Natural play and learning spaces integrated within zoos

by

Meredith Bryan

A REPORT

submitted in partial fulfillment of the requirements for the degree

MASTER OF LANDSCAPE ARCHITECTURE

Department of Landscape Architecture and Regional & Community Planning
College of Architecture, Planning & Design

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Approved by:

Major Professor
Howard Hahn

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Abstract

Time in nature is an essential part of childhood development to gain an understanding and relationship with nature; however, gradually, children today have reduced or limited access and opportunities to be directly engaged in natural environments. This diminishing access is exacerbated by school curricula, climate change, poor city planning, and social factors such as an increased emphasis on work and technology (Ernst 2014; Strife and Downey 2009; Szczepanski et al. 2006). This study aims to address this issue by examining how natural play and learning spaces can be integrated into informal educational institutions such as zoos. More specifically, this study investigates how the woodland natural area adjacent to Sunset Zoo in Manhattan, Kansas can serve as a natural play and learning space for local children. In addition to providing more opportunities for outdoor education, this study also shows how these natural spaces can increase the educational value of zoos. A literature review analysis, program analysis, precedent study, and a projective design were completed to explore this hypothesis. These findings offer more insights into the value of natural play and learning spaces, how they can be integrated into informal educational institutions, and how these spaces can add value to such institutions. The broader outcome of this study is related to its implications in natural play and learning spaces relationships with school curricula and childhood development.

MEREDITH BRYAN
MASTERS REPORT
SPRING 2022

NATURAL PLAY & LEARNING SPACES
INTEGRATED WITHIN ZOOS

Preface

Note: This document is intended to be viewed as a 2-page spread layout and printed double sided.
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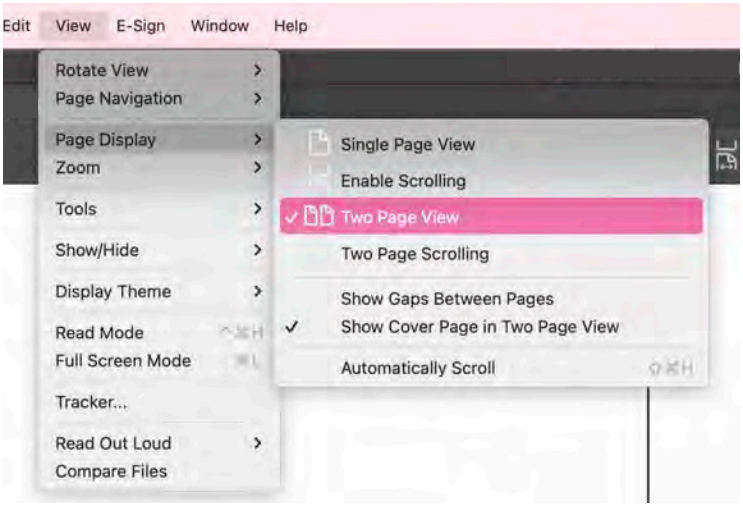

Natural Play and Learning Spaces as an Extension of Zoos

A report submitted in partial fulfillment of the requirements for the degree:
Master of Landscape Architecture

Department of Landscape Architecture and Regional & Community Planning
College of Architecture, Planning & Design
Kansas State University

Master's Project Committee:
Howard Hahn, Associate Professor, Department of LARCP
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ABSTRACT

Time in nature is an essential part of childhood development to gain an understanding and relationship with nature; however, gradually, children today have reduced or limited access and opportunities to be directly engaged in natural environments. This diminishing access is exacerbated by school curricula, climate change, poor city planning, and social factors such as an increased emphasis on work and technology (Ernst 2014; Strife and Downey 2009; Szczepanski et al. 2006). This study aims to address this issue by examining how natural play and learning spaces can be integrated into informal educational institutions such as zoos. More specifically, this study investigates how the woodland natural area adjacent to Sunset Zoo in Manhattan, Kansas can serve as a natural play and learning space for local children. In addition to providing more opportunities for outdoor education, this study also shows how these natural spaces can increase the educational value of zoos. A literature review analysis, program analysis, precedent study, and a projective design were completed to explore this hypothesis. These findings offer more insights into the value of natural play and learning spaces, how they can be integrated into informal educational institutions, and how these spaces can add value to such institutions. The broader outcome of this study is related to its implications in natural play and learning spaces relationships with school curricula and childhood development.

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"For a child to understand something he must construct it for himself, he must reinvent it … if future individuals are to be formed who are capable of creativity and not simply repetition."

—Jean Piaget

ACKNOWLEDGMENTS

It is important for me to give thanks to all those who have helped me get to where I am today in my academic career. First, to my parents and brother, who have supported me through the struggles of design school. Thank you for being patient and supportive as I've grown into my own over the years. Thanks to my Nanny, who passed down her green thumb and creative mind to me. Aunt Anne, thank you for always being supportive and inspiring me to explore the world. My classmates, who have become some of my best friends and design critics of several of my half-baked ideas.

I would not be able to get my work done without the continual support and vision of my major professor and committee members, Professors Howard Hahn, Jessica Canfield, and Bronwyn Fees. Thank you so much for your support.

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Figure 1.1 Children's nature walk in Discovery Park (Seattle Municipal Archives 1978). Used under Creative Commons Attribution Non-commercial

CHESSINGTON ZOO

COMBINED RAIL AND ADMISSION TICKETS FROM MOST SOUTHERN ELECTRIC STATIONS TO CHESSINGTON SOUTH, KINGSTON SURBITON OR LEATHERHEAD

CIRCUS

Indoor Model Railway & Miniature Railway

Pets Corner & Playground for Children

60 Acres of Grounds ⋆ Military Bands in Summer

Historical Mansion ⋆ Aquarium

Licensed Bars, Cafés & Restaurant

DOGS ARE NOT ADMITTED TO THE ZOO

BRITISH RAILWAYS

A.D.6405/4

CHAPTER 1

INTRODUCTION

ABSTRACT

Time in nature is an essential part of childhood development to gain an understanding and relationship with nature; however, gradually, children today have reduced or limited access and opportunities to be directly engaged in natural environments. This diminishing access is exacerbated by school curricula, climate change, poor city planning, and social factors such as an increased emphasis on work and technology (Ernst 2014; Strife and Downey 2009; Szczepanski et al. 2006). This study aims to address this issue by examining how natural play and learning spaces can be integrated into informal educational institutions such as zoos. More specifically, this study investigates how the woodland natural area adjacent to Sunset Zoo in Manhattan, Kansas can serve as a natural play and learning space for local children. In addition to providing more opportunities for outdoor education, this study also shows how these natural spaces can increase the educational value of zoos. A literature review analysis, program analysis, precedent study, and a projective design were completed to explore this hypothesis. These findings offer more insights into the value of natural play and learning spaces, how they can be integrated into informal educational institutions, and how these spaces can add value to such institutions. The broader outcome of this study is related to its implications in natural play and learning spaces relationships with school curricula and childhood development.

Figure 1.2 Chessington Zoo Poster.
Source: (Sheppard 1952). Used under Creative Commons Attribution Non-commercial.

PURPOSE

This research aims to directly support children's experiential learning in nature, increase children's physical activity, support environmental literacy in children, create opportunities for children to learn about and observe nature, and expand opportunities for educational programming in zoos. There is a significant lack of opportunity for children to spend time in nature (Strife and Downey 2009). Settings for outdoor play and exploration must be deliberately and intentionally created today, due to poor city planning, climate change, lack of importance in educational curricula, and social attitudes (Ernst 2014; Strife and Downey 2009; Szczepanski et al. 2006).

Though zoos are valuable educational hubs, this research suggests that integrating natural play and learning spaces will add significant educational value. Currently, zoos rely on interactive exhibits and signage as their primary educational method. Interactive exhibits in zoos are highly attractive for visitors, but the educational success of these exhibits is dependent on the careful design of the experience. To create an active prolonged engagement, designing not only a "hands-on" but also a "minds-on" experience is essential (Schwan, Grajal, and Lewalter 2014). Researchers conclude that being in natural environments proposes more opportunities for these "minds-on" experiences due to distinctive opportunities, motivations, and barriers only found in nature (Ernst and Tornabene 2012). For this reason, introducing a natural learning space will allow for an overall more engaging educational experience.

Nature Play & Learning Places is a guideline book that has inspired much of this project's direction. This book is a "cultural call to reframe childhood and nature, to create new types of places where children can enjoy nature play," (Moore 2014, 19). Sunset Zoo and its adjacent natural area offer an outstanding opportunity to create a space for connecting children with nature. This project produced a set of effective design considerations and a typology model for a zoo extending and integrating its programming into a natural play and learning space. This research project and its outcomes can be particularly informative to design professionals, zoo system managers, program developers, and educators.

PROBLEM

Zoos have the unique ability to provide environmental and conservation education to large numbers of people, but many fall short of this central goal (Patrick et al. 2010, 58). Currently, zoos educate visitors through animal exhibits in controlled environments. This study explores how extending the educational mission of zoos to include direct engagement with the natural environment can reinforce and improve the education offered by zoos.

RESEARCH QUESTION

How can zoos extend their educational experience to include direct contact with and observation of a natural environment to reinforce the education that is initially introduced through controlled exhibits? How can this expanded opportunity support K-12 science standards?

Figure 1.3 Children experiment outdoors from the Virginia Department of Conservation (2009). Used under Creative Commons Attribution Non-commercial

GLOSSARY

Nature play and learning place: “A designated, managed area in an existing or modified outdoor environment where children of all ages and abilities play and learn by engaging with and manipulating diverse natural elements, materials, organisms, and habitats, through sensory, fine motor and gross motor experiences,” (Moore 2014, p. vii).

Environmental Education: Refers to the educational topic of exploring environmental issues, how they function, and how human behavior impacts ecosystems. These lessons can take place in traditional classrooms, nature centers, museums, parks, and zoos. This research investigates on-site, outdoor environmental education. Educational experiences in the landscape can “animate the often-abstract concepts of the subject disciplines, and thereby create a local, ecological, historic, physical and social sense of place among children, students, and teachers,” (Szczepanski et al. 2006, 18).

Environmental Inequality: Inequitable access to green space due to poor urban planning and policy. Consistently, poor people and racial/ethnic minorities are disproportionately burdened with environmental inequity (Bowen 2002).

Activity Settings: Subspaces or elements within a nature play space that have the potential for a learning activity. Examples of activity settings include outdoor classrooms, educational gardens, or observation decks (Moore 2014).

Figure 1.4 Wildlife exploration
Source: (Barnyz 2017). Used under Creative Commons Attribution Non-commercial

Figure 1.5 Park Ranger leading forest walk in Discovery Park, Seattle, WA (Seattle Municipal Archives 1985). Used under Creative Commons Attribution Non-commercial

TIERGARTEN NÜRNBERG

LITHOGRAPHIE u. DRUCK v. WOLFRUM & HAUPTMANN, KGL. BAYER. HOFL. NÜRNBERG.

CHAPTER 2

BACKGROUND

CONTEXT

Sunset Zoo in Manhattan, Kansas is adjacent to a natural area that is rich in habitat value, which includes dramatic sloped topography, a rich wooded environment, Wildcat Creek, and a trail system. Because of these existing conditions, Sunset Zoo has many opportunities for environmental education programs here. This report explores how landscape architectural design intervention and further programming can transform this space into an experiential and educational learning environment.

Figure 2.1 Nuremburg Zoo poster from 1912. Image from Hohlwein (2015). Used under Creative Commons Attribution Non-commercial

SUNSET ZOO BACKGROUND

This project's focus is the design of the sloped woodland area adjacent to Sunset Zoo. This design will include natural play elements, educational exhibits, gathering spaces, educational trail loops, educational signage, wayfinding signage, and safe access to Wildcat Creek. This project also produced educational and recreational programming that connects Sunset Zoo with the adjacent natural wooded area.

While working towards these goals, Sunset Zoo's Strategic Masterplan and its goals were considered. Within this Masterplan there are six guiding principles what were followed:

1. Attendance and revenue growth
2. Animal welfare and conservation impact
3. Marquee exhibits and experiences
4. Mix of guest amenities, play spaces, and interactive experiences
5. Cost effective design/construction staging and implementation
6. Projects of Opportunity - lower cost, stand- alone projects that will deliver visible impacts (Sunset Zoo n.d.).

In addition to Sunset Zoo's guiding design principles, clear boundaries were established in relation to the project's educational goals. First, this space should provide a learning experience for all ages. Also, education is centered on ecology, geology, hydrology, and geomorphology. In short, the natural conditions present in the space are the foundation for science education.

The geographic boundary of the site is outlined in Figure 2.2. The main feature is a steep, sloped woodland area. The site is just north of a crossing with Manhattan's Linear Trail. Currently, there is a system of informal trails on the site. Wildcat Creek runs along the western edge of the site. These elements require design intervention due to its hazardous conditions. The total area of the site is approximately 35 acres.

Figure 2.2 Base Map of Project Area. Adapted from (Google Earth 2022).

Figure 2.3 Several existing stone tables and benches throughout the site (Hahn 2021)

Figure 2.4 Some existing tables are surrounded by overgrown vegetation and are less accessible (Hahn 2021)

Figure 2.5 View of Wildcat Creek up close
(Hahn 2021)

Figure 2.6 Existing naturalistic steps throughout the site (Hahn 2021)

Figure 2.7 Pathways are rocky and limestone ledges are present. Existing stone walls throughout the site (Hahn 2021)

Figure 2.8 Wood bridges span slope drainage-ways (Hahn 2021)

Figure 2.9 View of secondary entrance, cemetery to the left and zoo fence to the right (Hahn 2021)

Figure 2.10 Existing wood railings (Hahn 2021)

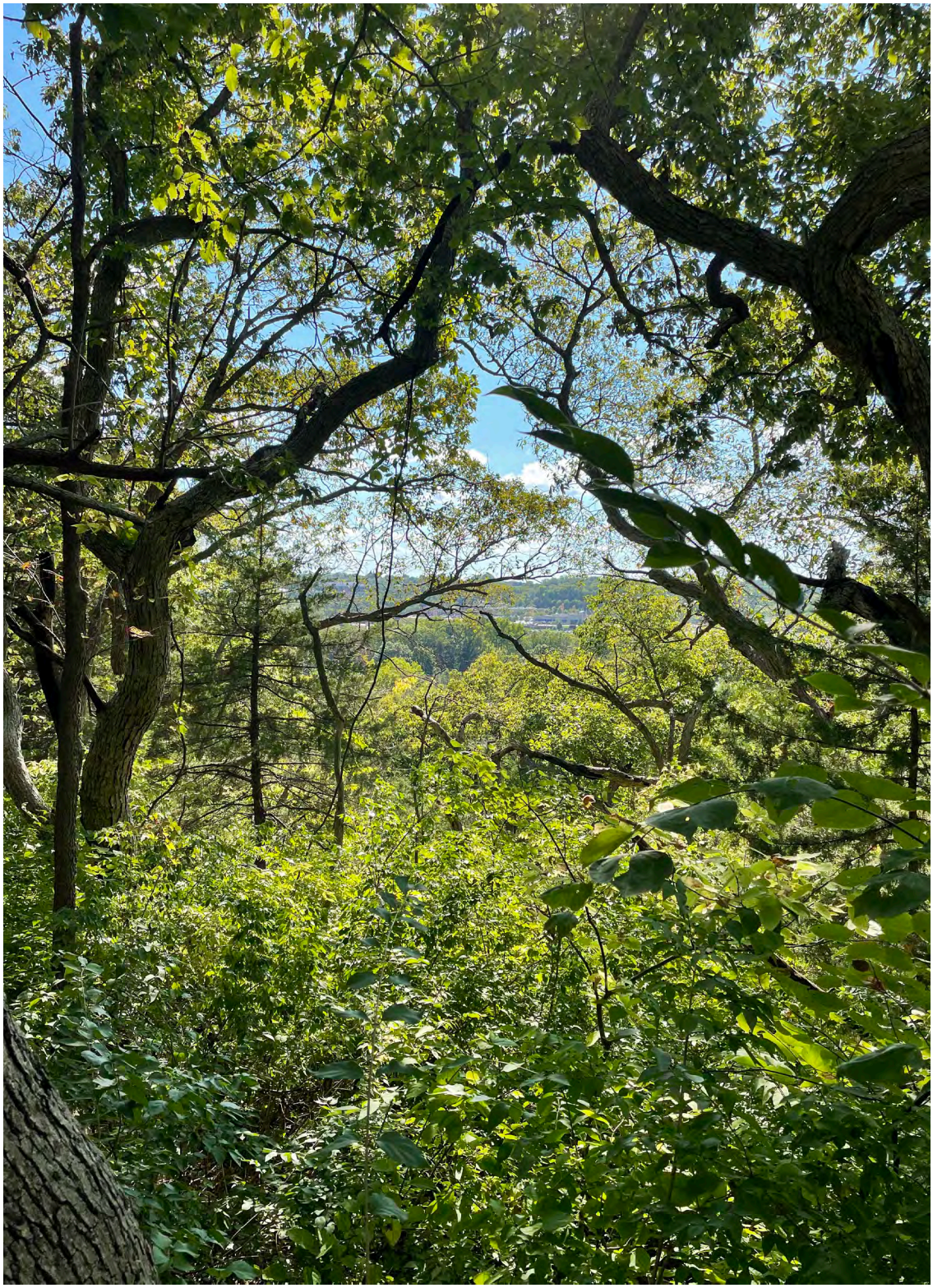

Figure 2.11 Scenic distant views occur on occasion along the trail (Hahn 2021)

SUNSET ZOO HISTORY

1933
Sunset Zoological Park was founded by the Manhattan Parks and Recreation Board. Dr. EJ Frick was a founder of the zoo and former head of surgery and medicine at Kansas State University's School of Veterinary Medicine. Frick served as a leader at Sunset Zoo until 1976, acquiring and caring for the animals (Sunset Zoo n.d.).

1980
A new Zoo Master Plan was created due to citizens of Manhattan pushing for a "modern" zoo. Sunset Zoo began charging a small admission fee to be used for ongoing improvements and maintenance (Sunset Zoo n.d.).

1989
Sunset Zoo received accreditation by the American Zoo and Aquarium Association (AZA). The Zoo continues to maintain accreditation status and renews every five years (Sunset Zoo n.d.).

RELATIONSHIPS WITH THE ZOO & MANHATTAN

Jared Bixby is the Curator of Education at Sunset Zoo. He has over 20 years of experience developing high- functioning teams to increase impact, attendance, and revenue of American Zoological Association accredited organizations, while mentoring future industry leaders for success. He joined the Sunset Zoo in 2008 and is instrumental in developing and maintaining education programs at the zoo.

Nicole Wade is the Programs and Education Animals Manager at Sunset Zoo, and she directly supervises the summer camp staff that utilize the nature trail and Wildcat Creek. Nicole was my direct contact for identifying staff that will be involved in this future design and past uses of the trail. Both Nicole and Jared have extensive experience with Sunset Zoo and education and were instrumental in this project. Other contacts that were a part of my process are Eddie Eastes, the Manhattan Park Planner and Assistant Director of Parks & Recreation and Assistant Director Wyatt Thompson.

2014
Phase Two of the John Woodard Memorial Gibbons Exhibit opened, featuring an outdoor exhibit yard and historic limestone viewing plaza (Sunset Zoo n.d.).

2021
Today, Sunset Zoo has 20 full-time employees and several part-time and seasonal staff. The facility is open 7 days a week, 360 days a year. Specialty departments within the Zoo include Administration, Animal Care, Education, Guest Services, Horticulture/Maintenance and Marketing/Development. Sunset Zoo owns 48 acres and operates on 26 acres of this space. The Zoo anticipates the opening of the Expedition Asia project, which will introduce tigers, sloths, and leopards to the Zoo (Sunset Zoo n.d.)

LITERATURE REVIEW

INTRODUCTION

This research and design project integrates several topics: zoos, environmental educational curricula and programming, and the design of educational landscapes. The following literature review explores each of these topics synthesizing current research and scholarship in order to inform the research question.

Time in nature is essential for childhood mental, physical, social, spiritual, and behavioral development (Pretty et al. 2009). Due to better diagnostic techniques, there is an unprecedented number of children in the United States identified to experience asthma, cancer, low IQs, and developmental disabilities (Strife and Downey 2009). There is considerable ambiguity as to the cause of these health ailments, but research in psychology, education, and environmental health suggests a link between children's engagement in nature and mental/physical health (Strife and Downey 2009). In other words, outside play and learning need to be a higher priority in children's lives. Spaces designed for environmental education may encourage children to connect with nature, increase physical activity, and improve mental health (Moore 2014).

Non-formal educational institutions, which include zoos, have great potential to be an effective place for nature-based play and learning. Many zoos already have professional educators and educational programs/ curriculum in place (Moore 2014). For these reasons, I hypothesize that by extending their educational programs to include nature-based play and learning, zoos will create opportunities for children to connect with nature and increase the educational value of their zoo experience.

EDUCATIONAL PROGRAMS IN ZOOS AND THEIR PURPOSE

ROLE AND PURPOSE OF ZOOS

Zoos are institutions meant to entertain and educate the public while conducting scientific research and conservation efforts (Packer and Ballantyne 2010). Zoos instill a profound influence on their visitors through animal observation, interactive exhibits, interpretive tours, and education programs. Visitor impact studies undertaken by the Association of Zoos & Aquariums show the following outcomes of a zoo visit:

1. Guests see themselves as a part of environmental and conservation action, meaning they have a deeper sense of responsibility and motivation for action.

2. Guests value zoos as important institutions for conservation education and animal care.

3. Guests feel a stronger connection to nature.

4. Guests leave with a stronger confidence in their ecological knowledge (Reinhard et al. 2007).

Zoos are categorized as informal science education organizations

(Schwan, Grajal, and Lewalter 2014). Other institutions that fall in this category include science museums, science centers, and aquariums. These types of institutions are said to play an important role in individual science-related learning biographies because zoos provide opportunities for the public to see, experience, or even be a part of science phenomena. With approximately 140 million people in North America visiting zoos a year, this reach and impact is profound (Schwan, Grajal, and Lewalter 2014).

EDUCATION IN ZOOS

INTERNATIONAL EDUCATIONAL STANDARDS FOR ZOOS

The World Association of Zoos and Aquariums (WAZA) is a global organization that sets standards for over 1,000 zoos and aquariums worldwide. These standards are related to promoting environmental education, wildlife conservation and environmental research. WAZA releases conservation strategy documents that serve as an international set of standards for zoos affiliated with the organization.

Figure 2.12 Observing Zoo Exhibits
Source: (Smithsonian 2007). Used under Creative Commons Attribution Non-commercial

WAZA asserts that education should serve a central role in the organizational strategy of zoos. These educational programs should have the central message of conservation. Other education standards stated in this document are:

1. Educational impact should be clear within the zoo's mission statement.
2. Zoos should have an education policy that focuses on methods to target all visitor types and ages (educate all visitors, not just visitors associated with school programs).
3. Zoos should keep track of how they are carrying out the educational policy through attendance figures, evaluation procedures, and research.
4. There should be a dedicated staff member who is responsible for execution of the education policy.
5. There must be a thorough and comprehensive signage in the zoo that labels each exhibit, enclosure, and then states if the animal species is threatened or endangered.
6. Animal demonstrations should have an educational outcome for the observers.
7. Enclosures should exhibit animals in the best conditions possible, similar to the animals' natural habitat. This is essential in ensuring an accurate educational aspect to the experience.
8. Educators should be involved in the design and planning of exhibits.
9. Zoos should have a reference library accessible to staff and possibly to the public.
10. Educational material such as guidebooks, teachers' notes, resource packs and worksheets should be displayed and available to zoo visitors (The World Zoo and Aquarium Conservation Strategy 2005).

TYPES OF ZOO VISITORS

Education is often a fundamental goal of zoos (Patrick et al. 2007). Zoos are environments that foster "free-choice learning" (71). This means individual learners have freedom regarding what, where, when, how, and with whom they learn (Packer and Ballantyne 2010, 26). Personal motivation is vital for guests to have an educational experience from zoos.

Research by Falk (2009) shows there are five types of zoo visitors in relation to education: explorers, facilitators, experience seekers, professionals/hobbyists, and rechargers. Research from Reinhard (2007) summarized these visitor types:

- Explorers are driven by curiosity and "seek to learn more about whatever they might encounter in the institution," (Reinhard et al. 2007, 7).
- Facilitators are "focused primarily on enabling the experience and learning of others in their accompanying social group," (Reinhard et al. 2007, 7).
- Professionals/Hobbyists "feel a close tie between the institution's content and their professional or hobbyist passions," (Reinhard et al. 2007, 7).
- Experience Seekers "primarily derive satisfaction from the fact of visiting this important site," (Reinhard et al. 2007, 7).
- Spiritual Pilgrims are "primarily seeking a contemplative and/or restorative experience," (Reinhard et al. 2007, 7).

Organizing zoo visitors into these categories gives further context on how to design educational programming. Staff should design the programs to accommodate these different types of guests, which will increase individual motivation for "free-choice learning." (Packer and Ballantyne 2010, 71).

EDUCATIONAL METHODS

Currently, zoos utilize a variety of educational methods, including printed media such as signage and leaflets, and person-to-person engagement approaches such as zookeeper presentations and animal demonstrations. The quality and quantity of these strategies in zoos worldwide vary dramatically according to research by Roe (2014). Research results suggest that zoo educators should focus on the quality and effectiveness of educational content included in printed media and in person-to-person educational programming (Roe, McConney, and Mansfield 2014).

Anderson points out that education in zoos has changed dramatically the past 30-35 years. In the past, education in zoos catered exclusively to school groups. Now, the goal of many zoos is to educate general visitors and make learning a part of everyone's experience (Andersen 2003); consequently; methods of education have changed.

These methods include day-camps, discovery workshops, education centers, touch tables, special events, social media education, special/behind-the-scenes tours, digital media, signs, pamphlets, worksheets, feeding presentations, zookeeper talks, animal shows, animal contact areas, and volunteers/guides (Roe, McConney, and Mansfield 2014; Mellish et al. 2021).

EDUCATIONAL CONTENT IN ZOOS

Environmental sustainability is often the main subject of education programs in zoos (Ballantyne, Packer, and Falk 2011). Zoos offer the unique ability to communicate messages of conservation education. Specifically, zoo staff can teach the public about the difficulties faced by non-human species of the earth, connect people to nature, and instill positive long-term environmental behavior change (Mellish et al. 2021; Ballantyne, Packer, and Falk 2011).

The intent of conservation education is to offer visitors knowledge and skills for conservation action (Patrick et al. 2007, 53).

Objectives related to conservation programming in zoos include:

1. Encourage visitors to make financial contributions to conservation causes;
2. Provide socio-economic incentives for the conservation of natural resources; and
3. Influence visitors' future behavior and attitude towards conservation (Ballantyne, Packer, and Falk 2011, 1243).

The primary areas of environmental concern are "decline and extinction of plant and animal species, pollution issues worldwide, the degradation and loss of aquatic and coastal habitats, and water quality," (Adelman, Falk, And James 2000, 55).

PROBLEMS OF EDUCATION IN ZOOS

Some issues with educational programs in zoos include the following:

- Interpretive signage in zoos tend to cater to family groups, but often neglect young and teenage children. Overall, there needs to be more focus on educational programs for these age groups (Roe, McConney, and Mansfield 2014).
- Success of zoo educational programs depends on visitors' interpretation of the exhibits, health of the animals, and perceived quality of life of the animals (Andersen 2003).
- There is a lack of a strong foundation of scholarly evidence that could influence the implementation and execution of educational programs in zoos (Mellish et al. 2021).
- There are several threats associated with the existence/continuation of zoo organizations including the endangerment and extinction of wildlife habitats and animal species, the increased influence of animal-welfare and animal-rights organizations, and the urbanization of the earth's human population (Hutchins 2003).

Figure 2.13 Flamingos at National Zoo
Source: (Smithsonian's National Zoo 2009). Used under Creative Commons Attribution Non-commercial

NATURAL PLAY & LEARNING SPACES

INTRODUCTION

"***Experience in nature is irreplaceable, and it provides learning and personal growth that cannot be provided through other means,***" (Moore 1997).

A natural play and learning space is a "designated, managed location in an existing or modified outdoor environment where children of all ages and abilities play and learn by engaging with and manipulating diverse natural elements, materials, organisms, and habitats, through sensory, fine motor, and gross motor experiences," (Moore 2014, 21). Education in nature differs from designed outdoor spaces such as playgrounds, parks, and urban green space. Nature is dynamic, unscripted, and unpredictable. The presence of "loose parts," such as fallen trees, protruding rocks or tree roots, and streams without bridges present stimulating and fun psychomotor challenges. There is more potential for creative and constructive problem-solving in nature than built environments (Bixler, Floyd, and Hammitt 2002). Nature play and learning spaces offer countless benefits, including the improvement of mental/physical health and encouragement for positive environmental attitudes/behavior.

BENEFITS OF NATURAL PLAY & LEARNING SPACES

MENTAL HEALTH BENEFITS

Providing opportunities for young children to experience nature is vital to their future comfortableness and understanding of the natural world. Education in natural environments helps foster creativity, sense of wonder, and appreciation of beauty in young children (Ernst and Tornabene 2012). Additionally, studies by Stevenson et al. (2019) show that exposure to the natural environment improves brain functions including reaction time, cognitive stability, and focus (Stevenson et al. 2019). Natural environments allow for unstructured play, which in turn creates opportunities for healthy personal development and self-discovery. This develops children's sense of freedom, independence, confidence, and mental strength (Pretty et al. 2009). In addition, research suggests environmental education increases social skills in children because nature creates opportunities to learn from, discuss and debate the meaning of events with, and seek social approval from fellow classmates (Bixler, Floyd, and Hammitt 2002).

MENTAL HEALTH BENEFITS FOR SPECIAL NEEDS CHILDREN

It is important to consider children with developmental disabilities and consider how nature play and learning spaces can be valuable and aid in their unique conditions. Additionally, universal design is the principle that designing for children with special needs is beneficial for all children (CAST 2018). Some of the most common developmental conditions in children are autism spectrum disorder (ASD) and attention deficit hyperactivity disorder (ADHD) (Zablotsky et al. 2019). There is a growing body of scholarship regarding the relationship between ASD and ADHD and engagement in nature-based interventions.

ASD is a neurodevelopmental condition that affects social interaction, communication, and behavior. This condition is common, affecting an estimated 1 in 68 children. At the same time, experts predict there is wide under-diagnosis. Because autism is a common disorder, it is important to prepare educational curricula to better serve children with autism (Li et al. 2019). Designing both curricula and physical environments in schools to increase student engagement and performance should be a primary goal of educational administrators. Studies have shown that outdoor play environments that support structured movement and imaginative play encourage children with autism to engage in more social interactions (Yuill et al. 2007). Along with well-designed play spaces, nature exposure and time outdoors has shown to be beneficial for children with autism. Research suggests that time in nature can have a restorative effect on children with autism. Children with ASD have shown to gain significant sensory-motor, emotional, social, and behavioral benefits from spending time in the natural environment (Li et al. 2019). Guidelines for designing a natural play environment that caters to children with autism is discussed further in the Design Guidelines section.

In 2016, there were an estimated 6.1 million children living with attention deficit and hyperactivity disorder (ADHD), or about 6-7% of children in the United States (Danielson et al. 2018). ADHD affects a person's attention capacity and in turn may have harmful effects on academic success, relationships, and many other aspects of life. Attention Restoration Theory proposes that spending time in nature can improve attention capacity. Taylor, Kuo, and Sullivan (2001) expand on this theory, suggesting that exposure to natural environments can be effective in restoring directed attention from fatigue. This is because natural environments assist in recovery from directed attention fatigue, while requiring involuntary attention instead of directed attention. Specifically, elements in nature such as movement (wind, wild animals, ecological processes) and pleasant visuals require involuntary attention instead of directed attention. This gives children brain breaks and lowers stress levels. In addition to the subconscious attention functioning, nature presents opportunities for mental and sensory stimulation. Nature allows for creative forms of play, and exploratory and divergent thinking. Allowing children to be physically active and participate in activities that encourage creativity are beneficial for children with ADHD (Taylor, Kuo, and Sullivan 2001).

PHYSICAL HEALTH BENEFITS

Physical activity is vital in both current and future health in children, cognitive development, and behavior. Studies show that children who are active outdoors (60 minutes of moderate to vigorous physical activity a day) have better quality brain development and function, live longer, and have a better quality of life into adulthood (Adams, Veitch, and Barnett 2018; Pretty et al. 2009). While it is widely accepted that physical activity is important to children, current research suggests children are not getting enough physical activity (Glickman 2012). This is evident because of rising childhood obesity numbers and physical activity becoming less of a priority in society (Dinkel et al. 2017). Most curricula require students to sit in a classroom for up to eight hours a day (Ellner 2019). This lack of physical activity is deteriorating children's health and disregards its benefits on cognitive development and behavior. For example, a study that analyzed brain scans showed that children learn best when active; neurons that facilitate learning and retention were stimulated while physically active (Hannaford, 1995). Stevens-Smith (2016), a professor of education at Clemson University, stated, "While children are physically moving, they are developing neurological foundations that assist with problem solving, language development, and creativity" (723). These findings suggest that nature play and learning spaces can be extremely effective in improving both physical health and academic learning because the education curricula in these spaces typically require at least a minimal amount of physical activity. In summary, nature education is an effective method of learning because of the combined opportunity for outdoor physical activity and the quality of learning (Pretty et al. 2009).

ENVIRONMENTAL BENEFITS

Nature play and learning spaces often focus on environmental education in their curriculum. Environmental education benefits not only the individual's personal well-being, but also the stewardship of the natural environment. Integrating environmental education into early childhood educational curricula instills values, attitudes, skills, and behaviors that support future sustainable development (Ernst and Tornabene 2012). Studies show that ten days of environmental education is related to positive attitude towards nature, which in turn creates more environmentally friendly behavior throughout life (Szczepanski et al. 2006). In addition to this, research with adults suggests that memorable early childhood experiences encourage interest in environmental activism later in life (Bixler, Floyd, and Hammitt 2002). Integrating environmental education into early childhood education can shape the next generation's attitudes and behavior towards the environment.

BARRIERS

Benefits of exposure to nature are significant, but access to nature play and learning spaces is not equitable; often, those who would benefit most from nature play and learning spaces have the least access to them (Stevenson et al. 2020). Low-income communities and communities comprised of mostly racial/ethnic minorities most often have less access to natural areas than wealthy communities (Wen et al. 2013). Research suggests children in low-income communities show increased benefits from time in nature compared to their wealthier peers (Stevenson et al. 2020). Potential barriers to accessible natural play and learning environments include educational curricula, individual teacher's agendas, and urban planning (Szczepanski et al. 2006; Ernst 2014; Strife and Downey 2009).

EDUCATIONAL CURRICULA

Currently, there is no national requirement or standard for environmental education in public school curricula (Ernst 2014). Additionally, public K-12 education continues to concentrate on academic preparation and achievement to improve standardized testing scores (Ernst 2014). This pressure for higher scores may makes it difficult for educators to incorporate experiences in nature into their curriculum (Ernst 2014). The lack of standards for environmental education can create issues in its framework. Szczepanski et al. (2006) analyzed current environmental education lesson plans in elementary schools in the US and suggests improvements. They found that children often cannot relate the scientific content in these lessons to their everyday life. Also, these lessons often miseducate children; children are taught to believe nature is defective, instead of focusing on human impact on the environment. In other words, the relationship between human behavior and environmental issues is not clear. The authors suggest further study of environmental education curricula and to analyze its effects and durability over time (Szczepanski et al. 2006).

TEACHERS

The beliefs of individual teachers may affect children's educational experiences. It is common for educators to not associate nature and outdoor settings as places for learning. Instead, they see these spaces as settings for physical and social development. This discrepancy severely limits the potential for environmental education in curricula (Ernst 2014).

Additionally, teachers may not be equipped with the appropriate tools and techniques to conduct lessons that take place in and relate to nature. Oltman (2002) wrote a guide on environmental education and says that "developmentally appropriate practice" is an education standard highly relevant to outdoor education. The National Association for the Education of Young Children (NAEYC) defines developmentally appropriate practice (DAP) as an education standard in which the educator matches the learning environment (teaching method, materials, schedule, curriculum, physical set-up) to the developmental levels of children (Bredekamp and Copple 1997). This technique is especially relevant to nature and outdoor education because of the lack of control and structure when teaching outdoors (Oltman 2002). Figure 2.14 shows techniques on how to teach most effectively outdoors and practice DAP. Oltman states that DAP is not a standard practice, so many teachers are not equipped to execute it. This creates a barrier to the use of natural learning spaces because this educational technique is especially significant to nature education (Oltman 2002).

