the Andes to kick the Spanish out Chile and free the Southern Cone from Spanish imperial domination. In the place of the barracks and prison, a tree nursery now exists as part of the park. This tree nursery is especially interesting for understanding the transformation of the park over time, and its role in forming and expressing Mendocino culture.

The original Thays Plan from 1896 (similar to Figure 4) indicated that a large botanic garden was to be constructed at the main entrance of the park, nearest to downtown Mendoza. In Buenos Aires, Thays would eventually design the first public botanic garden that would feature indigenous plants from around Argentina (Thays, 1910), a result of his plant collecting and documentation on trips throughout the country that would anticipate the efforts of Roberto Burle Marx half a century later. The botanic garden in Mendoza was to be a semi-circle organized with radial pathways that centered

on the main administrative building for the park. Interestingly, a plan drawn in 1911 exhibits the same pathway geometry but there is no administrative building and the area is labeled “tree nursery.” My discussions with current administrators and park designers in 2012 confirmed what these plans suggested that a tree nursery had been established in order to acclimate and propagate plant material for the reforestation project in the park. Drawing on the agricultural knowledge of residents, a decision was made to do away with the landscape dedicated to ornament and exhibition in favor of the pragmatic and productive enterprise. More surprising, its situation by the main entry suggests it was more than the result of practical considerations. Perhaps it was also a celebration of the labor and knowledge employed in the great undertaking: the continued cultivation and enlargement of a desert oasis at the foot of the Andes.

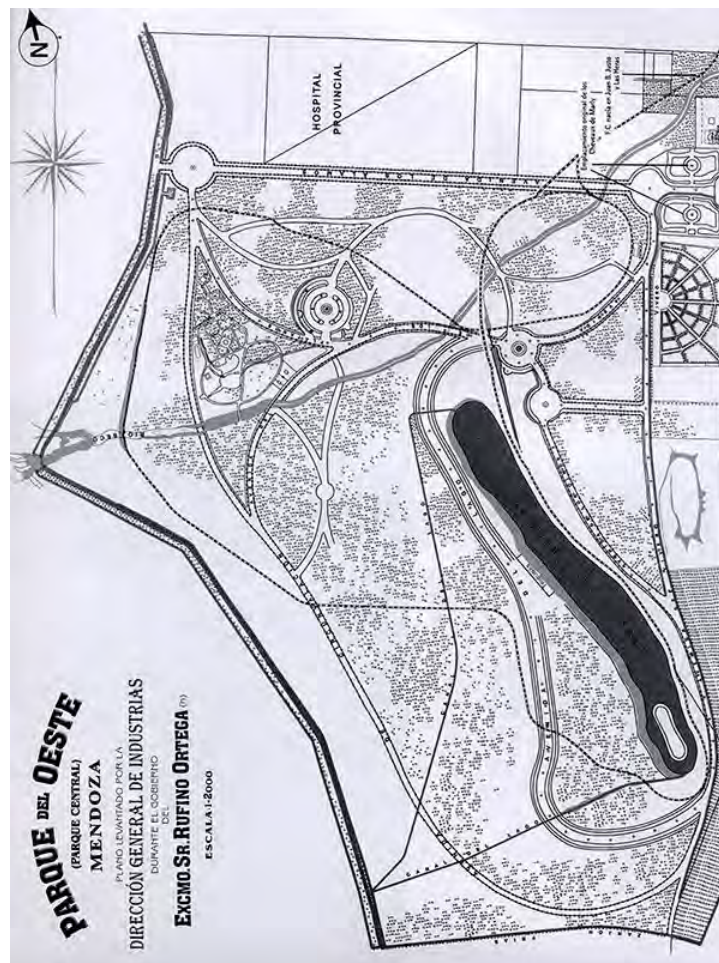


Figure 5. Plan of *Parque del Oeste* in 1911; Plan Has Been Reoriented to Maintain Consistency with Previous Plans. (Ortega, 1911)

4 CONCLUSION

In the early years of Park General San Martín the low precipitation and temperature extremes of the Andean semi-desert, combined with the fact that the scale of the project was beyond anything that the commercial nursery industry in the city could support necessitated the creation of a new institution- the park tree nursery. This instance of a productive landscape tucked inside of and supporting a recreational landscape is rare, or is at least not a prominent part of the histories of 19th century park projects. That it was located up front by the main entry to the new landscape that was supposed to be the very manifestation of aristocratic taste is even stranger. In fact, just four years prior to the drawing of this plan that shows the nursery, a set of elegant iron gates had been purchased from France and installed at this main entrance. In 1911 a resident of Mendoza may have walked from the town to the park, through the great ornamental gates, past a working nursery where propagation and cultivation for the entire project was occurring on a large scale, over bridges crossing primary irrigation canals and stormwater infrastructure and seen the area populated with tiny whips planted in clusters and rows among the green lawns, winding pathways and sinuous lakeshores of the park, evidence of the nascent forestation effort arranged to offer an array of social experiences and spaces. The aesthetic experience of the entry sequence created through the juxtaposition of the ornamental gates and the tree nursery is perhaps unique in the history of park design.

It has proven difficult thus far to discern exactly how the park project was initially received. However given formal changes that can be seen in the historical plans, the popularity and use of the place today, and the fact that it was similar in some of its performative aspects to the popular Alameda, it seems likely that early on it served as a primary social gathering place, offering residents a visual tableau of citizenship at the political and geographic edge of the young Argentine Republic. At the beginning of the twentieth century Argentina in general, and the city of Mendoza in particular, underwent a spectacular expansion in agricultural and industrial production as well as in population growth. The fact of the extension of the original *Parque del Oeste* (West Park) toward the mountains, the changing of its name to that of *Parque General San Martín* (after the hero of the War of Independence), and the reason for that change and expansion (a massive new monument of national independence, glory, and pride) attest to the fact the park was indeed the site of cultural

expression for the ambitious young nation, local elites, and perhaps a plurality of citizens. In fact, the shrinking of its original north-south dimension and its expansion westward, which allowed for it to encompass the peak of a nearby mountain, now renamed the *Cerro de la Gloria* (Glory Peak), suggest that the original infrastructural aspects of the park were somewhat sublimated, outsourced to a larger, regional hydraulic apparatus, as its symbolic and social characteristics grew in importance.

More study is needed to contextualize and analyze these shifts. Nonetheless, two important realizations suggest directions for next steps. First, the tree nursery is still operational and is now larger and diversified. It is the oldest institution in the park, operating continuously since its founding in 1900, though it is no longer situated at the park entrance. This unique institution may offer insights into the history of park-making and public space, especially in the extreme, richly historical environments found throughout the American Cordillera from Alaska to Tierra del Fuego. In addition, the idea of an intensely productive space prominently featured in an important recreation landscape suggests new and unique possibilities for conceiving of aesthetic experiences in public landscapes, especially as we confront issues of climate change and the desire to expand social agency. In addition, though the exact reasons for the contraction and expansion of the park are ambiguous, the resulting effect of reorienting the park from a north-south axis to an east-west axis suggests that the landscape took on additional symbolic and social significance while its importance as landscape infrastructure diminished, with those functions of stormwater retention and improving air quality being primarily performed by other parts of the hydrological infrastructure.

In both of these cases the concept of a *public recreation landscape as hydraulic apparatus* for city-making in Western Argentina is a potent idea that suggests the possibility of new revisionist histories and future forms of landscape design and research throughout this arid and extreme region. Perhaps most important, the realization that this park is not *merely* a local manifestation of a hegemonic, universal, decidedly European practice of municipal park-making, but rather is the result of cosmopolitan ideas interpreted and translated by local elites over time for their own purposes, and built through material and intellectual collaboration with the cultural contributions of earlier local societies, demands a radical revision of landscape history. It forces us to understand that just because power relations are often asymmetrical does not mean that the each side does not possess its own

agency, and is not capable of its own form of resistance through translation and transaction in the production and use of landscape.

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LANDSCAPE PERFORMANCE

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LANDSCAPE PERFORMANCE ASSESSMENT OF URBAN WETLAND PARK PLANNING AND DESIGN: CASE STUDY OF WUZHOU WETLAND PARK IN CHINA

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1 ABSTRACT

The study is to assess the landscape performance of a wetland park planning in China by comparing and quantifying eight key metrics with three planning proposals. A Landscape Performance Distribution Map (LPDM) method was introduced to interpret the relationship between sustainability and landscape performance. The method of the research was to apply a Multi Scenario Analysis (MSA) by using GIS and quantified landscape performance assessment (LPA). The case study focused on three phases: metrics selection, LPA and LPDM application. For the first phase, decision makers proposed to define eight metrics to assess the environmental, social and economic benefits. Then, based on the storm water analysis of the past decades precipitation and upstream storm water volume data, flood storage capacities (20-year, 50-year and 100-year) were calculated by inputting the three planning proposals using spatial GIS methods. Eight different metrics including the flood storage capacity were calculated and compared. The study proved the feasibility to apply LPA in landscape planning stage and provided LPDM as a potential method to bridge sustainability and LPA from environmental, economic and social aspects. The visualized results of LPDM improved the understanding how the tradeoffs could happen between economic, environmental and social aspects.

1.1 Keywords

landscape performance assessment, multi scenario analysis, landscape performance distribution map, wetland park

The purpose of this paper is to apply an integrated approach on the landscape assessment in a wetland park planning. This approach applies techniques such as landscape performance assessment (LPA) and Multi Scenario Analysis (MSA; Bood and Postma, 1998) and tools such as GIS spatial analysis to bridge the gap between landscape performance assessment and decision making process. LPA is a new concept that has aimed to develop a quantified outcome assessment tool for planning, design and decision-making after the landscape suitability analysis theory. The LPA is trying to help decision makers balance the environmental, economic and social outcome by understanding and quantifying what we did get from the landscape point of view. Most of the LPA case studies now were based on the finished projects and calculated the before-after performance difference. However, there is no answer if it is possible to use the LPA and how to use that during the planning and design stage due to the gap between planning tools and LPA methodology. Assessing the multi scenario landscape performance would greatly improve the decision-making process for landscape planning and design.

The overall objective of the study was to develop a Landscape Performance Distribution Map (LPDM) approach based on LPA as an urban planning supporting tool to integrate the spatial, data analysis. The method can support the spatial landscape planning processes on formulating and evaluating a number of planning scenarios by using simulation and quantified LPA methods.

2 INTRODUCTION

3 CONTEXTUAL OVERVIEW AND THEORETICAL TECHNIQUES FOR LPA

Landscape Architecture Foundation (LAF) defined LPA as “the measure of efficiency and effectiveness with which landscape solutions fulfill their intended purpose and contribute toward sustainability”. How to assess the outcome for landscape planning and design projects was a global phenomenon and firms are in need of metrics and standards to learn how to quantify benefits (Ndubisi and Li, 2013). The methods used in LPA now could be seen as a combination of quantified landscape studies including national stormwater calculator, green infrastructure values etc.

On the other hand, Landscape Suitability Analysis (LSA; Hopkins, 1977) theory proposed to analyze the fitness of the land and focused on the strategic development of the landscape planning. Numerous quantitative metrics have emerged from landscape planning (Botequilha and Ahern, 2002) from LSA or LPA methods. While comparing the toolkits used by LPA and LSA methods, we found the toolkits used by LPA was not only limited to constructed environment but also to provide an estimated performance or quick facts. But LPA was now limited to what kind of data could be collected (Ndubisi and Li, 2013). In this case, we could image very limited designers would prepare the data during the design-construction process which means a limited LPA application and a limited conclusion LPA could draw. It would be no doubt that if the researchers and practitioners could foresee the landscape performance before the construction. To use the LPA during the planning stage, the researchers had to deal with different scenarios.

As a strategic management tool, scenario analysis had been approved to be effective for decision-making. In landscape planning field, the Multi Scenario Analysis method (MSA; Wollenberg et al., 2000) is to depict several feasible status to achieve a series of social, ecological and economic goals. To integrate the MSA and LPA would be a worthy try for researchers and practitioners.

4 STUDY AREA

The selected study area was in the Longxu District of Wuzhou, Guangxi Province in China. The study area boundary was a 7.83 square kilometers wetland park (Figure 1). The aim was to find an optimal development scenario for the wetland park planning while improving ecological conditions and

creating recreational and educational activities. The goal for the Zoning plan was to create a new Eco-City while keeping the existing pond as a central lake providing storm water storage. The whole water system consists of three main elements. First one was the center lake serving as a big detention pond with a 1.8 million cubic meters flood storage capacity. Second was the canal for refilling the center lake with dam controlled during the drought season. And the last one was the focused study area as a wetland park (Figure 1).

This study area was chosen for several reasons. It is undergoing rapid economic and urbanization developing circle with several national and provincial policies, such as North Gulf Economic Zone Policy, the Experimentation cooperation area policy for Guangdong and Guangxi provinces etc. Due to the average 13% GDP developing rate, the Wuzhou government approved the regional master plan and set up the Canghai new district. It was a typical situation illustrating the forming of New Eco City in China, which usually developed with green infrastructure projects. The quick change of the land use in the coming years could help to understand how the LPA study could contribute to the relationship between urbanization and green infrastructure constructions.

Secondly, the site was historically known as a vulnerable flooding area and its huge loss. The development for a new city district required an improvement of the flood protection standard from 20-year to 50-year and even 100-years. With more observation stations were established, the data would be accessible. A 63 years' annual, monthly and daily water flow, precipitation database was set up and obtained by the researchers.

The site was the only exit for the Xiaoxiao River, which collecting storm water for a 673.13 square kilometer big watershed. It's a part of the total 80 kilometers long river with the 1.6% average slope. The historical data showed that the annual average highest water level for the river is between 19-21meters, but the flood variation dramatically changed during May to September. The extreme floods in 1994, 1998 and 2005 had a 300,000 tons farmland loss and flooded 66 square kilometers areas (PRWRC, 2014).

The average precipitation data was 1454.9mm annually. May is the highest precipitation month during the year with 15.7% of the whole volume. The local water system design institute PRWRC recommended focusing on the wetland park response to 50-year flooding situation.

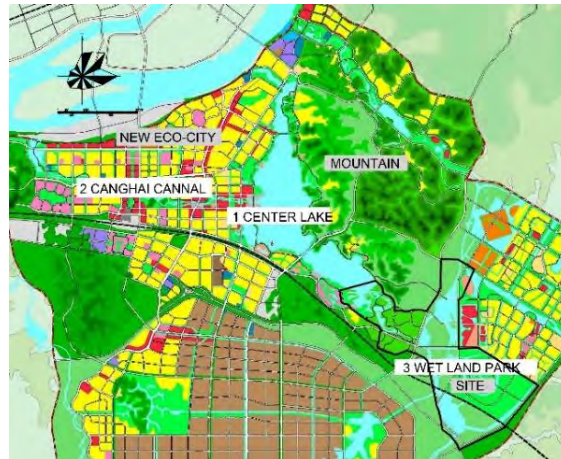


Figure 1. Location Map of the Site and Three Main Water System Components (2013)
Diagram by EBU Architects Design Consultation Company

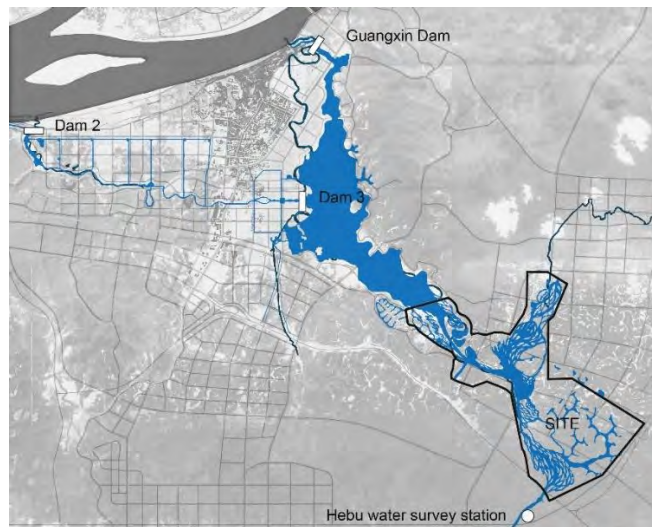


Figure 2. Location Map of the Main Water Elements, Dams and Water Survey Station (2013). Diagram by EBU Architects Design Consultation Company.

There are three water dams and one water survey station in the study area provided statistical data (Figure 2). The Hebu water survey station collected a series data from 1958 till 2011. Dam 2 and Dam 3 are controlling the artificial Canghai Canal to refill the main water body during drought season. For this study, the data came from the Hebu water survey and the Guangxin Dam to control the main water body. One of the key metrics was to assess the detention volume for different scenarios for 20, 50 and 100-year flooding situation.

5 METHODOLOGY

The three main phases of the methodology adopted for this research are Metrics Choice Phase, Multi Scenario Analysis Phase integrating LPA and Landscape Performance Distribution Map (LPDM) analysis phase. Based on these phases, spatial GIS approach was used to simulate the flooding capacity for three proposals. Land use information and trail length were vectorized and calculated in AutoCAD software. The cost related figures were calculated in AutoCAD and summarized based on local average cost provided by the investor based on the other ongoing projects. It showed the three phases of this study in a diagrammatic form as following figure. The details of the main processes would be presented below.

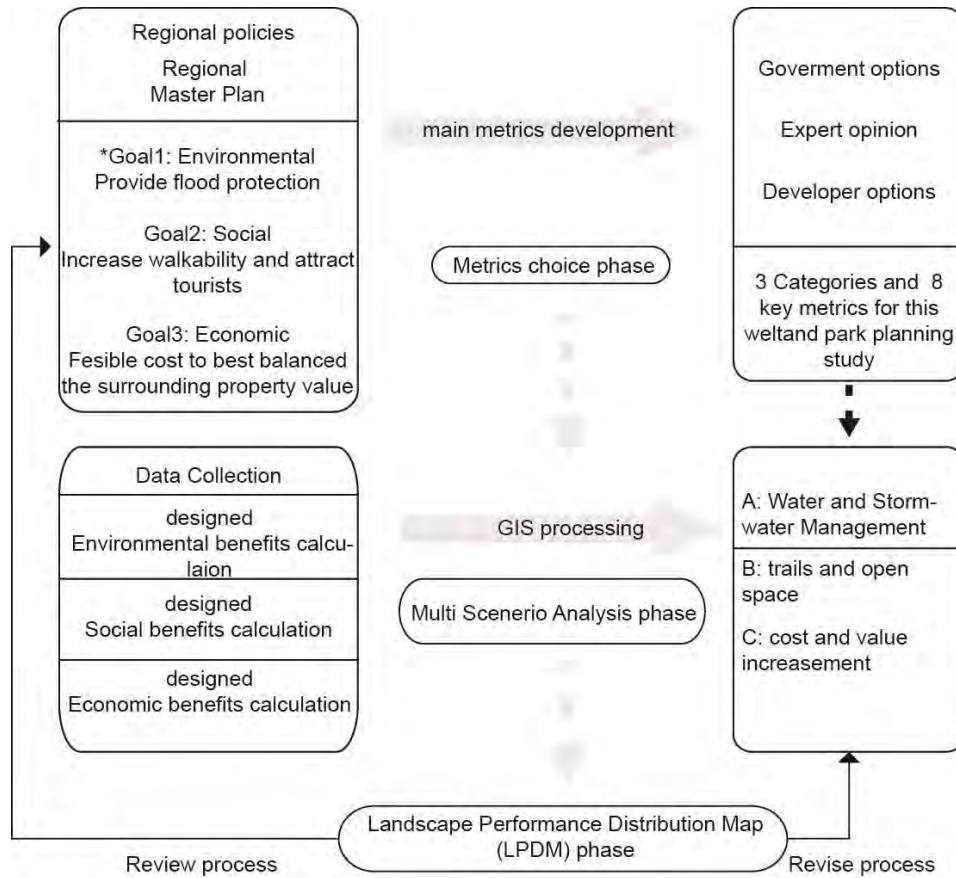


Figure 3. Methodology and Study Process for the Study (2013). Diagram by Authors

Table 1. Metrics selection based on threats and goals analysis

Category	Dominant threats	Main goals	Main Metrics to compare
Environmental Benefits	Historically floodplain	Provide flood protection	Flood storage capacity
			Meadow and forest area
Social Benefits	Lack of public space and attractive recreation	Increase walkability and attract tourists	Expected visitors
			Trail and electronic cart road length
Economic Benefits	Balance the construction cost with the property value increase	Create developable tourism or leisure oriented plots to balance the wetland construction cost	Developable land created
			Agriculture Land preserved
			Public building cost and village revitalization cost
			Construction cost

Table 2. Flood storage requirement simulations for Xiaxiao River (2013). PRWRC report

Time series	Cv	Cs/Cv	100-year	50-year	20-year	10-year	5-year	2-year
54 years	0.95	2	34.17	29.18	22.57	17.53	12.46	5.63
			million cubic meter	million cubic meter	million cubic meter	million cubic meter	million cubic meter	million cubic meter

5.1 Metrics Selection

Setting long-term goals, specifying objectives and formulating strategies to achieve these objectives are the key elements in a planning process (Prusty et al., 2010). In the first phase, the study used a Threats-Goal-Metrics logic after a series of meetings. The decision makers were combined with government representatives, regional water management bureau, master planners, professional designers and developers together. The triple bottom line concept was used as a theoretical base considering the economic, social and environmental threats. The dominant threats and goals for environmental, economic and social benefits were confirmed and eight key metrics including flood storage capacity, meadow and forest area, expected visitors, trails and electronic cart road length (note: the trails here means recreational trails, the electronic cart road length means the recreational transportation trails. Both the metrics was normally used in wetland park planning to assess the environmental capacity.), developable land created, agriculture land preserved, public building cost and village revitalization cost and construction cost.

One of the key metrics discussed mostly was the flood storage volume. According to the water system feasibility report and the flooding study, the regional flooding capacity for 20-year, 50-year, and 100-year was 22.57, 29.18 and 34.17 million cubic meters.

The central lake provided a storage volume from 18 million to 19.25 million cubic meters when the water level varying from 20 to 21.2 meter by itself. Due to the recreational and visual

requirements for the new city, the decision makers decided to control the water level 20 meters as much as possible. The study will use the 20 meters water level for the central lake and a storage capacity of 18 million cubic meters added to each scenario for the overall flooding capacity calculation. The 20-year, 50-year and 100-year flooding volume stored by the wetland park should be as close as to 4.57, 9.93 and 14.92 million cubic meters.

5.2 Multi Scenario Analysis

In the second phase, a GIS database was developed to provide data for spatial and analytical LPA. Existing topographic data and land use maps were collected and vectorised from three proposals. There are mathematic performance assessments and spatial analytical performance assessments in the study. Seven of the eight metrics selected for the study were used mathematic methods. For these metrics, an attribute database was established; vector maps were rasterized for each scenario (Figure 4).

A cost estimation was calculated into two parts. Due to the fact that the decision makers would like to achieve the cost and income balance, all three options proposed approximately the same 4% land use for profitable tourism land use, the study calculated the income from the land loaning price. The construction cost included trail system, public facility (included all the public buildings, e.g., toilet, the wetland science museum), vegetation construction fee (included the cut and fill fee) and water dam facilities.

Table 3. Cost estimations for three options

Option	Trail system length (Kilometer)	Public facility construction fee (million USD \$)	Vegetation construction fee (million USD \$)	Water dam construction fee (million USD \$)	Total construction cost (million USD \$)
A	4.4	31.2	60	9.9	105.5
B	4.7	19.3	74.5	11.8	110.3
C	2.8	46.4	60.7	5.9	115.9

(Note: the cost estimation unit price was provided by developers' undergoing landscape projects including human labor and transferred into USD \$.)

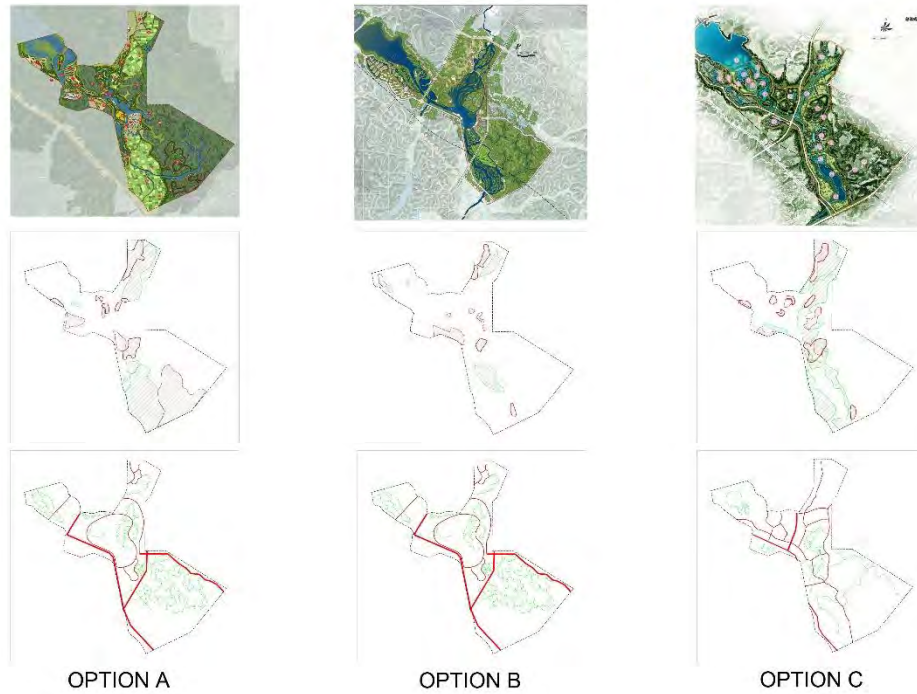


Figure 4. The Vectorised 3 Proposals for LPA (2013). Diagram by EBU Architects Design Consultation Company. (From Left to Right Were Options A, B and C, from Up to Down Were Master Plan, Vectorised Land Use and Trail System)

Table 4. Flood storage capacity calculated for three options
Environmental Benefits (flood storage capacity metric)

		Option A	Option B	Option C
Flood storage capacity of the wetland park (million cubic meters)	20-year scenario	21m WL 0.2	21m WL 0.24	20m WL 0.07
	50-year scenario	23.5m WL 0.45	23.5m WL 9.7	20.5m WL 0.14
	100-year scenario	25m WL 0.94	25m WL 15.18	21.2m WL 0.32
Flood storage capacity comparing the existing GIS model (million cubic meters)	20-year scenario	-4.37	-4.33	-4.5
	50-year scenario	-9.48	-0.23	-9.79
	100-year scenario	-13.98	0.26	-14.6

(Note: WL means water levels. The proposed water level and water flood storage capacity was input in the GIS model according to the designers' booklet. Option A and B had a new water dam proposed to temporarily increase the capacity for 50 and 100-year. Option C proposed no water dam. A negative number means the capacity volume was less than the flooding scenario.)

Table 5. The LPA result for the MSA vectorised metrics

Benefits and metrics	Units	Option A	Option B	Option C
<i>Environmental Benefits</i>				
Meadow and forest area	Ha.	472.5	586.46	478.35
Storage capacity for 100-year flooding	Million cubic meters	-13.98	0.26	-14.6
<i>Social Benefits</i>				
Expected visitors	1000 visitor per year	551	592	351
Trail and electronic cart road length	Kilometer	45.92	49.32	29.27
<i>Economic Benefits</i>				
Developable land created	Ha.	28.84	23.48	24
Agriculture Land preserved	Ha.	145.4	23	174
Public building and village revitalization land use	Ha.	44	21	34.5
Construction cost	Million US. \$	105.5	110.3	115.9

The flood storage volume was required using the spatial and analytical capabilities of GIS. A GIS existing topographical model was set up to test the flood storage volume for 20, 50 and 100-year, which were 4.57, 9.93 and 14.92 million cubic meters. Another three GIS based wetland park model was set up to test the planning scenarios for 20-year, 50-year and 100-year for the three options. The results showed that option B provided a very close flood volume for 25, 50 and 100-year.

Each of the proposals were calculated its land use for Meadow and forest area, Developable land created, Agriculture Land preserved, public building and village revitalization land. The trail and electronic cart road length together were calculated its length. The annual Expected visitors were calculated based on the trail length using local recreational codes based on open space provided.

5.3 LPDM Analysis

In phase 3, the results of the LPA were supposed to provide data for a consulting meeting. The report will be an important review material for the decision makers and public to make the final decision as well as a feedback to the designers to revise the master plan and landscape design

process in the future. The Landscape Performance Distribution Map (LPDM) was introduced and the final results were interpreted using the method.

The goal of LPDM was to introduce a method for decision makers and public to understand the LPA results. It could help to review the initial objectives and provide revise to the planning and design. The LPDM approach was based on the following understanding of sustainability and LPA:

- 1) Sustainability was not a fixed and steady scenario to achieve; it was a dynamic process kept changing.
- 2) Sustainability was a man-made definition from decision makers; whether the objective was quantified or not, the decision makers defined what is acceptable and what is close to that scenario.
- 3) There might be a number of scenarios satisfying the defined sustainability. LPA could be an important method to quantify them. The LPDM used a visualized distribution method to show the relationship between all the scenarios' performance and the expected sustainability.

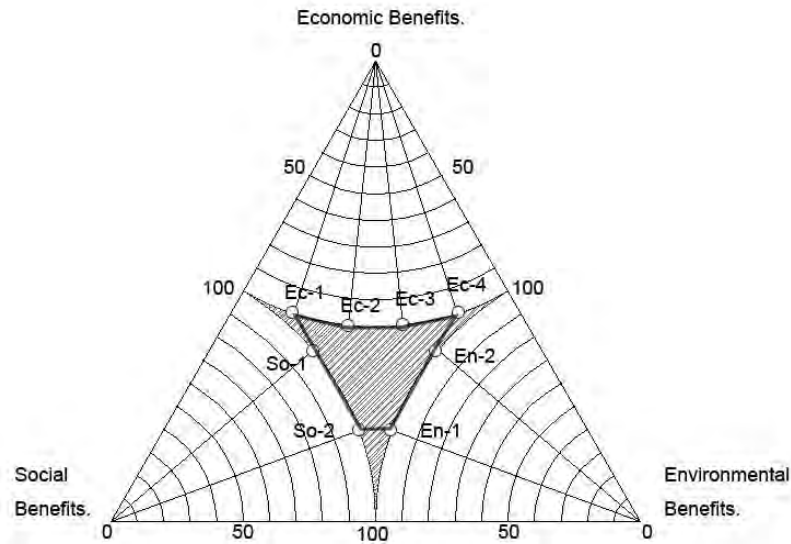


Figure 5. The Concept Diagram for LPDM (2014). Diagram by Authors

5.3.1 Concept of LPDM

The study defined a triangular and fan-shaped decimal graduation concept model used for understanding and comparing the multi scenario LPA. The center part will be the expected performance range of all possible scenarios defined by the best metric values from three proposals. The three fan-shaped area was divided into same number of metrics for economic, environmental and social aspects. In this case, we defined four economic metrics, two environmental metrics and two social metrics that was shown on the map as Ec-1, Ec-2, Ec-3, Ec-4, En-1, En-2, So-1 and So-2. The best metric percentage value defined the expected landscape performance formed an enclosed area. The key metrics were all equally distributed on the fan-shaped edge, the more metrics chosen, the area defined by the metrics edge would be more close to the expected status which supposed to be the “sustainable” area. For

example, the flooding capacity for the planning was expected to provide 100-year flood storage. Option B provided the maximum storage volume included the central lake as 34.43 million cubic meters as 100%, so option A and C provided 20.19 and 19.57 million cubic meters as 58.64% and 56.84%. The percentage was marked on the axis according to its value.

5.3.2 Landscape Performance Distribution Map (LPDM)

The objective to introduce the LPDM was trying to illustrate how far the proposal was comparing the expectation. Due to the fact that the key factor index was not considered in the study, the LPDM here was trying to provide a quick review for the decision makers to understand the final results. The bigger the areas enclosed in the map the less preferable of the option should be accepted.

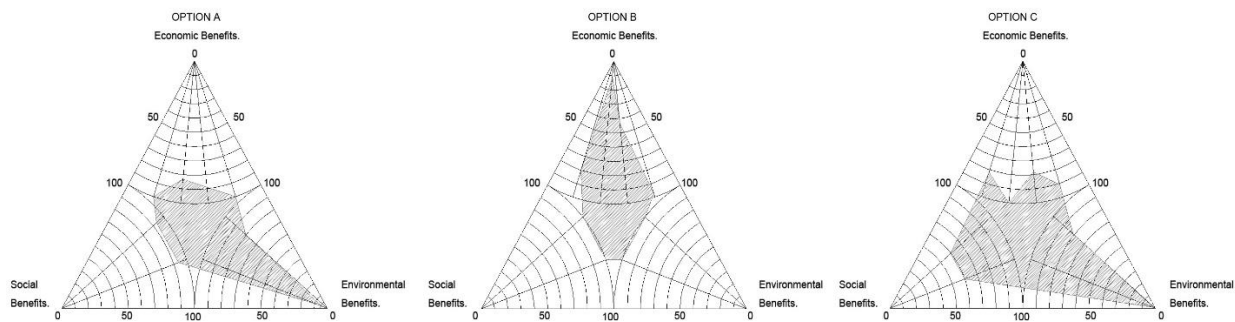


Figure 6. The LPDM for Three Options (2014). Diagram by Authors

6 CONCLUSION AND DISCUSSIONS

6.1 Feasibility to Apply LPA and LPDM as a Landscape Planning Supporting Tool

The study showed how LPA could be used to quantify the expected outcome for landscape planning stage. The feedback of the research was widely accepted by the decision makers and public. The introduced method could be a feasible and dynamic solution for the decision makers to understand and justify the goals for a long-term study considering social, economic and environmental benefits.

6.2 Tradeoffs between Triple Bottom Line and the Bottom of the “Triple Bottom Line”

The study found the metrics chosen for Economic, Environmental and Social categories had tradeoff within each category and between the triple bottom line categories. The area of the LPDM was dragged to different direction by the metrics at the same time. For examples, 1) the more developable tourism oriented land proposed led to dramatically income to compensate the investment; 2) Option B proposed the least agriculture land use to provide the biggest flooding capacity, which led to a tradeoff between environmental and social benefits; 3) the more recreational trails and more public facilities will increase the social benefits while decrease the economic benefits by increasing the cost. The approach for the LPDM was not to focus on the single tradeoffs but to concentrate on the overall benefits defined by the expected-

scenario. The expected scenario was defined by the expected outcome of each metric. There would be different importance for each metric and each category in different situations, the study proposed to adjust the distance for the decimal graduation for future usage. Define the bottom of the “triple bottom line” should be the first step for the decision maker to accomplish for future use of the method.

6.3 Cross-scale LPA

Another finding was to propose a cross-scale performance assessment method in the future. After comparing the site scale landscape performance, the study proposed another regional landscape performance research for the regional flooding performance improvement. We found there might be a scenario that higher cost for the wetland park led to a tremendous cost decrease for the other regional landscape components. For example, the proposal B provided the 100 yrs flood storage improved the regional flooding resilience and decreased at least 20 million RMB for the flooding walls construction.

We propose to extend the use of LPA from site scale to a regional scale to balance the different single projects’ performance and achieve the regional sustainable objective for the case study area. A cross-scale landscape performance analysis diagram was prepared to understand the overall performance. The cross-scale performance assessment will improve the decision makers and planners to better understand the LPA with a temporal spatial perspective (Figure 7).

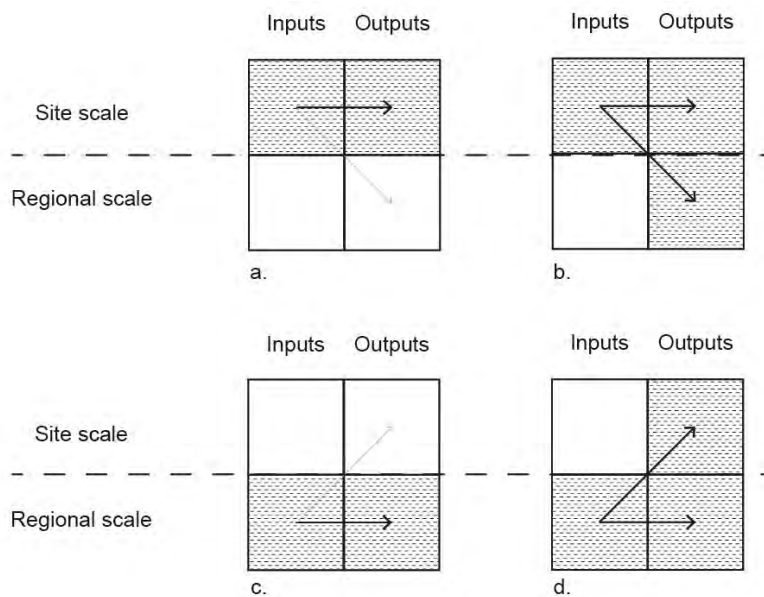


Figure 7. Diagram Illustrating the Cross-Scale LPA (2014). Diagram by the Authors

The diagrams above should be explained as follows:

a. Illustrated a scenario that the key improvements applied at the site scale and the performance will mainly contribute to the site scale. (e.g., Site bio-swale)

b. Illustrated a scenario that the key improvements applied at the site scale and the performance will mainly contribute to the site and regional scale. (e.g., 20 ha storm water detention pond as well as for outdoor recreation)

c. Illustrated a scenario that the key improvements applied at the regional scale and the performance will mainly contribute to the regional scale. (e.g., an existing canal collecting the storm water within an old city)

d. Illustrated a scenario that the key improvements applied at the regional scale and the performance will mainly contribute to site and regional scale. (e.g., riparian forest along a river and its surrounding plots)

The integration of LPA considering social, economic and environmental metrics within a spatial planning framework provided a spatial approach for decision making for future. This study illustrated a method that utilizes the LPA and LPDM method for multi scenario analysis in landscape planning, which will help to adjust the expected objective and scenario. It will provide a feasible visualized result for stakeholders and decision makers after people understanding what the output for the landscape investment is.

7 LIMITATION

The LPA and LPDM were trying to fill the gap between LPA and sustainability by integrating the LPA quantified research and the triple bottom line concept. Metrics selection, use of MSA and LPDM were main process limited by the one-time shot case investigation method. The case selection was limited by temporal-spatial and social development situation and other external variables. The best metrics defined by the decision makers before the proposals should work better than selecting the best metrics in this study since limited by the case selection.

To choose the right metrics from the LPA is the first and key process for the method introduced here. There are other key criteria to define the feasibility for a wetland park planning, such as silt treatments, contaminated soils treatment even the behavior of the local neighborhood etc. This paper proposes eight main metrics grouped into three categories after discussion with experts, decision makers and professional planners. For the use of LPA and LPDM during the planning stage, more

consideration should be researched on how and why to choose the right metrics. The multi-properties of the key metrics we chose in this study, especially flood protection was categorized strictly as an environmental benefit, but flooding had huge social and economic implications that this analysis didn't consider.

The use of MSA like TELSA model for forest management (Kurz et al., 2000) has been proved to be effective. For most of the landscape planners, the MSA is always limited to use due to the limitation of funding and time consuming. The methods used in this study was limited by the time: phase 2 of the study was to collect the data from three options which might be input errors from Autocad to ArcGIS; phase 3 illustrated the LPDM might continues the errors from phase 2. Phase 1 could only focused on the most concerned threats from a group of decision makers which required a more considerable metrics choice in the future. A more dynamic LPA and LPDM methodology integrating multi scenario assessment and cross-scale considerations should be discussed.

8 ACKNOWLEDGEMENTS

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A 'TEXAS THREE-STEP' LANDSCAPE PERFORMANCE RESEARCH: LEARNING FROM BUFFALO BAYOU PROMENADE, KLYDE WARREN PARK, AND UT DALLAS CAMPUS PLAN

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1 ABSTRACT

This research evaluates the performance of three acclaimed landscape architecture projects in Texas conducted for the Landscape Architecture Foundation (LAF) Case Study Investigation (CSI) Program in 2013: Buffalo Bayou Promenade, Houston; Klyde Warren Park, Dallas; UT Dallas Campus Identity and Landscape Framework Plan, Richardson. The paper reviews procedures and findings to highlight the importance of a consistent criteria and comprehensive framework to measure environmental, economic, and social performance. Although landscape architecture literature over the past two decades covers the importance of project performance and evaluation (LAF, 2013; Francis, 1999; Marcus and Francis 1998; Bookout et al., 1994) most inquiry to date focuses on singular case studies neglecting broader applications (Ozdil, 2008). The research searches for consistent and reliable criteria, and generalizable evaluation methods across all three cases. It combines quantitative and qualitative methods (Deming and Swaffield, 2011; Murphy, 2005; Moughtin, 1999). The research design and findings are informed by: LAF's Case Study Briefs (LAF, 2013), relevant design and planning literature (Francis, 1999; Gehl, 1988; Whyte, 1980), the 667 surveys, and onsite observations (Dillman, 1978, Marcus and Francis, 1998; Whyte, 1990), and secondary data. In conclusion, the paper reviews excerpts of social performance findings from the surveys, as well as selected economic and environmental performance benefits. The results illustrate that while each case study displays unique character and complexities, setting baseline criteria and methods to evaluate performance across varying typologies of landscape case studies would probe widespread applications and encourage generalizable research outcomes. Such emphasis denotes a critical

dimension of performance research and landscape architecture's future to communicate the greater impact and value to the society.