CITY PLANNING

Today, many children have an overexposure to pollution and an underexposure to nature (Strife and Downey 2009). Poor urban planning, beginning in the post Second World War period, continues to affect access to nature. There has been a continuing trend of urban sprawl, or cities spreading outwards instead of upwards (Pretty et al. 2009). This creates low density suburbs, with a heavy dependance on cars for transportation and increased socio-economical segregation. Along with these poorly planned suburbs, denser, urban cities are becoming increasingly overpopulated, congested, and polluted. (Wolch, Byrne, and Newell 2014). Implications for access to green space vary between high-density cities, suburbs, and rural areas. Although urban planning influences these types of cities differently, it is consistent that poor people and racial/ethnic minorities are disproportionately burdened by its effects. This phenomenon is known as environmental inequality (Bowen 2002).

Urban sprawl has caused landscape fragmentation, ecological degradation, biodiversity loss, and pollution (Mu et al. 2020). These processes limit access to viable natural areas in both cities and suburbs. Environmental education lesson plans are often centered around ecological biodiversity, so this degradation causes many nature areas unviable. In rural environments, green space is often agricultural land. Agriculture lands often span for miles, making it difficult to access natural environments (Wen et al. 2013). In all these instances, there

is a lack of easily accessible and viable natural areas, and in turn, opportunities for environmental education are threatened. This author suggests nature play and learning spaces must be a priority in master planning, urban design, and green infrastructure developments to ensure its accessibility.

"Natural settings for children's play that previous generations took for granted must now be deliberately created," (Moore 2014).

DEVELOPMENTALLY APPROPRIATE PRACTICE		
		
MOST DEVELOPMENTALLY APPROPRIATE	**SOMEWHAT DEVELOPMENTALLY APPROPRIATE**	**LEAST DEVELOPMENTALLY APPROPRIATE**
Activities are attuned to the child's level of cognitive, physical and social development including props, setting, language and timing. Learning is easier for the child and teacher.	Programs are presented at an appropriate level in language but other aspects may be inappropriate. There is some struggle but most of the concepts are comprehended.	Information is presented at an inappropriate level involving props, setting, language and timing. Children learn little and are either bored or overwhelmed.
Examples:		
Various learning stations such as water table with pond life, painting table with water colors, pond puppets and costumes and so forth are set up around the gathering area. Children are encouraged to choose at will between the activities offered. They are free to move about the area, play alone or with others, and explore materials at their own pace.	Various learning stations are set up around the gathering area and children rotate from station to station at the teacher's direction. Specific outcomes are expected at each station.	Children sit quietly while a naturalist explains the water cycle using words like transpiration and precipitation.

Figure 2.14 Developmentally Appropriate Practice Explained. Adapted from (Oltman 2002). Reproduction allowed for educational or non-profit purposes only.

K-12 SCIENCE EDUCATION STANDARDS

OVERVIEW

A Framework for K-12 Science Education (National Research Council 2012) is a comprehensive book that articulates the science concepts to be learned by K-12 students. The guidebook begins by acknowledging that adults in the United States often lack fundamental science knowledge. The goal of this book is to provide a framework for science educators to not only instill fundamental science knowledge in children, but ensure they graduate high school with an appreciation for science, have sufficient knowledge to engage in public discussion related to science, be informed consumers of news and information related to science and technology, and to prepare them for careers related to science, engineering, or technology. The authors make no specific reference to outdoor environmental education in the book (National Research Council 2012).

The Next Generation Science Standards (NGSS) is the science teaching framework, within the A Framework for K-12 Science Education, developed to better prepare K-12 students for STEM majors and careers. NGSS is not the same as Common Core State Standards, but they are aligned with each other. NGSS explores physical sciences, life sciences, earth and space sciences, and applications of science including engineering and technology (The Next Generation Science Standards 2013). Within NGSS are disciplinary core ideas (DCIs) which are the fundamental ideas that are needed to understand more complex ideas throughout multiple grade levels. Crosscutting concepts (CCs) are ideas that span across multiple domains of science. Performance expectations (PEs) are described as the skills and knowledge that should be demonstrated after instruction. PEs cover a specific scientific practice or principle, and NGSS includes teaching strategies for teachers to use for students to meet that PE (National Research Council 2012).

PROBLEMS

LACK OF ENVIRONMENTAL EDUCATION STANDARDS

Currently, there is no national requirement for environmental education in standard school curricula (Ernst 2014). The National Association for the Education of Young Children (NAEYC) is an accrediting organization aimed at maintaining and improving the quality of early childhood education programs. Accreditation from the NAEYC is optional, but their set of standards is strict and a good indicator of educational quality standards in the United States. Even within their standards for accreditation, there is only a brief mention of the outdoor environment's impact on early childhood education. The standards state that outdoor play areas in educational institutions should accommodate "exploration of the natural environment, including a variety of natural and manufactured surfaces, and areas with natural materials such as nonpoisonous plants, shrubs, and trees," (NAEYC 2008).

DISREGARD FOR OBSERVATION BASED ECOLOGY LEARNING
Merritt and Bowers (2020) note that there is too many PEs, and subsequently tests, that teachers are required to cover. As a result, teachers lack freedom to respond to students' academic interests or utilize learning opportunities in their local environment. The authors also mention that NGSS disregards observation-based ecology (OBE) skills. OBE is characterized by learning through observations of systems rather than through experimental methods. OBE is an essential learning function, and it is critical in the understanding of socio-ecological issues including climate change and decreasing biodiversity. For these reasons, NGSS serving as the national science education standards could be detrimental to future generations' perception of environmental issues (Merritt and Bowers 2020).

Figure 2.15 Outdoor Observation Exercises
Source: (Va. Dept. of Conservation & Recreation 2008).
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DESIGNING FOR NATURE EDUCATION

OVERVIEW

NATIONAL GUIDELINES

Nature Play & Learning Places: Creating and managing places where children engage with nature is a book of guidelines developed by the Natural Learning Initiative (NLI) for people who design, manage, or are involved with natural areas targeted for children. Moore lists the following as the audience for this book: policy makers and advocates, system managers, site managers, program developers, educators, design professionals, and urban planners and developers. The main goal of NLI is, "creating environments for healthy human development and a healthy biosphere for generations to come," (Moore 2014, iii). The guidelines include planning for and locating nature play areas, designing the space, and implementing the design, managing it, and risk management for the space.

Considered from a nature play design perspective, the NLI book has applicability to the goals and needs of this project. Moore states that the NLI book informs designers on how to integrate nature play into the urban public realm. Often designers lack knowledge in understanding the programmatic content of nature play spaces, but a thorough understanding is essential in creating an effective educational space. In addition to program knowledge, "circulation, entry sequence, location of areas by age, location of settings by play and learning function, position of social spaces, and topographical form," are the major considerations in the design of these places (Moore 2014, 27).

"Think of designated nature play and learning places and children playing there as dynamic, people-environment ecosystems constantly evolving and adapting to new ideas, user groups, and individual energies—always conditioned by the ebb and flow of time and money. The role of design is to create viable content in flexible settings that offer users a strong sense of place," (Moore 2014, 66).

DESIGN AND MANAGEMENT PROGRAM

The first step in designing for nature play is developing a design and management program. This means one must create a written and visual narrative of nature play on which to base design. Planning for the narrative should include:

Project mission statement, goals, and objectives; user groups to be served; age group needs; site assets and constraints; descriptions of each proposed activity setting; federal accessibility guidelines and other mandated requirements; agency needs; and other pertinent information (Moore 2014, 67).

SITE DESIGN

Site design consists of conceptual design, schematic design, and construction documentation.

ACTIVITY SETTINGS

In this context, activity settings are defined as subspaces within a nature play space that have potential for a learning activity. Common activity settings are

- Pathways
- Plants
- Trees
- Shrubs
- Perennials
- Permanent edible plants
- Vegetable gardens
- Annuals
- Natural surfacing
- Natural loose parts
- Natural construction
- Natural play structures
- Multipurpose lawns
- Meadows
- Woodland
- Landform
- Animals
- Aquatics
- Sand, Soil, Dirt
- Gathering
- Program Base & Storage
- Signage
- Boundaries (Moore 2014).

Figure 2.16 Outdoor learning activities
Source: (Bradley 2012). Used under Creative Commons Attribution Non-commercial.

MANAGING NATURE PLAY AND LEARNING PLACES
Factors that determine management practices are type of project, access, programming, organizational affiliation, and resource availability. Types of projects are renovation, new construction, and ecological restoration. Access must be established as either open access or controlled access. Environmental management is essential to keeping nature play and learning spaces alive (Moore 2014).

RISK MANAGEMENT
Any designed spaces that engage the public must consider potential risk liability. This process starts at site analysis and design inception. Besides physical factors, potential liability can be related to access, activity management operations, maintenance, and communications. Some factors to consider include:

- "Determine applicable design standards and standards of care in your jurisdiction
- Engage your insurer or risk manager
- Conduct a risk assessment and eliminate hazards presenting undue risk of harm
- Potential for falls
- Trees
- Head entrapment
- Conduct a risk assessment of natural features within a designated nature play space.
- Develop an inspection routine.
- Document and evaluate all incidents.
- Maintain records of inspections and incident reports coupled with regular staff evaluations and recorded responses.
- Communicate with users of the space," (Moore 2014, 118-122).

ADDITIONAL CONSIDERATIONS

DESIGNING FOR SPECIAL NEEDS

In order to design a natural play environment that is beneficial to children with autism, the following elements should be included or considered: "private areas to help emotional control, upgrade safety standards to prevent falling and tripping, provide open-ended play options, support a variety of play, and provide a variety of sensory stimuli in some areas but also create sound and light buffers in other spaces to fit the needs of children with different sensory processing conditions," (Li et al. 2019, 78).

STRUCTURES ON STEEP SLOPES

Designing on steep slopes presents a set of unique challenges and exciting opportunities. Key principles of designing on steep slopes are securing a solid base; making natural ecological recovery a priority, and using regional culture as a highlight. Additional principles include making

interdisciplinary design a key point; considering economic implications; integrating structural features with the slope; using hierarchal layout; and considering local climate conditions (Li et al. 2019; Song et al. 2012).

PROGRAMMING

The following questions need to be addressed when developing nature-based outdoor learning programs:

1. "Why am I doing this activity with these individuals at this time?
2. What does theory and experience tell me about the choice of activity and what young people are learning?
3. How do I know if I have been successful in achieving my stated aims?" (Szczepanski et al. 2006, p. 3).

Nature play and learning area programming should encourage long-term use, instead of being a one-time experience. Programming activities and curriculum should be sensitive to children's self-esteem, awareness, and inter-personal relationships. Adventure-based activities are effective in positively impacting these aspects of learning (Szczepanski et al. 2006).

Figure 2.17 Designing a Natural Play and Learning Space
Source: (Brenner 2013). Used under Creative Commons Attribution Non-commercial

Figure 2.18 Park Ranger leading forest walk in Discovery Park, Seattle, WA (Seattle Municipal Archives 1975). Used under Creative Commons Attribution Non-commercial

ZOO

Leipzig

CHAPTER 3

METHODOLOGY

OVERVIEW

The methods of this study include literature review analysis, precedent study, site analysis, and program analysis. A literature review was conducted first to understand the existing research on the role of zoos, natural play and learning spaces, K-12 science standards, and existing design guidelines for educational landscapes. From there, a literature review analysis was undergone. During this analysis, design considerations were developed and informed by the literature. Next, a precedent study was conducted, analyzing eight existing natural play and learning spaces. With this study, I was able to compare and find similarities between the project to understand elements of the design that made the space successful. The precedent study generated more design considerations. It also inspired ideas for activity settings, design elements, and programming. The next method, site analysis, further determined the activity settings and design elements. The site analysis looked at several site conditions related to topography, drainage, hydrology, and existing site elements. Finally, the program analysis looked at several potential programming relevant to the site conditions and determined activity settings. In the end, these methods determined design considerations, activity settings and design elements, and programming for the site design.

Figure 3.1 Leipzig Zoo Poster from 1934.
From (Elsner 2015). Used under Creative Commons Attribution Non-commercial

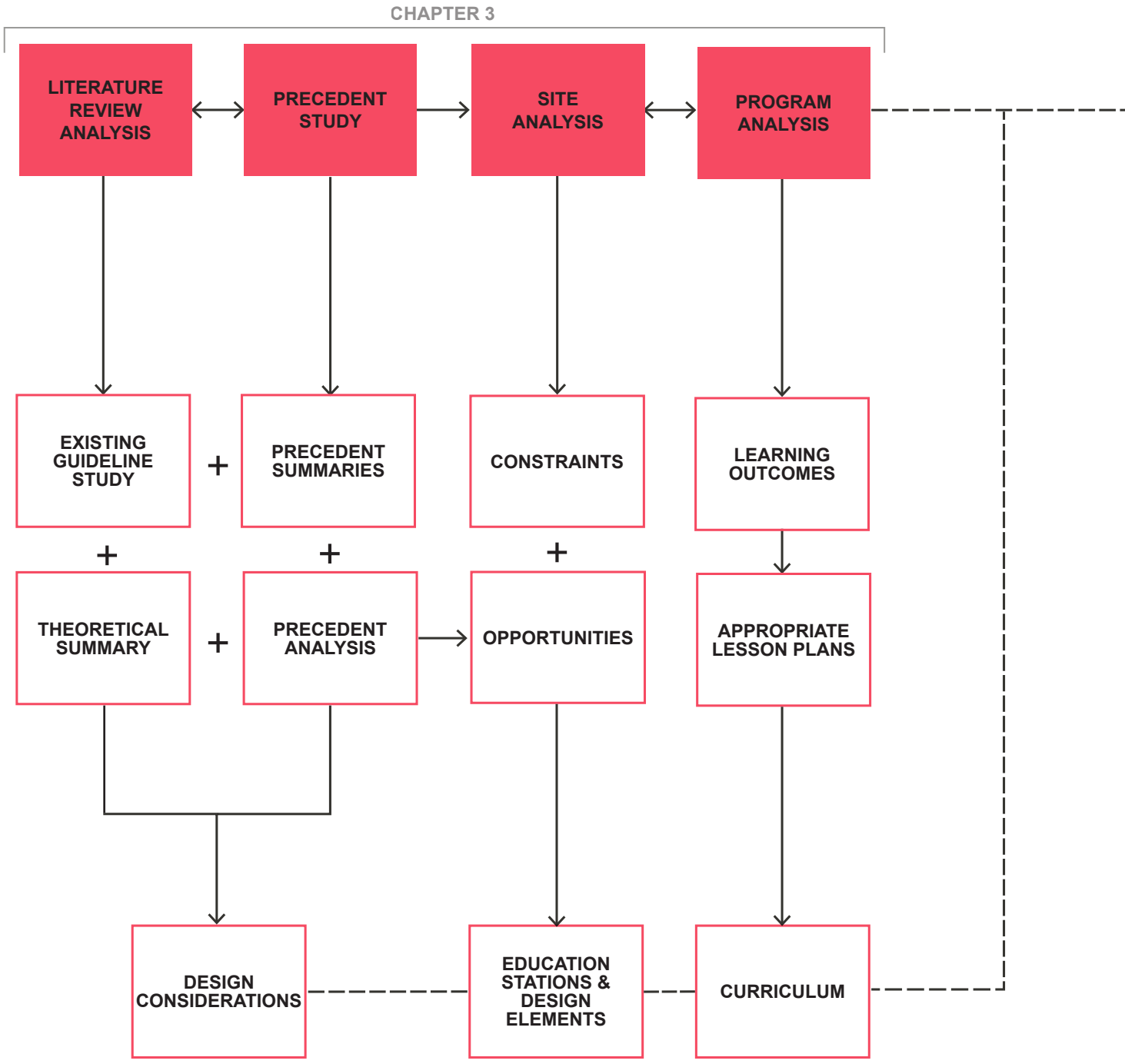
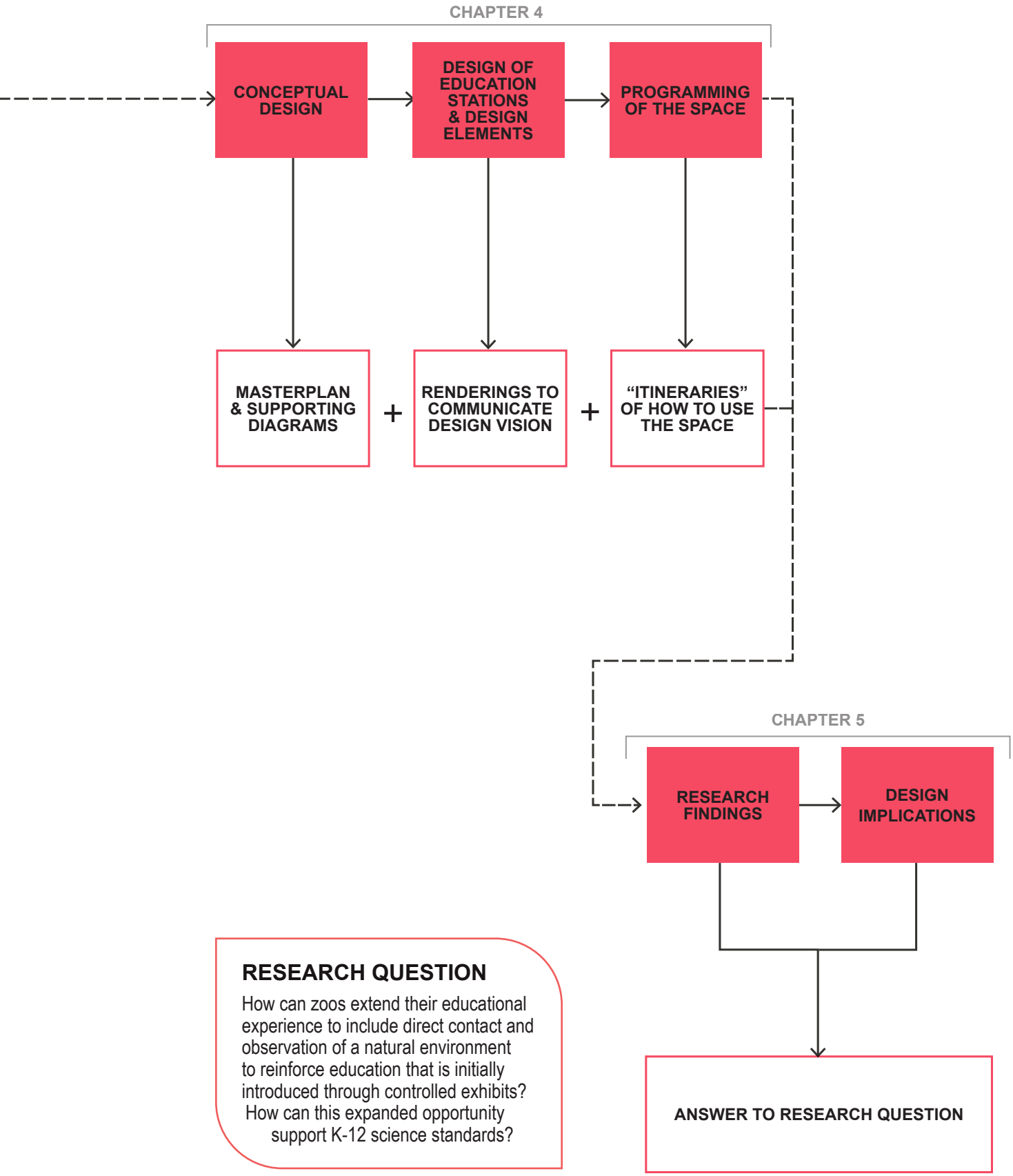


Figure 3.2 Methodology and Process Diagram
Source: Author



RESEARCH QUESTION

How can zoos extend their educational experience to include direct contact and observation of a natural environment to reinforce education that is initially introduced through controlled exhibits? How can this expanded opportunity support K-12 science standards?

PART ONE
LITERATURE REVIEW ANALYSIS

A thorough literature review is shown in the Background chapter of this report. The literature review focuses on educational programs in zoos and their purpose, nature play and learning spaces, K-12 science education standards, and designing for nature education. To identify design considerations from the literature review, an analysis and summary was completed. This analysis looks at research most relevant to the design and programming of a natural play and learning space.

This summary is highlighted in Figure 3.4, a diagram showcasing how the literature informs the design considerations. These considerations will be combined with the program analysis and precedent study findings, resulting in a set of comprehensive design considerations catered to the project and site.

The design considerations derived from this literature review analysis are to design for free-choice learning; allow for private rest areas; promote ecological learning outcomes; ensure thorough signage and wayfinding; encourage observation-based ecology; utilize loose parts for play features; use lessons for various learning levels & abilities; and ensure opportunities for physical activity for various abilities.

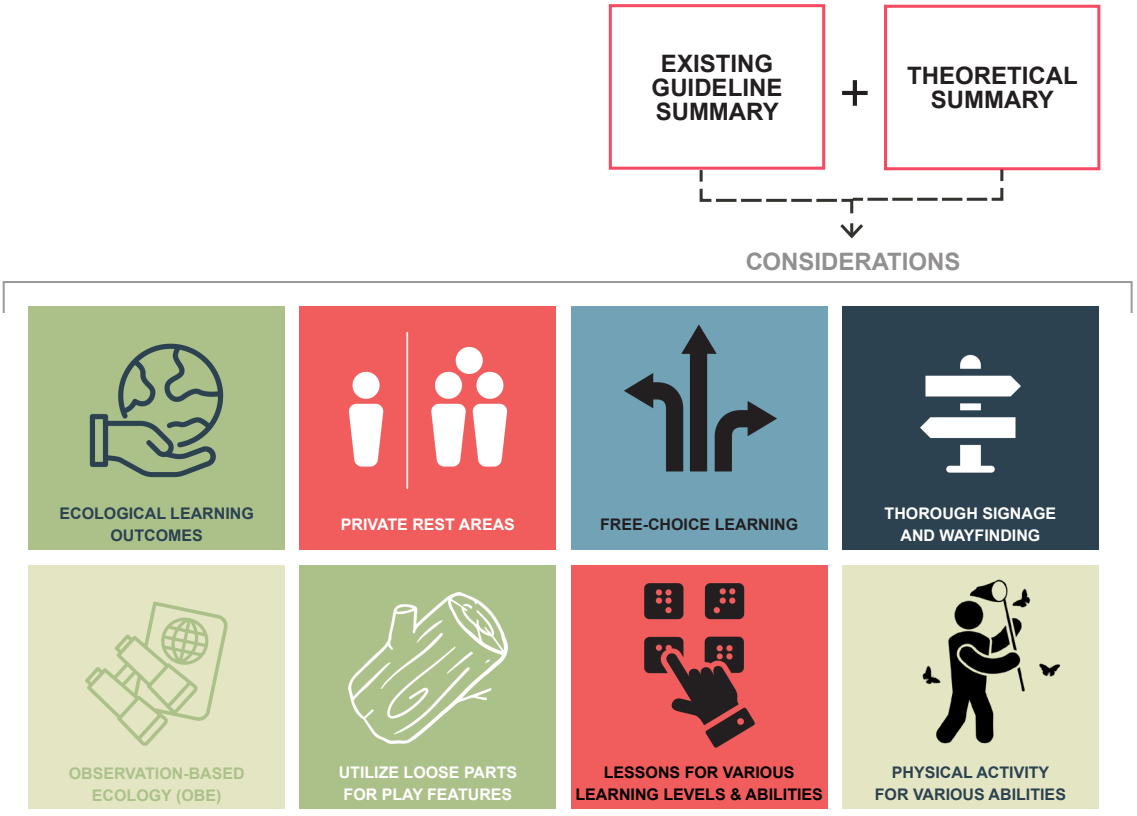


Figure 3.3 Considerations created from literature review
Source: Author

Research by Falk (2009) shows there are five types of zoo visitors in relation to education: explorers, facilitators, experience seekers, professionals/hobbyists, and rechargers. Designing to accommodate different types of guests will increase individual motivation to learn (Patrick et al. 2007 & Packer and Ballantyne 2010, 71).

Personal motivation is vital for guests to have an educational experience from zoos. To increase personal motivation, guests should have freedom regarding what, where, when, how, and with whom they learn (Packer and Ballantyne 2010, 26).

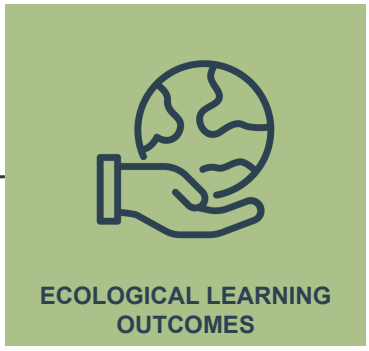
"Circulation, entry sequence, location of areas by age, location of settings by play and learning function, position of social spaces, and topographical form," are the major considerations in the design of these places (Moore 2014, 27).

"Private areas to help emotional control, upgrade safety standards to prevent falling and tripping, provide open-ended play options, support a variety of play, and provide a variety of sensory stimuli in some areas but also create sound and light buffers in other spaces to fit the needs of children with different sensory processing conditions," (Li et al. 2019, 78).

Visitor impact studies show that successful zoos allow guests to see themselves as a part of environmental and conservation action, meaning they have a deeper sense of responsibility and motivation for action. They leave feeling a stronger connection to nature and with a stronger confidence in their ecological knowledge (Reinhard et al. 2007).

Conservation education gives visitors knowledge and skills that encourages conservation action (Patrick et al. 2007, 53).

The primary areas of environmental concern are "decline and extinction of plant and animal species, pollution issues worldwide, the degradation and loss of aquatic and coastal habitats, and water quality," (Adelman, Falk, And James 2000, 55).



"Determine applicable design standards and standards of care in your jurisdiction. Engage your insurer or risk manager. Conduct a risk assessment and eliminate hazards presenting undue risk of harm. Potential for falls… head entrapment. Conduct a risk assessment of natural features within a designated nature play space. Develop an inspection routine. Document and evaluate all incidents. Maintain records of inspections and incident reports coupled with regular staff evaluations and recorded responses. Communicate with users of the space," (Moore 2014, 118-122).

Potential liability can be related to access, activity management operations, maintenance, and communications (Moore 2014).

THOROUGH SIGNAGE & WAYFINDING

OBE is characterized by learning through observations of systems rather than through experimental methods (Merritt and Bowers 2020).

OBE is an essential learning function, and it is critical in the understanding of socio-ecological issues including climate change and decreasing biodiversity (Merritt and Bowers 2020).

OBSERVATION-BASED ECOLOGY (OBE)

Nature is dynamic, unscripted, and unpredictable. The presence of "loose parts," such as fallen trees, protruding rocks or tree roots, and streams without bridges present stimulating and fun psychomotor challenges. There is more potential for creative and constructive problem-solving in nature than built environments (Bixler, Floyd, and Hammitt 2002).

Nature allows for creative forms of play, and exploratory and divergent thinking. Allowing children to be physically active and participate in activities that encourage creativity are beneficial for children with ADHD (Taylor, Kuo, and Sullivan 2001).

UTILIZE LOOSE PARTS FOR PLAY FEATURES

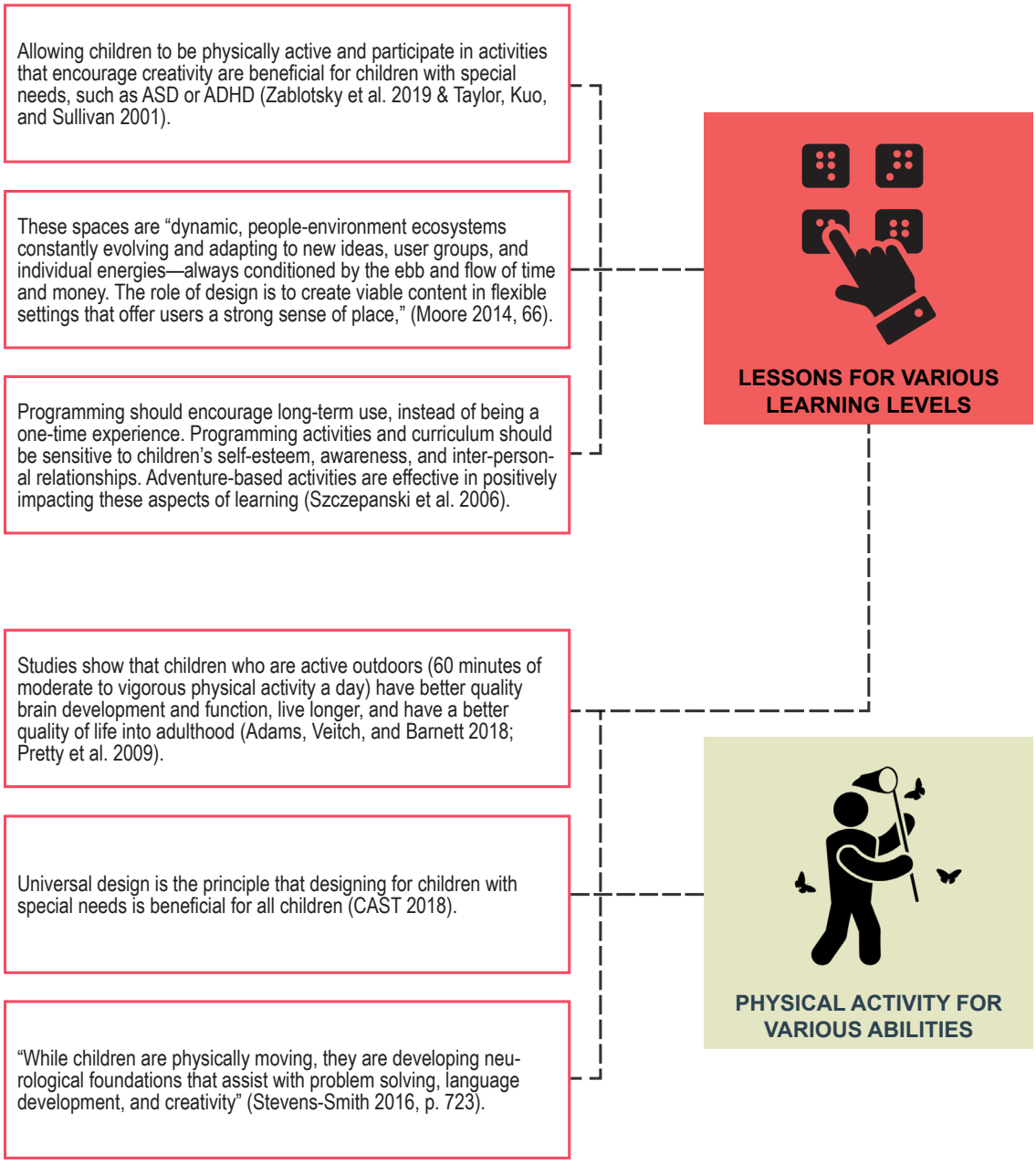


Figure 3.4 Literature review analysis process from Author

PART TWO
PRECEDENT STUDY

A precedent analysis was conducted to compile an understanding of a suitable design process and natural play and learning spaces in other contexts. Projects were selected for their relevance to the site and project goals. Projects vary and were chosen to inform design decisions related to theme, purpose, educational features, connection to an informal education center, and specific design elements or activity settings. Specifically, the projects that were chosen to analyze educational design and signage are Reflection Riding, Blanchie Carter Discovery Park, the Arlitt Nature Playscape, and Growing Place. The Museum Backyard and Nature Club House was studied to understand the connection between natural learning spaces and informal education institutions. Teardrop Park was chosen to study educational programming. Marge & Charles Schott Nature PlayScape and kidZone were studied for their design elements and activity settings. The following information is listed for each precedent: location, year of implementation, design team, length of planning process, stakeholders, project description, purpose, theme, process of analysis and design, programming activities, activity settings, curriculum, site management, design challenges, post occupancy evaluation status, public reception/opinion, demographics, funding, climate, materials, and ecology.

Precedents:

- Teardrop Park (North)
- Reflection Riding
- Blanchie Carter Discovery Park
- kidZone
- The Museum Backyard and Nature Club House
- The Arlitt Nature PlayScape
- Marge & Charles Schott Nature PlayScape
- Growing Place (Japan)

Figure 3.5 Map of Precedent Locations
Adapted from (Snazzy Maps 2022).

PRECEDENT #1

TEARDROP PARK

Figure 3.6 Teardrop Park Slide from (Sharon 2006).
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LOCATION

Park Place West,

Battery Park City,

New York, New York 10282 (Moore 2014)

CONTEXT

Dense urban, public park (Moore 2014)

OPENED

2006 (Moore 2014)

LENGTH OF PLANNING PROCESS

7 years (1999-2007) (Michael Van Valkenburgh Associates n.d.).

SIZE

1.8 acres (Landscape Architecture Foundation n.d.)

AGE RANGE

All ages, focus on school-age children

DESIGN TEAM

Lead: Michael Van Valkenburgh Associates (MVVA).

Artists: Ann Hamilton, Michael Mercil.

Play equipment: Fred Druck, PlayWorx.

Play consultants: Natural Learning Initiative (Moore 2014)

CONTRACTORS

Construction manager: Humphreys & Harding, Inc.

Site contractor: Metrotech Contracting Group.

Landscape contractor: Kelco Landscaping, Inc.

Metal work: Post Road Iron Works. (Moore 2014)

STAKEHOLDERS

Battery Park City Authority (BPCA).

Battery Park City Parks Conservancy (BPCPC).

FUNDING

$17 million (Landscape Architecture Foundation n.d.)

PROJECT DESCRIPTION

Teardrop Park is classified as a small park in a dense, urban location. This park is a part of Battery Park City, a predominantly residential neighborhood composed of upscale high-rise buildings. More than one-third of the neighborhood is green park space. The park is described as a naturalistic escape from the city. The park is described as a three-dimensional landscape that provides various opportunities for secluded and quiet experiences of nature.

PURPOSE

The park's purpose is "to address the urban child's lack of natural experience, offering adventure and sanctuary while also engaging mind and body," (Michael Van Valkenburgh Associates n.d.).

THEME

"Park as a natural playground for all," (Moore 2014).

PROCESS OF ANALYSIS AND DESIGN

Initial goals of the design were to transform this small and underutilized site, using "bold topography, complex irregular space, and robust plantings," (Moore 2014). Sustainability was used as an organizing principle, as opposed to a broad goal. Though the park is a public park and can be used by all ages, children were the focus of the design. For this reason, the NLI was selected as play consultants for the project.

BPCA hosted a series of work sessions and design charrettes with the design team, stakeholders, and neighborhood representatives. MVVA presented several design options, ranging from classic axial to avant garde concepts (Moore 2014).

Mediate harsh local microclimate (wind off the Hudson River) and lack of sunlight.

Sustainability is an organizing principle, including the use of fully organic soils and maintenance practices, utilize recycled materials and grey water from nearby high-rise buildings, and capture rainwater for irrigation.

Provide urban children access to a natural environment and adventure to engage mind and body.

Construct a complex, 3-dimensional landscape using topography, water features, natural stone, and lush plantings,

Create a space composed of intricately choreographed views and dramatic changes in scale (Moore 2014).

ACTIVITY SETTINGS

Shadbush Hill, Tunnel, Water Play, Slide Hill, Sand Lot, Sand Cove, Amphitheater, Overlook, Marsh (children's natural hideaway), Lawn Bowl, Geologic Section, Beech Grove, Reading Circle, Ice Wall, Witchhazel Dell, and multiple broad to narrow pathways.

PROGRAMMING ACTIVITIES/ CURRICULUM

BPCPC hosts several events and programs in Teardrop Park, year-round. Most events are aimed at children and families, but there are also events for special interest groups such as urban wildlife, poetry, and public art. "Fairy Days" is a popular biannual event that engages children in both warm and cold weather conditions. In the spring, children role play as fairies and elves who protect the park's forests and streams. In winter, children construct houses constructed of snow and ice (Moore 2014).

SITE MANAGEMENT

BPCPC manages Teardrop Park (Moore 2014). A security guard is always employed to monitor activities (Kent 2005).

DESIGN CHALLENGES

A main challenge of the site design was the heavily shaded microclimate due to being surrounding by high rise buildings. The designers addressed this challenge by installing three 8-foot-diameter heliostats. Heliostats, or solar mirrors, reflect the sun from the top of an adjacent residential apartment building, achieving approximately 90 percent of the sun's brightness on the otherwise shaded and dark park (Dumiak 2007). The other main design challenge noted by the design team was the small size of the site. This was addressed through the articulation of spatial and path hierarchy (Michael Van Valkenburgh Associates n.d.).