1.1 Keywords

landscape performance, urban landscape, evaluating benefits, case study, survey

2 INTRODUCTION & BACKGROUND

Project evaluation and performance are considered as the critical dimension of design and planning activities to inform future practices and learning with past lessons. Although some of the earlier scholarly work in the area of evaluation stem from the architectural literature focusing on the built environment and behavior (see for example Hall, 1966) such studies start gaining broader appeal in allied design fields (especially under the Post Occupancy Evaluation (POE) framework in the 1980's). POE is defined simply as the assessment of the performance of physical design elements in a given, in-use facility (Preiser et al., 1988). Project evaluation and performance, influenced by the POE framework, starts to gain greater recognition and adaptation in landscape architecture literature in the early 1990's (see examples Marcus & Francis 1998; Bookout, et al., 1994).

Similar to other allied design fields, the evaluation and performance studies in landscape architecture typically benefited from the case study approach (Francis, 2001) over the past two decades. This may be due to its ease in adapting varying project types and sizes and its appeal in the design profession. In addition to numerous case studies produced in the past decade, more structured attempts such as the Case Study Investigation (CSI) Program, initiated by Landscape Architecture Foundation in 2011 (LAF, 2013), start giving more emphasis and value to the relevance of

performance in landscape architecture. Although there are various specific lessons learned from these case studies within the past two decades, most inquiry to date focuses on singular case studies setting the stage for broader empirical applications (Ozdil, 2008) to inform landscape architecture scholarship and profession.

This research evaluates the performance of three acclaimed landscape architecture projects in Texas conducted as part of the LAF CSI Program in 2013. It is set to investigate the landscape social, environmental, and economic performance of: 1) Klyde Warren Park, Dallas, Texas; 2) UT Dallas Campus Identity and Landscape Framework Plan; Richardson, Texas 3) Buffalo Bayou Promenade, Houston, Texas. It is undertaken in collaboration with the project landscape architecture firms: 1) Office of James Burnett (OJB); 2) PWP Landscape Architecture (PWP); and 3) SWA Group (SWA). The review of the procedures and findings of the research highlights the importance of a consistent set of criteria which measure environmental, economic, and social performance and establishes a comprehensive and systematic framework to examine an array of projects. The emphasis on such a broad, empirical application in this research suggests the critical dimension of performance research and landscape architecture in the future to communicate the greater impact and value to society.

3 LITERATURE REVIEW

Design literature often argues that a completed projects' performance must be evaluated to assess its value and inform future design practices (Preiser et al., 1988; Hall, 1966). Landscape architecture projects are no exception to this. Literature from the past two decades broadly covers the importance and the value of evaluating landscape projects (LAF, 2013; Ozdil, 2008; Francis, 2001; Marcus and Francis, 1998; White, 1990; Bookout et al., 1994). Although the case study approach is commonly adopted in design literature, the consistency in performance indicators and variables combined with the validity and reliability of methods seem to be implicit and project specific. Other than a handful of research attempts, the empirical and systematic inquiry with consistent criteria on numerous projects is minimally tested. Evidence over the past decade in the literature displays a variety of indicators which can be organized under; environmental, economic, and social performance factors. This can be a basis for consistency in inquiry and comprehensive framework for larger applications.

Urban spaces are epicenters of economic

and social developments; however they are also the primary sources of major environmental problems which pose a challenge to humanity (Wu, 2008). Understanding environmental factors as part of landscape performance is critical in the evaluation studies of the 21st century due to increased awareness concerning rapid urbanization, the limitations surrounding natural resources and the rise of sustainable and green design practices. Landscapes designed to alleviate the environmental concerns seem to start receiving broader recognition within the past decade, and the landscape research seem to emphasis the environmental performance and value of landscape projects in greater capacity. For example, in 2010 a guideline is published by the Design Trust for Public Space in collaboration with The New York City Department of Parks & Recreation synthesizing the best practices for design, construction and maintenance of parks and open spaces to attain higher levels of performance – including social, ecological and economic factors (Carlisle and Pevzner, 2012). In more recent years, initiatives such as SITES or more specific efforts like the 21st Century Parks for New York provide metrics and standards for landscape performance which includes construction, maintenance best management practices (BMP) and water quality (Neckar and Pitt, 2011). The comprehensive review of LAF's CSIs also illustrates factors such as carbon sequestration, sustainable irrigation design, stormwater treatment, stormwater infiltration, reduced impervious surfaces, improvement of the water quality and air quality as commonly quantified environmental landscape performance variables (LAF, 2013).

The review of the literature also reveals greater focus on understanding economic factors and methods in relation to design improvements in landscape architecture and urban design within the recent years. From the review of urban design (Carmona et al., 2001; Ozdil, 2008 & 2012; Jerke, 2008; Prekosovich et al., 2011) to the landscape architecture methods (Crompton, 2001; Sherer, 2006; Ozdil, 2008) literature seem to be substantiated more with both case study research as well as multi-case evaluation studies in the recent years. The form of the economic indicators for design also builds from methods cataloged by the Urban Land Institute Development Case Studies (ULI, 2013) and the Landscape Architecture Foundation (LAF, 2013). The literature seems to convey research design structure for economic value added by understanding the direct value added by the landscape itself, indirectly to the adjacent properties and indirectly to the

surrounding urban context.

Literature also seems to highlight the importance of social factors as part of landscape architecture practice and scholarship in the recent years. Landscape architecture literature details how landscape design stimulates culture (Olin, 1988), impacts quality of life (Sherer, 2006; Kapper and Chenoweth, 2000; Chiesura, 2004) and provides early precedent to social value of Buffalo Bayou Promenade (Shafer et al., 2000) and Klyde Warren Park (Prekosovich et al., 2011). For example, various preference surveys ranging from a few factors in single sheet (Dallas Parks and Recreation, 2013) to comprehensive sets of factors (CPC, 2011) seem to suggest the performance inquiry regarding the social factors. Such factors also seem to be unveiled by observational methods as part of landscape evaluation and performance studies (see such as Whyte, 1980 or Gehl, 2013).

A systematic review of the landscape architecture literature and the case studies documented by Landscape Architecture Foundation, Urban Land Institute, and/or Environmental Protection Agency illustrates the diverse set of performance factors and measures that are available for comprehensive research framework. While the review reminds us of the critical role of criterion like project size, type, location and land use it also reveals the availability of a consistent set of indicators and factors which can be broadly organized and studied under environmental, social and economic performance factors across multiple-cases.

4 METHODOLOGY

In 2013, UT Arlington research team is selected as one of the nine team's across the United States to study landscape performance of three, acclaimed landscape projects in Texas. The research team followed quantitative and qualitative methods to document three landscape architectural projects, and to assess their performance benefits (Deming et al., 2011; Ozdil, 2008; Murphy, 2005; Moughtin, 1999). Methodological underpinnings of this case study research are primarily derived from a systematic review of performance criteria and variables from: (1) the Landscape Architecture

Foundation's landscape performance series *Case Study Briefs* (LAF, 2013), (2) the case study methods that are developed for designers and planners in related literature (Francis, 2001; Gehl, 1988; Preiser et al., 1988; Marcus et al. 1998), and (3) the primary data collection methods through; surveys (Dillman, 1978), site observations, behavior mapping, and assessment techniques (Marcus et al. 1998; Whyte, 1980 & 1990), (4) and finally project related secondary data collected from project firms, project stakeholders, public resources and databases. The data gathered from all the research instruments are further analyzed, synthesized and summarized as the performance benefits for the three case studies under investigation. The research is designed to highlight the values and the significance of these three landscape architecture projects by utilizing objective measures and by documenting and evaluating their performances to inform future urban landscapes. The research team acquired necessary permissions from Institutional Review Board at UT Arlington prior to primary data collection involving human subjects.

4.1 Research Design

The research strategy focused primarily on three thematic areas: environmental, economic, and social for all three case studies. In the beginning of the investigation, the research team benefited from this strategy to conduct a systematic research that produces replicable performance criteria and methods for all three sites (Figure 1). After the measurable criteria is identified to the fullest extent, the research team further refined its approach by customizing performance criteria and procedures to each case study site to better document and report the varying qualities of each site independently. While achieving a comparable set of performance benefits for all sites was the goal and this strategy produces the greater framework for the research, customizing detailed performance criteria later in the process helped the research team to overcome the concerns about data availability, varying project typologies, project goals and outcomes.

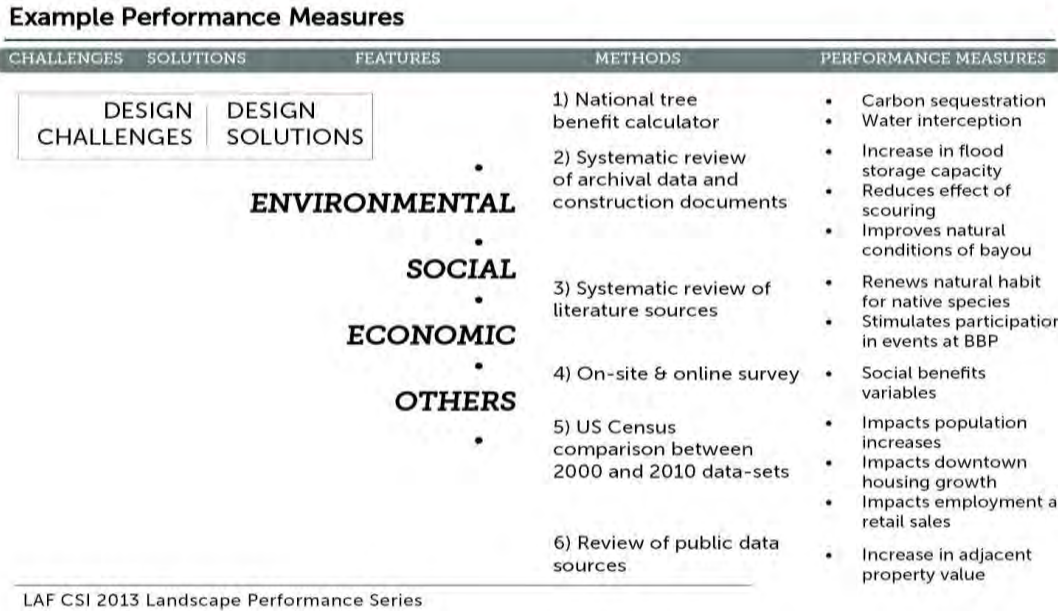


Figure 1. Research Design with Example Indicators and Methods

4.2 Data Collection Methods

Surveys: A survey instrument is developed with slight variations to collect social performance data across all three cases. It is developed to study user perception on topics such as; quality of life, sense of identity, health and educational benefits, safety and security, presence of arts, and availability of informal and organized events, and etc. The survey is composed of three parts. The first part of the questionnaire documents user profiles as well as user perception and choices on activities available on the site by using multiple choice questions. The second part of the survey asks users to rate performance related statements with Likert scale questions. The final portion of the survey is kept for additional comments/concerns of visitors. The survey is kept short and prepared for both online and on-site platforms in order to increase its utilization by potential respondents. Surveys for all three sites are conducted over a three week period in summer on both weekdays and weekends in random intervals.

Archival and/or Secondary Data: This research is heavily benefited from archival and secondary data attained from project firms, project stakeholders, public resources, and private databases. As part of LAF’s mission this research was a product of a partnership among academic research team, project firm, and LAF. Where and when data were available from the secondary sources, such as from the landscape architecture firm, client(s), project partners, scholarly literature, and public agencies, the project team

systematically collected and organized the data, diligently reviewed its content, and assessed its rigor and integrity. The research team later used the relevant data to document the project, and assessed the landscape performance for all three sites.

Site Observations: Passive observations, photography, video recording, site inventory and analysis techniques (such as street furniture counts/measurements, etc.), as well as behavior mapping and tracing methods are also utilized in most instances to better understand the case study features and the performance of the case study sites. The research team primarily benefited from site visits and observations to understand the user behavior about the way the spaces are being used. Observational methods utilized in this research did not involve any intrusive interaction with the subjects and necessary precautions are taken not to impede or govern the subjects’ activities. Although photography or video recording is used, the identity of the space users kept confidential or consent is requested. The research team in all three case studies informed the stakeholders prior to site visits, and acquired necessary permissions.

4.3 Data Analysis

Following the LAF framework, the research team, collected, reviewed, and analyzed/ synthesized project related data for over 20 weeks to prepare the case studies. The research team organized its investigation strategy and efforts under the three sub-category headings;

environmental, economic, and social (including cultural) to establish a comprehensive and systematic framework for the research, to ease the research process for multiple case studies, and to document a diverse set of findings. These sub-categories are used primarily to identify and organize the performance benefits of landscape architecture projects in this collaborative investigation. The analysis in all cases focused on first, site related performance benefits, then its immediate adjacencies, and finally on the project block group/neighborhood/district or zip code level information (see Figure 2). For example, performance benefits that are most direct and telling about the project site are more emphasized in comparison to indirect performance benefits and findings about the project adjacencies, or neighborhoods. This strategy is also used in the reporting of the findings to clarify the document and to ease the review. In conclusion, the data collected through these strategies were systematically reviewed and appropriate methods for analysis for specific performance criteria are highlighted in the detailed findings below.

5 FINDINGS AND RESULTS

5.1 Buffalo Bayou Promenade, Houston

Buffalo Bayou Promenade (also known as Sabine-to-Bagby Promenade) is a 23-acre urban park and a recreation area designed by the SWA Group beneath the Interstate 45 overpass. Completed in 2006, the park has transformed an impermeable urban greyfield into a functioning green infrastructure and a thriving urban waterfront. The project converts a neglected, overgrown, trash-soaked eyesore (intimidating to pedestrians and detrimental to flood control efforts) into 3,000 linear feet of urban park. The \$15 million landmark project was the result of a public/private partnership to revitalize the Buffalo Bayou. Buffalo Bayou Promenade (BBP) case study research produced various results concerning environmental, economic, and social factors illustrating that majority of the performance indicators identified earlier in the research can be attained for such project typology. As it is illustrated with the excerpts of the findings below, the survey instrument primarily establishes the understanding of social

factors and revealing insights to the human dimension of landscape performance.

The review of environmental performance indicators illustrate that the BBP added 641 newly planted trees to sequester 29.74 US tons (59,480 lbs.) of CO₂ annually (FHWA, 2013). The newly planted trees also intercept 337,411 gallons of stormwater runoff annually (measured from the tree canopies only). Environmental performance indicators were also valuable in the review of pre and post development conditions. For example, prior to the development of the bayou the project firm found it difficult for the channel to withstand the stormwater velocity of 2lb/ft². This condition created destructive flooding events to adjacent properties. The current development improved the channel's ability to withstand stormwater velocity by 400% and raised it to 8lb/ft² (SWA, 2013). BBP also serves as a habitat for 4 threatened and 14 endangered species, including native keystone species like Mexican Free-Tailed Bat and Buffalo Fish.

The review of economic performance indicators seems to be informative where data was attainable and provided insight to the value created as a result of this project. BBP turns a constrained edge condition into an opportunity to alleviate fragmentation between the downtown and midtown districts. Inside out, a before and after review of census data (US Census 2000 and 2010) displays the indirect effect of the introduction of BBP and its impact on the city core's revival. The impact of population change is 34.0% from 2000 to 2012. The housing impact, during the same time frame, includes values of change for 'occupied housing units' of 961, 'occupied structures with 50+ units' of 787, and 'renter occupied units' of 470. Employment (population in work force) increases by 10,454 between 2008 and 2012. During the same time frame, the number of establishments increase by 182 (downtown block group) and from 3 to 30 (midtown block group). An indirect impact is the increase in retail sales by \$46.814 million (downtown block group) and by \$15.381 million (midtown block group) (see Figure 2 above). Finally, a structure adjacent to BBP introduces 198 additional housing units and has seen a property value increase by 40% (HCAD, 2013).

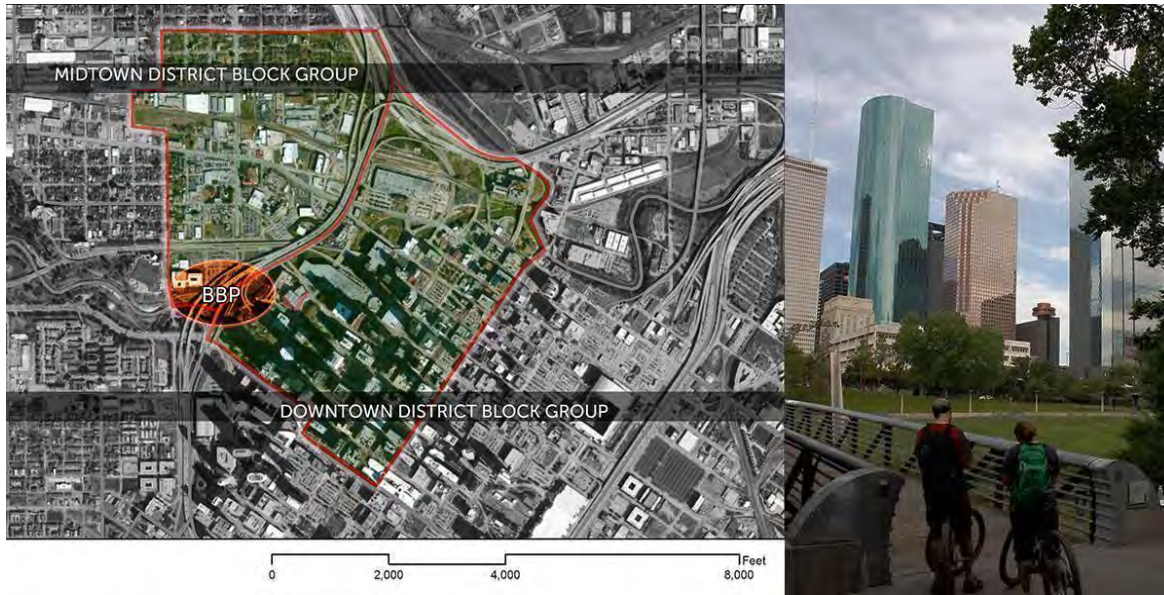


Figure 2. Aerial and Site Context for BBP

Excerpts from the BBP Survey:

108 Buffalo Bayou Promenade (BBP) users are surveyed between mid-July and early August, 2013 by UT Arlington research team. 97 of the responses come from on-site survey while 11 responses come from on-site survey. **88%** of the park users surveyed noted themselves as **'resident'** while **8%** as **'visitor'** and **7%** as **"employee"**. Survey findings also illustrated that only **4%** of the users were visiting the park **first time** while **87%** visits the park **at least one time per month**. Additionally, nearly **45%** of the respondents arrives BBP by using a **personal vehicle** while **31%** arrives by bicycle and **26%** arrives BBP **on foot**.

Respondents agreed with the statement that BBP:

- **Improves the quality of life for 99%** of the survey respondents primarily through increasing physical activity, providing a place to be outdoors, and reducing mental stress.
- **Is perceived favorably by 98%** of the respondents (69% strongly agree).
- **Promotes healthy living for 97%** of the survey respondents primarily through cycling, jogging/running, and passive activities.
- **Increases outdoor activity for 88%** of the survey respondents.
- **Creates a sense of identity for 84%** of the survey respondents.
- **Promotes art and artistic activities for 71%** of the survey respondents primarily through sculptures, garden design, and water features.
- **Promotes scheduled/organized events for 68%** of the survey respondents through music concerts, festivals, athletic events
- **Promotes a better understanding of sustainability for 67%** of the survey respondents through urban greenery, walkability, native planting, and stormwater management.
- **Promotes a safe & secure environment for 66%** of the survey respondents primarily through the lighting design, visibility, and planting scheme.
- **Encourages them to live within walking distance for 62%** of the survey respondents (while 25% neutral about this statement).
- **Accessible for all (American Disability Act-ADA) for 49%** of the survey respondents (15% do not consider this question applicable). N:108

The performance criteria and methodological framework set earlier in the research across three case studies seem to produce attainable results in the case of BBP. Although most performance indicators identified earlier in the research were documented for BBP, this project offered a different set of challenges due to its location and project goals and mission. The availability of archival and secondary data concerning its engineering was minimally available. The environmental benefits are supported by the secondary data from SWA Group and the overall report of the sustainable features is due to the notoriety of the water/greenway design. Where the lack of on-site interaction impacted the study the most occurred on the social benefits report. In conclusion, the seven year time frame between BBP's opening and the time of the research allowed for a stronger economic benefits study. Availability of before and after economic data specifically supports a stronger argument concerning BBP's indirect effect on Houston's downtown renaissance

5.2 Klyde Warren Park, Dallas

Bridging the divide between Uptown Dallas and the Arts District, the Office of James Burnett led the design for the largest suspended infrastructure to contain a park. 5.2 acre Klyde Warren Park (KWP) is created over an existing 8-lane Woodall Rogers freeway in October 2012. This innovative and landmark public space has been a vehicle to physically, socially and culturally connect the two bustling districts in the heart of downtown Dallas (see Figure 3 above). The design and engineering challenge required the rigidity to structurally support massive loads and the dynamism to foster sustainable ecosystems. This complex urban landscape project realized its vision through a collaborative public/private partnership to help fund the approximately \$115 million project.

KWP case study produced various landscape performance results concerning environmental, economic, and social factors also illustrating that majority of the performance indicators identified earlier design can be attained in such conditions. As it is illustrated within the excerpts findings below the survey instrument particularly was revealing for the social implications of the KWP.

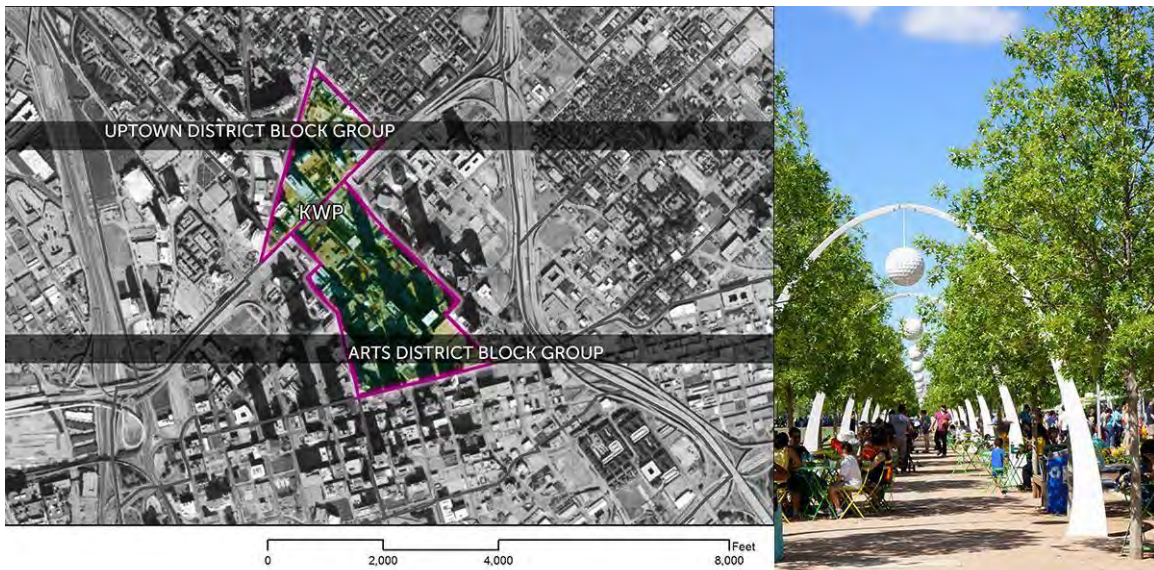


Figure 3. Aerial and Site Context for KWP

Excerpts from the KWP Survey:

224 Klyde Warren Park users are randomly surveyed in person within the final week of June, 2013 by UT Arlington research team. **50%** of the park users surveyed noted themselves as **'resident'** while **46.8%** as **'visitor'**. Survey also illustrated that **56.8%** of the users were visiting the park **first time** while **37.3%** visits the park **at least one time per month**. Additionally, nearly **70%** of the respondents arrived KWP by using a **personal vehicle** while **14.6%** arrived KWP **on foot** and **13.2%** by using various form of **public transportation**.

Respondents agreed with the statement that KWP:

- **Is perceived favorably by 90.8%** of the survey respondents (72.9% strongly agree).
- **Improves the quality of life for 90.9%** of the survey respondents primarily through reduced mental stress, better perception of place, and a place to be outdoors.
- **Promotes healthy living for 86.3%** of the survey respondents primarily through a place to relax, to enjoy passive activity, and for vigorous walking.
- **Promotes a safe & secure environment for 83.9%** of the survey respondents primarily through the lighting design, open visibility, and presence of others.
- **Promotes art and artistic activities for 81.7%** of the survey respondents primarily through garden design, water features, and access to performing arts.
- **Creates a sense of identity for 79.0%** of the survey respondents.
- **Accessible for all (American Disability Act-ADA) for 73.4%** of the survey respondents.
- **Increases outdoor activity for 69.0%** of the survey respondents.
- **Promotes a better understanding of sustainability for 64.4%** of the survey respondents.
- **Promotes educational activities for 63.3%** of the survey respondents primarily through children's education, outdoor classrooms, and a place to read.
- **Promotes scheduled/organized events for 63.0%** of the survey respondents.
- **Encourages them to live within walking distance for 45.4%** of the survey respondents (while **24%** disagree with this statement). N=224

The review of environmental performance indicators for KWP illustrate that the park added 230 newly planted trees which sequesters 8.39 metric tons (18,500 lbs.) of CO₂ annually (FHWA, 2013). These newly planted trees also intercept 64,214 gallons of stormwater runoff annually through tree canopies. KWP reduces the stormwater runoff by 3.63 cubic feet per second by adding 53% permeable surfaces which alleviates the stormwater run-off by 36.73% compared to the pre-development condition (100% impermeable). The park directly impacts urban heat island effect by reduction in the temperature in the park by 5.5 degrees Fahrenheit compared to the zip code average in which the park is located.

KWP's economic benefits begin during construction where 170 jobs were created from an estimate of 353,260 estimated man-hours (Bjerke, 2013). Presently, KWP employs 8 full time and 5 part time positions to conduct the ongoing maintenance and operations (The Park Foundation, 2013). The McKinney Avenue Trolley witnessed a 61% bump in ridership since KWP's opening (MATA, 2013). The increase in popularity influenced the projected \$9.9 million investment into the city's Main Street District public transit

infrastructure (DART, 2013). On-site, sustainable practices allowed KWP to save \$11,279 annually with LED lighting (Bjerke, 2013) and to lower the deck load by 180 tons through the use of geo foam with a cost saving of approximately \$6,600. The analysis of census data shows a projected population increase of 8.8% (within two block groups where KWP resides), housing increases by 4.1-4.8%, vacancy decreases by 12.1-13.1% and the Uptown District block group (north of KWP) shows a projected increase in 'renter occupied units' of 44.0% while the Arts District block group (south of KWP) shows a projected increase in 'renter occupied units' of 18.9% (see Figure 3). Finally, two key, adjacent real estate projects, Museum Tower and 2000 McKinney, display a total property value of \$291,175,000 (as of 2013) (2000 McKinney, 2013; DCAD, 2013; Museum Tower, 2013; Dallas Morning News, 2012).

The performance criteria and methodological framework set earlier in the research for all three case studies seem to produce attainable results also for the case of KWP. The uniqueness of the project and its urban context encouraged detailed exploration of additional performance criteria's. Environmentally, the

introduction of permeable green space over an impermeable roadway in itself is a unique feature that creates a sense of place out of nothing. The limited time frame of the study impeded a more thorough study of the environmental value of a deck park (especially urban heat island effect mitigation, noise reduction, and etc.). Socially, the intensive on-site survey recorded a marked perceived increase of quality of life for KWP users and produce findings consistent with other two case studies. The strong connection between the Arts and Uptown Districts has created a new cultural destination for Dallas. Although economic factors reviewed have the same potential with other cases, the relative newness of KWP is a limitation in the study of economic benefits. On the adjacencies, real estate market value is consistently increased in both housing and office structures. In conclusion, like Buffalo Bayou Promenade, KWP's design turns a once perceived impenetrable edge condition to a design opportunity to mitigate district fragmentation and increase multi-modal connectivity. The case is also stood out as a prime example of how green infrastructure can add environmental, social and economic value.

5.3 University of Texas Dallas Campus Identity and Landscape Framework Plan, Richardson

The University of Texas at Dallas Campus Identity & Landscape Framework Plan transitions the campus from being a suburban, car-centric environment to a pedestrian friendly space with the design vision of PWP Landscape Architecture. The campus today is considered the new public face of the university and even the increase in enrollment in some capacity is attributed to The University of Texas at Dallas Campus Identity & Landscape Framework Plan. The implementation of phase 1 of the master plan contributes to the university's ultimate goal of achieving a Tier-1 status (see Figure 4).

The University of Texas at Dallas Campus Identity & Landscape Framework Plan (UTD) also reveals various landscape performance findings concerning environmental, economic, and social factors. As it is highlighted with the survey results below, the results illustrate that the majority of the social performance factors identified earlier in the research design can be augmented for campus setting with additional consideration regarding the importance of their size and typology. As it is illustrated within the excerpts findings below, the survey instrument particularly seems to be revealing for the social implications of the UTD plan.

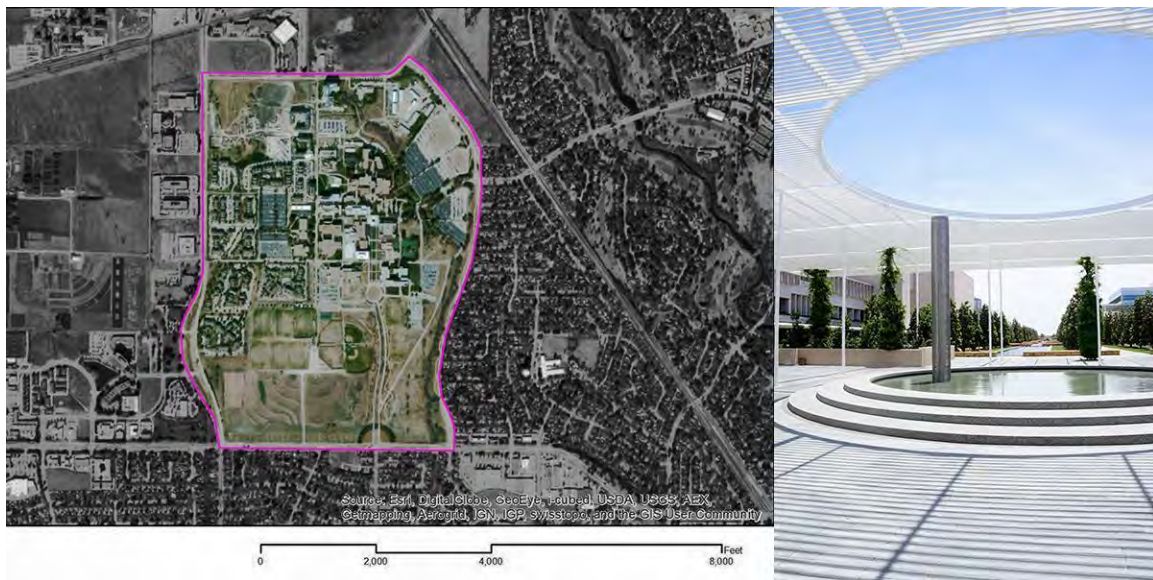


Figure 4. Aerial and Site Context UTD

Excerpts from the UTD Survey:

334 University of Texas at Dallas Campus Identity Landscape Framework Plan (UT Dallas) users are surveyed between mid-July and early August, 2013 by UT Arlington research team. **303** of the responses come from on-site survey while **31** responses come from on-site survey. **44%** of the respondents noted themselves as “Employee”, **28%** of the park users surveyed noted themselves as ‘**student commuter**’, while **20%** noted themselves as ‘**student resident**’. Survey findings also illustrated that **66%** of the users visits the campus **daily** while **18%** visits the campus **more than three times per week**. Additionally, **85%** of the respondents arrives UT Dallas by using a **personal vehicle** while only **8%** arrives **on foot** and **4%** arrives by a form of **public transportation**.

Respondents agreed with the statement that UTD:

- **Improves perception of the campus through renewed landscape for 87%** of the survey respondents primarily by enhancing campus greenery, improving outdoor experiences, renewing campus identity, and improving work environment.
- **Promotes a safe & secure environment for 80%** of the survey respondents primarily through the lighting design, visibility, security personnel, presence of others, and emergency kiosks.
- **Is perceived favorably by 75%** of the respondents (69% strongly agree).
- **Improves the quality of life for 70%** of the survey respondents primarily through improved perception of the area, reducing mental stress, a place to be outdoors, and a place to meet friends (20% neutral).
- **Creates a sense of identity for 68%** of the survey respondents.
- **Promotes healthy living for 67%** of the survey respondents primarily through passive activities (leisurely stroll), relaxing, and vigorous walk (31% neutral).
- **Promotes scheduled/organized events for 67%** of the survey respondents (21% neutral). The current campus landscape primarily promotes student fairs, festivals, music concerts, and exhibits as **scheduled/organized events**, and food consumption, and a place to take a break
- **Accessible for all (American Disability Act-ADA) for 64%** of the survey respondents.
- **Encourages them to live within walking distance for 52%** of the survey respondents (while 23% neutral about this statement).
- **Increases outdoor activity for 52%** of the survey respondents (23% neutral).
- **Promotes educational activities for 50%** of the survey respondents (35% neutral).
- **Promotes art and artistic activities for 49%** of the survey respondents (32% neutral).
- **Promotes a better understanding of sustainability for 44%** of the survey respondents through urban greenery, walkability, native planting, and stormwater management (35% neutral).
- **Influences decision to apply/enroll at UT Dallas for 44%** of the students respondents (34% was neutral, 22% disagrees with the statement). N:334

The University of Texas at Dallas Campus Identity and Landscape Framework Plan (UTD) added 5443 newly planted trees to sequester 139.61 metric tons (307,788 lbs.) of CO₂ annually (FHWA, 2013). These newly planted trees also intercept approximately 1,077,946 gallons of stormwater runoff annually through tree canopies only (EPA Water Trivia Facts, 2013). UTD reduces the stormwater runoff by 6.57 cubic feet per second by adding 13% permeable surfaces which alleviates the stormwater run-off by 18.7% compared to the pre-development condition. The peak flow rate of the stormwater is reduced to 1.15 cu.ft/sec post development compared to 1.98 cu.ft/sec peak flow rate pre-development (in a 2” rain event) along the campus entry drive with native woodland planting. This finding also suggests that there is a 42% reduction in the peak flow rate of the stormwater runoff. The new design of the bio-

retention area (along the campus entry drive with native woodland planting) has the capacity to filter and treat up to 100% of the stormwater as well as non-point source pollutants within its watershed. The findings illustrate that the post-development capacity of the bio-retention area to retain the stormwater is up to 100,550 cu.ft. This is equivalent to runoff created by a 9.975” rain event (assuming the porosity of the soil is 35%).

The University of Texas at Dallas Campus Identity & Landscape Framework Plan (UTD) evolves its mission’s scope outward by addressing the outdated look of the interior landscape. The high, modern design of the first phase of the central mall mixed with the naturalistic entry drive creates an environmentally and socially conscious setting that enhances the university’s sustainable initiative. There are indirect economic benefits as well. While as a fairly new project, there has been an observed

enrollment increase of 13% from 2010 to 2012. To 2018, the annual enrollment is projected to increase 4% as well (UTD Annual Report, 2012). The excitement of the updated landscape stimulated \$31.2 million in private donations to fund the construction and future university initiatives. Finally, approximately 150,000 man hours recorded from the landscape design, construction and consultation of phase 1 created 72 jobs between October 2008 and October 2010 (UTD Construction Facts, 2010).

Among the three cases reviewed here UTD was probably the most challenging site to explore consistent performance criteria and methodological framework in relation to other case studies. Although the indicators/measures of economic, environmental, and social performance criteria's were similar to other sites, the campus landscape as a typology requires a slightly different look and interpretation of documentation especially for economic factors. Economic benefits are more of an indirect effect created through the aesthetic value of the landscape design. Fund raising and student enrollment is interpreted as potential economic performance impact. A limitation in the economic study is the lack of adjacent development or distance of central campus to due to its adjacencies. The introverted qualities of a campus design produce stronger positive outcomes in regards to environmental and social factors (to a target population). The overall shift from paved surface lots to permeable spaces impacts the university's mission for a sustainable future as well. The social benefits, recorded through an extensive on-line survey, mark a perceived increase in quality of life variables for the campus users (mainly students, faculty and administration). Tied to the social benefits are the economic value increases (mainly enrollment and donation increases). In conclusion, UTD's recognition of its limited open and green space design stimulates an innovative design by PWP Landscape Architecture. The direct environmental benefits drive the indirect social and economic value increases while outlining the university's sustainable initiative.

6 CONCLUSIONS & DISCUSSIONS

This research evaluated and reported on the social, economic and environmental performance (as well as other performance factors independent from these categories) of three acclaimed landscape architecture projects in Texas. Beyond systematically evaluating performance of these unique cases, the paper reviews the procedures and findings to highlight the importance of a consistent criteria and comprehensive

framework across three case studies for broader applications. Landscape architecture literature within the past two decades provided a broad array of evaluation and performance criteria and strategies (See such as Ozdil, 2008; Francis, 2001; Marcus & Francis 1998; Bookout et.al., 1994; White, 1990). Performance research started gaining more traction with concerted efforts and documentation within the recent years (see such as LAF Case Study Series as well as ULI Case Studies). The literature review revealed that in most instances a case study approach is commonly adopted focusing only one study at a time adding very little to the broader body of scientific knowledge in landscape architecture. Other than a handful of cases, the empirical and systematic inquiry with consistent criteria on numerous projects is minimally tested within the realm of landscape architecture.

This research was a systematic attempt to explore a broad base landscape performance evaluation with only three landscape case studies where the cases exemplified varying subset of landscape project typologies. The research extracted a comprehensive set of baseline criteria/indicators as well as methods to test their validity to seek generalizable and replicable methods. Findings from the case studies with the confounds of adopted evaluation strategy illustrate that a level consistency and replicability in methodology as well as baseline performance criteria/indicators can be defined and measured, if the case specific (unique) performance factors and indicators customized later in the process for greater detail.

As it is summarized in the Table 1 below, a consistent set of performance criteria/indicators, informed by literature, was found to give meaningful results to document performance across three case studies. For example, environmental performance indicators produce meaningful findings on topics such as carbon sequestration, stormwater runoff, temperature, surface permeability for all cases. However, some case studies required more through exploration of specific indicators such as "improved habitat for endangered species" otherwise may not be applicable to all three cases. Meaningful sets of indicators such as job creation, sales and tax implications, cost saving in building material, housing/retail/office space values occupancy are also identified and documented for economic performance indicators. However, certain performance criteria/indicators set a baseline such as "financial incentives (TIF, PID, and etc.)" was not applicable measure for all case studies (see Table 1).

Table 1. Summary performance indicators & case study findings matrix

Summary Performance Criteria/Indicators Matrix				
Performance Criteria/Indicators	Case Studies			
	Buffalo Bayou Promenade - BBP	Klyde Warren Park KWP	The University of Texas at Dallas Campus - UTD	
Environmental	Carbon sequestration	●	●	●
	Stormwater interception by tree canopies	●	●	●
	Stormwater runoff	○	●	●
	Surface permeability	○	●	●
	Peak flow rate of stormwater runoff	○	○	●
	Removal of pollutants from stormwater runoff	○	○	●
	Temperature	○	●	○
	Flood storage capacity	●	○	○
	Ability to withstand stormwater velocity	●	○	○
	Improved habitat for endangered species	●		○
Social	Quality of life	●	●	●
	User perception	●	●	●
	Healthy living	●	●	●
	Sense of identity	●	●	●
	Art and cultural implications	●	●	●
	Scheduled/Organized events	●	●	●
	Understanding of sustainability	●	●	●
	Safety and security	●	●	●
	Proximity/accessibility	●	●	●
	Accessible for all (ADA)	●	●	●
	Educational activities	●	●	●
	Outdoor activities/participations	●	●	●
	Campus perception			●
Influence on enrollment decision			●	
Economical	Cost savings on building material	●	●	●
	Property value	●	●	●
	Job creation	○	●	●
	Donations and fundings	○	●	●
	Transportation impacts (public, private, & etc.)	○	●	○
	Award of PID, TIF's and/or financial incentives etc.	○	●	○
	Establishment/Employment opportunities	●	●	○
	Energy savings	○	●	○
	Retail & Sales (value as well as tax implications)	○	○	○
	Housing occupancy	●	●	○
	Real estate development impacts	●	●	○
Office rental space impacts	●	○	○	
Other	Presence on social networking media	○	●	○
	Rise in student enrollment			●

Legend:

- Performance criteria/indicators applicable for all cases
- Performance criteria/indicators specific to case study
- Performance criteria/indicators specific to case study but data was not attainable
- Performance criteria/indicators applicable for all cases but data was not attainable

One of the more consistent set of criteria/indicators found to be applicable to all three case studies as a result of this exploration was social performance indicators. Almost all of the social performance indicators used in all three case studies are identical. Criteria/Indicators commonly found in the literature such as perception, health, safety, participation in outdoors events or activities,

accessibility was attainable through primary data collection methods and were produced meaningful results across all case studies. Even in this category of performance indicators a greater understanding of a specific performance criteria regarding “perception of campus” as well as “enrollment decisions” of students was needed for the UT Dallas Campus (see Table 1 and Figure 5).