POST OCCUPANCY EVALUATION STATUS

The National Leaning Initiative (NLI) also conducted a post-occupancy evaluation in 2007. The Landscape Architecture Foundation (LAF) performed a post-occupancy evaluation on Teardrop Park as a part of their Landscape Performance Series in 2011, and cross references NLI's report. In the 2007 study, NLI reported high levels of physical activity in children at the park, primarily on water features, sandy areas, the slide, pathways and steps, lookouts, decks, and the rock paths linking them (Moore 2014). Following up in 2011, LAF reported similarly high levels of activity among children (Landscape Architecture Foundation n.d.).

PUBLIC RECEPTION/OPINION

Teardrop Park is used as an outdoor play and learning space by an estimated 200,000 children a year. It is estimated that 72% of users engage in physical activity and 69% engage in "constructive, dramatic, and functional play," (Landscape Architecture Foundation n.d.). Additionally, both post occupancy evaluations completed for eardrop Park show high visitor counts and high levels of active play (Landscape Architecture Foundation n.d. and Moore 2014). Teardrop Park received a 2009 ASLA Design Honor Award (Moore 2007).

Critics of the park note the park is uninviting and threatening, due to obstructed views and confusing navigation of the site. Though the vegetation is beautifully designed, it creates isolating spatial definition, causing the park to read as a private park for nearby building residents (Kent 2005).

CLIMATE

Humid continental (Landscape Architecture Foundation n.d.)

MATERIALS

Teardrop Park was designed to allow for children to interact with natural materials in this dense urban setting. Primary materials intended for interaction and play are water, plants, rocks, and sand.

ECOLOGY

Approximately 17,000 plants, including 3,260 woody trees and shrubs, installed for human comfort, engagement, and ecological benefits in a dense urban setting. This site was previously barren and considered a greyfield (Landscape Architecture Foundation n.d.). A greyfield is defined as an underused, outdated, and ecologically failing piece of urban land (Moore 2013).

Figure 3.7 Water Play Features from (Sharon 2002).
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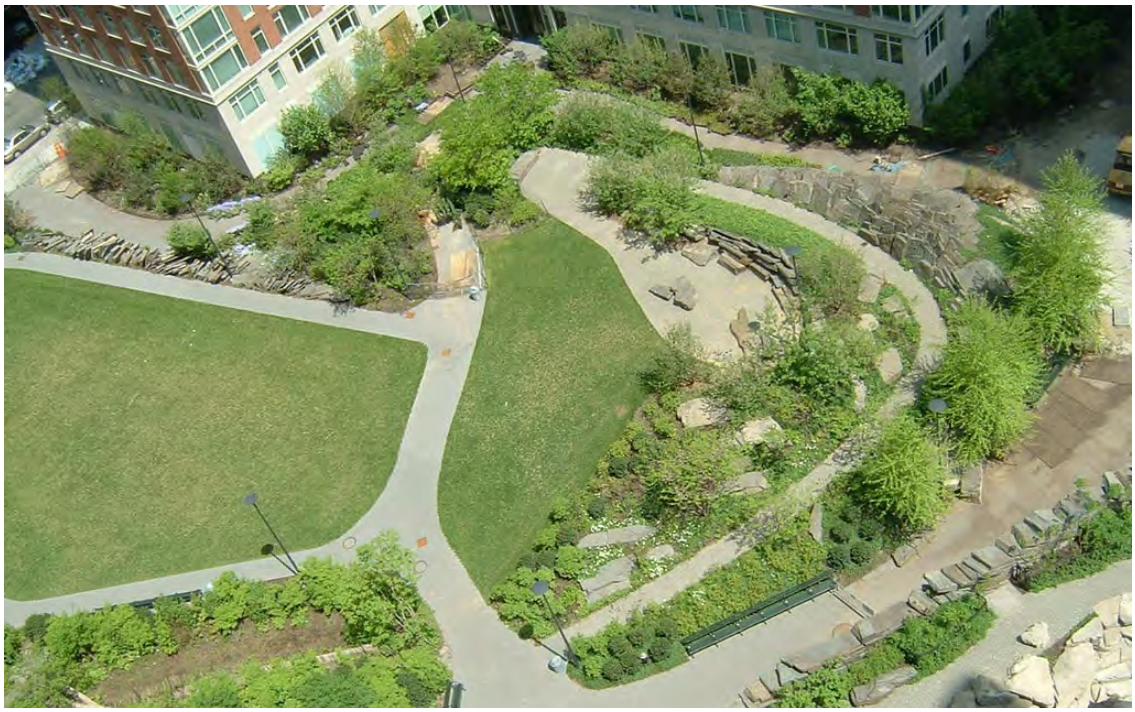

Figure 3.8 Teardrop Park from above from (Dreamymo 2002).
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PRECEDENT #2

REFLECTION RIDING

Figure 3.9 Reflection Riding plant sale from (Miller 2018).
Creative Commons Attribution Non-commercial

LOCATION

Chattanooga, Tennessee

CONTEXT

Ecological Design, Waterfront, Resilient Landscape

OPENED

Design process ongoing, estimated opening in 2030

LENGTH OF PLANNING PROCESS

October 2020-current

SIZE

317 acres

AGE RANGE

All ages

DESIGN TEAM

SCAPE Landscape Architecture

STAKEHOLDERS

Reflection Riding Organization

FUNDING

Private endowments

PROJECT DESCRIPTION

Reflection Riding Arboretum & Nature Center is a popular and admired arboretum and nature center, a short distance from downtown Chattanooga. The land was deemed as a public park by John and Margaret Chambliss in the 1950s, featuring over twelve miles of walking trails and a 3.4-mile loop drive (Reflection Riding Arboretum & Nature Center, n.d.). The site has great ecological and aesthetic value that, “offers an important window into the natural heritage of a metropolitan region impacted by urban sprawl and development,” (SCAPE Landscape Architecture 2021, p. 24). The Reflection Riding organization focuses on conservation programming and ecological education. SCAPE’s Framework for the Future is a comprehensive masterplan that celebrates

the natural and cultural heritage, while improving programming, managing the land efficiently, and increasing accessibility. This framework unifies the current programming and site and looks toward the future by planning for ecological maintenance and expanding existing educational programming and activities (SCAPE Landscape Architecture 2021).

PURPOSE

The purpose of Reflection Riding is to provide an accessible opportunity for everyone to experience nature. SCAPE's framework design looks to, "impress a sense of awe for the natural and cultural heritage of the 300-acre campus; catalyze active restoration and conservation of regional ecological communities; and educate generations of future ecological stewards," (SCAPE Landscape Architecture 2021).

DESIGN GOALS

"Respectfully reveal the ecology and rich history of the campus

Increase Reflection Riding's capacity to implement conservation and restoration initiatives

Initiate and promote restoration to propagate knowledge about native habitats

Engage and empower volunteers to advance restoration and conservation efforts

Engage and empower regional educators to provide a model for engaging youth with science

Create and plan facilities that enhance immersive programming opportunities

Support the development of coordinated curricula with a network of educational partners

Create interactive and interpretive resources for self-guided learning

Offer a wide range of recreational activities accessible to users of all ages, backgrounds, and abilities

Promote an environment that is safe, welcoming, and inclusive to all

Provide for intuitive circulation and wayfinding to ensure safe, universal, and multi-modal access

Balance increased visitation with ecological protection

Create a robust identity that remains resilient to change

Build organizational capacity to adapt to environmental, financial, and social change

Reduce risk to facilities, infrastructure, and programs from flooding and climate change

Leverage Reflection Riding's identity to foster philanthropic funding for the near and long term," (SCAPE Landscape Architecture 2021).

THEME

"Immersive environmental education for naturalists of all ages and ability levels," (Reflection Riding Arboretum & Nature Center, n.d.).

PROCESS OF ANALYSIS AND DESIGN

SCAPE describes the design process as a strong stakeholder-informed design process, including more than 800 people. Engagement includes Reflection Riding staff, board members, volunteers, partners, and community members. This process began in 2020, during the COVID-19 global pandemic, so engagement took place entirely socially distanced, with the majority undergone virtually.

ACTIVITY SETTINGS

Education Settings:

Wildlife Center, Nursery, Conservation Center, Learning Hub, Canopy Walk, Immersive Learning Pods, Lookout Mountain, Demonstration Gardens, Wildlife Loops, Research Stations, Floodplain Loop, Hydrology Loop, Cultural Trail, Understory Loop, Eco-Communities Loop, Mixed Mesic Forest Loop, Canoe Launch, Treehouse, Education Stations, "Get Down" Education Platform, Lookout Towers, Animal Enclosures, Wildlife Welcome Pavilion, Wildlife Enclosures, Amphitheatre, Viewing Platforms, Demo Platforms

Restoration Habitats:

Millison Field (wet meadow), Jump Field (grassland), Chestnut Orchard (resistant cultivars research), Upper Meadow (prairie and pine savanna), Lower Meadow (wet meadow), Buffalo

Field (prairie), Lower Pond (wetland), Sheets Sward (prairie), Upper Pond (wetland), Candy Flats (prairie), Floodplain Forest (bottomland forest)

PRE-CONSTRUCTION CONSIDERATIONS & PLANNING

Scape notes that a contractor and construction engineer team with local site and infrastructure knowledge needs to be formed to address construction feasibility. Pre-construction efforts that need to be undergone include physical surveys and site investigation, topographic surveys, subsurface investigations, tree surveys and other biological surveys, flood hazard/risk assessments or hydrologic modeling, permits, and more specific project designs.

DESIGN CHALLENGES

"Disconnected and confusing program elements; frequent flood damage caused by increased intensity and duration of storms; crowded parking lots; narrow drives; cramped offices; insufficient septic systems; aging infrastructure; conflicting land uses; various biological invasions; and residential-grade buildings attempting to serve commercial purposes," (SCAPE Landscape Architecture 2021).

PUBLIC RECEPTION/OPINION

Reflection Riding is considered one of the most beloved natural settings by the surrounding region (Reflection Riding Arboretum & Nature Center, n.d.). There is a very high level of engagement in the design process because of this community support (SCAPE Landscape Architecture 2021).

CLIMATE

Four-season humid subtropical climate (National Weather Service, n.d.).

ECOLOGY

Reflection Riding contains a nursery home to more than 100 species of native plants, which are used throughout the rest of the site to maintain and restore native habitats. The project also has a wildlife center that houses approximately 30 species of birds, mammals, reptiles, and amphibians. Additionally, the site has an extraordinary level of biodiversity due to its unique location between two prominent gaps—the Tennessee River and Running Water Creek gaps. Reflection Riding also is a part of the Ridge and Valley landscape, which is a corridor for movement of plants and animals along the Appalachians (SCAPE Landscape Architecture 2021).

Figure 3.10 Reflection Riding Sandhill Cranes from
(Miller 2018). Creative Commons Attribution Non-commercial

Figure 3.11 11. Education group tours Reflection Riding
(Miller 2018). Creative Commons Attribution Non-commercial

PRECEDENT #3

BLANCHIE CARTER DISCOVERY PARK

Figure 3.12 Longleaf Pine Reserve from (Dincher 2017).

LOCATION

Southern Pines Primary

School, 1250 W. New York

Avenue,

Southern Pines, NC.

CONTEXT

Natural play and learning space designed for an elementary school in a small, historic town located in the Sandhills Longleaf pine region.

OPENED

1998

LENGTH OF PLANNING PROCESS

3 years

SIZE

5 acres

AGE RANGE

5-7 years during school hours.

All ages out of school hours.

DESIGN TEAM

Robin Moore (NLI Director and Professor of Landscape Architecture) designed the masterplan

Michael Ortosky (NLI Landscape Architect) (Designed aquatic elements but were not implemented)

CONTRACTORS

Locally donated in-kind and at-cost services.

STAKEHOLDERS

Children, teachers, parents, and neighborhood residents. Moore County Schools, Southern Pines Department of Parks and Recreation.

FUNDING

$500,000; Funding from governmental and school sources, donations, and grants. Approximately

$150,000 of this funding were donations from the community, businesses, civic organizations, and foundations

PROJECT DESCRIPTION

Blanchie Carter Discovery Park is a large elementary school site designed to teach users about the natural environment through engagement and restoration efforts. Site maintenance is used as the vehicle for learning, with the students engaging in activities such as controlled burns and habitat restoration. These hands-on activities teach children valuable environmental education lessons. Other subjects such as history, English, and math are also taught in the outdoor classroom spaces, connecting the students with nature in multiple ways.

PURPOSE

The purpose of this project was to create "an inclusive place for healthy development, outdoor learning, and enjoyment for school and community," (Moore 2014, 173).

DESIGN GOALS

Reestablish the barren site to be a part of Longleaf Pine Forest

Create a socially and ecologically productive space

Extend vegetated edges back on to the site

Achieve water independence by drilling a well.

Create a pathway system for easy and access for children, teachers, and residents.

Use internal railings to define settings and protect plants.

Apply the universal design approach as much as possible

THEME

Inclusive play and learning activities in a diverse range of settings with an emphasis on eco-restoration (Moore 2014)

PROCESS OF ANALYSIS AND DESIGN

The design process began with a group of parents concerned about the state of their children's school's barren playground. A committee was formed comprised of parents, teachers, students, and community members. Robin Moore, Director of the Natural Learning Initiative and Professor of Landscape Architecture at North Carolina State University, joined the project as the lead designer (Kaboom Organization, n.d.). Moore engaged with parents, teachers, and students to develop the masterplan and activity programming (Moore 2014).

Implementation was incremental, dependent on funding and community engagement. Materials and workforce were provided at-cost. A community service program planted trees (Moore 2014).

ACTIVITY SETTINGS

- Naturalized, equipment-based play areas
- Pathway system
- Multi-purpose field with running track
- Vegetated hill
- Two gazebo gathering areas
- Bird blind
- Log cabin playhouse
- Council circle
- Vegetable garden
- Orchard
- Labyrinth
- Sandpit
- Picnic gathering setting
- Multiple tree- and shrub-based settings
- One-acre Longleaf Pine reserve (Moore 2014)

PROGRAMMING ACTIVITIES/ CURRICULUM

Students maintain medicinal herb and vegetable gardens after school, during recess, and in some classes. For the school's history third-grade curriculum, students are tasked with building a one-half scale log cabin and pioneer settlement using authentic 1800's hand tools. Students plant and tend to native grasses in the longleaf pine forest on site. They also participate in controlled burns of sections of the forest (Kaboom Organization, n.d.).

SITE MANAGEMENT

Part-time site manager/programmer from local

community college; school staff and parent volunteers (Moore 2014).

DESIGN CHALLENGES

Achieving approval and support from the school, long-term site management and maintenance, promoting use by teachers during school day for curricular activities in support of the NC Standard Course of Study (Moore 2014).

POST OCCUPANCY EVALUATION STATUS

None

PUBLIC RECEPTION/OPINION

Blanchie Carter Discovery Park instigated immediate positive change on the school and community. Children's enjoyment of the outdoors increased greatly. Additionally, the school experienced a notable drop in discipline occurrences (Moore 2014). The project improved the overall appeal of the school. This is not only due to the enhanced schoolyards, but also because the project provided a sense of ownership through community involvement in the design process. The park is also viewed as a source of pride by the neighborhood (Raver 1999 and Moore 2014).

CLIMATE

Sandhills Longleaf pine region (Moore 2014).

ECOLOGY

The site was previously barren, so a great reforestation effort was conducted to reintroduce the longleaf pine habitat. Edible gardens, teaching gardens, and a blueberry mase garden are other ecological communities on site (Moore 2014).

PRECEDENT #4

KIDZONE

Figure 3.13 kidZone located within the Zoological Park
Adapted from (Google Earth 2022).

LOCATION

North Carolina Zoological Park (state facility)

Asheboro, North Carolina

CONTEXT

Rural

OPENED

2014

LENGTH OF PLANNING PROCESS

7 years

SIZE

3 acres

AGE RANGE

Children aged 2-10 years old.

DESIGN TEAM

In-house designers from North Carolina Zoological Park

CONTRACTORS

Primarily in-house. Architect/ engineer and contractor appointed to assist with grading, drainage, and plumbing. Beanstalk Builders executed design/build Tree Top Trail.

STAKEHOLDERS

Joy Hamlin, NC Zoo Curator of Education

Linda Kinney, NC Zoo Education Specialist.

Zoo Education and Horticultural Education Divisions -Design Section and Horticulture Section

FUNDING

$450,000; NC Zoo Special Zoo Fund; NC Zoo Society Donations; Institute of Museums and Library Science (IMLS) grant

PROJECT DESCRIPTION

kidZone is a natural play and learning space apart of the North Carolina Zoological Park. This project is an unguided play environment in an open woodland setting. In addition to unguided play,

there are learning-through-play programs led by zoo educators, focused on teaching the connection between captive zoo animals and the regional wild animals.

PURPOSE

"Fostering a love of nature through play," (Moore 2014,165).

THEME

"Free play in natural settings," (Moore 2014, 165).

DESIGN GOALS

Create an outdoor area for children to engage senses in nature play.

Design interactive and open-ended nature play programming for individual families.

Foster an environment for positive family relations.

Allow for opportunities with both increased physical activity and quiet, individual reflection. Through this, encourage emotional and social development.

Develop environmental empathy in children through animal engagement (overseen by staff).

Provide opportunities for discovery-based learning opportunities, self-initiated exploration, and multi-sensory interactions with nature (Moore 2014).

PROCESS OF ANALYSIS AND DESIGN

The design of a Children's Nature Discovery Center for the North Carolina Zoological Park began in 2006. In 2007, the kidZone project began under this master project. kidZone was designed to be the nature play and learning space under the larger children's learning center. Zoo construction crewmembers implemented the design (Moore 2014).

ACTIVITY SETTINGS

- Entry walk-through stick sculpture entitled "Ready or Not" by artist, Patrick Dougherty
- Stream
- Sand/dirt play
- Mud café
- Campfire circle
- Treetop trail
- Woodland exploration
- Animal habitat/fort building
- Artist cove (chalk drawing, painting with water)
- Wildlife attraction pond
- Playhouse (roleplay: be an animal, keeper, vet, etc.)
- Grassy lawn area (aimed at loose parts play)
- Vegetable garden
- Music area (Moore 2014).

PROGRAMMING ACTIVITIES/ CURRICULUM

Staff members facilitate activities each day including building forts with natural materials, dipping in the pond, making mud pies, and other opportunities for engagement with nature (Moore 2014). There are also staff-supervised animal interactions and Nature Play Days. Nature Play Days are advertised, organized days for groups of children with activities such as sand digging, water play, rock building, nature art, and loose part free play (North Carolina Zoo, n.d.).

SITE MANAGEMENT

There is one full-time educator position dedicated to supervising day-to-day operations in kidZone. In addition, there are 3-4 seasonal, part-time staff. For animal interaction activities, two full-time and one part-time animal staff manage and handle the animals (Moore 2014).

DESIGN CHALLENGES

Fund raising.

Persuading zoo leadership that a designated area for children's play is valuable for the zoo.

Creating a safe natural environment that allows parents to be comfortable with their children interacting with nature and getting dirty (Moore 2014).

POST OCCUPANCY EVALUATION STATUS

The Natural Learning Initiative (NLI) performed a behavior-mapping post-occupancy study. “Findings demonstrate a strong association between dramatic play and science learning as well as an association between play with loose parts and dramatic play. Results suggest that children are more inclined to learn in settings they can manipulate at will,” (Moore 2014).

PUBLIC RECEPTION/OPINION

North Carolina Zoological Park hosts over 750,000 visitors a year. Positive feedback is reported for kidZone, as it allows for an engaging, hands-on experience for children and gives parents a chance to rest (Moore 2014).

CLIMATE

Mild climate that is often warm and rainy (National Weather Service, n.d.)

MATERIALS

Natural materials are used throughout the site. An entry sculpture is comprised of sticks gathered locally (Moore 2014).

ECOLOGY

A butterfly garden and wooded area cover much of the site (Moore 2014).

PRECEDENT #5

THE MUSEUM BACKYARD AND NATURE CLUB HOUSE

Figure 3.14 Stream on site used for nature play and learning from (Spliferella 2018). Creative Commons Attribution Non-commercial

LOCATION

Santa Barbara Museum of Natural History (SBMNH),

Santa Barbara, CA

CONTEXT

Urban neighborhood of single-family homes.

OPENED

2008 (Backyard)

2012 (Nature Club House)

LENGTH OF PLANNING PROCESS

5 years

SIZE

0.5 acre

AGE RANGE

All ages

DESIGN TEAM

Elaine Gibson, Education Specialist

Gary Robinson, Director of Facilities, SBMNH

Mark Frankavilla, Creative Landscape Design

CONTRACTORS

General contractor, design/build contractor, in-house and volunteer crews.

Boyd Hernandez Construction (Nature Club House renovation).

STAKEHOLDERS

Museum staff, environmental education partners, and visitors.

FUNDING

$230,000; from Local family foundations, Rotary Club, individual donations.

PROJECT DESCRIPTION

The Museum Backyard and Nature Club House is an outdoor extension of the Santa Barbara Museum of Natural History. The space is designed to be a "community-based, nature play and learning area attached to a non-formal education institution, developed with designed additions to an already diverse, wooded site within a stream corridor," (Moore 2014, 169). Programming on site varies, with opportunity for free form play in addition to organized programs such as Renovated Nature Club (Moore 2014).

PURPOSE

"To inspire a thirst for discovery and a passion for the natural world," (Moore 2014, 169).

DESIGN GOALS

Reconnect visitors of all ages to the natural world, through hands on interaction with nature.

Provide places for climbing, listening, building, searching, creating, imagining, socializing, and physically playing (Moore 2014).

THEME

"Connecting to nature," (Moore 2014, p. 169).

PROCESS OF ANALYSIS AND DESIGN

An outdoor school program in 2007 led to the idea for this site to become a natural play and learning space. The zoo's Director of Education & Exhibits and Education Specialist presented ideas to Museum leadership, and from there the project began (Moore 2014).

ACTIVITY SETTINGS

- Boulder pathway (climbing);
- Near creek under trees (listening);
- Bamboo poles (fort-building);
- Compost pile (searching);
- Mudpie place (creating);
- Water course with hand pumps,
- Stone plank bridge (water exploration);
- Gathering on stumps (social play);
- Fallen log (balance);
- Stage (socializing, imaginative play with scarves, drums)
- Nature Club House (animal interaction)
- Boardwalk
- Backyard Creek (Moore 2014 and Santa Barbara Museum of Natural History, n.d.).

PROGRAMMING ACTIVITIES/ CURRICULUM

Outdoor Nature Explorations (school programs), Museum Backyard self-guided explorations, monthly Family Nature Days, festival components, Discovery Backpacks to motivate exploration, Field Science with a Naturalist (Moore 2014 and Santa Barbara Museum of Natural History, n.d.)

SITE MANAGEMENT

Nature Education manager position oversee site management. VolunTeens, Quasars to Sea Stars (Museum program for teens) and volunteer naturalists are involved in the space's upkeep (Moore 2014).

DESIGN CHALLENGES

Managing loose parts was a major challenge of this project. A full-time naturalist needed to be recruited to manage volunteers (Moore 2014).

POST OCCUPANCY EVALUATION STATUS

None

PUBLIC RECEPTION/OPINION

A professionally conducted survey shows that visitors ranked The Museum Backyard and Nature Club House as their third most favorite part of the entire museum (Moore 2014).

CLIMATE

Located in Santa Barabara, California, the site experiences warm-summer Mediterranean climate (National Weather Service, n.d.).

MATERIALS

Mostly locally collected natural materials—stone and wood (Moore 2014).

ECOLOGY

Ecology is not the focus of this design, though the design is non-invasive and locally sourced. The design elements operate as green infrastructure for the stream corridor that cuts through the site (Moore 2014).

Figure 3.15 Educational signage on plants throughout the site (Spliferella 2018). Creative Commons Attribution Non-commercial

Figure 3.16 Children play at the site's amphitheater (Sanvictores 2006). Creative Commons Attribution Non-commercial

PRECEDENT #6

THE ARLITT NATURE PLAYSCAPE

Figure 3.17 Playscape is located on campus
Adapted from (Google Earth 2022)

LOCATION

University of Cincinnati,

Cincinnati, OH.

CONTEXT

University campus

OPENED

2012

SIZE

0.3 acre

AGE RANGE

Preschool aged children; open to community outside of preschool hours (Moore 2014).

DESIGN TEAM

Rachel Robinson-- Design Landscape Architecture, LLC

Consultant: Robin C. Moore-- Natural Learning Initiative & NC State University (Moore 2014).

CONTRACTORS

General Contractor: Mark Spaulding; Fencing: ZSR Construction; Plumbing: Queen City Mechanicals (Moore 2014).

STAKEHOLDERS

Arlitt Center Head Start program and preschool; Office of the University Architect, UC; College of Education, Criminal Justice, and Human Services. Families from nearby communities (Moore 2014).

FUNDING

$409,000

PROJECT DESCRIPTION

The Arlitt Nature PlayScape is an enclosed outdoor play and learning space primarily used by a preschool on the University of Cincinnati's campus.

This space is a research site for the college, and it investigates the impact of nature play on preschool children's development. Research focuses on social development, self-efficacy abilities, literacy, and STEM education (Moore 2014).

PURPOSE

"Provide a safe, outdoor place for children's exploration, discovery, play, learning, and positive social interactions, emphasizing the importance of the outdoor early childhood environment and serve as a research facility for the university community," (Moore 2014, 177).

DESIGN GOALS

"Convert an underused campus space into a place, where children can receive a "daily minimum dose" of natural experiences and acquire love and respect for the natural world.

Create a research venue and co-learning lab beyond indoor classrooms, offering professional development for early childhood educators.

Introduce parents to a backyard design model and a place to experience nature with children," (Moore 2014, 177).

THEME

"Remind parents, teachers, administrators, students, and local residents of how playing in nature can stimulate curiosity and the joy of learning at all stages of life," (Moore 2014, 177).

PROCESS OF ANALYSIS AND DESIGN

The design process for The Arlitt Nature PlayScape began in 2008. Dr. Vicki Carr, Associate Professor of Early Childhood Education and Human Development at the University of Cincinnati, and Bill Hopple, CEO of the Cincinnati Nature Center, co-founded the project. NLI was brought in as a design consultant and focused on programming. A landscape architect, NLI, and stakeholders met with campus stakeholders to develop the design (Moore 2014).

ACTIVITY SETTINGS

Main entrance from campus sidewalk and overlook with seating and signage

- Vegetated edges
- Primary and secondary pathways
- Treehouse in existing bosque
- Multiuse lawn
- Grassy banks
- Decks
- Puppet-theater
- Tunnels
- Play niches
- Arbors
- Hammock
- Full body contact vegetation
- Gross motor settings
- Earth and sand play
- Loose parts
- Herb and butterfly garden
- Vegetable and flower garden
- Fruiting plants
- Child-activated stream
- Art projects
- Storage/program base
- Shady observation stations for researchers (Moore 2014).

PROGRAMMING ACTIVITIES/ CURRICULUM

PlayScape's purpose is to provide an environment that supports science education for preschool aged children. In addition to improving science education, the space aims to encourage skills including self-determination, mapping skills, problem-solving, and cooperation (Moore 2014).

SITE MANAGEMENT

The site is managed by campus facilities and staff at the Arlitt Center (Moore 2014).

DESIGN CHALLENGES

Meeting campus design standards, supporting building costs, seeking continued funds for upkeep (Moore 2014).

POST OCCUPANCY EVALUATION STATUS

Teacher usability study. NSF-funded study, PlayScapes: Designed Nature Environments to Promote Informal Science Learning, directed by Dr. Carr (2011-2012) (Moore 2014).

PUBLIC RECEPTION/OPINION

With the implementation of PlayScape, staff at the preschool have reported fewer behavioral issues, more sustained engagement in activities, and positive learning outcomes (Moore 2014). Additionally, PlayScape proves, "how an underused campus green space can be transformed into an aesthetically pleasing, academically relevant, programmatically interactive landscape," (Moore 2014, 79).

MATERIALS

Metal fencing, wood, stone,

ECOLOGY

Planting design focused on creating a natural area in the campus setting (Moore 2014).

PRECEDENT #7

MARGE & CHARLES SCHOTT NATURE PLAYSCAPE

Figure 3.18 Aerial of Nature Playscape
Adapted from (Google Earth 2022)

LOCATION

Cincinnati Nature Center (CNC)

Milford, OH.

CONTEXT

Suburban/Rural Nature Center

OPENED

2011

LENGTH OF PLANNING PROCESS

5 years

SIZE

1.6 acres

AGE RANGE

All ages

DESIGN TEAM

The Niehoff Urban Studio

Natural Learning Initiative (Consultant)

CONTRACTORS

Sharon Floro, GroundWork Design Cincinnati LLC; Rachel Robinson, Design Landscape Architecture, LLC; Luke Schelly, LJS Design and Build; General Contractor, Andy Argo Construction; Bzak Landscaping; DeVore's Land and Water Gardens, Inc.; Eads Fence Company; Jonathan Young, Elk Run Construction.

STAKEHOLDERS

Cincinnati Nature Center, members and visitors; Arlitt Child and Family Research and Development Center (Arlitt Center), UC.

FUNDING

$500,000; Private donations, corporate donations, in-kind contributions.

PROJECT DESCRIPTION

Marge & Charles Schott Nature PlayScape is a natural play and learning space that is a part of the Cincinnati Nature Center (CNC). The Nature Playscape uses all natural materials to create an engaging play experience for all ages. The goal of this space is to increase access to nature for Cincinnati residents and educate the public on the importance of outdoor play (Moore 2014).

PURPOSE

"To stimulate healthy child development, family enjoyment, creativity, learning, a passion for nature, and sense of stewardship through spontaneous outdoor nature play, regardless of income or physical abilities," (Moore 2014, 157).

DESIGN GOALS

"For children: Facilitate child-initiated learning; encourage curiosity, exploration, and discovery; motivate physical activity; stimulate creativity; facilitate social interaction and respectful behavior; prompt decision making to test limits and become confident," (Moore 2014, 157).

"For adults: Demonstrate replicable nature play elements for families; encourage use as a research site and teaching tool; model play facilitation and build community among visitors, volunteers and members; inspire users to invest playful nature in residential yards, parks, and school grounds; train caregivers and teachers to overcome barriers to nature play," (Moore 2014, 157).

THEME

"Provide a dedicated place where children can wander off trail, dig, climb, pick flowers, build forts, play in mud, hop on rocks, and engage in all manner of natural adventures—in contrast to the strict rules in the remaining 1000-acre nature preserve," (Moore 2014, 157).

PROCESS OF ANALYSIS AND DESIGN

The design process of Marge & Charles Schott Nature Playscape began in 2007 when the NLI was working on the Arlitt Center as Nature PlayScape for the University of Cincinnati. The Niehoff Urban Studio and NLI worked together to produce a professional development program (PDP) on design for childhood and nature. PDP participants observed the design of the Nature PlayScape and participated in workshops with children. In the end, CNC staff, CNC members, the NLI, stakeholders, the Niehoff Urban Studio, and a group of children worked together to create the conceptual design (Moore 2014).

ACTIVITY SETTINGS

- recirculating stream
- gathering terrace
- pathways
- wetland
- hills
- rocky places, tunnel, and cave
- fallen logs
- forest and field habitats
- willow
- tunnel
- dirt piles
- sand and pebble play
- multipurpose lawn
- diverse, seasonal plant textures and colors
- pavilion
- shady picnic tables
- convenience station
- storage shed

PROGRAMMING ACTIVITIES/ CURRICULUM

The Nature PlayScape is usually unstaffed/ unsupervised. Periodically there are staff from the CNC or trained volunteers that provide organized play activities and materials (Moore 2014).

SITE MANAGEMENT

The CNC employs a seasonal gardener full-time. A part-time family program coordinator manages and plans for Nature PlayScape. Part-time staff assist for events. CNC grounds and facilities staff upkeeps Nature PlayScape.

DESIGN CHALLENGES

"To convey to visitors the notion of personal responsibility for assessing risks and help them not to assume that everything must be safe so that no thinking is required on their part," (Moore 2014, 159).

PUBLIC RECEPTION/OPINION

Family memberships to the Cincinnati Nature Center increased 30% in the year following the opening of Nature PlayScape. The CNC plans to implement shade structures to increase site comfortability and time spent on site (Moore 2014).

MATERIALS

All natural materials are used as play elements (Moore 2014).

ECOLOGY

Existing materials are used as play and learning elements (fallen logs, forest habitats, sand and pebbles) (Moore 2014).

PRECEDENT #8

GROWING PLACE

Figure 3.19 Children participate in insect themed lesson from (Ito 2013). Used with permission.

LOCATION

Keitaro Ito, Fukutsu City, Japan

CONTEXT

Elementary school biotope in an urban area

OPENED

April 2003

LENGTH OF PLANNING PROCESS

4 months (ongoing)

SIZE

.26 acres

AGE RANGE

School children

DESIGN TEAM

Keitaro Ito

CONTRACTORS

Community participatory process, 83 school children, 20 teachers and 12 students from Kyushu Institute of Technology

STAKEHOLDERS

Fukuoka Shiritsu Ikiminami Elementary School

FUNDING

Primarily grant funding, The Sumitomo Foundation

PROJECT DESCRIPTION

Growing Place is an area for children's play and ecological education. This natural play and learning space are in the courtyard of Ikiminami-primary school in Japan. In this urban area, children have very limited access to nature, so this space is heavily utilized by children to connect to nature and learn about the environment. Some factors that motivated the inception of this project are, "a lack of outdoor space to play in, fear of violence in public spaces, the longer working hours of parents, and the artificial nature of most playgrounds,"

(Keitaro 2013, 1).The space has a biotope with multifunctional characteristics to serve as both a play space and a space to learn ecological systems hands on (Keitaro 2013).

PURPOSE

To serve as both a play and engagement space, while serving real ecological functions permanently.

DESIGN GOALS

Create a biotope by using a process planning approach in combination with a multi-functional landscape planning approach

Serve real ecological functions to the surrounding urban area

Serve as both play and engagement spaces

Provide a habitat for several birds, insects, and fish

THEME

Ecological biotope

PROCESS OF ANALYSIS AND DESIGN

The designer used a process planning approach to the design of this educational biotope. This means focus was on the process itself, instead of solely the end form of the space.
Multi-Functional Landscape Planning was the design method, meaning the space was analyzed and then designed by dividing functions into layers (a layer for vegetation, water, playground, and ecological learning). This creates multi-functional areas in the space, and as a result children can learn multiple subjects at the same time and relationships between these layers. Participatory workshops were held with children, university students, and teachers. James J. Gibson's theory of affordances was applied to this design process. This means children's activities corresponded to the composition of the space, its function, and organization.

ACTIVITY SETTINGS

- Landscape mound
- Pond
- Bridge
- Log benches
- Ecological zones

PROGRAMMING ACTIVITIES/ CURRICULUM

Participatory maintenance and design

SITE MANAGEMENT

Children, university students, and teachers participated in the construction of this site during a "construction workshop." These workshops continue to be held as both educational sessions and to make improvements to the site. Some examples of these improvements are a water purification workshop and the construction of a new bridge.

DESIGN CHALLENGES

Some concerns raised from previous biotopes built in Japan are listed, "The children are not allowed to approach the biotope because of the emphasis on the protection of the ecosystem; Failure by the planners to consider the regional ecosystem, which has led to the destruction of that ecosystem; The biotope is too small to have an ecological function; The children and teachers of a school do not use the biotope because it was planned and constructed by the local council without their participation," (Ito 2013).

POST OCCUPANCY EVALUATION STATUS

Ongoing workshops are held to improve and add to design (230 workshops between April 2003 and July 2013). The designer continues to examine and study the site as a research project and has observed 186 kinds of play on site.

PUBLIC RECEPTION/OPINION

Public perception seems to be overwhelmingly positive, with continued support and participation of the maintenance of the space.

MATERIALS

Naturalistic biotope

ECOLOGY

Ecological function is at the forefront of the design of this biotope. The site began as a concrete parking area and transformed into a biodiverse rich habitat, home to several species of plants, animals, and insects.