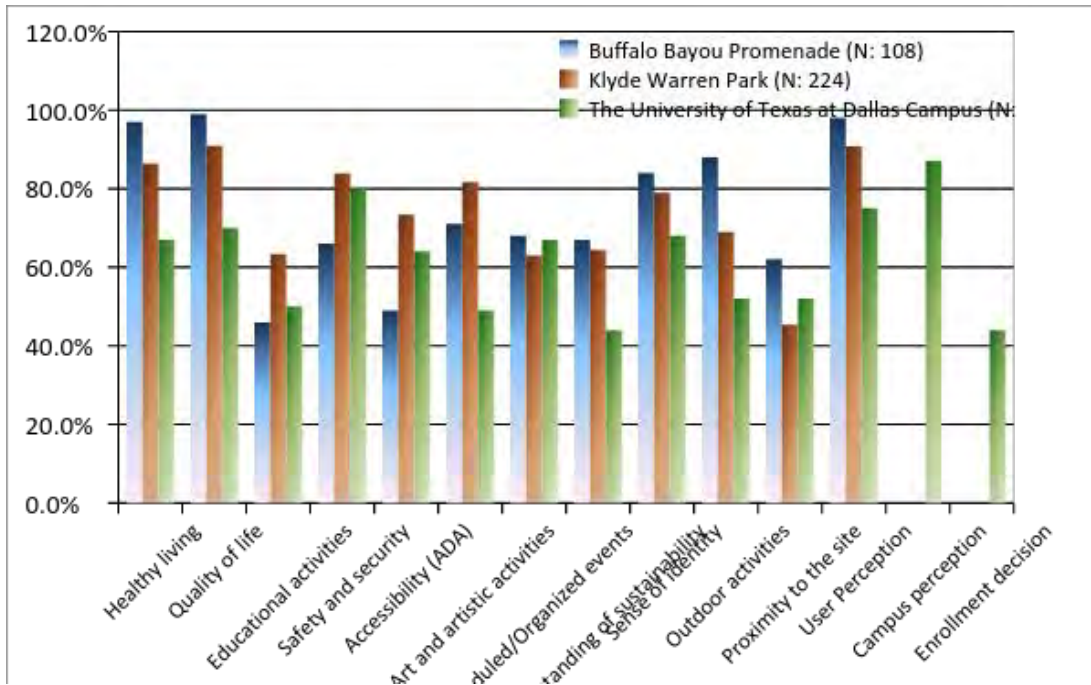


Figure 5. Combined Survey Results Performance

This was a reminder for the researcher that customization of additional indicators to address discrepancies across case studies after identifying and collecting generalizable indicators is a necessary step to achieve more robust outcomes about the specifics of a given case study.

The research findings illustrates that while each project (Buffalo Bayou Promenade, Klyde Warren Park, UT Dallas Campus Identity and Landscape Framework Plan) displays a unique range of character and complexities, a consistent set of methods, indicators and measures can be scrutinized from the literature and adopted for a widespread applications to a multi-case study framework. While the review of three performance studies exemplifies to us how project size, type, location, and project goals and missions can increase the complexity of such cross-sectional study, it also reveals the strength of understanding performance collectively (see Figure 5).

With this research it is also realized that the availability and/or attainability of performance data (whether environmental, economic or social) is the most critical factor in the evaluation and performance studies for multiple cases (see Table 1). As it is illustrated in the case summaries in the previous section as well as in Figure 5 for social factors, original data collection methods, such as surveys, seem to produce greater success to assure greater consistency and scientific rigor for

knowledge creation in landscape architecture as opposed to archival and secondary data. As a point of discussion as well as a limitation of this study one must realize that the exploration here generates a value statement based on a collective review of only three case studies. Even under such conditions consistency in evaluation across three cases seem to promise future research for generalizable empirical knowledge with broader applications.

In conclusion, the research signifies the importance of understanding how a comprehensive study of landscape performance benefits builds upon landscape architecture theory. The addition to landscape architecture theory contributes to innovative, knowledge-based design. Ultimately, such emphasis is belied to be a critical dimension of performance research and landscape architecture in the future to communicate the greater impact and value to society.

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USING A DELPHI METHOD TO DEVELOP CRITERIA FOR HIGH PERFORMANCE PUBLIC SPACES THAT CONTRIBUTE TO COMMUNITY SUSTAINABILITY

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1 ABSTRACT

The authors are conducting case study research to identify the factors that lead to the adoption of sustainable design practices in the planning and design of the public realm, resulting in the creation of High Performance Public Spaces (HPPSs). A HPPS is being defined as any publicly accessible outdoor and/or indoor space that generates economic, environmental, and social sustainability benefits for its community. The research is based on the Diffusion of Innovation Theory (DIT), which states that the diffusion and adoption of innovation is “a kind of universal process of social change” (Rogers, 2003, p.xvi). In order to select cases for research, the authors first needed to develop criteria to identify HPPSs. While sustainability indicator programs such as Leadership in Energy & Environmental Design (LEED) and Sustainable Sites Initiative (SITES) provided criteria for some dimensions of HPPSs, such as healthy ecosystems, the authors sought to develop criteria for a public space that generates the full array of economic, environmental, and social sustainability benefits. An initial set of 41 HPPS criteria was developed from a review of literature regarding great public spaces and sustainability indicators. The authors then employed a two-round Delphi method to review, refine, and develop 25 performance criteria for a HPPS. The resulting criteria were used to solicit, rank, and select three cases of HPPSs for further study into the factors that influence the adoption of sustainable design innovations in the planning and design of public spaces.

1.1 Keywords

sustainability, public spaces, diffusion of innovation, Delphi Method, indicators

2 INTRODUCTION

Over the past two decades, local communities in the United States have sought new

ways to become more sustainable. One opportunity to improve a community’s sustainability is through its ‘parks and open space system’, also known as its ‘public realm’. The public realm generally refers to a community’s system of streets and sidewalks, parks and civic spaces, historic and cultural areas, and natural areas and trails (Barth, 2013). It also includes public infrastructure such as drainage swales, stormwater treatment ponds, utility corridors and/or other lands owned and managed by city, county, regional, state and federal agencies. It is estimated that the public realm comprises as much as 25 – 50 percent of a community’s land mass. Public rights-of-way alone can account for up to 35 percent of the developed lands in U.S. cities (Jacobs, 1993). A community’s public realm can generate significant sustainability benefits: “parks and green belts can be framed as contributing to social sustainability (by providing access to spaces of recreation and social interaction), ecological sustainability (by setting aside green spaces and parks for carbon sequestration, habitat connectivity and species migration), and economic sustainability (by increasing property values of adjacent properties and neighborhoods” (Dooling, 2012, p.179). For the purposes of this study, a publicly accessible space that generates economic, environmental, and social sustainability benefits for their local community has been termed a High Performance Public Space (HPPS). A HPPS can be a park, trail, square, green, natural area, plaza or any other element of the public realm that generates all three types of benefits.

This study explores the reasons why some public space planning and design teams (including public agency staff and consultants) adopt sustainable design innovations in the planning and design process to create HPPSs, while others don’t. More specifically, this study seeks to identify the key factors that influence the adoption of sustainable design practices in the planning and

design of public spaces. Sustainability researchers note that “what’s missing from the [sustainability] literature is analysis and evaluation of why some local governments adopt sustainability principles into their policy-making process and why these policies work in some places as opposed to others” (Saha, 2009, p.18).

In order to research the factors that lead to the adoption of sustainable design innovations in the planning and design of public spaces, criteria had to be developed to identify cases of HPPSs for study. Current sustainability indicator programs such as Leadership in Energy & Environmental Design (LEED) (<http://www.usgbc.org>) and Sustainable Sites Initiative (SITES) (<http://www.sustainablesites.org>) provide criteria for some dimensions of HPPSs, such as healthy ecosystems. However the authors sought to develop criteria for the full array of economic, environmental, and social sustainability benefits that define a HPPS. Therefore the authors used a Delphi method to develop consensus for such criteria in order to identify cases of HPPSs for further study.

3 RESEARCH DESIGN, DATA AND METHODS

The Delphi method is an “iterative process to collect and distill the anonymous judgments of experts using a series of data collection and analysis techniques interspersed with feedback. The Delphi method is well-suited as a research instrument when there is incomplete knowledge about a problem or phenomenon” (Skulmoski et al., 2007, p.1). According to the RAND Corporation, the Delphi method was developed in the 1950s to forecast the impact of technology on warfare: “The method entails a group of experts who anonymously reply to questionnaires and subsequently receive feedback in the form of a statistical representation of the ‘group response,’ after which the process repeats itself. The goal is to reduce the range of responses and arrive at something closer to expert consensus” (<http://www.rand.org/topics/delphi-method.html>).

Delphi methods have been used for a variety of research projects, including national park selection criteria, taxonomy of organizational mechanisms, and ranking of personnel characteristics (Skulmoski et al., 2007). Delphi methods have also been used for sustainability-related research projects such as developing a framework for appraising the indicators of sustainable construction (Huang and Hsu, 2011).

The typical Delphi process for graduate students’ research projects involve from as few as

three to over 170 participants, and from one to three ‘rounds’ of feedback (Skulmoski et al., 2007). Typical steps in the process include:

1. develop the research questions,
2. design the research,
3. research sample [participants],
4. develop Delphi round one questionnaire,
5. Delphi pilot study,
6. release and analyze round one questionnaire,
7. develop round two questionnaire,
8. release and analyze round two questionnaire,
9. develop round three questionnaire,
10. release and analyze round three questionnaire [if required], and
11. verify, generalize and document research results [if required] (Skulmoski et al., 2007, p.6).

The research question for this study was “What criteria should be used to identify High Performance Public Spaces?” A literature review was conducted to develop initial criteria for review. The literature review focused on two areas of research related to HPPSs: characteristics of great public spaces and indicators of sustainable development.

The authors and other faculty members identified over 40 public space or sustainability experts (including academics, consultants, researchers, and public/ non-profit agency staff) to participate in the Delphi process; 21 experts agreed to participate.

In the first round of the Delphi method, participants were e-mailed the findings from the literature review and the resultant initial criteria. They were asked to delete any criterion that they believed to be irrelevant in identifying a HPPS; add any new criteria that they believed necessary to identify a HPPS; and revise any criteria to clarify meaning or intent. The authors compiled the results, which resulted in an expanded list of 46 criteria.

The purpose of the second round was to prioritize and reduce the number of criteria. Participants were e-mailed the expanded list from round one and asked to select and highlight their top five criteria within each category (economic, social, environmental) for a total of 15 criteria; rank and number each of the criteria from 1 – 5 (1 being the highest priority, 5 being the lowest) within each category; and revise any of their 15 selected criteria if necessary to clarify meaning or intent.

The list of criteria was included in surveys sent to City/County Managers and Parks and Recreation Directors throughout Florida, asking

them to identify HPPSs that met these criteria. Of the more than 30 spaces identified, the five highest scoring spaces were selected for further study.

The purpose of future study is to identify the factors that influence the adoption of sustainable design into the planning and design of HPPSs.

4 INITIAL CRITERIA

4.1 Characteristics of Great Public Spaces

The concept of harnessing the power of parks, streets, and other elements of the public realm to create more livable and sustainable communities in the United States is not a new idea. Yet over the span of a little more than 150 years, the concept has been sequentially embraced, practically forgotten, and recently re-discovered.

Since evolving from the sanitary reform movement in the mid-19th century (Peterson, 2003), parks and public spaces have consistently been planned and designed to respond to the social, economic and (more recently) environmental needs of an urbanizing society (Cranz, 1982; Cranz and Boland, 2004). In that time it is estimated that over 100,000 parks have been constructed in the U.S., managed by over 12,000 agencies (nrpa.org). These parks and public spaces have been credited with generating such social benefits as instilling discipline and values, reducing crime, and improving health and vigor (Peterson, 2003); providing places for people to meet, exchange information, attend events, conduct business, and move about the community (Gehl, 2011); and providing wholesome, safe activities for families (Putnam, 2000). They have generated ecological benefits by cleansing the air (Girling and Kellett, 2005; Peterson, 2003), protecting water quality, preserving natural scenery (Girling and Kellett, 2005; Scott, 1969), and providing wildlife habitat (Garvin, 2000). Plus, they have generated economic benefits such as increasing property values, providing jobs, and improving neighborhoods (Crompton, 2000; Garvin, 2000). Parks and public spaces are also credited with creating order, controlling land use, and shaping civic form and beauty (Cranz, 1982). Frederick Law Olmstead wrote extensively on the benefits of parks including their “soothing influence” on weary city dwellers, their role as a meeting ground for a democratic society, and their ability to foster “communicative associations – what today is often called social capital” (Low et al., p.209).

Characteristics of these public spaces include a unique sense of place; a variety of uses and things for people to do; low maintenance

plantings and hardscape materials; positive impacts to surrounding uses; connectivity via greenways and boulevards; adequate drainage and sanitation; and meeting users’ social and psychological needs (Jacobs, 1993; Van der Ryn and Calthorpe, 1986; www.olmsted.org). Great public spaces also have adequate sitting space, moveable tables and chairs, access to the sun, protection from the wind, trees, water that is “accessible, touchable, and splashable,” food, a relationship to the street, access for the disabled, and other amenities such as bicycle parking, drinking fountains, game tables, artwork, play equipment, fountains, open air cafés and kiosks (Whyte, 1980).

Additional, more recent characteristics include self-sufficiency of resources and maintenance; solving larger urban problems outside of park boundaries; and adopting new standards for aesthetics and landscape management (Cranz and Boland, 2004). The Project for Public Spaces (PPS) summarizes the characteristics into the categories of access and linkages; comfort and image; uses and activities; and sociability (pps.org).

The 2010 *High Performance Landscape Guidelines: 21st Century Parks for NYC* represents one of the most recent efforts to integrate elements of sustainability into the characteristics of great public spaces. Guidelines include *Design* (engage all users, engage nature, and respond to site context); *Ecology* (support ecological function, and increase diversity and interconnectivity); *Economy* (resiliency, performance); and *Society* (collaboration and participation, public health, education, and long-term thinking) (Design Trust for Public Space, 2010).

4.2 Indicators of Sustainable Development

Sustainable Development Indicators (SDIs) are another source of potential criteria for HPPSs. SDIs are tools to measure and monitor progress towards sustainability goals (Rydin et al., 2003; Cox et al., 2002). According to the “Community Indicators Handbook” (Redefining Progress, 1997), local economic and social indicators projects in the U.S. were first developed by planning departments in the 1970s but had faded away by the early 1980s. SDIs re-emerged as a central component of the international sustainability movement in the 1990s; the United Nations *Agenda 21* called on communities to develop SDIs that “can provide solid bases for decision-making at all levels and contribute to a self-regulating sustainability of integrated

environment and development systems” (UM, 1992; UN DESA, 2001; Monssen, 2005) (Chai, 2009, p.120).

Currently there are no nationally or internationally agreed-upon SDIs to help measure and monitor progress towards sustainability (<http://sustainabledevelopment.un.org/>). However there are numerous sources of indicators that can be used as a basis for HPPS criteria. For example as mentioned above, indicator initiatives such as LEED, SITES, and the Landscape Architecture Foundation Case Study Initiatives (CSIs) (<https://lafoundation.org/>) have established common indicators to measure the sustainability performance of the built environment. Many local agencies have also developed their own SDIs to promote more sustainable development at the local level (Astleithner and Hamedinger, 2003; Saha, 2009). Initially developed as purely quantitative, technical measures of sustainable development, they now also include “soft outcomes such as capacity building and empowerment” (Holman, 2009, p.371). Recent indicator projects also take a qualitative as well as a quantitative approach in order to capture the less well-defined dimensions of community sustainability, such as quality of life, social interaction and community resilience (Bell and Morse, 2001; Scerri and James, 2010). The broader qualitative approach also helps to include people who have historically been disenfranchised and excluded from decision-making processes (McAlpine and Birnie, 2005). Most recently the United Nations System Task Team on the Post-2015 UN Development Agenda outlined a comprehensive vision for sustainable communities in *Realizing the Future We Want for All*, their June 2012 report to the Secretary-General. The vision included general indicators for each of the four core dimensions of Inclusive Social Development, Environmental Sustainability, Inclusive Economic Development, and Peace and Security (Post-2015 UN Development Agenda, 2012).

5 FINDINGS: CRITERIA FOR HIGH PERFORMANCE PUBLIC SPACES

An initial list of 41 potential HPPS criteria was developed from the literature review of the characteristics of great public spaces and indicators of sustainable development. The initial criteria were refined through the two rounds of the Delphi process, resulting in the following list of 25 criteria to identify High Performance Public Spaces:

Economic Criteria:

- The space creates and facilitates revenue-generating opportunities for the public and/or the private sectors.
- The space creates meaningful and desirable employment.
- The space indirectly creates or sustains good, living wage jobs.
- The space sustains or increases property values.
- The space catalyzes infill development and/or the re-use of obsolete or under-used buildings or spaces.
- The space attracts new residents.
- The space attracts new businesses.
- The space generates increased business and tax revenues.
- The space optimizes operations and maintenance costs (compared to other similar spaces).

Environmental Criteria:

- The space uses energy, water, and material resources efficiently.
- The space improves water quality of both surface and ground water.
- The space serves as a net carbon sink.
- The space enhances, preserves, promotes, or contributes to biological diversity.
- Hardscape materials are selected based on longevity of service, social/ cultural/ historical sustainability, regional availability, low carbon footprint and/or other related criteria.
- The space provides opportunities to enhance environmental awareness and knowledge.
- The space serves as an interconnected node within larger scale ecological corridors and natural habitat.

Social Criteria:

- The space improves the neighborhood.
- The space improves social and physical mobility through multi-modal connectivity – auto, transit, bike, pedestrian.
- The space encourages the health and fitness of residents and visitors.
- The space provides relief from urban congestion and stressors such as social confrontation, noise pollution, and air pollution.
- The space provides places for formal and informal social gathering, art, performances, and community or civic events.
- The space provides opportunities for individual, group, passive and active recreation.
- The space facilitates shared experiences among different groups of people.

- The space attracts diverse populations.
- The space promotes creative and constructive social interaction.

The list of criteria was included in surveys sent to City/County Managers and Parks and Recreation Directors throughout Florida, asking them to identify HPPSs that met these criteria. Of the 34 nominations received, 13 were self-scored by the nominees as meeting 80% or more of the HPPS criteria. Field visits and interviews were conducted for the five top-scoring cases, and the nominations were re-scored by the researcher based on the findings. The three top-ranked cases were selected to study the factors that influenced the adoption of sustainable design innovations in the planning and design process of each of the cases.

6 CONCLUSIONS

The Delphi method is an effective and efficient means of building consensus regarding a previously undefined concept. Some keys to conducting an effective Delphi method include the development of a clear research question; the creation of short, succinct questionnaires and exercises for each round, accompanied by well-grounded research for reference; and the selection of a cross section of highly qualified participants. Some participants may express concern regarding the time required to participate in the process, so researchers should strive to make the process as convenient as possible. The use of digital methods such as e-mail, word processing, and cloud-based file storage can simplify the process; most participants reported that each round only required 15 – 30 minutes of their time.

The HPPS criteria developed through the Delphi method could be used by community leaders, public agency staff, planning and design consultants, community activists, and/or others interested in generating the most benefits from the public realm. There is little question that High Performance Public Spaces can make a significant contribution to a community's economic, social, and environmental sustainability. Diffusion and adoption of the findings from this study may increase the probability that more public spaces will be designed as High Performance Public Spaces.

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HOW DOES IT CHANGE AFTER ONE YEAR? A COMPARISON OF THE LANDSCAPE ARCHITECTURE FOUNDATION'S PUBLISHED CASE STUDIES IN 2011 AND 2012/2013

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1 ABSTRACT

Since 2011, Landscape Architecture Foundation (LAF) has started to support a Case Study Investigation (CSI) program to systematically quantify performance of built landscape projects in the three environmental, economic, and social aspects. The goal of CSI is to test whether performance of landscape solutions fulfill designers' intentions and contribute toward achievement of sustainability. So far, about 76 cases are published including 39 cases from 2011 CSI program and 37 cases from 2012/2013 CSI programs. After publishing the 39 case studies in 2011, LAF realized that most cases have environmental benefits well documented, but fail to thoroughly quantify economic and social benefits. Therefore, in its 2012 and 2013 CSI programs, LAF requires research teams to particularly document economic and social benefits. Each case study should report a minimum of five performance benefits and there should be at least one of each type – environmental, economic, and social.

The purpose of this study is to examine whether this requirement transformed benefit composition in the 2012/2013 CSI case studies and to discuss how to improve the future CSI programs. In this study we compared the average total, economic, and social benefits of 2011 and 2012/2013 case studies. We also used a performance benefit composition scale to illustrate the relative ratio of each type of benefits. In addition, we compared the project type, size, location, and completion data of the 2011 and 2012/2013 cases, and also explored the influence of completion date on the benefit composition. The result shows that, in 2012/2013 cases studies, the average number of social benefits increased significantly, and the average number of economic benefits increased just slightly. More rural projects are included. The number of projects in different size categories is more balanced. As for the

completion date, the 2011 and 2012/2013 cases are similar, and it seems to have no influence on benefit composition.

1.1 Keywords

landscape performance, composition, economic, social

2 INTRODUCTION

Landscape performance is initiated by Landscape Architecture Foundation in 2010. It is defined as “*The measure of efficiency with which landscape solutions fulfill their intended purpose and contribute toward achieving sustainability*” (LAF, 2012). Landscape performance attempts to systematically quantify performance of built landscape projects in the three environmental, economic and social aspects. Its significance is that it collects evidence, informs decision making, and clarifies landscape architects' contribution toward sustainability.

Since being put forward, sustainable development has been defined in various ways. The most popular definition is “*design, construction, operation, and maintenance practices that meet the needs of the present without compromising the ability of future generations to meet their own needs*” (WCED, 1987), which emphasizes balancing the three environmental, economic and equity concerns of current and future generation (WCED, 1987; Campbell, 1996). Landscape performance's theoretical framework is built upon the sustainability triad: environment, economy and society (Li et al., 2013). It includes two levels of meanings: first, it examines whether applied landscape solutions create benefits that were envisioned, and second it tests whether the interrelationships between environmental, economic and social benefits are converging and contribute toward sustainability (Luo and Li, 2014) (Figure 1).

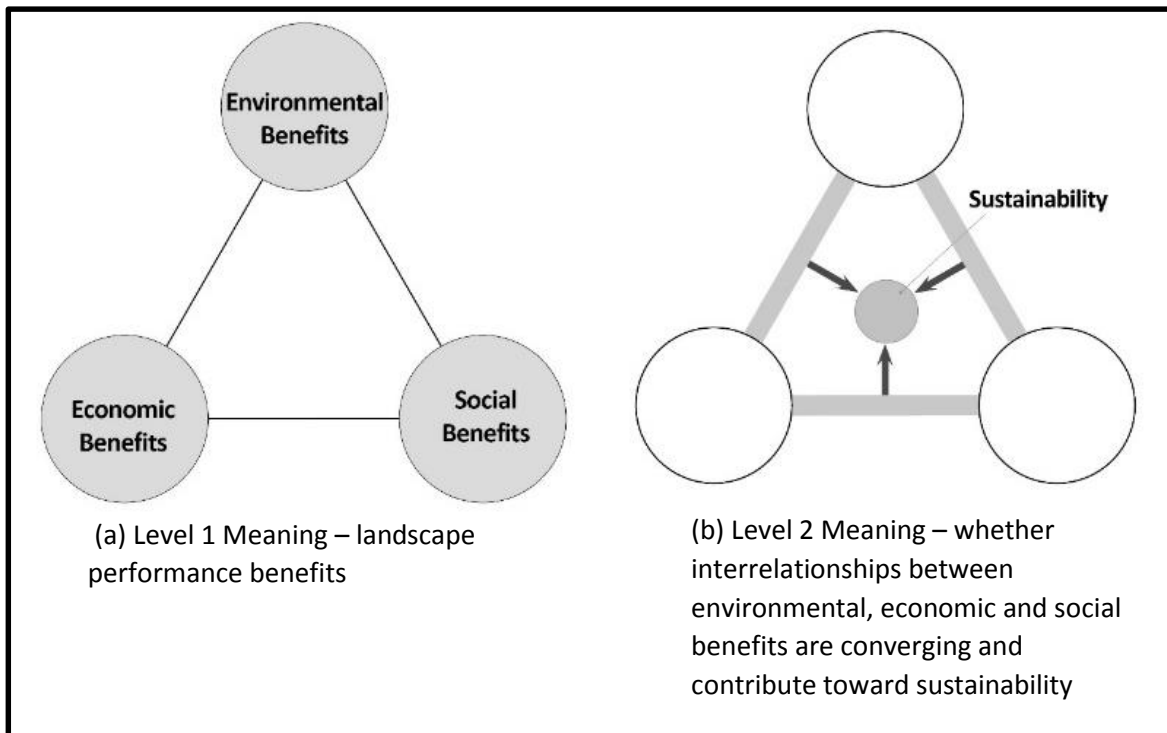


Figure 1. Meanings of Landscape Performance. (Source: Luo and Li, 2014)

Since 2011, LAF has been supporting a Case Study Investigation (CSI) program. CSI is a collaboration of faculty, student and leading practitioners to document performance of high-performing landscapes (LAF, 2012). By now, more than 29 research teams and more than 52 leading landscape architecture firms have participated in the CSI programs (Luo and Li, 2014). As of January, 2014, 76 cases are published, including 39 cases from the 2011 CSI program and 37 cases from the 2012/2013 programs.

Last year, we analyzed the 39 landscape performance case studies published by LAF in its 2011 CSI program. Below is a summary of our findings:

- 1) The composition of the CSI projects is unbalanced in terms of the project type, location, and size.
 - a. Some project types such as park and natural preserve have 19 and 7 cases, respectively; some other project types such as multi-family residence and office have only 1 and 2 cases, respectively.
 - b. As for location, only seven of the 39 cases are located in rural areas and the rest 32 cases are located in urban areas.

- c. In terms of size, 30 of 39 cases range from 1-100 acres, and there are three cases in each of the other three categories: 1) less than 1 acre; 2) 100-1000 acres; and 3) larger than 1000 acres categories.
- 2) Most cases have more environmental benefits quantified than economic and social benefits. Among the 39 cases, nine have no economic benefits documented, and eight have no social benefits documented.

We attributed this finding to that landscape architects are more familiar with knowledge and techniques regarding the environmental aspect of sustainability. They are not trained to quantify economic and social benefits of landscape projects and do not have sufficient knowledge and skills to collect data and calculate economic performance. Also, it is possible that collecting economic and social data within limited time is challenging. In addition, as Haines-Young (2002) argues sustainability is not a state but a changing process, so some benefits might not appear until a later time.

The unbalanced benefit composition also caught LAF's attention. In the 2012/2013 CSI programs, LAF required research teams to particularly document economic and social

benefits. Each case study should report a minimum of five performance benefits and there should be at least one of each type – environmental, economic and social. The purpose of this study is to examine whether these requirements transformed benefit composition in the 2012/2013 CSI studies and to discuss how to improve the future CSI programs.

3 METHODS

In order to examine whether the 2012/2013 cases are improved in terms of project composition and benefit composition, we conducted an assumption based case study. The samples we used are LAF's 39 case studies published in 2011 and 37 case studies published in 2012/2013. To conduct this case study, we made three assumptions: 1) all research teams endeavored to collect data and document landscape performance benefits; 2) the data source and research methods the research teams adopted are reliable; and 3) the basic information of case studies is accurate.

Last year, we created a Landscape Performance Benefit Composition Scale to study each case study's benefit composition (Figure 2). In this scale, the total benefit number of a project is considered 100%, and the relative ratio of each of the three environmental, economic and social categories is calculated using the following equation (Luo and Li, 2014):

$$R = \frac{\text{number of each type of benefits}}{\text{(total number of benefits)}} \times 100$$

where R is the relative ratio of each type of benefits. As shown in Figure 2, the top corner of the scale represents projects that have more economic benefits documented, the left bottom corner represents more environmental benefits, the right bottom corner represents more social benefits, and the triangle in the center represents projects that have similar number of environmental, economic, and social benefits. Admittedly, number of benefits associated with relative ratio of the three aspects cannot fully address the balance of sustainability. Some other factors such as weight, and significance of each benefit could make a substantial difference. However, we feel this scale could be used to demonstrate the trend of landscape performance benefit quantification.

We used the same scale to compare the benefit composition of the 2012/2013 and 2011 case studies. Then we calculated and compare 2012/2013 and 2011 case studies in terms of the average number of total, economic, and social benefits. We also classified the 37 cases (2012/2013) by project type, size, location (rural/urban) and time of completion to see how the project composition is different from the last year. Lastly, we sorted the total 76 cases (2011 and 2012/2013) according to projects' completion date to examine whether projects completed earlier create more total, economic, and social benefits.

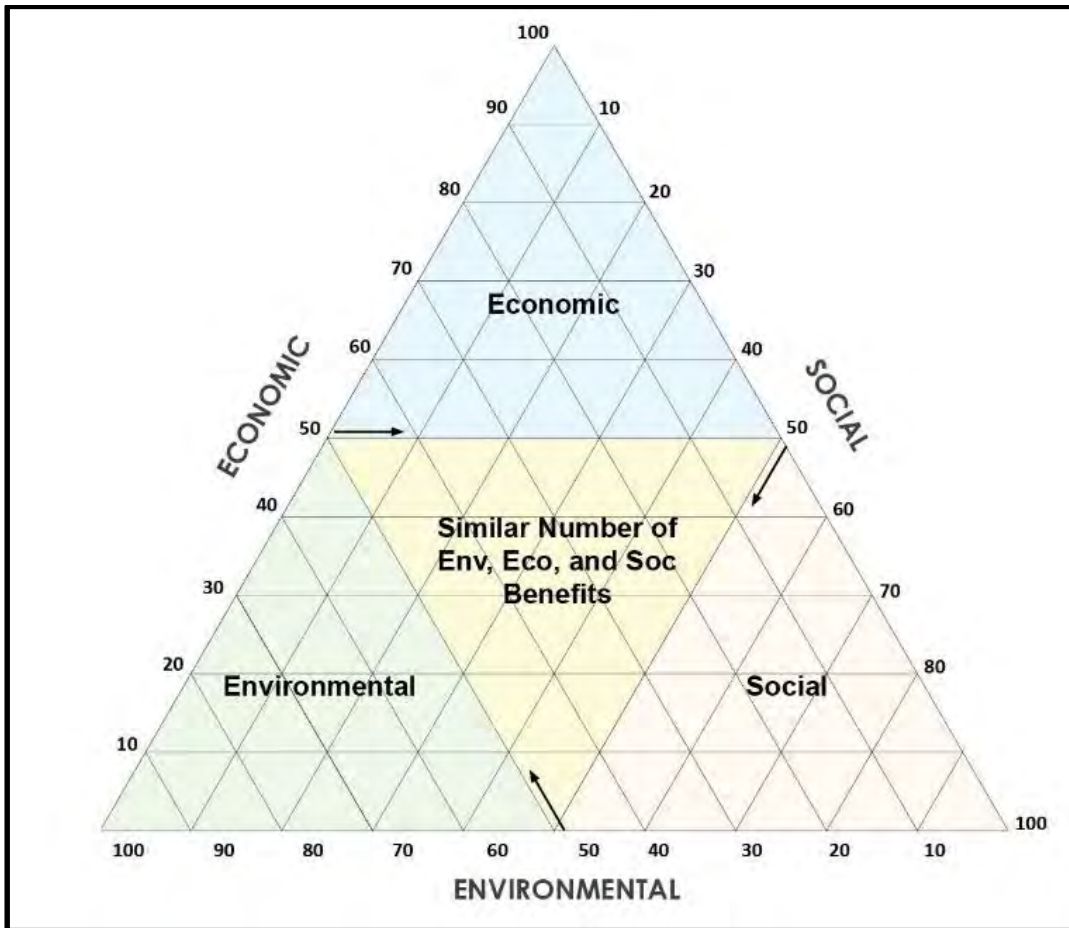


Figure 2. Landscape Performance Benefit Composition Scale. (Source: Luo and Li, 2014)

4 RESULTS AND DISCUSSION

4.1 Project Benefit Composition

The result of comparing project benefit composition of 2011 and 2012/2013 cases is shown in Figure 3. Figure 3a represents 2011 cases, and Figure 3b represents 2012/2013 cases. In 2011, 25 cases have more environmental benefits documented, two cases have more economic benefits, two cases have more social benefits, and 10 cases have similar number of environmental, economic and social benefits. Nine cases are located on the environmental bar, representing no economic benefits, and eight cases are located on the economic bar, representing no social benefits. In 2012/2013, majority of cases (22 of 37) are located in the central triangle in the scale, meaning that they have similar number of environmental, economic and social benefits, 11 cases have more environmental benefits, one has more economic benefits, and three have more social benefits. No

case is located on the economic bar, meaning that all projects have at least one social benefit, while there are still seven cases located on the environmental bar, representing that they have no economic benefits documented.

We also calculate the average number of total, economic, and social benefits. In 2011, the 39 cases' average number of total benefits is seven, the average number of economic benefits is 1.6, and the average number of social benefits is 1.8. In 2012/2013, the 37 cases' average number of total benefits is 8, the average number of economic benefits is 1.9, and the average number of social benefits is 2.4.

Compared to 2011 cases, the average number of total benefits in 2012/2013 does not increase greatly (7 to 8), while benefit composition of 2012/2013 cases are more balanced (move to the center triangle). Social benefits documentation is significantly improved.

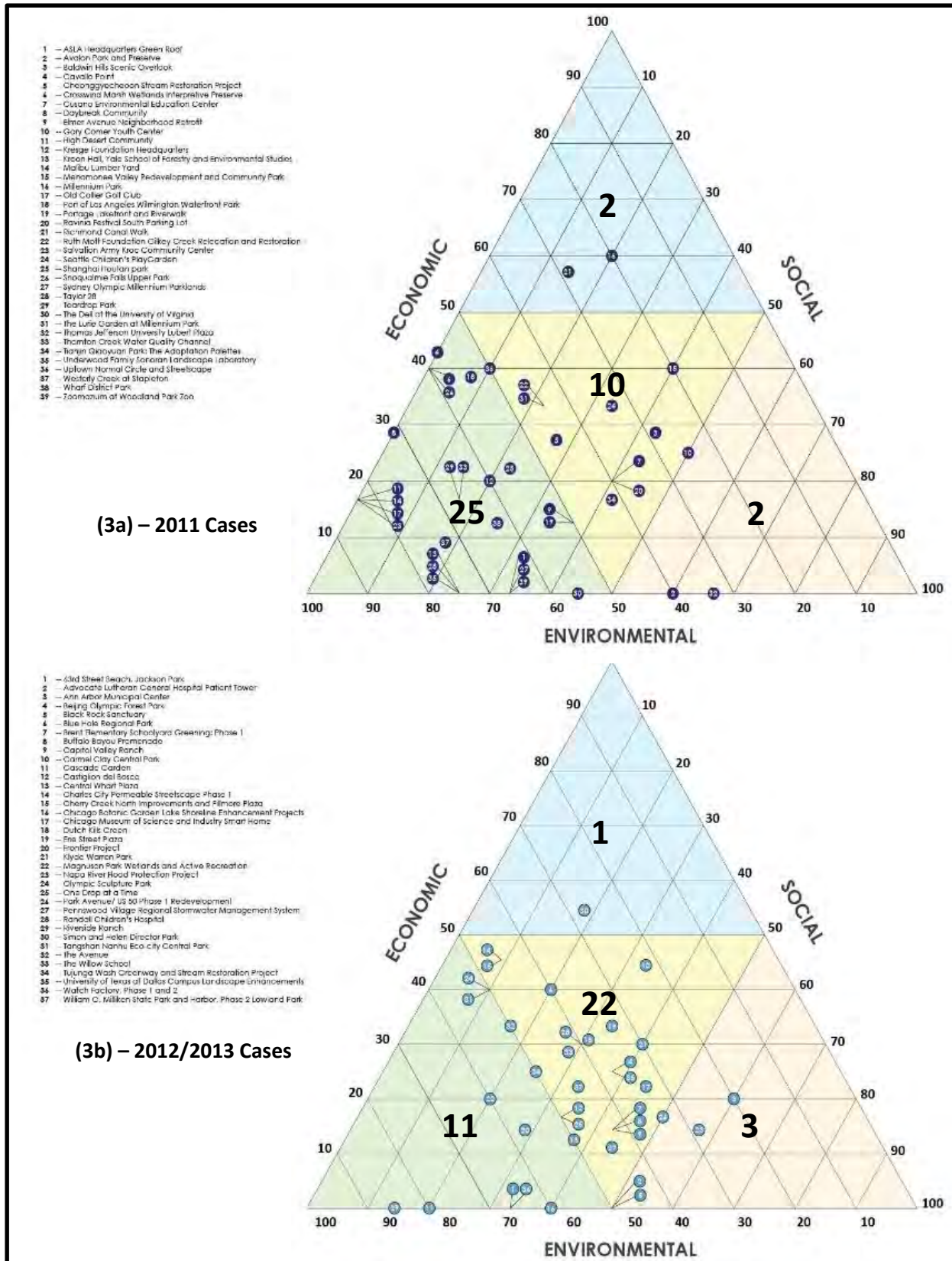


Figure 3. Comparison of Project Benefits Composition Between 2011 and 2012/2013 Cases

Social benefits that were reported mostly include recreational value, educational value, and increase of satisfaction and life quality. There is also an increase in view/scene quality improvement, crime prevention, and historical site preservation. As for the average number of economic benefits, the increase is not as remarkable as social benefits. Cost saving/avoiding is the mostly reported economic benefit. The reasons that contribute to cost saving vary largely from project to project, such

as water saving, materials recycling, energy saving, and volunteering. Since there are still seven projects that reported no economic benefit, other assistance seem to be necessary to help strengthen economic benefit documentation. We would like to suggest including a research assistant or a research fellow from relevant majors (land development, real estate, and economics) for future CSI programs.

Table 1. Project type of 2011 and 2012/2013 CSI case studies

Project Type	2011	2012/2013	Total
Conference / Retreat Center	1		1
Golf course	1		1
Industrial park	1		1
Sports facility, other	1		1
Civic/Government Facility		1	1
Resort/Hotel		1	1
Working Landscape		1	1
Recreational trail		1	1
Community	2		2
Multi-family residence	1	1	2
Playground	1	1	2
Urban agriculture	2		2
Healthcare facility	1	2	3
Office	2	1	3
Other	1	3	4
Retail	2	2	4
Transportation	2	2	4
Single Family Residence		4	4
Garden / Arboretum	4	2	6
Waterfront redevelopment	2	4	6
School / University	4	3	7
Stream restoration	5	2	7
Wetland creation/restoration		7	7
Streetscape	3	7	10
Nature preserve	7	5	12
Stormwater management facility	8	4	12
Courtyard / Plaza	6	11	17
Park	19	14	33

Table 2. Comparison of portion of size categories between 2011 and 2012/2013 cases

	Area ≤ 1 acre	1-10 acres	10-100 acres	100-1000 acres	Area ≥ 1000 acres
2011	3	16	14	3	3
2012/2013	8	11	9	5	4

4.2 Project Type

The comparison of project types between the 2011 and 2012/2013 case studies is presented in the table below. In 2012/2013, six new project types are reported, including civic/government facility, wetland creation/restoration, single-family residence, resort/hotel, working landscape, and recreational trail. In both years (2011 and 2012/2013), most project types studied are park, stormwater management facility, and natural preserve. Cases in courtyard / plaza, streetscape, and wetland creation/restoration increase significantly, while cases in many other project types, such as conference, industrial park, resort, playground and multifamily remain few. Certainly, some of these project types are less popular; however, community, multi-family residence and playground are quite common. Including more cases from these project types could help with conducting comparative studies between cases of the same type, and better contribute to future landscape designs of these popular project types.

4.3 Project Size

The result of project size comparison is shown in Table 2. The graphs show the portion of each of the five size categories of the projects in

2011 and 2012/2013: 1) less than 1 acre; 2) 1-10 acres; 3) 10-100 acres; 4) 100-1000 acres and 5) larger than 1000 acres. The graphs in the upper level represent the 2011 case studies, and graphs in the lower level represent the 2012/2013 case studies. In 2011, most cases are in “1-10 acres” and “10-100 acres”, which limits the generalizability of cases studies in the other three size categories. In 2012/2013, the cases are more evenly distributed across three categories. This change helps increase the diversity of the CSI programs and improves the reliability of the Landscape Performance Series.

4.4 Project Location

We classified the 2011 and 2012/213 cases into rural and urban groups based on population density of the places where the projects are located. The result is shown in Figure 4. In 2011, seven of 39 cases are located in rural areas, accounting for 18% or all cases. In 2012/2013 case studies, nine of 37 cases are located in rural areas, accounting for 24% of all cases. The result indicates that the rural projects increase slightly in comparison to 2011, but majority of the projects are still located in urban areas.

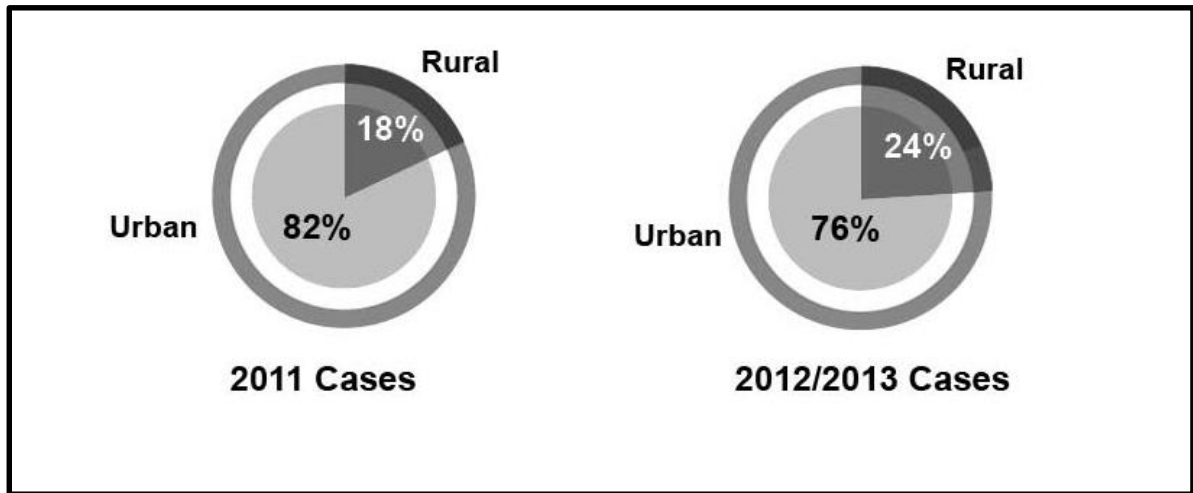


Figure 4. Comparison of Portion of Location Between 2011 and 2012/2013 Cases

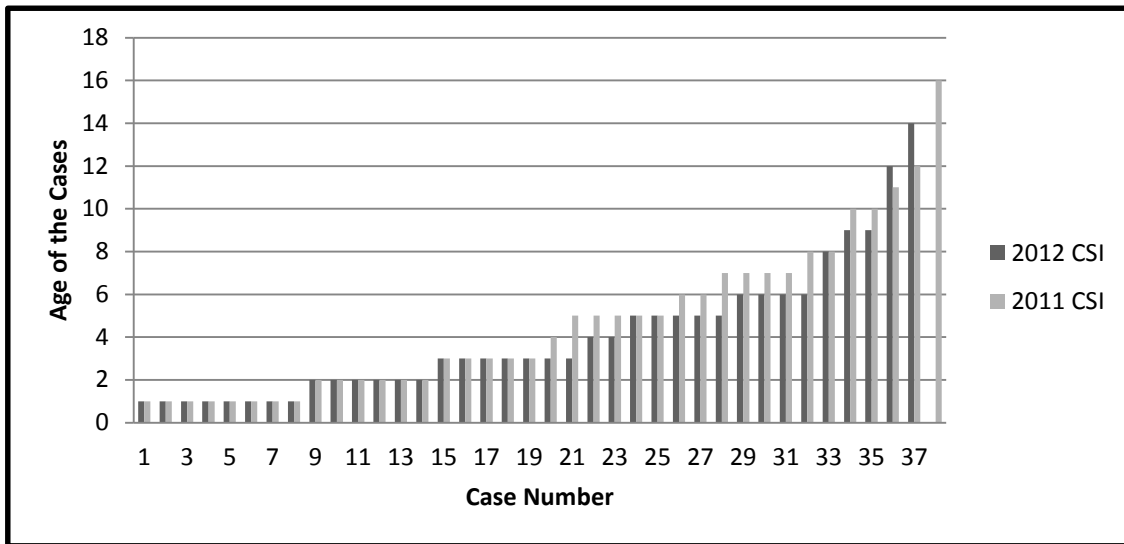


Figure 5. Comparison of Ages of Cases Between 2011 and 2012/2013

4.5 Completion Date

The result of comparing the completion dates of the 2011 and 2012/2013 CSI cases is shown in the Figure 5. Overall, there is no significant difference between 2012/2013 cases and 2011 cases. The majority of cases in both years were completed in less than 5 years ago. Among the 2011 cases, 25 were finished within 5 years, 10 were finished within 6-10 years, and 3 were finished within 10-20 years. Among the 2012/2013 cases, 28 were finished within 5 years, 7 were finished within 6-10 years, and 2 were finished within 10-20 years. Landscape changes and develops overtime. It will be an improvement to CSI if time can be taken into consideration. One suggestion is to select projects that were completed across different time periods, especially projects that are of similar type, size, and social context, such that we can comparatively study similar projects over time.

4.6 Influence of Completion Date on Total Benefit Number

As mentioned before, landscape is a changing process, and some benefits might take

time to reveal. For example, the soil improvement by native species, property value increase by recreational trail, and residents' satisfaction increase due to improved stormwater management might take years to achieve. Hence, it is possible that a project's completion date would influence the total number of measurable benefits. Given that, we studied the influence of time of completion on the total benefit number. The result is shown in Figure 6. The x axis represents the 76 (2011 and 2012/2013) cases' age when the landscape performance quantification was conducted. The y-axis represents total number of measured benefits documented. The figure shows that the total numbers of benefits do not differ significantly throughout the different ages. In other words, the projects that were finished earlier do not generate more measurable benefits in comparison to the newly finished projects. However, it needs to be noted that for projects that are built earlier, it is more difficult to collect baseline data. Moreover, LAF's requirement in 2012 and 2013 is at least five benefits for each project. Under the tight timeframe and limited budget, research teams might choose to meet the minimum requirement.

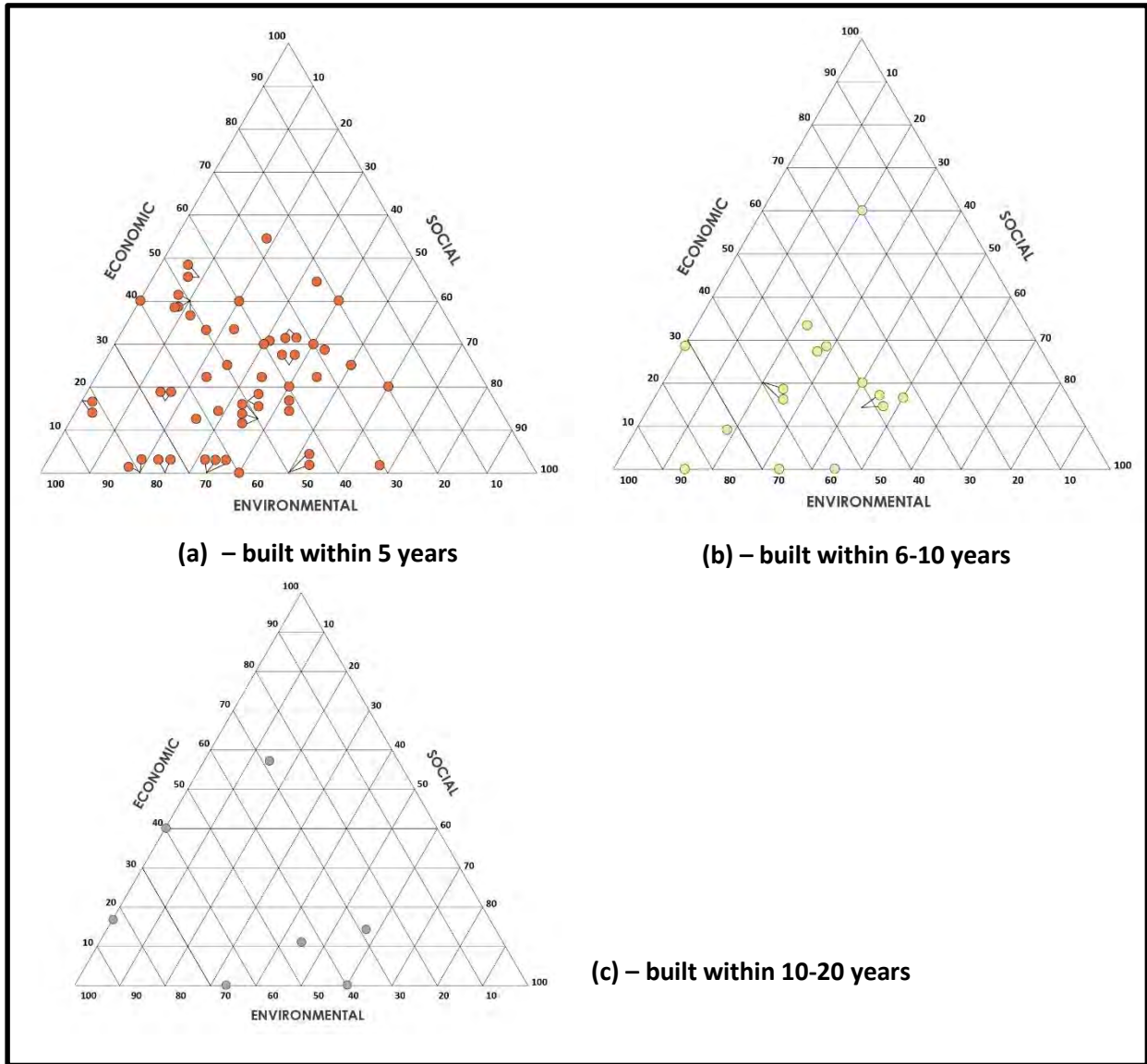


Figure 7. Influence of Projects' Age on Benefit Composition

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“PARK SEVENTEEN” RESIDENTIAL ROOF GARDEN: LANDSCAPE PERFORMANCE AND LESSONS LEARNED

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1 ABSTRACT

The purpose of this study is to present the results of landscape performance investigations and lessons learned from quantifying benefits of the Park Seventeen project, a ¾ acre residential roof garden in uptown Dallas, Texas. Park Seventeen is the residential component (25-story tower) of an urban mixed-use development completed in March 2011. It is complemented by a 19-story office tower that sits to the immediate east of Park Seventeen. The research team was formed to quantify their landscape performance benefits during the summer of 2012 and sponsored by Landscape Architecture Foundation’s Case Study Investigation Program. Because of limited resources (funding and time), the research team identified simple environmental, economic and social metrics that could effectively provide meaningful performance information. Metrics were used to investigate urban heat island mitigation qualities of the roof garden, stormwater detention characteristics, residents’ satisfaction and sense of community, and cost comparison between a conventional rooftop and the project. By measuring the air temperature on ground and roof surfaces, researchers found that the roof garden mitigated urban heat island effect by reducing the average air temperature by 1.3 °F, and the average surface temperature by 15.9 °F. The growth media used on the roof garden could hold the equivalent of 2.5-inch rainfall. For the cost comparison analysis, the cost for constructing a park on the ground within the uptown Dallas of the same size would be much higher than that for the Park Seventeen project. As for the social benefits, 78% of residential and commercial tenants who regularly

used the roof garden felt the sense of the community through socializing with others. The researchers documented the lessons learned related to material selection and wind/heat effects on user’s comfort and safety during the summer. Elements that are deemed sustainable are also compiled as a guide for designing future urban roof garden projects in hot climate areas.

1.1 Keywords

sustainability, stormwater, green roof, urban heat island

2 INTRODUCTION

Landscape Architecture Foundation (LAF) has been promoting landscape performance research since 2010 through a series of calls for Case Study Investigations (CSI). LAF’s intent is to fill a critical gap in the marketplace and make the concept of landscape performance and its contribution to sustainability as well-known as other discipline such as building performance is (LAF, 2014). This effort has been producing case study briefs that document built projects’ benefits and has been published by LAF on its web site. The intent is to provide “an online interactive set of resources to show value and provide tools for designers, agencies and advocates to evaluate performance and make the case for sustainable landscape solutions. (LAF, 2014)” Its theoretical framework is built upon the sustainability triad: environment, economy and society (Li et al., 2013). Through the quantification of environmental, economic and social benefits of a built landscape, its performance can be determined (Figure 1).

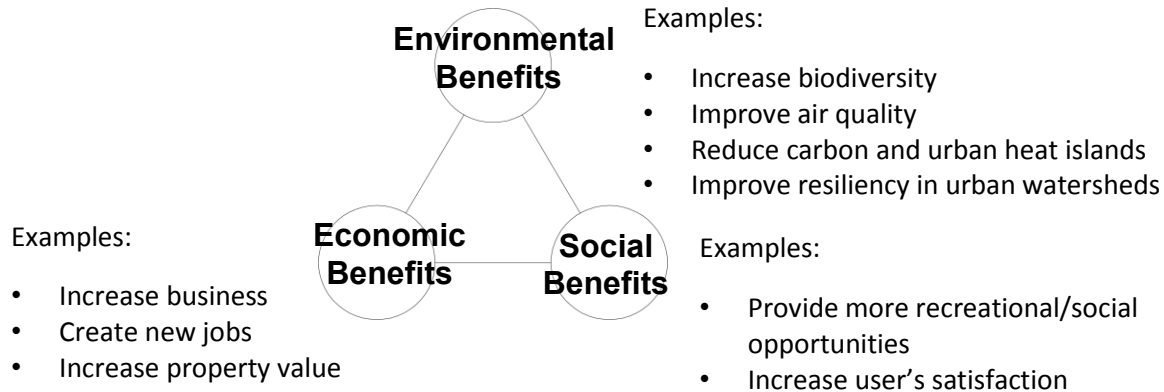


Figure 1. Landscape Performance Benefit Framework

The use of rooftops as usable space has a long history in Western culture from the Hanging Gardens in Babylon to the many elevated gardens and terraces (Osmundson, 1999) built during the Renaissance. At the turn of the Twentieth Century, building construction techniques changed radically with a shift of structural loads from thick walls with short roof spans to concrete and steel post and beam construction which allowed longer spans and cheaper materials. This radically changed building construction so that rooftops could be constructed with ample structural loads without significant costs or the constraints of wall placement (Werthmann, 2007). The modern building techniques spawned a radical change in building programming where many buildings in the late 1800's and early 1900's now had rooftop playgrounds, restaurants, theaters, private gardens, swimming pools and gardens (Jarger, 2008). The United States was a world leader with rooftop garden construction in the early 1900's until the invention of air-conditioning. Prior to the application of mechanical air-conditioning, the rooftop was a novel and cool environment to hang out during the summer. With the advancement of air-conditioning technology, rooftop gardens became less popular and faded from American skylines (Jarger, 2008). Today, with the advancement of lightweight construction materials and a desire by people to reconnect with nature, rooftop gardens are becoming more

popular, especially in dense cities. North America has experienced significant growth of green roofs in many forms including residential and mixed use developments (Green Roofs for Healthy Cities, 2010). The United States is lagging behind parts of Europe and Asia in terms of new rooftop construction, but it is emerging as a leader in research about the performance of green roofs (Blank, et al., 2013). Traditional research often evaluates a single topic of study. Thus a full spectrum of the performance of green roofs is often difficult to assess. This study evaluates environmental, social and economic outcomes of a constructed rooftop garden in Dallas, Texas.

Park Seventeen is the residential component (25-story tower) of an urban mixed-use development in the uptown district of Dallas completed in March 2011. It is complemented by the 1717 McKinney project, a 19-story office tower that sits to the immediate east of Park Seventeen. Both towers sit atop and share a common 7-story parking structure. The top of the structure has been developed as a roof garden for the overall development and occupies approximately $\frac{3}{4}$ acre between the two towers (Figure 2). This seventh floor park provides both visual and physical amenities such as a swimming pool, fireplace, and sitting and gathering spaces for residents and office tenants alike (Figures 3 and 4).



Figure 2. Photograph of the Park Seventeen Roof Garden. (Source: TBG Partners)



Figure 3. Site Plan of the Park Seventeen Roof Garden. (Source: TBG Partners)



Figure 4. View to Uptown Dallas from Park Seventeen. (Source: TBG Partners)

In 2012, LAF selected the research team composed of Texas A&M University and TBG Partners to investigate the landscape performance benefits of Park Seventeen. Specific expertise represented by the researchers includes green roof, stormwater management and urban design. LAF required that the landscape performance benefits must be quantified in three aspects: environmental, economic and social. A minimum of five benefits should be documented. The timeframe of the study began in May 2012 and ended in August 2012.

The purpose of this paper is to present the results of landscape performance benefit testing, as well as lessons learned from the designer's perspective. The lessons learned can help designers, practicing educators and students revisit design strategies when designing similar urban roof gardens surrounded by high rise residence buildings.

3 METHODS

3.1 Environmental Benefits

The research team faced the constraints of time (less than four months) and budget and determined that a snapshot cross-sectional method be used to quantify the environmental performance benefits. Therefore, the research team focused on the urban heat island effect mitigation by the roof

garden and stormwater detention because these were the team's expertise and relevant to the project. For the cross-sectional comparison purpose, air and surface temperatures were measured on the Park Seventeen roof garden and the parking lot below the roof garden. Readings were taken on July 11, 2012 between 2:31 PM and 3:10 PM. The weather prior to and during the temperature readings was partly cloudy with maximum temperatures for the day at 96 degrees at 3:50 in the afternoon, with average wind speeds of 8.4 MPH and relative humidity of 35 percent (NOAA, Climate Report).

Surface temperatures were measured with an Extech IR thermometer. Figure 5 shows the researcher taking the temperature reading of the synthetic turf on the roof deck by using the thermometer. Several readings were averaged to represent the recorded temperatures. The IR thermometer was held approximately three feet above the surfaces. Air temperatures were taken with a Radio Shack® digital Indoor/outdoor thermometer. Air temperatures were taken at approximately chest height. The air temperature thermometer was allowed to rest in place from location to location until the readings stabilized. Although it was a partly cloudy day, temperatures (air and surface) were taken only during sunny conditions.



Figure 5. Extech IR Thermometer Reading Surface Temperatures of Synthetic Turf



Figure 6. Growing Media Plan of Park Seventeen. (Source: TBG Partners)

The research team also estimated the potential quantity of stormwater runoff that could be detained by the growing media installed on the roof garden. Figure 6 shows the growing media plan of Park Seventeen that details the depth and area of different planting zones.

3.2 Economic and Social Benefits

Economic benefits were estimated by comparing the difference between the costs of a

conventional structural garage deck versus the improved garden terrace condition presented herein. The research team used the typical land cost in uptown Dallas area around 2012 for estimation.

Social benefits were measured by three metrics: the resident's sense of place, social events held per year, and educational activities occurred per year. From July 6th to July 10th, 2012, a survey about residents' perception of the roof garden was conducted through SurveyMonkey.

Table 1. Surface and air temperatures of the roof garden and parking lot below on a 96°F day

Location	Materials	Air Temperature (°F)	Range (°F)	Surface Temperature (°F)	Range (°F)
Parking lot (Sun)	Pavement	97.2	97.0 - 97.4	145.8	142.7 - 150.0
Parking lot (Shade)	Pavement	94.8	95.0 - 97.4	96.8	96.5 - 97.0
Roof garden (Sun)	Average of all surfaces	95.9	93.8 - 97.0	129.8	114.0 - 158.0
Roof garden (Shade)	Average of all surfaces	92.2	92.0 - 93.0	90.5	85.4 - 96.4

The survey was composed of 7 multi-choice questions and 2 open questions. The multi-choice questions were about the frequency and typical time that respondents use the garden, the social value generated by the garden, how much the respondents enjoy using the garden and also the respondents gender and age range, while the two open questions were about the microclimate condition on the roof garden, and general comments.

4 RESULTS

4.1 Environmental Benefits

Overall, the parking lot air and surface temperatures were greater than the roof garden (Table 1). The average parking lot air temperature was 97.2 °F and ranged from 97.0 to 97.4 °F. The average surface temperature was 145.8 °F and ranged from 142.7 to 150.0 °F. In the shade, the average parking lot air temperature was 94.8 °F with a range of 95.0 to 97.4 °F and the average surface temperature was 96.8 °F with a range of 96.5 to 97.0 °F. The average roof garden air temperature was 95.9 °F in areas open to the sky and ranged from 93.8 to 97.0 °F. The average surface temperature was 129.8 °F and ranged from 114.0 to 158.0 °F. It is interesting to note that the synthetic turf measured the highest surface temperature of all the surfaces recorded including the dark colored parking lot below. The coolest surface temperatures open to the sky were the white concrete roof tiles. In the shade, the average air temperature was 92.2 °F with a range of 92.0 to 93.0 °F and the average surface temperature was 90.5 °F with a range of 85.4 to 96.4 °F.

For the estimation of detained stormwater runoff, TBG Partners provided the Green Roof Growing Media Analysis on the water holding capacity for the intensive mix and extensive mix. The water holding capacity of the intensive mix and extensive mix is 482 cubic inches of water per cubic foot of soil and 354 cubic inches of water per cubic

foot of soil, respectively. The intensive mix of 3 feet in depth was used at tree areas and the extensive mix of 1.5 feet in depth was used at shrub areas. The calculation procedure is presented below.

Water holding volume by intensive mix:

Area of the intensive soil is 5,118.5 square feet

$$5,118.5 \times 3 = 15,355.5 \text{ ft}^3$$

$$15,355.5 \times 482 = 7,401,351 \text{ in}^3$$

Water holding volume by extensive mix:

Area of the extensive soil is 5,575.2 square feet

$$5,575.2 \times 1.5 = 8,362.8 \text{ ft}^3$$

$$8362.8 \times 354 = 2,960,431.2 \text{ in}^3$$

By dividing the total water holding volume by the total roof area, an equivalent rainfall depth can be estimated. The total area of the roof garden is 32,670 square feet (= 4,704,480 square inches).

Water holding volume: $7,401,351 + 2,960,431.2 = 10,361,782.2 \text{ in}^3$

Water holding volume divided by the total roof deck area: $10,361,782.2 / 4,704,480 = 2.2 \text{ inches}$

The inference is that, for rainfalls of 2.2 inches or less, 100% of stormwater on the roof deck could be captured by the soil mixes, assuming that the drainage system would transport stormwater runoff to all soil areas. According to the Natural Resource Conservation Service, the 2-year, 24-hour rainfall in Dallas County is approximately 4 inches. Should a rainfall of such magnitude occur, 55% ($2.2/4=0.55$) of stormwater could be detained by the soil mixes.

4.2 Economic Benefits

As described, the research team evaluated the difference between the costs of a conventional structural garage deck versus the improved garden terrace condition presented herein. The total area

of the deck is 32,670 square feet, and the cost to provide waterproofing, landscape, irrigation and pedestrian hardscape and amenities within this space was approximately \$1,800,000. This equates to a premium cost per square foot of \$63 for the roof garden. A traditional parking deck, without any waterproofing, landscape, hardscape or amenities would cost approximately \$712,500 to build (assuming \$7,500 per space and a total of 95 spaces would be built). This is the base cost of approximately \$22 per square foot ($\$712,500 / 32,670$ square feet) for a parking deck, as opposed to \$85 per square foot for a roof garden (\$22 base cost plus the roof garden premium cost at \$63).

Further, a property searched online (reference accessed on July 25th, 2012) approximately 0.6 mile away from Park Seventeen would cost \$63.54 per square foot indicating that building a park on the ground level within the uptown Dallas area would cost \$2,075,851.80 in land acquisition ($\$63.54 \times 32,670 = \$2,075,851.80$). Together with the cost of construction, landscape, irrigation, pedestrian hardscape and other amenities, the total cost is higher than the roof garden.

The resultant change represented by the roof garden improvements was identified in the early stages of design, in collaboration between consultants and the general contractor. This early evaluation was done to ensure a cost impact that was within financeable limits and that could legitimately be determined as “recoupable” within a pre-determined period of time, based upon leasing projections for both residential as well as office tenants.

4.3 Social Benefits

Based upon an on-site capture of 350 or so residents within 292 units and an approximate current office population of 325 tenants, about 44 resident socials are programmed per year with an average attendance of 15-18 people. It should be noted that approximately 50% (+/- 160) of the total office tenant population has been included in office tenant events such as receptions, open houses, and tenant parties.

According to TBG Partners, the total approximate number of students touring the project on an annual basis (2011) is 120, including ASLA student chapters, and program tours from Texas A&M, Texas Tech and UT Arlington; the total approximate number of professionals (real estate, design consultants) touring the project on an annual basis (2011) is 180, including USGBC tours (2), Institute of Real Estate Management, and CREW.

4.4 Limitations

With the three month timeframe for this study, two apparent limitations exist. Firstly, the research team only measured the temperatures on a typical summer day. A full-year temperature comparison would be of great interest to many if temperatures of other seasons were also measured. Secondly, the economic metric chosen and measured by the research team only represented a hypothetical cost comparison. Actual long-term property data can reflect the economic benefits of the project better and should be considered if the timeframe allows.

5 DISCUSSION: LESSONS LEARNED

LAF allows the research teams to select the metrics for measuring environmental, economic and social benefits but only gives approximately three months for research under its funded CSI Program. The positives of this arrangement include (1) the freedom of choosing the metrics may develop an original, innovative and effective method in measuring benefits; (2) the research team should choose “doable” metrics that represent the teams’ strength; and (3) the results using cross-sectional comparison become available in a timely fashion. The negatives may include (1) the research team may avoid measuring certain metrics that are more relevant but require significant efforts; and (2) since long-term monitoring was not possible, some ecosystem services, like health benefits, could not be used as metrics of landscape performance. For future CSI studies, the research team recommends these to be addressed for improvement.

The survey revealed how valuable the roof garden is for the residents as a place where a sense of community is maintained. Without the roof garden, residents said they would drive or walk to the nearest park. The residents use the roof garden on a regular basis on weekend (77%). Although there was frequent mention that the garden can be too windy or too hot, it still gets used on a consistent basis and provides a stable location for social events.

One interesting finding was the contribution of synthetic turf to increased temperatures on the roof garden. It was assumed that the roof garden would be cooler, especially in the shade, however, it was not anticipated that the synthetic turf would become a source of increased discomfort on the roof garden. The average mid-afternoon temperature of the synthetic turf in the sun was 151.0 degrees and air temperature was 95.9 degrees. These temperatures were equal to the parking lot temperatures. Since live turf was not

allowed on the roof garden, perhaps the findings provide evidence for future allowance of code variances to allow real turf, especially drought tolerant varieties on roof gardens.

Microclimates on conventional roofs in Texas can reach extreme temperatures, but live plants on green roofs can create cooler microclimates (Dvorak, Bruce and Astrid Volder 2013). Therefore, material choice on rooftops is critical especially when occupied. According to the survey about residents' perception of the roof garden, conducted between July 6th and July 10th, 2012, many users' level of satisfaction with the roof garden was hindered by the high temperatures and wind. Therefore, roof garden designers should consider providing more opportunities for live vegetation, shade and wind breaks to create more pleasant and usable spaces on rooftops.

Stormwater retention was also investigated and found to be similar to other findings in Texas. Field studies in Texas found that stormwater retention from shallow green roofs can play an important role in managing runoff from rooftops. The 4.5 inch deep green roofs at Texas A&M University retained 78% average over the growing season (Volder, Astrid and Bruce Dvorak 2013). One inch storms were captured at near 100% retention; however, for the Park Seventeen roof garden, over two inch storms were estimated to be retained at the 100% level. The deep substrates allow for intense rainfall events to be retained on the roof for plants and evaporative cooling.

Many challenges exist with the development of a park of this magnitude atop a structure. At seven stories above street level, these challenges included wind load and load of landscape elements, including trees, paving and a pool (impacts upon both comfort and function). Load challenges were overcome through careful coordination with the design team to ensure adequate clearances in the parking structure below while accommodating the extensive package of amenities above. The solution included variable depths between beams to allow for placement of the pool and large specimen trees in deep areas and lighter loads in areas of turf and/or paving only.

For wind loading, which is exasperated by the "funnel" effect created by curving building facades, design solutions were proposed that included: canopy trees in areas where they could contribute to dissipation of force; special detailing to anchor vertical elements (including tree anchoring) to the structural slab below; selection of weighting furnishings and amenities; binding agents used within aggregate surfacing.

6 CONCLUSION

This paper presents the results of landscape performance investigations and lessons learned from quantifying benefits of the Park Seventeen project, a $\frac{3}{4}$ acre residential roof garden in uptown Dallas, Texas. The effort was part of the LAF's 2012 CSI Program. Documented benefits in this investigation are summarized below:

- Mitigates urban heat island effect by reducing the average air temperature by 1.26 °F, and the average surface temperature by 15.9 °F (based upon temperature readings taken on 7/11/2012).
- Holds a maximum stormwater volume equivalent to a 2.2 inch rainfall in the engineered soil mix.
- Provided a sense of place for 78% of tenants who regularly used the roof garden.
- Promotes social activities between neighbors; every year approximately 44 resident socials are programmed, and the average attendance is 15-18 people.
- Provided educational opportunities to approximately 120 university students and 180 professionals in real estate and architectural design, and from US Green Building Council in 2011.
- CSI's short timeframe and less stringent requirements for choosing metrics may be adjusted to address the issues raised in the Discussion section.

7 ACKNOWLEDGEMENTS

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LANDSCAPE PLANNING AND ECOLOGY

Edited by Charlene LeBleu

AN APPROACH TO IMPROVE COASTAL COMMUNITY RESILIENCE THROUGH PLANNING AND DESIGN OF A RECREATIONAL TRAIL: A MASTER PLAN FOR THE MISSISSIPPI COASTAL HERITAGE TRAIL

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1 ABSTRACT

As coastal populations are growing and the number of coastal disasters is escalating, communities are starting to look for ways to increase coastal community resilience following catastrophic events. This is especially true in places where hard infrastructural barriers have failed in the midst of disaster, e.g. New Orleans' flood wall during Katrina. While greenways are known to connect communities, ecosystems, and destinations, and boost the local economy, their influence on coastal community resilience has not been discussed in the literature. Greenways, being long linear connective tissue, could act as a landscape infrastructure and help promote symbiotic relationships between ecological and social systems and become catalysts for building stronger community.

Using the Mississippi Coastal Heritage Trail (MCHT) master plan as a model, the study attempts to bridge the gap, presently observed in the literature, between the theory of coastal community resilience and coastal recreational trail planning. It focuses on developing a methodology for greenway planning with the main goal to stimulate coastal community resilience. To achieve this goal, the study first employs review of community resilience focused planning literature to aid in formulation of the goals and objectives for the master plan. Secondly, the identified objectives guide all the phases of MCHT planning and design process, from suitability analysis to design proposals. The methodology, explored in the study, can provide an efficient way for landscape architects and planners to account for larger regional interests in the stimulation of coastal resilience during the design phase of a multi-jurisdictional trail.

1.1 Keywords

resilience, community, coastal, trails, green infrastructure.

2 INTRODUCTION & BACKGROUND

The edge of water and land seems to attract people both emotionally and economically. At the moment 52% of the total population of the United States lives in coastal counties, while coastal counties only account for 14% of land in the country (NOAA, 2012). Furthermore, over 43% of people in the U.S. take part in marine recreation (NOAA, 2010). However, coastal areas face a diverse range of threats from natural disasters and failing constructed systems. Beatley (2009, p.14) identifies the three main categories of coastal natural hazards as meteorological (nor'easters, hurricanes, etc.), geological (landslides, tsunamis, etc.), and hydrological (flood events, El Nino, etc.). Recent failures in infrastructural and industrial systems such as the levee failure during Hurricane Katrina in 2005 and the Deepwater Horizon oil spill of 2010 have resulted in tremendous social, economic and ecological harm (FEMA, 2008; NOAA, 2013).

New approaches in reaction to these catastrophic events have shifted from hard infrastructural barriers to responses that promote resilience. For the purpose of this research, resilience is understood as the capacity of a community to adapt and improve following catastrophic events (Beatley, 2009, p.3-5).

Holling (1973, p.17) introduces the term of resilience in 1973 in relation to natural systems, such as the budworm forest community. "Resilience determines the persistence of relationships within a system and is a measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters, and still persist." Importantly, Holling concludes that resilient system can "capitalize on change opportunities" (p.18).

Currently, community resilience is viewed as an important part of resilient city. Godschalk (2003, p.137-138) states that communities are the social and institutional components of the city. "...

[T]he communities act as the brain of the city, directing its activities, responding to its needs, and learning from its experience. During a disaster, the communities must be able to survive and function under extreme and unique conditions ... A city without resilient communities will be extremely vulnerable to disasters.” Moreover, Godschalk proposes that mitigation programs in addition to physical systems, like infrastructure, to focus on teaching the city's social communities and institutions to reduce hazard risks and respond effectively to disasters, since they will be the ones most responsible for building ultimate urban resilience.

Similarly, Berke and Campanella (2006, p.206) consider efforts “to repair a community's torn social fabric - a process that fundamentally entails reconnecting severed familial, social, and religious networks of survivors at a grass roots level” an essential component of post disaster recovery. The authors underscore “that cities, towns, and villages are more than the sum of their buildings and infrastructure. They are a tapestry of human lives and social networks that are essential to the heart and soul of the place.”

Walker and Salt (2006, p.145-148) describe a “resilient world” through values of diversity (biological, landscape, social, and economic), ecological variability, modularity (in order to reduce transmitting shocks), slow variables associated with thresholds, tight feedbacks (strength and rapidity of effects of change), social capital, innovation, overlap in governance, and ecosystem services. They understand social capital “as well-developed social networks and leadership. Resilience ... is very strongly connected to capacity of people in that system to respond, together and effectively, to change any disturbance” (p.147).

Recreational trails have the potential to connect communities, ecosystems, and destinations (Hellmund and Smith, 2006), assisting in strengthening the coastal environment. The positive effects of trails have been the subject of several studies. These studies have shown that recreational trails make large contributions to strengthening economic (NPS, 1995), social and environmental conditions (Flink, 2001, p.5-8; Forman, 1995, p.147-153; Schasberger et al., 2009, p.343).

This research argues that the design of a recreational trail has the potential to foster coastal community resilience, adapting seven of the nine physical characteristics of a resilient coast identified by Beatley (2009, p.73-93) as objectives of a trail master plan. These characteristics are: pedestrian and bicycling connectivity between and inside

community centers; protection, preservation and the restoration of ecological systems; direct access to nature and natural systems; public awareness of natural and man-made disasters; green Infrastructure over conventional infrastructure; social and community interaction spaces, public gathering spaces and links between them; growth patterns based on historic patterns of towns and villages.

2.1 Study Area

The study area is located in three coastal counties of Mississippi. The Coastal Mississippi region is characterized by a flat topography, a warm to hot, humid maritime climate, and its proximity to the ocean. This last peculiarity endows the area with rich surface water resources, diverse estuarine and tidal systems, and extensive wetlands. Due to these unique landscape features, the area has various ecological systems, many of which are home to a variety of endemic species (The Nature Conservancy, 2001). In the past decade, this area has been subjected to two major disasters, Hurricane Katrina and the Deepwater Horizon Oil Spill. Both of these disasters have significantly undermined the economic, social, and ecological resources of the coast. (FEMA, 2008; NOAA, 2011). Currently the region is trying to formulate new ways to respond to disasters, to strengthen the regional economy, to improve the quality of life for residents, and to create a more sustainable regional future (Mississippi Gulf Coast Sustainable Communities Initiative, n.d.).

Jim Foster, the president of the Gulf Coast Heritage Trails Partnership, and Liz Smith-Incer, Rivers, Trails and Conservation Coordinator in Mississippi with the National Parks Service, identified the Mississippi Coastal Heritage Trail (MCHT) as the number one priority in trail development on the Mississippi Gulf Coast (Personal interviews, 2012). The Gulf Coast Heritage Trails Partnership (GCHTP) (2010) envisions the trail as a 101 mile long connection from the Alabama boundary to the Louisiana Boundary following the coast line. (GCHTP is a non-profit group that strives for a safe, coast-wide network of diverse trails that connect neighborhoods to businesses, schools, green spaces, and blue spaces where everyone can enjoy scenic, historic, educational and natural areas. The group helps to organize the community efforts, and makes the needs of the community known.) The trail is designated as a national trail by U.S. Department of Interior. A portion of the trail is currently approved as a part of the Sand Beach Master plan. Other parts are planned to be shared-

use paths and or “share the road” segments. A shared-use path is a paved, off-street travel way designed to serve nonmotorized travelers (U.S. Department of Transportation Highway Administration, 2006). “Share the road” segments are planned to consist of a shoulder addition to existing roads.

2.2 The Purpose of the Study

The purpose of this study is to test the hypothesis that the design of a recreational trail, given comprehensive analysis and physical assessment, can provide a way to improve coastal community resilience. The study debates that the master plan of a trail can improve cultural, ecological, and economic aspects of coastal community resilience. The design attempts to ensure connectivity between and inside community centers. It also aspires to include social and community interaction spaces, public gathering spaces, and sustainable stormwater management strategies. Furthermore, the master plan tries to integrate interpretive design/art components in order to stimulate public awareness of natural and man-made disasters, provide direct access to nature and natural systems, highlight historic patterns of towns and villages, and incorporate the restoration of connectivity between natural systems.

2.3 Limitations

The major limitation of the study results from distant research and restricted opportunities to conduct on the ground site analysis and stakeholder engagement. Another limitation relates to the narrow timeframe of six months to complete this study as the Master’s thesis research.

2.4 Delimitations

Due to limited time and resources the study did not attempt to accomplish an initial community engagement and survey of opinions to evaluate output of the GIS analysis and Master Plan by collecting feedback from stakeholders. This study did not focus on the introduction of hard storm barriers, nor did it explore the physical resilience of the trail itself and the durability of materials in a catastrophic event.

3 Methodology

In an effort to improve resilience of the Mississippi Gulf Coast, this study employs a qualitative approach. The methodology consists of literature review and application of the resilience theory to a greenway master plan. The review of

resilience related planning literature helped to identify characteristics of resilient community, which are applicable in greenways planning. The characteristics of resilient communities can help formulate the goals of the planning process. Additionally, some of the impacts of built trails correlate with resilience principles. At the same time the literature review revealed no current overlap between greenways planning and resilience theory literature.

The study applies the theory of the community resilience to the MCHT master plan. The master plan uses characteristics of a resilient coast identified by Beatley (2009, p.73-93) in all phases of plan development, from analysis to design proposals, and utilizes them as objectives, see Table 1. The planning process started with spatial data gathering and analysis using GIS software and physical site assessment. Jennifer Evans Cowley, thesis committee member, provided a completed coastal Mississippi regional GIS database. The database was assembled during 3 years of work on regional plans, sponsored by HUD and included data regarding environmental and socio-economic conditions. Karen Clark, Mississippi Planning and Development District GIS coordinator, provided the data regarding existing and proposed recreational trails, both pedestrian and water trails, as well as access points to water recreation. All spatial data is imported into a vector-based GIS system with projected MCHT location for display and analysis. Analysis of data helped to assess whether the alignment of the trail, proposed by Mississippi Gulf Heritage Trails, has a potential to incorporate identified objectives, i.e., whether the proposed trail alignment is able to connect communities and provide access to socially and ecologically significant for those communities sites. On-the-ground site analysis, possible due to a generous Ohio State University Alumni Grant for Graduate Research and Scholarship, allowed to understand the types of conditions that the trail goes through and explore significant for community locations in order to identify potential sites for design interventions.

The planning process concluded with a design master plan based on previous research. The design proposes possible ways to implement the trail with considerations to context with a goal to increase coastal community resilience. The design phase included a series of physical hypotheses that were consequently tested and explored through three-dimensional modeling, design drawings, and orthographic projections. Parallel to the design phase the study undertook simplification of data representation and transferred key data aspects

from GIS using Adobe Creative Suite, simplifying the configuration of the trail to maximize understanding of accomplishments relative to the resilience concept.

Finally, the design was evaluated by experts from the Ohio State University: Jacob Boswell, thesis committee chair, Assistant Professor and Undergraduate Chair in Landscape Architecture Section, and Jennifer Evans-Cowley, committee member, Associate Dean of Academic Affairs and the Administration at Ohio State University, College of Engineering, who has ten years of planning experience in the Mississippi Gulf Coast. The experts were asked to evaluate the master plan and preceding analysis with regard to improvement of coastal resilience. The study was also presented to local officials and advocates of trail development: Jim Foster, the president of the GCHTP; Liz Smith-Incer, Rivers, Trails and Conservation Coordinator in Mississippi with the National Parks Service; Geneva Dummer, administrator with the GCHTP; David Taylor, Planning Director, Gulf Regional Planning Commission; and Jeff Loftus with the Gulf Regional Planning Commission. The master plan is shared with these regional representatives for use in community engagement, acquiring funds, and following implementation.

4 MISSISSIPPI COASTAL HERITAGE TRAIL MASTER PLAN

4.1 Goals and Objectives

The master plan for the MCHT attempts to stimulate coastal community resilience by achieving three goals: ensuring connectivity; providing continuity and identity for the trail; and utilizing the trail as a landscape infrastructure. These three goals incorporate objectives derived from Beatley's principles of coastal community resilience: pedestrian and cycling connectivity between and inside community centers; protection, preservation and restoration of ecological systems; direct access to nature and natural systems; public awareness of natural and man-made disasters; green infrastructure over conventional infrastructure; social and community interaction spaces, public gathering spaces and links between them; growth patterns based on historic patterns of towns and villages.

4.2 Chapter 6: Stages of the Project

The master plan resulting from this study divides the project into three main stages: planning and layout; measures for the initial phase of implementation; and actions for the final phase of implementation. These stages correspond to the goals of the master plan. The planning and layout stage intends to ensure connectivity, measures for initial phase of implementation focus on establishing continuity and identity of the trail, while actions for the final phase of implementation build upon the linear and continuous nature of the trail and utilize it as a landscape infrastructure.

4.2.1 Ensuring Connectivity: Planning and Layout

The first phase of this project focuses on mapping and trail alignment, more specifically on ensuring that the trail achieves the connectivity goal of the master plan. This phase attains the following objectives: pedestrian and cycling connectivity between and inside community centers; direct access to natural resources; links between community interaction spaces and public gathering places; and emphasis on historic patterns of towns and villages.