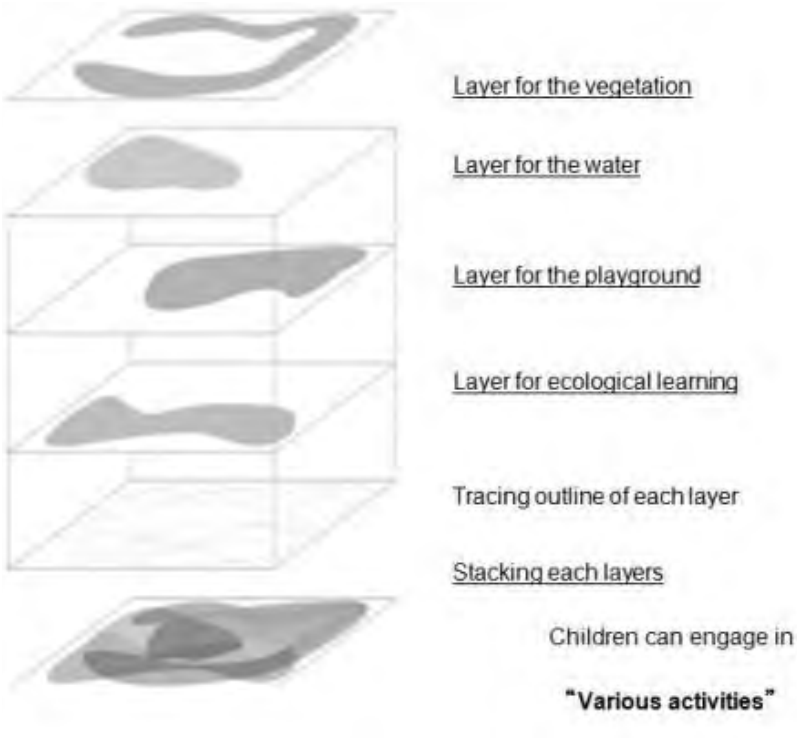


Figure 3.20 Multi-Functional Landscape Planning Diagram from (Ito 2013). Used with permission.

Figure 3.22 Site prior to design intervention from (Ito 2013). Used with permission.

Figure 3.21 Scale model of site design from (Ito 2013). Used with permission.

	CONTEXT	ACTIVITY SETTINGS
TEARDROP PARK	Dense urban, public park (Moore 2014)	Shadbush Hill, Tunnel, Water Play, Slide Hill, Sand Lot, Sand Cove, Amphitheater, Overlook, Marsh (children's natural hideaway), Lawn Bowl, Geologic Section, Beech Grove, Reading Circle, Ice Wall, Witchhazel Dell, and multiple broad to narrow pathways
REFLECTION RIDING	Ecological Design, Waterfront, Resilient Landscape	Wildlife Center, Nursery, Conservation Center, Learning Hub, Canopy Walk, Immersive Learning Pods, Lookout Mountain, Demonstration Gar-dens, Wildlife Loops, Research Stations, Ecotype walking loops, Canoe Launch, Tree house, Education Stations, "Get Down" Education Platform, Lookout Towers, Animal Enclosures, Wildlife Welcome Pavilion, Wildlife Enclosures, Amphitheater, Viewing Platforms, Demo Platforms, Ecotype gardens/zones
BLANCHIE CARTER DISCOVERY PARK	Elementary school in a small, historic town	Naturalized, equipment-based play areas, Pathway system, Multi-purpose field with running track, Vegetated hill, Two gazebo gathering areas, Bird blind, Log cabin playhouse, Council circle, Vegetable garden, Orchard , Labyrinth, Sandpit, Picnic gathering setting, Multiple tree- and shrub-based settings, One-acre Longleaf Pine reserve
KIDZONE	Rural Park	Entry walk-through stick sculpture, Stream, Sand/dirt play, Mud café, Campfire circle, Treetop trail, Woodland exploration, Animal, habitat/ fort building, Artist cove, Wildlife attraction pond, Playhouse, Grassy lawn area, Vegetable garden, Music area (Moore 2014).
THE MUSEUM BACKYARD AND NATURE CLUB HOUSE	Museum located in an urban neighborhood of single-family homes.	Boulder pathway (climbing); Near creek under trees (listening); Bamboo poles (fort-building); Compost pile (searching); Mudpie place (creating); Water course with hand pumps, Stone plank bridge (water exploration); Gathering on stumps (social play); Fallen log (balance); Stage (socializing, imaginative play with scarves, drums) Nature Club House (animal interaction) Boardwalk Backyard Creek (Moore 2014 and Santa Barbara Museum of Natural History, n.d.).
THE ARLITT NATURE PLAYSCAPE	University campus	Main entrance from campus sidewalk and overlook with seating and signage, Vegetated edges, Primary and secondary pathways, Tree-house in existing bosque, Multi use lawn, Grassy banks, Decks, Puppet-theater, Tunnels, Play niches, Arbors, Hammock, Full body contact vegetation, Gross motor settings, Earth and sand play, Loose parts, Herb and, butterfly garden, Vegetable and flower garden, Fruiting plants, Child-activated stream, Art projects, Storage/program base, Shady observation stations for researchers (Moore 2014).
MARGE & CHARLES SCHOTT NATURE PLAYSCAPE	Suburban/Rural Nature Center	Recirculating stream, Gathering terrace , pathways, wetland hills, rocky places, tunnel, and cave, fallen logs, forest and field habitats, willow, tunnel, dirt, , sand and pebble play, multipurpose lawn, seasonal plant textures and colors, pavilion , shady picnic tables, convenience station, storage shed
GROWING PLACE	Elementary school biotope in an urban area	Landscape mound, Pond, Bridge, Log benches, Ecological zones

Figure 3.23 Precedent Analysis Chart. Source: Author

PURPOSE	PROGRAMMING	SITE MANAGEMENT
"To address the urban child's lack of natural experience, offering adventure and sanctuary while also engaging mind and body," (Michael Van Valkenburgh Associates n.d.).	Year-Round events and programs; "Fairy Days," Biannual, all-weather event	Managed by neighborhood association, full-time surveillance
To "impress a sense of awe for the natural and cultural heritage of the 300-acre campus; catalyze active restoration and conservation of regional ecological communities; and educate generations of future ecological stewards," (SCAPE Landscape Architecture 2021).	Engage and empower regional educators to provide a model for engaging youth with science. Create and plan facilities that enhance immersive programming opportunities. Support the development of coordinated curricula with a network of educational partners. Create interactive and interpretive resources.	Large site, mostly unsupervised; paid entry
The purpose of this project was to create "an inclusive place for healthy development, outdoor learning, and enjoyment for school and community," (Moore 2014, 173).	Participatory maintenance and building exercises; maintain plants, controlled burns	Part-time site manager/ programmer from local community college; school staff and parent volunteers (Moore 2014).
"Fostering a love of nature through play," (Moore 2014, 165).	Building forts with natural materials, dipping in the pond, making mud pies, and other opportunities for engagement with nature. Staff-supervised animal interactions and Nature Play Days-- advertised, organized days with sand digging, water play, rock building, nature art, and loose part free play (North Carolina Zoo, n.d.).	One full-time educator position to supervise daily operations; 3-4 seasonal, part-time staff; two full-time and one part-time animal staff manage and handle the animals (Moore 2014).
"To inspire a thirst for discovery and a passion for the natural world," (Moore 2014, 169).	Outdoor Nature Explorations (school programs), Museum Backyard self-guided explorations, monthly Family Nature Days, festival components, Discovery Backpacks to motivate exploration, Field Science with a Naturalist (Moore 2014 and Santa Barbara Museum of Natural History, n.d.)	Nature Education manager position oversee site management. Volunteers, Quasars to Sea Stars (Museum program for teens) and volunteer naturalists are involved in the space's upkeep (Moore 2014).
"Provide a safe, outdoor place for children's exploration, discovery, play, learning, and positive social interactions, emphasizing the importance of the outdoor early childhood environment and serve as a research facility for the university community," (Moore 2014, 177).	PlayScape's purpose is to provide an environment that supports science education for preschool aged children. In addition to improving science education, the space aims to encourage skills including self-determination, mapping skills, problem-solving, and cooperation (Moore 2014).	The site is managed by campus facilities and staff at the Arlitt Center (Moore 2014).
"To stimulate healthy child development, family enjoyment, creativity, learning, a passion for nature, and sense of stewardship through spontaneous outdoor nature play, regardless of in-come or physical abilities," (Moore 2014, 157).	The Nature PlayScape is usually unsupervised. Periodically there are staff from the CNC or trained volunteers that provide organized play activities and materials (Moore 2014).	Seasonal gardener full-time; part-time family program coordinator manages and plans for Nature PlayScape. Part-time staff assist for events. CNC grounds and facilities staff upkeeps Nature PlayScape.
To serve as both a play and engagement space, while serving real ecological functions permanently.	Participatory maintenance and design. Teacher or school staff supervision	Children, university students, and teachers participated in the construction of this site during a "construction workshop" for participatory maintenance

	VARIED ACTIVITY SETTINGS	PARTICIPATORY ACTIVITIES	ENCOURAGE DISCOVERY	CONTROLLABLE ACCESS
TEARDROP PARK				
REFLECTION RIDING				
BLANCHIE CARTER DISCOVERY PARK				
KIDZONE				
THE MUSEUM BACKYARD AND NATURE CLUB HOUSE				
THE ARLITT NATURE PLAYSCAPE				
MARGE & CHARLES SCHOTT NATURE PLAYSCAPE				
GROWING PLACE				

Figure 3.24 Considerations from each precedent study
Source: Author

PRECEDENT ANALYSIS

The precedent studies' findings were collected, then analyzed by comparing 5 factors: context, purpose, activity settings, programming, and site management. These factors were analyzed through imputing each project's information into a chart (Figure 3.23), which allowed for cross comparison. From this comparison and the overall findings of each precedent, a list of design considerations was developed that will inform the projective design of Sunset Zoo's Natural Play and Learning Space. The four design considerations drawn from the precedent comparison are to have varied activity settings, participatory activities, to encourage discovery, and to have controllable access. The projects where these themes are present is depicted in Figure 3.24.

DESIGN CONSIDERATIONS

Precedent projects were located across the world in various contexts. Though the design of this report is a natural play and learning space as an extension of a zoo, looking at projects in other contexts informs several other design dilemmas. Several projects are on school grounds or a museum, similar to this project's zoo context. These projects take advantage of their location, utilizing staff and students for site management. Site management, or supervision/staffing, is important to consider in the design of this project. Projects range from minimal surveillance to interminable supervision. The level of supervision is dependent on activity settings on site and perceived risk of access. The project site is currently public accessible land. From this precedent analysis, it is concluded that there will need to be restricted accessibility to at least some areas on site to safely implement activity settings and elements. Because the land is currently public with trail connectors, some land will likely need to remain publicly accessible. Initiation of an accessibility study is suggested.

Several activity settings were collected in this precedent study. Many of the projects shared similar elements for play/learning, such as a grand entry sculpture, ecotype educational gardens, natural play equipment, council circles or gathering areas, fort-building areas, adventure loops, overlook decks, and a connection to water. Other relevant activity settings from the precedent study include a geologic study area, “get-down” education platform, research stations, tunnels, an artist cove, hammocks, and a wildlife observation treehouse. These activity settings are further explored during the design process.

Related to the activity settings found from the precedent study, there are several relevant programming opportunities from the studied projects. Several programming activities include participatory site maintenance or hands-on group building/creation. Other activities include independent self-guided exploration, all-weather themed programs, interactive stations/ signage, interpretive resources for solo or group exploration, loose-part play, problem-solving activities, mapping activities, and group activities.

Finally, the precedents were studied to understand each project’s central objective and how this relates to the chosen activity settings and programming. Each purpose is similar but vary marginally. Most purposes are to connect people (or specifically children) to a safe space in nature and to encourage discovery, learning, and social connections.

Figure 3.25 Considerations generated from precedent study
Source: Author

PART THREE
SITE ANALYSIS

Sunset Zoo in Manhattan, Kansas is adjacent to a natural area that is rich in habitat value, which includes steep sloped topography, a rich wooded environment, Wildcat Creek, and a trail system. Because of these existing conditions, Sunset Zoo has many opportunities for environmental education programs.

This site analysis primarily considers the site's topography, drainage, views, existing landscape features, and site access and connectivity. A series of maps were created to analyze the site conditions. From there, the site opportunities and constraints were determined. The mapping and analysis helped determine suitable activity settings and design elements.

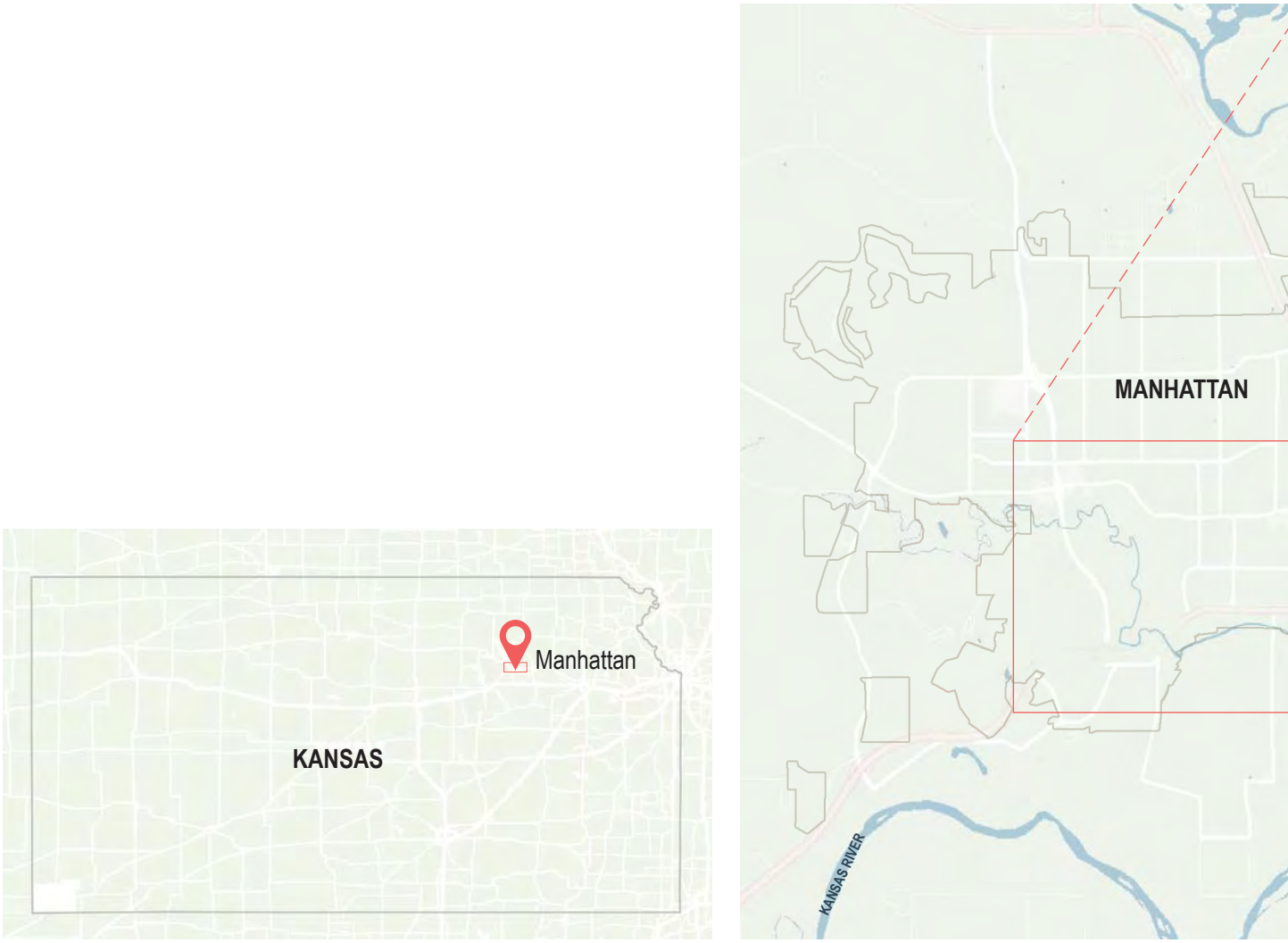


Figure 3.26 Sunset Zoo in Context of Kansas and Manhattan. Not to scale. Source: Adapted from (Snazzy Maps 2022).


Project Site
SUNSET ZOO
LINEAR TRAIL
BIG BLUE RIVER
KANSAS RIVER

SUNSET ZOO INVENTORY

Sunset Zoo's masterplan has been studied in order to design in accordance with the zoo's goals and mission. This process benefits the project because by understanding the zoo's goals, plans (past, present, or future), and strategies, the design can accurately fit in with and add to Sunset Zoo. This allows me to respond to the research question by providing a successful natural play and learning space that improves the educational value of Sunset Zoo.

The Sunset Zoo Strategic Plan was created in 2018 and is to be completely implemented by 2023. GLMV Architecture and Zoo Advisors LLC worked with Sunset Zoo to create the plan. This document outlines an updated list of core values, goals, mission, and vision (Sunset Zoo 2018). The five main strategic goals are shown in Figure 3.27. From these five goals, strategies are listed on how to achieve the goals. Several of these strategies support the implementation of a natural play and learning space. Strategies relevant to education and natural play and learning spaces were extracted from the document and listed in Figure 3.28. These applicable goals taken from the Strategic Plan informed the design of my project.

Figure 3.27 Five strategic goals of 2018 Masterplan. Adapted from (Sunset Zoo 2018).

NATURAL PLAY & LEARNING SPACE RELEVANT STRATEGIES

- Increase conservation relevance of animals and exhibits.
- Increase earned income: admissions fees, program fees, rentals, concessions.
- Consider small events/activities with good ROI and low staff impact to showcase the Zoo, increase awareness and revenue.
- Build strategic partnerships with select school districts.
- Enhance guest learning experiences - encounters, shows, and more.
- Improve wayfinding and accessibility.
- Add new guest amenities such as restrooms, seating areas, food, and gift concessions.
- Improve interpretation at current exhibits and increase opportunities for interaction Zoo-wide.
- Align Wildlife Conservation Plan with strategic plan and identify resource needs.
- Integrate conservation initiatives with animals, exhibits, programs, communication.
- Develop strategies to increase awareness of Sunset's conservation program.
- Explore additional/expanded partnerships with K-State, Discovery Center/libraries, others.
- Promote Zoo as "civic commons" - meeting space, "town hall" for all.

Figure 3.28 Extracted strategies from 2018 Masterplan. Adapted from (Sunset Zoo 2018).

AMENITIES & EXHIBITS

Mammals on exhibit are the Amur Leopard, Asian Small-clawed Otter, Bennett's Wallaby, Black & White Colobus Monkey, Black-tailed Prairie Dog, Bobcat, Bolivian Reed Titi Monkey, Chacoan Peccary, Cheetah, Chimpanzee, Giant Anteater, Malayan Tiger, Maned Wolf, Red Panda, Spotted Hyena, Western Tufted Deer, and the White-handed Gibbon. Birds on exhibit are: American Flamingo, American White Pelican, Black Swan, Canada Goose, Crested Screamer, Emu, Green Aracari, Kookaburra, Red-crowned Crane, Silver Gull, Straw-necked Ibis, Turkey Vulture, and the Violet Turaco. Sunset Zoo has one reptile on exhibit, the Red-footed Tortoise (Sunset Zoo 2022).

Amenities at the zoo include the Expedition Café, vending machines, parking, a playground, picnic areas, the Safari Outpost Gift Shop, and restrooms. Additionally, there are garden spaces at the zoo, including the Master Gardener's Butterfly Garden, Pat Freeman's Hummingbird Garden, Rain Gardens, Sally Hummel Wagner Memorial Garden, and the Town & Country Garden Club's Sensory Garden (Sunset Zoo 2022).

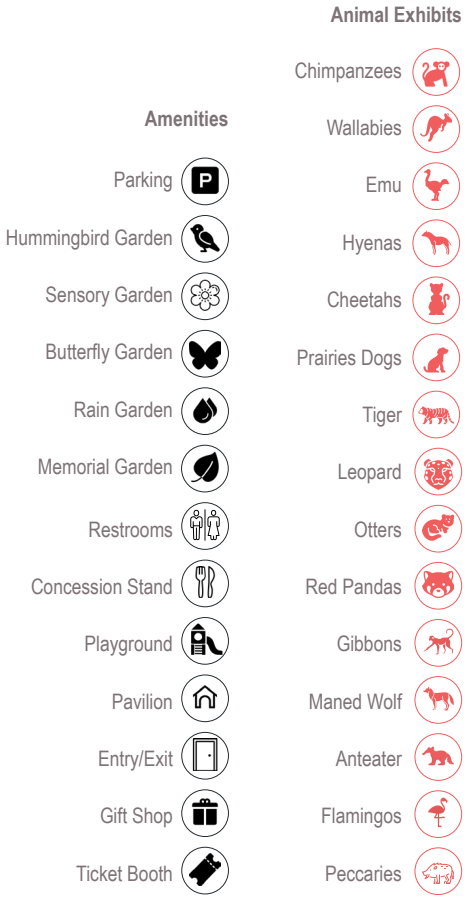


Figure 3.29 Sunset Zoo Plan
Adapted from (Sunset Zoo 2018)


ENTRY TO SITE
AUSTRALIAN WALKABOUT
AFRICAN TRAIL
NATURE EXPLORATION CENTER
KANSAS PLAINS
AMPHITHEATER
NATURE PLAYGROUND
SOUTH AMERICAN TRAIL
ASIAN TRAIL
POSSIBLE EXPANSION AREA
ENTRY TO SITE
0
50
100'

PROGRAMS

Sunset Zoo has several existing educational programs that are successful resources for the Manhattan community. These programs include the Animal Ambassador Program, Discovery Programs, Girl Scout workshops, guided zoo tours, overnight adventures, behind the scenes experiences, group and school programs, military group programs, adventure camps, summer camps, online "zoofari" tails, scientific research programs, and customized educational programs (Sunset Zoo 2022). According to the zoo's 2023 strategic plan, the zoo plans to continue to build on this existing success and "create a compelling learning environment for Zoo visitors that's fun—an experience that inspires them to explore and discover science and return in the future," (Sunset Zoo 2018, p. 11).

Figure 3.30 Sunset Zoo Education and Play Activity Map
Adapted from (Sunset Zoo 2018).

SITE INVENTORY

Figure 3.31 Site Context and Adjacencies Plan
Adapted from Google Earth and (Sunset Zoo 2018).

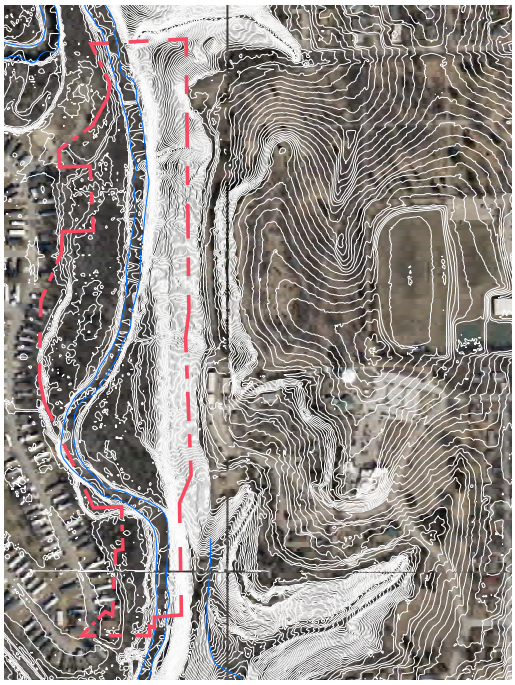


Figure 3.32 Contour Map
Adapted from (Riley County GIS Database).

Figure 3.33 Slope Map
Adapted from (Riley County GIS Database).

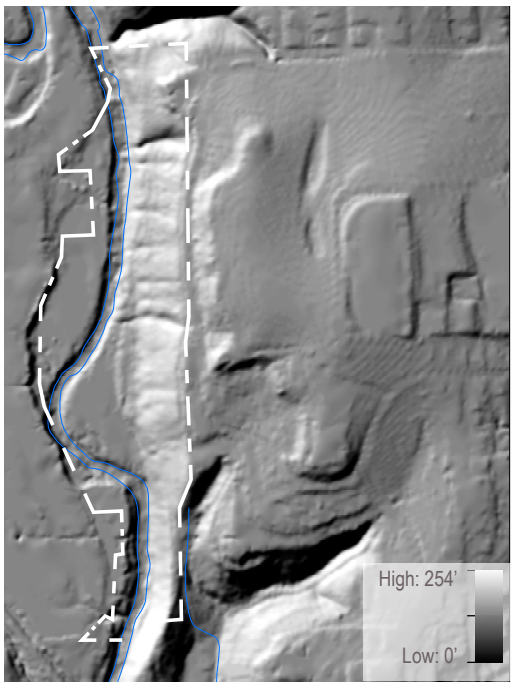


Figure 3.34 Hillshade Map
Adapted from (Riley County GIS Database).

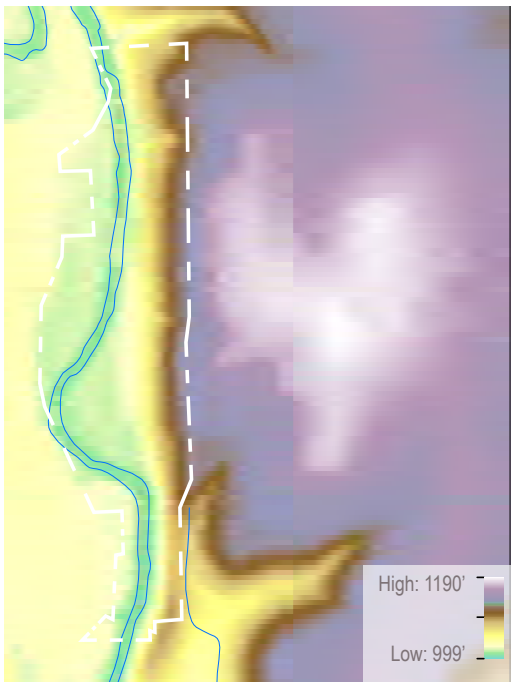


Figure 3.35 Elevation Map
Adapted from (Riley County GIS Database).

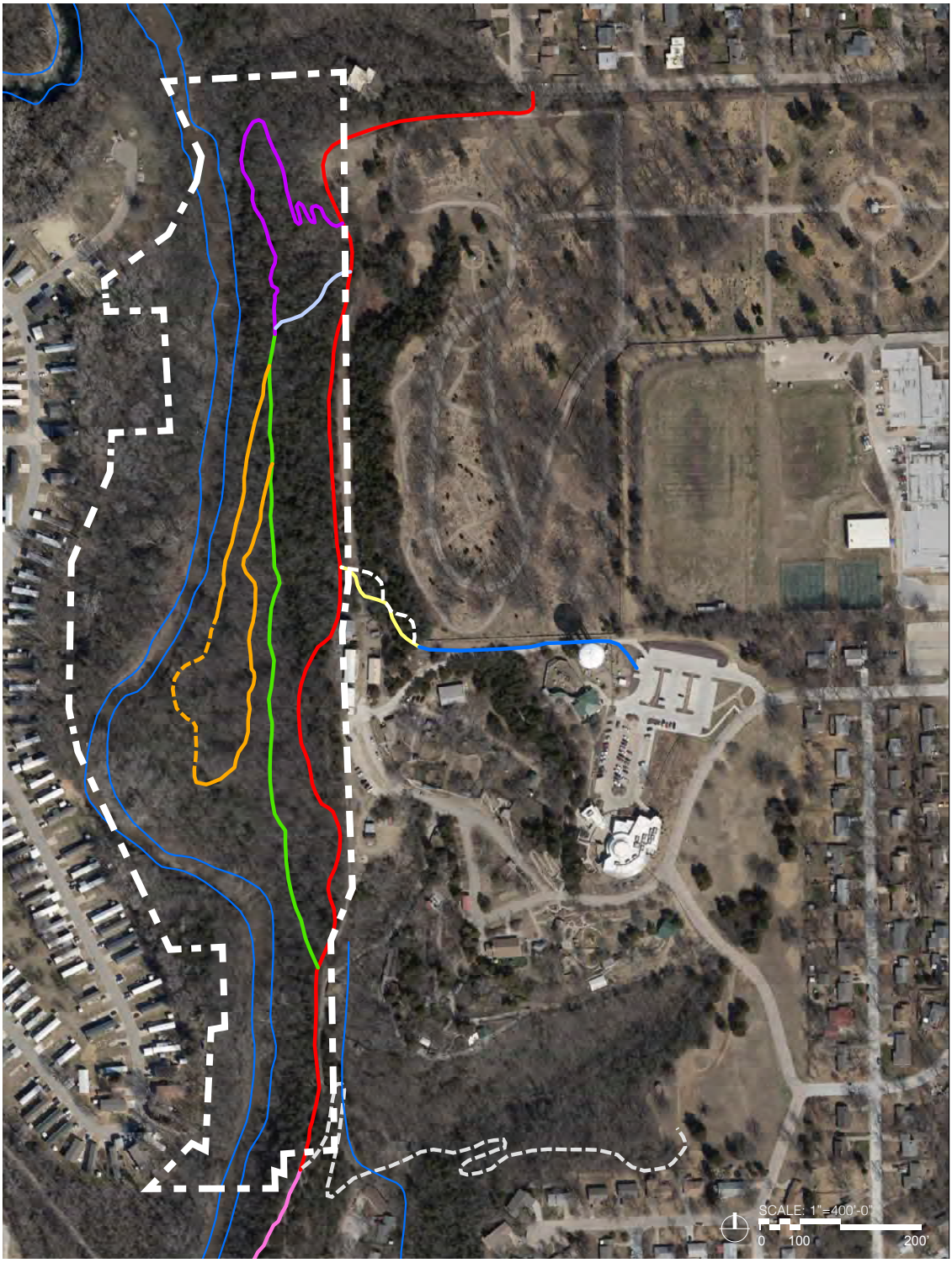


Figure 3.36 Existing and Proposed Trail Types Adapted from (Riley County GIS Database).

Figure 3.37 Flood Hazard Map.
Adapted from (Riley County GIS Database).

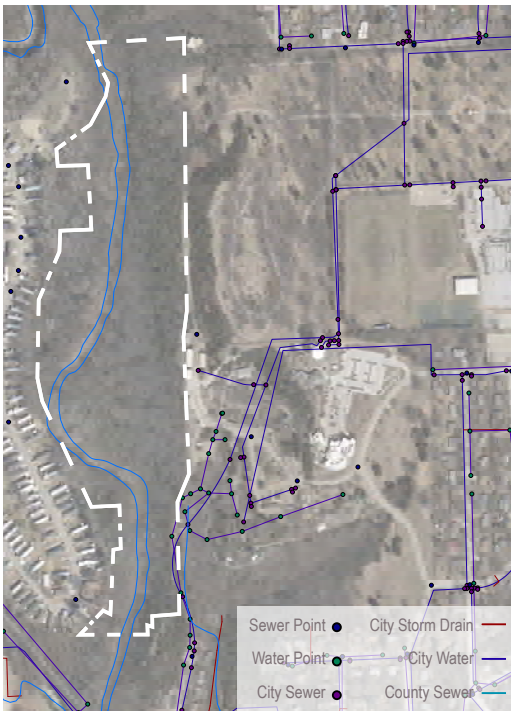


Figure 3.38 Utility Map
Adapted from (Riley County GIS Database).

Figure 3.39 Bike Routes
Adapted from (Riley County GIS Database).

Figure 3.40 Vehicle Roadways
Adapted from (Riley County GIS Database).

Figure 3.41 Drainage Infrastructure
Source: (Hahn 2021)

Figure 3.42 Typical Bridge Drainage Crossing
Source: (Hahn 2021)

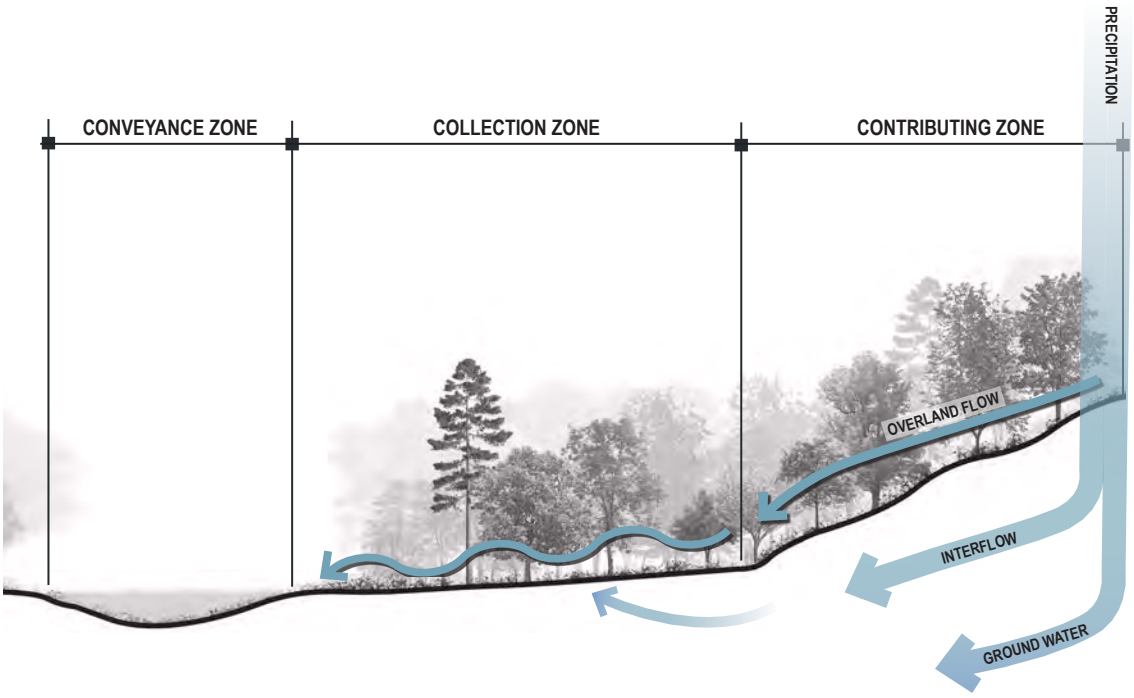


Figure 3.43 Section AA showing hydrological zones and drainage flow
Source: Author, informed by (Marsh 2005, p. 247).

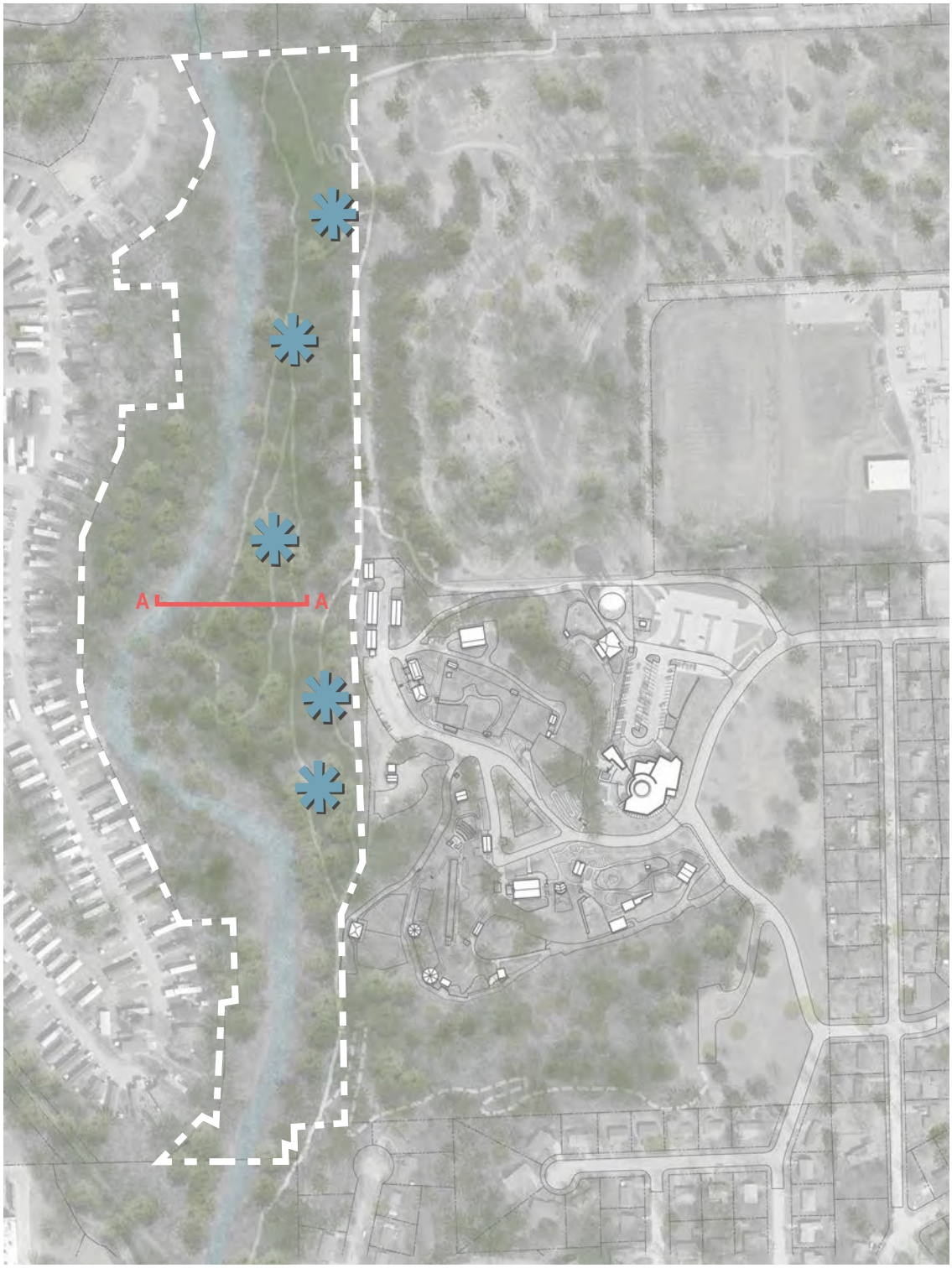


Figure 3.44 Drainage and Hydrology
Apdated from (Google Earth 2022).