Initially the study undertakes analysis of the existing trail alignment, proposed by GCHTP. Existing trail layout is tested via GIS analysis on whether or not it connects the coastal cities, provides access to a variety of ecological conditions, and links important community, ecological, and historical sites. For clarity, the results of GIS analysis are summarized in diagrams generated with Adobe Creative Suite.

This analysis confirmed that the trail as proposed succeeds in connecting all coastal cities and towns, and diverse coastal ecosystems. These ecosystems form distinct character zones along the trail, see Figures 1-2. (For more information on ecosystems of the coastal counties that the trail enables access to see The Nature Conservancy (2001). Additionally, the trail as proposed connects an array of sites important to nearby communities as social, ecological and educational assets. These sites already have lots of value for communities and are already significant destinations that the trail will link together when implemented. These existing destinations are represented with white circles on the map in Figure 2. Moreover, the trail is successful in highlighting and linking important historical and cultural sites.

Table 1. The relationships between interventions and community resilience principles

Key elements of coastal community resilience (Beatley, 2009, pp.73-93)	Ensuring Connectivity: Planning and Layout	Providing Continuity and Identity: Initial Phase for Implementation	Landscape Infrastructure: Final Phase of Implementation
Pedestrian and bicycling connectivity between and inside community centers	Connections to city centers along the coast		
	Connections to important community areas/organizations		
	Connections to socially vulnerable communities		
Social and community interaction spaces, public gathering spaces and links between them	Physical links between existing community interaction spaces, public gathering spaces	Site design that accommodates, stimulates public gathering and interaction	
Green infrastructure over conventional infrastructure, e.g. sustainable stormwater management strategies			Restore wetlands along sand beach at large storm outlets/Courthouse Rd.
			Establish shore buffer through dunes cultivation along the beach segments of the trail
			Incorporating sustainable stormwater management strategies into the built trail where possible
Growth patterns based on historic patterns of towns and villages	Trail connections to historic sites/town centers		Restore wetlands along sand beach at large storm outlets
Public awareness of natural and man-made disasters			Interpretive design/art components, e.g. show historic flood elevation
Direct access to nature and natural systems	Connections to existing water recreation access points	Road marking highlighting specificity of the trail segment character	
	Connections to various types of ecological systems, wetlands types and habitats	Amenities for bike parking/storage at points of intersections with blueways, pedestrian trails	
	Take trail off road where the land is community owned and there are natural settings/interest points	Interpretation sites in various ecological conditions	
	Connections to important birding sites, identified by Audubon Society		
Protect, preserve and restore ecological systems			Site design with minimal disturbance of sensitive ecological systems
			Restore wetlands along sand beach at large storm outlets/Courthouse Rd.
			Planting strategy along sand beach to protect dunes
			Restore connectivity between natural systems at trail and road crossing

For example, just in the Gautier Loop segment the trail traverses through 13 historic sites dating from 400 AD to early 1900 BC. Overall, the analysis of the trail concludes that the proposed alignment of the trail is successful in ensuring connectivity for coastal community resilience.

This study proposes additional extensions from the main spine of the trail to connect to other important points for community social functions and access to natural resources. On the map in Figure 2 the proposed additions to the trail are highlighted in blue. The proposed destinations that refer to social gathering points and educational opportunities are identified by yellow circles. The points significant for direct access to nature are identified by red.

4.2.2 Providing Continuity and Identity: Initial Phase for Implementation

The next large step that this master plan calls for is ensuring continuity and identity on the ground. Currently, the trail is a concept, a map on paper. But how is it experienced on the ground? The trail is proposed to go through the existing road infrastructure in different conditions, identified during site analysis: rural areas, narrow and wide urban streets, urban beaches, and bridge overlooks. A multiuse trail is already in place in beach segments and bridge overlook segments. The GCHTP proposes that the remaining segments of the trail, where the trail is nonexistent now, share the existing roads with vehicular traffic, as an economic solution. Presently those three conditions pose safety issues, where the user of the trail has to compete with vehicles on the road.

The plan suggests using road marking, as a cost-effective short-term measure to delineate sub functions of the road: bike lanes and drive lanes. See an example of a current condition and suggested road marking of a rural road segment in figure 3. In addition to making shared use roads safer, the road marking system will highlight the trails' identity and ensure that the user knows he is on the Mississippi Heritage Trail. Moreover, the markings could carry educational messages that correspond to the trail character zones and call attention to its important components (see top left corner on Figure 2).

Another way to enhance the trail's identity on the ground is using existing infrastructure to signal the trails' course. For instance, electric poles located all along the trail could be incorporated into manifesting the presence of the trail. Bases of the poles can be colored into bright colors to

accentuate the trail experience. Moreover, this measure could serve as a means of increasing awareness of coastal disasters. Beatley (2009, p.83-84) considers building awareness of coastal disasters an important characteristic of resilient coastal community. The level of the previous high water marks during floods could be represented by colored designs on the electric poles, as seen in a section of Figure 3. The painting process could become a community art activity.

Moreover, in order to allow stops and destinations along the trail to be accessible for cyclists (the destinations are identified by white, yellow, and red circles with black outline on Figure 2), there needs to be bicycle parking at all the trail destination points.

Additionally, spaces for pauses should be located not less than 2.8 miles apart. Dill et al. (2012) found 2.8 miles to be the median single bike trip distance. This means that average people are unlikely to bike more than 2.8 miles without a stop. Hatch marks on the map in Figure 2 show the approximate spacing of the resting points. At those rest locations there is no necessity for bike parking facilities, but there needs to be basic seating and signage for educational purposes, as seen in Figure 4.

The simple and cost-effective measures of using road marking, registering the height of previous flood levels on existing infrastructure, including bike parking in destinations, and adding rest areas could become the first phase of implementing the trail on the ground and insure the continuity and identity of the trail.

4.2.3 Landscape Infrastructure: Final Phase of Implementation

Once the trail gains support and popularity the next phase in strengthening coastal community resilience is to elaborate and utilize the long linear nature of the trail as green infrastructure. At the same time this final step in trail implementation will also enhance user experience.

One of the proposed measures of this stage is moving the trail off-road to improve the experience of the rider and to allow for the incorporation of stormwater runoff treatment from the road surface, see Figure 4.

Another way the trail could perform functions of green infrastructure is by reestablishing a connection between natural systems, where the connection has been lost. An intersection of the trail and highway I-90 is a good example of this measure, see Figures 5-6.

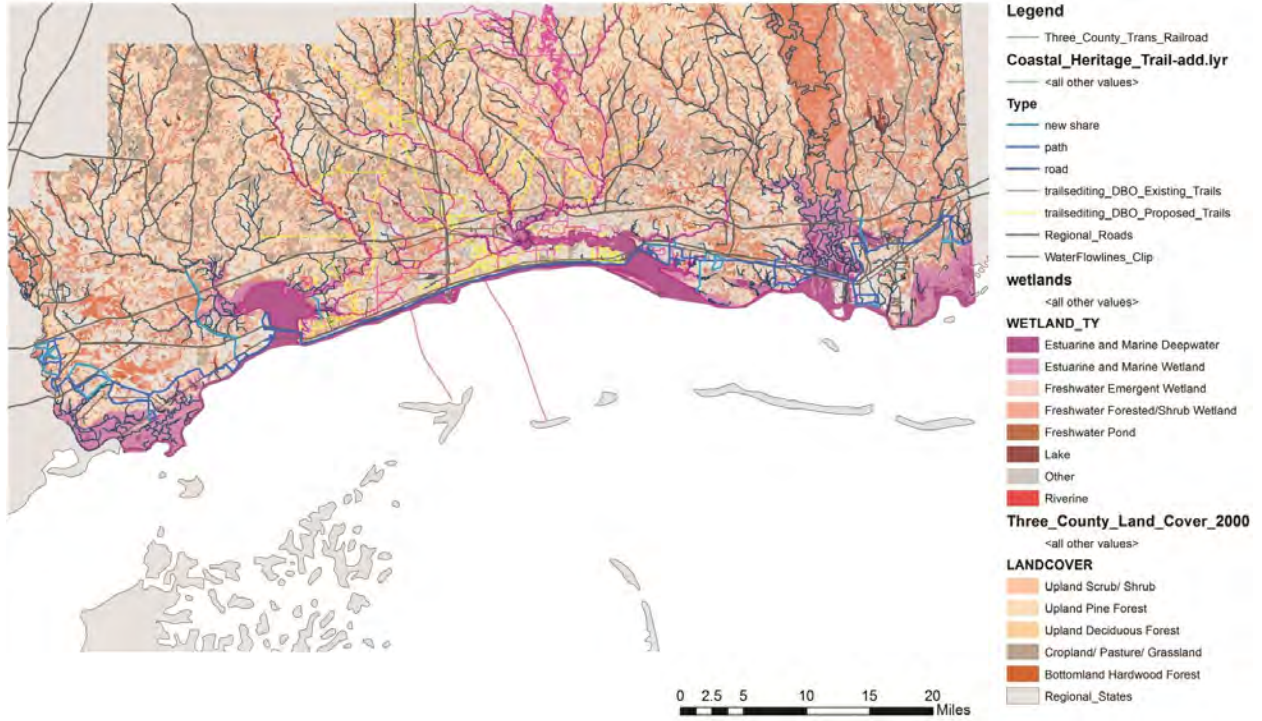


Figure 1. Habitat Types along the Trail. GIS Map by the Author

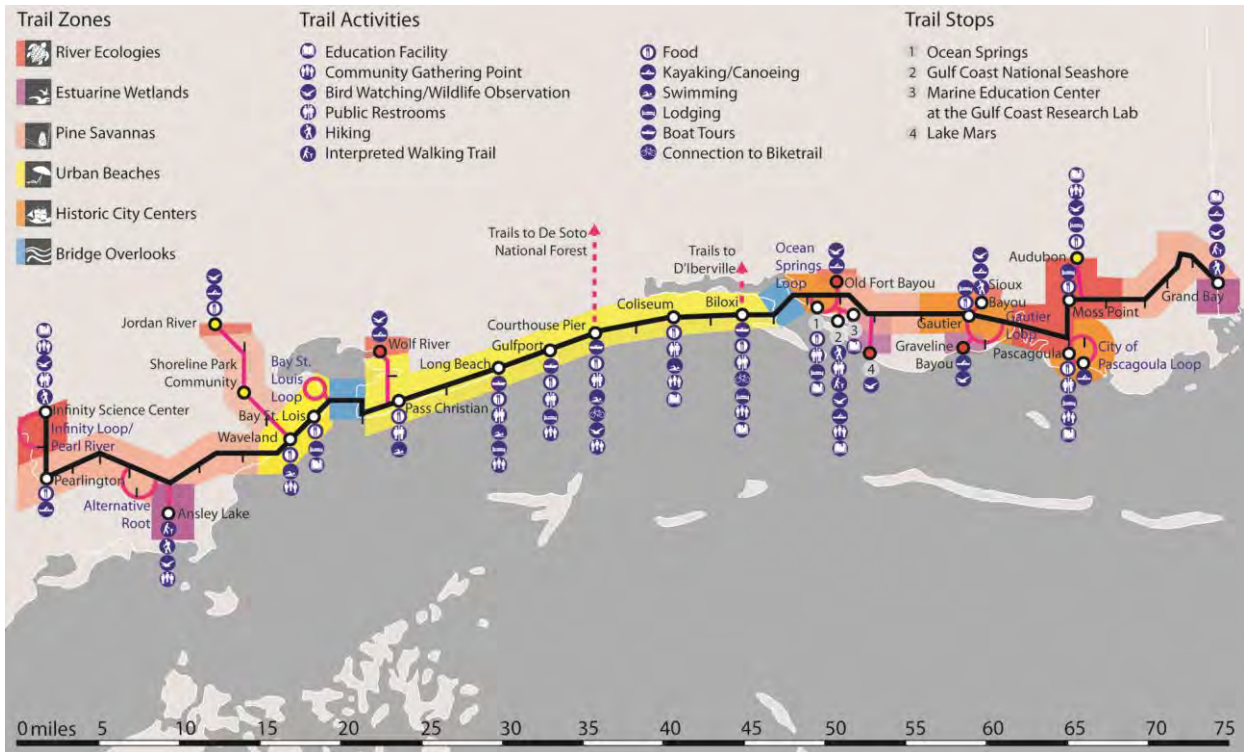


Figure 2. Mississippi Heritage Trail. Map by the Author

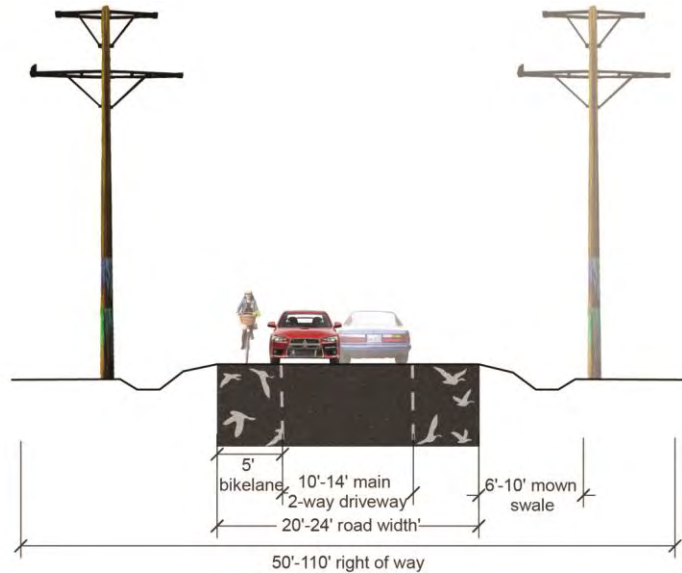


Figure 3. Ansley Road, Bay St. Louis. Rural Road Making Strategy. Section and Photo by the Author

The trail could act as a traffic calming device, a speed bump, and at the same time provide a connection between disrupted wetlands of the Escatawpa River drainage area. The underpass for amphibians and reptiles could stimulate the health of the ecosystem and decrease road kill (Speckhardt, 2012).

Additionally, within the extensive urban beach segments the trail construction could incorporate vegetated shore buffer strategies. Integration of sand dunes and a restored marshy shoreline could help treat stormwater and provide wind barriers (Beatley, 2009, p.84-85). Natural systems of marshes and dunes help absorb floods, provide coastal protection from waves, storm surge, and coastal erosion (Barbier et al., 2011, p.179, 183). This intervention can be viewed as restoration of a natural condition of marshy shoreline prior to development. Originally the shoreline had a soft marshy edge. In 1928, the US Corps of Engineers first built a floodwall and later, in 1950-1951 added a sand buffer (Sullivan, 2009, p.51, 82), creating the present sand beach. In the selected location at the Courthouse road pier, see Figure 7, softening and strengthening the edge of the water could take place. The diagrams show how vertical sand walls and gabion walls are positioned to capture the prevailing summer and winter winds sand deposition, as well as, how they can aid in accumulation of sand for sand dunes. Sediment collected from culverted tributaries and drains can form a new wetland edge.

5 CONCLUSIONS

This study illustrates that the MCHT has a high potential to strengthen coastal community resilience. The trail incorporates Beatley's principles of coastal community resilience (2009, p.73-93) by establishing three main goals of the project (guaranteeing connectivity through trail alignment, ensuring continuity and trails' identity, and, finally, taking advantage of the trail as green landscape infrastructure). More specifically, the trail will help to provide: pedestrian and bicycling connectivity between and inside community centers; protection, preservation and restoration of ecological systems; direct access to nature and natural systems; public awareness of natural and man-made disasters; green Infrastructure over conventional infrastructure; social and community interaction spaces, public gathering spaces and links between them; growth patterns based on historic patterns of towns and villages. The relationships between interventions and community resilience principles are shown in Table 1.

Socially, the master plan, first of all, attempts to strengthen the social capital, and formulate "social and cultural matter" of the Coast, the matter "defining the essence and identity" (Campanella, 2006, p.142) of the region as one community. This master plan focuses on building a sense of place – Mississippi Coast – with its vast ecological, historical, and cultural resources. The trail attempts to bring together and define residents of multiple cities and towns as one coastal community with common wealth and common threats.

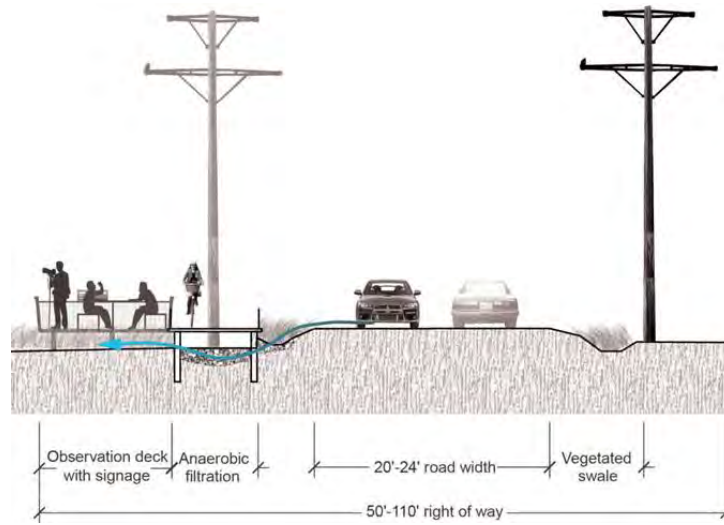


Figure 4. Trail as Green Infrastructure: Stormwater Filtration. Section by the Author

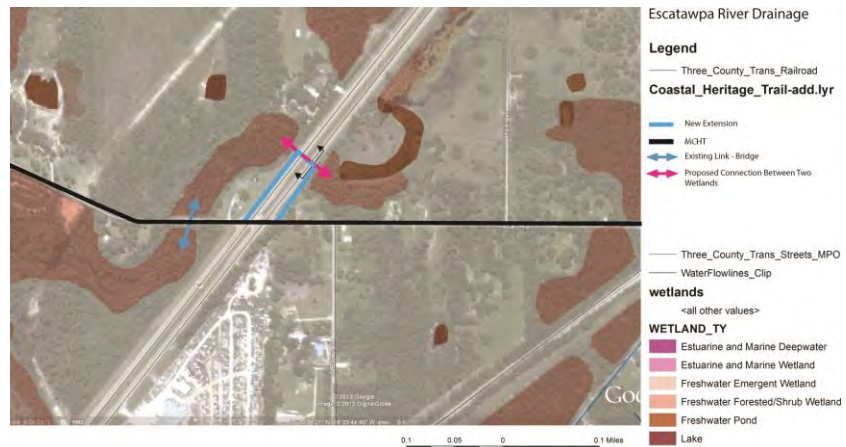


Figure 5. Trail as Green Infrastructure: Intersection of Trail and I-90. Aerial Copyright by Google 2013, Overlaid with GIS Wetlands Map by the Author

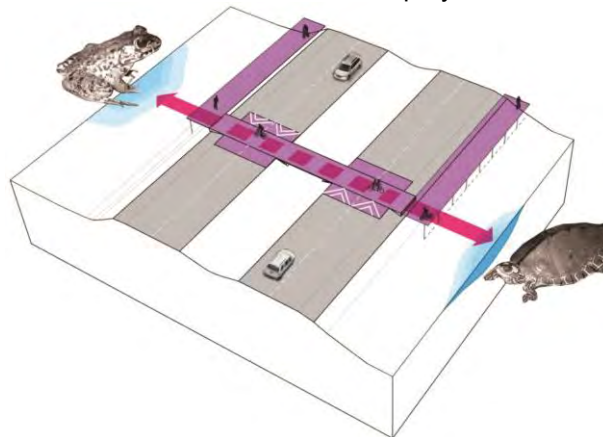


Figure 6. Trail as Green Infrastructure: Intersection of Trail and I-90. Speed Bump Combined with Reptiles and Amphibians Underpath. Photos: River Frog from Public Domain fl.biology.usgs.gov; Pascagoula Map Turtle from commons.wikimedia.org, Diagram by the Author



Figure 7. Trail as Green Infrastructure: Courthouse Road Pier Intervention. Areal copyright 2013 by Google Modified in Adobe Creative Suite by the Author

Additionally, provisions for connections between multiple urban centers and important community destinations facilitate the use of the trail as a mode of transportation, which encourages a healthy lifestyle (Schasberger et al., 2009, p.343). Moreover, the trail incorporates measures to increase disaster awareness, e.g. light posts with flood elevation marks. Consequently, physically and emotionally healthy residents will be able to cope much better with any adverse events, be it a hurricane or a rapid decline in fossil fuels supply.

Economic impacts of the trails have been studied and quantified (NPS, 1995). Just like numerous case studies in this report, the MCHT has potential to increase real property values, support recreation-oriented businesses and employment, attract visitors and increase cultural and ecological tourism. Walkability and biking opportunities increased by the trail can help the community better adapt to declining oil supplies. State-long MCHT can expand the narrow tourism base, mostly focused on casino gambling at the moment (Mississippi Development Authority/Tourism Division, 2011) and create diversity in a tourist economy. The trail will provide expanded opportunities for nature and culture based tourism, which in turn can diversify and widen sources of income for the residents, making economy more resilient. Additional and existing destinations with water recreation access have potential to spur new interactions between locally owned small recreational businesses, prompting new partnerships between water equipment renters and bike renters.

Ecologically, the trail seeks to raise protection of natural resources through providing access and framing the natural beauty, increasing awareness of breadths and functions of ecological systems. Beyond higher appreciation of the natural environment, the trail can act as landscape

infrastructure. The master plan illustrates integration of stormwater treatment into trail profile. MCHT includes provisions to restore connections between ecosystems, previously disrupted. This measure will result in stronger more functional ecosystems, like in an example of an underpath for amphibians and reptiles across I-90. Restored coastal marshes and constructed dunes along the beach segments will help clean stormwater water, protect the shoreline from waves, storm surges, and erosion, and moreover act as a natural sponge for floods.

Therefore the trail does not attempt to physically stop a hurricane or an oil spill. The trail will help build Community; Community that is healthier and less dependent on vehicular transport, Community that is proud of its heritage and wealth of its natural resources. This Community will have more internal capacity to withstand adverse effects of catastrophic events or economic changes.

5.1 Limitations of the MCHT Master Plan and Trail Design for Community Resilience

Trail design for stimulating coastal community resilience has several major limitations, as can be illustrated on the MCHT. First of all, during the design phase the impacts of the trail can only be estimated. Furthermore, even upon installation of all the proposed measures of the MCHT master plan registering its impact on resilience could be very difficult. Secondly, the study is largely based on a single approach to community resilience building formulated by Beatley (2009). Additionally, two out of nine characteristics of a resilient coast, from Beatley's definition, are not incorporated into the MCHT master plan. The first one has to do with placement of critical facilities, e.g. hospitals, and infrastructure

outside of high-risk locations. This measure is simply outside of the scope of trail planning. Second characteristic that is not integrated into MCHT master plan calls for development outside of high-risk zones. This measure is also outside of the trail planning capacity. Moreover, since the trail follows the coastline, at times it is situated in a flood zone, which can possibly stimulate development near it, since the trail is an amenity. This raises a question of whether trail planning is sufficient as a single measure to stimulate resilience. While the potential of the positive impact of trails on resilience is high, trail planning should be a part of a comprehensive strategy for resilience building, not its only measure.

5.2 Significance to the Field and Expected Outcomes

This research has theoretical, methodological, and empirical contributions to the field and the region. In theoretical discourse Hellmund and Smith (2006, p.xii) describe the design of trails as a key stage in bridging the gap between theory and practice. The trail design in their opinion aids in protecting landscapes, allowing wildlife connectivity, and finding ways to bring people into nature. Currently, there is no overlap in the literature between the theory of coastal community resilience and coastal recreational trail planning. This study argues that trail design has the potential to incorporate the essential function of stimulating coastal community resilience. The methodology, explored in the study, can provide an efficient way for landscape architects and planners to consider the larger regional interests around stimulating coastal resilience during the design phase of a trail, without complicating the process, and thus could serve as an example for trail designers in a coastal context. Therefore, this study merges two theoretical topics important in landscape architecture – coastal resilience and recreational trail functions. This study also suggests a methodology for a practical application in coastal regions.

Additionally, the master plan is helpful for the region in acquiring funding and support of local officials, as well as community feedback. To make this research available to the region, the author provided a copy of the master plan and analysis to the local trails development instigators: Liz Smith-Incer, Rivers, Trails and Conservation Coordinator with the National Park Service, and Jim Foster, president of the Gulf Coast Heritage Trails. Moreover, the author expects that this research will be instrumental for coastal residents and local

officials in creating trails in other communities that perform on multiple levels.

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RECLAMATION OF POST-MINED LANDSCAPES

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1 ABSTRACT

The Anthracite Coal Region is only a small part of the large scale energy extraction landscape in Pennsylvania. While hydraulic fracturing operations are the most recent extraction process, in the past, it was anthracite coal mining that caused environmental, ecological, and economic concerns. After many years of prosperous extraction of our earth's "black diamonds", the coal mining process has resulted in scarring the area's cultural and natural ecosystems. Degraded, barren and devastated landscapes became the norm in the region. The anthracite coal region is now stamped with abandoned coal mines, new landforms of mining waste and a contaminated landscape of sulfur and iron polluted watersheds. This acid mine drainage is visible in most of the region's streams, but there are resolutions to these hydrological and environmental problems. The purpose of this paper is to define the planning processes that must be enacted in order to successfully reclaim the mining sites, their individual ecologies, and communities in the coal region. This method of research begins with precedent studies of a successfully remediated bituminous coal mine in eastern Pennsylvania, and the planning methods of International Bauausstellung (IBA) Fürst-Pückler-Land for mining sites in Germany. This paper will review the successful remediation work of landscape architects, scientists, and engineers specifically due to community involvement. Innovative designs and planning measures are seen to help rebuild post-mined landscapes into healthy, productive, and reusable land that will economically strengthen and re-energize the community.

1.1 Keywords

anthracite mining, reclamation, biotopes, remediation, community

2 OBJECTIVES

This paper will review the precedent built reclamation project, the AMD&ART Project. This project proves success with a defined planning process including the involvement of the community, landscape architects, scientists, and engineers. Further study of the planning efforts of the German organization, International Bauausstellung (IBA) Fürst-Pückler-Land, provides vivid and innovative design efforts that have rebuilt post-mined landscapes into healthy, productive and reusable land that has economically strengthened and re-energized communities.

3 INTRODUCTION

The Anthracite Coal Region in Northeastern Pennsylvania was first defined in the late eighteenth century. As mining of this economic resource began, mining corporations were formed and employed a great number of miners. Communities and small towns were established around the mining source and the communities grew as the mines developed. Mining communities were built in what was termed "patches" or villages where typically, everyone's home was owned by the coal companies. The coal mine was the hub of activity (Poliniak, 1993). Over time and after extensive mining, the anthracite coal would become depleted and the mining production would come to an end. The mine would shut down and the scarred landscape would become abandoned. Coal miners and their families would often have to relocate or find a new economic resource or industry that would sustain the strength of community.

When mining of this economic resource began, the Appalachian landscape was altered. The geologic processes of the region have formed the layers of rock and coal veins into deep threads that run hundreds of feet into the earth. Access to the anthracite coal started with deep coal mining extraction. Miners would dig based on their mapping a series of tunnels underground that cut the landscape both vertically and horizontally. The mined landscape had been mapped in plan-view but, most importantly, sectionally, so men could tunnel through the landscape and extract the anthracite coal, or earth's diamond (Figure 1).



Figure 1. Deep Coal Mining, Ashland, Pennsylvania (2012); Strip Mining at Blaschak Coal Corporation, Mahanoy City, Pennsylvania (2012). Photos by Author

Traversing through the series of underground mazes was the most prevalent way that coal miners could extract the coal. When it came to mining safety, strip coal or surface mining was the safer and more economical procedure. Mountainsides were ripped with explosives, revealing the shallow layers of coal veins amongst the rock. The strip mining procedures and techniques quickly removed and carved out large landforms and mountains, leaving barren open pits which posed hazards to individuals walking in the mountains (Figure 1). This method was safer for the mine workers; however, the strip mining left a larger visual scar on the earth's surface than the deep coal mining. In both deep coal mining and strip coal mining, a waste product, culm, is the end result once all of the usable coal is filtered out. An astonishingly massive quantity of culm results from each mining site. New landscapes and culm mounds are formed, altering the site's topography dramatically (Montrie, 2003).

Most often, deep mining and strip mining both have negative impacts visually and environmentally. The underground mines and their supports often fail over time resulting in the earth shifting and evidence of this is seen on the surface by the presence of dangerous sink holes. In 1962, an underground fire ignited from a trash dump in Centralia, PA (Devine, 1991). This fire, which still burns today, has resulted in deadly gases and unstable soils that have made the town of Centralia too dangerous for human habitation. In 1984, the U.S. Congress allocated more than \$42 million for relocation efforts. In 1992, Pennsylvania Governor Bob Casey invoked eminent domain on all properties in the borough, condemning all buildings within the borough. The pressing questions are: Is there ever a chance of Centralia being safe and livable again? Is there any hope for reclamation of either the landscape or the community (DeKok, 2000).

4 ENVIRONMENTAL IMPACTS OF MINING

In 1977, the Surface Mining Control Act

was approved and states that "this Act establishes a program for the regulation of surface mining activities and the reclamation of coal-mined lands, under the administration of the Office of Surface Mining, Reclamation and Enforcement, in the Department of the Interior. The law sets forth minimum requirements for all coal surface mining on Federal and State lands, including exploration activities and effects of underground mining. Mine operators are required to minimize disturbances and adverse impact on fish, wildlife and related environmental values and achieve enhancement of such resources where practicable. Restoration of land and water resources is ranked as a priority in reclamation planning" (Green, 1977). The requirement to reclaim land takes time and money but restoration is needed on the sites that were abandoned and scarred before this law was enacted.

The major visual artifacts of mining, culm banks have become the new landscape in the coal region. These resulting black landforms cannot support abundant plant life and, consequently the runoff contaminates the local watersheds, resulting in Acid Mine Drainage (AMD). The culm banks are toxic to plants and the unplanted large black landforms are highly erodible. Rainwater seeps through these contaminated banks draining onto the watershed surfaces and into local streams (Squillace, 2009).

Early coal mining companies did not have the knowledge to realize the long term affects their mining practices had on the environment. Thousands of miles of streams were contaminated when pyrite (an iron sulfide) was exposed and reacted with air and water, forming sulfuric acid and dissolved iron. Some or all of this iron can precipitate to form red, orange or yellow sediments along the streams (Figure 3). The acid runoff further dissolves heavy metals such as copper, lead and mercury into the ground or surface water. AMD disrupts growth and reproduction of the aquatic plants and animals that are necessary for the environment to be healthy.



Figure 2. The Vinton Colliery Site (1997). Permission by T. Allan Comp, PhD; Culm bank at Blaschak Coal Corporation, Mahanoy City, Pennsylvania (2012). Photo by Author



Figure 3. Acid Mine Drainage Reclamation, Nesquehoning, Pennsylvania (2012); Local stream contaminated with AMD, Ashland, Pennsylvania (2012); Acid Mine Drainage Reclamation, Nesquehoning, Pennsylvania (2012). Photos by Author

This AMD also diminishes valued recreational fish species which devalues and degrades outdoor recreation and tourism, negatively affecting the economy. Most importantly, AMD contaminates surface and groundwater drinking supplies, and causes acid corrosion of the wastewater pipe infrastructure. More than 3,000 miles of streams and associated ground waters are affected by these mines, affecting four major river basins in Pennsylvania (www.arippa.org).

5 CASE STUDY

In order to analyze and study precedent mining reclamation projects, one built project will first be presented. This project was selected because it has been remediated for nine years and has been proven successful by the scientists, hydrologists, ecologists, and community members involved. The second precedent study is based on the design and planning strategies of remediated mining sites of the successful organization, International Bauausstellung (IBA) Fürst-Pückler-

Land in Germany.

5.1 AMD&ART, Vintondale, PA

Location: Vintondale, Pennsylvania
 Site: The Vinton Colliery
 Size: 35 Acres

The core Design Team: T. Allan Comp, Historian and Project Director; Bob Deason, Hydrologist; Stacy Levy, Sculptor; Julie Bargmann, Landscape Architect

AMD&ART is a remediation project that was conducted from 1994-2005, on the past Vinton Colliery site in Vintondale, Pennsylvania. The post-mined landscape was contaminated from AMD and the strategy was to utilize historians, scientists, hydrologists, artists, and landscape architects to remediate and rebuild the site. This local abandoned community was experiencing the derelict, scarred landscape and contaminated watershed. The site was redesigned with a series

of cleaning ponds, gardens, and wetlands that would be used in part as an educational tool for the public and additionally as a cleaning system for the watershed. The AMD Treatment System would function both aesthetically and scientifically as the vegetation, soils, and aeration techniques help to extract the contaminating metals from the water. The water treatment begins in a holding pattern where the contaminated water resides and is a clear visual marker of the localized AMD (Figure 4). This pond references the beginning visual educational indicators, starting with the orange pond. From the first orange acidic pond, water will next drain into the following three ponds that utilize vegetation and soil compost to increase the pH of the water (Figure 5). Pond 5 uses a thick layer of organic material under the top two feet of water (Figure 6). Four feet of limestone and a drainage system below is situated under this organic material layer. Each of these layers takes on the additional

role to deoxygenate and continue to clean the flow of water. The water passes through an aerator to empty into the sixth remediating pond that is now free of the orange color. Testing has proven that the pH increases and the water that empties in the design Litmus Garden is metal-free. It is here that native trees and shrubs are shown in a carpet of color that enhances the appealing visual experience of a fall landscape. The fall display is also an occasion for celebration among community members who now indulge in the beauty of a clean watershed (Comp, AMD&ART, Inc., 2003-2007).

The clean water that traveled through the series of treatment ponds empties into a designed wetland conceived by the Wildlife Habitat Council. This area was once the site of all of the major Vinton Colliery buildings (Figure 7). Remnants or footprints of the torn-down structures that were left in the wetland area are evident as structures that are found among the wetland vegetation.



Figure 4. Site Signage for the Acid Pool and Litmus Garden (2005). Permission by T. Allan Comp

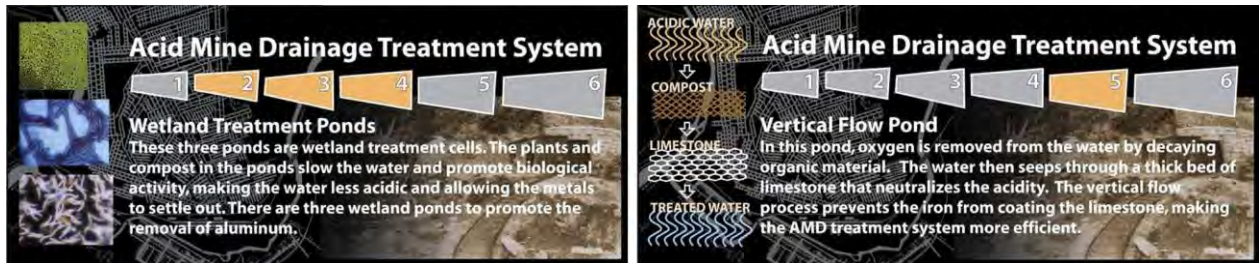


Figure 5. Site Signage for the Wetland Treatment Ponds and the Vertical Flow Pond (2005). Permission by T. Allan Comp



Figure 6. Site Signage for the Final Settling Pond and the Wetlands Habitat (2005). Permission by T. Allan Comp



Figure 7. Vinton Colliery Washery and Power House in 1906, Collage of the old building on the reclaimed land, and the AMD&ART Park today (2005). Permission by T. Allan Comp

This historic mining area now shows biotope success in this new wetland environment that attracts birds and wildlife. Thousands of native wetland plants were planted that now attract local bird and insect species, local wildlife and even native bats (Comp, AMD&ART, Inc., 2003-2007).

Artists were also part of the planning process and there are currently three art installations on site that indicate the mining history and those who worked in the mines. One installation visualizes the past history of the site map that once was on the mining site and what the reclamation site has mapped out. The before – after overlay provides the viewer with a clear visual history ranging from what was historically located there to what the ponds and wetlands function as now (Comp, AMD&ART, Inc., 2003-2007).

The success of this remediated biotope first relied on the removal of the four-to-eight feet of mining waste that covered this area of the site. A Government Financed Construction Contract Permit had to be issued by the Office of Surface Mining and the state mining office that allowed a coal hauler to remove 70,000 tons of waste material at no cost. One of the first steps or issues that many remediation sites begin with is the mountainous culm banks. The fundamental questions are: Is there funding possible for removal? Are there new energy resources for recycling this material (Comp, AMD&ART, Inc., 2003-2007)?

The scientists and design team worked closely with the community to give form to community aspirations. Public art spotted around the site provides historical perspective and an artful celebration for sustainable community development. Artists were also part of the planning process and there are currently three art installations on the site that indicates mining history and those who worked in the mines. One installation visualizes the past history of the site map of what was once on the mining site and what the reclamation site has mapped out. The before – after overlay provides the viewer of a clear visual history of what was once there to what the ponds and wetlands function as now. The community was now able to participate in an educational learning

experience from the six “cleaning” ponds and enjoy the wetland biotope, public art, and recreation area (Comp, Science, Art, and Environmental Reclamation: three projects and a few thoughts, 2008).

AMD&ARTS formed a successful team of designers that worked closely with the community to build a successful remediated post-mining site that is educational, aesthetic, and that has functionally remediated the AMD from the mining process landscape.

5.2 International Bauausstellung (IBA) Fürst-Pückler-Land

International Bauausstellung (IBA) Fürst-Pückler-Land is a German organization that has led design competitions, workshops and planning efforts in the mining regions of Germany. IBA has given economical, creative and ecological impulses for restructuring past industrial sites as they did with Peter Latz’s Emscher Park in Duisburg. From 2000-2010, IBA Fürst-Pückler-Land refocused their efforts in reshaping the mining landscapes in Brandenburg. Within these ten years, IBA was engaged in thirty projects that comprised a “Workshop of New Landscapes”. IBA hosts workshops that enable and guarantee a high-quality standard of landscape architecture and leads to innovative designs. My personal experience was to participate in the 2001 work in Cottbus, Germany that connected multiple universities from 14 different countries to study and propose designs for the city of Cottbus. IBA is an incremental planning instrument for these mining communities. The philosophy of IBA was to facilitate these mining communities into finding and developing new economical and innovative visions for the region through seven main topics: Industrial heritage, Waterscapes, Energy Landscapes, New Land, Border Landscapes, Cityscapes, and Transitional Landscapes (Hunger, 2005)

IBA intends to preserve the industrial heritage, culture, and history of the site. However, the hope is also to design new alterations for the site that increases tourism and possibly renames and add uses for previous structures. At Emscher

Park, the historic buildings are reused for housing, workplaces and leisure activities. Old structures have been turned into climbing walls, and the gasometer is now a diving tank. As designers, it is crucial to retain elements of the past, but restructure, reprogram, and reuse the structures and spaces.

Waterscapes will be the product of a resulting landscape of new surface water. The strip mining pits will be flooded and will become lakes within the region. In Lusatia, there will be a chain of ten lakes over 35 kilometers long, linked by navigable canals. Increased recreational tourism in the area is the emphasis on creating sporting recreation, including sailing, surfing, cycling, skating, riding and golfing. In part development of the Lusatian Lakeland is aimed toward reintroducing a new mobile waterfront/waterscape of floating houses. As the water levels rise over time, the floating homes will move with the water's edge, keeping the shorelines free from construction and still active during the years of filling (Scholz, 2010).

Energy Landscapes, consisting of wind, sun, and biomass can be ideally located in these expansive pre-mined landscapes. "IBA has been examining concepts for energy landscapes to combine different energy sources for a new, variably usable and ecologically enduring cultural landscape." Brandenburg University of Technology has a project entitled "Energy Landscape Welzow", which investigates how mining companies may cooperate with possible agricultural and forestry systems in rotation with plantations of wood for energy use. The wood is a revenue source for the community that was relocated for mining (Scholz, 2010).

New Land is the result of the mine scarred land that enables the creation of new topography, slopes, and uses. Landscape architects have an infinite vision for iconic, innovative and artistic sculptural landscapes that have a new purpose without forgetting the mining history. One IBA project dreamt up having both the desert-barren landscape that is the result of mining, adjacent to the oasis of a natural protected area. The unfortunate nature of citizen unpopularity and possible technical difficulties did not allow this proposal to progress. However, additional landform projects like "Art-Landscape" helped influence the new landscape designs (Scholz, 2010).

Border Landscapes are designs that have been drawn across the border to Poland. Following the Second World War, the new border between the countries had separated cultural landscapes and towns that were once one community. IBA's goal was to reconnect these communities across

borders and reconnect them. The International Geopark Muskau Coal Crescent is one example that now offers potential tourism (Scholz, 2010).

Cityscapes are the power or influence to reshape and rebuild these previous mining communities that have hope of repopulating after deindustrialization in their region. IBA has focused on the re-valuing of space and reprogramming remnant architectural structures into new usable pieces of architecture. Additional IBA projects focused urban development in these disappearing cities (Scholz, 2010).

Transitional Landscapes, in theory, is meant to give new vision to this mined landscape and provide an educational background of this scarred landscape before and during reclamation. Through mining tours, IBA envisioned the possibility of visitors to experience these landscapes and reinterpret the idea on which mining altered the vision and function of the landscape. This new educational form of tourism would be introduced for visioning of the built remediation process (Scholz, 2010).

6 DISCUSSION

As the Environmental Protection Agency has set rules, standards, and laws to protect human health and the environment, The Surface Mining Control and Reclamation Act of 1977 establishes regulations of surface mining activities and the reclamation of coal-mined lands. This Act emphasizes pre-planning of potential mining sites with continued land-use planning, development, and reclamation as part of the mining process. Landscape Architects enact in this planning process that is multi-jurisdictional and involves private industry, the general public, and many State and Federal Agencies (USGS, BLM, Forest Service, State Land Department, Fish and Game, etc.) Landscape Architects have the potential to harmoniously incorporate mined lands into something that is visually appealing, successfully follows proper land-use plans, and reclaims the land from any pollutants from mining (American Society of Landscape Architects, 1978).

It is essential to first identify the key issues, gather the data to help answer the appropriate questions, and organize the potential project implementation while still understanding the underlying core team involved. Surface mining in Pennsylvania has a variety of methods used to reform the land during the mining process. The integration of new landform allow for endless opportunities including agricultural uses, wildlife refuges, parks and gardens (American Society of Landscape Architects, 1978). As suggested by

International Bauausstellung (IBA) Fürst-Pückler-Land, there is great potential in reprogramming the post-mined lands as new transitional landscapes, waterscapes and energy landscapes (Scholz, 2010). The critical factor is the slope of the land and its potential for re-grading based on the planned program of the site (American Society of Landscape Architects, 1978). It is most economical to involve landscape architects at the beginning of the planning process where they may use part of the mining-related landforms for potential land-uses that follow the “mined” slopes. It is most effective to have the decision makers and public to be part of this process. Communities play a vital role in the success of localized reclaimed land. Within the coal region, the mine workers and their families had built or created the small towns and communities. When mines closed, the region’s economy suffered as a by-product. The miners’ struggles represented a response to the national Depression as well as the decline of anthracite coal. As the nation and region recovered from the Depression, the anthracite crisis still remained (Light, 2005). Manufacturing and industrial employment were on the rise but not all communities were able to make that employment transition a success. Those that experienced successful transition were now the community members who lived in the midst of a mine-scarred landscape. AMD&ART is an apparent built example where economic, ecological, and preserved cultural success is the result of a powerfully-driven community teaming with scientists, hydrologists, historians, artists, and landscape architects. Success of remediation sites will not happen unless the public is involved. As designers, we need to be certain to address the underlying culture of each site as much as the ecology and hydrology of the project location. Successful projects not only have the scientific parts worked out, but there also must be cultural reclamation where the community and its economy continue with a healing process as well (Comp, Science, Art, and Environmental Reclamation: three projects and a few thoughts, 2008).

With input from civil and mining engineers, geologists, surface water and ground water hydrologists, ecologists, sociologists and economists, Landscape architects can utilize their site planning skills to determine the land use plan, reuse of existing infrastructure, and designate the reclaimed ecological systems that will help clean the “wasted” landscapes of culm banks and the cleansing of the local watersheds (Research Committee on Coal Mine Spoil Revegetation in Pennsylvania, 1971). The mined landscape does not necessarily have to be completely forgotten or

completely reshaped, but rather integrated within innovative designed landscapes with reuse of remaining infrastructure. Allowing the public to access these reclaimed sites encourages them to experience the past, and become connected to and knowledgeable of the site’s history and its effect on that landscape (Burley, 2001).

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RESILIENCE THINKING IN LANDSCAPE PLANNING: A TRANSDISCIPLINARY FRAMEWORK AND A CASE FOR CLIMATE CHANGE ADAPTATION

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1 ABSTRACT

Climate change and urbanization have exacerbated environmental hazards and affect health, safety, and welfare of society. *Resilience thinking provides a foundation for landscape planning framework to investigate social-ecological drivers and outcomes in the linked social-ecological systems. Transdisciplinary approach includes organizational, institutional, and interdisciplinary hierarchies and collaborations and plays an important role in redefining issues and building consensus for achieving common goals. The proposed transdisciplinary planning framework aims to build adaptive capacity through a revolving feedback loop. A case study from the Boston Metro Area Urban Long-Term Research Area-Exploratory project demonstrated the use of the proposed planning framework. Growth scenarios were developed through transdisciplinary planning process. The study evaluated planning innovations in growth strategy (e.g., infill redevelopment) and green infrastructure (e.g., stormwater detention) for climate change adaptation. Climate change-induced flooding risks, served as social-ecological outcomes, were measured through integration of flooding hazard index and social vulnerability index under multiple climate change and land use scenarios in the Charles River watershed. The results from empirical study support the role of integrating anticipated climate change-induced social and ecological impacts into spatial planning decisions to mitigate impacts, minimize exposure of hazards, and increase adaptive capacity. In addition, innovations in green infrastructure planning and design serve as climate change adaptation strategies. Applying the transdisciplinary planning framework, the findings can be used to inform decision-making and prioritize climate change adaptation strategies to serve the needs of the socially vulnerable groups. The study provides an insight of integrating transdisciplinary approach in landscape planning for building social-ecological resilience.*

1.1 Keywords

social-ecological systems, resilience, transdisciplinary planning framework, climate change adaptation

2 INTRODUCTION

Climate change has exacerbated climate related disasters (IPCC, 2007) and associated casualties and property damages, particularly in already risk-prone areas, not only in low- and middle-income countries but also in developed countries (Leary, 2008). The interaction and reciprocal feedback between social and ecological systems has augmented complexity in landscape planning aiming toward resilience and sustainability. The scale of complexity in the interlinked social-ecological systems involves cross-institutional and organizational consensus-building as well as interdisciplinary collaboration. Coping with the dynamics of change therefore requires integration of resilience thinking and transdisciplinary approach in landscape planning framework. I propose a landscape planning framework integrating transdisciplinary participatory planning process in the interlinked social-ecological systems for research and practices to untangle complex issues such as climate change. Applying the framework to the Boston Metro Area Urban Long Term Research Project-Exploratory (BMA ULTRA-ex) project, the social-ecological outcomes are presented through the evaluation of stakeholder-input growth scenarios and climate change-induced flooding risks assessment in the Charles River watershed. The study provides insights in applying the transdisciplinary landscape planning framework for climate change adaptation planning strategies in building social-ecological resilience.

3 BACKGROUND

3.1 Resilience Thinking in Planning

Resilience theory is rooted in ecology. Ecological resilience refers to non-equilibrium and inter-connected open systems that possess

adaptive capacity to absorb disturbances, reorganize within a threshold level, and re-generate in order to cope with change (Holling, 1973; Folke, 2006; Walker and Salt, 2006). Resilience thinking opened a window for a more comprehensive theory in connecting ecological, social, and physical dimensions in the linked social-ecological systems. Social-ecological systems emphasize the integrated concept of humans-in-nature and interplay between human and natural systems (Berkes and Folke, 1998). Human activities, socio-economic drivers, and institutional structures across temporal and spatial scales have impacts on ecosystems, which then have reciprocal feedback and impacts on human systems (Grimm et al., 2000; Folke, 2006). Social resilience associated with livelihood of human systems is therefore linked with ecological resilience (Adger, 2000). In addition, resilience thinking has been applied to planning in building adaptive capacities in governance, institutions, communities, and cities to cope with shocks (e.g., natural disasters, economic depressions, wars), uncertainty and change (e.g., climate change) (Adger, 2006; Pendall et al., 2010; Beatley, 2009; Wilkinson, 2012).

Resilience thinking provides a powerful metaphor and inspiration in landscape planning research and practices. Resilience research has provided an insight of linking structure and function in the non-equilibrium and interlinked social-ecological systems, which offers an effective framework to study integrated ecological and social heterogeneity of patterns and processes in landscape and urban systems (Pickett et al., 2004). In addition, the concept of adaptive cycle across multiple temporal and spatial scales in resilience theory has spurred resilience thinking in the development of adaptive planning and design. For example, Ahern (2011) suggested learning-by-doing planning strategy with multifunctional, diverse, redundant modules, multi-scale connectivity, and safe-to-fail design to provide opportunities for building resilience capacity. Moreover, social-ecological resilience thinking can serve as a common framework in transdisciplinary research on complex and multifaceted issues such as climate change adaptation (Deppisch and Hasibovic, 2013). Built upon previous research, this paper aims to apply resilience thinking through the lens of building adaptive capacity of the social-ecological systems to cope with climate change in a transdisciplinary landscape planning framework.

3.2 Transdisciplinary Landscape Planning

Landscape planners are facing challenges of planning issues that involve multiple dimensions in the interlinked social-ecological systems across multiple disciplines (e.g., ecology, economy, sociology, archeology, engineering, art, architecture, public policy, public health) and multiple institutional hierarchies (e.g., global, national, regional, local, individual) simultaneously. The concept of transdisciplinarity, which can be traced back to the education system proposed by Jantsch (1970), promotes an innovation system through a multi-level, multi-goal, hierarchical system interlinked with interdisciplinary coordination. Fry (2001) used transdisciplinary approach to address multi-functionality and interdisciplinarity challenges in landscape research. Tress and Tress (2001) applied transdisciplinary approach for landscape research in an interactive people-landscape model with multiple disciplines from biological, geographical, social, cultural, and spiritual elements and multiple levels of spatial, temporal, and mental dimensions. Stokols (2006) proposed transdisciplinary action research (TDAR) that involves interactions of organizational scope (inter-sectoral, inter-organizational, intra-organizational), analytical scope (biological, psychological, social/environmental, community/policy), and geographical scale (local group, community, regional, national/global).

The TDAR model in particular has gained prevalent attention in the field of landscape and urban planning involving participatory planning as an effective approach to address issues in complex social-ecological systems. Schroth et al. (2011) employed TDAR framework and landscape visualization tools in multiple case studies involving researchers and community stakeholders in the landscape planning processes as well as landscape design and policy implementation. In addition, Antrop and Rogge (2006) evaluated the process of employing TDAR approach involving interdisciplinary researchers, program team, and stakeholders for preserving cultural landscapes. Moreover, Thering and Chanse (2011) argued for plural design using TDAR framework by addressing challenges of using transdisciplinary approach in landscape planning processes. Furthermore, Deppisch and Hasibovic (2013) included interdisciplinary researchers and practitioners to work with stakeholders in the scenario planning process for developing climate change adaptation strategies in the urban region. Combined with resilience thinking in social-ecological systems, transdisciplinary approach provides an effective

common planning framework to include multiple actors, stakeholders, and communities, as well as interdisciplinary researchers and practitioners at multiple organizational hierarchies to work in tandem to address complex landscape planning issues such as climate change adaptation (Deppisch and Hasibovic, 2013).

4 TRANSDISCIPLINARY PLANNING FRAMEWORK IN SOCIAL-ECOLOGICAL

In order to have a comprehensive understanding of linked systems, it is necessary for a synthesis and integration of several different conceptual frames (Costanza et al., 1993). First, social-ecological resilience concept is embedded in the planning framework (Deppisch and Hasibovic, 2013) to include both social and ecological drivers and their interactions and outcomes, which then inform planning decisions. Second, a revolving learning-by-doing feedback loop in the planning framework serves as windows of opportunity to evolve and adapt. Adaptive planning processes include identifying goals and objectives, plan formulation, plan implementation, plan evaluation, and plan monitoring (Kato and Ahern, 2008). Third, adopting the TDAR framework, transdisciplinary participatory planning process includes three dimensions: vertical (i.e., institutional hierarchy), horizontal (i.e., interdisciplinary collaboration), and organizational hierarchy. Finally, transdisciplinary approach in the planning framework provides opportunities for learning, integration, synthesis, and innovation for sustainable and resilient development (Meppem and Gill, 1998). Integrating resilience thinking in the interlinked social-ecological systems and transdisciplinary approach, I propose a landscape planning framework in a feedback loop as following (Figure 1):

- (1) Initiate a transdisciplinary participatory planning process that involves interdisciplinary researchers and practitioners, local authorities, stakeholders, and the general public through a combination of various forms of participatory methods (e.g., preference surveys, small group discussion, memory mapping) that allow consensus-building toward common goals (Innes, 1996)
- (2) Integrate transdisciplinary participatory planning process that drives plan-making development to incorporate planning interventions and decide social-ecological drivers based on the goals and objectives in the planning agenda.
- (3) Conduct empirical research in the social-ecological systems for the evaluation of plans

that are formulated through planning intervention and indicators identified in the planning process.

- (4) Document and monitor social-ecological outcomes from the plan evaluation and share findings and lessons learned with the transdisciplinary participants.
- (5) Continue the transdisciplinary participatory planning process with the new insights from social-ecological outcomes and improve plans and/or modify social-ecological drivers as adaptive planning processes toward resilience and sustainability.

5 CASE STUDY

5.1 Study Context and Area

Climate change is projected to increase the intensity and frequency of storm events that would increase flooding hazards in the Northeast region (IPCC, 2007; Rock, et al., 2001). Urbanization associated with land use and land cover change has altered hydrological cycles by increasing stormwater runoff, reducing baseflow and increasing flooding hazards. Combined urbanization and climate change impacts on long-term riparian flooding during future growth are likely to affect more socially vulnerable populations. The Boston Metropolitan Area, consisting of 101 communities with a population of 3.16 million, is expected to grow 10% by 2030 (MAPC, 2009). Currently, the population is aging, becoming more diverse in its younger cohort, increasing in inequality in socio-economic status, and increasing in needs for support for minority groups and immigrants. The current demographics and socio-economic structure exemplify with some of the key concepts of social vulnerability. The increased frequency of extreme storm events in recent decades—Superstorm Sandy in 2012, Hurricane Irene in 2011, and serious floods in 2011, 2010, and 2005—has coincided with climate change projections in the Northeast. The socially vulnerable groups are likely to be impacted most.

The Charles River watershed encompasses 778 km² and is predominately within the Boston Metropolitan Area with minimal coastal lines. The watershed consists of 35 municipalities, includes large portions of the City of Boston, is the most densely populated, and covers the most environmental justice (EJ) populations among nine watersheds in the metropolitan area. The EJ populations defined by the Massachusetts Office of Geographic Information (MassGIS) include non-white, low-income, and English-isolated groups, which are corresponding to characteristics of socially vulnerable groups (Cutter et al., 2003).

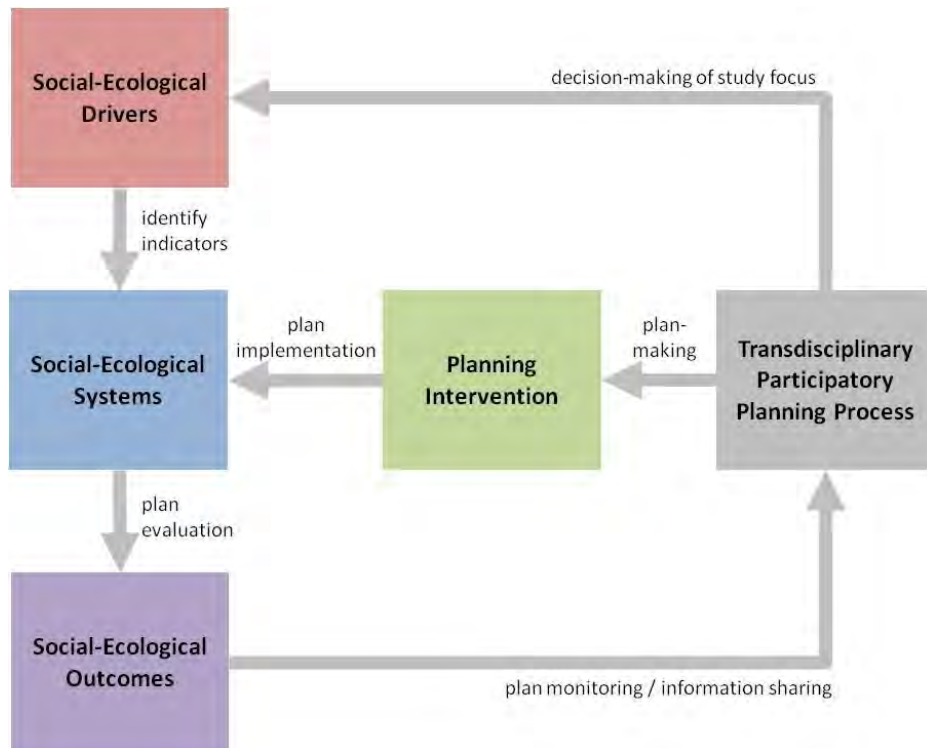


Figure 1. Transdisciplinary Landscape Planning Framework in Social-Ecological Systems.
Diagram by the Author

Therefore, Charles River watershed is susceptible to increased social impacts and climate change-induced flooding hazards in the Boston Metropolitan Area under anticipated urbanization and climate change. The term “climate change-induced flooding” refers to floods that are exacerbated by climate change in this study.

5.2 BMA ULTRA-ex Project and Study Goals

The BMA ULTRA-ex project aimed to understand the socio-economic (e.g., land use policy, population change, investment, social capital) and bio-physical (e.g., climate change) drivers that influence social-ecological processes (e.g., land use and land cover change, urban greening development, environmental stewardship) that interact within ecosystems and their impacts on social-ecological outcomes (e.g., biodiversity, water quality, stormwater management, natural hazards, public health, social equity) (BMA-ULTRA, 2011). The project team engaged with stakeholders in two workshops and developed four growth scenarios in a transdisciplinary scenario planning process (Ryan et al., 2013).

Growth strategies and green infrastructure were two planning interventions identified during

the workshops for plan evaluation. Infill redevelopment as a growth strategy focused on compact form and redevelopment of existing built areas in contrast to suburban sprawl that often results in the clearance of agriculture, forest, wetlands and large open space during the urbanization process. The four growth scenarios varied in allocating the same amount of projected population through various levels of infill redevelopment between the inner cities and the suburbs. *Current Trends* scenario followed a suburban sprawl pattern with the lowest level of infill redevelopment. *MetroFuture* scenario aligned with policies set forth by the Metropolitan Planning Area Council (MAPC) for the region and focused on developing lands along transportation corridors and public transit cores with moderate level of infill redevelopment. *Green Equity* scenario emphasized allocating urban green infrastructure (e.g., trees, stormwater best management practices) for underserved neighborhoods (e.g., low-income, minority) with slightly less infill redevelopment than *MetroFuture* in order to provide more space for urban greening in the inner cities. A separate study has demonstrated *Green Equity* scenario encompassed the most equitable distribution of urban tree canopy comparing to other scenarios in relation to low-income neighborhoods in the City of

Boston (Danford et al., 2014). Finally, *Compact Core* scenario explored the highest level of possible infill redevelopment in the inner cities.

Applying the transdisciplinary landscape planning framework, the study goals were (1) to understand the social-ecological dynamic interaction through an integrated flooding risk assessment that combines climate change-induced flooding hazards and their exposure to socially vulnerable groups, and (2) to evaluate the effects of planning interventions (infill redevelopment and stormwater detention) in mitigating climate change-induced flooding and associated social impacts.

5.3 Study Design in the Planning Framework

Applying the proposed transdisciplinary landscape planning framework, climate change and population change were considered as social-ecological drivers and growth strategies and green infrastructures were the planning interventions identified in the BMA ULTRA-ex project (Figure 2). Flooding risks served as a medium for studying the interactions between social and ecological systems. Population change shaped land cover through land use change derived from growth scenarios. A flooding hazard index (HI) was defined as the probability of number of days in a period of 45 years when the stream outflow would exceed the baseline bankfull discharge volume under current climate. HI was constructed through a hydrological model—Soil and Water Assessment Tool (SWAT) (Arnold et al., 1998). A Social Vulnerability Index (SoVI) (Cutter et al., 2003) was constructed based on 30 demographic and socio-economic characteristic variables from the U.S. Census 2010 through statistical methods. Subsequently, a climate change-induced flooding risk index (RI) (Cheng, 2013) was constructed through multiplying the flooding hazard index and SoVI.

Planning intervention evaluations were conducted through inputs of land use and climate variables and pot hole function in SWAT modeling. Four growth scenarios were converted into land use change (Cheng et al., 2013). A total of 3% of the Charles River watershed land areas associated with public open space were modeled for stormwater detention function (Cheng et al., 2013). A climate sensitivity study testing firstly was conducted to include 150 climate conditions (combinations of mean temperature change of 0, +1, +2, +3, +4, +5°C, mean precipitation change 0, ±10,

±20%, precipitation variation change 0, ±10, ±20%) (Cheng, 2013). Among positive impacts on the increased flooding hazards, a total of 36 climate combinations—mean temperature 0, 1, 2 or 3°C increase, mean precipitation at 0%, 10% or 20% increase, and precipitation variation at 0%, 10% or 20% increase—were tested further for the evaluation of stormwater detention (Cheng, Brabec, Yang, & Ryan, 2013). Finally, three climate change scenarios that closely matched the general circulation models (GCMs) projection for the Northeast were selected. *Low Impact*, *Medium Impact*, and *High Impact* climate change scenarios were composed of 3°C, 2°C, and 1°C increase in mean temperature, 10%, 10%, and 20% increase in mean precipitation, and 0%, 10%, and 20% increase in precipitation variation respectively (Cheng, 2013).

The social-ecological outcomes play an important role in closing the feedback loop of the planning framework and informing planning decisions through continued revolving transdisciplinary participatory planning processes. Additionally, the planning interventions serve as both climate change mitigation (e.g., reducing carbon emissions, minimizing impervious surfaces, reducing urban heat island effects) and climate change adaptation strategies (e.g., enhancing resilience to climate change-induced flooding risks).

5.4 Social-ecological Outcomes

The climate change-induced flooding risk index (RI) derived from the integration of climate change-induced flooding hazard index and Social Vulnerability Index represented social-ecological outcomes of this study. Figure 3 illustrated the flooding risk index in *Current Trends* scenario among the climate change impact scenarios. Across scenarios, higher flooding risks were located at the lower basin of the watershed. In *High Impact* scenario, a significant increase of flooding risk index presented throughout the entire watershed. Among the growth scenarios, flooding risk held similar patterns across scenarios with the higher flooding risks located at the lower basin of the watershed. However, little variance was shown for the effects of growth strategy and associated land use and land cover change on the increased flooding risks (RI between 0 and 1.2%) (Figure 4) in contrast to the significant effects of climate change impacts on flooding risks (RI increased up to 3%) shown in Figure 3.

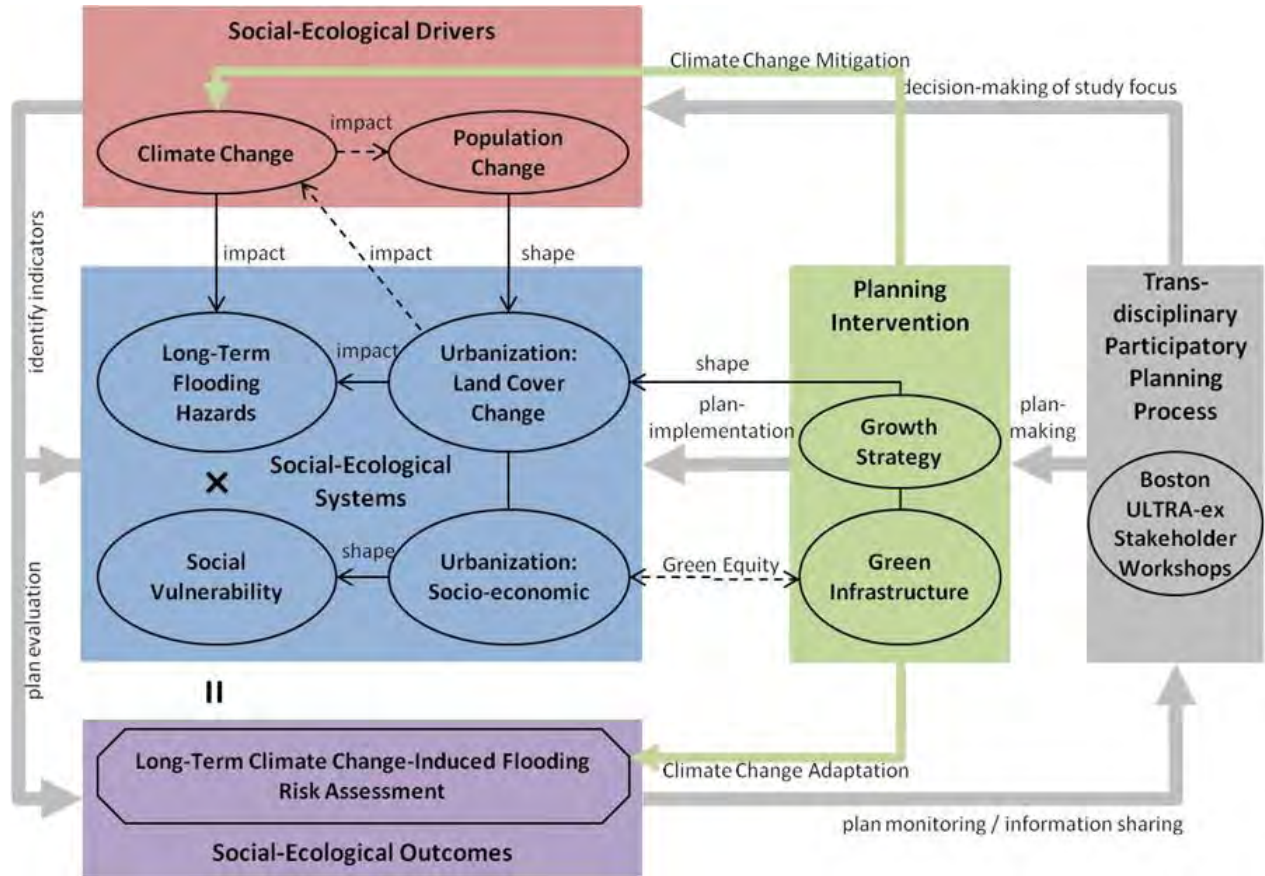


Figure 2. BMA ULTRA-ex Case Study Applied to the Transdisciplinary Landscape Planning Framework. Diagram by the Author

Social impacts corresponding to climate change impacts varied greatly among growth scenarios by the variance of the amount of projected population who were likely to be exposed to areas with high flooding risks (hot spots) (Figure 5). The flooding risk hot spots were generated through spatial statistics in geographic information systems (GIS) of RI value with the standard deviation of z score greater than 1.65. *Current Trends* scenario distributed the largest percentage of projected population growth (4.5%) with 2877 more people allocated to flooding risk hot spots than that of the *Compact Core* scenario (3%).

The effects of using stormwater detention on mitigating climate change-induced flooding

hazards were significant within flooding risk hot spots in all climate change scenarios. Figure 6 illustrated the difference in flooding risk index (RI) values between stormwater detention treatment and no treatment. The negative values (shown in green and blue areas) represented positive effects in mitigating climate change-induced floods. In general, stormwater detention was effective throughout the entire basin except in some upper stream areas (shown in positive values and in yellow, orange and red areas) in all climate change scenarios. Even in *High Impact* scenario, the small amount of the detention area (3% of land area applied in this study) remained having positive effects in mitigating climate change-induced floods.

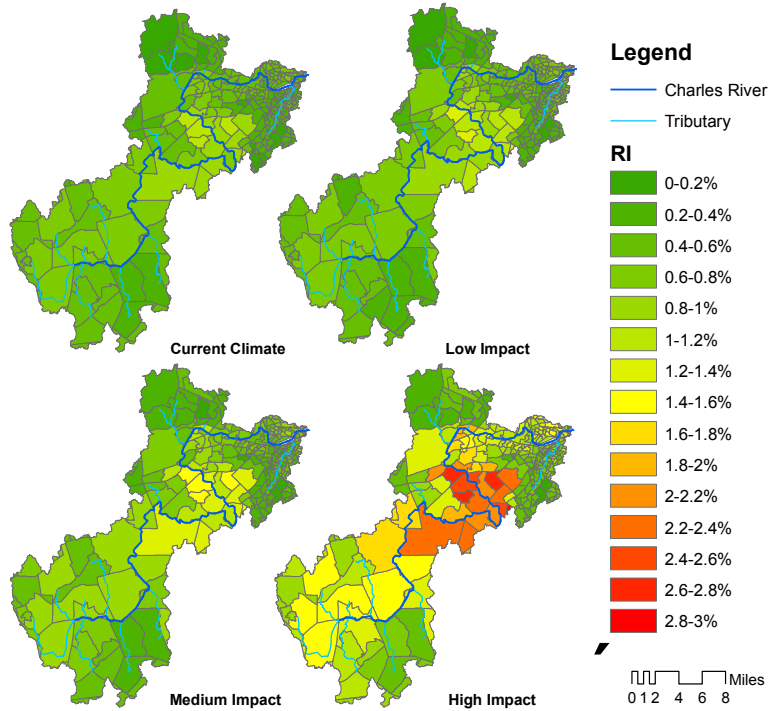


Figure 3. Maps of the Long-Term Climate Change-Induced Risk Index (RI) in *Current Trends* Scenario among Climate Change Impact Scenarios. Diagram by the Author

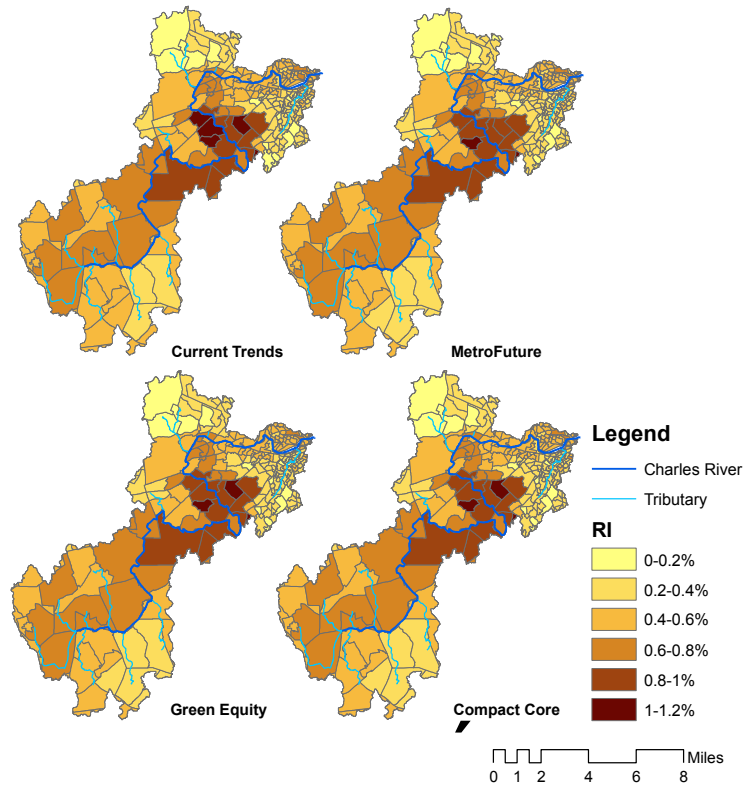


Figure 4. Maps of Climate Change-induced Flooding Risk Index (RI) under Current Climate Conditions among Growth Scenarios. Diagram by the Author

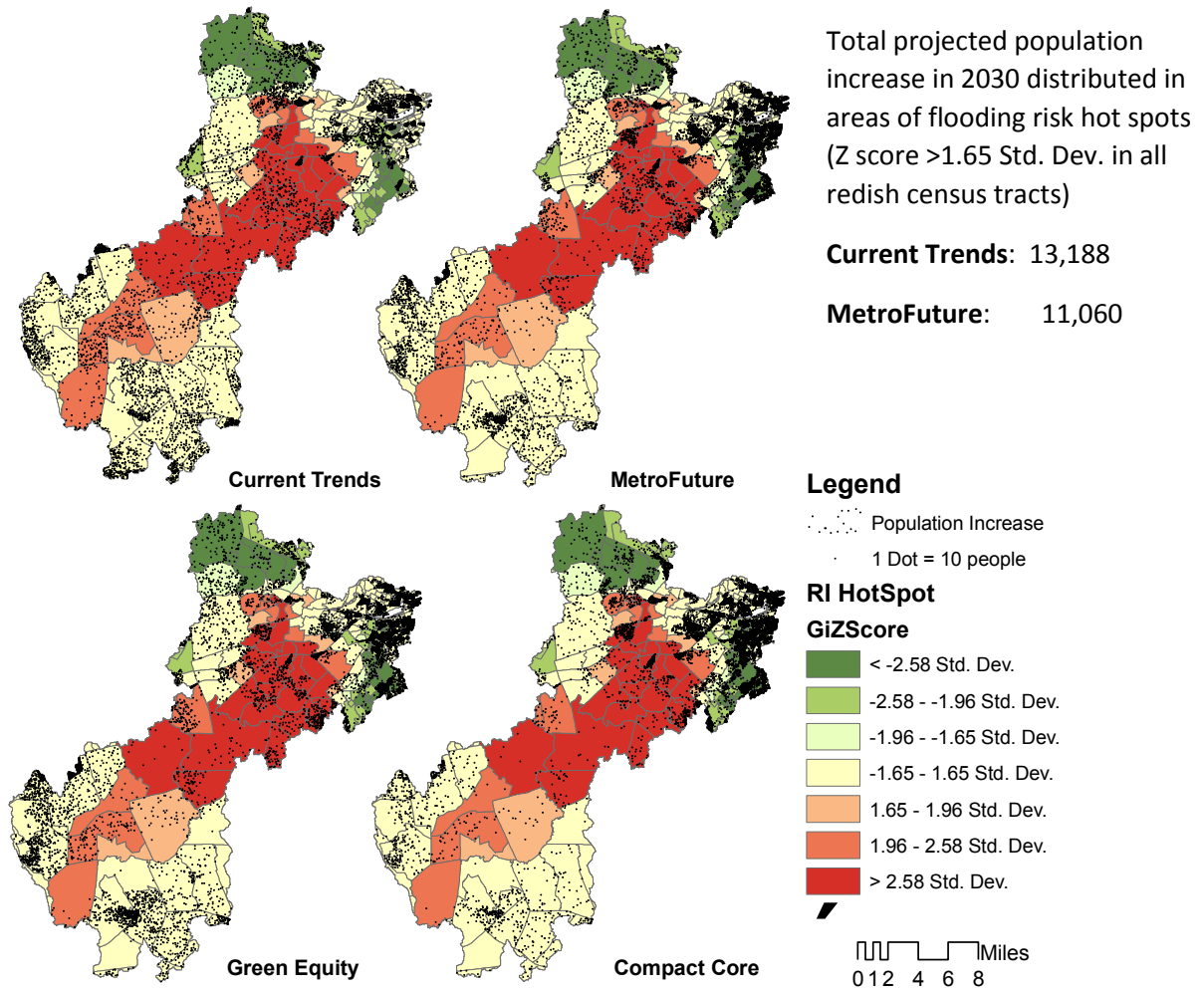


Figure 5. Maps of Allocation of Projected Increased Population in Growth Scenarios Overlaid with Current Climate Conditions of Long-Term Flooding Risk Index (RI) Hot Spots. Diagram by the Author

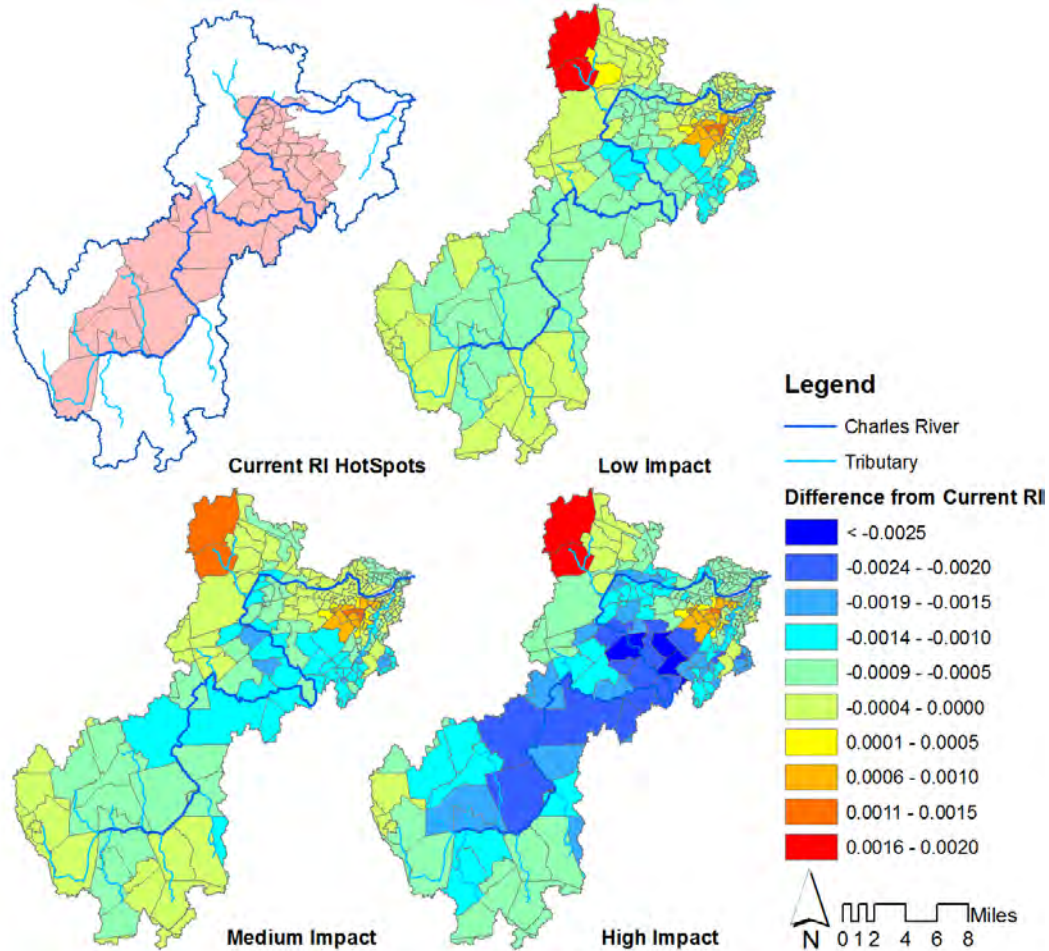


Figure 6. Positive Effects of Applying Stormwater Detention Function on Mitigating Climate Change-induced Floods in Climate Change Impact Scenarios; Particularly Effective within the Flooding Risk Index (RI) Hot Spots in Current Climate Conditions. Diagram by the Author

6 DISCUSSION

6.1 Resilience Thinking and Planning Implications

This study has demonstrated the effects of planning interventions in mitigating social-ecological impacts from climate change and serving as adaptation strategies. The root cause of social vulnerability resides in social systems created by society and is inherent in the process of urbanization under social, political, economic, and cultural context (Beck, 1992). In addition, social vulnerability is place-specific (Cutter, Boruff, and Shirley, 2003), particularly associated with natural disasters and environmental justice (Colten, 2006; Walker and Burningham, 2011). Therefore, spatial planning for the allocation of projected population should take anticipated environmental hazards and associated health and safety impacts into considerations. In this case, planning agencies (e.g., MAPC) and local municipalities could use the

social-ecological outcomes shown in Figure 5 to refine the growth management and land use plans by accounting for projected climate change-induced flooding hazards and socially vulnerable groups. To enhance social-ecological resilience, communities could consider (1) mitigate climate change impacts, (2) minimize exposures to hazards, and (3) increase adaptive capacity. In light of uncertainty in planning exacerbated by climate change, place-based assessment plays a critical role in providing parameters of climate change impacts and assisting in setting policy frames for building social-ecological resilience. Furthermore, this study demonstrated the positive effects of using stormwater detentions in mitigating climate change-induced floods, which in turn enhancing safety and livelihood of the communities. Therefore, green infrastructure also serves as climate change adaptation strategy. Growth strategy and green infrastructure are planning interventions connected through land use/landscape planning and site

design. Innovations in adaptive land use in the interconnected green infrastructure system network across rural to urban transect (Cheng, 2013) can help to restore and enhance ecosystem functions (e.g., stormwater detention, biodiversity, carbon sequestration, micro climate moderation) and eventually strengthen social-ecological resilience.

6.2 Closing the Loop

The social-ecological outcomes from this study were presented to the interdisciplinary research teams that consist of multiple institutions and disciplines (e.g., landscape architecture, regional planning, conservation biology, ecology, public policy, geography, hydrologic engineering, and environmental psychology). The other research teams have used growth scenarios developed from the transdisciplinary participatory planning process to explore other social-ecological drivers and outcomes. For example, one team is investigating water conservation policies and people's perceptions on green infrastructure in relation to water quality and accessibility. Another team is exploring carbon sequestration in the Charles River watershed based on land cover change associated with various growth scenarios. Furthermore, our team has evaluated the effects of using landscape preference and scenarios as visualization tools in the transdisciplinary process during the stakeholder workshop for deliberating common goals in sustainability. Currently, the BMA ULTRA-ex research teams are working on assembling interdisciplinary social-ecological outcomes for sharing with stakeholders and closing the loop of the planning framework. This study serves as a seed project in the exploratory efforts for the social-ecological long-term research in Boston Metro Area. The ultimate goal is to apply the transdisciplinary planning framework in a continuous feedback loop that allow plans to be adopted and evolved overtime with new insights from the empirical social-ecological outcomes. Subsequently, plans can be adaptive in coping with climate change and uncertainties in planning, which eventually build social-ecological resilience at multiple scales. Therefore, it is critical to close the loop gap and secure resources for long-term transdisciplinary participatory process in the proposed landscape planning framework.