Bridge Drainage Crossing

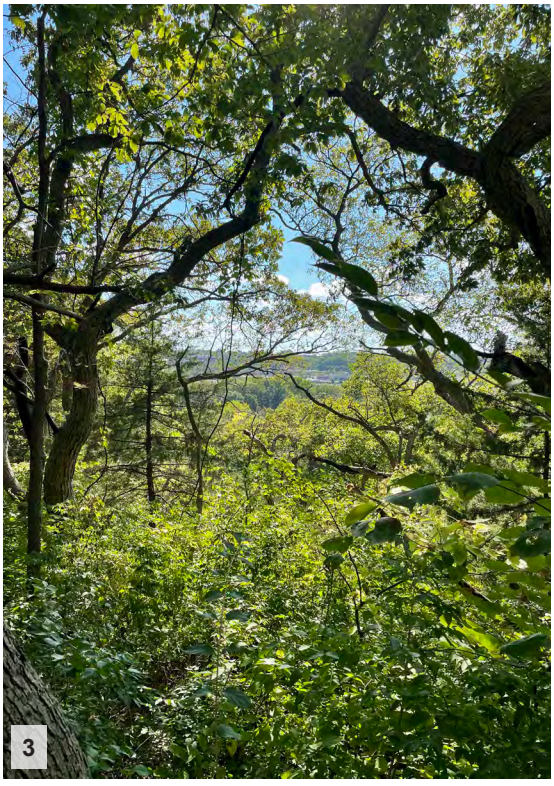


Figure 3.45 Notable Views Photos
Source: (Hahn 2021)

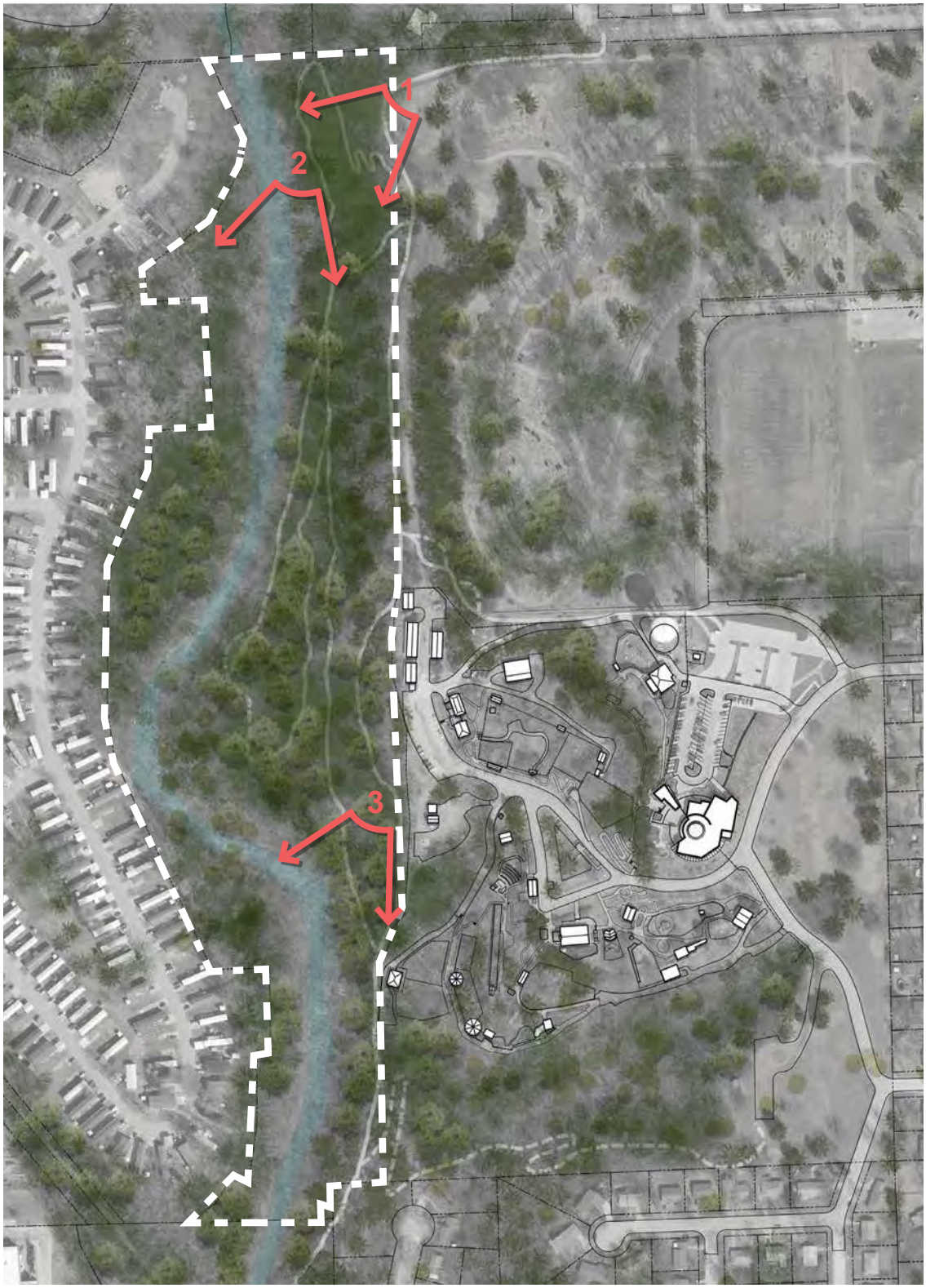


Figure 3.46 Notable Views Map
Adapted from (Google Earth 2022).

Figure 3.47 Existing Elements
Source: (Hahn 2021)

Figure 3.48 Existing Elements Map
Adapted from (Google Earth 2022).

Figure 3.49 Northern Primary Entry.
Source: (Hahn 2021)

Figure 3.50 Southern Secondary Entry
Source: (Hahn 2021)

Figure 3.51 Southern Primary Entry
Source: (Hahn 2021)

Figure 3.52 Northern Secondary Entry
Source: (Hahn 2021)

Figure 3.53 Site Access
Adapted from (Google Earth 2022).

LOCAL CLIMATE

Manhattan has a humid continental climate. This means the city normally experiences hot, humid summers and cold, dry winters (Zepner et al. 2020). Winter months average temperatures are about 30 degrees Fahrenheit, while the summer months average 75-80 degrees. The average yearly mean temperature is 56 degrees Fahrenheit (Zepner et al. 2020).

The average yearly precipitation sum is 920.3 millimeters (Zepner et al. 2020). Because Manhattan is located at the junction of the Kansas and Big Blue rivers, the city has experienced several destructive flooding events (U.S. Geological Survey 2008). The site contains a portion of Wildcat Creek and is located partially in a floodplain (Geographical Information Systems 2022).

Month	Temperature (°F)	Precipitation (mm)
January	30°	23.1
February	35°	35,5
March	45°	58.0
April	55°	94.3
May	65°	128.7
June	75°	117.0
July	80°	101.2
August	77°	117.6
September	69°	88.5
October	57°	73.3
November	44°	46.4
December	33°	36.8

Figure 3.54 Temperature and Precipitation by Month. Adapted from (Zepner et al. 2020)

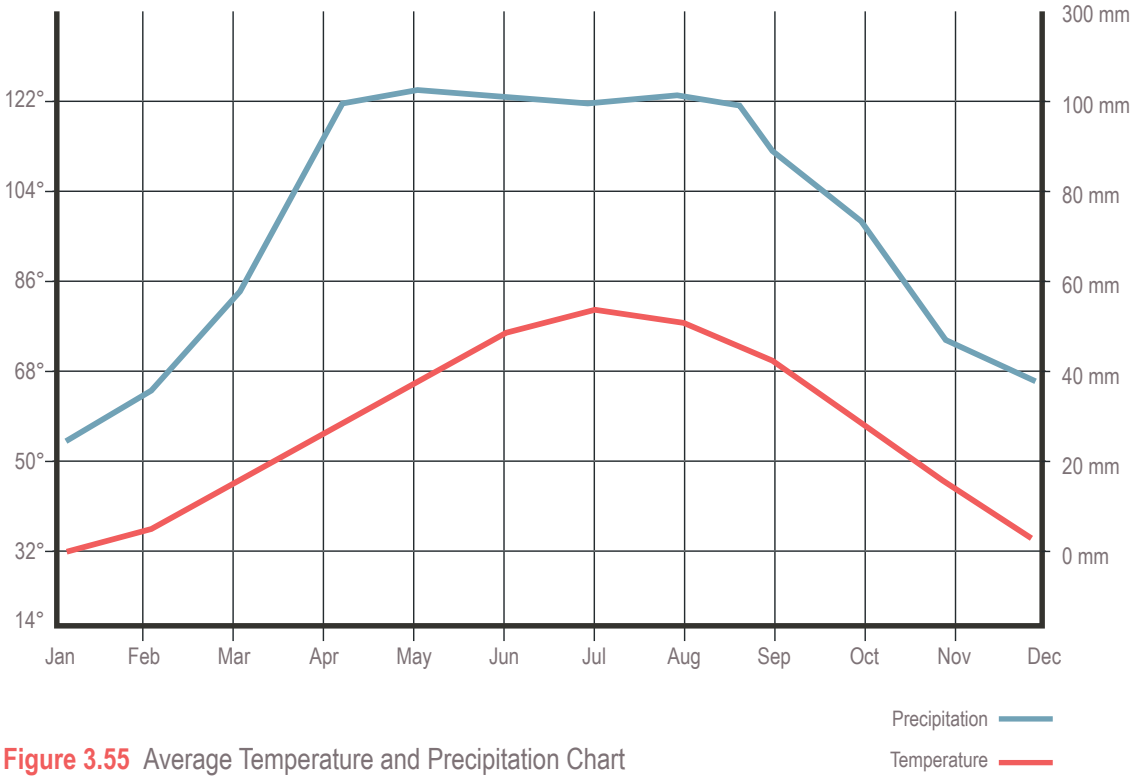


Figure 3.55 Average Temperature and Precipitation Chart Adapted from (Zepner et al. 2020)

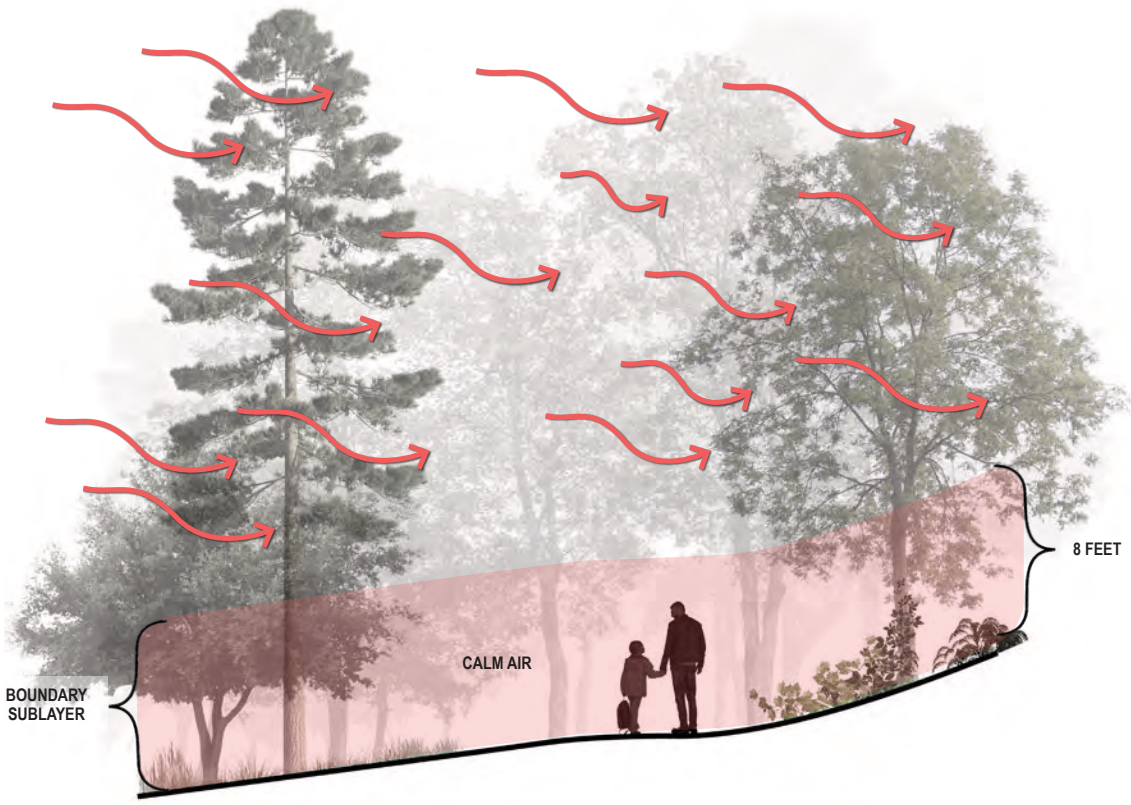


Figure 3.56 Vegetation density creates calm-aired microclimate.
Source: Author informed by (Moore 2005, p. 366).

MICROCLIMATE ON SITE

Because the site is a dense forestland, the microclimate is much calmer than the rest Manhattan's climate (Moore 2005). Though Manhattan, Kansas is a relatively windy city, with average wind speeds of 11 mph, the site has much calmer air (Weather Spark 2021). This is due to the shelterbelt affect, where a calm zone forms under canopy due to vegetation forcing the streamlines of wind upwards (Moore 2005, p. 366). The site is also noticeably cooler than the reported daily temperature due to the shade created from the canopy cover.

VEGETATION INVENTORY

The site is characterized as a dense forestland, with dominant plant types of elm/ash/cottonwood trees. The site is considered a forest because its trees have an average height greater than 15 feet and there is at least a 60% canopy cover (Marsh 2010). This plant community serves as a slope face floodplain. The site is steeply sloped, with sloped exceeding 30% in areas. The high density of mature trees stabilizes this slope and mitigates the flooding of Wildcat Creek. This forest protects Sunset Zoo and surrounding neighborhoods from flooding. There are several fallen trees throughout the site. These dead, fallen trees are at various stages of the decomposition process. To better understand the vegetation on site, species types were inventoried through a site visit. Figures 3.58 and 3.59 show a sampling of the plant species found on site.

Figure 3.57 Planting density plan enlargement
Source: Author

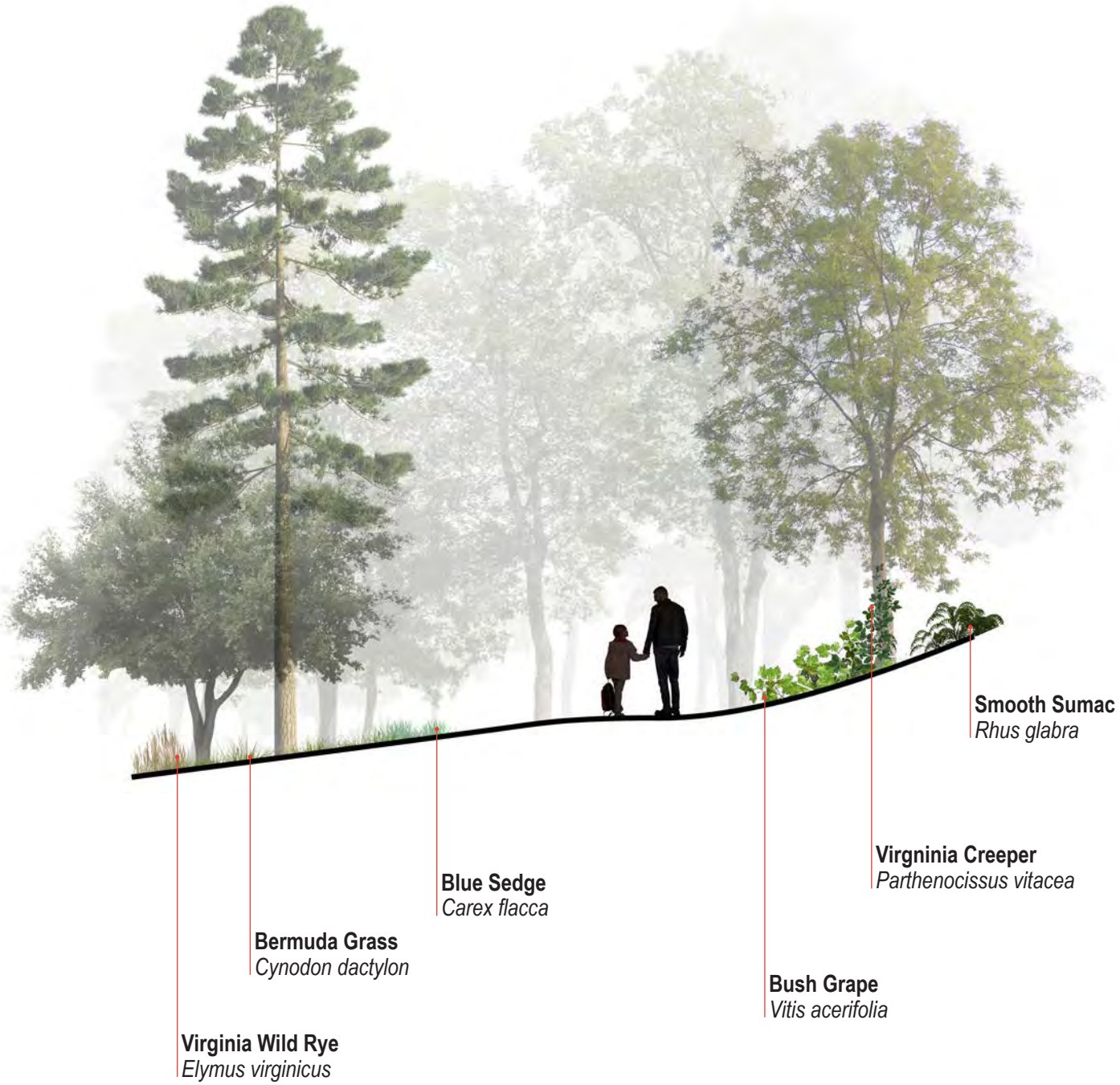
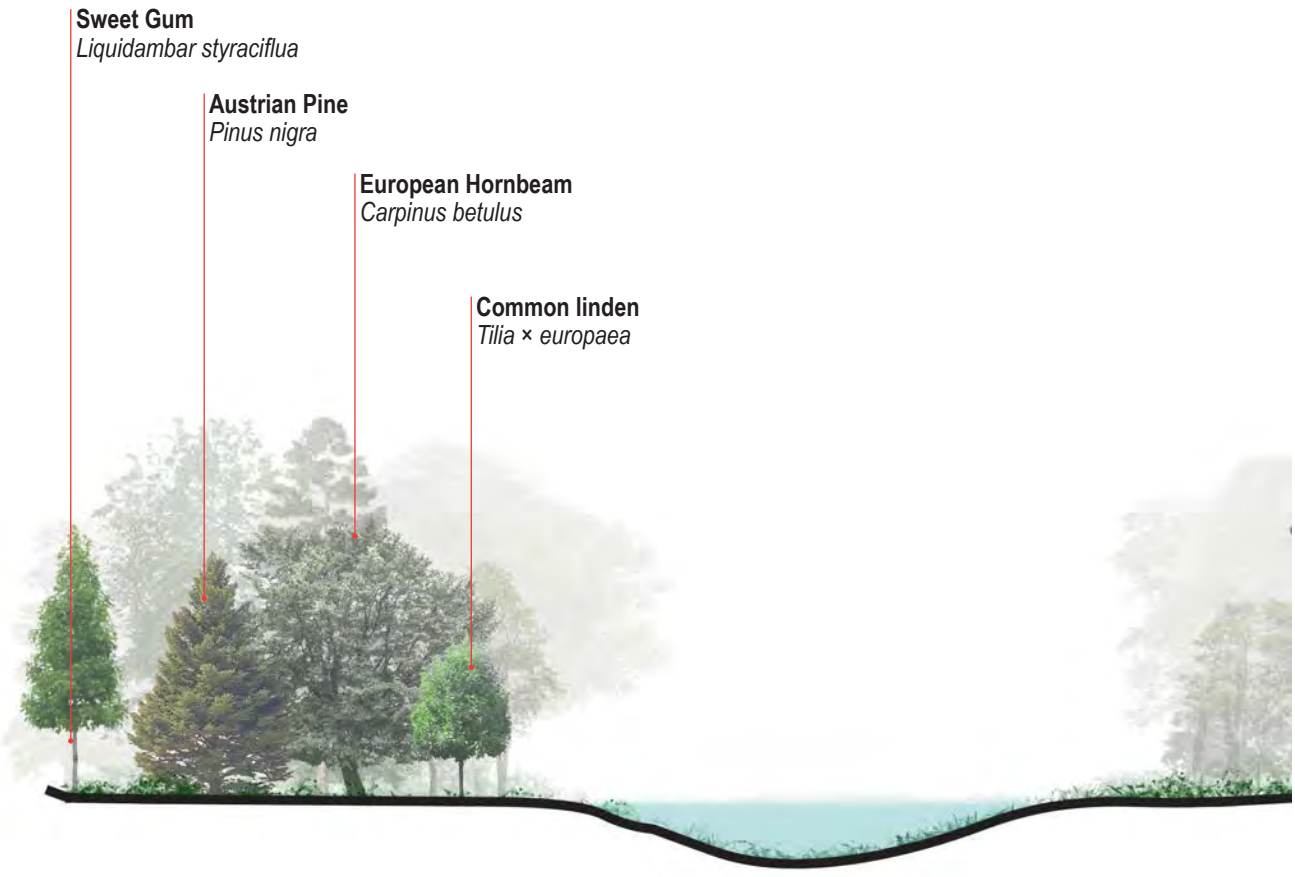


Figure 3.58 Section showing understory plant community on site
Source: Author


Sweet Gum
Liquidambar styraciflua
Austrian Pine
Pinus nigra
European Hornbeam
Carpinus betulus
Common linden
Tilia × europaea

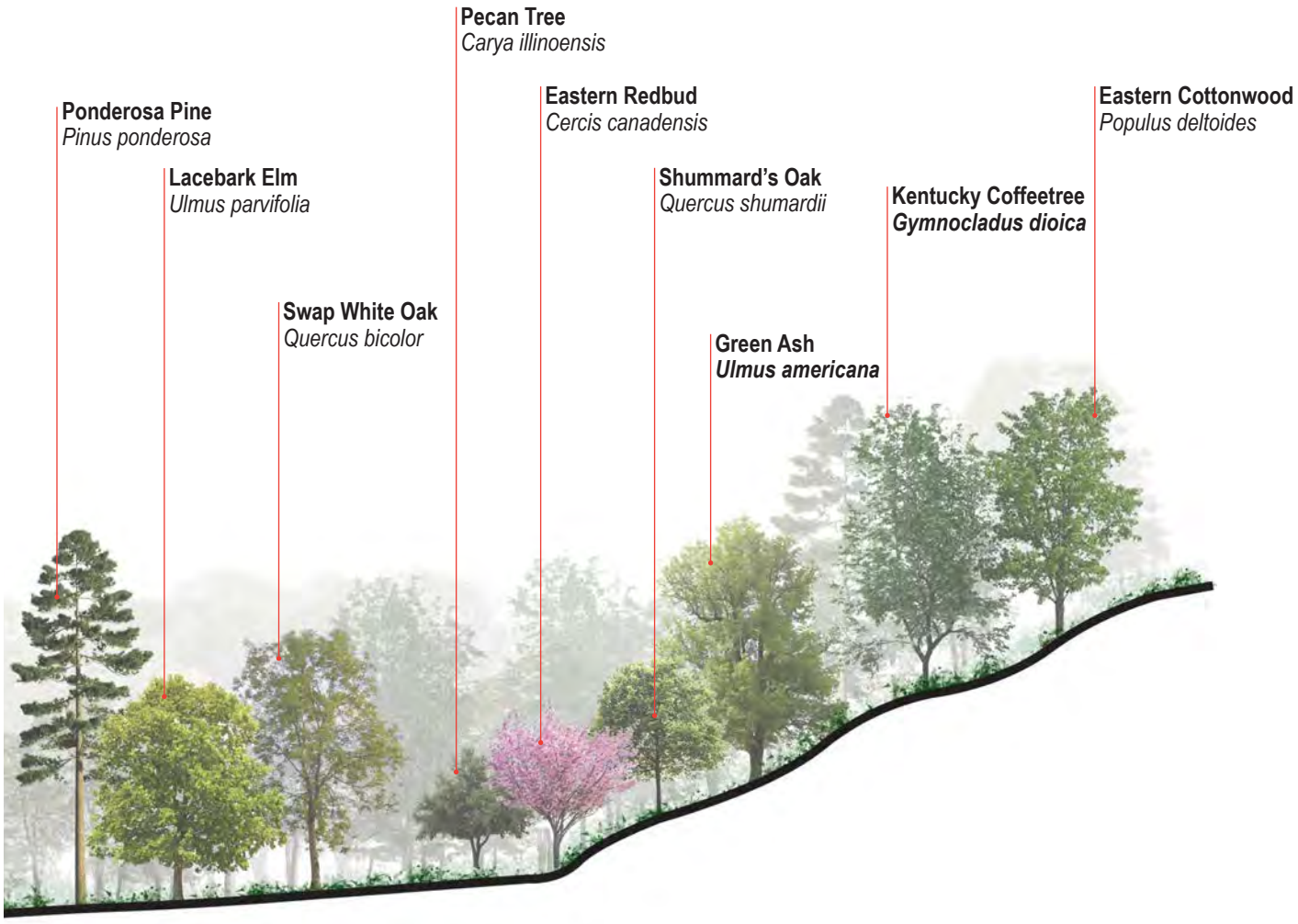


Figure 3.59 Section showing plant community on site and common plant species
Source: Author

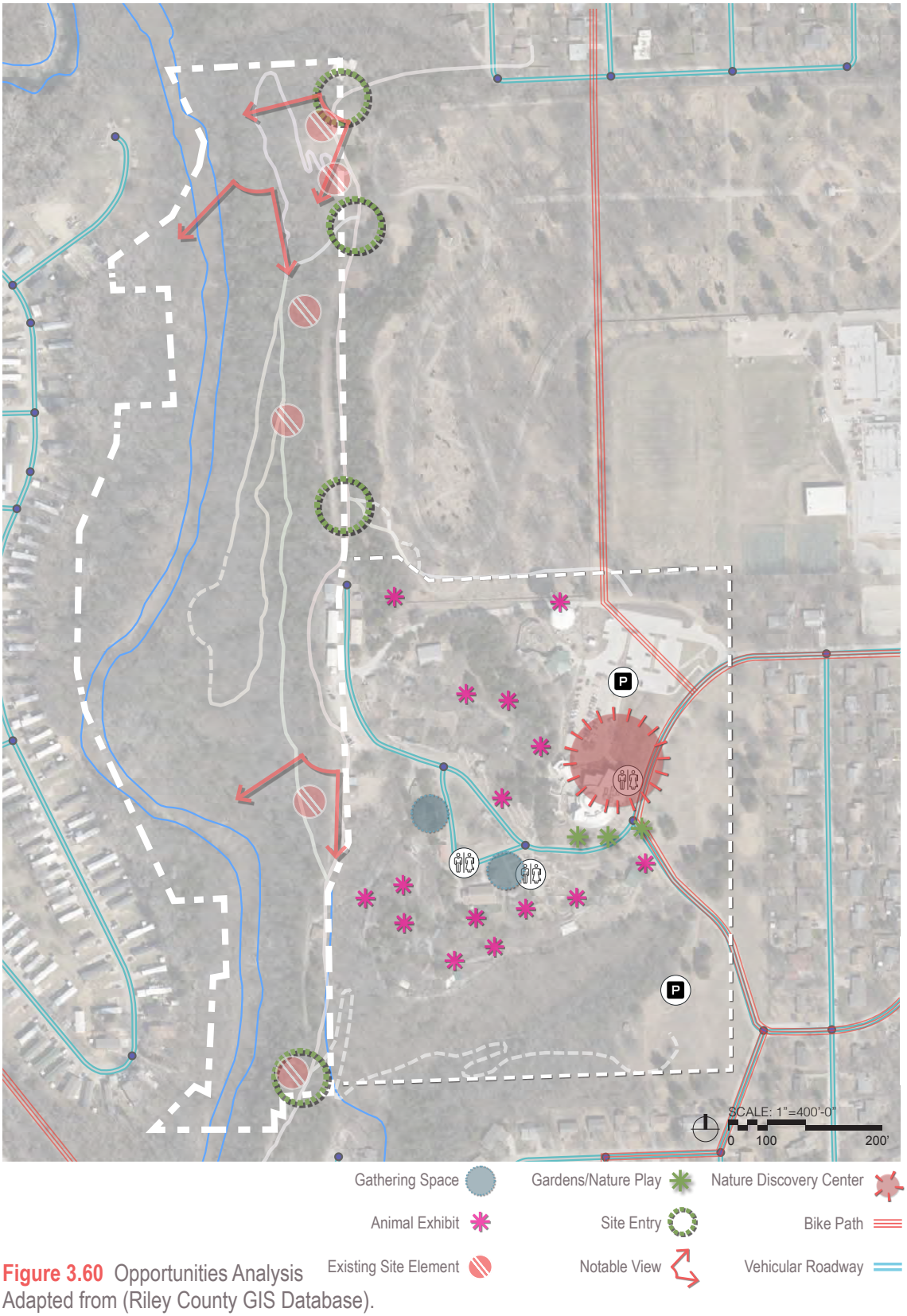


Figure 3.60 Opportunities Analysis
Adapted from (Riley County GIS Database).

Figure 3.61 Constraints Analysis
Adapted from (Riley County GIS Database).

SITE ANALYSIS OPPORTUNITIES & CONSTRAINTS

SITE INVENTORY	OPPORTUNITIES	CONSTRAINTS
DRAMATIC SLOPES (MOSTLY <15%)	BOARDWALKS AND DECKS TO BE BUILT, GEOLOGY EDUCATION STATION	LIMITED ACCESSIBILITY
UNSAFE CREEK WATER	OBSERVATION DECK & WATER QUALITY STATION	NO DIRECT WATER INTERACTION
DRAINAGE CROSSINGS	HYDROLOGY EDUCATION STATION	UNSAFE CONDITIONS DURING PRECIPITATION
EXISTING PERMANENT WPA TABLES, WALLS, AND SHELTER	GATHERING SPACES BUILT AROUND THESE EXISTING ELEMENTS	HEAVY, UNMOVABLE ELEMENTS
HEAVILY WOODED	SELECT LOOKOUT, VIEWING DECKS	LIMITED VISIBILITY
ACCESSIBLE FROM LINEAR TRAIL AND SUNSET CEMETERY	PUBLICLY ACCESSIBLE	SITE MANAGEMENT AND SURVEILLANCE NEEDS TO BE CONSIDERED
EXISTING EDUCATIONAL ACTIVITIES AT SUNSET ZOO	CONNECTION TO ZOO PROGRAMMING	MUST BE IN LINE WITH SUNSET ZOO EDUCATIONAL MISSION & PURPOSE
DENSE WOODLAND ECOLOGY	ECOLOGICAL EDUCATION STATION	ECOLOGICAL CONSIDERATIONS WITH THE ADDITION OF DESIGN ELEMENTS
FALLEN TREES AND LOGS THROUGHOUT SITE	TREE LIFE CYCLE EDUCATION STATION	EVERCHANGING FOREST
QUIET, SERENE SENSORY EXPERIENCE	MEDITATION GARDEN, QUIET PRIVATE SEATING AREAS	OCCASIONAL NOISE FROM ZOO ANIMALS
EXISTING TRAIL SYSTEM	TRAIL IMPROVEMENTS	SOME TRAIL DEGRADATION AND UNSAFE CONDITIONS

Figure 3.62 Site Inventory determines Opportunities & Constraints
Source: Author

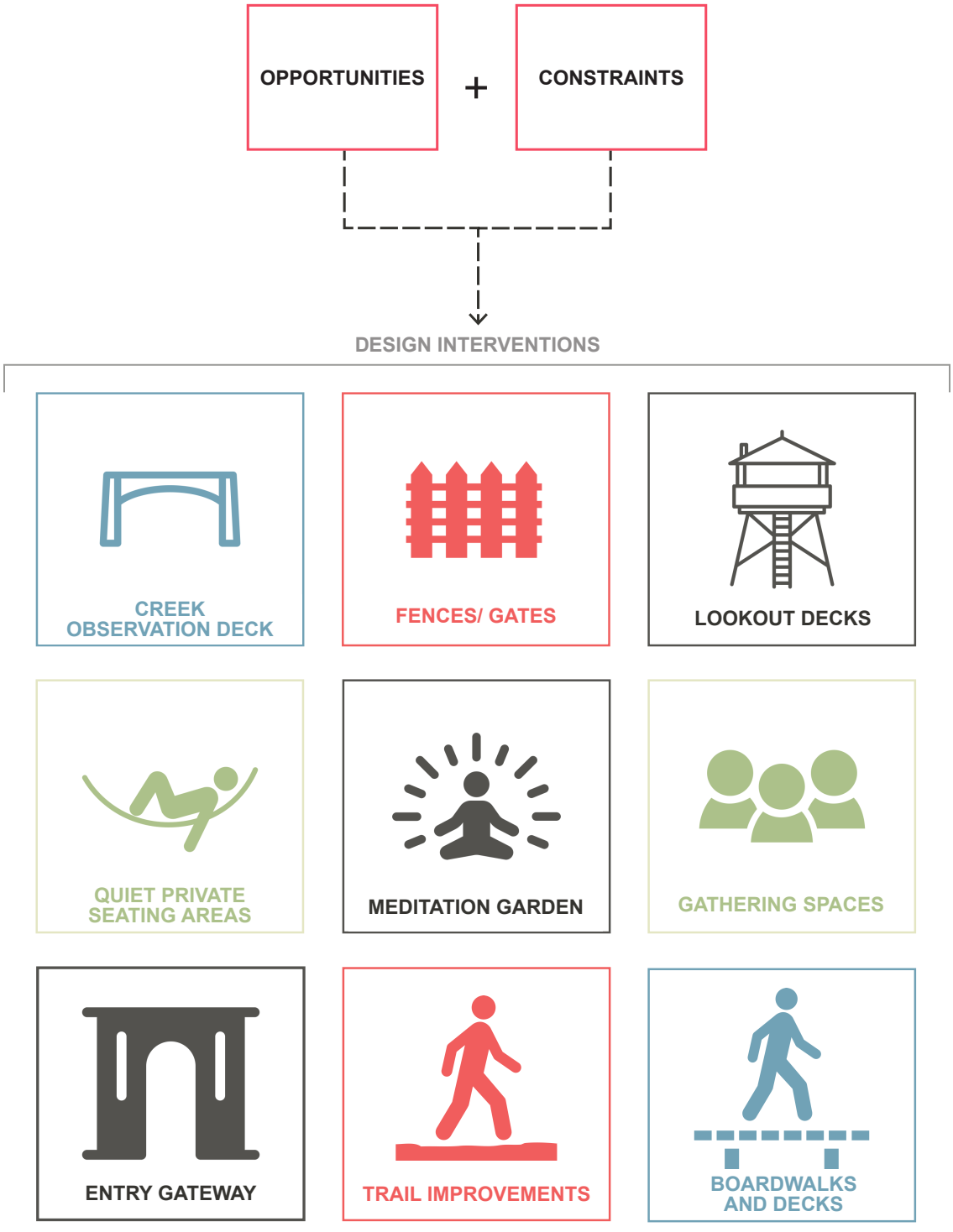


Figure 3.63 Determined Design Elements
Map Source: Author

PART FOUR
PROGRAM ANALYSIS

In order to provide learning opportunities in this natural play and learning space, education stations were designed to facilitate an interactive, educational experience. These education stations were determined from the site analysis and utilized the existing natural elements and systems to educate site users. It was determined the appropriate learning settings would be related to geology, water, ecology, wildlife, and tree life cycles. Figure 4.64 outlines how the site inventory determined these education stations. The following pages outline the program analysis, which looks at several educational resources and activity plans related to each education station. These relevant activities informed the design of each education station, as they determine relevant materials and learning outcomes for each station. These stations will be used for multiple activities and learning outcomes but inventorying several existing programming opportunities informed the design of the station.