7 CONCLUSIONS

Climate change and urbanization impacts on associated disasters have increasingly become an eminent threat to cities. This paper has contributed to theoretical framing of landscape planning research issues, empirical case studies,

and knowledge gained for building innovations in landscape planning and design practices. The planning framework can be applied in landscape and urban planning processes involving dynamics of social and ecological factors and processes in the interlinked social-ecological systems and to address complex issues such as climate change. Plan evaluations through empirical studies on landscape performance and social-ecological outcomes could inform policy-makers and practitioners for setting climate change parameters and seeking innovations in landscape planning policies and practices. This knowledge is critical for the integration of ecological design, environmental justice, and climate change mitigation and adaptation in landscape planning. The proposed transdisciplinary planning framework allows continuous feedback loop at multiple scales across organizational hierarchies, interdisciplinary coordination, and institutional hierarchies. The transdisciplinary approach is particularly important for building mutual understanding and consensus towards common goals and for setting priorities in allocating resources and planning strategies to enhance people's livelihoods and ecosystem services for building resilient and sustainable communities.

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PEOPLE-ENVIRONMENT RELATIONSHIPS

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THE UNIVERSAL ATTRACTIVENESS OF UNIVERSALLY ACCESSIBLE PLAY ENVIRONMENTS: A PILOT STUDY

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1 ABSTRACT

This informal systematic observation study was undertaken in spring 2012 exploring the hypothesis that playgrounds designed to higher universal accessibility standards, are more attractive to children of all abilities and to the general population, than are those designed simply meeting minimum ADA Standards. User counts were conducted in the playgrounds of seven parks in a single community. One park had a highly accessible playground, built using universally accessible concepts, having ramps and other features significantly exceeding ADA. The six comparison parks had playgrounds designed to meet ADA minimums. All seven parks were located in a suburban Dallas, Texas community with similar socio-demographics and similar park attributes such as size, amenities, and maintenance qualities. Findings showed the universally accessible playground had use ratios of children per play event being over three times the mean use ratios of the other playgrounds. These findings appeared supportive of the hypothesis that a playground built to the higher standards of universal accessibility, can attract more use by children and by all users than playgrounds meeting only minimum ADA standards. Despite the pilot nature of this study, it brings attention to the potential and understudied value universally accessible playgrounds may contribute to stimulating outdoor play activity and furthering the benefits of healthy active living for all children. Formal research is being developed using more rigorous protocols that combine analysis of physical conditions, user observations and user surveys to further test the hypothesis and support policies and guidelines encouraging the implementation of universally accessible play environments.

1.1 Keywords

accessibility, children, fitness, park, playground

2 BACKGROUND

A pilot study was conducted to explore the hypothesis that playgrounds designed to higher universal accessibility standards are more attractive to children of all abilities, and to the general population, than those designed simply meeting minimum accessibility standards. The study is an informal systematic observation study counting users of playgrounds in seven public parks within one community. It focuses on the issue of universal accessibility in playgrounds as a potentially important factor influencing play activities among children and families without special needs in addition to those having special needs.

Research has shown that outdoor play and active living can make a substantial contribution to the lives of children and adults alike. Frequent and regular physical activity can increase longevity, well-being, and reduce the risk of obesity and many other chronic health problems (Active Living Research, 2010). Play is a conduit for physical activity especially among children, and has been found to bring many additional benefits such as stress reduction and intellectual development (Active Living Research, 2010). Neighborhood parks, outdoor recreation facilities and playgrounds can help people of all backgrounds to include a more active lifestyle in their weekly routines (Active Living Research, 2010).

In 1991, the Americans with Disabilities Act (ADA) brought an increased awareness of designing for people with disabilities giving impetus to design for accessibility and play for children with special needs. Research has shown considerable support for the value of play promoting socialization in children of all abilities. However, there is little quantitative evidence regarding the general popularity of play environments designed with a focus on inclusion.

2.1 Play and Child Development

“Play is the child’s work. The world is his laboratory, and he is the scientist” (Friedberg,

1970). Good design creates a child's world where the child is at home and the adult is the outsider. Design should create the opportunity to steer a child's exploratory process toward creative thinking for imaginative experiences. Spatial elements of masses and voids and the equipment that defines them can be used to make a variety of links to further enhance the choices in play and increase the creative element of spontaneous choices for the child (Friedberg, 1970).

Childhood involves a tremendous amount of learning and growth. Play can be a medium for development as a child gains information about themselves, their bodies, their friends and the new world in which they live. At the fundamental level, growth revolves around the four dimensions of social, emotional, physical and cognitive development. Each of these dimensions contributes to the overall development of a child (Thompson, 1992).

Spontaneous, free play in children is one of the most important and most beneficial types of play (Frost, 2004). Free play has five dimensions identified by play scholars and researchers. It is primarily voluntary, allowing participants to enter or leave at will. Free play is spontaneous; at any time it can be changed by any of the players. It is imaginary, involving a pretend element that is different from everyday life. Free play is engaging; players are separated from other activities as they engage in the play activity. The fifth dimension is simply being fun, pleasant and enjoyed by the participants (Frost, 2004).

Many health care professionals and educators consider play to make important contributions to a child's development. It is a process where children can develop through interaction with their physical and social environment on their own terms. In free play, children's reading readiness and sociometric status among their peers is readily seen through their play behaviors (Pellegrini, 1988).

Children aren't the only ones that exhibit the behaviors of play. Animals from mammals down through birds, reptiles and fish have been observed in play. Play has been shown to allow animals to prepare themselves for changing conditions in a continuously evolving environment by testing their abilities without threatening their own well-being. Individual animals that play have been found to have more brain development than those who don't (Brown, 2009). In animals that don't play, neural growth has been found to be in only one part of the brain as opposed the whole brain growth in those that play. Essentially, play has been shown to stimulate brain growth, add to

intelligence, and improve survival through adaptability (Brown, 2009).

2.2 Accessibility and Playgrounds

Inclusion in all aspects of society is becoming recognized as the new standard of social integration in the developed world. Over the years, people with physical limitations in general and children specifically have lived in a socially restricted minority group that imposes restrictions on the activity and interactions of people with physical and/or cognitive impairments that result in an undermining of their psycho-emotional state of well-being. From this point of view, a disability is a socially imposed restriction based on a certain physical impairment significantly limiting a child's social interactions with their peers (Burke, 2012).

While the value of play has been demonstrated as a critical part of a child's life and development, it is important to recognize that playgrounds don't lead to positive outcomes for all children. In many environments children with physical disabilities have become marginalized and often their parents become marginalized as well. In an effort to recognize that people having physical impairments and disabilities are 'people first' before their disability, it is recommended that a 'person first' terminology and language be used when discussing children with different physical conditions such as autism or the need to use a mobility device such as a wheel chair (Jeanes, 2012).

An important element of play and the play environment is that it becomes a medium for communication and interaction with peers. Children of all abilities have reported the playground as a place where they can have privacy, especially from adults, and interact with their friends. Just sitting around and talking with peers has been reported as a valuable activity. Children express the importance of the conversations being private interactions among children without adult presence. In the mind of many children of all abilities, the playground is as much a social space as a place for activity (Prellwitz, 2007).

High quality inclusive play environments are needed to foster development in children of all abilities in an effort to reverse the trend of the disenfranchisement of those with different physical impairments. In response to the need for inclusion, the concept of universal design in play goes beyond the minimum statutory requirements of the ADA Standards for Accessible Design. The concept seeks to design environments that are usable for all people, of all abilities, without the need for adaptation. The resulting universally designed environment has

the potential to encourage more use by people of all abilities to link children with peers and parents with parents in a recreational setting benefiting adults and children alike (Moore, 2007).

Some basic elements of providing play environments for people of all abilities include removing physical barriers by providing a good accessible route, making sure play features and site amenities are available to everyone. The effect of limiting accessible play elements to a single specially designed space simply reinforces the social segregation that universal design seeks to overcome (Jeannes, 2012). This discussion has focused on children with disabilities. There are many parents and care givers of able bodied children that need to use mobility devices and who would like to or need to be able to accompany their children to the playground. The inclusive environment seeks to include parents and caregivers who have physical disabilities as well as children (Goltsman, 2011).

2.3 Regulatory Framework for Accessible Playgrounds in the US

There has been much work done in the last ten years to develop accessibility standards around the world. In the United States, the Americans with Disabilities Act (ADA) was enacted in 1990. The original accessibility rules found in the 1991 Americans with Disabilities Act Accessibility Guidelines (ADAAG) recognized the need but did not include any specifications for recreation areas or playgrounds. The first rules for accessibility in playgrounds were adopted by the U.S. Access Board in October, 2000.

In 2010, the Justice Department adopted a set of standards for accessibility, the "2010 Standards for Accessible Design". The new Standards generally follow the Access Board rules, devoting two full chapters to play areas themselves, defining minimum requirements for accessibility of play area ground surfacing, play structure accessibility, and accessibility requirements for play elements. The new Standards became a statutory requirement for all facility design March 15, 2012 (U.S. Department of Justice, 2010).

The first step to providing accessible facilities, including playgrounds, is the need for an accessible route to the facility, and within the facility to the play events. To access play structures in smaller playgrounds, the Standards allow a transfer platform. A child with mobility impairments who has some ambulatory capability but uses a wheelchair, can challenge their abilities by transferring from the wheel chair to the platform and onto the structure. The Standards also define elevated play and

ground level play, the need for 50% of elevated play being on an accessible route, required numbers of ground level events, accessible play surfacing, and when ramps onto the play structure are needed (U.S. Department of Justice, 2010).

The concept of universal design goes beyond the minimums of ADA. The minimum standards only require one-half of the play elements to meet accessibility requirements, transfer platforms are allowed in smaller playgrounds and accessible loose fill surfacing is allowed. Loose fill surfacing can shift to form humps and rolls if not frequently maintained thereby limiting accessibility. Going beyond the minimum standards includes making all or nearly all play features accessible, providing ramps to the majority of play features, and using highly accessible unitary surfacing on the ground level. Universally designed playgrounds should be designed to give children and people of all abilities access to all elements in a play environment offering play opportunities for those of all abilities (Goltsman, 2011).

2.4 Case Study

The case study of Kids Together Playground in Maria Dorrel Park in Cary, North Carolina provides a theoretical foundation for the pilot study. The methodology used a mixed-method design that combines user observations in behavior mapping with tracking the activities of individual families having a child with a disability, and interviews with the families. The strength of the methodology was the use of behavior mapping to identify and graphically locate the numbers of children using different elements of the play environment including the play equipment, pathways and gathering areas (Moore, 2007).

The playground opened in 2000 as a destination facility occupying approximately 2 acres having a reported construction cost of approximately \$1M. The park is characterized by three large circular pathways that intersect with each other to form the framework of the playground. The research divides the play environment into seven functional use zones that are further subdivided into 12 setting types. A total of 40 settings are identified, including play areas having different types of manufactured equipment, circulatory spaces, gathering spaces, open lawn areas, and a large ground level sculptural dragon (Moore, 2007).

Being a destination facility and much larger than the playgrounds in University Park, Kids Together Park is a good example of a best practices facility. Among the seven functional use zones, the most popular zone was the one having the

horizontal play structure that was ramp accessible. This most popular zone also had the most setting types within it. The study considered the number and combination of play settings along with the higher level of accessibility as contributors to the higher attraction. The research identifies the promise of quantitative analysis and more extensive data sets as a future contribution to understanding the dynamics of behavior in the built environment (Moore, 2007).

3 PURPOSE

The goal of the study was to explore a hypothesis that a playground built to the highest standards of accessibility in terms of the standards of ADA and professional practice will attract more use by all children than playgrounds designed to only meet minimum ADA standards. There is a growing body of evidence reflecting the impact outdoor open space and public parks have in facilitating active living and increased levels of physical activity, with a potential benefit of improving health, reducing obesity, and reducing the cost of public healthcare (Active Living Research, 2010).

There is little research that has examined the contribution of specific amenities to public park use or promotion of physical activity (Kaczynski, 2008). Along with this lack of research is a reciprocal lack of research using direct observation and detailed park evaluations to investigate associations between amenities, use, and physical activity (Colabianchi, 2011). Along with these expressed research needs, no research was found that addressed the value universally accessible facilities or play environments provide to the general public.

The pilot study has sought to fill these gaps and provide a foundation for further research. Support for the hypothesis is thought to benefit both the able bodied and people having disabilities by showing the value universal accessibility has beyond the population of the physically challenged. This has the potential of validating expanded funding for universally accessible facilities by showing benefit to all people in the community beyond those with physical challenges while benefiting the physically challenged as well.

4 METHODS

An informal systematic observation study was undertaken in spring 2012 exploring the hypothesis that playgrounds designed to higher

universal accessibility standards, going beyond the minimum standards of ADA, are more attractive to children of all abilities and to the general population, than are those designed simply meeting minimum ADA Standards. User counts were conducted in the playgrounds of seven parks. One had a highly accessible playground with ramps and other features significantly exceeding ADA, the six other playgrounds were designed to meet statutory ADA minimums.

4.1 Study Setting

This study involved one case and six comparison playgrounds located in the City of University Park, Texas. University Park is a small, 3.8 square mile city, founded in what was rural Dallas County in 1915 and formally incorporated in 1924 (University Park, 2013). It is a bedroom suburb, built around a major private university, approximately five miles north of downtown Dallas, dominated by single family housing of approximately 8,600 homes with a population of 23,500 residents. It is one of the most highly educated communities in the country with 72% of the residents over 25 years of age having college or advanced degrees and property values in the city are among the highest in the nation (University Park, 2013).

The City Parks and Recreation Department operates and maintains eight neighborhood parks in residential areas of the community. Seven of the parks have playgrounds, all built to meet the ADA standards. During an informal interview, the director of parks and recreation had stated that the playground at Coffee Park built in 2009 to the highest standards of ADA accessibility, was reported to have unusually high user traffic. Figure 1 shows the play environment in Coffee Park which is the *case* playground in this study, with the six *comparison* playgrounds built to meet the minimum ADA requirements.

The figure also illustrates the similar qualities of the seven playground environments. While they vary in age, each meet current playground safety and ADA standards, they are well maintained, and are kept in good repair. The playgrounds are all built using equipment from the same playground manufacturer being of the same line and specifications using the post and platform style. Of the playgrounds, six use transfer accessibility and meet the basic ADA standards while the case playground at Coffee Park is designed to significantly exceed ADA standards.



Figure 1. Coffee Park Playground (Case) and Six Comparison Playgrounds, Photos by First Author

The setting presents advantages for this empirical study because the parks are all located in predominantly single family neighborhoods with apparent homogeneous populations allowing to at least partially control for the influence of demographic variables. Functionally, they all have accessible routes to the playgrounds, drinking fountains and toilets, and are within a couple miles of each other. Park features include large mature trees, and a variety of attractive amenities such as water features, tennis courts, picnic areas, and active sports fields. For an informal study, this provides a setting where there is reasonable similarity between a number of environmental variables. Figure 2 shows the location of the parks illustrating their close proximity to one another.

To begin quantifying the differences and similarities between the parks and the playgrounds, some of the basic physical characteristics and demographics have been compiled. Table 1 shows the number of play events, playground square footages, park acreages, surfacing type and demographics within a ¼ mile radius of each park. Data is shown for Coffee Park and each comparison park. Averages are reported for the six comparison parks excluding Coffee Park.

All of the parks are under 10 acres and within the size of a neighborhood park. They range from Curtis Park being the largest park at 9.5 acres to Smith Park being the smallest at 1.9 acres. Coffee Park, at 4.3 acres is slightly below the mean

of 5.8 acres. Demographically, the neighborhood area within ¼ mile of Coffee Park is above the mean of the comparison parks in the number of households and total population but nearly the same in terms of child population as reported by the Esri Community Analyst GIS mapping software (ESRI, 2013). Racial composition of the neighborhoods is very consistent having a mean of 95.5 percent white, with the Coffee Park neighborhood being 95.4 percent white.

The range of numbers of play events in each of the seven playgrounds was a high of 40 at Coffee Park and a low of 16 at Smith Park and Germany Park. The average or mean number of play events was 26 including all seven parks and a mean of 24 in the six comparison parks. Among the seven study parks, the playgrounds at Curtis Park, Caruth Park and Coffee Park, had play event counts above the mean, and were the most comparable in terms of size and numbers of play events.

The square footage (s.f.) of the play areas range from a high of 7,900 s.f. at Caruth Park to a low of 2,900 s.f. at Germany Park with a mean square footage for all the parks of 5,833. This places Coffee Park, at 6,400 s.f., about 10% above the mean. Surfacing used on the playgrounds consisted of five having loose fill engineered wood fiber (EWF) surfacing and two with unitary poured in place (PIP) surfacing.



Figure 2: Coffee Park and Six Comparison Parks

Table 1. Physical and demographic conditions

	Play Events	Playground S. F.	Play Surface*	Park Acres	Households	1/4 Mi. DEMOGRAPHICS Children Under 10	TOTAL Population	% White
CASE PLAYGROUND (n=1)								
Coffee Park	40	6,400	PIP	4.3	567	155	1,147	95.4
COMPARISON PLAYGROUNDS (n=6)								
Mean	24	5,833		5.8	337	152	1,034	95.5
COMPARISON PLAYGROUNDS: Individual counts								
Burleson Park	24	6,500	EFW	5.0	463	216	1,749	91.5
Curtis Park	32	5,700	EFW	9.5	428	177	1,173	96.2
Caruth Park	37	7,900	EFW	7.1	352	190	1,106	97.6
Smith Park	16	5,500	EFW	1.9	308	158	958	97.4
Williams Park	19	6,500	EFW	4.8	68	18	178	94.9
Germany Park	16	2,900	PIP	6.5	404	151	1,039	95.1

* PIP: Poured in place unitary surface; EFW: Engineered wood fiber loose fill surface

** 2012 Estimate from ESRI

The EFW meets the basic requirements of ADA while the PIP goes beyond the standards for a higher degree of accessibility. Parks with PIP surfacing are Coffee Park and Germany Park.

4.2 Data Collection

The principal investigator (PI) undertook a non-random visual count of the users of the playgrounds at each of the seven parks in 2012. Each of the parks was visited on a six mile driving circuit where all of the seven parks could be checked individually within an hour’s time. Users of the playground environment were counted at each facility and recorded as either children or adults.

Teenagers (children over 12 years) were only observed in a few instances congregating separately and were reported as adults. The playground environment was considered to include everyone in the direct vicinity of the playground, including those using surrounding grounds and picnic tables. There was no formal definition of distance from the play area but it was clear who was in the area specifically to use the playground facility. These people were generally within 50 to 100 feet of the playground border. As a result, people of all ages who were on the playground and in the playground environment were counted as shown in Table 2.

Table 2. User counts of case and comparison playgrounds from six observations

Observation	1	2	3	4	5	6	Mean
Date	3/13/2012	3/14/2012	3/16/2012	3/16/2012	3/16/2012	3/18/2012	
Time	11:00-12:00	1:30-2:30	10:30-11:30	11:30-12:30	1:30-2:30	1:00-2:00	
Weather	68°	75°	70°	74°	75°	75°	
	Overcast	Overcast	Overcast	Overcast	Overcast	Overcast	
CASE PLAYGROUND (n=1): Coffee Park							
Children	70	47	43	50	26	18	42.3
Total Users	105	78	69	80	48	35	69.2
Children %	66.7%	60.3%	62.3%	62.5%	54.2%	51.4%	61.1%
COMPARISON PLAYGROUNDS (n=6): Mean of the six parks							
Children	11.7	6.8	8.0	7.2	6.3	3.3	7.2
Total Users	18.8	13.0	13.7	12.8	11.3	6.0	12.6
Children %	61.9%	52.6%	58.5%	55.8%	55.9%	55.6%	57.1%
COMPARISON PLAYGROUNDS: Individual counts							
Burleson Park							
Children	5	4	2	4	2	5	3.7
Total Users	10	9	3	8	4	7	6.8
Children %	50.0%	44.4%	66.7%	50.0%	50.0%	71.4%	54.4%
Curtis Park							
Children	21	12	9	14	16	1	12.2
Total Users	33	21	16	26	27	2	20.8
Children %	63.6%	57.1%	56.3%	53.8%	59.3%	50.0%	58.7%
Caruth Park							
Children	11	15	7	12	7	5	9.5
Total Users	18	27	14	22	14	11	17.7
Children %	61.1%	55.6%	50.0%	54.5%	50.0%	45.5%	53.7%
Smith Park							
Children	9	6	16	10	4	4	8.2
Total Users	17	12	24	15	7	7	13.7
Children %	52.9%	50.0%	66.7%	66.7%	57.1%	57.1%	59.9%
Williams Park							
Children	14	2	7	3	8	5	6.5
Total Users	20	4	11	5	14	9	10.5
Children %	70.0%	50.0%	63.6%	60.0%	57.1%	55.6%	61.9%
Germany Park							
Children	10	2	7	0	1	0	3.3
Total Users	15	5	14	1	2	0	6.2
Children %	66.7%	40.0%	50.0%	0.0%	50.0%	n/a	53.2%

Six rounds of user counts were performed during the spring break week in March of 2012. Observations were conducted on four separate days with a single observation on three of the days and three observations on one day. Three of the four days were weekdays and the fourth was a weekend day. The weather on all days was overcast and humid with the temperatures being between 68 and 75 degrees Fahrenheit. In all of the observations, there were 514 children and 355 adults observed in the play environments totaling 869 persons observed.

Permission to do user counts was obtained from the Director of Parks and Recreation of the City of University Park. At the time of the study, the PI had no affiliation with any university restricting

the ability to analyze confounding variables. With current university affiliation, Institutional Review Board (IRB) review has been obtained and the existing research has been given exempt status by the Texas A&M University IRB.

Generalizability of this study is limited based on the cross sectional design, the numbers of observations, and the single city setting in which it was conducted. Being a pilot study, quantification of other physical and environmental factors was limited. Users were only counted in the playground environments and not in the parks as a whole. No attention was given to recording gender or race for this pilot phase of the research. No contact was made with the playground users to find out their preferences in play, travel choices or any other

attitudinal or perceptual issues. Collection of this data and its analysis will be the subject of future research.

5 FINDINGS

In an effort to create a common denominator between playgrounds of different sizes, user counts were translated into ratios of both children per play event and of all users per play event. Play events include individual elevated and ground level play elements in the playground. Overall, children made up 61.1% of total users in the case park, compared to 57.1% on average for the comparison parks, revealing that more than one in three playground users were adult. This illustrates the need to design for parents accompanying children to the play environment and parents with special needs as well. Table 3 shows the number of play events and use ratios for children and total users in each playground of the study.

The range of numbers of play events in each of the seven playgrounds was a high of 40 at Coffee Park and a low of 16 at Smith Park and Germany Park. The average or mean number of play events was 26 including all the parks and 24 for the six comparison parks. Among the seven study parks, the playgrounds at Curtis Park, Caruth Park and Coffee Park, had play event counts well above the mean, and were the most comparable in terms of size and numbers of play events. In terms of total play events, Curtis Park has 32 play events,

Caruth Park has 37 play events and there are 40 play events at Coffee Park.

Of the parks in the study, Coffee Park and Germany Park had unitary poured in place surfacing. While observations show Coffee Park had the highest mean use ratio of 1.06 children per play event, Germany Park which is also the newest park in the system had a child per play event ratio of 0.21 that was among the lowest of the comparison parks in the city and was about one fifth the use at Coffee Park. Further analysis of other park elements may shed light on this relationship but the observation ratios in this study would tend to discount surfacing alone as contributing to higher use levels.

Figure 3 shows the ratios of mean numbers of children observed at each of the playgrounds per play event on the specific playground. The observations showed the playground facility at the case playground in Coffee Park, had a use ratio of 1.06 children per play event. This is higher than other parks by over three times the average of 0.30 children per play event in the six comparison parks. Of the individual parks, the two most comparable to Coffee Park in size and facility amenities, Curtis Park with 0.38 children per play event and Caruth Park with 0.26 children per play event, showed about one-third and one-quarter the Coffee Park child user ratio respectively. Among the comparison parks, Smith Park, the smallest, showed the highest user ratios of 0.51 children per play event but was still less than half that of Coffee Park. Use ratios at the remaining parks were less than one quarter of those at Coffee Park.

Table 3. Analysis

	Play Events	MEAN USER RATIOS*	
		Children Per Event	Total Users Per Event
CASE PLAYGROUND (n=1)			
Total	40	1.06	1.73
COMPARISON PLAYGROUNDS (n=6)			
Total	144		
Average	24	0.30	0.53
COMPARISON PLAYGROUNDS: Individual counts			
Burleson Park	24	0.15	0.28
Curtis Park	32	0.38	0.65
Caruth Park	37	0.26	0.48
Smith Park	16	0.51	0.85
Williams Park	19	0.21	0.55
Germany Park	16	0.21	0.39

* Mean number of observed users in the play environment per observation, per play event.

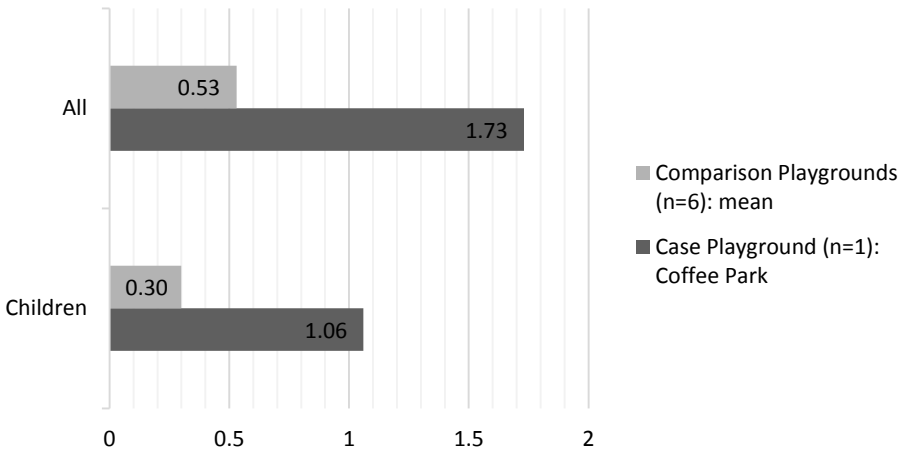


Figure 3. All Users versus Child Users per Play Event in Case and Control Playgrounds

To check the strength of the data, statistical power analysis was done using STATA version 12 with both a priori and a posteriori statistical methods. Analysis was done on the pilot study data using an alpha of 0.05 and power of 0.90. The a priori analysis returned a minimum need for 5 observations of each the case and the control parks to achieve a power of 0.90. The a posteriori analysis of the pilot study data also using an alpha of 0.05 returned statistical power of 0.9734, where a power of 0.80 is considered a large effect (Acock, 2012).

With this being a pilot study having limited numbers of observations, only simple descriptive statistics were applied. Even with the relatively low numbers of observations, the statistical power analysis shows significant strength based on the large spread between the user ratios of the case and control. The magnitude of the spread between use ratios found at Coffee Park in relation with the six comparison parks would give support to the hypothesis that highly accessible play environments have higher popularity among the general population than do play environments built only meeting statutory ADA standards.

6 CONCLUSION

These findings are consistent with one aspect of the case study findings by Moore and Cosco at Kids Together Playground in Cary, North Carolina. Among the seven functional use zones of the study, findings showed the zone having the universally accessible play structure, with ramp accessibility, was the most highly used area in the playground accounting for nearly 40% of the observed use (Moore, 2007). The higher levels of use on the universally accessible play structure is consistent with the observations in this study.

For the purposes of this article, there are two primary differences between the case study and this pilot study. The first is that Kids Together Playground, covering approximately 2 acres, is considerably larger than any of the playgrounds in University Park. It is a playground that would be considered a destination facility of proportions that are beyond that of the ordinary neighborhood or community park. In contrast, the playground at Coffee Park is of more common proportions, built in a neighborhood park setting. The second difference is that the findings at Kids Together Playground are comparing different areas of the same facility (Moore, 2007), where Coffee Park is a separate park on its own, being compared to other parks within the same metropolitan park system.

As a pilot study conducted in a single setting with limited number observations, findings from this study offer only some exploratory insights about the playgrounds' accessibility and use levels. Due to the small sample size and the lack of other available variables, only descriptive statistics are reported in this paper. Although efforts were made to carefully select the study parks to help control for other confounding factors, it is likely that factors other than the playground's ADA characteristics have some influence on the differences in the user count ratios found between the case and comparison parks. Despite these limitations, this pilot study brings attention to the potential and understudied values of highly accessible playgrounds in promoting play activities among all children, which can bring many health, developmental, and social benefits.

Further research that includes a designed research process, combining more structured observational methodologies with demographic and environmental variables, and user attitude

surveys, would be valuable to strengthen the findings. Support found in the user observations for the prime hypothesis would also tend to give support to the thought that accessible design has positive benefits to the general population as a whole. The findings have the potential of contributing to support many inclusive policies and projects in the physical environment as they relate to accessibility, benefiting everybody in the community.

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SERVICE LEARNING AND COMMUNITY ENGAGEMENT

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SKILLS THAT DEMOCRATIC DESIGNERS WILL NEED: THE PLACE OF PARTICIPATION

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1 ABSTRACT

Democratic design is viewed by some within the profession of landscape architecture as an important alternative to traditional design practices and an essential tool to strengthen democracy itself (Liu and Hanauer 2011). However, it is unclear what skills democratic designers will need in the future, but it is important to try to predict the necessary skills in order to develop curricula to prepare practitioners to be successful. The skills are likely to be some combination of ones historically employed by community designers, landscape architects and the people who have recently produced ecological, cultural and technological innovations in the profession (McNally, 2013). Although not easily comparable, there are studies on these three groups gathered for different purposes and at different times, but in similar enough formats to identify emerging patterns of overlap and exclusion and draw speculative conclusions.

This paper attempts to define the skills landscape architects will need to be effective in democratic design by reviewing these studies. First, the skills historically considered important for participatory design are reviewed. Second, the ideas introduced by landscape architects and environmental planners that significantly impacted society in the recent past and the skills shared by the people most responsible for those innovations are compiled (Hester, 2001; Litton et al., 1992; Hester, 1990). Third, these skills are compared to the skills listed as essential in the 2004 Landscape Architecture Body of Knowledge Study Report (ASLA Report) (ASLA, 2004). The skills shared by those who introduced the ideas that have most impacted society, the ASLA Report skills and the historic skills of community designers were analyzed and merged to create a list of skills most essential for participatory designers.

The merged skill sets include the following: 1. Core skills in design/planning, 2. Participatory design theory, group processes and techniques for collaborative design, 3. Political organizing, empowerment and changing power structures, 4. The functions of community as people, place and ecosystem, 5. Environmental justice, need-based

programs, micro social patterns and macro trends, 6. Development of a vision for society, courage of convictions and civic ambition and 7. Mastery of multiple disciplines, employing oppositions to maximize outcomes. This paper discusses the seven skills relative to the skills called for in the ASLA 2004 Study Report, those of participatory designers and those of innovators. In the context of debates about design versus participation, it suggests ways to learn important skills missing from present curricula. The paper concludes with suggestions about how to proceed from these speculative conclusions to better define the skills that democratic designers will need.

1.1 Keywords

democratic design, improving community participation, essential skills

2 CONTEXT

Since Karl Linn and Larry Halprin along with dozens of youthful 1960s idealists introduced participatory processes to landscape architecture, community design and collective creativity have been parts of professional debate. Clearly not mainstream these democratic approaches have often been marginalized and remain somewhat ill-defined (Cooper Marcus, 2013). Within the academy democratic design may be a teaching tool, service-learning or advocacy intervention. Democratic design is variously referred to as community, participatory, transactive or collaborative design. It may focus on environmental injustices related to race, poverty and marginality or broader challenges of democratic societies. This paper embraces both foci, best described as democratic design, an umbrella for multiple approaches that are participatory, transparent, justice seeking and concerned with the form and reform of community and democracy.

In recent years democratic design has achieved privileged status within landscape architectural research producing significant advances in theory (Stokols, 2011; Hester and Chang, 1999) and practice (Angotti et al., 2011; McNally, 2011; Chanse, 2011). There is evidence of distinct approaches (Liu, 2005; Palermo, 2000;

Hester, 1985; Halprin, 1969), nuanced methods (Doble and King, 2011; Organization of Urban Res., 2005) and cultural trends in American society and emerging democracies (Hester, 2012; Hou, 2010). Still within academia there remains tension between participation and design excellence (Hester, 2005; Halprin, 1999). This is partly a quandary over what skills landscape architects will need and which educational priorities should dominate and partly the continuing question about the roles of professionals regarding laypeople in a democratic society (Bowring, 2012; Treib, 2008; Liu, 2005). And there remains the largely unspoken question of what skills community designers lack that would enable them to more effectively transform communities and society. So what skills will be most needed to do participatory design in the future? The paper answers this in a preliminary way that likely will provoke serious discussion among the many academics and few practitioners who are attempting to articulate the skills the next generation will require to advance democratic design.

3 SKILLS HISTORICALLY ASSOCIATED WITH PARTICIPATORY DESIGN

As a historic benchmark regarding the skills needed for doing participatory design, the 1990 study of community designers was used. The analysis of their responses to an open-ended query "What do you perceive to be the essential skills of a community designer?" revealed extraordinary agreement on four factors (Hester, 1990). 73 percent of the respondents listed group process skills to get people to work together to solve problems creatively. 70 percent listed political organizing; 50 percent listed assessing and manipulating the power structure to address environmental inequities. 47 percent listed traditional design skills. There was significant agreement on other skills as well. 40 percent listed communication between designer and users; 37 percent, financial resourcefulness; 35 percent, use of questionnaires and interviews; 33 percent, translating cultural factors into design form; 30 percent, listening; and 27 percent, two way teaching and learning.

4 SKILLS THE STUDY REPORT EXPECTS LANDSCAPE ARCHITECTS TO MASTER

The 2004 Landscape Architecture Body of Knowledge Study Report (ASLA Report) provided a benchmark of the skills considered most important for the practice of landscape architecture. The

respondents, "individuals known to be thoughtful contributors" in education and practice, agreed on four core competencies. These included 1. Analyze relationships among design elements by determining opportunities and constraints, 2. Develop conceptual design, planning and management solutions, 3. Evaluate design alternatives to determine an appropriate solution and 4. Maintain and support professional ethical standards. Then the report describes skills that about half of the respondents felt had to be mastered in the first professional degree including land information sources, natural site conditions, creativity and process including design theory, aesthetic principles of design, accessibility regulations, elements of vehicular and pedestrian circulation, grading, drainage and storm water management and graphic presentation.

Next there are skills for professional practice about which there is little agreement among landscape architects known to be thoughtful contributors. Here is the first mention in the ASLA 2004 Study Report of skills distinctively associated with participatory design. 18 percent of the respondents considered it important to master social and cultural influences on design or design needs of special populations; by comparison, 33 percent of community designers ranked a similar skill as essential. In a post professional context, seven (7) percent of the ASLA Report respondents considered determining users' values through such things as focus groups and surveys as important (ASLA, 2004). This compares to 73 percent of participatory designers who listed group process skills as important and 35 percent of community designers who listed use of questionnaires and interviews as important skills, in response to an open ended question (Hester, 1990).

Caution should be exercised in comparing the results of these two surveys beyond priorities at a general level. But it seems reasonable to conclude that there is agreement between thoughtful landscape architects and participatory designers about the importance of core design skills, and little else. The differences pointed out above are striking. Most notable is the lack of attention that landscape architects are expected to pay to political organizing and redistributing power compared to the highest priorities of community designers. As has been pointed out elsewhere, this unconcern can be explained most simply because landscape architects generally are dependent upon and benefit financially from relationships with clients whose vested interest is the political status quo. It is in this context that Philip Johnson, in describing designers, acknowledged, "We are all

whores”, who sell services, talents or names for less than worthy purposes (Hester, 1975).

5 MOST IMPORTANT IDEAS IN RECENT PAST

This phase of the research included an analysis of literature in landscape architecture and environmental planning completed for a related project to determine what have been the essential ideas landscape architects and environmental planners introduced in the recent past that advanced humanity (Litton et al., 1992). The study considered ideas from the last half of the previous century. Each of the ideas enjoyed an extended period of coverage in *Landscape Architecture Magazine*; most were subject of critical discussion in *Landscape Journal*. These are summarized along with key innovators for each idea.

1. Landscape architecture serves not only private but also corporate interests extremely well and profitably, especially in the efficient and gracious use of space and in expressions of power and identity. Garrett Eckbo and Hideo Sasaki exemplify this innovation; both created firms capable of delivering exceptional design at scales, refinement and complexity to meet the needs of local, national and international governments and corporations.
2. Landscape architects can deliberately apply ecological theory and principles to land use planning and site design to create more resilient cities and regions. This idea was crafted most clearly by Ian McHarg and reformed for urbanity by Anne Spirn. Michael Hough demonstrated how to apply the theory and principles to city scale design. Joan Nassauer showed how to interject this thinking into contentious politics at regional scales. Richard Forman acknowledged the importance of translating ecological theory into design guidelines and joined landscape architects in an effort to merge science with landscape practice (Hough, 1984).
3. Society's very fabric depends on designing and making community and creating environmentally just communities (Gans, 1968). Dr. Martin Luther King, Jr. awakened the nation to the idea that city form from Urban Renewal and Negro Removal to school facilities, bus routes and city freeways through Black neighborhoods could destroy or enhance community and justice. Paul Davidoff responded with a new way to plan, advocacy. Karl Linn showed the role landscape architects could play in creating community and environmental justice through Neighborhood

Commons. Others followed Linn's lead to create what is now called service-learning. John K.C. Liu and Chao Yu perfected this approach in California and more recently in Taiwan and China (Davidoff, 1965).

4. Experiencing wild and cultured nature is essential to health, healing, place attachment, memory, emotional growth and design inspiration. Nature is the most authoritative power for the profession of landscape architecture and environmental planning. Although this had long made intuitive sense to many people inside and outside the profession, only in recent years did systematic research “prove” the various claims about the power of the experience of nature. Geographers and environmental psychologists and later medical professionals recognized the importance of working collaboratively with landscape architecture academics. J.B. Jackson, Ted Relph, Yi-Fu Tuan, Rachel and Steven Kaplan, among others, made direct connections to landscape architecture. Roger Ulrich's work offered empirical medical evidence regarding the relationship between health and nature. Larry Halprin showed how to create powerful places of constructed nature in the city parallel to the advancing research (Relph, 1976).
5. In all these endeavors design matters. Mid-century corporate design was challenged by approaches that stressed ecological, urban, socially concerned and/or participatory design. These approaches produced what high-style and more art-oriented designers considered unsatisfactory projects. Although it remains unclear if this was primarily a matter of subjective and elitist judgments, some important professionals felt that design was being short-changed, even neglected by the approaches that addressed public issues beyond private gardens and corporate interests. Michael Van Valkenburgh represented a new generation trained to consider broad public concerns but still primarily interested in landscape design as an art. He organized an exhibition, *Transforming the American Garden: 12 New Garden Designs*, that announced that design was going to make a comeback. Throughout this time, Larry Halprin proved over and over that skilled professionals could produce the most innovative landscape architecture of the era and address important public issues. Their practices exemplify the elegant resolution of site design and some of the pressing public issues of their times. It is clear that design

matters in addressing critical public problems; it is less clear that design aesthetics that appeal to professional tastes is essential to the public good.

6. Landscape architecture must develop its own technology and approaches to infrastructure, not just rely on engineers and others to produce technology that professionals borrow. Some professionals realized that borrowing indiscriminately from others undermines professional intentions with techniques counter to landscape goals. Jack Dangermond has made the strongest, most publicized case for this. People like Linda Jewell, Bruce Ferguson, Mark Francis and Len Hooper have also advanced technology expressly oriented to landscape architecture (Francis, 2003).
7. The needs of different users are not exactly the same. Wants and needs vary by social class, race, life-cycle stage, home ownership, region, national origin, length of residency and many other factors (Hester, 1975). This requires that designers and planners pay attention to universal and idiosyncratic needs. Users are a source of native wisdom and inspiration, but most designers are not skilled in ways to understand the unique needs or potential inspiration. Herbert Gans, William Whyte, Mark Francis, Robin Moore, Chao Yu, Henry Sanoff, John K. C. Liu and many others have contributed techniques to enable designers to discover and utilize the distinctive needs of different populations. EDRA, and to a lesser extent CELA, attended to the research required to address this issue. Charles Fountain created a program in a historically Black university. Clare Cooper Marcus exemplifies this "discovery" of the different needs of different people. She develops guidelines for designers (Cooper, 1975; Cooper Marcus, 1995).
8. Whereas corporate design undermines deep democracy, participatory design, even done poorly, cultivates informed and responsible democracy. The more skillfully and inventively it is done, the better the outcomes, including the form of democratic places. Larry Halprin and Karl Linn introduced different ways to do participatory design for distinctly different purposes. Daniel Iacofano demonstrates how readily participation produces multiple public benefits (Iacofano, 2001; Halprin, 1969).
9. Power over landscape decisions is increasingly globally networked, and these networks can centralize power in placeless economies that enhance only the "one percent" and/or decentralize knowledge and professional skills

to serve place-based economies that distribute wealth among the other 99 percent. This requires a global perspective. Frances Moore Lappe and publications like *Justice Rising* advocate amendments that would disallow corporate personhood and abolish other barriers to place-based economies. Among designers, Jeff Hou demonstrates mastery in design as a global endeavor to create landscape-based economies (Lappe, 2010).