Figure 3.64 Site Inventory determines Educational Opportunities
Source: Author

SITE INVENTORY	EDUCATION STATIONS
UNSAFE CREEK WATER; DRAINAGE CROSSINGS THROUGHOUT	WATER EDUCATION STATION
EXISTING EDUCATIONAL ACTIVITIES AT SUNSET ZOO; HEAVILY WOODED ECOSYSTEM	WILDLIFE EDUCATION STATION
HEAVILY WOODED ECOSYSTEM	ECOLOGICAL EDUCATION STATION
FALLEN TREES AND LOGS THROUGHOUT SITE	TREE LIFE CYCLE EDUCATION STATION
STEEP SLOPES (MOSTLY <15%)	GEOLOGY EDUCATION STATION

WATER EDUCATION STATION

THEME	LESSON	LEARNING OUTCOMES
WATER QUALITY	Water Filtration (EPA)	Grades 4-8: To demonstrate the procedures that municipal water plants may use to purify water for drinking.
	Resource Management: Protecting your Drinking Water (EPA)	Grades 9-12: use a simple mathematical model of ground water vulnerability to estimate the vulnerability of a small town's water supply.
DRAINAGE	Flood! (Earth Science Week)	Grades 5-12 NSES: Earth's Systems (ESS2), Earth and Human Activity (ESS3). Understand different types of soil have different capacities for retaining rainwater
	Groundwater Movement (Earth Science Week)	Grades K-12 NGSS: Earth's Systems (ESS2), Earth and Human Activity (ESS3). Understand how water moves through rock materials such as sand, gravel, and clay.
	Identifying Your Watershed (Earth Science Week)	Grades 9-12 NGSS: Earth and Human Activity (ESS3). Identify the watershed you live in, source of water used at home, and pathway of surface runoff in your watershed.
PRECIPITATION	Earth's Hydrologic Cycle (Earth Science Week)	Grades 1-12 NSES: Earth's Systems (ESS2). Construct a simple model of the hydrologic cycle to help visualize and understand the movement of liquid water and heat.
	It's the "Rain," Man (Earth Science Week)	Grades K-12 NSES: Earth's Systems (ESS2). Build a rain gauge, collect data about the amount of precipitation, and compare your measurements.

Figure 3.65 Water Curriculum/Activities
Chart created by author informed by (American Geosciences Institute 2022) and (United States Environmental Protection Agency, n.d.)

THEME	LESSON	LEARNING OUTCOMES
IDENTIFICATION	Tricky Tracks (NWF)	Grades K-4: Students will identify the tracks of several different types of mammals. Students will explain how people can use tracks to find out more about mammal habits and behaviors.
	Massive Migrations (NWF)	Grades 5-8: Students will map and calculate the migration routes of Arctic species to learn about animals that spend part of their lives in the Arctic and how they are connected to other parts of the world for food and shelter.
HABITAT	Wildlife Burrows (NWF)	Grades 6-12: Students will create models of different wildlife burrows and examine and contrast the functions.
	Links in the Food Chain (NWF)	Grades K-4: Students will learn what a food chain is and sing or act out the rhyme “There Once Was a Daisy”.
	Sensory Discovery Walk (NWF)	Grades K-6: Students “open their eyes” to nature by exploring their surroundings without sight. Then they map and retrace the path they traveled.
	Build a Bat House! (NWF)	Grades 2-8: Students build a bat house and continue to observe the habitat over time
HUMAN IMPACT	Pond Life (NWF)	Grades 9-12: Students will research fresh-water biomes of ponds and lakes and conduct experiments to understand pond life, food webs and the impact of human influences on ponds.
	Controversy over Wildcats (NWF)	Grades 3-8: Students take part in a role-playing game to help them understand the complexity of the issues surrounding species, habitat conservation and human interests.

Figure 3.66 Wildlife Curriculum/Activities
Chart created by author informed by (The National Wildlife Federation, n.d.)

ECOLOGICAL EDUCATION STATION

THEME	LESSON	LEARNING OUTCOMES
PLANT IDENTIFICATION	Dynamic Wetlands (Earth Science Week)	Grades 9-12: Earth's Systems (ESS2) To increase student awareness of the value and importance of our wetlands
	Vegetation Survey (ASU Ecology Explorers)	Grades K-4: Survey, map, describe and think about local environments such as our neighborhoods, school yards and parks.
PROCESSES	Leaf It to Me (Earth Science Week)	Grades 3-10: Earth's Place in the Universe (ESS1), Earth's Systems (ESS2) Observe and understand plant transpiration.
	Soil, Plants, and the Energy Cycle (Earth Science Week)	Grades 9-12: Understand CO2 sequestration is the removal of CO2 from the atmosphere
	Exploring Microcli-mates (ASU Ecology Explorers)	Grades 6-12: compare the land cover and temperatures iC different microclimates to begin to explain why organisms live where they do.
THREATS/ RISKS TO ECOLOGICAL COMMUNITIES	Where Growth Meets Growth (Earth Science Week)	Grades 5-8: Earth and Human Activity (ESS3) To identify fire risk factors for a property located near a wildland area.
	Habitat Fragmentation: A Bird's Eye View (ASU Ecology Explorers)	Grades 6-12: Recognize that different species respond differently to perturbations in their environment; Work collaboratively to generate possible solutions to the problem of conserving biodiversity in a human-managed ecosystem

Figure 3.67 Ecological Curriculum/Activities
Chart created by author informed by (American Geosciences Institute 2022) and (Arizona State University Global Institute of Sustainability and Innovation, n.d.)

THEME	LESSON	LEARNING OUTCOMES
IDENTIFICATION	Tree Growth (Pennsylvania State University)	Grades 2-4: Learn the layers of a tree; kinds of tree growth: height, diameter, and root growth; Influences on tree growth including damage, shade, drought, pests, harvesting, and so on
ECOSYSTEM IMPACT	Please the Trees, But Not These, Please! (Pennsylvania State University)	Grades 3-6: Identify basic requirements for tree survival and indicate how these needs are met
	Big Roots for Big Problems: Exploring the Ecosystem Services of Roots (Michigan State University)	Grades 6-12: Understand how healthy ecosystems provide valuable services
	Seeing the Forest from the Trees (Michigan State University)	Grades K-2: Name factors affect plant growth; understand plants need energy, water and nutrient to survive; explain how leaf size and tree height are shaped by sunlight and soil water
HUMAN USE OF TREES	The Giving Tree (Pennsylvania State University)	Grades 2-4: Students will distinguish between wants and needs and recognize individual differences. Students will list objects that we either make from trees or that are produced by trees.

Figure 3.68 Tree Life Cycle Curriculum/Activities
Sources: Chart created by author informed by (Pennsylvania State University Department of Ecosystem Science and Management, n.d.) and (Michigan State University 2015)

THEME	LESSON	LEARNING OUTCOMES
EARTH PROCESSES	Erosion Activity (USGS)	Understand how waves and water movement affect the movement of sand and erode cliffs on a coastline
	Making Caves: How Solution Caves Form (Earth Science Week)	Grades K-12 NGSS: Earth's Systems
SOIL IDENTIFICATION	Core Sampling (Earth Science Week)	Grades 5-8 NSES: Earth and Space Science (A), Physical Science (B), Science and Technology (D), Science in Personal and Social Perspectives (E), Science as Inquiry (G)
	Finding Slope (Earth Science Week)	Grades 6-12 NGSS: Earth's Systems (ESS2), Earth and Human Activity (ESS3)
ROCK IDENTIFICATION	Awesome Fossils (Earth Science Week)	Grades K-8 NGSS: Earth's Place in the Universe (ESS1), History of Earth
	Investigating Different Rock Types (Earth Science Week)	Grade 5-8 NGSS: Earth's Systems
MATERIAL PROPERTIES	Tracking Change over Time (USGS)	Grades 5-8 NGSS: Analyzing and Interpreting Data, Electromagnetic Radiation, Natural Hazards, Human Impacts on Earth Systems; NSES: Science in Personal and Social Perspective
	The Lifecycle of a Mineral Deposit (USGS)	Grades 5-8 NSES: Earth and Space Science (A), Physical Science (B), Science and Technology (D), Science in Personal and Social Perspectives (E)

Figure 3.69 Geology Curriculum/Activities
Chart created by author informed by (American Geosciences Institute 2022) and (United States Geological Survey, n.d.)

DETERMINED EDUCATION STATIONS & DESIGN ELEMENTS

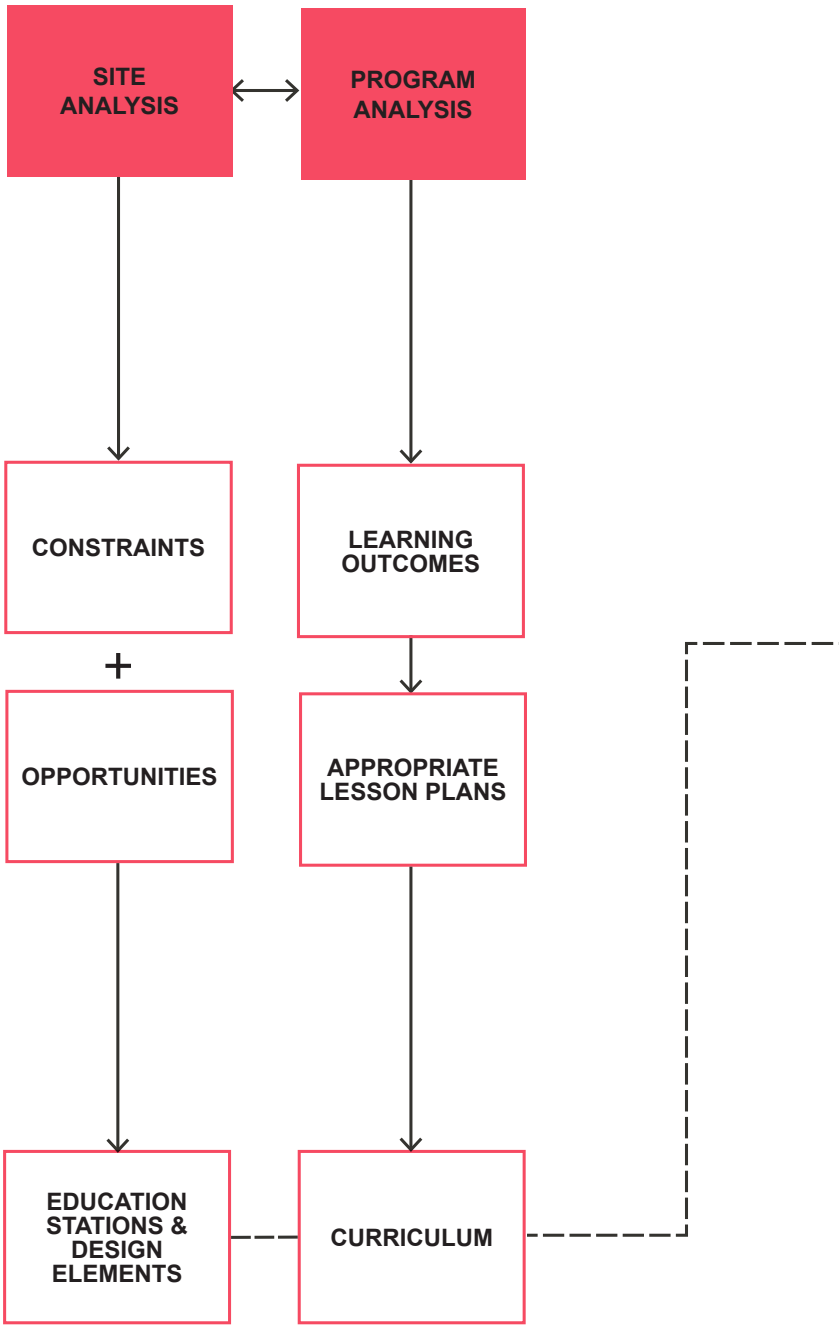


Figure 3.70 Process and Activity Settings & Design Elements to be Designed
Source: Author

COMPREHENSIVE DESIGN CONSIDERATIONS

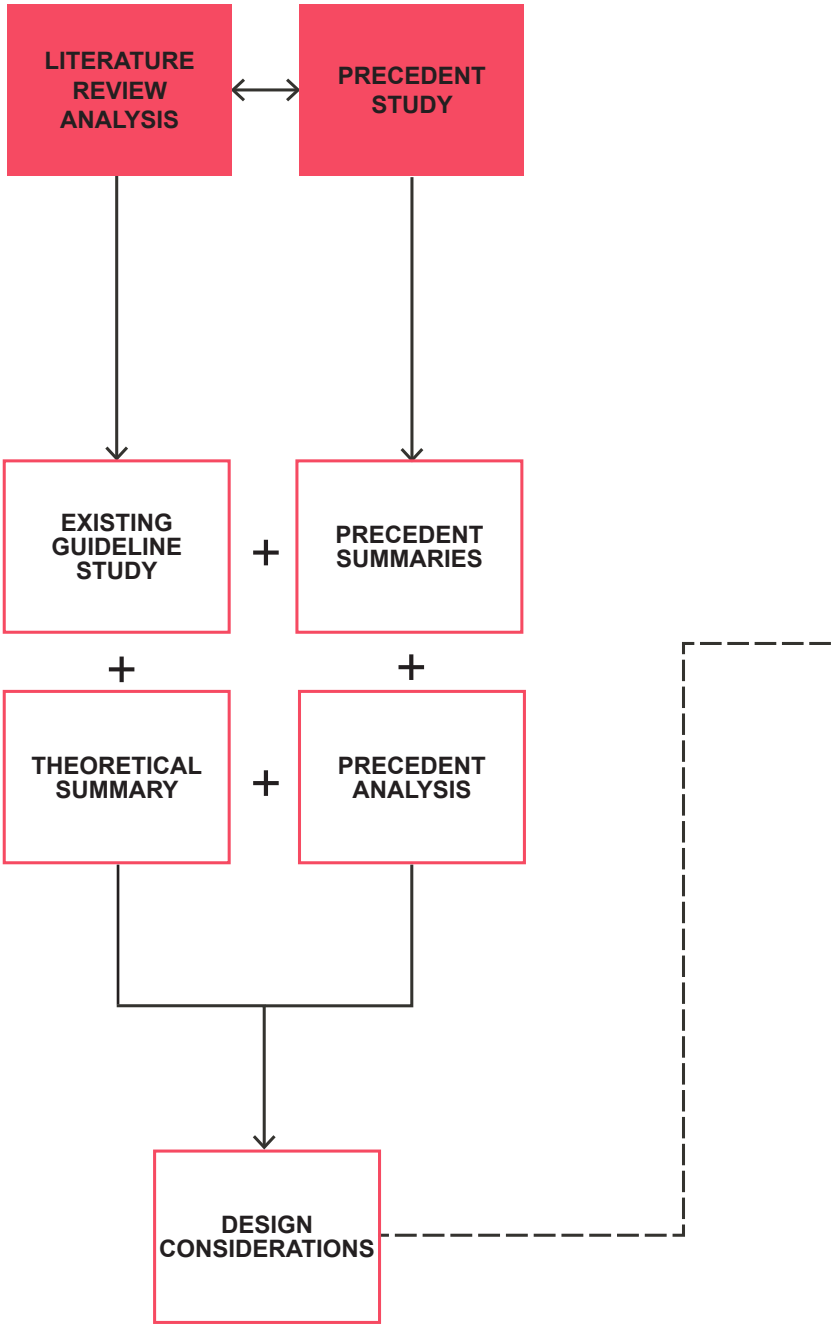
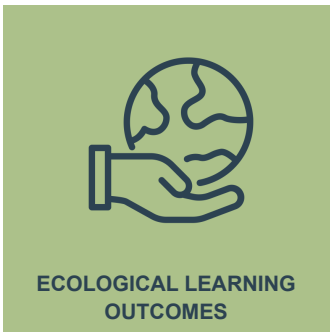


Figure 3.71 Process & Design Considerations
Source: Author

DETAILED DESIGN CONSIDERATIONS



PROMOTE ECOLOGICAL LEARNING OUTCOMES

Given the site context in a natural woodland environment, learning outcomes and settings were determined from the existing conditions on site. Teaching users about the ecological functions through hands-on activities gives them a stronger connection to nature that lasts beyond their visit.

ENCOURAGE DISCOVERY IN THE DESIGN AND PROGRAMMING

This design strategy ensures guests will be able to return to the site multiple times and have new experiences each time. In order to encourage discovery, the design allows for varied learning outcomes, journeys through the site, views, rotating programming, varied activity settings, and ranges of interaction.

ENCOURAGE OBSERVATION-BASED ECOLOGY

In addition to the hands-on activities offered, there are opportunities for less interactive learning experiences, or observation-based ecology learning. Learning through observations is accomplished through signage and wayfinding, experiential walking loops, and viewing platforms.

DESIGN FOR FREE-CHOICE LEARNING

This design strategy considers the different types of visitors and the level of interaction or learning they are willing to engage in. Avoiding overly structured activities and experiences throughout the site was important to consider in planning and design. Personal motivation varies, so guests should have the freedom to interact.

ENSURE OPPORTUNITIES FOR PHYSICAL ACTIVITY FOR VARIOUS ABILITIES

Natural play and learning spaces are valuable for people of all ages and physical abilities. Modifiable levels of activity should be available in activity settings. Ensuring accessible circulation and proximity to lessons subjects (ex. Ecological activity should be close to the planting community being observed) will increase accessibility.

PROVIDE LESSONS FOR VARIOUS LEARNING LEVELS & ABILITIES

Similarly, natural learning spaces are beneficial for people of all ages, learning abilities, and disability status. Designing spaces and choosing lessons that are capable of being accommodated or fitted is essential to ensure accessibility for all users.

DESIGN FOR PARTICIPATORY ACTIVITIES

Participatory site maintenance or hands-on group building/creation are excellent programming opportunities for this space. Group exploration and activities encourage social development and problem solving. Spaces should be designed to accommodate large groups. Gathering spaces should be placed in multiple locations.

UTILIZE LOOSE PARTS FOR PLAY FEATURES

Existing site elements should be used as design elements or learning opportunities. The nature of the site provides several loose parts such as fallen trees, dying trees/plants, and aged stone elements. There are several opportunities to use these loose parts to teach lessons on life cycles in ecology.

SITE SHOULD HAVE CONTROLLABLE ACCESS AND DETERMINE PUBLIC VERSUS PRIVATE USE

The site is currently all publicly accessible land. With the addition of these design elements and education stations, it will be necessary to implement fences and gates to privatize certain zones. At the same time, there needs to be an accessible route that connects public trails.

PROVIDE THOROUGH SIGNAGE AND WAYFINDING

Interpretive signage should be implemented throughout to inform the visitor on trail distances, wildlife and native habitats that can be viewed. This creates moments of discovery through use of interpretive messaging and educational interventions. It also increases accessibility and ease of access on the site.

PROVIDE VARIED ACTIVITY SETTINGS

Designing for varied activity settings increases programming opportunities and encourages people to use the site multiple times in multiple ways. Spaces should be designed to accommodate various activity types. This increases the value of the space.

ALLOW FOR PRIVATE REST AREAS ON SITE

Private rest areas throughout the site serves several purposes. This increases possible activity opportunities and small group sizes to meet on site. It also increases accessibility for people with special needs who benefit from quiet rest moments.

METHODOLOGY SUMMARY

The methods undergone have produced a set of design considerations, determined the relevant design elements, education stations, and appropriate programming for the design of this natural play and learning space. In the end, the design considerations show that successful natural play and learning spaces have the following characteristics: participatory activities, encourage discovery in the space, facilitate controllable access for the space, allow for varied activity settings, encourage ecological learning outcomes, allow for observation-based ecology, create lessons for various learning abilities, utilize loose parts for play features, ensure thorough signage and wayfinding, ensure spaces and activity settings allow physical activity for various abilities, facilitate a space for free-choice learning, and ensure there are private rest areas throughout the space. The education stations and design elements that will be designed and follow these considerations are a wildlife education station, geology education station, tree life cycle education station, ecological education station, water education station, creek observation deck, boardwalks, and decks, gathering spaces, lookout decks, fences and gates, a meditation garden, trail improvements, an entry gateway, and quiet private seating areas.

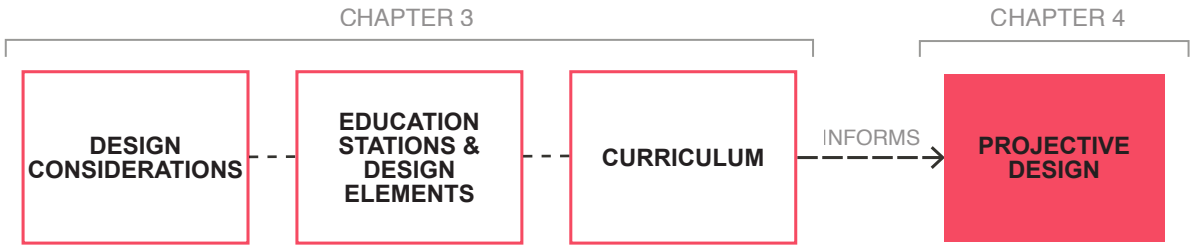


Figure 3.72 Methodology Informs Design
Source: Author

Figure 3.73 Ranger Paul leading forest walk in Discovery Park, Seattle, WA (Seattle Municipal Archives 1982). Used under Creative Commons Attribution Non-commercial

PAVILION
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ZOO

AQUARIUM, EXOTIC BIRDS, WILD ANIMALS AND PETS

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Admission: Adults 1/- Children 14 years and under **6d.**

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CHAPTER 4

PROJECTIVE DESIGN

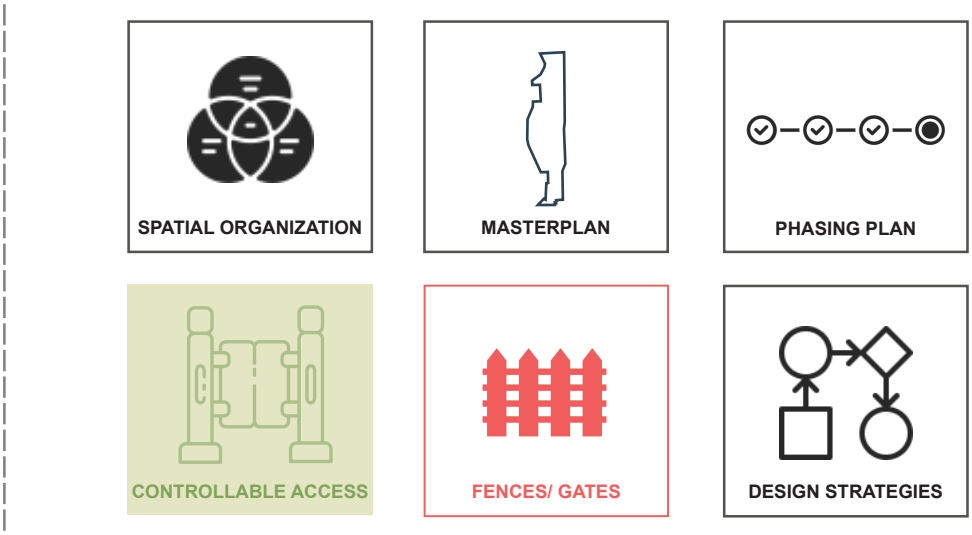
INTRODUCTION

This chapter presents the projective design resulting from the methods. The final design refines the findings generated in Chapter 3 into an illustrative site plan, a detailed plan enlargement, explanatory diagrams, design strategy diagrams, and perspective visualizations of the proposed design elements. Additionally, program itineraries were developed to show how to use the site for educational excursions. These itineraries are schedules of specific activities, with correlating maps displaying where the activities take place on site. These itineraries are broken up by age group and length of excursion (half-day or full day).

Figure 4.1 Lynmouth Pavilion Zoo Poster Source: (Aldridge 2016). Used under Creative Commons Attribution Non-commercial

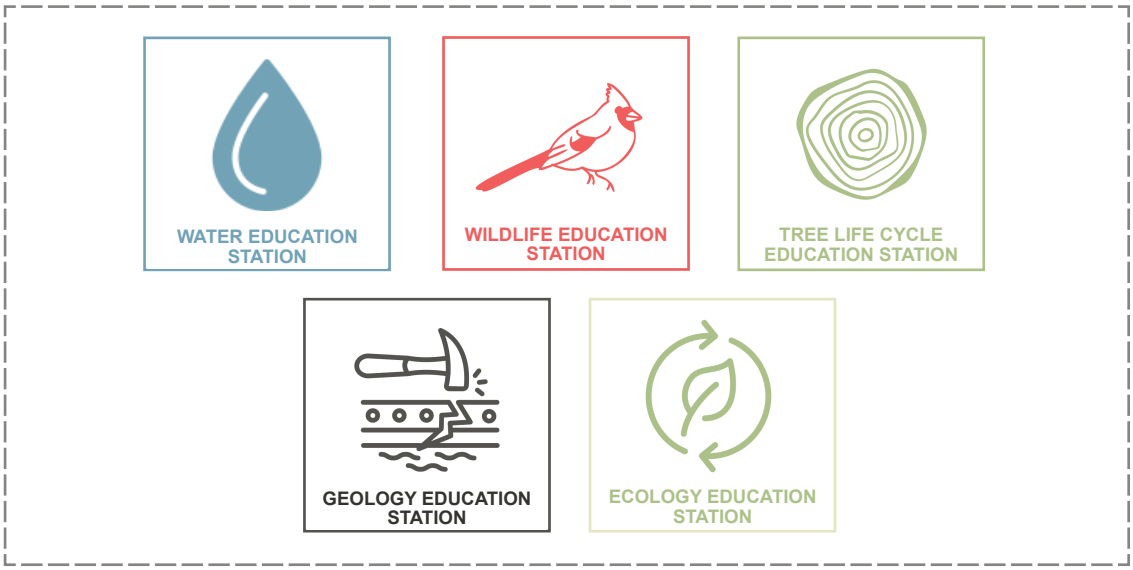
CHAPTER ORGANIZATION

PART 1
DESIGN OVERVIEW PAGES 142-153



PART 2
DESIGN ELEMENTS PAGES 152-163

PART 3
EDUCATION STATIONS PAGES 164-185



PART 4
PROGRAM ITINERARIES PAGES 185-193

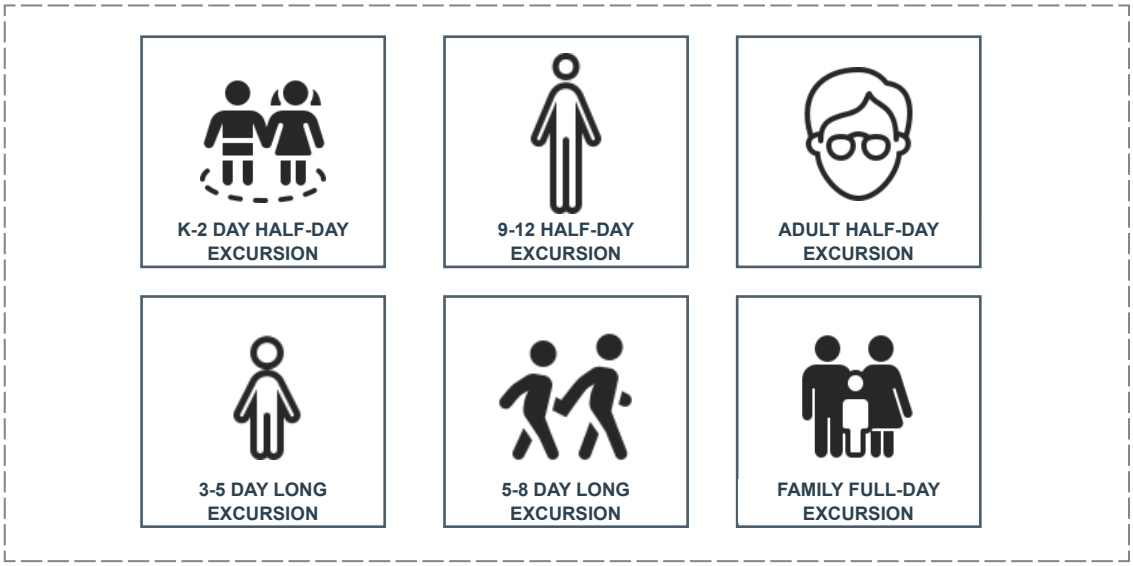


Figure 4.2 Chapter Contents & Organization Diagram
Source: Author

PART 1: DESIGN OVERVIEW

SITE DESIGN

Figure 4.3 depicts the proposed distribution and layout of the design elements, education stations, and circulation. The illustrative masterplan (Figure 4.4) and detailed enlargement (Figure 4.5) show the design in more detail. An important design consideration was to ensure controllable access to natural play and learning spaces. The site contains public trails and is large at approximately 35 acres; in addition to being heavily wooded and steeply sloped, this presented a challenge for controllable access. For this reason, a control area (approximately 6 acres) was defined and privatized to be an extension of Sunset Zoo. Select trails become private, and the educational exhibits were placed in this private area. Gates and a control station are added to the design to ensure that public trail users cannot access the private education stations and select gathering spaces. This controlled area becomes a central hub that serves as a nexus for educational programming and other activities on the site. The creation of this controlled educational hub not only allows for more efficient maintenance and surveillance, but it also limits environmental disturbance, protecting the ecological health and scenic beauty of the site. From this central educational hub, visitors can access a network of trails, offering quiet immersion into the site's landscapes and the opportunity to contemplate the ecological lessons introduced at the education stations.

ACCESS

Though a portion of the site is privatized, there are design elements added throughout the site that remain accessible to the public. Gathering spaces are added to or developed at the spaces with existing elements (stone table areas and the stone structure). A lookout deck is added to one public space with a scenic view. Several trails remain publicly accessible, and increased use is anticipated with the addition of these design interventions.

The site is accessible by four entry points. Gathering spaces are developed at each of these entry points to allow users to gather and collect before embarking on their journey of the site. Entry features at these gathering spaces will establish a hierarchy of circulation that helps orient visitor to the site. Additionally, entry signage is added to create an invitation to the site that informs the user of the opportunities to explore, play, and learn. Three entry points are publicly accessible and are less formal than the private entry space. The private entry point draws visitors in from Sunset Zoo, integrating this natural play and learning space with the zoo. This entry gathering space can be used by classes, camps, families, and can hold zoo events. These zoo events can include animal encounters or demonstrations, or special events such as the zoo's Party for the Planet - Earth Day Celebration, Wine in the Wild, Santa's Luminary Trail, Brew at the Zoo, and more. This large gathering space with scenic views creates additional opportunities for events at the zoo.

Figure 4.3 Program Distribution & Organization Map
Source: Author


WILDCAT CREEK
Education Station
Public Gathering Space
Private Gathering Space
Control Point
Viewing Tower
Trail
Controlled Area

From this primary entry point, private visitors can begin exploring the site. Visitors have the option of accessing the education stations and private spaces via a scenic boardwalk or through the trail loops. The addition of boardwalks makes the site easier to navigate while still providing more connectivity, more exploration, and a larger variety of sights to see.

PHASING STRATEGY

The design of this natural play in learning space is a large and ambitious proposal. For this reason, a phased approach is suggested. Taking a phased approach has many advantages, and allows the scope of work, timeline, and cost structures to be divided into segments. This strategy allows for ongoing fund raising and budget considerations. Figures 4.6 to 4.9 depict the suggested phasing strategy. The suggested phases are:

PHASE 1: Increase Accessibility on Site

The first phase will make the site easier to navigate through the implementation of trail Improvements and boardwalks. Increasing visibility and user-friendliness is the first step in the process.

PHASE 2: Encourage Public Use

Signage, public gathering spaces, restrooms, and water fountains should be implemented in Phase 2. With the introduction of these elements, the space will become more attractive to trail users. The educational quality of the site is introduced with educational signage focused on the site's ecology, geology, wildlife, and creek. Public gathering spaces and site amenities encourage classes, camps, and tour groups to explore the site for longer periods of time.

PHASE 3: Extend Zoo Programming onto the Site

Private gathering spaces, Wildlife Education Station, and control gates will be introduced in the third phase. The controlled area is privatized in this phase, allowing for private Zoo events to occur in the controlled area. Zoo classes and camps can be held in the private gathering spaces, including the Entry Gathering Space, Meditation Garden, and Creek Observation Deck. The first Education Station is implemented, which introduces zoo educators and local teachers to this type of space. After Phase 3, educators can begin exploring possible activities and programming that can occur at all the stations.

PHASE 4: Fulfill the Design's Various Learning & Activity Settings

The final phase implements the remaining design features, including the final four Education Stations and Viewing Towers. The prior three phases set up the required infrastructure and accessibility for the final design. The result is a multi-faceted natural play and learning space with varied learning and activity settings.

Figure 4.4 Illustrative Masterplan
Source: Author


VIEWING TOWER
Natural Play & Leaning Spaces
GATHERING SPACE
GATHERING SPACE
WILDCAT CREEK
CONTROL STATION
CONTROL STATION
CONTROLLED AREA BOUNDARY
PRIMARY ENTRY
CREEK OBSERVATION DECK
VIEWING TOWER
VIEWING TOWER
GATHERING SPACE
GATHERING SPACE
Tree Life Cycle Education Station
Ecology Education Station
Wildlife Education Station
Geology Education Station
Water Education Station

Figure 4.5 Illustrative Masterplan of Controlled Area
Source: Author


ENTRY
GATHERING SPACE
PUBLIC/PRIVATE
CONTROL STATION
BOARDWALK
WILDLIFE
EDUCATION STATION
MEDITATION GARDEN
GATHERING SPACE
TREE LIFE CYCLE
EDUCATION STATION
VIEWING TOWER
SUNSET ZOO
VIEWING TOWER
0'
30'
60'
120'

PHASING STRATEGY

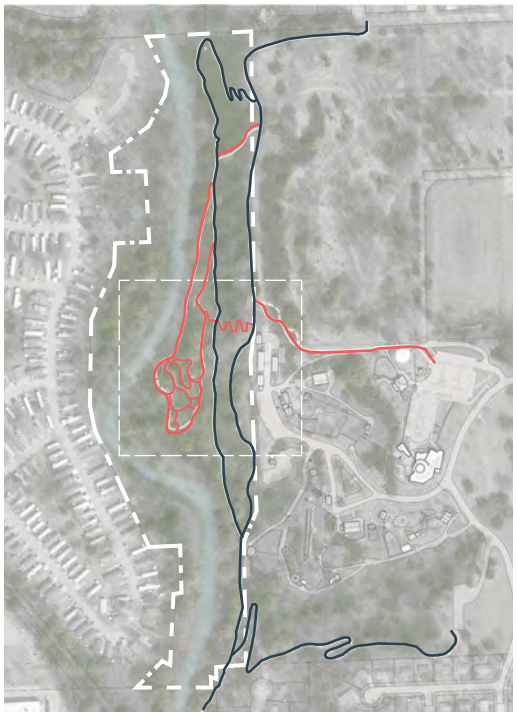


Figure 4.6 PHASE 1: Implement the Trail Improvements and Boardwalks

Figure 4.8 PHASE 2: Signage, Public Gathering Spaces, Restrooms, and Water Fountains

Figure 4.7 PHASE 3: Private Gathering Spaces, Wildlife Education Station, and Control Gates

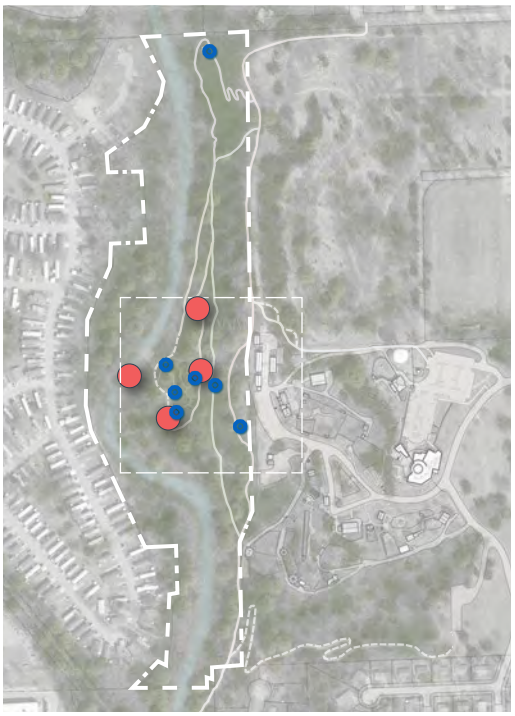


Figure 4.9 PHASE 4: Implement Remaining Education Stations and Viewing Towers

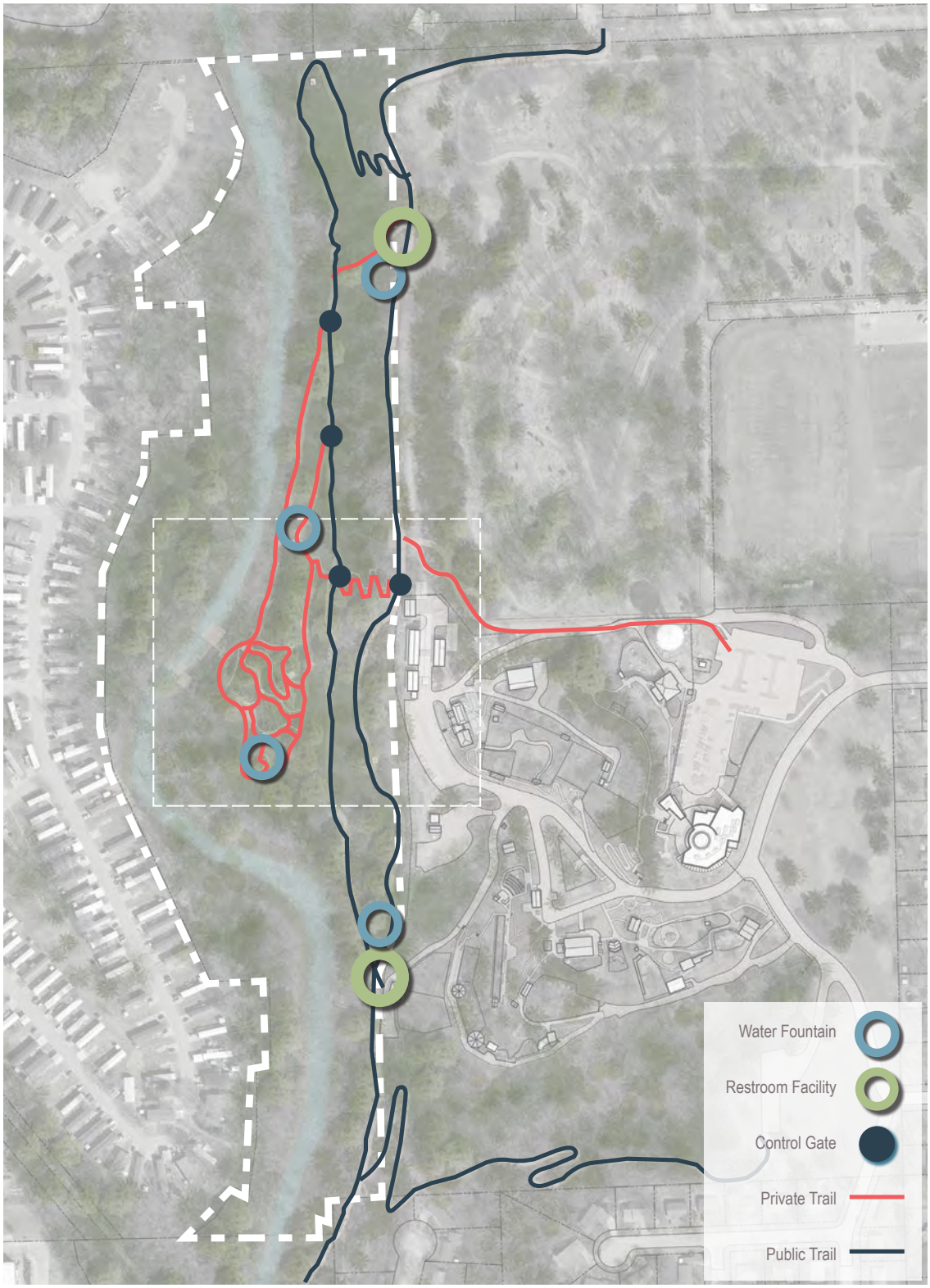


Figure 4.10 Access & Amenities Map
Source: Author

PUBLIC & PRIVATE EXPERIENCE

PRIVATE USER

All five Education Stations are privately controlled and not accessible to the public. These stations feature interactive educational features, group seating, and educational signage. Boardwalks, gathering spaces, and the treetop trail are all private.

Figure 4.11

Figure 4.12

Figure 4.13

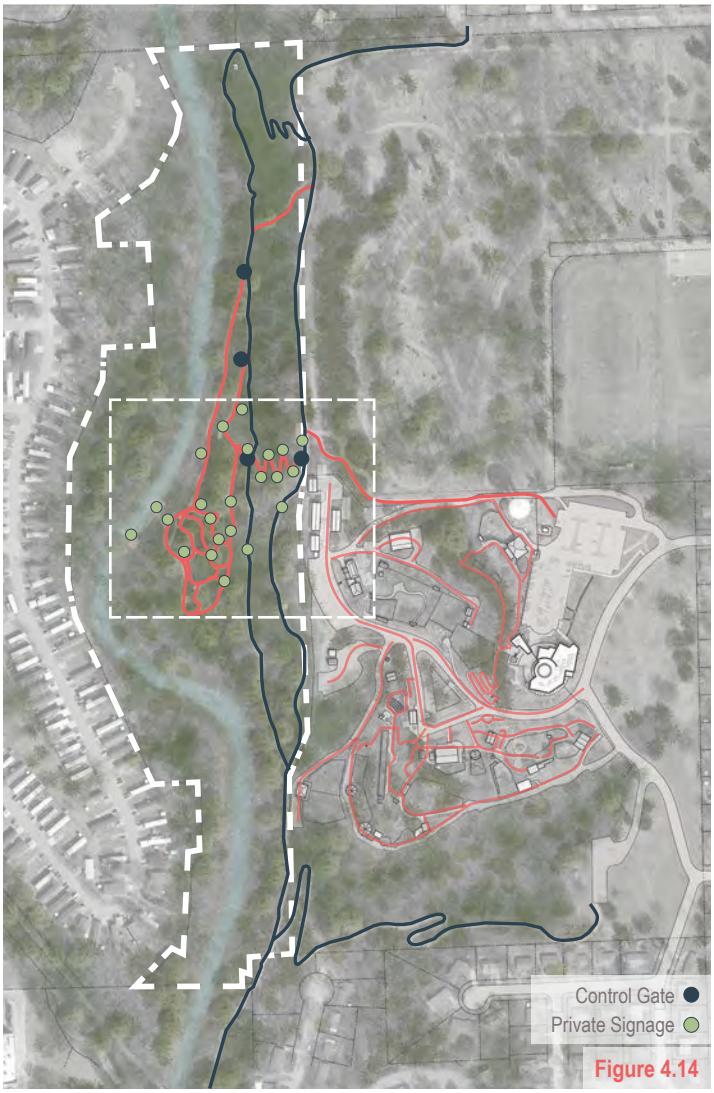


Figure 4.14

Figure 4.11 Interactive Educational Exhibits and Deck over Creek

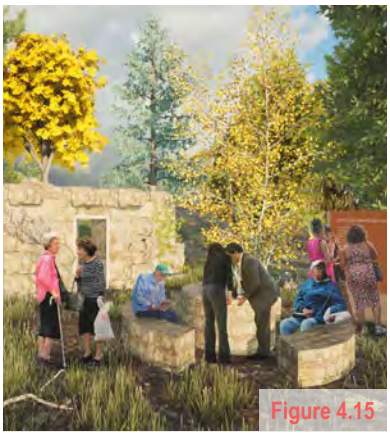
Figure 4.12 Elevated Treetop Trails maximize views to site

Figure 4.13 Creek Observation Deck serves as large group gathering space

Figure 4.14 Map of trails accessible to private users
Source: All from Author

PUBLIC USER

Educational signage was added throughout the site and can be viewed by the public. Areas with existing tables become gathering spaces that remain publicly accessible. Amenities including water fountains and restrooms are accessible to public trail users.



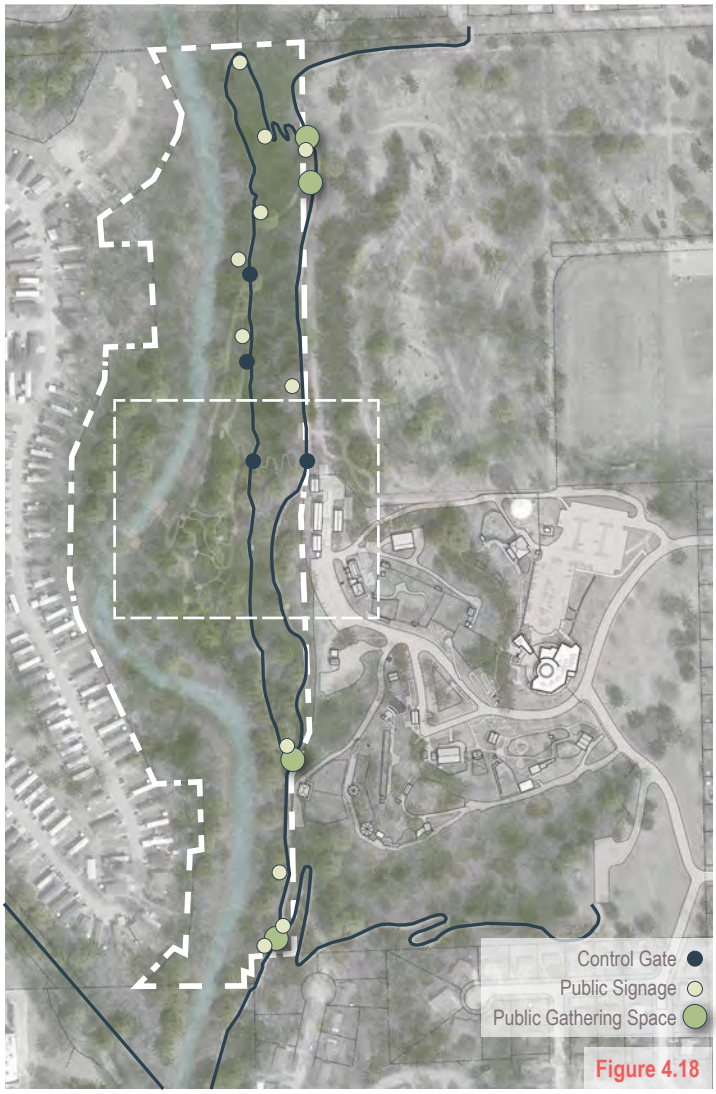


Figure 4.15 Existing WPA structure becomes gathering space through addition of a table, seating, and signage

Figure 4.16 Degraded trails on site with high slope have boardwalks added in place

Figure 4.17 Educational signage is added throughout the site to teach users about their surroundings

Figure 4.18 Map of trails accessible to public users
Source: All from Author

DESIGN STRATEGIES

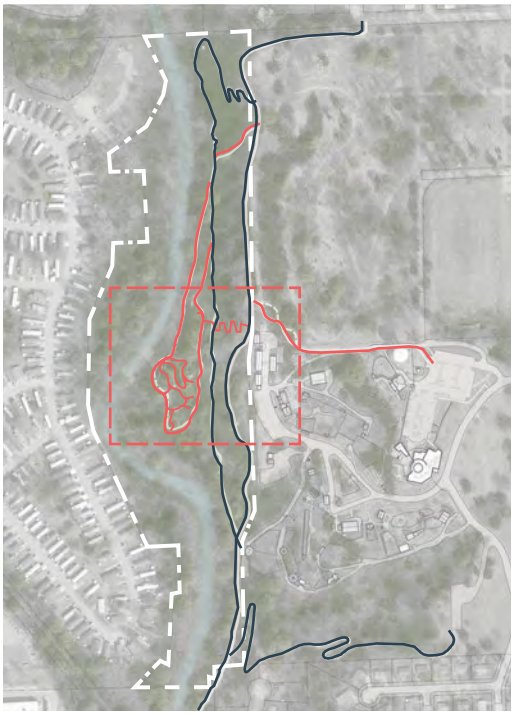


Figure 4.19 Privatize Portion of the Site

Figure 4.20 Public Educational Signage throughout; Select Gathering Spaces remain Publicly Accessible

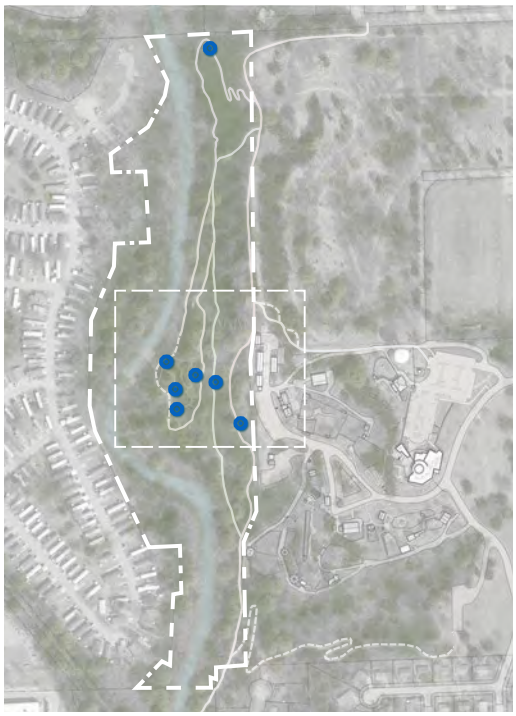


Figure 4.21 Lookout Points Located at Valuable Viewpoints

Figure 4.22 Geology Education Station located to utilize slope for Observation Exhibit

Figure 4.23 Ecology Station Located in flat area with Valuable Views to Observe Plant Communities and Ecology Learning Loops

Figure 4.24 Tree Life Cycle Built Around Existing Fallen logs

Figure 4.25 Wildlife Education Station adjacent to Sunset Zoo for animal exhibitions

Figure 4.26 Water Education Located to Observe Water and Not obstruct flow

PART 2: DESIGN ELEMENTS

GATHERING SPACES

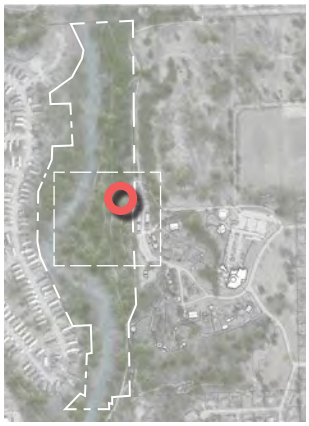
The addition of gathering spaces encourages guest exploration and comfort by incorporating a variety of intimate and open spaces for inclusion, reflection, and socialization. These spaces allow for moments within the site that encourage visitors to pause and absorb sights, smells, sounds, and textures. Figure 4.23 shows an example of a public gathering space. Public spaces are less formal and more naturalistic, following the existing palette of stone seating and tables. These gathering spaces can be used by individuals for these pause moments, or by groups such as classes, camps, tour groups, or families.

KEY PLAN

Figure 4.27 Stone seating and educational signage is added adjacent to existing WPA stone structure to create an informal gathering space.
Source: Author

BOARDWALKS AND DECKS

Sunset Zoo's Natural Play and Learning Space will feature a boardwalk forest trail in areas of high slope. The forest walk will be an interactive, educational recreational amenity that connects Manhattan residents and visitors of Sunset Zoo with the natural environment. The boardwalks follow a zig-zag pattern to not only decrease slope, but this pattern controls and enhances views, establishing a "conceal and reveal" experience. This experience enhances the scenic quality of the site. Rest nodes are purposefully integrated into the boardwalks and trail loops that will allow people to pause and interact with the landscape.



KEY PLAN

Figure 4.28 View of Boardwalk Forest Trail. Boardwalks zig-zaging through patches of dense forestland, creating a "conceal and reveal" experience. Source: Author

Figure 4.29 Entry Gathering Space during Special Lantern Release Event
Source: Author

LOOKOUT DECKS

Lookout decks are added in areas with scenic views. These areas were determined from the site analysis, geolocating where site photos were taken with attractive views. These lookout decks allow visitors to rise above the trails and observe the landforms and natural features on site. Additionally, several lookout decks connect the Treetop Trail at the Ecological Education Station. These lookout decks and the Treetop Trail allow visitors to easily observe the plant communities and functions. Users are immersed in tree canopies, offering an intimate experience with the forestland. These trails and lookout decks encourage a playful and scenic connection to nature.

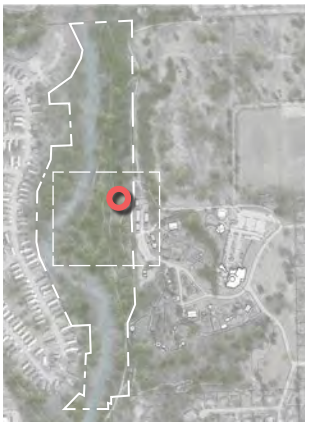
KEY PLAN

Figure 4.30 Lookout decks serve as landing pads for Treetop Trail
Source: Author

Figure 4.31 Treetop Trail gives users unique experience to walk among the trees and view the entire site. Source: Author

SIGNAGE AND WAYFINDING DESIGN

A wayfinding system for new and existing trails allows for a self-guided educational experience across the entire site. Signage emphasizes key site themes—wildlife, geology, hydrology, and ecology—and weaves them together to tell the story of the site. Interpretive signage informs the visitor on trail distances, wildlife, and native habitats that can be viewed. Moments of discovery are created through use of interpretive messaging and educational lessons or activities. This encourages and facilitates interaction with the landscape. Additionally, there is opportunity for digital tools such as applications on smart phones to connect visitors to supplemental digital media, information, and lessons. This also creates opportunities to participate in citizen science and crowd-sourced monitoring of site conditions.



KEY PLAN

Figure 4.32 Signage along boardwalk frames viewing experiences
Source: Author

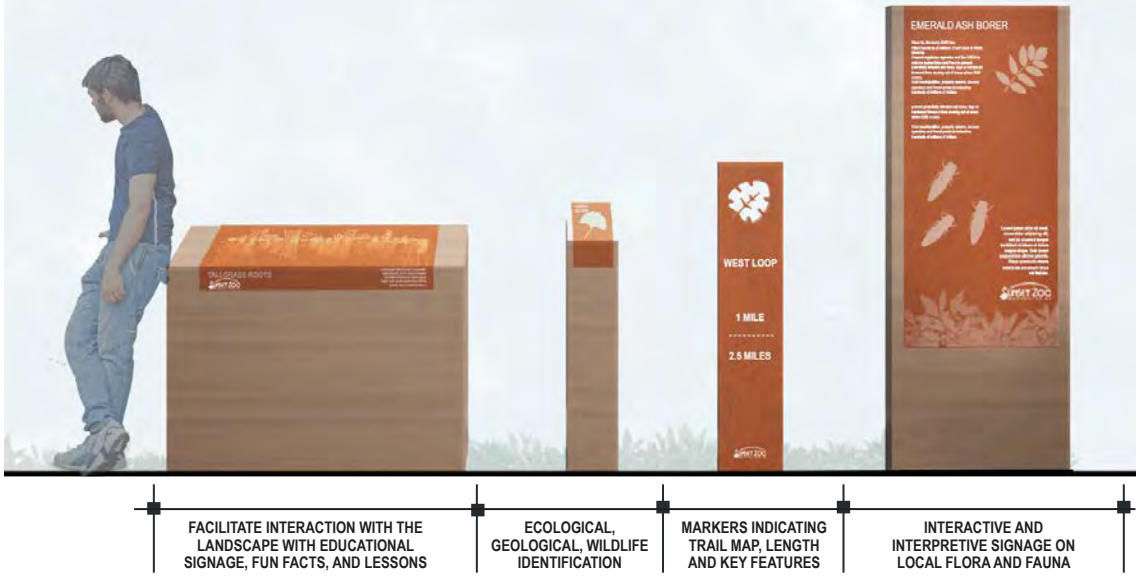


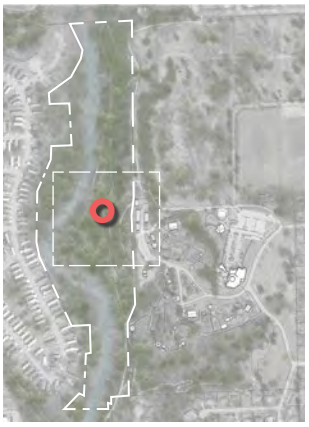
Figure 4.33 Elevation detail of signage placed throughout site.
Source: Author

Some subjects of the signage and wayfinding include:

- "Journey through the Woodland" sequential story through the site
- Trail Map with discovery station locations: "You are Here"
- Interactive/Interpretive signage on local flora & fauna
- "Fun Facts" related to site conditions related to wildlife, geology, hydrology, and ecology
- Exploration challenges: "Can you Spot..."
- Interchangeable supportive signage; trail hours, private accessibility, safety rules, & weather or flood reports

MEDITATION GARDEN

Much of the site is highly active with educational and play features. It is important to conserve the natural peacefulness of the site and allow for quiet moments. The Meditation Garden is a deck space with expansive views to the forest and Wildcat Creek. Nestled in the slope, a shaded boardwalk trail leads visitors through the dense forestland to the meditation garden. The sloped landform and dense plantings create a sound and sight buffer to the space. This allows for privacy within the garden and framed views to nature, as opposed to views to the more active gathering or play spaces. This privacy allows for visitors to be immersed in nature and connect more intimately with the forest. The Meditation Garden can be used by individuals or meditation/ yoga classes can be facilitated by the zoo.

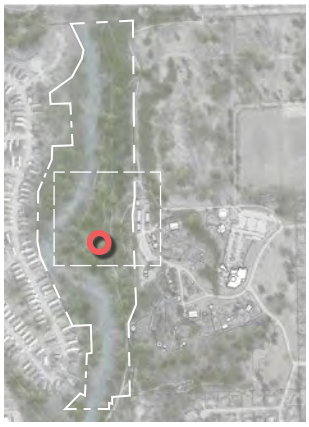


KEY PLAN

Figure 4.34 Meditation garden being used for yoga class
Source: Author

QUIET PRIVATE SEATING AREAS

Rest nodes are placed throughout the trail and boardwalk system to allow for these peaceful quiet moments. These nodes can accommodate small groups to pause and collect during site explorations. Vegetation and landforms enclose these spaces to create more privacy.



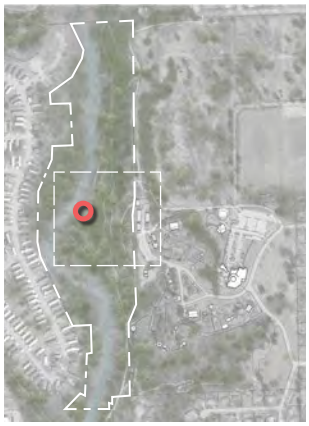
KEY PLAN

Figure 4.35 Quiet Private Seating Areas along boardwalk
Source: Author

CREEK OBSERVATION DECK

The Creek Observation Deck is a large deck with stepped seating, which can accommodate large groups and educational demonstrations. The deck overlooks Wildcat Creek, allowing visitors to observe the movement and processes of the water. Dense forestland continues on the west side of the creek, creating an aesthetically pleasing backdrop for presentations or demonstrations on the deck. A trellis covers part of the deck, allowing for a comfortable shaded space. Boardwalks connect visitors to the creek and lead to the adjacent Water Education Station.

Figure 4.36 Creek Observation Deck serves as a large-group gathering space
Source: Author



KEY PLAN


INDIVIDUAL REFLECTION WHILE VIEWING CREEK
GROUP GATHERING FOR CLASSES OR CAMPS

PART 3: EDUCATION STATIONS

WATER EDUCATION STATION

Education stations focus on place-based curriculum. This means the education stations were located based on access to the educational subject matter. The Water Education Station cantilevers over Wildcat Creek, allowing for an immersive educational experience focused on observation of the watershed's processes. The deck space features seating and educational features for individuals, groups, or classes. An interactive watershed education screen displays facts and data on the creek and shows its context in the larger Kansas River watershed. A get-down area allows visitors to walk along the creek and observe the water edge and riparian plantings. Educational signage further shows subjects related to the hydrologic cycle in the context of Manhattan.

KEY PLAN

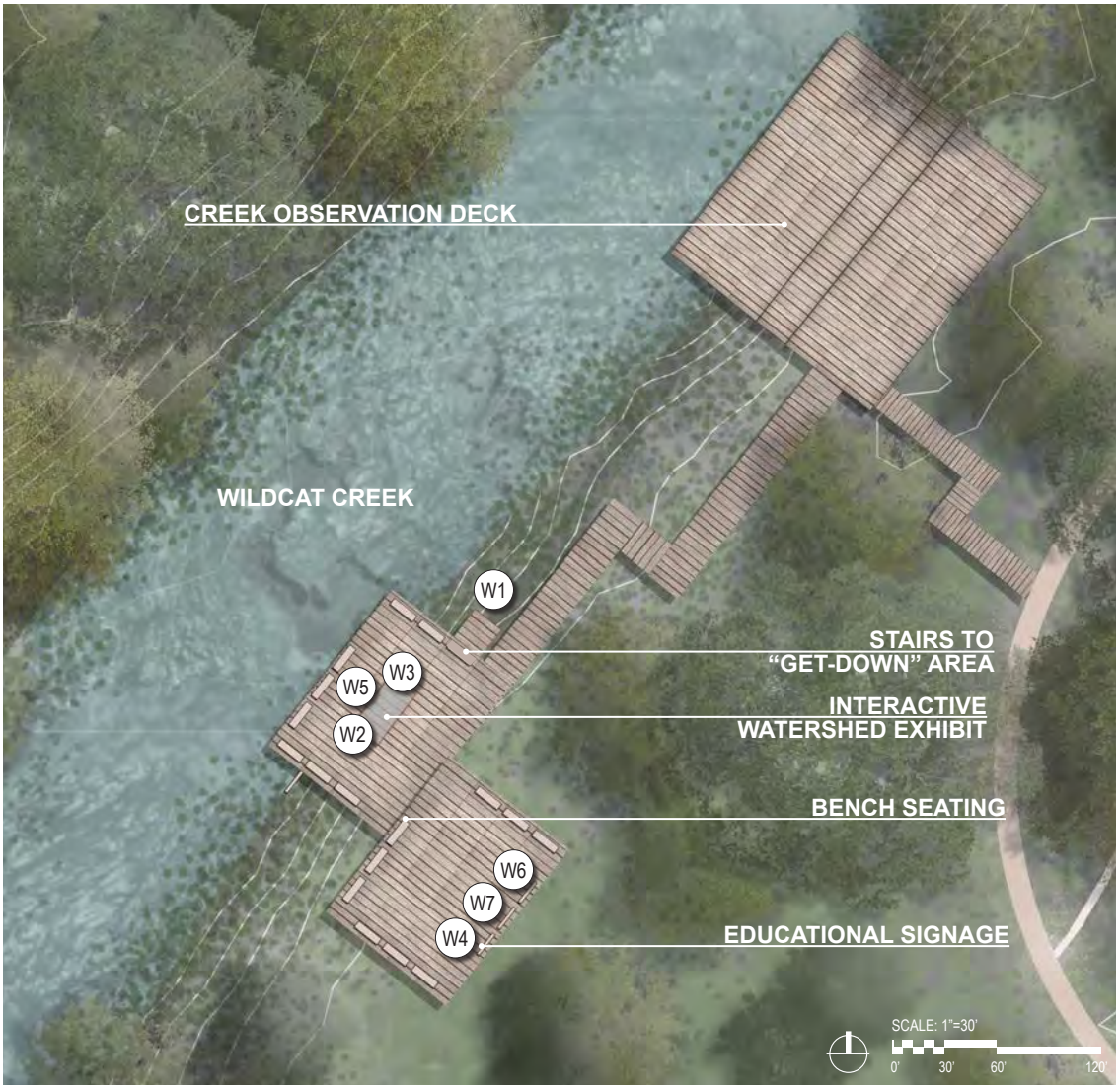


Figure 4.37 Wildlife Education Station Plan Enlargement
Source: Author

THEME	LESSON	LEARNING OUTCOMES	LABEL
WATER QUALITY	Water Filtration (EPA)	Grades 4-8: To demonstrate the procedures that municipal water plants may use to purify water for drinking.	W1
	Resource Management: Protecting your Drinking Water (EPA)	Grades 9-12: use a simple mathematical model of ground water vulnerability to estimate the vulnerability of a small town's water supply.	W2
DRAINAGE	Flood! (Earth Science Week)	Grades 5-12 NSES: Earth's Systems (ESS2), Earth and Human Activity (ESS3). Understand different types of soil have different capacities for retaining rainwater	W3
	Groundwater Movement (Earth Science Week)	Grades K-12 NGSS: Earth's Systems (ESS2), Earth and Human Activity (ESS3). Understand how water moves through rock materials such as sand, gravel, and clay.	W4
	Identifying Your Watershed (Earth Science Week)	Grades 9-12 NGSS: Earth and Human Activity (ESS3). Identify the watershed you live in, source of water used at home, and pathway of surface runoff in your watershed.	W5
PRECIPITATION	Earth's Hydrologic Cycle (Earth Science Week)	Grades 1-12 NSES: Earth's Systems (ESS2). Construct a simple model of thew to help visualize and understand the movement of liquid water and heat.	W6
	It's the "Rain," Man (Earth Science Week)	Grades K-12 NSES: Earth's Systems (ESS2). Build a rain gauge, collect data about the amount of precipitation, and compare your measurements.	W7

Figure 4.38 Water Curriculum/Activities
Chart created by author informed by (American Geosciences Institute 2022) and (United States Environmental Protection Agency, n.d.)


BOARDWALK LEADING DOWN FROM CREEK OBSERVATION DECK
"GET-DOWN" AREA
GABION WALL SUPPORT

Figure 4.39 Water Education Station cantilevers over Wildcat Creek
Source: Author

MAJOR CONSIDERATIONS APPLIED:

Figure 4.40 Educational Signage on Wildcat Creek
Source: Author

Figure 4.41 Interactive Watershed Touch Exhibit
Source: Author

WILDLIFE EDUCATION STATION

The Wildlife Education Station is located adjacent to Sunset Zoo. Zoo visitors are just a short walk away from expanding their educational experience from animals in controlled exhibits to wild animals in the forest. Stepped seating allows for group gathering and demonstrations. Game cameras are to be placed throughout the site, and the Wildlife Education Station features a virtual display of the footage. This encourages users to explore and observe the forest, searching for these animals. An interactive animal track exhibit teaches visitors to identify animal tracks of the local wildlife. From here, visitors can embark on the trails and boardwalks to search for and identify the animals that surround them. Birdhouses at the station invite birds to inhabit the space. Cameras can be set up in these enclosures to allow for up-close observation of the nesting and development of birds. A hearing station encourages users to use their sense of hearing to identify local birds and animals. This element amplifies sounds of the forest and encourages users to listen for bird calls, with an adjacent sign that helps identify the species.

KEY PLAN

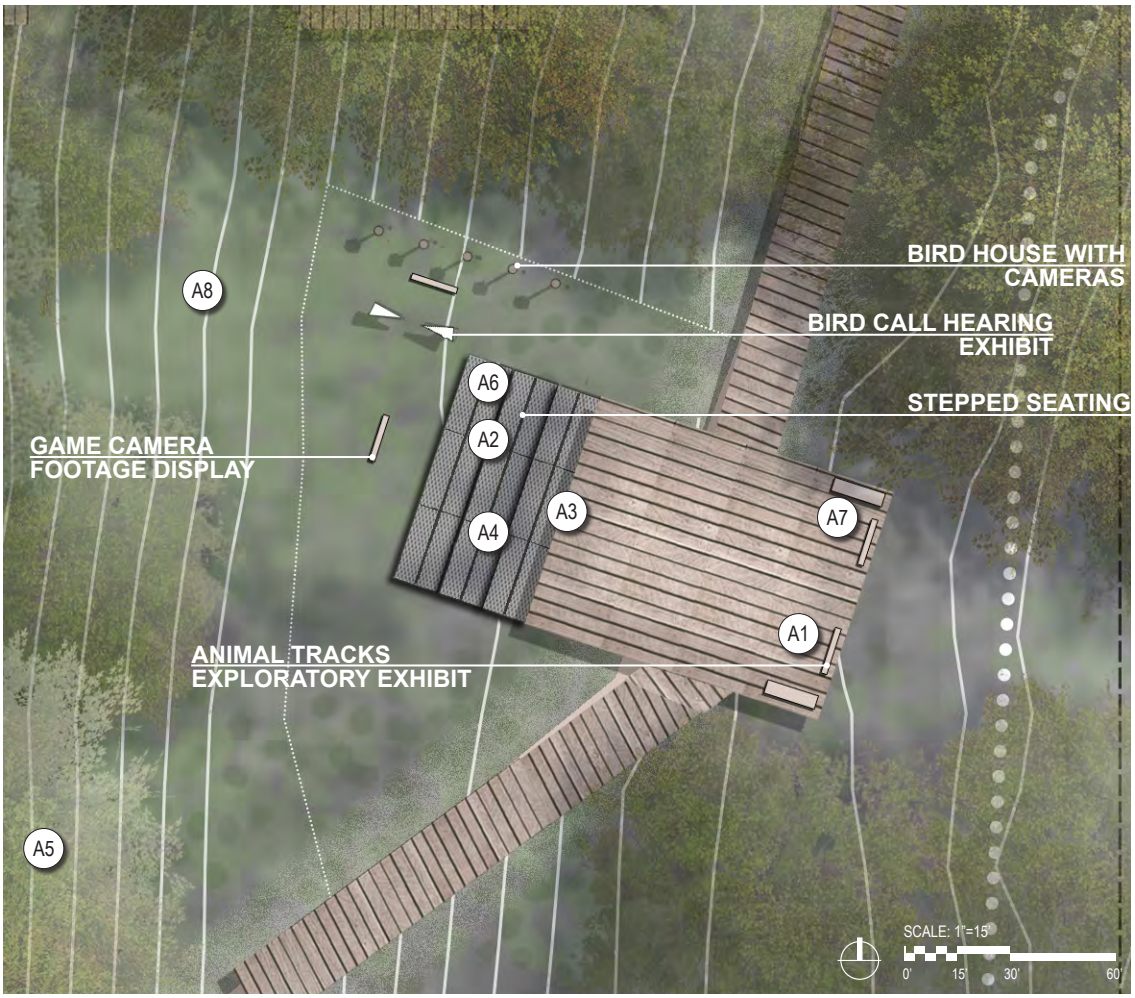


Figure 4.42 Wildlife Education Station Plan Enlargement
Source: Author

THEME	LESSON	LEARNING OUTCOMES	LABEL
IDENTIFICATION	Tricky Tracks (NWF)	Grades K-4: Students will identify the tracks of several different types of mammals. Students will explain how people can use tracks to find out more about mammal habits and behaviors.	A1
	Massive Migrations (NWF)	Grades 5-8: Students will map and calculate the migration routes of Arctic species to learn about animals that spend part of their lives in the Arctic and how they are connected to other parts of the world for food and shelter.	A2
HABITAT	Wildlife Burrows (NWF)	Grades 6-12: Students will create models of different wildlife burrows and examine and contrast the functions.	A3
	Links in the Food Chain (NWF)	Grades K-4: Students will learn what a food chain is and sing or act out the rhyme “There Once Was a Daisy”.	A4
	Sensory Discovery Walk (NWF)	Grades K-6: Students “open their eyes” to nature by exploring their surroundings without sight. Then they map and retrace the path they traveled.	A5
	Build a Bat House! (NWF)	Grades 2-8: Students build a bat house and continue to observe the habitat over time	A6
HUMAN IMPACT	Pond Life (NWF)	Grades 9-12: Students will research fresh- water biomes of ponds and lakes and conduct experiments to understand pond life, food webs and the impact of human influences on ponds.	A7
	Controversy over Wildcats (NWF)	Grades 3-8: Students take part in a role-playing game to help them understand the complexity of the issues surrounding species, habitat conservation and human interests.	A8

Figure 4.43 Wildlife Curriculum/Activities
Chart created by author informed by (The National Wildlife Federation, n.d.)

DESIGN CONSIDERATIONS APPLIED:

Figure 4.44 Animal Tracks Interactive Exhibit
Source: Author

Figure 4.45 Bird Call Interactive Observation Exhibit
Source: Author

ECOLOGICAL EDUCATION STATION

The Ecological Education Stations showcases ecological habitats at various scales—from smaller demonstration gardens to a sizeable forest restoration area. Walking loops draw users into the restored forest area, to be immersed in the habitat and observe the plantings. Signage is places along these loops to identify species names and functions. A demonstration garden plot is added to the deck gathering space. Classes or groups initially gather at this deck with stepped seating, followed by individual exploration of the walking loops and Treetop Trail. Users can view the forest from various heights and perspectives, increasing awareness of the ecological form and function of the site.