10. Public serving practice follows infrastructure investment whether in parks, wildlife corridors and preserves, rails to trails, housing, freeways or light rail, parking or anti-parking, antiterrorism or war, flood control or climate change mitigation. Retrofitting infrastructure with multiple purposes can create new economies and more resilient, elastic regions, if the designer has and inspires a vision beyond the immediate situation. Robert Moses showed how to do this with brute power. Joe Edmiston and Rosey Jencks demonstrate more public serving innovations at regional and city scales. Through *Rebar and Parking Day* John Bela and Blaine Merker inspire with grass-roots actions that become international in scope (McNally, 2011).

6 COMMON CHARACTERISTICS OF INNOVATORS

In the next phase of this research, the author identified the characteristic skills shared by the people who introduced these ten essential ideas by considering the skills in the ASLA Report and then adding distinctive skills of the people who introduced the essential ideas. The assumption was that many of the skills needed for landscape architects to significantly contribute ideas that would serve or advance humanity in the near future would be found in the characteristics that distinguished the people with the most innovative and important ideas in the recent past. The issues were not expected to be the same in the future, but common skills might be. These skills could then be compared to the 1990 report on participatory designers and the Body of Knowledge presently articulated in the ASLA Report describing the core skills for landscape architecture education and practice. With the exception of seven people the author knew the innovators well enough to make a preliminary evaluation about each skill. If 80 percent of the innovators the author knew well possessed a skill, that skill made the list that follows. The skills were arranged into three categories: 1. ones shared with the list of most important competencies in the ASLA Report, 2.

ones not listed in ASLA Report but consistent with professional behavior, and 3. qualities that distinguish the innovators' skills from the skills described in the ASLA Report. Comparisons are also made to the skills historically associated with participatory design.

7 COMPARING SKILLS

The first category is the skills shared by innovators and ASLA Report respondents. The innovators who introduced the essential ideas had mastered the four core competencies of landscape architecture listed in the ASLA Report and which participatory designers also considered essential. They all knew how to 1. analyze relationships among elements determining opportunities and constraints, 2. develop conceptual design, planning and management solutions, 3. evaluate alternatives to determine an appropriate solution and 4. support ethical standards. They had mastered both scientific and intuitive methods and possessed common and uncommon sense associated with creativity. Many valued native or local wisdom as well as scientific knowledge. They could conduct extensive research and analysis, but when the time came they were able to act on the basis of incomplete information. They could articulate and effectively communicate their ideas in both drawing and words. Most learned these skills in professional programs of landscape architecture and practice, but some learned them in a related field or from working with landscape architects. Two thirds of the people who introduced essential ideas knew how to design with topography and could do grading and drainage as well as planting plans and construction documents. Like many landscape architects they had also mastered several fields and knew what they did not know but knew where to find it. This is similar, although more encompassing, to the expectation that the first professional degree prepares one to utilize multiple land information sources. And, like most landscape architects and community designers, those who introduced essential ideas got immense daily pleasure in what they did.

The findings that create the second category contrast the characteristics of the innovators, the ASLA Report and the skills of participatory designers. The ASLA Report is narrowly focused and inconsistent with skills of innovators. For example only six percent of participants in the ASLA Report considered attention to emerging trends and issues as an important skill to learn, even in post professional study. In contrast all of the innovators and community designers understood the importance of

the landscape and connected that understanding to a big emerging cultural issue. Similarly all of those who introduced essential ideas and participatory designers possessed a strong and broad personal vision about how the world should be, but community designers often focused primarily on injustices and immediate user desires. Like innovators they paid attention to detail. They also combined ideas from multiple unrelated fields and applied those ideas as an integrated whole to the design, planning and/or management of the landscape. And they seldom whined even in the face of adversity and failure.

There are a number of skills that nearly all of the people who introduced essential ideas possess that many landscape architects possess in part that are not addressed in the ASLA Report. The innovators were expert in social and/or ecological systems and over half were expert in both. In contrast, 27 % of respondents in the ASLA Report considered it important to master ecological planning principles and 18% considered mastery of social and cultural influences on design important in professional practice. Participatory designers historically paid greater attention to social factors and less to ecological factors. All of the innovators had the ability to work effectively both alone and with others in contrast to the ASLA Report which stresses primarily personal technical training; only 18 % in the ASLA Report considered consensus and team building essential and, only as a specialized topic post professionally. Participatory designers depend disproportionately on group problem solving compared to others. It is reasonable to conclude that community designers will be more effective if they develop better skills in critical analysis, independent thinking, and synthesis external to group process.

The third category consists of clusters of distinctive skills of innovators missing entirely in the ASLA Report. These may be named, with some over-simplification, Personal and Political Courage, Grounded Boundlessness and User/Provider Collaboration.

8 PERSONAL AND POLITICAL COURAGE

The first cluster includes personal and political courage of conviction regarding the idea. To incubate and see an idea that truly serves humankind to fruition required (in addition to the above skills) taking a big risk, working harder at the idea than most people worked, being self-critical about the idea and sticking with the idea when it was unfashionable and indefensibly formed. Innovators in landscape architecture could accept

ostracism and were reasonably immune to immediate external gratification. Meaningful contributions resulted from digging deeply, never superficially. Interestingly, innovators, while passionate about their ideas, were able to disengage and abstract it from time to time, often even playfully. They could do this even though their identities were tied to their missions. As the idea took shape, the innovators were savvy in political arenas appropriate to the ideas. Most utilized a full range of political approaches and tactics from education and cooperation to conflict and civil disobedience. In contrast to shrinking violets, often used to characterize landscape architects, the people who introduced essential ideas were rather like Venus Fly Traps. Like innovators, community designers generally exhibit personal and political courage. In the 1990 study 50 percent of the community designer described themselves as having a strong commitment to their principles, but there is little data regarding how they compare with innovators regarding the associated subcategories listed above.

9 GROUNDED BOUNDLESSNESS

Different than the depictions of landscape architects and participatory designers, innovators were simultaneously solidly grounded and intellectually boundless. They possessed a rare combination of confidence in their core fields and compulsion to connect to other alien fields. They knew that solutions to pressing problems lie outside or at junctions of, not inside, specialized fields and were willing to range far beyond landscape architecture. They more easily crossed disciplinary boundaries than most people. They were able to hold multiple, often competing or even mutually exclusive, ideas in their minds at once; eventually they harnessed these conflicting ideas and maximized the strengths of each opposition as a whole, a unity. In contrast to landscape architects who focus on either small scale design or large scale planning, they worked at multiple scales from site to region and beyond, making small scale projects bigger and big scale projects smaller, in order to understand the appropriate roles of both policy and site design interventions.

10 USER/PROVIDER COLLABORATION

Although the idea likely originated in some subconscious passion and a rigorous search across disciplines, each of the people who introduced an essential idea diagnosed and solved a problem accurately by considering the issue from the points of view of both the service providers and

the users. They did this through direct participation with or research about the provider and user. They answered the critical questions of “what does the designer need to know that the users already know?” and “what do the users need to know that the designer already knows?” Often this inquiry led to a discovery itself and, in almost all cases, enabled the innovator to implement the discovery. Successful implementation depended upon the development of a precise technology suitable for widespread use and poetic enough to enable providers and users to communicate effectively. This made some invisible problem, and often some invisible professional innovation, visible and explained exactly how to go about solving it. Often this was done through a publication like McHarg’s *Design with Nature*, Halprin’s *RSVP Cycles* or Francis’ *Case Study Method*. In other cases short courses trained providers and users to work collaboratively, expanding the knowledge of both. This required convincing providers and users that the problem was serious, that this approach could address it and that working collaboratively would increase the success rate. Also the innovator had to provide a common language and methods to enable collaborative work. This is strikingly like the approach Friedmann (1973) outlined in his theory of transactive planning. Historically this cluster of skills has been among the essential skills of the most successful participatory designers, but it is unclear if these skills are taught or practiced in the diagnostic manner of the innovators.

11 SEVEN ESSENTIAL SKILLS

For participatory designers to be effective in the future their roles, like those who introduced essential ideas in the past, must be meaningful to society in the context of the big challenges society faces; therefore, they will likely need skills unique to those innovators. In addition they will need core skills of landscape architects. And they will need skills particular to the practice of community design. Merging critical capacities from each provides one possible set of skills for the future: 1. Core skills in design/planning, 2. Participatory design theory and group processes and techniques for collaborative design, 3. Political organizing, empowerment and changing power structures, 4. The functions of community as people, place and ecosystem, 5. Environmental justice, need-based programs, micro social patterns and macro trends, 6. Development of a vision for society, courage of convictions and civic ambition and 7. Mastery of multiple disciplines, employing oppositions to maximize outcomes. These skills would empower participatory designers to address real problems

not be decorators, to lead, to develop solutions at site, regional, policy and legislative scales and to demonstrate how to joyfully dwell while coping with overwhelming challenges.

Considering the seven skills above, most professionals educated in landscape architecture and environmental planning can be expected to master the first but to have little experience in the others. Although students focused on participatory design gain a rudimentary knowledge of the other skills if they take courses in social factors, city planning and service-learning, they likely need extensive practice in the three clusters of skills noted above: Personal and Political Courage, Grounded Boundlessness and User/provider Collaboration. How can these skills be better developed? Here the author will speculate on techniques that might be useful (and playful) ways to gain skills that seem missing in present academic curricula. These come from creative sources mostly outside the landscape profession. If you are offended by them, notify the author or propose your own.

12 GAMES TO DEVELOP COURAGE OF CONVICTION

The landscape architecture profession has been described as caring, passive, nurturing, conflict averse and largely politically naïve and ineffective (Cooper Marcus, 2013; Cranz, 1992; Saegert, 1980). Community designers and the people in the profession who introduced the essential ideas that served society in the recent past possessed additional qualities. They understood civic responsibility. Many of them exhibited not only caring but also public courage. Not all of the innovators engaged public debate directly, but more than half did. Almost all experienced conflict with some public or academic group. Developing and implementing ideas to meet big challenges changes public action that generates controversy. This requires taking big risks in the public realm, unusual courage of conviction and political savvy. Effective use of power interpersonally and in the public arena is one key to successful political intervention. Political savvy derives from understanding power systems and a willingness to use the full range of political tactics from collaboration and facilitation to conflict generation and resolution and civil disobedience. Many landscape architects and community designers rely excessively on accommodation to avoid disagreement (Forester, 1988; Alinsky, 1971).

How does one unlearn constant conflict avoidance and learn how to exercise power

effectively, fairly and in caring and healthy ways? This cluster of skills requires practice just like designing a park, grading a site, learning plants suitable to a region or running the marathon. If landscape architects are to be effective in addressing big challenges, they need to begin early in life to practice the exercise of power in the public domain. Old-fashioned debate societies, product boycotts, Student Council, civics classes and Chamber of Commerce leadership courses provide basic training in civic leadership.

To overcome the fear of conflict Eleanor Roosevelt urged everyone to “Do one thing every day that scares you.” James Scott (2012) is more explicit. He suggests doing a set of daily calisthenics to prepare oneself for big stakes political struggle. Scott argues that without daily practice in small conflicts, one will wilt in the face of significant opposition. He chose jay walking as a safe way to practice civil disobedience, and even that was not easy. Variations including experiential sustainability games, attack on privilege, exclusion, conflict role play, fantasy power pushups and participation with a view might train landscape architects who want to effectively practice community design with the discipline of the Marines, the physical strength of rock climbers, the inner strength of Yoda, the political will of Robert Moses and the political vision of Dr. King.

A course in participatory design could easily incorporate such skills in productive conflict as well as cooperation. Students could learn to be more fully engaged in volatile political field work situations riddled with conflict. During the budget debates about reducing spending on California higher education Marcia McNally helped students make piggy banks and organize the piggy-bank protest during which they intercepted officials at public meetings and begged for pennies or loose change for higher education. Their protest was carried to the Legislature in Sacramento. For many students this was the first assertive public political action they had taken, and it was scary. It also was good practice (Green, 2010). Participatory theory is most effective when combined with the experience of conflict.

Courses in environmental policy and law provide essential background. Professional practice courses might focus on civics, public procedures and leadership from Robert’s Rules of Order and Alinsky to working with agencies and creating non-governmental organizations. Among the readings, Frances Moore Lappe’s *Liberation Ecology* and *Getting a Grip 2* (Lappe, 2010; 2009) might be required to put personal action in its larger context. Mapping power should be a step in every

design project (Hester, 2006). It might also help at liberal universities to make the structure of landscape architecture and environmental planning curricular clear, rigid and distinct enough that students can rebel against it and develop personal manifestoes that require real courage to articulate and act upon.

13 PRACTICING GROUNDED BOUNDLESSNESS

The people who introduced essential ideas were grounded in core skills but knew that solutions to meaningful problems lie outside or at junctions not inside specialized fields. They combined ideas from multiple unrelated disciplines. They worked at multiple scales, harnessed opposing mutually exclusive forces and maximized each in a single unified concept. Again practice is required to master this capacity.

One way to achieve this is to organize education in landscape architecture and environmental planning around Systems Theory and sampling. This builds on the claim that landscape architects are most effective as generalists but with specific core skills. An essential first step is to overcome the schism between landscape architecture and environmental planning. The former may be governed by aesthetics and the later by ethics, but they are indistinguishable in the societal context. To produce effective professionals they should share a common curriculum requiring topography, grading, drainage and environmental law and policy. This would also serve to dispel the misperception that participatory design is limited to small projects. Participation depends upon the type of government, not scale. Participatory designers prefer democracy, including the right and responsibility of citizens to engage in making the public sphere. Some landscape architects prefer a technocracy, unchallenged by citizens or democratic process; most benefit from **a corporatocracy that pays well at ecological and cultural expense. In a democracy, scale is not the limiting variable.** Transactive design mastery is. Mastery requires dedicated practice, and landscape architects usually start at the small park or garden scale before implementing larger commissions. Participatory design is no different in this regard (Palermo, 2000).

Malcolm Gladwell (2008) concludes that it requires 10,000 hours of practice to master something. It is reasonable then to expect mastery of basic core skills plus three or four other fields of expertise by graduation with a first professional degree. Candidates for degrees might demonstrate

by exam this multi-mastery and how each of the three or four areas as a whole will address one of society's big challenges at multiple scales, using native and scientific approaches. The value of this is presently expressed by three year graduate programs where at least two distinct fields will be mastered and by dual degree programs with city planning and architecture. To accomplish the goal of dealing with irreconcilable oppositions requires dual degrees in far more diverse disciplines like medicine, statistics, real estate economics, law and anthropology.

Applying Gladwell's outlier calculation to a professional career, continuing education would enable the mastery of at least 25 more distinct capabilities. To achieve this all landscape architects must learn how to teach scientists and citizens to work with them. The goal would be to become a Jack or Jill-of-all-trades and a master of 30.

The curriculum could introduce this way of imagining grounded boundlessness by teaching juggling with different objects to practice handling oppositions. The foundational idea is that the next generation prides its ability to multi-task; they can text, eat, sleep and take notes in class simultaneously, so they should be able to learn multiple skills and address conflicting topics at once. For example hand graphics and computer spatial analysis could be taught as one class. Plant identification and participatory techniques could be taught as another. At Chung Yuan Christian University (CYCU) Big Tree Classroom teaches landscape architecture freshmen site design, social/ecological factors and community participation simultaneously. Students then consider these a whole system from the beginning and do not perceive these as opposing or segmented forces. CYCU freshmen learn theory and application of ecological and cultural community first hand from living in an Aboriginal village whose culture establishes status from rat to bear hunting. An internship in farming, forestry or fishing might similarly teach hands-on systems thinking.

14 USER AND PROVIDER TRANS-ACTIONS

What is participation anyway? The people who introduced essential ideas possessed participatory skills but employed them differently than participatory designers. Each diagnosed a problem by considering the service provider and the end user through direct participation and/or research. Then they developed technology suitable for widespread use, trained professionals and users to work collaboratively expanding the knowledge of

both and creating much better informed results. The need for direct communication between the landscape professional and users parallels an emerging awareness in medicine of the importance of making the black box of professional skills transparent and improving professional–user communication for better problem solving. Intermountain Health is a leader in this movement, concluding that they save \$250 million per year and 1000 lives through an intensive transparent collaboration between doctors and patients. At Dalhousie University a new medical curriculum includes a Critical Thinking Program that exposes 50 biases of doctors that lead to incorrect diagnoses. Then they train doctors to 1.Listen better to patients and 2.Teach patients enough language that they become partners in solving their problems. This collaborative skill is central to the future of medical curricula and may need to be required in the core of any professional education that hopes to address important challenges in the future (Landro, 2013). Those who teach participatory design may find instruction in the approach the innovators employed and may need to rethink which participatory skills are most important and how to develop and improve them.

15 CONCLUDING THOUGHTS: LIMITS AND NEXT STEPS

I set out to understand what skills young landscape architects will need to be effective in democratic design as it is evolving. I know many of the skills required fifty years ago are still essential, but some have been superseded, and new ones are emerging to address changing needs. I used what information regarding skills that I could find. What I found could be compared, culled and synthesized but only with creative interpretation. The “data” did not lend itself to reduction. It required comparing apples and oranges as one insightful reviewer pointed out. I would add a third, paw paws. Each was picked up and put in a basket.

Through the effort I discovered seven essential skills. And I offered suggestions as to how some of those skills might be learned: the challenge of “teaching” courage, reconciling paradoxes of specialization and collaborative boundlessness and learning from other professions that more recently than landscape architecture have discovered value in participatory action. In retrospect I acknowledge that my concern for the future of democratic design and my curiosity about skills combined with the various unrelated resources and my method of integrating them creates a disjointed argument. The urgency of this subject required “risky” research to initiate a more inclusive discussion and possibly

more conventional research by others in the future. One reviewer suggested “a more systematic manner of research, e.g., surveys, interviews, focus groups etc.” That reviewer went on to urge that academics and professionals should place skills in the context of philosophical and theoretical frameworks in which democratic design is grounded. I agree.

Undertaking systematic research begs for a collaboration of young scholars combining social science skills and community design practice with ethical and theoretical thinking. I hope this paper inspires this research.

The question of essential skills needs to be debated and thoughtfully processed in a participatory process, possibly through focus groups, possibly through a Delphi probe. Others are organizing such efforts in the ASLA, CELA, the Democratic Designers in the Pacific Rim and EDRA. This paper may contribute one framework for these critical discussions. Participatory design will continue to distinguish democratic societies, but, to thrive, both democracy and participatory design will have to reverse corporate control of the political process, compensate for their shortcomings and strengthen their own capacities. This requires combining skills in landscape design and planning, traditional skills of community design and distinctive skills of innovators.

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SUSTAINABILITY

Edited by Mintai Kim

INTEGRATING LANDSCAPE ECOLOGY AND URBANISM IN TRANSPORTATION CORRIDORS DESIGN AND DELIVERY: AN AUSTRALIAN CASE STUDY

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1 ABSTRACT

The potential of infrastructure systems for performing the additional function of shaping architectural and urban form and helping ecology of the city is largely unrealized. The planners and designers have most often been charged with hiding, screening and mitigating infrastructure. The interrelationships between ecological and landscape urbanist approaches and engineering practice in planning, design and delivery of transportation corridors, i.e. urban highways are studied in the current research in order to find out how and to what degree these can be integrated in planning, design, construction, and operation process and help the project sustainability and multiple functions. Novel approaches to road infrastructure development indicate a shift in values from a traditional engineering approach and instead adopting an urban design and landscape approach to the development of road and related transport infrastructure. This approach helps the sustainability of these projects in the urban context. In order to determine the values of urban built infrastructure, specifically movement corridors, at the scale of an urban project, a case study is conducted on EastLink, a large scale infrastructural transportation project in Melbourne, Australia, to present a framework for observing and mapping actual design and delivery process. The case study is done using Infrastructure Sustainability (IS) rating scheme developed by the Australian Green Infrastructure Council (AGIC), recently renamed to Infrastructure Sustainability Council of Australia (ISCA). As a result, the research presents an approach for urban infrastructural projects based on the sustainable development principles and provides an argument for assisting planner, designers, and builders of urban infrastructure to enhance them from an ecological and urban perspective in interaction with other urban land uses for multiple functions at regional and local scales. The results of investigating the influence of large scale infrastructural projects on the ecology of cities, and their interrelationships with ecological concepts and methods can be used by built

environment professions to present new planning and design frameworks. Considering the complexities of infrastructure projects, built environment professions including landscape architecture can help in the process of integrating landscape ecology and urbanism approaches in transportation corridors design and delivery.

1.1 Keywords

infrastructure, transportation corridor, landscape ecology, landscape urbanism, sustainability

2 INTRODUCTION

“Infrastructure, no longer belongs in the exclusive realm of engineers and transportation planners. In the context of our rapidly changing cities and towns, infrastructure is experiencing a paradigm shift where multiple-use programming and the integration of latent ecologies is a primary consideration. Defining contemporary infrastructure requires a multi-disciplinary team of landscape architects, engineers, architects and planners to fully realize the benefits to our cultural and natural systems” (Aquino et al., 2011).

As an intrinsic characteristic of urban infrastructural plans, many disciplines and factors influence the planning and design of urban infrastructure and numerous criteria should be taken into consideration during their design process and a team of experts should utilize and integrate their expertise in the a project design and delivery. The significant roles of landscape architecture, landscape ecology and landscape urbanism in the urban infrastructure design process are the core of this research to find out how urban infrastructural projects can be built more sustainably and multifunctional.

3 BACKGROUND AND LITERATURE REVIEW

The potential of infrastructure systems for performing an additional function of shaping architectural and urban form and helping ecology of the city is largely unrealized. The planners and

designers have often been charged with hiding, screening and mitigating infrastructure. They are rarely asked to consider infrastructure as an opportunity. Infrastructure has the capacity to serve as the material of design or establish a local identity with tangible synergic relationship to the region. It can be designed with a formal clarity that expresses its importance to society and environment, at the same time creating new layers of spaces and connections (Strang, 1996).

The landscape urbanism is a recent school of thought in design and planning (Weller, 2008) and urban landscape ecology investigates the structural and functional interrelationships between the abiotic, biotic and cultural aspects of the environment (Forman, 1995a, Forman, 1995b, Forman, 1998, Niemela, 2011). These approaches can provide the theoretical background for the study of urban infrastructural projects due to the numerous factors and elements that influence these large scale plans. These projects are where landscape, ecology and urbanism (Mostafavi et al., 2010, Mostafavi and Najle, 2003) can meet to increase the ecosystem services at the landscape scale (Müller et al., 2010).

Approaches such as urban design approach to road infrastructure development (Raeburn, 2005) indicate a shift in values from a traditional engineering approach and instead adopting an urban design and landscape approach to the development of road and related transport infrastructure. While achieving its transport objectives in moving people and goods, road networks and infrastructure projects should contribute to the form of human settlements and their accessibility. Raeburn (2005), using several case studies in Australia, emphasizes that such projects should regard the natural ecology as well as the built, natural and cultural heritage by taking urban design approach.

Similarly, landscape ecological thinking can potentially play important roles in the planning and designing urban infrastructure and landscape architecture can act as a driving force for physical application of the ecological principles in such urban projects. Ideas such as green infrastructure (Benedict and McMahon, 2006, Davies et al., 2006, Gill et al., 2008, Ignatieva et al., 2011) and urban infrastructural design (Bélanger, 2009, Meyboom, 2009, Strang, 1996, Tatom, 2006) increasingly confirm the crucial roles of landscape and landscape architecture in urban infrastructure. The interaction of ecological sciences and methods such as landscape ecology, landscape architecture and urban design seem as a logical solution for solving many of the today's environmental

concerns. Figure 1 shows these interactions and the position of built environment profession and their fields of activities.

For example, in "Green Infrastructure: Connected and Multifunctional Landscapes", UK Landscape Institute states that green infrastructure (GI) needs to be taken as seriously as the more familiar "grey infrastructure" of roads, railways and power lines. Green Infrastructure represents an approach to land use that emphasizes multifunctional and connected spaces, underpinned by the concept of ecosystem services and recognizes the many benefits that are generated by natural ecosystems (Landscape Institute, 2009).

In the utilitarian approach to urban infrastructure design, the blue (water), grey (urban built) and green (natural or built) infrastructure for the cities are mostly designed separately at different periods of time or are planned and utilized incompatibly. Sometimes the green infrastructure is built after a long time of the initial grey and blue infrastructure. Very often the grey infrastructure destroys environmental potentials during construction. The urban built infrastructure can provide other opportunities for landscape architects similar to that of the natural infrastructure in the city. In other words, the transportation systems across landscapes, including urban landscapes, can provide ecological flows and biological diversity in addition to safe and efficient human mobility (Forman and Deblinger, 2000). Therefore, in investigating the influence of large scale infrastructural projects on the ecology of cities, ecological concepts and methods can be used by built environment professions to present new design frameworks.

4 GOALS AND OBJECTIVES

Due to the vital and inevitable roles of both natural and built infrastructure in the livability of the cities, an integrated approach towards designing and building the infrastructure is necessary and landscape urbanism and ecological approach can be of great help to solve this problem by their comprehensiveness to bring the potential services and roles of the ecologically designed infrastructure into urban environments. The current research tries to find out how urban infrastructure can be designed more ecologically sound, sustainable, and responsive to the urban environment based on landscape ecological/urbanist approach. In ecological urbanism studies, there is a gap between the concepts and methods presented in the ecological sciences and the current planning and design process.

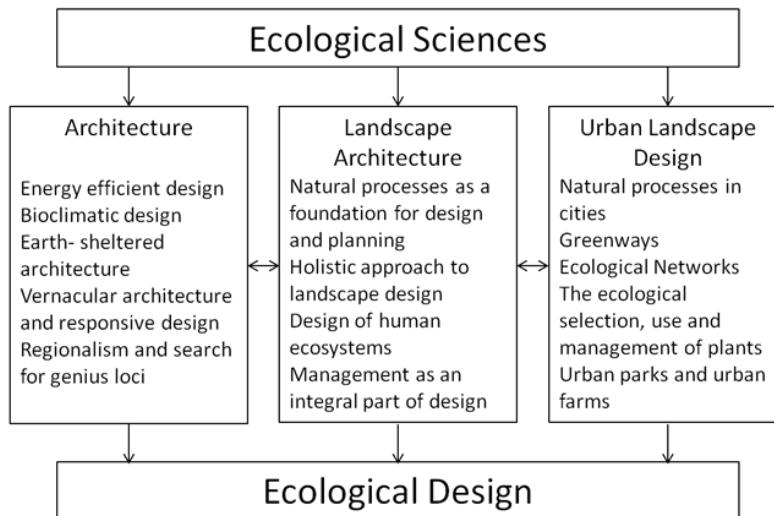


Figure 1. The Interface of Ecology with Architecture, Landscape Architecture and Urban Landscape Design (Makhzoumi and Pungetti, 1999 p.192)

The research tries to fill this gap and more specifically focuses on built urban movement corridors, i.e., highways within urban settings.

The research is seeking to answer one basic question; "How can urban infrastructure, specifically movement corridors, be designed to improve the ecology of the city, and delivered in practice?" Within a landscape ecological approach in urban infrastructural projects, the environmental features and processes play important roles and should be considered in the design and delivery process of built infrastructure along with engineering factors. The main focus of this research will be on the built corridor and the natural aspects will be studied according to their relationships and impacts on and the form and function of highway corridors. The main goal is increase the attention to ecological features of infrastructure projects and their integration with other aspects and features followed by a discussion of ideas and providing new perspectives to infrastructure planning and design.

5 MATERIALS AND METHODS

In order to evaluate the effectiveness of the design and delivery of a built infrastructural project in an ecological sense, a case study is conducted and several aspects including ecologically important landscape elements and urban features and their functions in the project are studied and analyzed using IS (Infrastructure Sustainability)

rating scheme. The current research will explore the theoretical and practical knowledge in that field of activity in EastLink, Melbourne, Australia.

EastLink, a large scale infrastructural transportation project in Melbourne, is regarded unique and extreme by the authorities and can be considered as a critical case in theorization of the ecological urban design and delivery framework. The project is the largest road ever constructed in Victoria and Australia's largest urban road project. It is an integration of both built and natural features and it is also a fundamentally important connecting element to the eastern part of the city region and acts as crucial urban transportation corridor, a vital connection for 1.5 million people living in Melbourne's eastern and south-eastern suburbs, completed and opened to traffic in 2008 (Figure 2).

Many recent environmental considerations are applied in its design and construction process regarding the contextual natural and built features including wetlands and water quality treatment systems and tunnels to preserve parklands. The 39km motorway is connected to the surrounding urban fabric by a network of bridges, cycling and walking pathways. The project involved construction of 45km of new roadway including 6km of bypass roads and 35km EastLink Trail for walking and cycling. More than 3.6 million plants are being used along the corridor in an area of 480 hectares which is larger than the parks and gardens in the City of Melbourne combined.

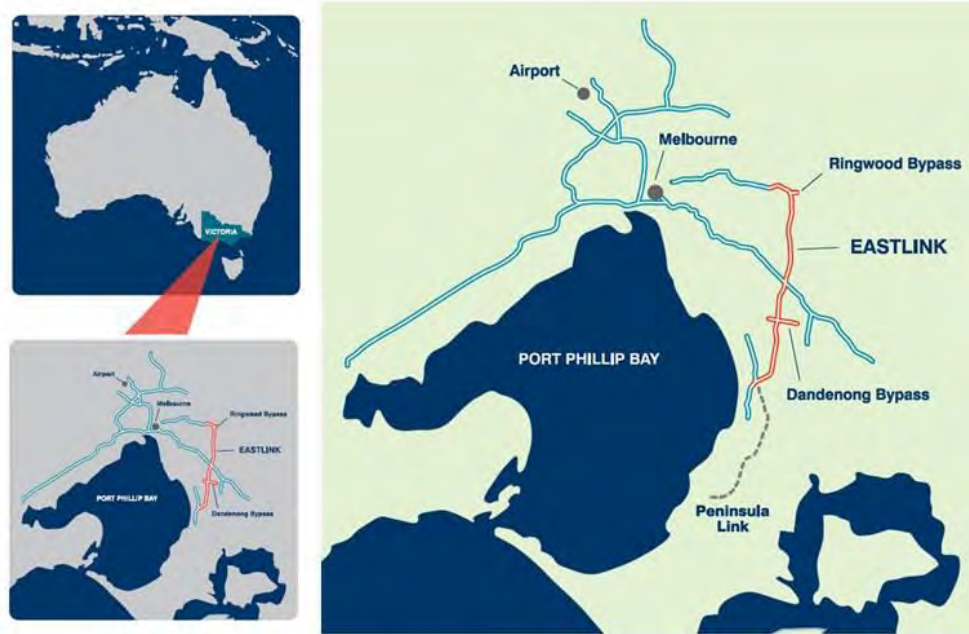


Figure 2. The Location of EastLink in Melbourne, Australia (<http://www.linkingmelbourne.vic.gov.au>)



Figure 3. EastLink Project and Its Relationship to the Environmental Context (<http://www.connecteast.com.au>)

More than 60 wetlands and water quality treatment systems are located along the way to treat water runoff from the motorway. The 1.6km Melba and Mullum Mullum Tunnels preserve the Mullum Mullum Parkland above, including significant Valley Heath Forest species. A natural wetland was successfully relocated during the construction phase (<http://www.eastlink.com.au>). From a landscape architectural point of view, it has been awarded by the Australian Institute of Landscape Architects (AILA) for the landscape architecture and urban design section of the project (Figure 3) and landscape architects were very

occasionally and actively involved during different phases of the design and delivery process.

EastLink incorporates an extensive shared use path network for cyclists and pedestrians, which will connect with Melbourne's existing paths. The pathway route was refined after an extensive review process involving discussions with the Department of Sustainability and Environment (DSE), VicRoads, Bicycle Victoria and representatives from city councils and local environmental groups. Several walks through the area were conducted with these groups to identify further small areas of sensitive plant life. As a result of these inspections, a final pathway design was



Figure 4. Wetlands along EastLink for Water Retention, Infiltration, Wildlife Habitat, And Recreation (Author 2013)

determined which protects areas of greatest ecological significance.

The shared use path route through the valley section of EastLink will stretch 2.75 kilometers. ConnectEast, the owner and operator of EastLink, established around 70 constructed wetlands, water retention basins and bioretention strips along EastLink’s route, representing a degree of wetland provision unparalleled for a roadway project of this magnitude in Australia. These wetlands function as a north-south string of new aquatic habitats within the road corridor, connecting to existing waterways, drainages and creek channels (Figure 4). The wetland ponds will create a safe ecosystem for frogs, water birds, insects and small mammals in these areas. They have been designed for the capture and treatment of all road

surface water run-off throughout the freeway standard motorway. The series of wetlands has been designed to accept all of this water before it is safely released into the waterways nearby.

The case study is done through a post-construction evaluation using IS (Infrastructure Sustainability) rating scheme which is developed and administered by the Australian Green Infrastructure Council (AGIC). IS pays special attention to planning/design phase and evaluates this phase as a separate section of the rating tool in addition to construction and operation phases (Figure 5). The three modes of the rating tool (Design, As Built, and Operation) cover a wide range of multi-criteria and multi-functional aspects of infrastructural projects.

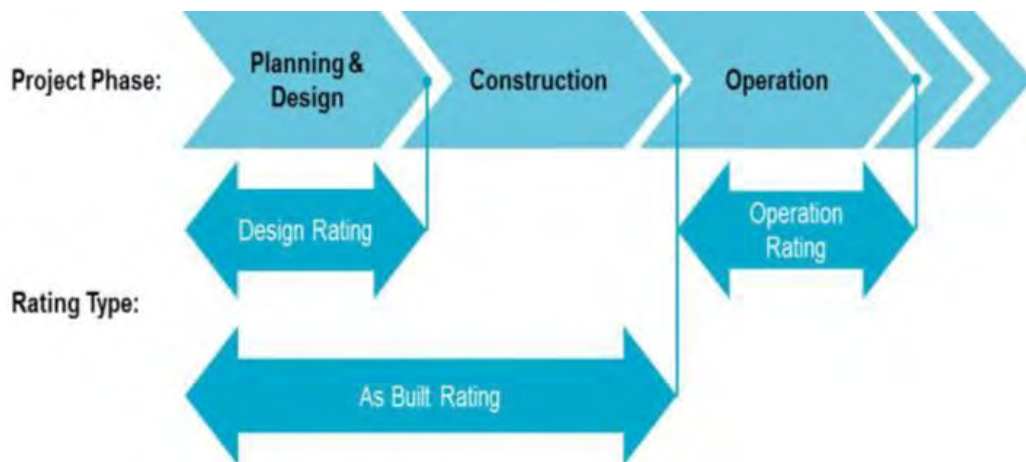


Figure 5. Different Modes of IS Rating Tool and Project Phases (<http://www.agic.net.au>)

6 RESULTS

As the sustainability of the infrastructure gains increasing attention worldwide (Pollalis et al., 2012), many stakeholder in Australia feel the need for a new trajectory and paradigm shift in their projects. IS rating tool is developed by AGIC to influence infrastructural design, construction and operation. Infrastructure Sustainability is similar to Leadership in Energy and Environmental Design LEED (United States Green Building Council, 2009), Envision rating tool (Harvard University Graduate School of Design, 2010) applied by Institute For Sustainable Infrastructure (ISI) (www.sustainableinfrastructure.org), and Sustainable Sites Initiatives (SITES) (American Society of Landscape Architects et al., 2009). However, different types of LEED cover a wide spectrum of projects and spaces, SITES is basically designed for sites and landscapes, Envision and IS are specifically designed for infrastructural plans and projects.

The IS rating scheme has the following 15 categories of measures and a number of sub-categories and credits in different physical, biological and cultural themes (<http://www.agic.net.au>).

- 1- Management Systems (Man)
- 2- Procurement and Purchasing (Pro)
- 3- Climate Change Adaptation (Cli)
- 4- Energy and Carbon (Ene)
- 5- Water (Wat)
- 6- Materials (Mat)
- 7- Discharges to Air, Land & Water (Dis)
- 8- Land (Lan)
- 9- Waste (Was)
- 10- Ecology (Eco)
- 11- Community Health, Well-being and Safety (Hea)
- 12- Heritage (Her)
- 13- Stakeholder Participation (Sta)
- 14- Urban and Landscape Design (Urb)
- 15- Innovation (Inn)

The IS rating tool uses a 100 point scale to measure performance and this score determines the rating level achieved as follows: Scores <25 points are not eligible to apply for a certified rating.

Scores from 25 to <50 points are eligible to apply for a “Good” rating. Scores from 50 to <75 points are eligible to apply for an “Excellent” rating. Scores from 75 to 100 points are eligible to apply for a “Leading” rating. Available and achieved points and levels are calculated and portrayed in tables and graphically displayed for each mode of the model which is defined for different phases of the project. Site and context analysis, site planning, urban design and urban design implementation and management in the urban and landscape design category of IS rating measures are extremely important from a landscape architectural and urban design point of view. The evaluation criteria at these sections and inform the expertise and ideas that can be brought to design and delivery teams from built environment professions including landscape architects and urban designers.

During the course of the case study, the Environment Effects Statement (EES) from the 1990s, the legislation and acts from 2000s, and project planning and design documents, were reviewed to find out the embedded sustainability and landscape ecological and urbanist concerns. They were used in evaluation and rating of the project. In addition to that, interviews were conducted with different stakeholders, especially designers and planners, who were evolved at different stages of the project. A number of site visits were done as sources of information for the post-construction evaluation and design and delivery process analysis.

After filling out the spreadsheets and tables for different modes of the rating Design (A), As Built (B), and Operation (C) for EastLink, the project achieved 65%, 65%, and 55% of points in each phase respectively (Figure 6). In other words, the project is eligible to apply for an “Excellent” rating. The results can be interpreted for every category of measures and each phase of the project separately and comparatively in more details regarding the references, aims and levels of achievement at IS rating scheme. Detailed calculation and spreadsheets and tables for different modes of the rating are not presented here in the paper but they can be used by built environment professions to point out the shortcoming at each section during different design, construction and operation phases which is an ongoing section of the current research.



Figure 6. EastLink Transportation Corridor Design and Delivery Phases Rating using IS Tool: (A) Design, (B) As Built, and (C) Operation

7 CONCLUSIONS

With the increasing urban population and the need for more built infrastructure to support this population, infrastructure sustainability has become fundamentally important. It has gained much expert attention among different built environment professions and policy makers. The research presents a perspective to design approach for urban infrastructural projects based on sustainability issues and helps to provide a framework for assisting designers and planners of built urban infrastructural corridors, i.e. urban

highways using an applied rating tool. It is aimed to enhance the projects and plans from an ecological perspective in interaction with other urban land uses especially green and open spaces, water features and alternative modes of transport such as walking and cycling, to add to the project’s multi-functionality. In this proposed approach, the whole project and its periphery is regarded as a constructed ecology with many synergies of built and natural elements which need to be addressed in design and delivery process. Many built environment professions including architecture,

urban planning and design in addition to landscape architecture should take this opportunity and use their contemporary tools and methods, such as Geodesign and spatially informed digital knowledge in the process of integrating landscape ecology and urbanism approaches in transportation corridors design and delivery. Landscape architects can play a leading role in this process.

The results of application of the proposed approach are applicable both in planning, design and construction of new projects and evaluation of similar existing constructed projects. The product of considering landscape ecology and landscape urbanism approaches to the urban infrastructure corridors design and delivery is more than just urban "Green Infrastructure", it is about "Greening the Infrastructure", specifically urban built transportation corridors of highways as pathways to urban sustainability.

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LANDSCAPE RESEARCH RECORD

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The *Landscape Research Record* publishes top quality articles selected from manuscripts submitted to the Council of Educators in Landscape Architecture (CELA) annual conference each year. The Record serves the mission of the CELA, that is, to encourage, support and further education in the field of landscape architecture specifically related to teaching, research, scholarship, and public service. The Record contains recent research and scholarship in all aspects of landscape architecture, distributed in the following tracks:

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- Design Education and Pedagogy
- Design Implementation
- History, Theory and Culture
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- Landscape Planning & Ecology
- People-Environment Relationships
- Research & Methods
- Service-Learning and Community Engagement
- Sustainability
- Urban Design

The steps and typical timeline of the peer review are described below.

Abstract Submittal: September

Peer-reviewed article publication on the Record starts from the abstract submittal to the CELA annual conference. The CELA executive office sends out Call for Abstracts around August each year.

Abstract Review: September-October

The Vice President for Research leads the track chairs in the abstract review. Double blind review is used. Each abstract is reviewed by at least two reviewers.

Paper Submittal: January 20-25

Authors of accepted abstracts receive the invitation to submit a full paper in November. The deadline is in January of the following year. The papers submitted at this time are not peer reviewed but only edited to satisfy the conference standard. Papers that do not follow the template of the conference are rejected.

The CELA Annual Conference: March-April

Paper Review: May-June

Papers that are submitted in time in January and stratify the conference standard become eligible to enter the peer review for the publication in the Record. The track chairs manage the review for their tracks and select high quality papers based on the score of abstract review, grammar, completion of study, contribution of new knowledge, format quality, etc. The track chairs then send out selected papers to at least two reviewers.

Review Result and Revision: July

Track chairs collect review results and make recommendations on the manuscripts. Papers that are accepted with revision requirement will be sent back to the authors in July.

Final Manuscript Submittal: August

Authors submit final manuscripts by August 31st. All papers are published by December 31st.

The Outstanding Paper Award: December-March

The CELA Executive Committee has authorized The Outstanding Paper Award for published papers in the Record. The Vice President for Research and track chairs collectively select the winning paper. CELA notifies the winner(s) of the award, which is presented at the following CELA Annual Conference.