KEY PLAN

Figure 4.46 Ecological Education Station Plan Enlargement
Source: Author

THEME	LESSON	LEARNING OUTCOMES	LABEL
PLANT IDENTIFICATION	Dynamic Wetlands (Earth Science Week)	Grades 9-12: Earth's Systems (ESS2) To increase student awareness of the value and importance of our wetlands	E1
	Vegetation Survey (ASU Ecology Explorers)	Grades K-4: Survey, map, describe and think about local environments such as our neighborhoods, school yards and parks.	E2
PROCESSES	Leaf It to Me (Earth Science Week)	Grades 3-10: Earth's Place in the Universe (ESS1), Earth's Systems (ESS2) Observe and understand plant transpiration.	E3
	Soil, Plants, and the Energy Cycle (Earth Science Week)	Grades 9-12: Understand CO2 sequestration is the removal of CO2 from the atmosphere	E4
	Exploring Microclimates (ASU Ecology Explorers)	Grades 6-12: compare the land cover and temperatures iC different microclimates to begin to explain why organisms live where they do.	E5
THREATS/ RISKS TO ECOLOGICAL COMMUNITIES	Where Growth Meets Growth (Earth Science Week)	Grades 5-8: Earth and Human Activity (ESS3) To identify fire risk factors for a property located near a wildland area.	E6
	Habitat Fragmentation: A Bird's Eye View (ASU Ecology Explorers)	Grades 6-12: Recognize that different species respond differently to perturbations in their environment; Work collaboratively to generate possible solutions to the problem of conserving biodiversity in a human-managed ecosystem	E7

Figure 4.47 Ecological Curriculum/Activities
Chart created by author informed by (American Geosciences Institute 2022) and (Arizona State University Global Institute of Sustainability and Innovation, n.d.)

MAJOR CONSIDERATIONS APPLIED:

Figure 4.48 Demonstration Plot Exhibit
Source: Author

Figure 4.49 Ecology Loops feature thorough Signage to learn as you walk
Source: Author

TREE LIFE CYCLE EDUCATION STATION

The Tree Life Cycle Education Station gives in-depth lessons on trees and their functions at various ages. Users are taught to identify the species, age, and health of trees. The station features a fallen tree, which is labeled on areas of decomposition and identifies the species that may grow on or inhabit the dead tree. This showcases the interconnectedness of the forest ecosystem habitat. Tree stumps are used as seating for a gathering space, where groups can carry out the lessons and activities shown in Figure 4.47.

KEY PLAN

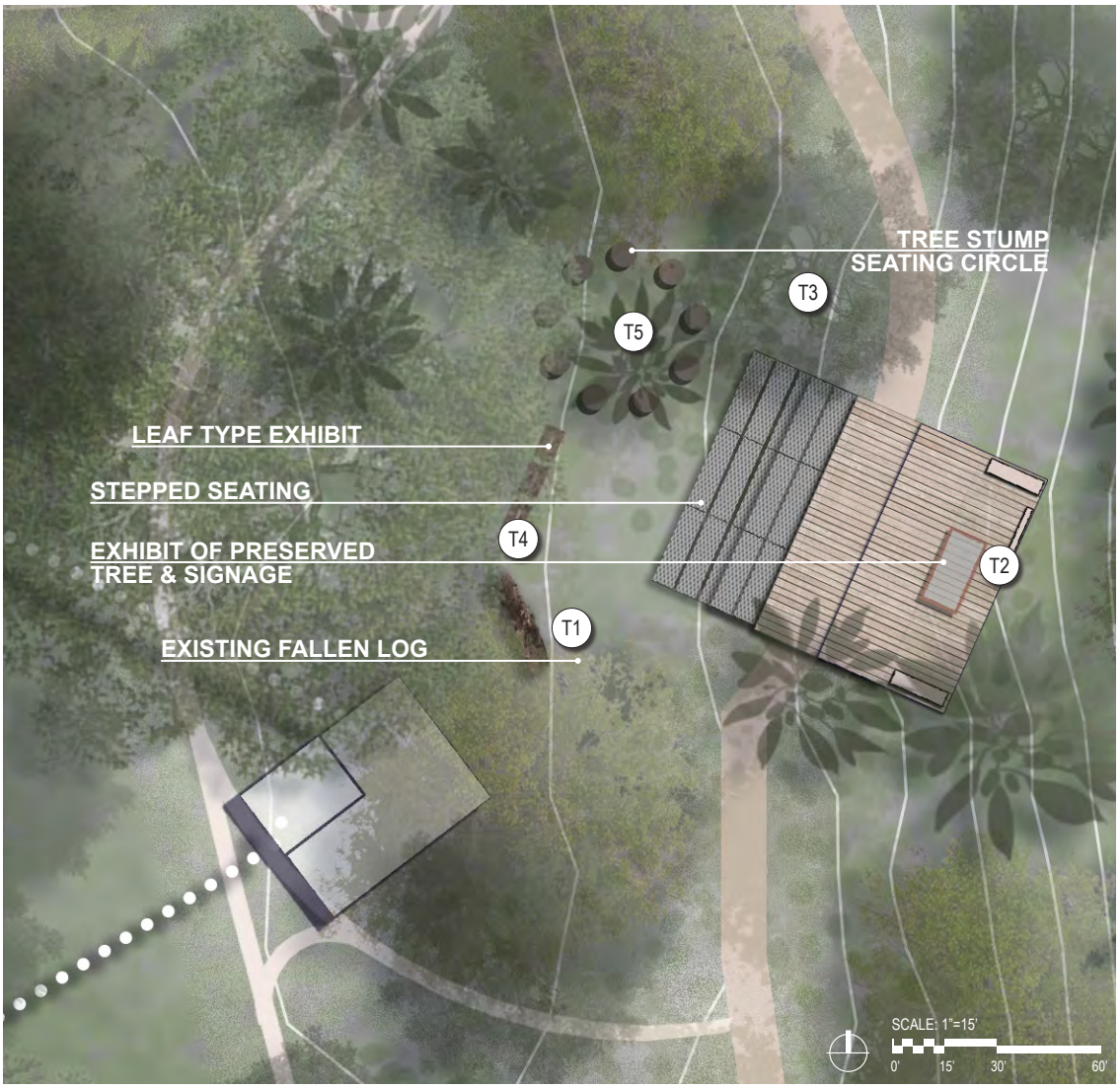


Figure 4.50 Tree Life Cycle Education Station Plan Enlargement
Source: Author

THEME	LESSON	LEARNING OUTCOMES	LABEL
IDENTIFICATION	Tree Growth (Pennsylvania State University)	Grades 2-4: Learn the layers of a tree; kinds of tree growth: height, diameter, and root growth; Influences on tree growth including damage, shade, drought, pests, harvesting, and so on	T1
ECOSYSTEM IMPACT	Please the Trees, But Not These, Please! (Pennsylvania State University)	Grades 3-6: Identify basic requirements for tree survival and indicate how these needs are met	T2
	Big Roots for Big Problems: Exploring the Ecosystem Services of Roots (Michigan State University)	Grades 6-12: Understand how healthy ecosystems provide valuable services	T3
	Seeing the Forest from the Trees (Michigan State University)	Grades K-2: Name factors affect plant growth; understand plants need energy, water and nutrient to survive; explain how leaf size and tree height are shaped by sunlight and soil water	T4
HUMAN USE OF TREES	The Giving Tree (Pennsylvania State University)	Grades 2-4: Students will distinguish between wants and needs and recognize individual differences. Students will list objects that we either make from trees or that are produced by trees.	T5

Figure 4.51 Tree Life Cycle Curriculum/Activities
Chart created by author informed by (Pennsylvania State University Department of Ecosystem Science and Management, n.d.) and (Michigan State University 2015)

MAJOR CONSIDERATIONS APPLIED:

Figure 4.52 Fallen tree serves as specimen for learning the life cycles of trees
Source: Author

GEOLOGY EDUCATION STATION

The Geology Education Station is nestled into a sloped landform. This allows for the soil layers exhibit to be shown in context of accurate depths. This station also features a gravel pit area, which creates opportunity for “dig and find” activities related to rock and mineral identification. Displays are found adjacent to the sand pit for users to identify their findings. A demonstration worktable is added to accommodate a variety of geology lessons and activities.

KEY PLAN

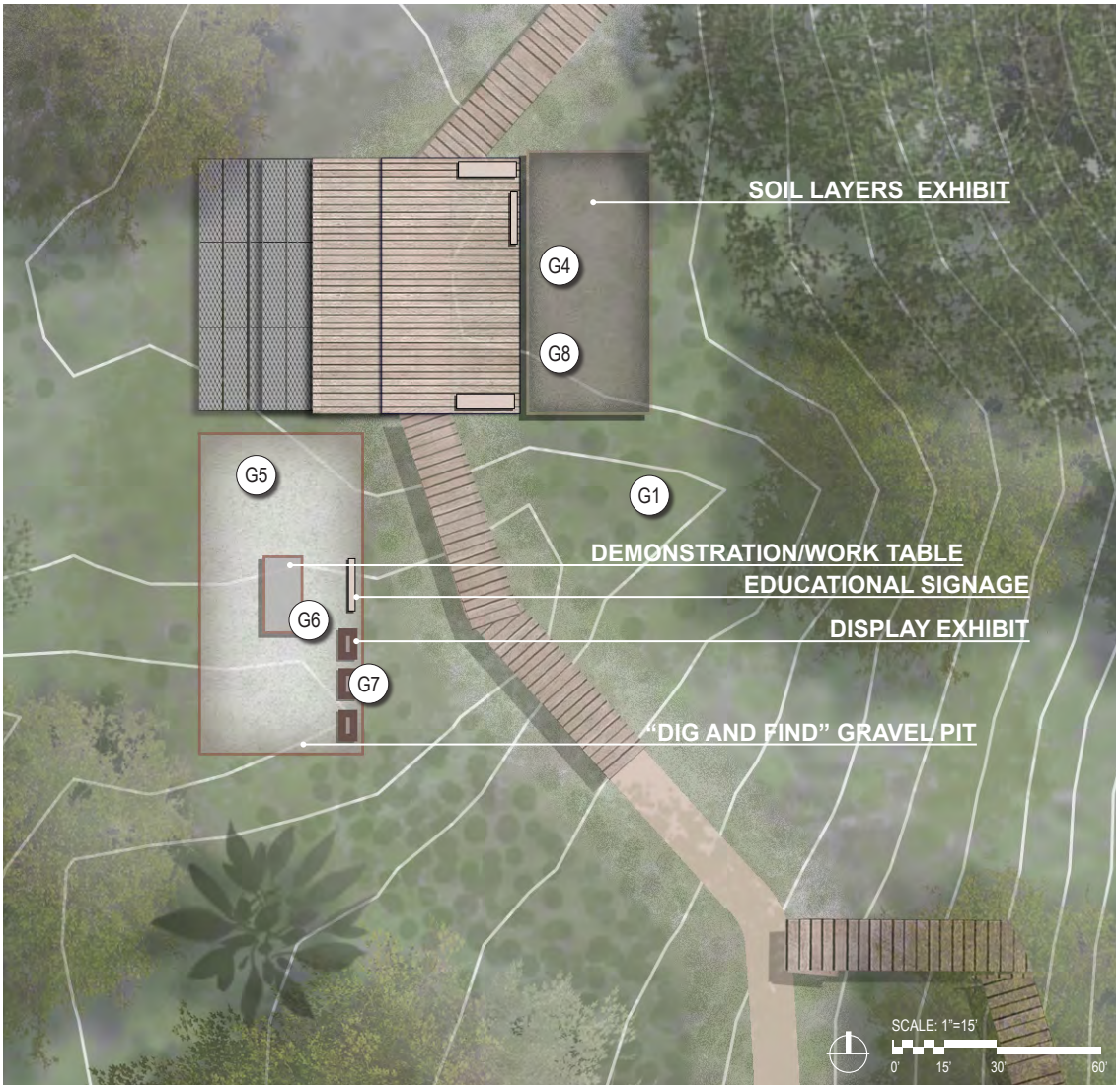


Figure 4.53 Rendering of Creek Observation Deck
Source: Author

THEME	LESSON	LEARNING OUTCOMES	LABEL
EARTH PROCESSES	Erosion Activity (USGS)	Understand how waves and water movement affect the movement of sand and erode cliffs on a coastline	G1
	Making Caves: How Solution Caves Form (Earth Science Week)	Grades K-12 NGSS: Earth's Systems	G2
SOIL IDENTIFICATION	Core Sampling (Earth Science Week)	Grades 5-8 NSES: Earth and Space Science (A), Physical Science (B), Science and Technology (D), Science in Personal and Social Perspectives (E), Science as Inquiry (G)	G3
	Finding Slope (Earth Science Week)	Grades 6-12 NGSS: Earth's Systems (ESS2), Earth and Human Activity (ESS3)	G4
ROCK IDENTIFICATION	Awesome Fossils (Earth Science Week)	Grades K-8 NGSS: Earth's Place in the Universe (ESS1), History of Earth	G5
	Investigating Different Rock Types (Earth Science Week)	Grade 5-8 NGSS: Earth's Systems	G6
MATERIAL PROPERTIES	Tracking Change over Time (USGS)	Grades 5-8 NGSS: Analyzing and Interpreting Data, Electromagnetic Radiation, Natural Hazards, Human Impacts on Earth Systems; NSES: Science in Personal and Social Perspective	G7
	The Lifecycle of a Mineral Deposit (USGS)	Grades 5-8 NSES: Earth and Space Science (A), Physical Science (B), Science and Technology (D), Science in Personal and Social Perspectives (E)	G8

Figure 4.54 Geology Curriculum/Activities
Chart created by author informed by (American Geosciences Institute 2022) and (United States Geological Survey, n.d.)

MAJOR CONSIDERATIONS APPLIED:

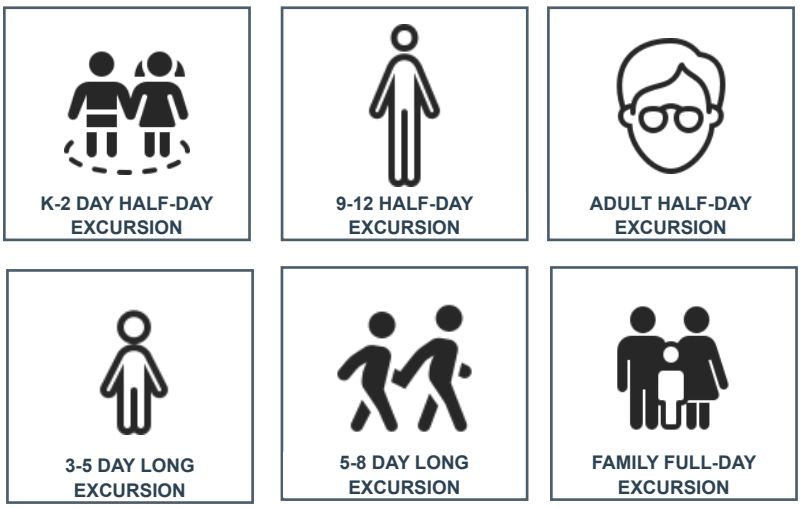
Figure 4.55 Dig-and-Find Sandpit and Work Station
Source: Author

Figure 4.56 Exhibit showing the layers of soil, cut into the terrain
Source: Author

PART 4: PROGRAM ITINERARIES

INTRODUCTION

The following program itineraries were developed to show the multitude of ways to use the site for educational excursions. These itineraries are schedules of specific activities, with correlating maps displaying where the activities take place on site. Perspectives of the spaces being used are included to better visualize the experience. These itineraries are organized by target age group/learning level and length of excursion (half-day or full day). This set of itineraries is not comprehensive but offers example models on how to activate the space for educational outcomes. Itineraries included are:



HALF-DAY ITINERARIES

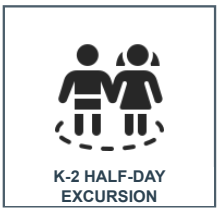



Figure 4.58


Figure 4.59


Figure 4.60

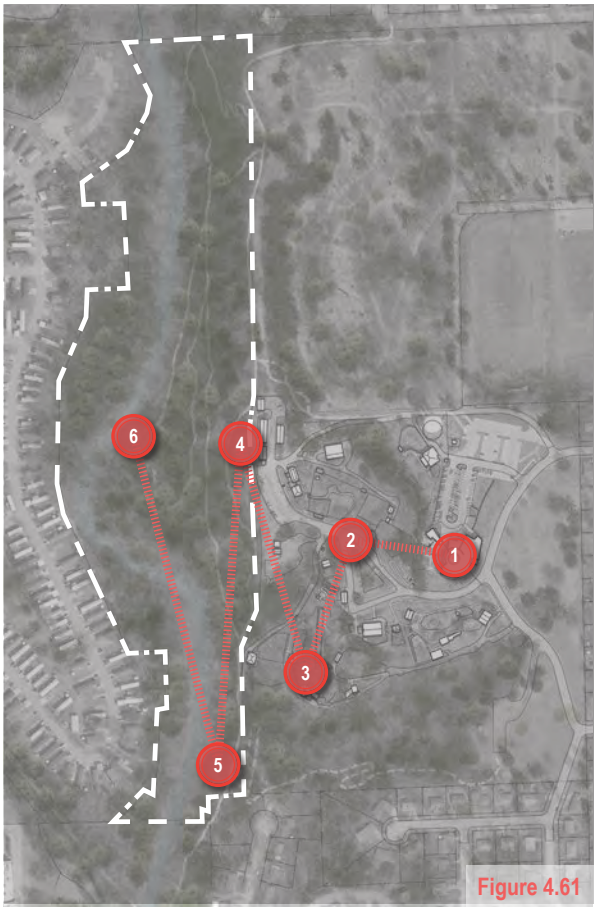


Figure 4.61

LABEL	TIME	ACTIVITY
1	15 min	Introduction Meeting to establish expectations for the day and review schedule
2	45 min	Zoo Tour and Walk
3	30 min	Animal Encounter in Zoo
4	60 min	A1: Tricky Tracks Lesson at Wildlife Education Station
5	20 min	Snack Break at outdoor Gathering Space
6	60 min	W6: Earth's Hydrologic Cycle

Figure 4.57 Chart Showing Itinerary Schedule
Figure 4.58 View of Water Education Station
Figure 4.59 View of Wildlife Education Station
Figure 4.60 View of Gathering Space
Figure 4.61 Sequence Map of Activities

Source of all: Author

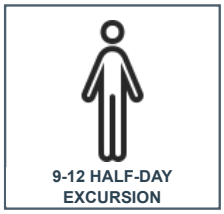



Figure 4.63


Figure 4.64


Figure 4.65

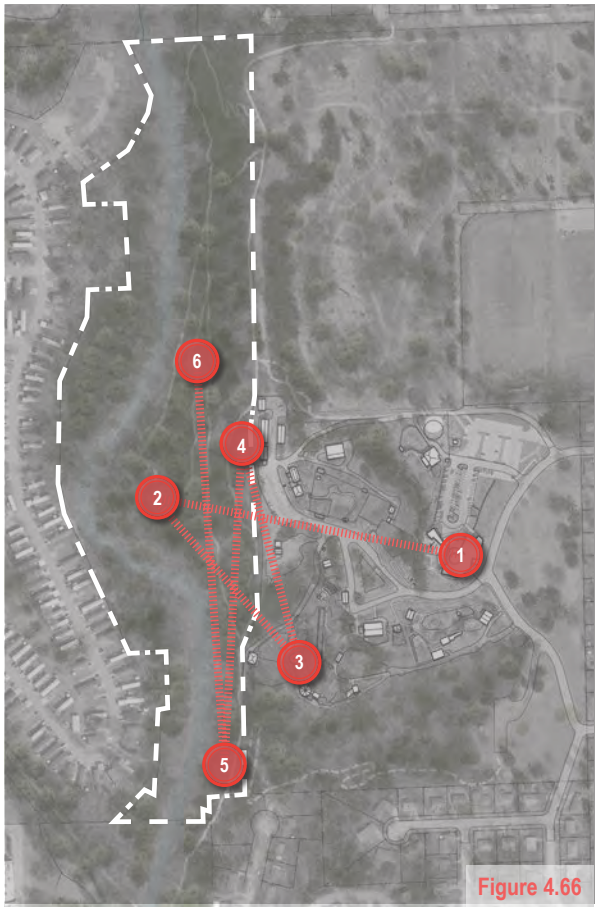


Figure 4.66

LABEL	TIME	ACTIVITY
1	15 min	Introduction Meeting to establish expectations for the day and review schedule
2	45 min	E1: Dynamic Wetlands Activity at Ecology Station
3	30 min	Animal Encounter in Zoo
4	60 min	A3: Wildlife Burrows Activity at Wildlife Station
5	20 min	Snack Break at outdoor Gathering Space
6	60 min	G4: Finding Slope Activity at Geology Station

Figure 4.62 Chart Showing Itinerary Schedule
Figure 4.63 View of Wildlife Education Station
Figure 4.64 View of Geology Education Station
Figure 4.65 View of Ecology Education Station
Figure 4.66 Sequence Map of Activities

Source of all: Author


Figure 4.69


Figure 4.68


Figure 4.70

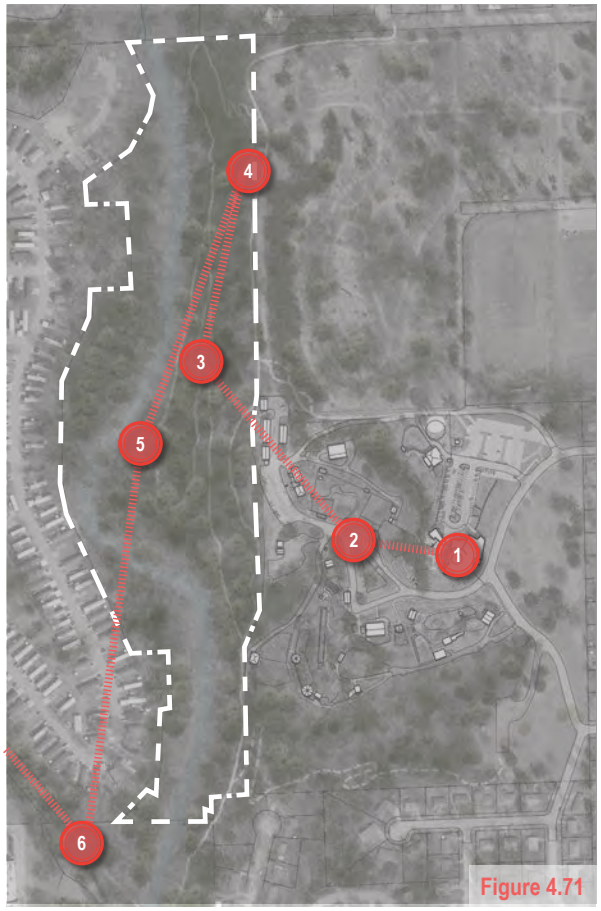


Figure 4.71

LABEL	TIME	ACTIVITY
1	15 min	Introduction Meeting to establish expectations for the day and review schedule
2	45 min	Zoo Tour and Walk
3	60 min	G1: Erosion Activity at Geology Education Station
4	20 min	Short Break at outdoor Gathering Space
5	60 min	W4: Groundwater Movement at Water Station
6	60 min	Linear Trail Guided Ecology Tour

Figure 4.67 Chart Showing Itinerary Schedule
Figure 4.68 View of Geology Education Station
Figure 4.69 View of Wildlife Education Station
Figure 4.70 Photo of Gathering Space
Figure 4.71 Sequence Map of Activities

Source of all: Author; Photo by (Hahn 2021)

FULL-DAY ITINERARIES

Figure 4.73

Figure 4.74

LABEL	TIME	ACTIVITY
1	15 min	Introduction Meeting to establish expectations for the day and review schedule
2	45 min	Zoo Tour and Walk
3	30 min	Animal Encounter in Zoo
4	45 min	A5: Sensory Discovery Walk Activity at Wildlife Education Station
5	2 hrs	T2: Please the Trees, But Not These, Please! Activity at Tree Life Cycle Station
6	30 min	Lunch Break at outdoor Gathering Space
7	60 min	G2: Making Caves: How Solution Caves Form Activity at Geology Education Station
8	60 min	W1: Water Filtration Activity at Water Station
9	45 min	Treetop Walk Exploration at Ecology Station

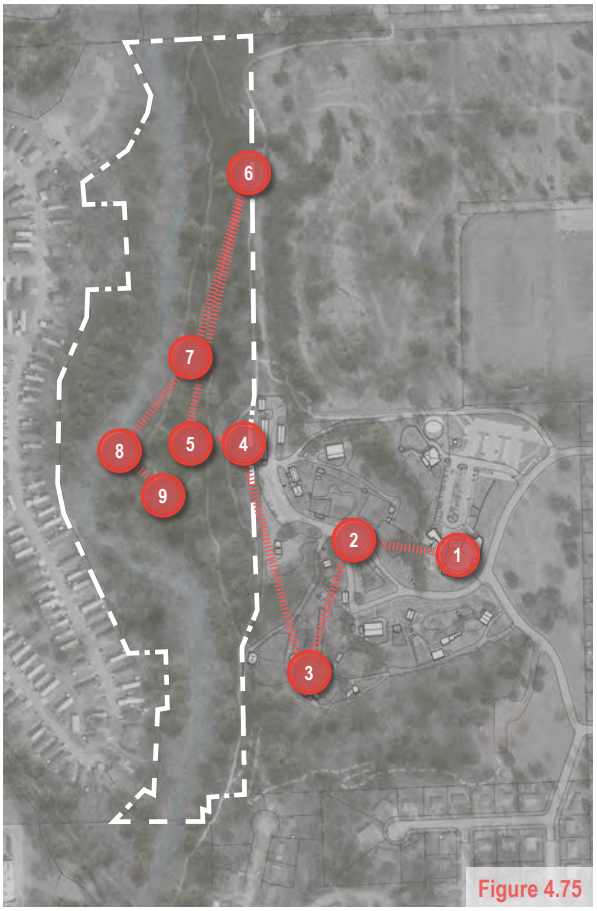


Figure 4.75

Figure 4.72 Chart Showing Itinerary Schedule
Figure 4.73 View of Trail & Viewing Towers
Figure 4.74 View of Tree Life Cycle Station
Figure 4.75 Sequence Map of Activities

Source of all: Author


Figure 4.77


Figure 4.78

LABEL	TIME	ACTIVITY
1	15 min	Introduction Meeting to establish expectations for the day and review schedule
2	45 min	Zoo Tour and Walk
3	30 min	Animal Encounter in Zoo
4	60 min	A2: Massive Migrations Activity at Wildlife Education Station
5	2 hrs	W3: Flood! Activity at Water Education Station
6	30 min	Lunch Break at outdoor Gathering Space
7	65 min	T3: Big Roots for Big Problems Activity Tree Life Cycle Station
8	60 min	E7: Habitat Fragmentation Activity at Ecology Station
9	45 min	Treetop Walk Exploration at Ecology Station

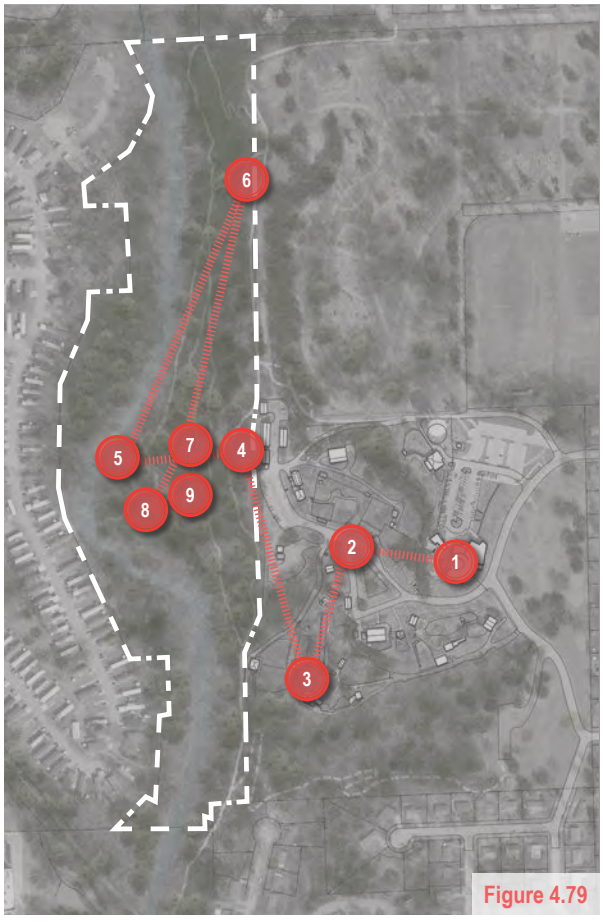


Figure 4.79

Figure 4.76 Chart Showing Itinerary Schedule

Figure 4.77 View Treetop Trail

Figure 4.78 View of Ecology Education Station

Figure 4.79 Sequence Map of Activities

Source of all: Author


Figure 4.81


Figure 4.82

LABEL	TIME	ACTIVITY
1	15 min	Introduction Meeting to establish expectations for the day and review schedule
2	45 min	Zoo Tour and Walk
3	30 min	Animal Encounter in Zoo
4	45 min	A5: Sensory Discovery Walk Activity at Wildlife Education Station
5	60 min	E3: Leaf It to Me Activity at Ecology Station
6	30 min	Lunch Break at Zoo Expedition Cafe
7	60 min	G2: Making Caves: How Solution Caves Form Activity at Geology Education Station
8	60 min	W6: Earth's Hydrologic Cycle Activity at Water Station
9	45 min	Linear Trail Guided Ecology Tour

Figure 4.83

Figure 4.80 Chart Showing Itinerary Schedule
Figure 4.81 View of Water Station Signage
Figure 4.82 View of Water Education Station
Figure 4.83 Sequence Map of Activities

Source of all: Author

Figure 4.84 Park Ranger leading forest walk in Discovery Park, Seattle, WA (Seattle Municipal Archives 1982). Used under Creative Commons Attribution Non-commercial

ZOOLOGISCHER GARTEN

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CHAPTER 5
CONCLUSION

IMPLICATIONS

This research project's design of Sunset Zoo's natural play and learning space creates a valuable educational resource for the zoo and the city of Manhattan. The project responds to the goals of Sunset Zoo as outlined in their Strategic Master Plan and addresses Manhattan's need for accessible nature areas that promote learning and play. Its design was guided by a literature review analysis, program analysis, and precedent study to create a research-informed projective design. Through this research process, I have answered the questions: "How can zoos extend their educational experience to include direct contact and observation of a natural environment to reinforce education that is initially introduced through controlled exhibits? How can this expanded opportunity support K-12 science standards?"
The projective design in this study shows the research-informed design process applied to Sunset Zoo to create a successful proposal of a natural play and learning space serving as an extension of the existing educational programming within the zoo. The design and program-itinerary examples show how learning opportunities and outcomes increase with the addition of this space. Additionally, these itineraries show the specific learning outcomes, which support K-12 science standards. This project shows how educational activity settings in nature increase opportunity for engaging and interactive K-12 lesson plans.

Figure 5.1 Vintage German Zoo Garden Poster
Source: (Klinger 2009). Used under Creative Commons Attribution Non-commercial.

More specifically, the design of this natural play and learning space can provide zoo with:

- Increased opportunities at Sunset Zoo for interpretive signage related to conservation
- Interactive elements with varied learning outcomes
- Small events or activities with low staff impact
- The building of partnerships with local K-12 schools and Kansas State University
- Increased number of amenities
- Advancement in sustainable practices and resource management
- Increased community awareness of the zoo's conservation efforts
- Ability to function as a meeting space of civic commons
- Increased member and community participation

Overall, the addition of this space aids in the completion of the zoo's Strategic Masterplan goals by providing additional outdoor educational and recreational resources. Furthermore, the methods undergone produced research-informed design considerations, design elements, and activity settings appropriate to integrating natural play and learning spaces with zoos. This project can be viewed as an advancement in the design process of integrating natural play and learning spaces with zoos.

LIMITATIONS

There are several important limitations to note when considering the findings from this study. The body of academic research on the subject matter of natural play and learning spaces and educational landscapes is limited. Also, this project is multidisciplinary in nature, so involving an educational curriculum developer and interactive exhibit specialist would have further developed the design quality and detail. Additionally, the site presented some challenges, with its dramatic slope and status of being publicly accessible because of the existing trail loops. It is possible for this natural play and learning space to be a public amenity. However, there were conflicting findings related to the safety and feasibility of the design elements being publicly accessible. Further research and design iterations could explore a safe, public natural play and learning space. Such a space would be a highly valuable public amenity and would increase the educational and recreational value of the Manhattan Parks System. Despite these constraints, the report is successful in answering the original research question and conducting a thorough research-backed projective design.

Figure 5.2 Children find joy in discovery.
Source: (Moonjazz 2010). Used under Creative Commons Attribution Non-commercial.

Figure 5.3 Outdoor play spaces can be anywhere. Source: (Shlabotnik 2018). Used under Creative Commons Attribution Non-commercial.

FUTURE RESEARCH

This project is a contribution to the design process of integrating natural play and learning spaces into zoos. From here, further research related to designing activity settings to learn and play outdoors will improve the quality and learning-potential of these spaces.

As mentioned, zoos are only one example of institutions that can benefit from the addition of a natural play and learning space. Other places that can integrate natural play and learning spaces are city, regional, state, or national parks; botanical gardens; green infrastructure developments; school grounds; and childcare centers. Integrating outdoor learning spaces to these institutions can follow a similar process as this research project, with further research on the specific institution's needs, goals, and problems. Additionally, future projects can explore publicly accessible natural play and learning spaces, as such a space would provide equitable access to educational and recreational resources.

Research related to children with special needs' use of natural play and learning spaces needs to be expanded. These children have the potential to benefit greatly from these spaces, so further research is needed related design accommodations and lesson plans that allow them to benefit to the greatest extent. Additionally, further research on how access to these spaces can support childhood development will further reinforce the value of these spaces. For example: what happens when children do not have access to natural areas to play and learn in; do local schools' science curricula suffer due to the lack of access to hands-on learning in nature?

RECOMMENDATIONS

Sunset Zoo and the Manhattan School District (USD 383) can use this research project and design as a starting point for grant funding to implement a natural play and learning space, outdoor classroom space, or outdoor laboratory. The phasing strategy outlined on pages 144 and 148 show a proposed process of integrating a natural play and learning space with an incremental approach. This approach would allow for ongoing fundraising and involvement for the community and local educators.

Kansas Department of Wildlife Parks & Tourism's program called OWLS (Outdoor Wildlife Learning Sites is a potential funding source. An OWL site is an outdoor environmental/wildlife laboratory with native habitat features used for educational opportunities. Examples of an OWL site would be a demonstration plot of native grasses or a bird and other animal feeding station (Kansas Department of Wildlife, Parks, and Tourism, n.d.). The five education stations designed in this project—ecology, geology, wildlife, tree life cycle, and water stations—have the potential to receive funding from this grant. The graphics produced from this project can be used to apply to the grant. The OWLS grant will need involvement from local K-12 educators with Sunset Zoo serving as the supporting organization. A committee should be assembled to apply for the grant, composed of, at minimum, two teachers, one administrator, one maintenance person, two students and one parent.

SIGNIFICANCE & BROADER IMPACT

Children are spending less time outdoors and their connection to nature is declining. This is due to school curricula, climate change, poor city planning, and cultural and social shifts that place less importance on spending time in nature. Being outdoors promotes mental and physical health and can contribute to learning outcomes particularly related to environmental education. Additionally, developing a physical connection to nature teaches people about dependence human health has on ecosystem health-- we need a healthy earth to live comfortably. This relationship encourages people to support conservation causes and lead environmentally responsible lifestyles. This relationship and understanding of nature, created by spending time outdoors early in life, can encourage future generations to live greener at a larger scale.

Increasing the amount and creating new types of places for children to learn and play in nature is essential to ensure that children receive these benefits and that this relationship to nature is developed. The design of this natural play and learning space is one example of how these spaces can be integrated into the urban fabric. Utilizing informal educational institutions, such as a zoo, to locate these spaces is one method of increasing access to nature. These institutions have great potential for the addition of these spaces, as they already have professional educators on staff to monitor, program, and manage the space. They also can integrate educators from local schools to assist in these processes and bring children to the space as a part of field trips or lesson plans. These spaces also increase the educational value of the institution, by providing an increased amount of relatively low-cost educational activity settings. In all, integrating natural play and learning spaces to accessible and easily managed locations connects children to nature, therefore promoting health and environmental stewardship to the next generation.

Figure 5.4 Nature walk in Discovery Park in Seattle, WA (Seattle Municipal Archives 1978). Used under Creative Commons Attribution Non-commercial

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